Appendix A. Scoping Summary Report

Subject	**Open House Scoping Meeting and Public Outreach Report**	**Project Name**	Larkspur Ferry Service Expansion and Parking Project
Attention	Ron Downing		
From	Loretta Meyer, Jacobs		
Date	November 20, 2024		
Copies to	**Project File**		

Open House Scoping Meeting Summary

The Open House Scoping Meeting for the Larkspur Service Expansion and Parking Project was hosted by the Golden Gate Bridge, Highway and Transportation District (Bridge District) on Tuesday, October 15 from 5:00-7:00 PM. The event was held at Drakes Landing Community Room, 300 Drakes Landing in Greenbrae, Marin County. The Bridge District selected the venue due to its proximity to the Larkspur Ferry Terminal, public transit, and its accessibility for people with disabilities. The Open House format allowed attendees to learn more about the project, view project updates since the earlier Open House held on May 14, 2024, and engage with District staff, the consultant team and subject matter experts to ask questions and get project feedback. The Open House Scoping Meeting was held after regular work hours and allowed attendees to come within a two-hour window to allow flexibility for the public and their schedules.

Notice of Preparation

A Notice of Preparation (NOP) was submitted to the Office of Planning and Research State Clearinghouse and published on October 1, 2024. The NOP announced that the public scoping period would be held for 31 days from October 1 through October 31. The NOP also announced that the Bridge District would initiate the preparation of an Environmental Impact Report (EIR) under CEQA and also included the proposed project description and potential environmental impacts of project implementation. The NOP officially initiated the environmental process for the Larkspur Ferry Expansion and Parking Project. The NOP also included notice of the Open House Scoping Meeting date, location, and time (see summary above).

The NOP is in Attachment A.

Scoping Meeting Public Outreach

In addition to the NOP, the Bridge District used various communication channels to promote the Open House Scoping Meeting, including:

- Posters and A-frame signs at the Larkspur Ferry Terminal
- Social media posts on the Bridge District's Instagram and Facebook accounts
- Open House Scoping Meeting details posted on the Larkspur Ferry Service Expansion and Parking Project website
- Email outreach to stakeholders that the Bridge District engaged in 2021

- Email outreach to elected officials, community-based organizations, homeowners associations and neighborhood groups, and small businesses across Marin County
- Email outreach to city offices to post on information their websites and social media accounts, including Instagram, Facebook, and NextDoor
- USPS bulk mailings to residents within a one and a half-mile radius of the Larkspur Ferry Terminal
- A Scoping Meeting Notice advertised in the *Marin Independent Journal* on October 6, 2024.

For promotional materials used to circulate information about the Open House Scoping Meeting, see Attachment B.

Open House Scoping Meeting

The purpose of the Open House Scoping Meeting was to provide the public as well as local decisionmakers and stakeholders, an opportunity to ask questions and provide scoping comments on the project regarding what information and environmental analysis should be included in the Draft EIR. The scoping meeting began with a presentation of the proposed project by Ron Downing, Director of Planning at the Bridge District. The scoping meeting included a PowerPoint presentation, and twenty-two (22) poster boards placed throughout the event room. The poster boards displayed the proposed project, background, existing conditions, environmental process, conceptual parking structure alternatives, Transportation Demand Management alternatives, parking demand forecasts, wake wash analysis from existing ferry vessel operations in the Corte Madera Channel and proposed technical studies that will provide analysis for the Draft EIR. Following Mr. Downing's opening remarks, the public attendees circulated throughout the room and were able to directly engage, ask questions, and share their scoping meeting feedback with the project team. In addition, the public was offered four methods for attendees to provide written and verbal scoping comments to the Bridge District:

1) Comment cards were available at a table in the center of the comment room for attendees to share written scoping feedback about the project and key topic areas
2) A QR code was displayed on a poster and on the comment sign that was posted in multiple places for the public to scan and submit written comments to the project website
3) An email address was provided for written comments to be submitted to the District, and
4) A court reporter was available to record verbal comments from the attendees.

Attendees

In addition to the project team, there were thirty-four (33) attendees representing the following groups:

- State agencies including the Department of Fish and Wildlife, California State Lands Commission and Caltrans D4.
- Elected Officials from the Marin County Board of Supervisors and Larkspur City Council
- Community Organizations including the Greenbrae Boardwalk, Friends of Corte Madera Creek, and the Greenbrae Boardwalk Improvement Council
- Partner Agencies including Transportation Authority of Marin
- Marin Audubon Society
- Transportation Solutions Defense and Education Fund (TRANSDEF)
- WTB-TAM
- Marin Transit
- Local residents

- Local Media
- Interested Individuals/Stakeholders

Public Scoping Input

Public input was received through comment cards, emails, website submittals and through the court reporter. The totals of comments received by the Bridge District at the end of the public scoping Comment period, October 31, are as follows:

- 45 comment submissions from a combination of individuals and 12 different organizations
    - 7 verbal comments with court reporter; at scoping meeting
    - 6 comment cards; at scoping meeting
    - 32 email comments

- (245) sub comments assigned to (411) categories (multiple categories for some comments). From these sub comments, the following themes were identified:
    - Ferry service schedule
    - Forecast Demand (10)
    - Traffic (31)
        - Reducing traffic congestion in the project area and along Sir Francis Drake Boulevard
    - Investigating Transportation Demand Management alternatives and Landside Access to reduce need for increased parking (48)
        - Increasing pedestrian and bike access (including e-bikes) to the Ferry Terminal
        - Increasing bus shuttles to the Ferry Terminal
        - Transit connectivity with SMART, local bus schedules
    - Many opposed a parking structure (54)
    - Aesthetics/Views of SF Bay and Ferry Terminal blocked by parking structure on Main Lot
    - Current parking lot and proposed parking structure lighting impacts on the Greenbrae Boardwalk community
    - Wake wash from ferry vessel operations (11)
    - Land Use/ Mixed-use housing for the parking lots (12)
        - Transit-Oriented Development
    - Marsh Erosion (52)
    - Bulkhead & Revetments (20)
    - Improved revetments to protect marsh and shoreline erosion near Greenbrae Boardwalk (20)
    - Shoreline Erosion (26)
    - Noise Pollution (11)
    - Air Quality (15)
    - Impacts to Biological Resources including marsh habitat
    - Sea Level Rise (7)
    - Ferry Operations and Safety (13)
    - Impacts on biological features (6)
    - Vessel design (1)
    - Questions about the general project design (13)

The top four categories were Parking Structure, Marsh Erosion, TDM/Landside Access and Traffic Congestion.

The 22 sub comment categories were organized into higher level categories for viewing (see Attachment C). The most common sub comment category is no. 2 (77 sub comments), followed by no. 5 (35 total).

- 1-Project
- **2-Landisde-Project Design-Ops**
- 3-EIR & Env. Studies
- 4-Vessel and Wake
- **5-Marsh, Bulkhead, Revetment**
- 6-Out of Project scope

The public scoping comments can be found in Attachment C.

Next Steps

1. Project team will not be responding to public scoping comments but will include this feedback in the Draft EIR. After the Open House held on May 14, 2024, the Project team developed a FAQ in response to that feedback, posted it on the Bridge District website and alerted Open House attendees. The FAQ includes many of the same comment themes received at the Scoping Meeting.
    a. The project team plans to review and update project FAQ information following analysis of the scoping comments received as well as provide an update about the environmental process directly in the FAQ part of the website.
2. Based on the high volume of comments regarding the TDM/Landside Access alternative, the Project team will work with the Bridge District to develop a TDM alternative that will be evaluated in the Draft EIR.
3. Prior to commencement of several technical studies, the team will need to develop a more detailed Project Description of the parking structure(s) including location, footprint, number of stories, bulk and scale, building facade treatment details, construction staging, construction equipment, construction operations, etc. This detail is necessary to conduct several studies necessary for the Draft Environmental Document.

Attachment A-1: Notice of Completion

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P.O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH #

Project Title: Larkspur Ferry Service Expansion and Parking Project

Lead Agency: Golden Gate Bridge, Highway and Transportation District
Contact Person: Ron Downing, Director of Planning

Mailing Address: 1011 Anderson Drive, San Rafael, CA
Phone: 415-257-4583

City: Larkspur
Zip: 94901-5318
County: Marin

Project Location: County: Marin
City/Nearest Community: Larkspur

Cross Streets: Sir Francis Drake Boulevard
Zip Code: 94901

Longitude/Latitude (degrees, minutes and seconds): ____° ____ ' ____" N / ____° ____ ' ____" W Total Acres: ____

Assessor's Parcel No.: ____
Section: ____ Twp.: ____ Range: ____ Base: ____

Within 2 Miles: State Hwy #: I-580 and U.S. 101
Waterways: San Francisco Bay and Corte Madera Creek

Airports: N/A
Railways: Larkspur SMART
Schools: N/A

Document Type:

CEQA: ☒ NOP ☐ Draft EIR
☐ Early Cons ☐ Supplement/Subsequent EIR
☐ Neg Dec (Prior SCH No.) ____
☐ Mit Neg Dec Other: ____

NEPA: ☐ NOI ☐ EA ☐ Draft EIS ☐ FONSI

Other: ☐ Joint Document ☐ Final Document ☐ Other: ____

Local Action Type:

☐ General Plan Update ☐ Specific Plan ☐ Rezone ☐ Annexation
☐ General Plan Amendment ☐ Master Plan ☐ Prezone ☐ Redevelopment
☐ General Plan Element ☐ Planned Unit Development ☐ Use Permit ☐ Coastal Permit
☐ Community Plan ☐ Site Plan ☐ Land Division (Subdivision, etc.) ☐ Other: ____

Development Type:

☐ Residential: Units ____ Acres ____
☐ Office: Sq.ft. ____ Acres ____ Employees ____
☐ Commercial: Sq.ft. ____ Acres ____ Employees ____
☐ Industrial: Sq.ft. ____ Acres ____ Employees ____
☐ Educational: ____
☐ Recreational: ____
☒ Water Facilities: Type Ferry Terminal MGD ____

☒ Transportation: Type ____
☐ Mining: Mineral ____
☐ Power: Type ____ MW ____
☐ Waste Treatment: Type ____ MGD ____
☐ Hazardous Waste: Type ____
☐ Other: ____

Project Issues Discussed in Document:

☒ Aesthetic/Visual ☐ Fiscal ☒ Recreation/Parks ☐ Vegetation
☐ Agricultural Land ☐ Flood Plain/Flooding ☐ Schools/Universities ☒ Water Quality
☒ Air Quality ☐ Forest Land/Fire Hazard ☐ Septic Systems ☐ Water Supply/Groundwater
☒ Archeological/Historical ☐ Geologic/Seismic ☐ Sewer Capacity ☒ Wetland/Riparian
☒ Biological Resources ☐ Minerals ☒ Soil Erosion/Compaction/Grading ☐ Growth Inducement
☐ Coastal Zone ☒ Noise ☐ Solid Waste ☒ Land Use
☐ Drainage/Absorption ☒ Population/Housing Balance ☐ Toxic/Hazardous ☒ Cumulative Effects
☐ Economic/Jobs ☒ Public Services/Facilities ☒ Traffic/Circulation ☒ Other: Sea Level Rise, Wake Wash

Present Land Use/Zoning/General Plan Designation:

Transportation

Project Description: *(please use a separate page if necessary)*

The Larkspur Ferry Service and Parking Expansion Project proposes increased capacity by adding more high-speed boats, potentially creating a new ferry route to the foot of 16th Street near San Francisco's booming Mission Bay and UC San Francisco medical center and expanding Larkspur Ferry Terminal parking. The Project proposes the opportunity to connect Golden Gate Ferry with SMART's Larkspur station, located in the near vicinity.

Note: The State Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".
If you have already sent your document to the agency please denote that with an "**S**".

X Air Resources Board
X Boating & Waterways, Department of
____ California Emergency Management Agency
____ California Highway Patrol
____ Caltrans District # ____
____ Caltrans Division of Aeronautics
____ Caltrans Planning
____ Central Valley Flood Protection Board
____ Coachella Valley Mtns. Conservancy
____ Coastal Commission
____ Colorado River Board
____ Conservation, Department of
____ Corrections, Department of
____ Delta Protection Commission
____ Education, Department of
____ Energy Commission
X Fish & Game Region # ____
____ Food & Agriculture, Department of
____ Forestry and Fire Protection, Department of
____ General Services, Department of
____ Health Services, Department of
X Housing & Community Development
X Native American Heritage Commission
X Office of Historic Preservation
____ Office of Public School Construction
____ Parks & Recreation, Department of
____ Pesticide Regulation, Department of
____ Public Utilities Commission
X Regional WQCB # ____
____ Resources Agency
____ Resources Recycling and Recovery, Department of
X S.F. Bay Conservation & Development Comm.
____ San Gabriel & Lower L.A. Rivers & Mtns. Conservancy
____ San Joaquin River Conservancy
____ Santa Monica Mtns. Conservancy
____ State Lands Commission
____ SWRCB: Clean Water Grants
____ SWRCB: Water Quality
____ SWRCB: Water Rights
____ Tahoe Regional Planning Agency
____ Toxic Substances Control, Department of
X Water Resources, Department of

____ Other: ____
____ Other: ____

Local Public Review Period (to be filled in by lead agency)

Starting Date ____ Ending Date ____

Lead Agency (Complete if applicable):

Consulting Firm: ____
Address: ____
City/State/Zip: ____
Contact: ____
Phone: ____

Applicant: ____
Address: ____
City/State/Zip: ____
Phone: ____

Signature of Lead Agency Representative: ____ **Date:** October 1, 2024

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

Attachment A-2: Notice of Preparation

Notice of Preparation

To: State Clearinghouse
P.O. Box 3044
Sacramento, CA 95812-3044
(Address)

From: Ron Downing, Director of Planning
Golden Gate Bridge, Highway and Transportation District
1011Anderson Drive, San Rafael, CA 94901
(Address)

Subject: Notice of Preparation of a Draft Environmental Impact Report

The Golden Gate Bridge, Highway and Transportation District will be the Lead Agency and will prepare an environmental impact report for the project identified below. We need to know the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval for the project.

The project description, location, and the potential environmental effects are contained in the attached materials. A copy of the Initial Study (☐ is ☒ is not) attached.

Due to the time limits mandated by State law, your response must be sent at the earliest possible date but not later than 30 days after receipt of this notice.

Please send your response to Ron Downing at the address shown above. We will need the name for a contact person in your agency.

Project Title: The Larkspur Ferry Service and Parking Expansion Project

Project Applicant, if any: Same as above

Date October 1, 2024

Signature 

Title Director of Planning

Telephone 415-257-4583

Reference: California Code of Regulations, Title 14, (CEQA Guidelines) Sections 15082(a), 15103, 15375.

Project Description

The Golden Gate Bridge, Highway, and Transportation District (District) operates regional ferry service from the Larkspur Ferry Terminal, in the city of Larkspur, providing a transit alternative for residents to travel from Sonoma and Marin counties to downtown San Francisco, Mission Bay, and the Oracle Park and Chase Arena, with operations for all three ferry routes based at the Larkspur Ferry Terminal. The District is the lead agency for the environmental review of the Larkspur Ferry Service and Parking Expansion Project (Project).

The Larkspur Ferry Terminal is located on Sir Francis Drake Boulevard in the city of Larkspur. The ferry terminal is also located on San Francisco Bay. The Project will serve the ferry's foreseeable 21st Century needs. This includes increasing capacity by adding more high-speed boats, potentially creating a new ferry route to the foot of 16th Street near San Francisco's booming Mission Bay and UC San Francisco medical center, and expanding Larkspur Ferry Terminal parking on the main terminal parking lot and/or the north parking lot located in the Country Mart shopping center across Sir Francis Drake Boulevard. The project will include measures to accommodate ridership that arrives via modes other than single-occupant vehicle (Transportation Demand Management). Such measures may include shuttle buses, parking and ticket pricing strategies, and enhanced bicycle and pedestrian facilities. The project will also include improvements to the connection between the ferry terminal and the Sonoma-Marin Area Rail Transit (SMART) system's Larkspur station (see Figure 1, Project Location Map).

Purpose and Need for the Project

Golden Gate ferry operations at the Larkspur Ferry Terminal are currently constrained for the following reasons:

- The number of ferry revenue trips per day is capped at 42.
- The terminal site is space-constrained with limited parking.
- Vehicular ingress/egress of ferry customers to and from Sir Francis Drake Boulevard, a busy arterial, contributes to queuing and congestion during the morning and evening peak hours.

The purpose of the Larkspur Ferry Service and Parking Expansion Project is to:

1) Relieve congestion within the US-101 highway corridor and the Golden Gate Bridge by providing increased ferry service;

2) Meet increasing demand for ferry service from Larkspur and Sonoma and Marin Counties to existing and planned ferry terminals in San Francisco;

3) Develop parking solutions that will accommodate additional passengers accessing current and expanded ferry service to San Francisco.

The need for the proposed project is to meet forecasted ferry demand. Larkspur ferry service has traditionally been in high demand, particularly during peak commute hours. Prior to the pandemic, the primary and overflow parking lots at the Larkspur Ferry Terminal would be filled before 10 a.m. and vessels frequently would reach full capacity.

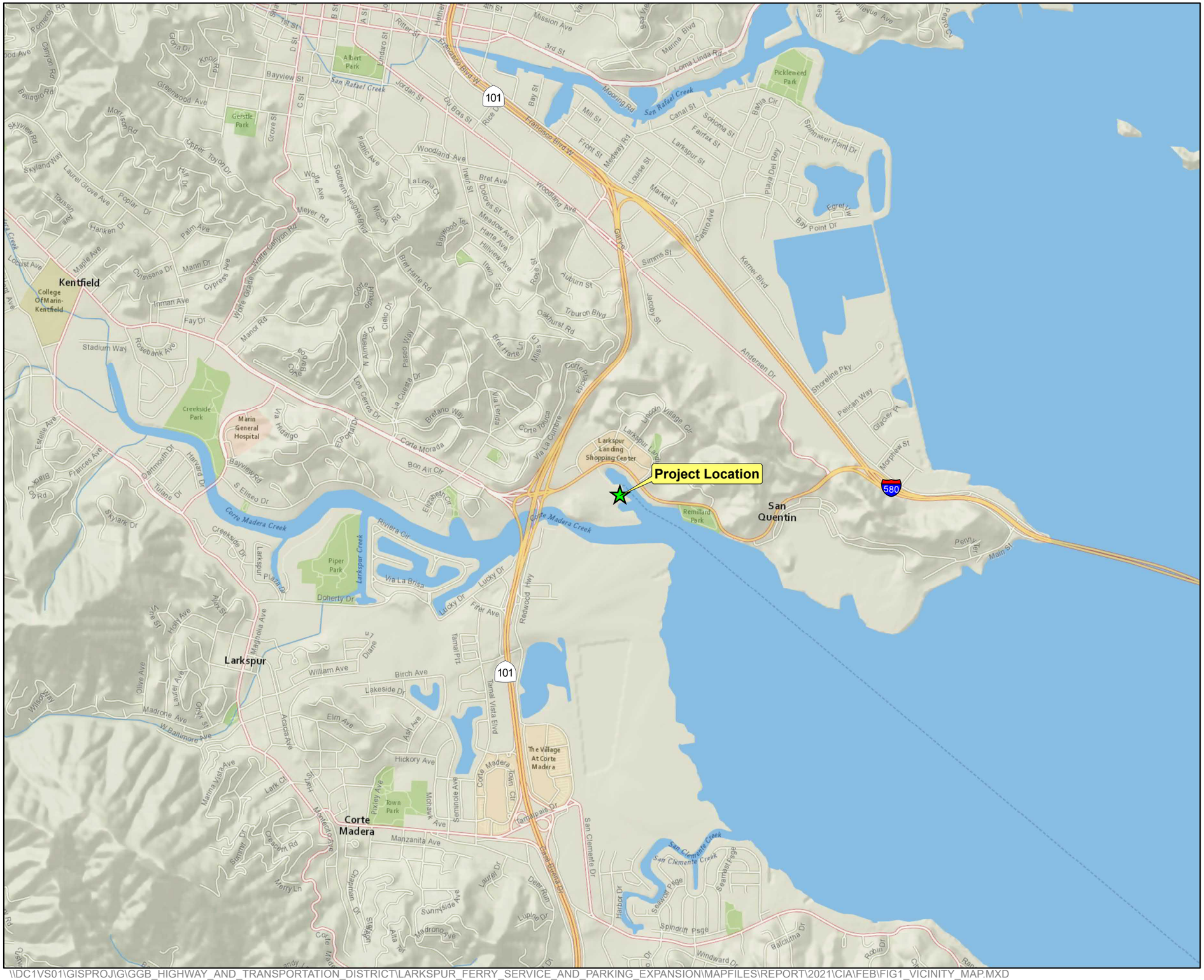
Potential Environmental Impacts

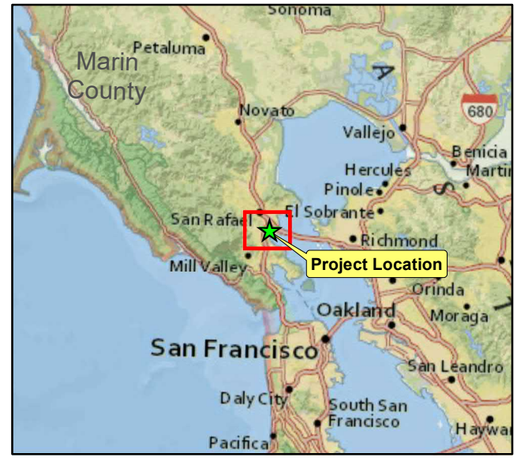
The Project may have the following potential environmental impacts:

- Aesthetic/Visual,
- Air Quality,
- Archeological/Historical,
- Biological Resources,
- Noise,
- Population/Housing Balance,
- Public Services/Facilities,
- Water Recreation,
- Soil Erosion/Compaction/Grading,
- Traffic/Circulation,
- Transit Connectivity and Demand
- Pedestrian and bicycle Access
- Water Quality,
- Wake Wash,
- Wetlands,
- Land Use, and
- Sea Level Rise
- Energy
- Greenhouse Gas
- Tribal Cultural Resources

Scoping Meeting

The District will be holding a scoping meeting for the public and agencies during the 30 day Notice of Preparation period (October 1 through October 30) for input on the scope of the Environmental Impact Report. The scoping meeting will be held on October 15, 2024 from 5:00 to 7:00 p.m. at the Drakes Landing Community Room located at 300 Drakes Landing in Greenbrae. Comments on the Notice of Preparation should be submitted during the Notice of Preparation period to: LFEP@goldengate.org, Attention: Ron Downing





LEGEND

★ Project Location

N

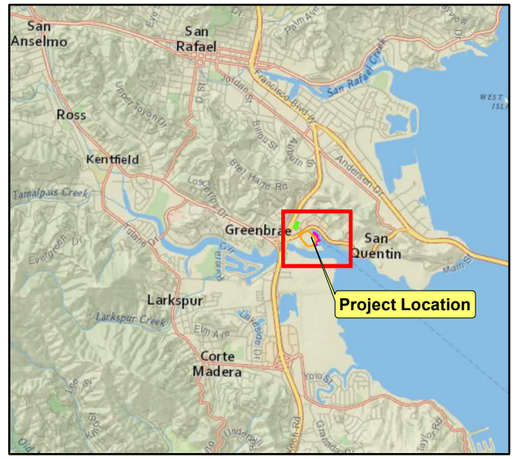
0 2,000 4,000

Feet

FIGURE 1
Vicinity Map
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\CIA\FEB\FIG1_VICINITY_MAP.MXD





LEGEND

- Larkspur Ferry Terminal
- Main Parking Lot
- Overflow Parking
- Larkspur SMART Station
- Corte Madera Channel

N

0 300 600

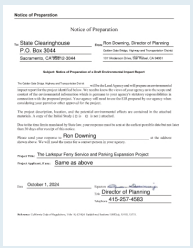
Feet

FIGURE 2
Project Location
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\CIA\FEB\FIG2_PROJECT_LOCATION.MXD

PAC Test Report

DOCUMENT



Title

Notice of Preparation

Filename

Larkspur Ferry-Notice of Preparation_Fi...e2_508.pdf

Language	Tags	Pages	Size
en	130	5	2 MB

RESULT

The PDF/UA requirements checked by PAC are fulfilled.

Date/Time	Standard
2024-09-24 13:58	PDF/UA-1

CHECKPOINT	PASSED	WARNED	FAILED
Basic Requirements			
PDF Syntax	145	0	0
Fonts	35	0	0
Content	9885	0	0
Embedded Files	0	0	0
Natural Language	4808	0	0
Logical Structure			
Structure Elements	40	0	0
Structure Tree	130	0	0
Role Mapping	178	0	0
Alternative Descriptions	275	0	0
Metadata and Settings			
Metadata	3	0	0
Document Settings	4	0	0

ABOUT PAC

Version: 24.0.0.1

OS: Windows

PDF Accessibility Checker (PAC) evaluates the accessibility of PDF files, for machine checkable criteria, according to ISO 14289-1 (PDF/UA) by using the Matterhorn Protocol.

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PAC Test Report

DOCUMENT



Title

Notice of Completion & Environmental Docume...mittal

Filename

Larkspur Ferry-Notice of Completion_508.pdf

Language	Tags	Pages	Size
en	88	2	1011 KB

RESULT

The PDF/UA requirements checked by PAC are fulfilled.

Date/Time	Standard
2024-09-24 12:48	PDF/UA-1

CHECKPOINT	PASSED	WARNED	FAILED
Basic Requirements			
PDF Syntax	95	0	0
Fonts	16	0	0
Content	2241	0	0
Embedded Files	0	0	0
Natural Language	1052	0	0
Logical Structure			
Structure Elements	4	0	0
Structure Tree	87	0	0
Role Mapping	88	0	0
Alternative Descriptions	176	0	0
Metadata and Settings			
Metadata	3	0	0
Document Settings	3	0	0

ABOUT PAC

Version: 24.0.0.1

OS: Windows

PDF Accessibility Checker (PAC) evaluates the accessibility of PDF files, for machine checkable criteria, according to ISO 14289-1 (PDF/UA) by using the Matterhorn Protocol.

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Attachment B - Promotional Materials for Oct 15 Scoping Meeting

Part 1: Postcard sent via USPS bulk mail

Learn More About the Larkspur Ferry Service Expansion and Parking Study

The Golden Gate Bridge District (Bridge District) invites you to participate in the upcoming scoping meeting for the Larkspur Ferry Service Expansion and Parking Project. This project aims to increase the frequency of Larkspur Ferry service and alleviate traffic congestion on Highway 101 and existing roadways.

When: Tuesday, October 15 from 5-7 PM

Where: Drakes Landing Community Room, 300 Drakes Landing Road, Greenbrae

In order to add more ferry service and support greater demand, the Bridge District needs to complete an environmental review through the California Environmental Quality Act (CEQA) and have the Bridge District Board adopt a new service plan. To increase ferry service, the Bridge District will also address customer access, including a potential shortfall of parking availability at the Larkspur Ferry Terminal (main and North/overflow lots).

Conozca Más Sobre el Estudio de Expansión del Servicio de Ferry y Estacionamiento de Larkspur

El Distrito del Puente Golden Gate (Distrito del Puente) lo invita a participar en la próxima reunión de alcance para el Proyecto de Expansión y Estacionamiento del Servicio de Ferry de Larkspur. Este proyecto tiene como objetivo aumentar la frecuencia del servicio de Ferry de Larkspur y aliviar la congestión del tráfico en la autopista 101 y las carreteras existentes.

Cuándo: martes 15 de octubre de 5-7 PM

Dónde: Drakes Landing Community Room, 300 Drakes Landing Road, Greenbrae

Para agregar más servicios de ferry y satisfacer una mayor demanda, el Distrito del Puente debe completar una revisión ambiental a través de la Ley de Calidad Ambiental de California (CEQA) y hacer que la Junta del Distrito del Puente adopte un nuevo plan de servicio. Para aumentar el servicio de ferry, el Distrito del Puente también abordará el acceso de los clientes, incluida una posible escasez de disponibilidad de estacionamiento en la Terminal de Ferry de Larkspur (lotes principal y norte/de desbordamiento).

GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

Golden Gate Bridge Highway and Transportation District
P.O. Box 29000, Presidio Station,
San Francisco, CA 94129-9000



To learn more about the project, please visit

goldengate.org/larkspurferrystudy

Para obtener más información sobre el proyecto, visite

goldengate.org/larkspurferrystudy

GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

Attachment B - Promotional Materials for Oct 15 Scoping Meeting
Part 2: Social Media Posts





A-frame and posters at Larkspur Landing Ferry Terminal and inside ferries

Larkspur Ferry passengers

The Bridge District wants to hear from you! Here are opportunities where you can share your feedback on the Larkspur Ferry Service Expansion & Parking Study.

Take the 5-10 minute Larkspur Ferry Passenger Survey

by September 30 to be eligible to win a $25 Clipper Card!

Visit surveypluto.com/q/mlmkABbwj to take the survey

Attend the Larkspur Ferry Service Expansion & Parking Study Environmental Scoping Meeting

Tuesday, October 15
5-7 PM

Drakes Landing
Community Room
300 Drakes Landing Road

Pasajeros de Larkspur Ferry

¡Pasajeros de Larkspur Ferri, el Distrito GGB quiere saber su opinión! Aquí hay varias opciones en las que puede compartir sus comentarios sobre el Estudio de la Expansión del Servicio y del Estacionamiento de la Terminal de Ferri de Larkspur.

¡Realice la encuesta de 5-10 minutos de pasajeros del ferry de Larkspur

antes del 30 de septiembre para tener la oportunidad de ganar una tarjeta Clipper de $25!

Visite surveypluto.com/q/e5DNVGlaR para realizar la encusta

Asista a la Reunión de Alcance Ambiental del Estudio de Expansión y Estacionamiento del Servicio de ferri de Larkspur

Martes 15 de octubre
5-7 PM

Salón Comunitario de
Drakes Landing
300 Drakes Landing Road

GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

For more information visit
Por más información, visite
goldengate.org/larkspurferrystudy

GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

SCOPING MEETING

TUESDAY, OCTOBER 15, 2024

Get involved!

¡Participe!

SUBMIT YOUR COMMENT BY
ENVÍE SU COMENTARIO ANTES DEL

THURSDAY / JUEVES
OCT· 31· 2024



OUR PURPOSE

The purpose of this scoping meeting is **to formally initiate the environmental process** for the Larkspur Ferry Service Expansion and Parking Study Project.

At this meeting, you'll have the opportunity to:

LEARN ABOUT THE PROJECT: Understand the proposed improvements to ferry service and parking.

PROVIDE FEEDBACK: Share your thoughts on the scope of the environmental document (Environmental Impact Report, or EIR) and potential environmental and resource impacts that may result from implementing the project.

OUR GOAL

Obtain feedback on the ferry service expansion and on the "scope" of environmental analysis in the upcoming Draft EIR. **Scoping comments to be submitted by October 31, 2024.** At the Scoping Meeting, you'll find information on:

- **Project background and context**
  Antecedentes y descripción general del proyecto
- **Environmental process and ferry demand forecasts**
  Proceso ambiental y pronósticos de demanda de ferry
- **Landside access to the ferry terminal**
  Acceso terrestre a la terminal de ferry
- **Water impacts of ferry service**
  Impactos del servicio de ferry sobre el agua

PROPÓSITO

El propósito de esta Reunión de Alcance es **iniciar formalmente el proceso ambiental** para el Proyecto de Expansión del Servicio de Ferry de Larkspur y Estudio del Estacionamiento.

En esta reunión, tendrá la oportunidad de:

CONOCER EL PROYECTO: Comprender las mejoras propuestas al servicio de ferry y al estacionamiento.

PROPORCIONAR COMENTARIOS: Comparta su opinión sobre el alcance del documento ambiental (Informe de Impacto Ambiental, o EIR, por sus siglas en inglés) y los posibles impactos ambientales y de recursos que pueden resultar de la implementación del proyecto.

OBJETIVO

Obtener comentarios sobre la expansión del servicio de ferry y sobre el "alcance" del análisis ambiental en el próximo Borrador de EIR. **Los comentarios de alcance se presentarán antes del 31 de octubre de 2024.** En la Reunión de Alcance, encontrará información sobre:

Submit Your Feedback ▪ Envíe sus comentarios

Your input is essential! Submit your comments on this Scoping Meeting using one of the following options:

¡Su participación es escencial! Envíe sus comentarios sobre esta Reunión de Alcance utilizando una de las siguientes opciones:

COMMENT CARD

Provide your comments in writing using the comment cards provided during the scoping meeting.

TARJETA DE COMENTARIOS

Proporcione sus comentarios por escrito utilizando las tarjetas de comentarios provista durante la Reunión de Alcance.

VERBAL COMMENTS

Submit verbal comments to the court reporter at the comment table.

COMENTARIOS VERBALES

Presente sus comentarios verbales al reportero de la corte en la mesa de comentarios.

EMAIL

Send your feedback to:
LFEP@goldengate.org

CORREO ELECTRÓNICO

Envíe sus comentarios a:
LFEP@goldengate.org

ONLINE

Submit comments on the project's website

www.goldengate.org/district/district-projects/larkspur-ferry-service-parking-expansion-study/

EN LÍNEA:

Provea sus comentarios en el sitio web del proyecto

NEXT STEPS:

- Incorporate community feedback and scoping comments into the Draft EIR
- Begin environmental review and preliminary design

PRÓXIMOS PASOS:

- Incorporar los comentarios de la comunidad y los comentarios de alcance en el Borrador de EIR
- Iniciar la revisión ambiental y el diseño preliminar

LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
AND FUTURE PROJECT UPON INITIATION OF THE ENVIRONMENTAL PROCESS

ESTUDIO DE LA EXPANSIÓN DEL SERVICIO Y DEL ESTACIONAMIENTO DE LA TERMINAL DE FERRY DE LARKSPUR
Y FUTURO PROYECTO UNA VEZ INICIADO EL PROCESO AMBIENTAL



GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

THANK YOU!

The **Larkspur Ferry Service and Parking Expansion Study team** would like to thank you for attending our scoping meeting today.

¡GRACIAS!

El equipo del Estudio de la expansión del servicio y estacionamiento de la terminal de ferry de Larkspur le agradece su participación en nuestra reunión de hoy sobre el alcance del proyecto.



WE WANT TO HEAR FROM YOU!
¡Queremos escuchar su opinión!

Your input is essential! It would be helpful if you can submit your comments on this Scoping Meeting by October 31, 2024, using one of the following options:

¡Su participación es escencial! Sería muy útil que pueda enviar sus comentarioss sobre el alcance del proyecto antes del 31 de octubre de 2024, utilizando una de las siguientes opciones:

Get involved!
¡Participe!

SUBMIT YOUR COMMENT BY
ENVÍE SU COMENTARIO ANTES DEL

THURSDAY / JUEVES
OCT• 31• 2024

COMMENT CARD
Provide your comments in writing using the comment cards provided during the scoping meeting.

TARJETA DE COMENTARIOS
Proporcione sus comentarios por escrito utilizando las tarjetas de comentarios provista durante la Reunión de Alcance.

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EN LÍNEA:
Provea sus comentarios en el sitio web del proyecto

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NORTH BAY CONTEXT

Contexto de vivienda para
EL NORTE DE LA BAHÍA

Future Population Growth in Marin and Sonoma Counties

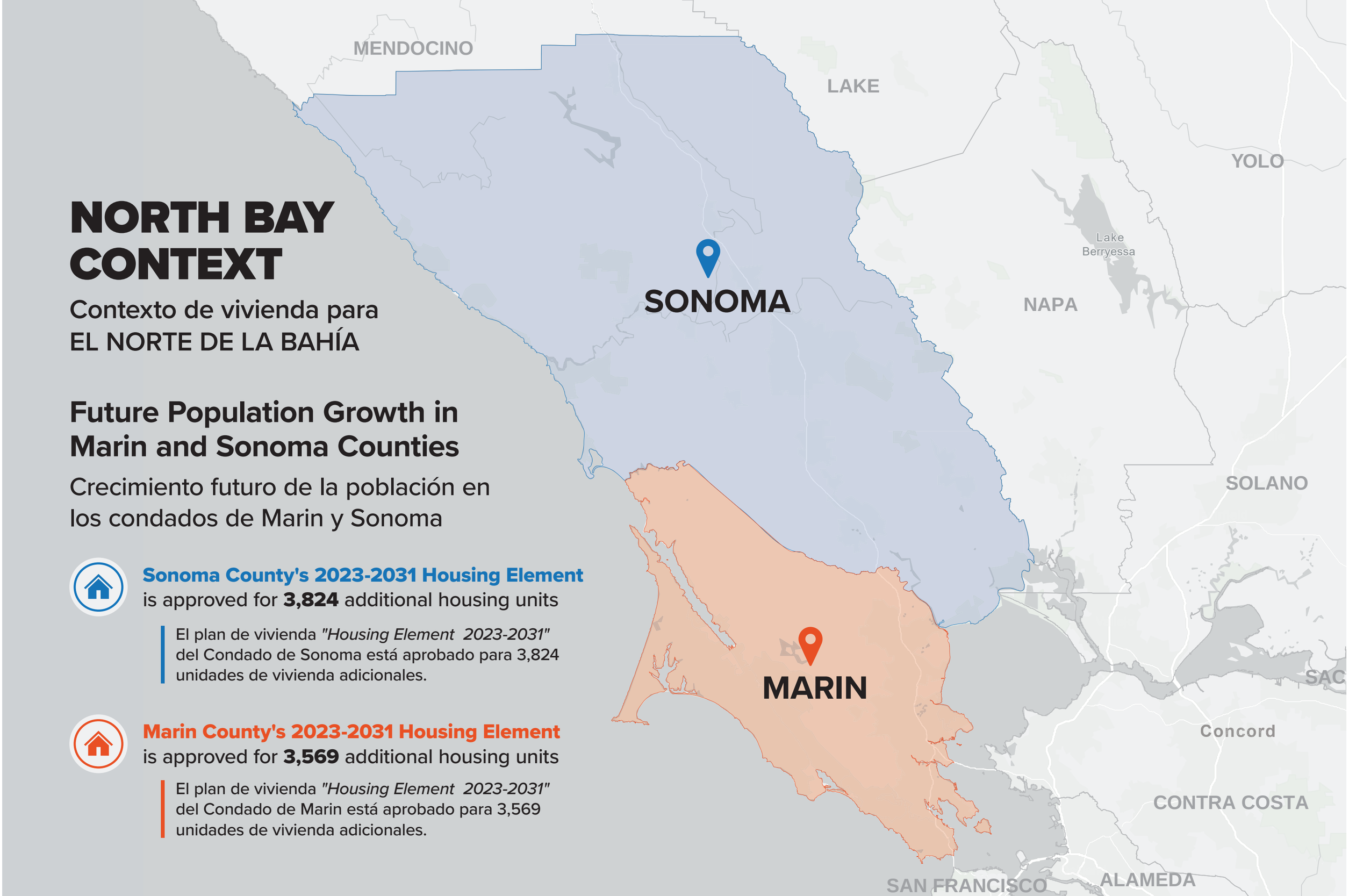
Crecimiento futuro de la población en los condados de Marin y Sonoma

Sonoma County's 2023-2031 Housing Element is approved for **3,824** additional housing units

> El plan de vivienda *"Housing Element 2023-2031"* del Condado de Sonoma está aprobado para 3,824 unidades de vivienda adicionales.

Marin County's 2023-2031 Housing Element is approved for **3,569** additional housing units

> El plan de vivienda *"Housing Element 2023-2031"* del Condado de Marin está aprobado para 3,569 unidades de vivienda adicionales.



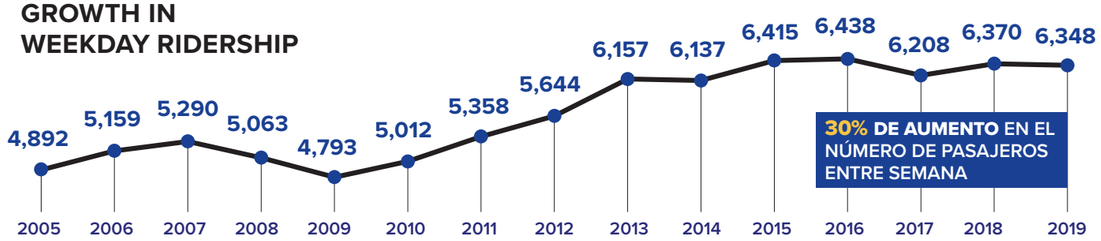
HISTORY & BACKGROUND PRE-COVID
Historia y antecedentes pre-COVID

GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

OVERVIEW / DESCRIPCIÓN GENERAL

2005-2019 RIDERSHIP / PASAJEROS

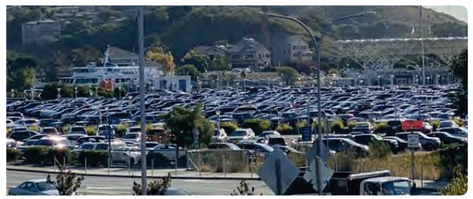
30% ↑
GROWTH IN WEEKDAY RIDERSHIP



MAXIMUM DAILY TRIPS / VIAJES DIARIOS MÁXIMOS



TERMINAL ACCESS / ACCESO A LA TERMINAL



MAIN PARKING LOT – At capacity from 9:30 a.m. to 10:00 a.m. weekdays

ESTACIONAMIENTO PRINCIPAL – Lleno a capacidad de 9:30 a.m. a 10:00 a.m. en días de semana



NORTH PARKING LOT – Often also at capacity

ESTACIONAMIENTO NORTE – A menudo también lleno a capacidad

79%
OF FERRY RIDERS DRIVE AND PARK AT THE TERMINAL

EL **79%** DE LOS PASAJEROS DE FERRY CONDUCEN Y ESTACIONAN EN LA TERMINAL



LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
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PROJECT AREA MAP

Mapa del área del proyecto

GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

OVERVIEW / DESCRIPCIÓN GENERAL



LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
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FERRY SERVICE EXPANSION AND PARKING STUDY

Ampliación del Servicio de Ferry y Estudio del Estacionamiento

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

OVERVIEW / DESCRIPCIÓN GENERAL

PURPOSE / PROPÓSITO

The Purpose of the Larkspur Ferry Service and Parking Expansion Study is to:

1. Relieve congestion within the US 101 highway corridor
2. Meet increasing demand for ferry service from Larkspur and Marin County to existing and planned ferry terminals in San Francisco and the greater Bay Area
3. Develop access solutions that will accommodate additional passengers using ferry service to San Francisco and the greater Bay Area

El propósito del Estudio de la Expansión del Servicio y del Estacionamiento de la Terminal de Ferry de Larkspur es:

1. Aliviar la congestión dentro del corredor de la autopista US 101
2. Satisfacer la creciente demanda del servicio de ferry desde Larkspur y el condado de Marin a las terminales de ferry existentes y previstas en San Francisco y el área metropolitana de la bahía
3. Desarrollar soluciones de acceso que acomoden a pasajeros adicionales utilizando el servicio de ferry a San Francisco y el área metropolitana de la bahía

FOUNDATIONS OF THE PROJECT ARE BUILT ON THREE WORK ELEMENTS:

1. Robust ferry service demand analysis and innovative parking structure alternatives development
2. Efficient and effective environmental analyses and clearance
3. A stakeholder outreach and community engagement strategy for Larkspur Ferry service patrons and the Marin County community

LAS BASES DEL PROYECTO ESTÁN CONSTRUIDAS SOBRE TRES COMPONENTES DE TRABAJO:

1. Análisis robusto de la demanda del servicio de ferry y desarrollo de alternativas innovadoras de estructuras de estacionamiento
2. Análisis y autorización ambiental eficientes y efectivos
3. Una estrategia de alcance y participación comunitaria para los clientes del servicio de la terminal de ferry de Larkspur y la comunidad del condado de Marin

RIDERSHIP FORECAST OVERVIEW

Resumen del Pronóstico de Pasajeros:

2019	10-YEAR AÑOS (2030)	20-YEAR AÑOS (2040)
Daily Ridership Número de pasajeros diario **6,348**	LOW/BAJO: **4,610** HIGH/ALTO: **5,310**	LOW/BAJO: **10,270** HIGH/ALTO: **11,030**
Daily Ferry Service Servicio diario de ferry **40 - 42**	**40 - 42**	**54 - 56**
Parking Demand Demanda de estacionamiento **2,023**	LOW/BAJO: **1,600** HIGH/ALTO: **1,800**	LOW/BAJO: **3,700** HIGH/ALTO: **3,900**

FORECASTS OF INCREASED FERRY RIDERSHIP INFORM THE PROJECT

Demand for ferry service originating out of Larkspur is anticipated to increase beyond pre-COVID pandemic levels (refer to the table at the upper-right). Ferry service may also be an important component of the transportation network in the context of post-COVID travel. This Project is needed to address future demand by potential ferry passengers.

PRONÓSTICOS DE AUMENTO EN EL NÚMERO DE PASAJEROS DE FERRY INFORMAN EL PROYECTO

Se prevé que la demanda de servicios de ferry con origen en Larkspur aumente más allá de los niveles anteriores a la pandemia de COVID (consulte la tabla superior). El servicio de ferry también puede ser un componente importante de la red de transporte en el contexto de los viajes posteriores a la pandemia de COVID. Este proyecto es necesario para hacer frente a la demanda futura de los posibles pasajeros de ferry.

LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
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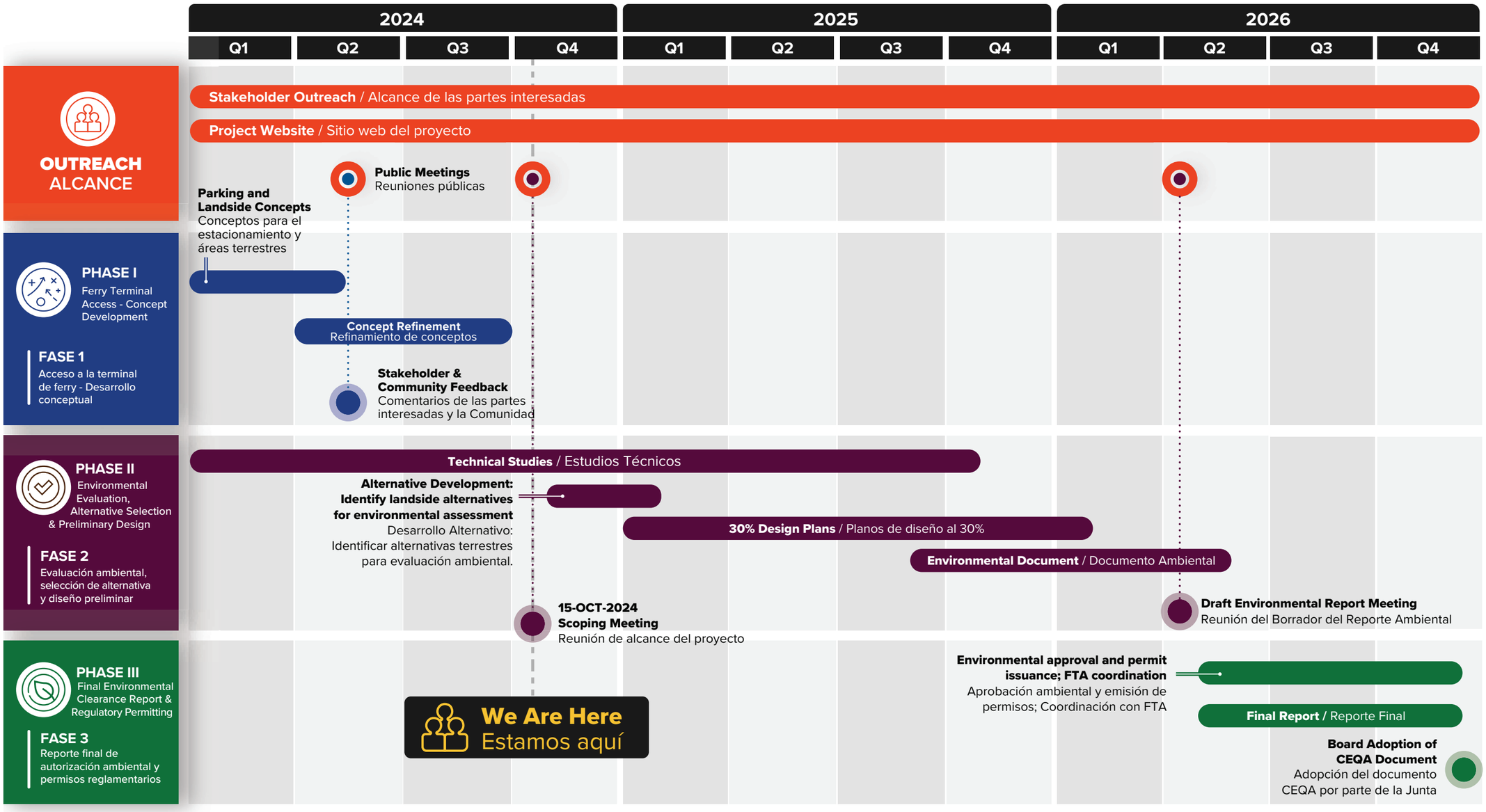
SCHEDULE / CRONOGRAMA

Larkspur Ferry Service Expansion and Parking Study

Estudio de la Expansión del Servicio y del Estacionamiento de la Terminal de Ferry de Larkspur

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

OVERVIEW / DESCRIPCIÓN GENERAL



LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
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SAMPLE CONSTRUCTION

TIMELINE

Ejemplo de cronograma de construcción

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

OVERVIEW / DESCRIPCIÓN GENERAL

Q1 2027

BOARD ADOPTION OF THE CEQA DOCUMENT

Adopción del documento CEQA por parte de la Junta

APROBACIÓN DE LA JUNTA

PARA AVANZAR AL DISEÑO FINAL Y LA FINANCIACIÓN

Q3 2027

BOARD APPROVAL

TO ADVANCE TO FINAL DESIGN AND FUNDING

FINANCIAMIENTO

12-30 MESES

Q3 2027

FUNDING

12-30 MONTHS

DISEÑO Y PERMISOS

18 MESES

Q1 2028

DESIGN & PERMITTING

18 MONTHS

LICITACIÓN Y ADJUDICACIÓN

9 MESES

Q4 2029

BIDDING & AWARD

9 MONTHS

ADQUISICIÓN Y CONSTRUCCIÓN

18 MESES

Q3 2030

PROCUREMENT & CONSTRUCTION

18 MONTHS

Q1 2032

FINALIZACIÓN DEL PROYECTO

PROJECT COMPLETION

COMMUNITY OUTREACH
Alcance Comunitario

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

OVERVIEW / DESCRIPCIÓN GENERAL

The Bridge District has conducted extensive outreach for this Study, including:
El Distrito GGB ha realizado una extensa divulgación para este estudio, como:

STAKEHOLDER INTERVIEWS

25

ENTREVISTAS CON PARTICIPANTES CLAVE

To understand the needs, issues, drivers, key questions, and areas of concerns of the Study with the following groups:

- Government and elected officials
- Environmental organizations
- Commercial and residential property owners
- Community-based organizations
- San Francisco and regional leaders
- Transportation agencies and transit groups
- Business leaders

Para entender las necesidades, problemas, motivaciones, preguntas importantes y preocupaciones del estudio con los siguientes grupos:

- Gobierno y funcionarios electos
- Organizaciones ambientales
- Propietarios de propiedades comerciales y residenciales
- Organizaciones comunitarias
- Líderes de San Francisco y la región
- Agencias de transporte y grupos de tránsito
- Líderes empresariales

DEVELOPMENT OF THE STUDY WEBSITE AND FAQ DOCUMENT IN ENGLISH AND SPANISH

PROJECT WEBSITE // Sitio Web
www.goldengate.org/district/district-projects/larkspur-ferry-service-parking-expansion-study/

Creación del sitio web del estudio y las preguntas frecuentes en inglés y en español

SCAN THE QR CODE TO ACCESS
Escanee el código QR para acceder

FAQs // Preguntas Frecuentes
https://www.goldengate.org/district/district-projects/larkspur-ferry-service-parking-expansion-study/faqs/

COMMUNITY OPEN HOUSE
in May 2024 where feedback was solicited from attendees via comment cards and email

JORNADA DE PUERTAS ABIERTAS para la comunidad en mayo de 2024, donde se recopilaron comentarios de los asistentes mediante tarjetas de comentarios y correo electrónico

LARKSPUR FERRY PASSENGER SURVEY
in September 2024

- More than **550 respondents** and approximately two-thirds are regular ferry riders (1-5 times/week).
- A majority of respondents would take more trips in non-commute hours with improved access to the terminal (e.g., transit, parking, bike).

WANT TO TAKE OUR FERRY RIDER SURVEY?
Scan the QR code to take the survey

SURVEY IN ENGLISH
https://surveypluto.com/q/ImkABbwj?collect=3

ENCUESTA de pasajeros del Ferry de Larkspur, en septiembre de 2024

- **Más de 550 encuestados** y aproximadamente dos tercios son pasajeros regulares del ferry (de 1 a 5 veces por semana).
- La mayoría de los encuestados realizaría más viajes en horas no pico si se mejorara el acceso a la terminal (por ejemplo, transporte público, estacionamiento, bicicleta).

¿QUIERES PARTICIPAR EN NUESTRA ENCUESTA DE PASAJEROS DE FERRY?
Escanee el código QR para realizar la encuesta

ENCUESTA EN ESPAÑOL
https://surveypluto.com/q/e5DNVGlaR

What We Heard
Lo que escuchamos

Key Themes
FROM THE MAY 2024 COMMUNITY OPEN HOUSE

- Ferry service schedule questions and concerns
- Transit connectivity and demand
- Pedestrian and bike access
- Reducing traffic congestion in the project area and along Sir Francis Drake Boulevard
- Considerations and priorities for lighting the Ferry Terminal and parking areas
- Restoration and protection of the tidal marshes
- Potential for mixed-use housing for the site

Temas principales
DE LA JORNADA DE PUERTAS ABIERTAS DE MAYO DE 2024

- Preguntas y preocupaciones sobre el horario del servicio de ferry
- Conectividad y demanda de tránsito
- Acceso peatonal y para bicicletas
- Reducción de la congestión del tráfico en el área del proyecto y a lo largo de Sir Francis Drake Boulevard
- Consideraciones y prioridades para la iluminación de la terminal de ferry y las áreas de estacionamiento
- Restauración y protección de los humedales costeros
- Potencial para viviendas de uso mixto en el sitio

What's Next
¿Qué sigue?

2025 UPCOMING ACTIVITIES

Environmental Review

- Develop landside alternatives for environmental assessment
- Conduct technical studies

PRÓXIMAS ACTIVIDADES 2025

Revisión Ambiental

- Desarrollar alternativas terrestres para la evaluación ambiental
- Realizar estudios técnicos

LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
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DEMAND FORECAST

FERRY SERVICE, PARKING, AND RIDERSHIP

Pronóstico de demanda del servicio de ferry, estacionamiento y número de pasajeros

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

ENVIRONMENTAL / AMBIENTAL

FERRY RIDERSHIP DEMAND
DEMANDA DE PASAJEROS DE FERRY

FINDINGS:
Hallazgos:

In approximately 2033, ridership is anticipated to be restored to the 2019 pre-COVID level

Aproximadamente en 2033, se prevé que el número de pasajeros se restablezca al nivel pre-COVID de 2019

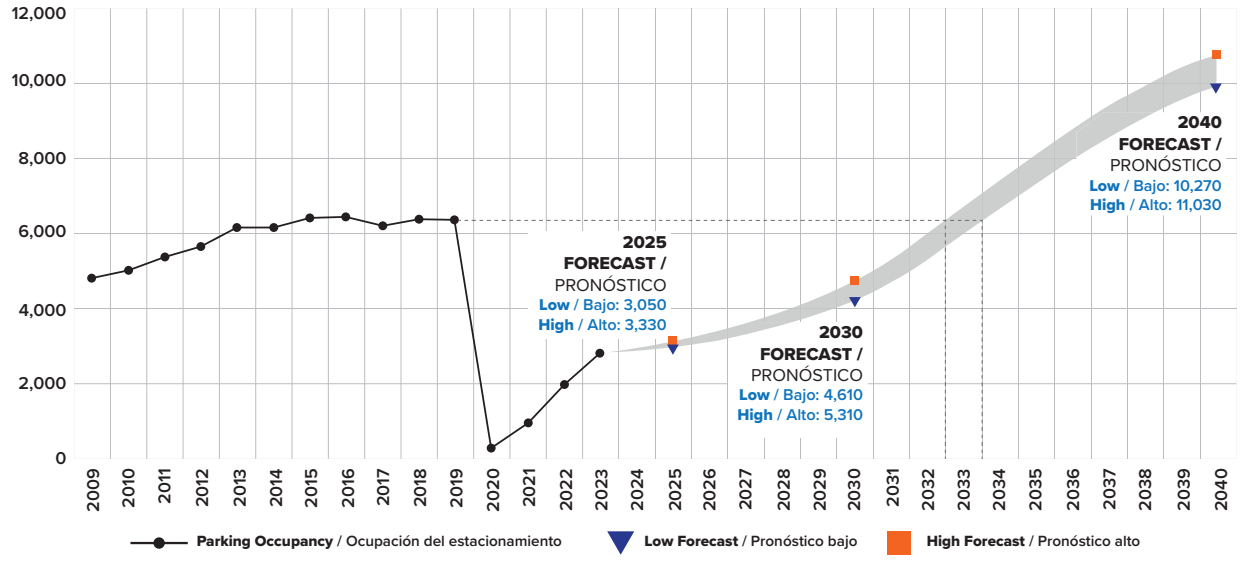
By 2040, ridership could increase by 62% to 74%

Para 2040, el número de pasajeros podría aumentar entre un 62% y un 74%

FORECAST / PRONÓSTICO:

- **Used the countywide travel demand model**
  Se utilizó el modelo de demanda de viajes en todo el condado
- **Considered COVID pandemic impacts**
  Se consideró el impacto de la pandemia de COVID
- **Tested three work-from-home scenarios (11.5%, 25%, and 42%)**
  Se probaron tres escenarios de trabajo desde casa (11.5%, 25% y 42%)

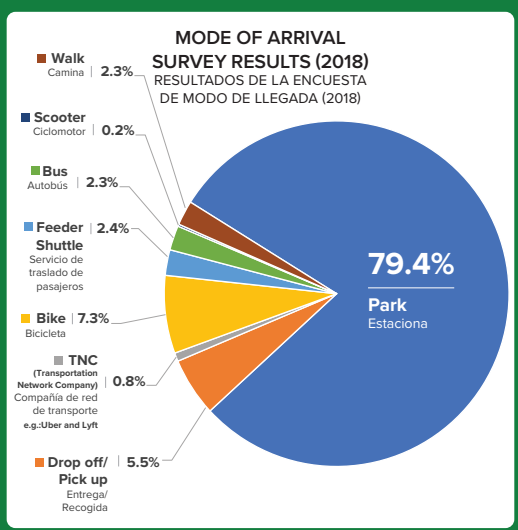
FERRY RIDERSHIP DEMAND FORECAST
PRONÓSTICO DE DEMANDA DE PASAJEROS EN FERRY



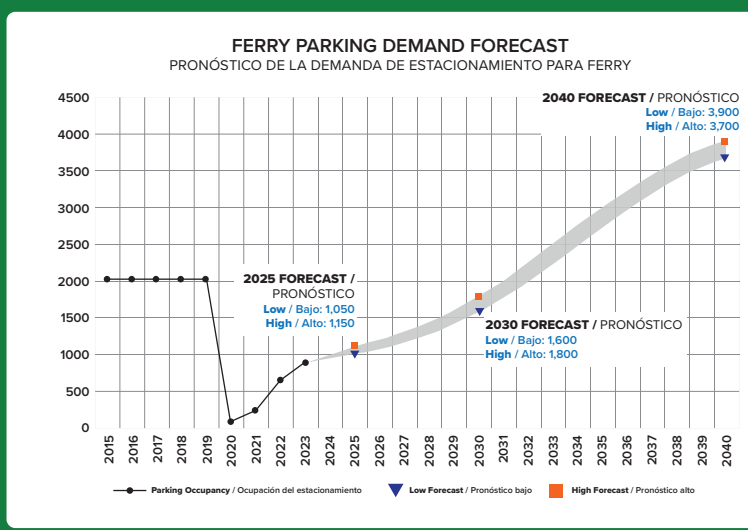
FERRY SERVICE AND PARKING DEMAND
SERVICIO DE FERRY Y DEMANDA DE ESTACIONAMIENTO

- **Parking forecast is based on the future ridership forecast and current mode of access**
  El pronóstico de estacionamiento se basa en el pronóstico futuro de pasajeros y el modo actual de acceso.
- **Average vehicle occupancy rate of 1.12 is assumed**
  Se supone una tasa media de ocupación de vehículos de 1.12
- **Higher bike, transit, and walk mode splits could reduce parking demand**
  Un mayor uso de la bicicleta, el transporte público y usuarios a pie podría reducir la demanda de estacionamiento.
- **Added parking supply would accommodate more midday demand, which was constrained by parking spot availability before the pandemic**
  Un aumento en la oferta de estacionamiento podría acomodar una mayor demanda a mediodía, que estaba limitada por la disponibilidad de espacios de estacionamiento antes de la pandemia.

MODE OF ARRIVAL SURVEY RESULTS (2018)
RESULTADOS DE LA ENCUESTA DE MODO DE LLEGADA (2018)



FERRY PARKING DEMAND FORECAST
PRONÓSTICO DE LA DEMANDA DE ESTACIONAMIENTO PARA FERRY



FERRY SERVICE FORECAST // PRONÓSTICO DEL SERVICIO DE FERRY

YEAR / Año	DAILY CROSSINGS / Travesías diarias	HOURLY CROSSINGS PER DIRECTION (PEAK HOURS) / Travesías por hora por dirección (horas pico)	HOURLY CROSSINGS PER DIRECTION (OFF-PEAK HOURS) Travesías por hora por dirección (fuera de horas pico)
2019	40-42	2-3	1-2
5-Year / 5 años **(2025)**	34-36	1-2	1-2
10-Year / 10 años **(2030)**	40-42	2-3	1-2
20-Year / 20 años **(2040)**	54-56	2-4	1-2

Note: Nonrevenue crossings or special event crossings are not included // **Nota:** No se incluyen las travesías sin fines de lucro ni las travesías para eventos especiales.

SPECIAL EVENT SERVICES

Servicios durante Eventos Especiales

GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

ENVIRONMENTAL / AMBIENTAL





Most special event ferry services depart Larkspur Terminal around 4:00 p.m. on weekdays or on weekends. Ferries serve San Francisco Giants home games and select special events at Oracle Park.

La mayoría de los servicios de ferry para eventos especiales salen de la terminal de Larkspur alrededor de las 4:00 p.m. durante la semana o los fines de semana. Los ferrys sirven para los juegos en casa de los Giants y eventos especiales seleccionados en Oracle Park.

2024 FERRY SERVICE FOR SAN FRANCISCO GIANTS:

Servicio de ferry para los juegos de los San Francisco Giants en 2024:

82 **BASEBALL GAMES** JUEGOS DE BÉISBOL

1 **PRE SEASON** PRETEMPORADA

81 **REGULAR SEASON** TEMPORADA REGULAR



LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY

AND FUTURE PROJECT UPON INITIATION OF THE ENVIRONMENTAL PROCESS

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ENVIRONMENTAL / AMBIENTAL

ENVIRONMENTAL PROCESS
Proceso ambiental

California Environmental Quality Act (CEQA) Review

- Technical analyses and environmental document for Larkspur Ferry expansion
  - CEQA review will evaluate the aquatic impacts of additional ferry service
  - CEQA review will evaluate parking structure expansion and landside access concepts for both parking lots
- When federal funding is secured: National Environmental Policy Act (NEPA) review
  - NEPA review will build on CEQA review

CEQA Approach – Possible Programmatic and Tiered Environmental Document

- Programmatic CEQA environmental document for long-term demand forecasts; project-level environmental impact report for immediate parking/landside needs and increased ferry vessel trips
- Programmatic CEQA will address cumulative impacts and allows tiering on original CEQA document at later stages

CEQA Technical Studies

UNDERWAY:

- Wake and Shoreline Erosion Analysis (refer to presentation boards)
- Aquatic Resources Delineation Report
- Community Impact Assessment

UPCOMING:

- Traffic Technical Report – Vehicle Miles Traveled
- Visual Impact Analysis
- Air Quality and Greenhouse Gas Report
- Noise Study Report
- Natural Environment Study
- Cultural Resources Assessment
  - Initial work has begun
  - Graton Rancheria consultation ongoing

Revisión de la Ley de Calidad Ambiental de California (CEQA, por sus siglas en inglés)

- Análisis técnicos y documento ambiental para la expansión del Ferry de Larkspur
  - La revisión de CEQA evaluará los impactos acuáticos del servicio de ferry adicional
  - La revisión de CEQA evaluará la expansión de la estructura de estacionamiento y los conceptos de acceso terrestre para ambos estacionamientos
- Cuando se obtengan fondos federales: revisión de la Ley Nacional de Política Ambiental (NEPA, por sus siglas en inglés)
  - La revisión de la NEPA se basará en la revisión de la CEQA

Enfoque CEQA – posible documento ambiental programático y escalonado

- Documento ambiental programático CEQA para pronósticos de demanda a largo plazo; informe de impacto ambiental a nivel de proyecto para necesidad inmediata de estacionamiento/acceso terrestre y el aumento de viajes en ferry
- El CEQA programático abordará los impactos acumulativos y permitirá la clasificación por niveles del documento CEQA original en etapas posteriores

Estudios técnicos de CEQA

EN MARCHA:

- Análisis de la estela y la erosión de la costa (consulte los tableros de presentación)
- Informe de delineación de recursos acuáticos
- Evaluación de Impacto comunitario

PRÓXIMO:

- Informe técnico de tráfico – millas recorridas por el vehículo
- Análisis de impacto visual
- Informe de calidad del aire y gases de efecto invernadero
- Informe del estudio de ruido
- Estudio del medio natural
- Evaluación de recursos culturales
  - Se han comenzado los trabajos iniciales
  - Se está realizando la consulta sobre Graton Rancheria

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION (BCDC) JURISDICTION

- Jurisdiction is 100 feet from shoreline
- Parking structure approach is greater than 100 feet from shoreline



JURISDICCIÓN DE LA COMISIÓN DE CONSERVACIÓN Y DESARROLLO DE LA BAHÍA DE SAN FRANCISCO
(BCDC, POR SUS SIGLAS EN INGLÉS)

- La jurisdicción está a 100 pies de la costa
- La aproximación a la estructura de estacionamiento está a más de 100 pies de la costa

2025 UPCOMING ACTIVITIES
Environmental Review

- Develop landside alternatives for environmental assessment
- Conduct technical studies

PRÓXIMAS ACTIVIDADES 2025
Revisión Ambiental

- Desarrollar alternativas terrestres para la evaluación ambiental
- Realizar estudios técnicos

ENVIRONMENTAL STUDIES
Estudios Ambientales

Main Parking Lot and North Parking Lot Sites
Sitios de Estacionamiento Principal y Estacionamiento Norte

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

ENVIRONMENTAL / AMBIENTAL

LARKSPUR FERRY

Future Demand Forecast

20-Year (2040) Forecast
Expected to nearly double 2019 ridership and parking patronage

Parking Structures on Main and North Parking Lots
Both may be required to meet 2040 demand

Programmatic and Tiered (CEQA) Environmental Clearance

- To address the Purpose and Need statement (20-year demand forecast)
- Environmental Study of both parking lots
- Focused EIR on Project to meet nearer-term demand forecast
- Programmatic EIR on Project to meet 20-year (2040) demand forecast

CEQA = California Environmental Quality Act

FERRY DE LARKSPUR

Pronóstico de la demanda futura

Pronóstico a 20 años (2040)
Se espera que el número de pasajeros y el uso del estacionamiento casi dupliquen los niveles de 2019.

Estructuras de estacionamiento en los estacionamientos principal y norte
Es posible que ambos sean necesarios para cumplir con la demanda de 2040

Autorización Ambiental Programática y Escalonada (CEQA)

- Para atender la declaración de propósito y necesidad (pronóstico de demanda a 20 años)
- Estudio ambiental de ambos estacionamientos
- EIR enfocado en el proyecto para cumplir con el pronóstico de demanda a corto plazo
- EIR programático para el proyecto para cumplir con el pronóstico de demanda a 20 años (2040)

CEQA = Ley de Calidad Ambiental de California, por sus siglas en inglés

EVALUATION CRITERIA
Criterios de evaluación

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

A set of evaluation criteria has been developed for use in reviewing the project alternatives for the Larkspur Ferry Service and Parking Expansion Study. The performance indicators provide detailed screening to advance alternatives.

Se ha desarrollado un conjunto de criterios de evaluación para su uso en la revisión de las alternativas del proyecto para el Estudio de la Expansión del Servicio y del Estacionamiento de la Terminal de Ferry de Larkspur. Los indicadores de rendimiento proporcionan una selección detallada para avanzar en las alternativas.

SUSTAINABILITY & CLIMATE RESILIENCY
Sostenibilidad y Resiliencia Climática

FOCUS AREA
Evaluates the ability to meet long-term needs of ferry customers and the landside facilities' climate resiliency for forecasted sea level rise.

ÁREA DE ENFOQUE
Evalúa la capacidad de satisfacer las necesidades a largo plazo de los clientes del ferry y la resiliencia climática de las instalaciones terrestres ante el aumento previsto del nivel del mar.

STAKEHOLDER CONCERNS

Long-Term Ferry Customer Needs:
Traffic and congestion porblems caused by increased ridership.

PREOCUPACIONES DE LAS PARTES INTERESADAS

Necesidades a largo plazo de los clientes del ferry:
Problemas de tráfico y congestión causados por el aumento de pasajeros.

CRITERIA ALIGNMENT EXAMPLES
Ferry terminal facility improvements sufficient for increased ridership growth

EJEMPLOS DE ALINEACIÓN DE CRITERIOS
Mejoras en las instalaciones de la terminal del ferry suficientes para el crecimiento del número de pasajeros.

MOBILITY & ACCESSIBILITY
Movilidad y Accesibilidad

FOCUS AREA
Accommodates increased patronage via all modes and by all users. Encourages use by non motorized modes, without requiring patrons to do so. Provides flexibility in the event future ridership shifts modes.

ÁREA DE ENFOQUE
Responde al incremento de la demanda por todos los medios y usuarios. Fomenta el uso de modos no motorizados, sin requerir que los usuarios lo hagan. Proporciona flexibilidad en caso de que los pasajeros cambien de modo en el futuro.

STAKEHOLDER CONCERNS

Transit Connectivity:
Make ferry trips and services synchronous with other forms of public transit.

PREOCUPACIONES DE LAS PARTES INTERESADAS

Conectividad de transporte:
Hacer que los viajes y servicios del ferry estén sincronizados con otras formas de transporte público.

CRITERIA ALIGNMENT EXAMPLES
- Ability to reconfigure space to accommodate cars or bikes
- Availability of transit options that drop off near the terminal
- Onsite and offsite customer/ patron access

EJEMPLOS DE ALINEACIÓN DE CRITERIOS
- Capacidad para reconfigurar el espacio para acomodar automóviles o bicicletas
- Opciones de transporte público con paradas cercanas a la terminal
- Acceso de clientes/usuarios dentro y fuera de las instalaciones

COMMUNITY & ENVIRONMENT
Comunidad y Medio Ambiente

FOCUS AREA
Includes community impacts, changes to the visual/aesthetic environment and Bay viewsheds, increased ferry traffic, and noise levels. Considers regional growth and development, regional and local traffic, and economic use.

ÁREA DE ENFOQUE
Incluye impactos en la comunidad, cambios en el entorno visual/estético y en las vistas de la bahía, aumento del tráfico de ferrys y niveles de ruido. Considera el crecimiento y desarrollo regional, el tráfico regional y local, y el uso económico.

STAKEHOLDER CONCERNS

Community Impact & Environmental Concerns:
Affects surrounding wetlands and habitats, visual impacts of expanded parking, and impact from ferry wake.

PREOCUPACIONES DE LAS PARTES INTERESADAS

Impacto en la comunidad y preocupaciones ambientales:
Afecta los humedales y hábitats circundantes, impactos visuales del estacionamiento ampliado y el impacto del oleaje del ferry.

CRITERIA ALIGNMENT EXAMPLES
- Operational noise and light pollution (local)
- **Visual/Aesthetics:** Bay Shoreline and viewshed or view corridors

EJEMPLOS DE ALINEACIÓN DE CRITERIOS
- Ruido operacional y contaminación lumínica (local)
- **Visual/Estética:** Línea costera de la bahía y vistas o corredores visuales

COST: Considers the cost efficiency of the design, including operations and maintenance costs, return on investment, and construction cost

COSTO: Considera la eficiencia de costos del diseño, incluyendo costos de operación y mantenimiento, retorno de inversión y costo de construcción.

SAFETY will be incorporated into all alternatives under consideration. Because safety is considered a baseline requirement, it is not a part of the evaluation criteria.

LA SEGURIDAD se incorporará en todas las alternativas bajo consideración. Debido a que la seguridad se considera un requisito básico, no es parte de los criterios de evaluación.

TRANSPORTATION DEMAND MANAGEMENT STRATEGIES

Estrategias de Gestión de la Demanda de Transporte

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

LANDSIDE / LADO TERRESTRE

WHAT IS TDM?

Transportation Demand Management (TDM) seeks to improve air quality and reduce congestion by reducing reliance on single-occupant vehicles. TDM recognizes that ferry users should have realistic options to get to the terminal.

Examples of potentially applicable TDM strategies include:

- **Encouraging bike use.** Improve connections to the local street system. Provide more bike storage on ferries and at the terminal.
- **Shuttle and Feeder Services:** Shuttle buses scheduled when and where ferry patrons start and end their trips; for example, the SMART Connect Larkspur shuttle pilot service.
- **Carpooling.** Carpooling to the Larkspur Ferry Terminal can be encouraged by discounting parking for carpools and providing reserved parking near the terminal.

How does it relate to the Ferry Service Expansion Project?

Interest in nonmotorized transportation is growing in Marin County. The Ferry Terminal Service Expansion Project will build on initiatives already underway, ensuring that as ferry services expand and the number of ferry users increases, other options could provide alternate means to access the ferry.

What might be included?

- Ability to ride a bike and be assured of a safe and secure place for it.
- Availability of shuttle service to deliver ferry riders to the terminal if the demand exists.
- Ability to drive to the ferry terminal if users want or need to.

¿QUÉ ES TDM?

La Gestión de la Demanda de Transporte (TDM, por sus siglas en inglés) busca mejorar la calidad del aire y reducir la congestión al reducir la dependencia de los vehículos de un solo ocupante. TDM reconoce que los usuarios de ferry deben tener opciones realistas para llegar a la terminal.

Algunos ejemplos de estrategias de TDM potencialmente aplicables son:

- **Fomentar el uso de la bicicleta.** Mejorar las conexiones con el sistema de calles locales. Proporcionar más espacio para bicicletas en los ferrys y en la terminal.
- **Servicios de transporte y servicios complementario:** Autobuses de enlace programados cuando y donde los clientes de ferry comienzan y terminan sus viajes; por ejemplo, el servicio piloto de autobús de enlace de Larkspur SMART Connect.
- **Uso compartido de vehículo:** Se puede fomentar el uso compartido de vehículos hacia la Terminal de Ferry de Larkspur mediante descuentos en el estacionamiento para grupos de personas que compartan vehículos y proporcionando estacionamiento reservado cerca de la terminal.

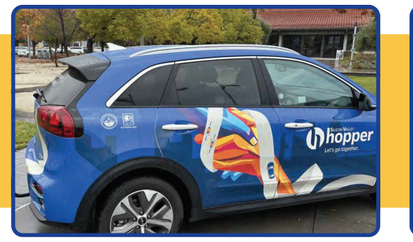
¿Cómo se relaciona con el proyecto de la expansión del servicio de ferry?

El interés por el transporte no motorizado está aumentando en el Condado de Marin. El Proyecto de Expansión del Servicio de Terminales de Ferry se basará en iniciativas ya en marcha, asegurando que a medida que los servicios de ferry se expandan y aumente el número de usuarios de ferry, otras opciones puedan proporcionar medios alternativos para acceder al ferry.

¿Qué podría incluir?

- Capacidad para andar en bicicleta y tener la seguridad de un lugar seguro para ella.
- Disponibilidad de servicio de transporte para llevar a los pasajeros de ferry a la terminal si existe demanda.
- Posibilidad de llegar en automóvil hasta la terminal de ferry, si los usuarios así lo prefieren o necesitan.











LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
AND FUTURE PROJECT UPON INITIATION OF THE ENVIRONMENTAL PROCESS

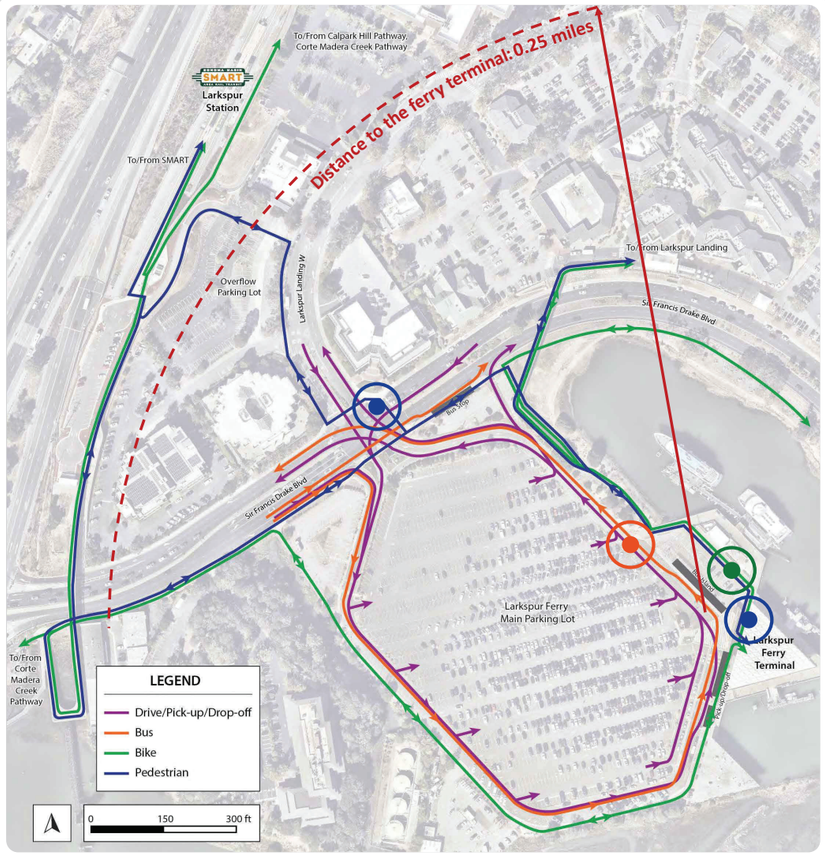
ESTUDIO DE LA EXPANSIÓN DEL SERVICIO Y DEL ESTACIONAMIENTO DE LA TERMINAL DE FERRY DE LARKSPUR
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LANDSIDE ACCESS
Acceso Terrestre

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HIGHWAY & TRANSPORTATION DISTRICT

LANDSIDE / LADO TERRESTRE

EXISTING LANDSIDE ACCESS FOR ALL MODES
Acceso terrestre existente para todos los modos



SMART Train Connection/
Conexión de tren SMART

12-17 mins walk/mins a pie (0.5-0.65 miles/millas)
4-5 mins bike/mins en bicicleta (0.65 miles/millas)



Pedestrian Improvements
Mejoras peatonales



Pedestrian / Peatonal

- **Create safe and direct pedestrian paths in the parking lot behind the Marin Transit bust stop as well as the ADA parking lot.**
- **North lot access: Add a crosswalk on Larkspur Landing Circle.**
- **Streamline the pedestrian connection between the garage and the Terminal.**

- Crear caminos peatonales seguros y directos en el estacionamiento detrás de la parada de autobús de Marin Transit, así como en el estacionamiento ADA.
- Acceso al estacionamiento norte: Añadir un cruce peatonal en Larkspur Landing Circle.
- Optimizar la conexión peatonal entre el garaje y la terminal.



Bus Island
Isla de autobuses

Transit / Tránsito

- **Extend the existing bus island to 200 feet (can accommodate three buses at the same time) by relocating motorcycle parking spaces to the new garage.**

- Ampliar la parada de autobuses actual a 200 pies (para dar cabida a tres autobuses a la vez) reubicando los estacionamientos de motocicletas en el nuevo garaje.



Bicycle Parking
Estacionamiento de bicicletas

Bicycle / Bicicleta

- **Add 100 additional bicycle parking spaces in the Terminal area to accommodate increased bicycle demand.**
- **Convert the existing bike racks outside the Terminal to secured bicycle boxes.**

- Añadir 100 espacios de estacionamiento para bicicletas adicionales en el área de la terminal para satisfacer la creciente demanda de bicicletas.
- Convertir los portabicicletas existentes fuera de la terminal en cajas de bicicletas con seguridad.

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PARKING STRUCTURE CONSIDERATIONS

Consideraciones Estructurales del Estacionamiento

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

LANDSIDE / LADO TERRESTRE



Iconic Ferry Building
Edificio icónico del Ferry de Larkspur

Source: Jacobs



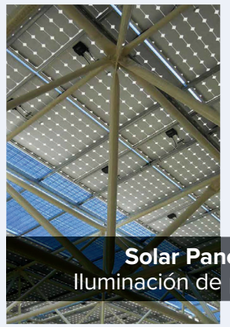
Electric Vehicle Charging
Área de carga de vehículos eléctricos

Source: DLR



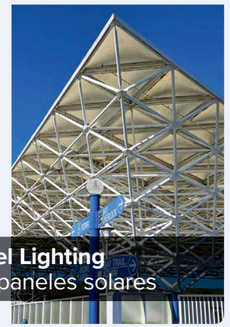
Bicycle Storage
Almacenamiento de bicicletas

Source: iStock

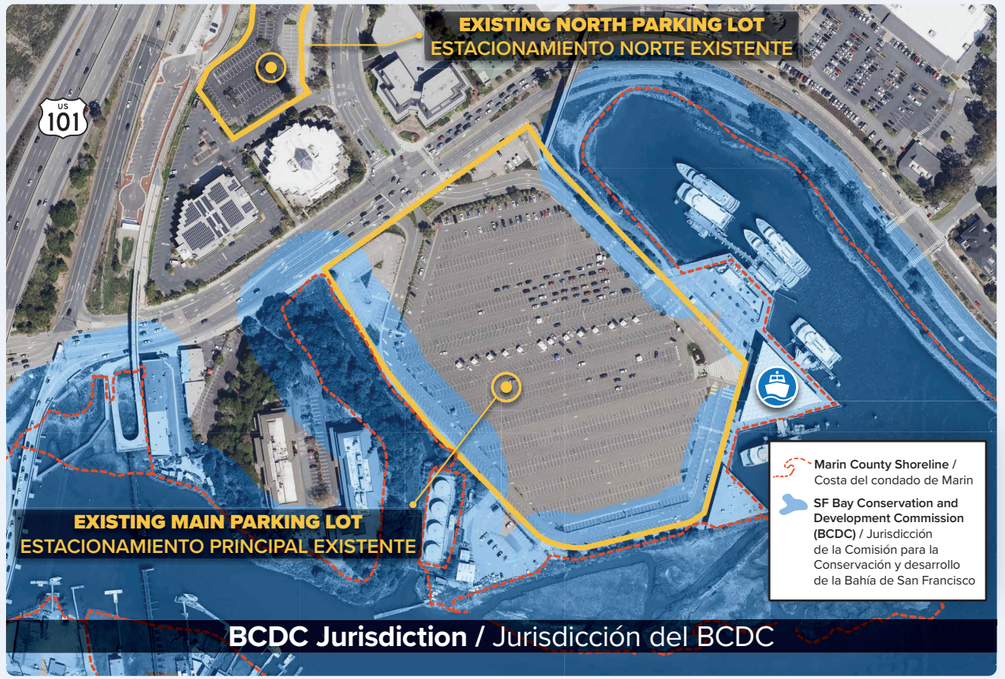


Solar Panel Lighting
Iluminación de paneles solares

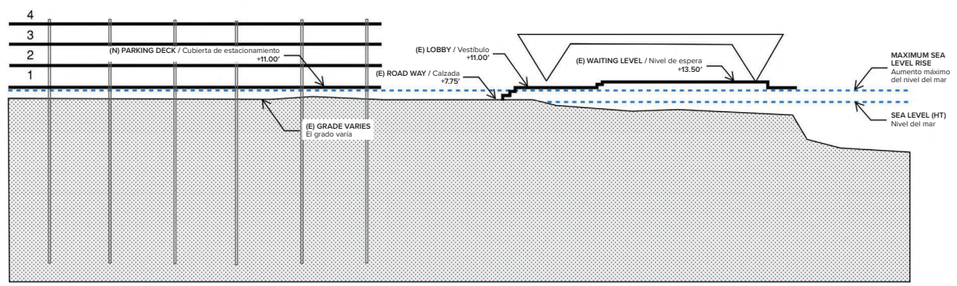
Source: DSC Spaceframes



Source: Jacobs



Source: Jacobs



Sea-level Rise / Aumento del nivel del mar

Source: DLR

- **Bay and Environmental Impacts**
  Impactos en la bahía y el medio ambiente
- **Visual Impacts**
  Impactos visuales
- **Pedestrian Access**
  Acceso peatonal
- **Multimodal and Multiuse**
  Multimodal y multiuso
- **Seismic Stability**
  Estabilidad sísmica
- **Displacement during Construction**
  Desplazamiento durante la construcción
- **Demand Management**
  Gestión de la demanda
- **Phased Approach:** Near-, Medium-, and Long-Term Needs
  Enfoque por fases: necesidades a corto, mediano y largo plazo

MAIN PARKING LOT A CONCEPT

Diseño conceptual para el estacionamiento principal A

4 Stories / 4 Niveles

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

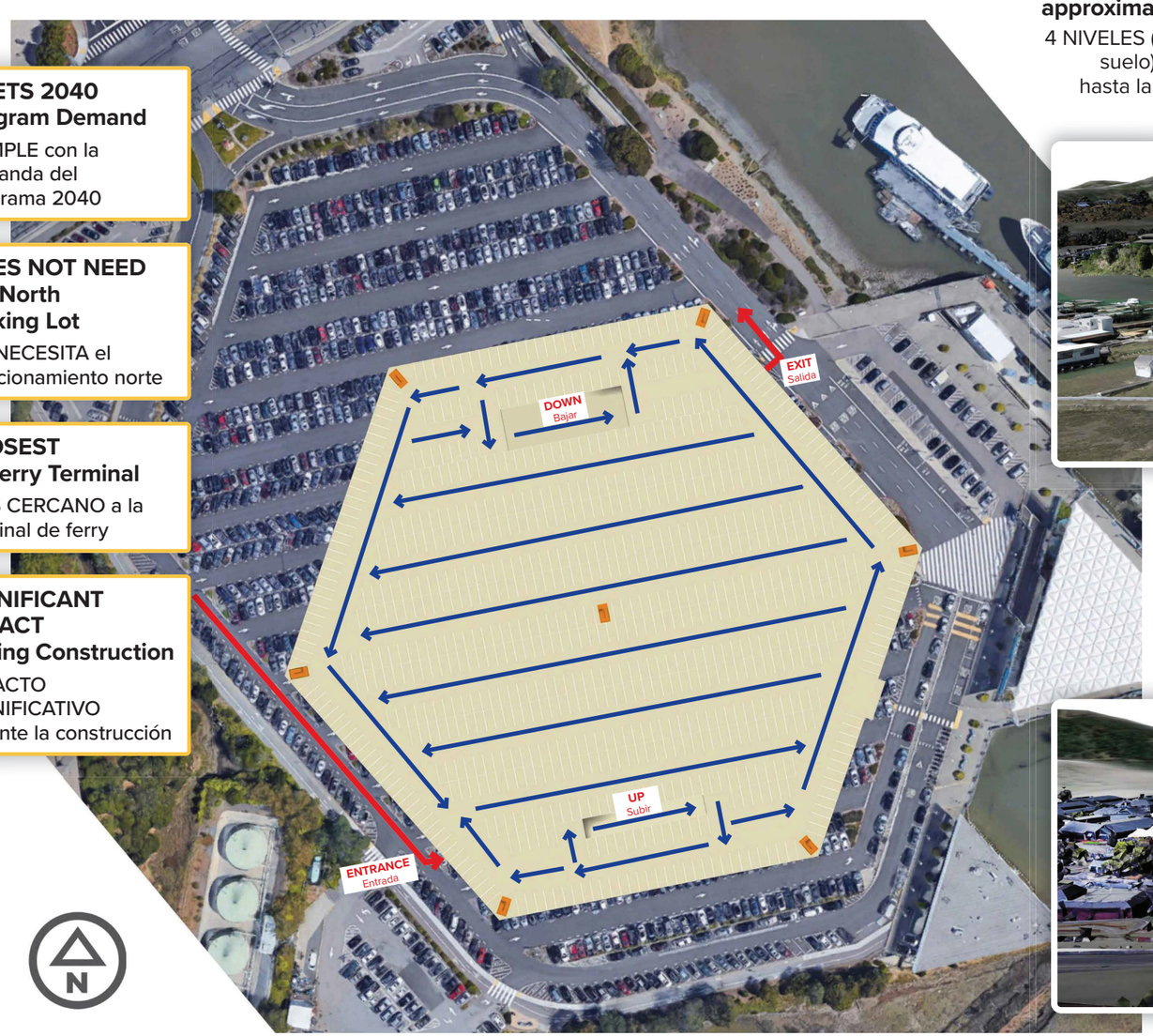
LANDSIDE / LADO TERRESTRE

MEETS 2040 Program Demand
CUMPLE con la demanda del programa 2040

DOES NOT NEED the North Parking Lot
NO NECESITA el estacionamiento norte

CLOSEST to Ferry Terminal
MÁS CERCANO a la terminal de ferry

SIGNIFICANT IMPACT During Construction
IMPACTO SIGNIFICATIVO durante la construcción



4 STORIES (3 decks above grade) approximately 42′-0″ to top of parapet
4 NIVELES (3 plataformas sobre el nivel del suelo) aproximadamente 42′-0″ hasta la parte superior del parapeto

FERRY TERMINAL BUILDING
Edificio de la terminal de ferry



FERRY TERMINAL BUILDING
Edificio de la terminal de ferry

ADDITIONAL SOLAR PANEL ARRAY shown on top level, setback from building edge
ARREGLO ADICIONAL DE PANELES SOLARES mostrado en el nivel superior, retirado del borde del edificio



LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
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ESTUDIO DE LA EXPANSIÓN DEL SERVICIO Y DEL ESTACIONAMIENTO DE LA TERMINAL DE FERRY DE LARKSPUR
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MAIN PARKING LOT B CONCEPT

Diseño conceptual para el estacionamiento principal B

3 Stories / 3 Niveles

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

LANDSIDE / LADO TERRESTRE

MEETS 2040 Program Demand
CUMPLE con la demanda del programa 2040

DOES NOT NEED the North Parking Lot
NO NECESITA el estacionamiento norte

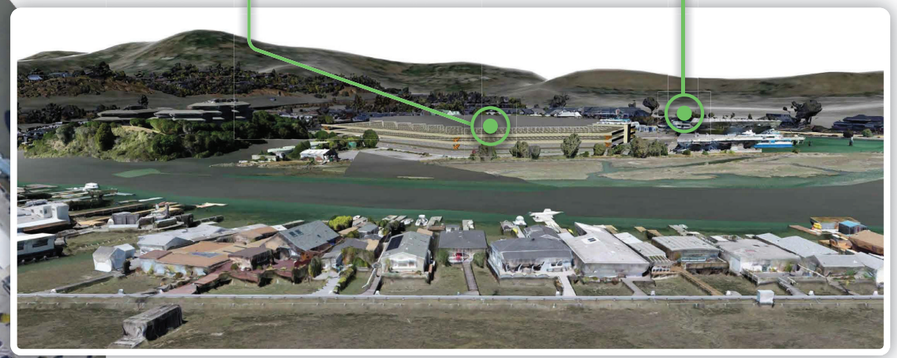
CLOSE to Ferry Terminal
CERCANO a la terminal de ferry

LARGEST IMPACT During Construction
MAYOR IMPACTO durante la construcción



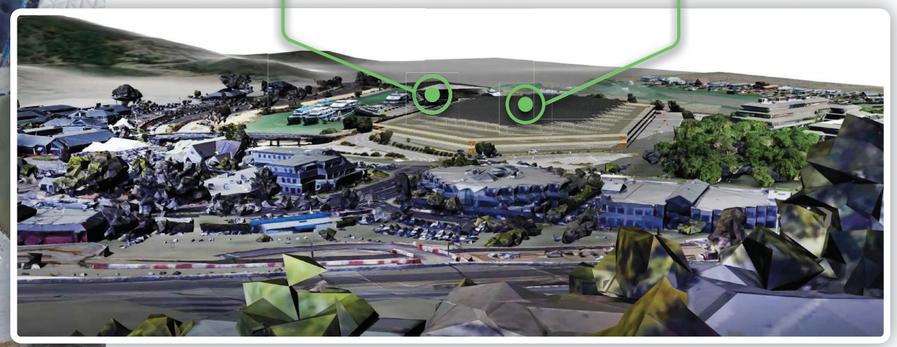
3 STORIES (2 decks above grade) approximately 30′-0″ to top of parapet
3 NIVELES (2 plataformas sobre el nivel del suelo) aproximadamente 30′-0″ hasta la parte superior del parapeto

FERRY TERMINAL BUILDING
Edificio de la terminal de ferry



ADDITIONAL SOLAR PANEL ARRAY shown on top level, setback from building edge
ARREGLO ADICIONAL DE PANELES SOLARES mostrado en el nivel superior, retirado del borde del edificio

FERRY TERMINAL BUILDING
Edificio de la terminal de ferry



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MAIN PARKING LOT C CONCEPT

Diseño conceptual para el estacionamiento principal C

3 Stories / 3 Niveles

GOLDEN GATE BRIDGE®
HIGHWAY & TRANSPORTATION DISTRICT

LANDSIDE / LADO TERRESTRE

DOES NOT MEET 2040 Program Demand Unless Combined with the North Parking Lot

NO CUMPLE con la demanda del programa 2040 a menos que se combine con el estacionamiento norte

NEEDS the North Parking Lot

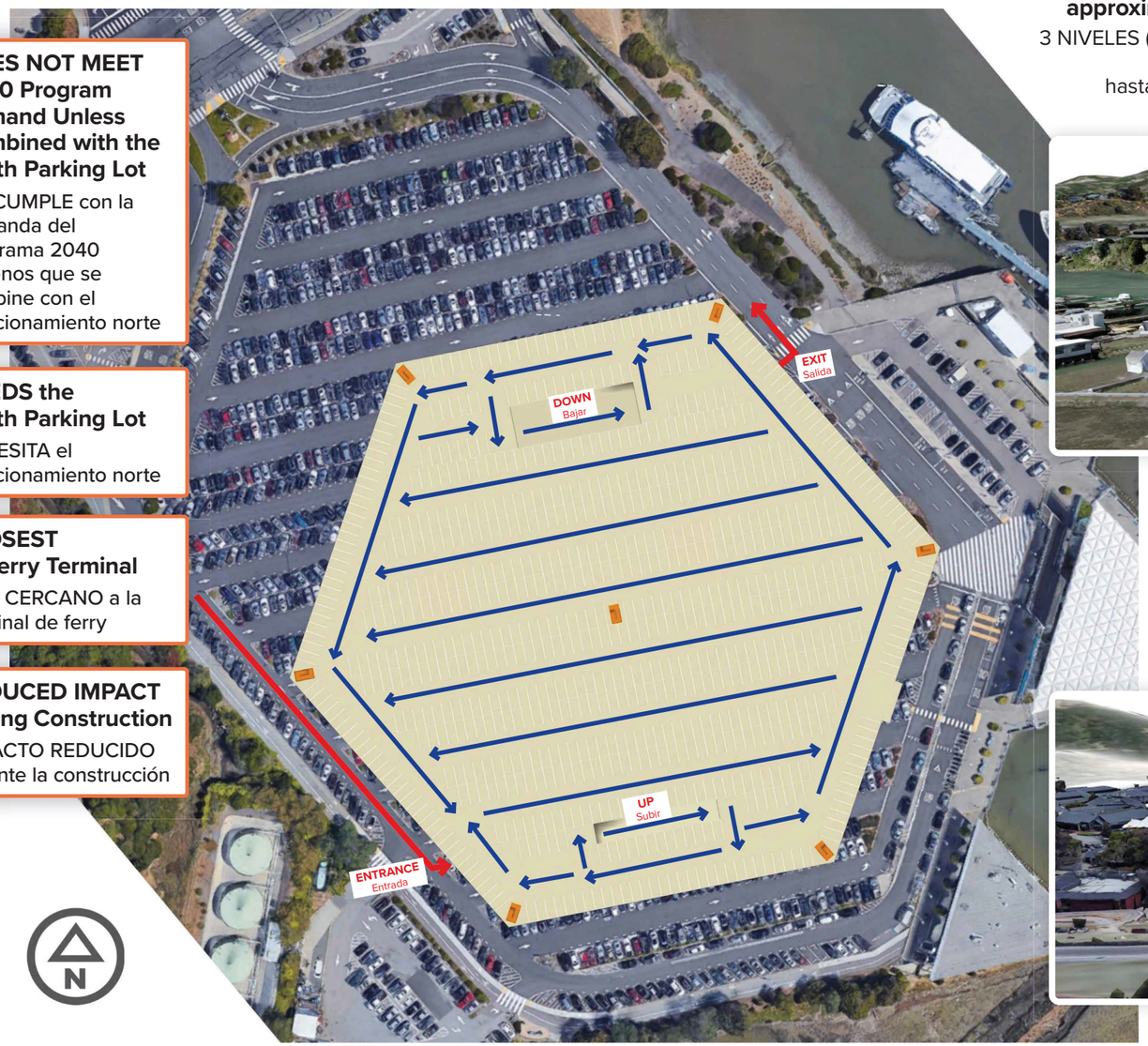
NECESITA el estacionamiento norte

CLOSEST to Ferry Terminal

MÁS CERCANO a la terminal de ferry

REDUCED IMPACT During Construction

IMPACTO REDUCIDO durante la construcción



3 STORIES (2 decks above grade) approximately 30'-0" to top of parapet

3 NIVELES (2 plataformas sobre el nivel del suelo) aproximadamente 30'-0" hasta la parte superior del parapeto

FERRY TERMINAL BUILDING

Edificio de la terminal de ferry



ADDITIONAL SOLAR PANEL ARRAY shown on top level, setback from building edge

ARREGLO ADICIONAL DE PANELES SOLARES mostrado en el nivel superior, retirado del borde del edificio

FERRY TERMINAL BUILDING

Edificio de la terminal de ferry



LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
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NORTH PARKING LOT CONCEPT

Diseño conceptual para el estacionamiento norte

5 Stories / 5 Niveles

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

LANDSIDE / LADO TERRESTRE



DOES NOT MEET 2040 Program Demand Unless Combined with the Main Parking Lot

NO CUMPLE con la demanda del programa 2040 a menos que se combine con el estacionamiento principal

NEEDS the Main Parking Lot

NECESITA el estacionamiento principal

FARTHEST to Ferry Terminal

MÁS ALEJADO a la terminal de ferry

VERY LOW OR NO IMPACT During Construction

MUY BAJO O NINGÚN IMPACTO durante la construcción

NORTH PARKING LOT STRUCTURE

Estructura del estacionamiento norte

FERRY TERMINAL BUILDING

Edificio de la terminal de ferry



5 STORIES (4 decks above grade) approximately 55′-0″ to top of parapet

5 NIVELES (4 plataformas sobre el nivel del suelo) aproximadamente 55′-0″ hasta la parte superior del parapeto

FERRY TERMINAL BUILDING

Edificio de la terminal de ferry



LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY

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PHASING OPTIONS AND CONSTRUCTION IMPACTS OF PARKING CONCEPTS

Opciones de Fases e Impactos de Construcción de Conceptos del Estacionamiento

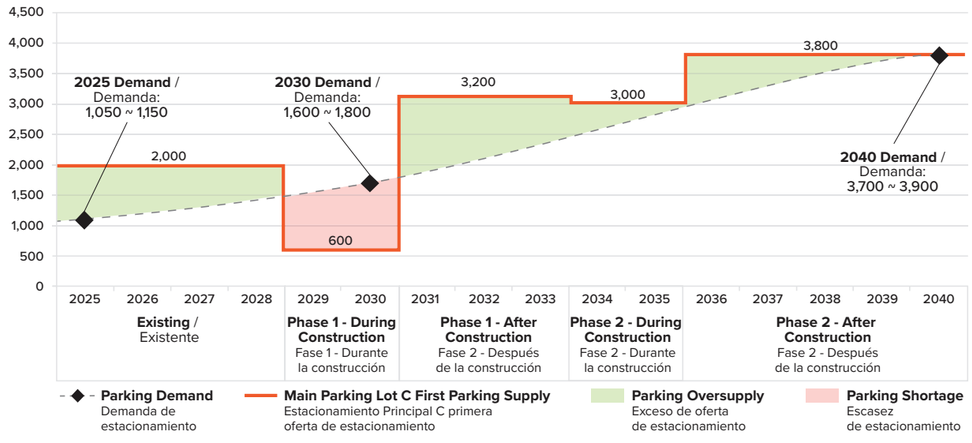
GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

LANDSIDE / LADO TERRESTRE

MAIN PARKING LOT C CONCEPT
Estacionamiento principal concepto C

Three-story structure on Main Parking Lot C
Estructura de tres pisos en el estacionamiento principal C

PARKING SUPPLY VERSUS PARKING DEMAND – MAIN PARKING LOT C FIRST
Oferta de estacionamiento versus demanda de estacionamiento – Estacionamiento principal C primero



MAIN PARKING LOT C FIRST

Minimizes parking shortage during construction

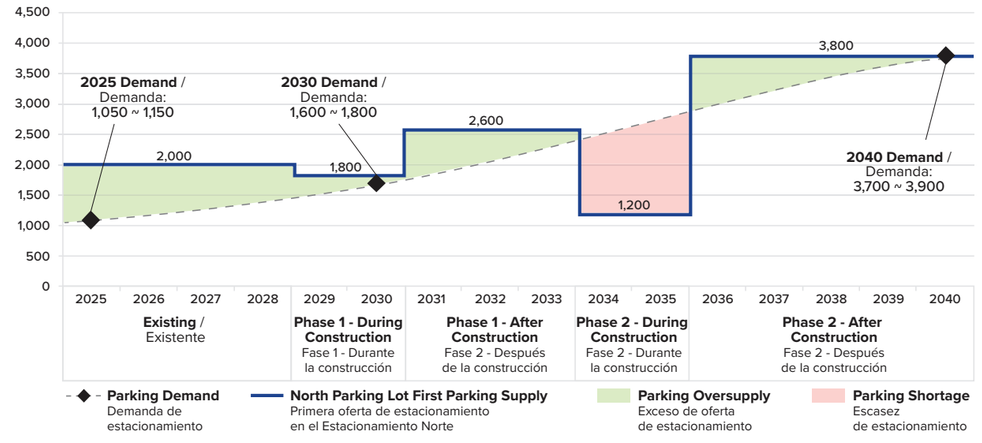
ESTACIONAMIENTO PRINCIPAL C PRIMERO

Minimiza la escasez de estacionamiento durante la construcción

NORTH PARKING LOT CONCEPT
Concepto de estacionamiento norte

Five-story structure on North Parking Lot
Estructura de cinco pisos en el estacionamiento norte

PARKING SUPPLY VERSUS PARKING DEMAND – NORTH PARKING LOT FIRST
Oferta de estacionamientos versus demanda de estacionamientos – Estacionamiento norte primero



NORTH PARKING LOT FIRST

Minimizes parking over supply during construction

ESTACIONAMIENTO NORTE PRIMERO

Minimiza el exceso de oferta de estacionamiento después de la construcción

LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY
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PHASING OPTIONS AND CONSTRUCTION IMPACTS OF PARKING CONCEPTS

Opciones de Fases e Impactos de Construcción de Conceptos del Estacionamiento

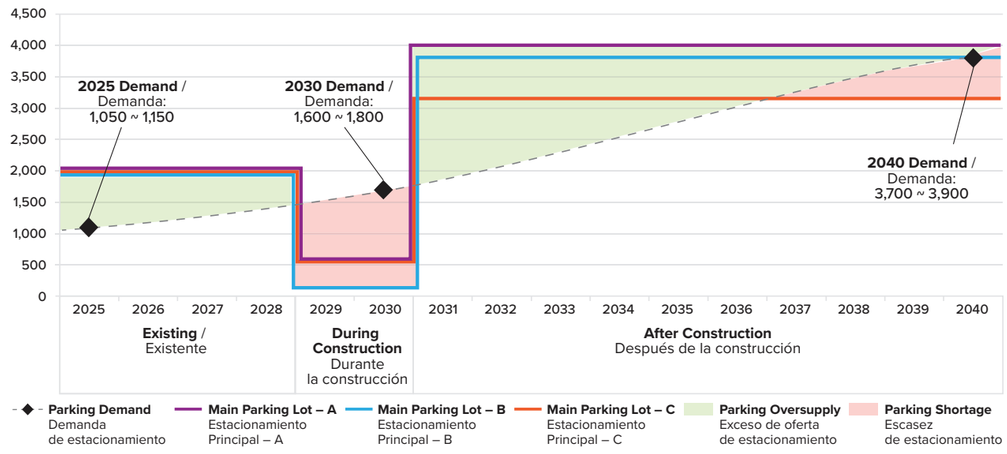
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LANDSIDE / LADO TERRESTRE

MAIN PARKING LOT CONCEPTS ONLY
Conceptos del estacionamiento principal solamente

A single structure on Main Parking Lot
Una sola estructura en el estacionamiento principal

PARKING SUPPLY VERSUS PARKING DEMAND – MAIN PARKING LOT ONLY
Oferta de estacionamiento versus demanda de estacionamiento – Solo estacionamiento principal



PARKING SUPPLY – MAIN PARKING LOT ONLY
Oferta de estacionamiento – Solo estacionamiento principal

MAIN PARKING LOT ONLY Estacionamiento principal solamente	DURING CONSTRUCTION Durante la construcción	AFTER CONSTRUCTION Después de la construcción
A **Main Parking Lot – A** Estacionamiento Principal – A	600	3,800-4,000
B **Main Parking Lot – B** Estacionamiento Principal – B	200	3,600-3,800
C **Main Parking Lot – C** Estacionamiento Principal – C	600	3,000-3,200

A MAIN PARKING LOT – A

- **Four-story** structure on Main Parking Lot close to the Terminal
- Tallest structure among all options on Main Parking Lot

ESTACIONAMIENTO PRINCIPAL – A

- Estructura de **cuatro** pisos en el estacionamiento principal cerca de la terminal
- La estructura más alta entre todas las opciones en el estacionamiento principal

B MAIN PARKING LOT – B

- **Three-story** structure on Main Parking Lot covering the full area
- Biggest parking shortage during construction

ESTACIONAMIENTO PRINCIPAL – B

- Estructura de **tres pisos** en el estacionamiento principal que cubre toda el área
- La mayor escasez de estacionamiento durante la construcción

C MAIN PARKING LOT – C

- **Three-story** structure on Main Parking Lot close to the Terminal
- Could not meet 2040 demand without TDM strategies

ESTACIONAMIENTO PRINCIPAL – C

- Estructura de **tres pisos** en el estacionamiento principal cerca de la terminal
- No podría satisfacer la demanda de 2040 sin las estrategias de TDM

WAKE AND SHORELINE EROSION ANALYSIS

Análisis de erosión de la costa y la estela marina

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WATERSIDE / EN EL AGUA

OBJECTIVE

Assess the impact of Golden Gate Bridge, Highway and Transportation District (GGBHTD) ferry wakes in Corte Madera Bay, including the Greenbrae Boardwalk Community and the Paradise Cay Yacht Harbor.

Objetivo

Evaluar el impacto de las estelas de los ferrys de Golden Gate Bridge, Highway and Transportation District (GGBHTD) en la Bahía de Corte Madera, incluyendo la Comunidad de Greenbrae Boardwalk y el Paradise Cay Yacht Harbor.

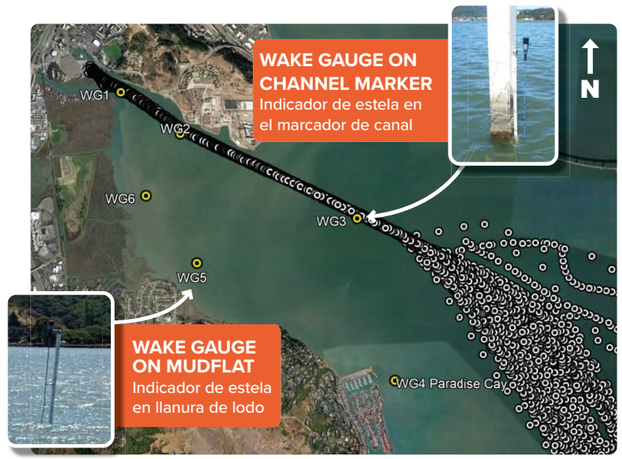
METHODOLOGY

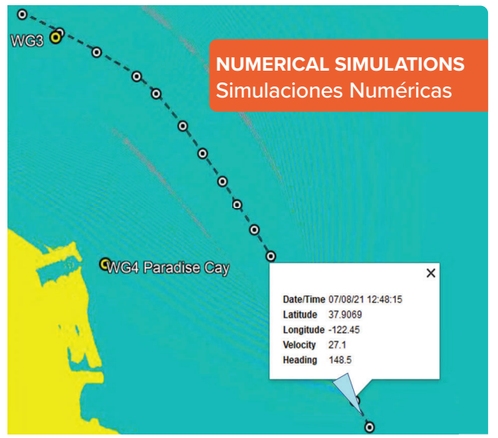
- Studied multihull (catamaran) and monohull (Spaulding Class) ferries
- Performed wake measurements
- Collected actual ferry tracks (location, speed, and heading)
- Selected one inbound and one outbound track
- Simulated ferry passages and wakes in Corte Madera Bay
- Compared simulated and measured wakes
- Assessed wake impacts:
  - » Bottom and shoreline erosion
  - » Boats and docks
  - » Shoreline protection structures
  - » Passive boating
  - » Benthos (flora and fauna at the bottom of the Bay)
  - » Water turbidity

GGBHTD FERRY FLEET // FLOTA DE FERRYS

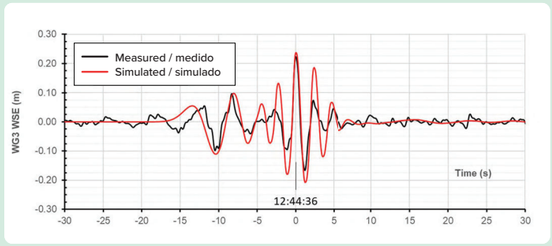


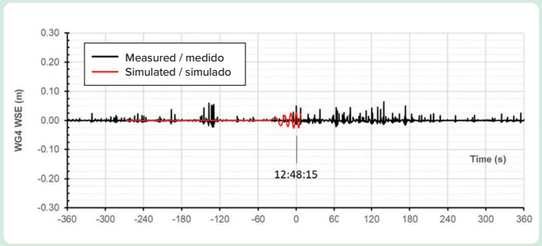
MENDOCINO | **DEL NORTE** | **NAPA & GOLDEN GATE** | **SPAULDING CLASS** (MARIN, SAN FRANCISCO, SONOMA)





SIMULATIONS VS. MEASUREMENTS // Simulaciones vs. Medidas





METODOLOGÍA

- Estudio de ferrys multicasco (catamarán) y monocasco (Clase Spaulding)
- Se realizaron mediciones de la estela
- Se recopilaron las rutas reales de los ferrys (ubicación, velocidad y rumbo)
- Se seleccionó una pista de entrada y otra de salida
- Travesías y estelas simuladas de ferry en la bahía de Corte Madera
- Comparación de estelas simuladas y medidas
- Evaluación de los impactos de las estelas:
  - » Erosión del fondo y de la costa
  - » Embarcaciones y muelles
  - » Estructuras de protección de la costa
  - » Navegación pasiva
  - » Bentos (flora y fauna en el fondo de la bahía)
  - » Turbidez del agua

LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY

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WAKE AND SHORELINE EROSION ANALYSIS

Análisis de la estela y la erosión de la línea costera

Corte Madera Bay: Key Features and Activities / Características y actividades principales

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WATERSIDE / EN EL AGUA



LEGEND / LEYENDA:

- **BULKHEAD** / MURO DE CONTENCIÓN
- **CONCRETE DEBRIS** / ESCOMBROS DE CONCRETO
- **DOCK & BOATS** / MUELLES Y BARCOS
- **NATURAL SHORELINE** / LÍNEA COSTERA NATURAL
- **PASSIVE BOATING** / NAVEGACIÓN PASIVA
- **REVETMENT** / REVESTIMIENTO

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PRELIMINARY WAKE AND SHORELINE EROSION ANALYSIS
Análisis preliminar de la estela y la erosión de la costa

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FERRY WAKE ASSESSMENT // Evaluación de la estela de ferry

WATERSIDE / EN EL AGUA

Maximum wake height measurement of outbound and inbound ferry vessels

Medición de la altura máxima de la estela de los ferrys que llegan y salen

LEGEND / LEYENDA:

- **No Impact** / Sin impacto
- **Moderate Impact** / Impacto moderado
- **High Impact** / Alto impacto
- **Not Applicable** / No aplica

BE: bottom erosion / erosión del fondo

SE: shoreline erosion / erosión de la costa

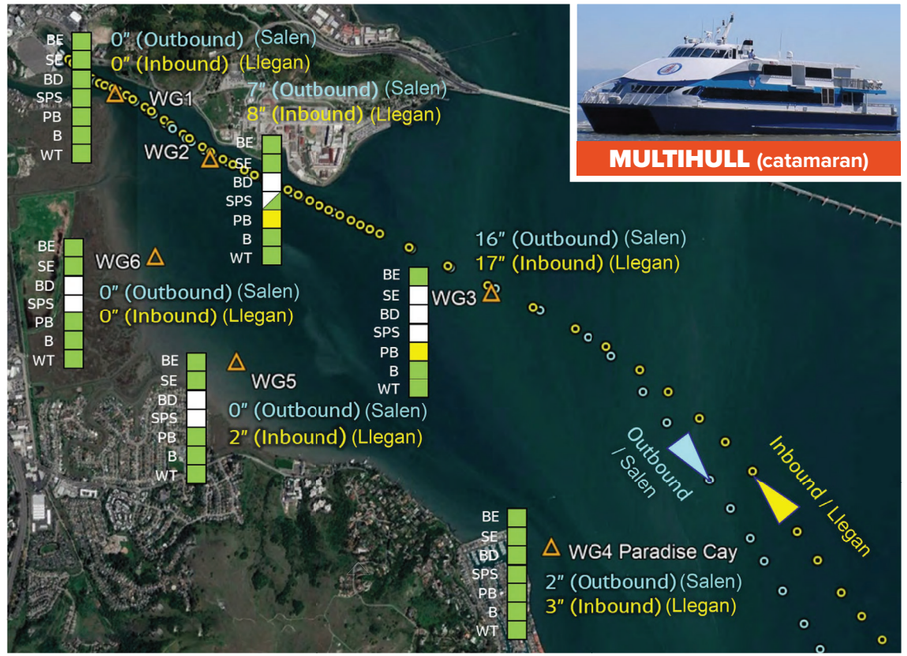
BD: boats and docks / embarcaciones y muelles

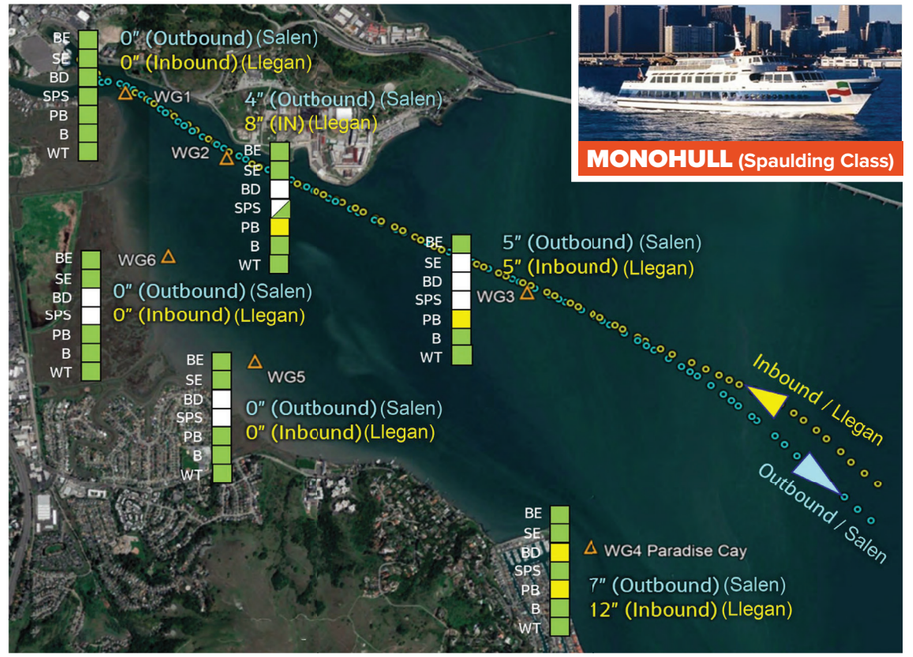
SPS: shoreline protection structures / estructuras de protección de la costa

PB: passive boating / navegación pasiva

B: benthos / bentos

WT: water turbidity / turbidez del agua





- **Bottom erosion:** no impact where wakes are small or water depth relatively deep
- **Shoreline erosion:** no impact where wakes are small or shoreline armored
- **Boats and docks:** wakes less than 1 foot
- **Shoreline protection structures:** no impact, wakes are smaller than 100-year wind wave
- **Passive boating:** no impact where wakes are less than rowing shell freeboard, moderate impact if rowing shell not heading into the wakes
- **Benthos:** no impact, wake-induced bottom shear stress does not erode bottom
- **Water turbidity:** no impact, naturally high suspended sediment levels

- **Erosión del fondo:** sin impacto donde las estelas son pequeñas o la profundidad del agua es relativamente honda
- **Erosión de la costa:** sin impacto donde las estelas son pequeñas o la costa está protegida
- **Embarcaciones y muelles:** estelas de menos de 1 pie
- **Estructuras de protección de la costa:** sin impacto, las estelas son más pequeñas que las olas de viento de 100 años
- **Navegación pasiva:** sin impacto cuando las estelas son menores que la altura libre de la embarcación de remo, impacto moderado si el bote de remo no se dirige hacia las estelas
- **Bentos:** sin impacto, la tensión cortante del fondo inducida por la estela no erosiona el fondo
- **Turbidez del agua:** sin impacto, niveles naturalmente altos de sedimentos suspendidos

FUTURE FERRY FLEET
Flota futura de ferrys

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WATERSIDE / EN EL AGUA

OCTOBER 2023 BOARD ACTION:
MOVE ALL FERRIES TO MULTIHULL (CATAMARAN) VESSELS

Acción de la Junta – Octubre 2023:
Convertir toda la flota de ferrys a embarcaciones de multicasco (catamaranes)

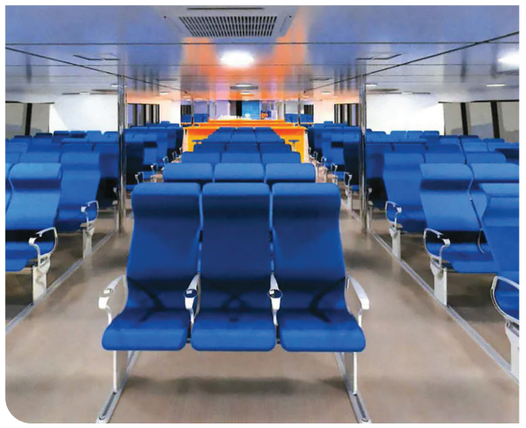


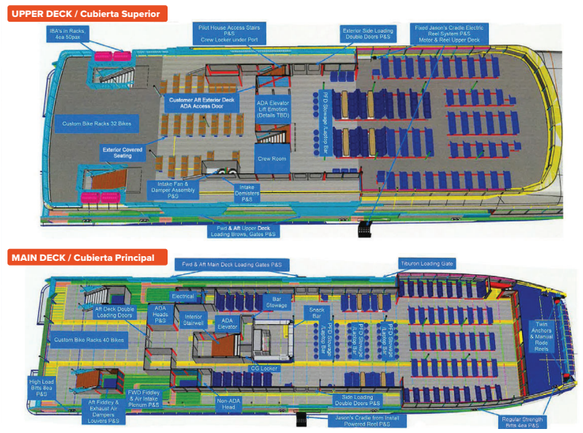


CURRENT FERRY SERVICE
Servicio actual de ferry

38
TRIPS PER DAY
Viajes por día

NO WAKE AND SHORELINE EROSION IMPACTS
Sin impacto de la estela o erosión costera





FUTURE FERRY SERVICE UNDER STUDY

- Up to 56 trips per day (2040)
- No change in ferry types, routes, speed for the Larkspur route
- Anticipate reduced wake profile when compared to current catamarans*

* **CORRECTION** made on 10/23/24, previously stating: *"No wake wash and shoreline erosion impacts expected"*

MULTIHULL
(CATAMARAN) FERRY
Ferry multicasco (catamarán)

MULTIHULL (CATAMARAN) FERRY CHARACTERISTICS

- Surface-piercing hulls, producing less wake
- Wider (beam) and more stable, reducing rolling and pitching (which can contribute to wakes)
- Can plane at high speed, reducing submerged volume, resulting in less drag and wake

Futuro servicio de ferry bajo evaluación

- Hasta 56 viajes por día (2040)
- Sin cambios en los tipos de ferry, rutas, velocidad de la ruta de Larkspur
- Se anticipa un perfil de estela reducido en comparación con los catamaranes actuales*

* **CORREGIDO** el 23/10/24, anteriormente se decía: "No se esperan impactos de la estela y erosión de la costa"

Características del ferry multicasco (catamarán)

- Cascos de perforación de superficie, produciendo menos estela
- Más anchos y más estables, reduciendo el balanceo y el cabeceo (lo que puede contribuir a las estelas)
- Pueden planear a alta velocidad, reduciendo el volumen sumergido, lo que resulta en menos resistencia y estela

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TIMELINE / CRONOGRAMAS

LARKSPUR FERRY SERVICE EXPANSION–SCOPING MEETING
Reunión sobre el alcance de la expansión del servicio de Ferry de Larkspur

GOLDEN GATE BRIDGE® HIGHWAY & TRANSPORTATION DISTRICT

WATERSIDE / EN EL AGUA

LARKSPUR FERRY SERVICE AND VESSEL HISTORY AND PLANS

Servicio de Ferry de Larkspur e historia y planes del barco

1972

Property acquired for the Larkspur Ferry Terminal; contract awarded for construction of three Spaulding class vessels

Propiedad adquirida para la Terminal de Ferry de Larkspur; se adjudica contrato para la construcción de tres buques clase Spaulding

1974

Larkspur ferry terminal construction contract awarded

Adjudicación del contrato de construcción de la Terminal de Ferry de Larkspur

1976

Commute service commenced: Spaulding class vessel

Se inició el servicio de traslado: Buque de la clase Spaulding

1977

Two vessels used for service (third as backup)

Dos buques utilizados para el servicio (el tercero como respaldo)

1980s

Wake-reducing operating restrictions put in effect along the Corte Madera Creek channel to Point San Quentin

Se implementan restricciones operativas que reducen la estela a lo largo del canal del arroyo Corte Madera hasta Point San Quentin

1985

- **Spaulding engine conversion: Gas turbine to diesel**
- **Service frequency increase: Three Spaulding class vessels in use**

- Conversión de motor Spaulding: turbina de gas a diésel
- Aumento de la frecuencia de servicio: tres buques de la clase Spaulding en uso

1998

First catamaran in service for Larkspur: M.V. Del Norte

Primer catamarán en servicio para Larkspur: M.V. Del Norte

2004

Larkspur service reconfigured: All trips except one served by high-speed catamaran

Reconfiguración del servicio Larkspur: todos los viajes excepto uno atendido por catamarán de alta velocidad

SUMMER 2023

All Larkspur service provided by high-speed catamaran

Todos los servicios de Larkspur proporcionados por catamarán de alta velocidad

2023

Board authorizes contract to replace entire ferry vessel fleet (seven vessels) with new high-speed catamarans

La junta autoriza el contrato para reemplazar toda la flota de ferrys (siete buques) con nuevos catamaranes de alta velocidad

2027

Delivery anticipated of first new high-speed catamaran, anticipate one new vessel delivered per year

Se prevé la entrega del primer nuevo catamarán de alta velocidad y se prevé la entrega de una nueva embarcación por año

Attachment C: Scoping Period Public Comments (All)

Affiliation	Comment Category(s)	Comment Summary	Subcomment
The Greater Marin	1-Project 2-Landside-Project Design-Ops	Commenter wants to knowmore about ferry rider travel patterns and if using SMART is a better suited mode of transportation for those riders.	Ron, Good evening! I hope this email finds you well.I just saw the IJ article about the planned environmental study regarding expanding Larkspur Ferry service. First of all, that's very exciting to see, and I'm glad GGF is looking forward to when ridership is back up to normal. I was wondering if you could answer a few questions for me, either on or off the record? 1) Have there been studies about where ferry riders who drive come from in the county? I know GGBHTD has experimented with shuttles before but had limited success, but I'm thinking more about how many riders might be induced to take SMART if the tracks were realigned to put the station into the terminal (probably a $50 million project) and if that would have a lesser impact on traffic but similar benefit to ridership than a comparably-priced garage.
	1-Project 2-Landside-Project Design-Ops		2) SMART's 32-minute headways are a major problem with inducing ridership even in the existing system. Has the system put forward any estimates, either formally or informally, about what it might take to change them to a clockface that could align better with the ferry schedule?
WTB/TAM	3-EIR & Env. Studies	Commenter suggests that project team consider the existing traffic congestion, adding housing on top of the parking structure, alternative modes of transit to the ferry terminal, and providing EV charging (if the parking structure is built).	Our comments on the EIR Scoping for the Larkspur Ferry Service and Parking Expansion Project fall into two categories, which we have labeled PART 1 and PART 2. The first, **PART 1,** consists of environmental impacts and negative externalities which should be studied and analyzed as part of the project EIR. These include traffic, cost, environmental, safety, aesthetic, and land use inefficiency.The second, **PART 2,** consists of different multi-modal improvements that should be included in a "No Build + Multi-Modal Improvements Alternative" in the project EIR. This alternative would be in addition to the alternatives covering the various parking structure configurations as well as in addition to (and separate from) the required "No Build" alternative which simply maintains the status quo. The multi-modal improvements to be included in this alternative in the EIR include parking demand management, SMART, buses, multi-use pathways, bike parking, bikeshare, bike lease, and transit-oriented land use. Let us be clear that we are strong supporters of the Larkspur Ferry and of public transportation in general. We are glad that the District is forecasting increased ferry ridership in the future. More people on ferries instead of on our roads and highways is good for Marin County and good for the Bay Area. However, we have significant reservations with the District's models which assume that most of the forecast increase in ridership translates to an increase in demand for parking at the ferry terminal. We believe those models fail to account both for recent and planned and future improvements in multi-modal access to the Larkspur Ferry Terminal. Let us also be clear that we are not "anti-car" or "anti-parking." We know that a majority of Larkspur Ferry riders currently access the ferry terminal by car, and that parking is an important component of the ferry's accessibility to the general population. We understand that some ferry riders rely on parking for various reasons such as age, comfort, distance, and trip-chaining needs and that some would choose other modes besides the ferry if that parking were not available. We acknowledge that a certain amount of parking will always be necessary to accommodate those riders who are unable or unwilling to shift their home-to-ferry terminal commute to modes other than driving. That said, we believe that through a mix of parking demand management strategies and incentives, and encouragement of alternative modes for accessing the ferry terminal, the District can accommodate the forecast increase in ferry ridership without building any new expensive, controversial, and environmentally problematic parking structures.
	2-Landside-Project Design-Ops		**Traffic** The Larkspur Ferry Terminal is at the epicenter of one of the worst perennial traffic jams in Marin County. Everyone in Marin is familiar with the gridlock that occurs daily on the access routes leading to the ferry: Sir Francis Drake Boulevard, and northbound Highway 101 before the Sir Francis Drake exit. Adding additional parking capacity at the ferry will generate additional car trips on local roads and intersections, exacerbating the current traffic problem. Reducingvehicle trips and vehicle miles traveled should be the goal, but the proposed parking garage will do the opposite. This negative externality is best understood through concept of "induced demand. By adding capacity that does not currently exist, the proposed garage structures will create new car trips where there was no demand for them before. It will encourage people to drive who otherwise might have considered other modes. This is the opposite of what the District should be doing: dampening demand for parking by making it easier to reach the ferry by means other than driving.
	1-Project 2-Landside-Project Design-Ops		**Cost** Although the District's consultants have not yet performed detailed cost estimates of the different parking structure alternatives, it is safe to say that none of them will come cheap. The national average cost per parking space in multi-story parking structures is $40,000 to $60,000. With constructions costs higher than the national average in California, and higher than the state average in Marin County, the cost would surely be near or at the upper end of that range. More importantly, the cost of designing, permitting, and constructing the parking structure carries a tremendous opportunity cost. It represents funds that could be invested more efficiently on other improvements, such as new ferries, improved bus service, or other first-mile solutions as detailed in the second half of this letter.
	2-Landside-Project Design-Ops 3-Enviro Studies		**Environment** The Larkspur Ferry is one of the most energy-efficient modes of transportation between Marin and San Francisco. Ferry vessels traveling on the Bay save energy through reduced friction with the water surface versus tires on asphalt. A single ferry vessel holds more people than any car or bus. And the ferry takes the shortest, most direct route between Larkspur and the City. Having left their cars behind in Larkspur, ferry riders are already relying on alternative modes of transportation for their "last mile" needs to reach their final destinations in San Francisco after disembarking at the Ferry Building. Asking some of those riders to consider alternative modesfor their "first mile" needs between their homes and the Larkspur Ferry Terminal is not that big of a reach. More parking capacity means more car trips. Beside more traffic, more car trips also means more vehicle miles traveled, more greenhouse gas emissions. Even with electric vehicle adoption, more car trips still means more energy expended. Finally, on the physical infrastructure side, the concrete and steel materials needed for the proposed parking structures carry a significant environmental footprint and will increase the urban heat island effect.
	2-Landside-Project Design-Ops		**Safety** Increased car traffic is directly correlated with worsened safety outcomes for all users of the transportation network. More parking capacity means more car trips to and from the Larkspur Ferry Terminal. With more car trips and especially more cross-movements at intersections comes increased risk of collisions, injuries, and fatalities. The risk is greatest for pedestrians and bicyclists, who are the most vulnerable users of the transportation network. But the risk also extends to motor vehicle drivers and passengers as well. In the 2024 Marin County Local Road Safety Plan, the Transportation Authority of Marin identified East Sir Francis Drake Boulevard between Larkspur Landing Circle West and Larkspur Landing Circle East as part of the City of Larkspur's High Collision Network due to the high rate of collisions on this road segment. The intersection of East Sir Francis Drake Boulevard and Larkspur Landing Circle West, which is also the intersection at the entrance to the Larkspur Ferry Terminal, was also identified as part of the High Collision Network.
	2-Landside-Project Design-Ops		**Aesthetic** Parking structures are amongst the least aesthetic buildings in the built environment. The visual impact of the proposed parking structures on the main lot would be especially visceral given the ferry terminal's idyllic waterfront location. The parking structures would block existing view corridors towards the San Francisco Bay. They would also block views of the iconic ferry structure designed by internationally acclaimed architect Jacques de Brer. The proposed parking structure on the auxiliary lot would be even taller due to that site's smaller buildable footprint. It would block views from the SMART Larkspur station towards the ferry terminal and the Bay, severing the visual connection between the two modes of transit.
	2-Landside-Project Design-Ops		**Land Use Inefficiency** Parking is one of the most inefficient uses of land in the urban built environment. The District has in its possession a valuable asset in the form of land on which the proposed parking structures would be built. This land, currently used for parking, is prime waterfront land. It lies within the City of Larkspur's targeted area for high-density housing development, and is in a Transit-Oriented Community as defined by the Metropolitan Transportation Commission. Its most productive use would be as housing or mixed-used development, which would generate additional revenue for the District as well as supply a steady source of ferry riders who do not require parking. It is in the District's interest to maximize the efficiency of land use on its land holdings. This includes seeking ways to reduce parking demand at the Larkspur Ferry Terminal so that more land can be used for more productive uses. If the District builds the proposed parking structure, it will likely remain there indefinitely due to sunken costs. This means that it will be more difficult for the District to respond to future changes in transportation behavior and reductions in demand for parking. It will also make it more difficult for the District to pivot to using the existing parking lot for future uses such as housing as called for in Initiative #18 in its Draft Strategic Plan.
	2-Landside-Project Design-Ops		**Parking Demand Management** The District should implement a parking demand management program to reduce the demand for parking at the Larkspur Ferry Terminal and encourage ferry riders to choose alternative modes to travel between their homes and the ferry terminal. Such a program would make use of both positive and negative incentives. Positive incentives might be discounted ferry tickets for ferry riders who travel to the ferry terminal by carpool, transit, or active transportation. Negative incentives might be higher parking fees, parking fees on weekends, or dynamic parking fee that respond to fluctuating demand. We can look to successful examples of both positive and negative incentives elsewhere in the Bay Area's transportation system. Discounted tolls on the Golden Gate Bridge and seven BATA bridges are an example of positive incentives, and dynamic, demand-responsive parking meter fees in San Francisco are an example of negative incentives.
	2-Landside-Project Design-Ops		**SMART** In December 2019, SMART began service to Larkspur. One month later, the Covid-19 pandemic began spreading across the Bay Area, and Larkspur Ferry ridership has not returned to pre-Covid levels since. This means that for the entire duration of time when the parking lot was regularly filled to capacity, there was no train to Larkspur. SMART is a newcomer in Marin's transportation landscape. Lately, its ridership has fully recovered to, and surpassed, pre-Covid levels, with ridership breaking records every week. Surveys show the Larkspur Ferry Terminal is the number one destination for SMART riders. SMART is a new modal alternative for ferry riders to reach the Larkspur Ferry Terminal, and one that will only improve as more people learn about it. In its 2024 Strategic Plan, SMART identified first-and-last-mile connections as the number one strategy to increase ridership and an area for continued investment and optimization. One example, launched in June 2024, is the SMART Connect shuttle, which provides a quick and convenient option for ferry riders making the transfer from the train station who prefer not to walk or for whom physical limitations make walking difficult. We suspect that the District's forecasts are not adequately taking into the account the role that SMART plays — and will play in the future — in reducing demand for parking and getting people to the ferry.
	2-Landside-Project Design-Ops		**Buses** The Larkspur Ferry Terminal is currently served by a limited number of bus routes: Marin Transit Routes 17, 29, and 228 and Golden Gate Transit Route 132. Most of these routes operate infrequently and are not practical as a modal alternative for most Larkspur ferry riders. Golden Gate Transit's more frequent express bus service, Routes 130 and 150, do not stop near the Larkspur Ferry Terminal. Adding a stop on these routes closer to the ferry could leverage existing transit service and increase access to the Ferry Terminal. Restoration of the former ferry feeder bus routes (see Appendix Exhibit A) could also reduce parking demand and meet ferry riders' first-and-last-mile needs. We understand that the District did temporarily restore the feeder bus routes in 2008, and that the usage was disappointing. However, with enhanced outreach and marketing and with more optimization of the feeder routes, we think that feeder bus routes could be successful again. Improving ferry access with both SMART and bus routes is in alignment with Initiative #16 of the District's Draft Strategic Plan.
	2-Landside-Project Design-Ops		**Multi-Use Pathway Network** The Larkspur Ferry Terminal is more connected via active transportation routes than ever before. Several of the pathways that today lead directly to the Larkspur Ferry Terminal were not even completed prior to the Covid-19 pandemic when the parking lots were last regularly filled to capacity. As with the role of SMART, we suspect that the District's forecasts for ferry access by modal share are not adequately taking into account the role that pathways can play in bringing ferry riders to the ferry terminal and reducing demand for parking. The ferry terminal lies at the confluence of a system of pathways known that radiate out in all four cardinal directions: the SMART Pathway to the north, the East Sir Francis Drake Boulevard Pathway to the east, the North – South Greenway to the south, and the Corte Madera Creek Pathway to the west. The Transportation Authority of Marin and SMART have both invested millions of dollars in building the Central Marin Ferry Connection Project, an award-winning system of grade-separated overcrossings and tunnels that provide pedestrians and bicyclists with a safe, separated, and near-flat pathway connection to the ferry that avoids busy arterial traffic and bridges geographical barriers such as Corte Madera Creek and Cal Park Hill (see Appendix Exhibit B). With the completion of the Andersen Drive to Second Street segment of the SMART Pathway and the Marquard Avenue to Shaver Street segment of the Cross – Marin Bikeway, all of Central San Rafael is now easily accessible to the ferry via the Cal Park Hill Tunnel. Further planned projects for safe and separated bicycle routes on Bellam Boulevard and through Downtown San Rafael will further increase access to the ferry for the largest city in Marin County, and the number one point of origin for ferry riders. The City of Larkspur and Town of Corte Madera are also well-connected to the ferry with a network of existing pathways, and the planned gap closure of the Southern Segment of the North – South Greenway Gap Closure Project will complete the all-ages-and-abilities connection to the ferry from the south. Additional planned pathway improvements will make it possible for ferry riders from across central and southern Marin to reach the ferry. With the growth of the e-bike market, the distance that people can travel efficiently and comfortably by bicycle is getting longer and longer. This means that more people and neighborhoods are within practical and convenient bicycling distance of the ferry, and that bicycle mode share should increase well beyond the 7.3% measured prior to the Covid pandemic.
	2-Landside-Project Design-Ops		**Bike Parking** Increased bicycle trips to the ferry terminal must be accommodated through improved bike parking. This is stated as much in Initiative #4 of the District's Draft Strategic Plan. Most of the increase in bicycle mode share to the Larkspur Ferry Terminal will come from riders who do not need a bike once they reach San Francisco because they work within walking distance of the Ferry Building. This means they will need more space to park their bikes on the Larkspur side. We understand that that one of the planned improvements in the Ferry Expansion Project is to replace the bike racks outside the Ferry Terminal with bike lockers. This is fine, but not the only solution. Bike lockers are space-intensive, and because they require pre-registration or membership, the barriers to use are significant. We recommend increasing the amount of traditional non-locker bike parking within the paid area of the Ferry Terminal, as this bike parking is largely secure within the monitored paid area perimeter. Images of proposed new bike parking infrastructure shown at the May 14th Open House showed vertical bike parking racks. While space-efficient and suitable for traditional bikes, these racks are not suitable for e-bikes, which are heavier than traditional
	2-Landside-Project Design-Ops		**Bikeshare** The Transportation Authority of Marin, through the third-party contractor Drop Mobility, recently launched a Countywide bikeshare system known a Redwood Bike Share. Shared e-bikes are now deployed at bikeshare hubs located at and in the vicinity of transit centers throughout the County, including all SMART stations and all Golden Gate ferry terminals. However, the scale of Redwood Bikeshare is limited, with just a handful of bikes based at the Larkspur Ferry Terminal hub, and even fewer in the surrounding neighborhoods. A robust bikeshare system is an essential component of the multi-modal equation that will bring people to the ferry terminal without increased demand for car parking. In order to fully leverage the power of bikeshare, the District must either partner with TAM/Drop to expand the scale of Redwood Bikeshare system at and around the Larkspur Ferry Terminal, or the District must supplement the Redwood Bikeshare system with a bikeshare system of its own. The ferry needs a fleet of shared bikes much larger than a dozen bikes. Most importantly, bikeshare hubs must be numerous and well-positioned throughout the neighborhoods and activity centers within a 5-mile radius of the ferry terminal, where ferry riders live and work. This District-branded supplemental bikeshare system will require capital and operational funding, but the cost is merely a fraction of what the District is contemplating spending on the proposed parking structures. The cost savings from each parking space that the District does not need to build is enough to fund a fleet of bikeshare bikes.
	2-Landside-Project Design-Ops		**Bike Lease** Another model similar to bikeshare is "bike lease." Bike lease is currently the fastest-growing segment of the bicycle market in Europe. In one possible business model, the District would contract with a bikeshare operator to implement and maintain a fleet of e-bikes that would be leased on a one-to-one basis to individual ferry riders. These bikes would be used for the specific purpose of commuting from the rider's home in Marin County to the ferry terminal. The bikes would be leased to the ferry riders for free, provided they use them to ride to the Larkspur Ferry Terminal a set minimum number of times per week. We think three times a week is a good place to start, but this could be adjusted according to evolving commuting trends. Users of this program could be incentivized with a discount on their ferry ticket. They would not be allowed to take the bike onboard the ferry. There would be designated parking and charging stations for the leased e-bikes within the secure perimeter of the ferry terminal. This is where charging of the bikes would occur, as well as most maintenance of the bikes by the third-party contractor.
	2-Landside-Project Design-Ops		**Transit-Oriented Land Use** Land use planning is one of the most powerful tools available to the District to increase ridership of its ferries without increasing demand for parking. The Larkspur Ferry Terminal parking lots are prime land for transit-oriented development. This is stated as much in Initiative #18 of the District's Draft Strategic Plan. It is also emphasized in the SMART Larkspur Station Area Plan, and in the Housing Element of the Larkspur General Plan, which specifically designates the District-owned parking lot on Larkspur Landing Circle as one of Larkspur's "Housing Opportunity Sites" to be developed to meet the City's state-mandated housing targets. The value proposition of housing on the District's ferry terminal land far exceeds the value proposition of the proposed parking structures. By developing the land that it owns with housing or mixed-use development, the District would both generate profits from the development itself, and increased ticket revenues from new ferry riders who would have no need for the proposed parking structures because they would live within walking distance of the ferry. The District could also take advantage of future trends in "reverse commuting" by building mixed-use and office space on its ferry terminal properties that would attract ferry riders who live in San Francisco but work in Marin. This would help balance out ridership amongst ferry trips, putting more people in Larkspur-bound ferries during the morning commute, and San Francisco-bound ferries during the afternoon commute.

Affiliation	Comment Category(s)	Comment Summary	Subcomment
CA State Lands Commission	2-Landside-Project Design-Ops 3-Enviro Studies 4-Vessel and Wake 5-Marsh, Bulkhead, Revetment	Commenter requests reconsideration of parking lottocation due to concersn marsh impacts, flood protection and sea level rise. Commenter also requests that sea level rise be studied as part of the EIR.	**1. Project Area and Location:** The Project area should include the marsh on the northern bank of Corte Madera Creek that is directly adjacent to the south side of the Larkspur Ferry Terminal main parking lot. This marsh was the prior mitigation site for the rock rip rap wall installed along the south bank of Corte Madera Creek at the Greenbrae Boardwalk. This parcel is approximately 7.4 acres and was under a previous lease (PRC 7309) with the Commission. The marsh may be impacted by Project activities to expand the main parking lot and enhance the bike path, and those impacts should therefore be addressed in the EIR. The marsh should also be integrated into the Project itself because the marsh will provide flood protection and minimize impacts from sea level rise to the expanded main parking lot and bike path, as well as the existing ferry terminal. To adequately perform that function over the course of the Project's lifespan, the marsh needs to be actively managed and adapted to sea level rise. Adaptation strategies to maintain the marsh's flood control function could include elevating the marsh with sediment, planting native vegetation for erosion control, and improving drainage systems. The marsh is within the Commission's jurisdiction, and a lease would be required for activities to manage the marsh and its resources. In addition, the Project area should include the existing rock rip rap revetment that was previously installed along the Greenbrae Boardwalk community as mitigation for the original Larkspur Ferry Terminal. The revetment is under lease with the Commission (PRC 7187), and a new lease is scheduled for consideration by the Commission at its meeting on Tuesday, December 17, 2024 (https://www.slc.ca.gov/meetings/). The revetment's purpose is to protect the upland property from the wake of existing ferry vessel activities. In its current deteriorated state, the revetment is not functioning as intended. Given that the Project contemplates more ferry trips and use of faster vessels, the shoreline can reasonably be expected to need significantly increased protection from larger and more frequent vessel wakes. Sea level rise will also compound the flood risk to the Greenbrae Boardwalk community. The sea level in this area is projected to rise between 0.8 to 1.3 feet by 2050, according to the Ocean Protection Council's 2024 Sea Level Rise Guidance. The revetment has significantly degraded since its installation. The land underneath the revetment has subsided over the years, and portions of the revetment are sunk into the underlying bank and, in some cases, covered over with sediment. The preliminary Wake and Shoreline Analysis performed by the District did not appear to measure wake height for this area, only the northern Corte Madera Creek Channel. The District should undertake a more detailed Wake and Shoreline Analysis study that includes this area and measures wake impacts to the revetment. Given these risk factors for flooding in the Boardwalk community, the Project may need to be augmented to include repair or replacement of the revetment. Alternative strategies to hard armoring, such as nature-based solutions like living shorelines, should be considered in any activities to modify the revetment and improve flood protection and resiliency of the upland property, consistent with the Commission's 2023 Shoreline Adaptation and the Public Trust report.
	3-EIR & Env. Studies		**Environmental Review** Commission staff requests that the District consider the following comments when preparing the EIR, to ensure that impacts to State sovereign land are adequately analyzed if the Commission uses the EIR to support a future lease approval related to the Project. **Climate Change** **2. Sea Level Rise:** The NOP indicates that sea level rise will be studied as part of the EIR. The Commission recommends that the study uses the projections from the most recent State guidance (referenced above) and includes consideration of the Intermediate scenario as the lower bound and the High scenario as the upper bound for analysis. Sea level rise scenarios should also be incorporated into wake height impact studies. Thank you for the opportunity to comment on the NOP for the Project. As a trustee agency, Commission staff requests to be kept advised of changes to the Project Description and associated document scope. Please send additional information on the Project to the Commission staff listed below as the EIR is being prepared. Please refer questions concerning climate change to Maren Farnum, Senior Environmental Scientist, at (916) 574-0966 or via email at Maren.Farnum@slc.ca.gov. For general questions concerning environmental review, please contact Afifa Awan, Senior Environmental Scientist, at (916) 574-1891 or via email at Afifa.Awan@slc.ca.gov. For questions concerning Commission leasing jurisdiction, please contact
N/A, Individual	2-Landside-Project Design-Ops 3-Enviro Studies	Commenter wants project team to include a future flyover that brings SMART directly to the ferry terminal. Commenter also wants the anti-environment imposed cap on ferry trips to be eliminimated.	Hello, Please include a study of a future flyover bringing SMART trains direct to the Larkspur ferry terminal for a convenient transfer at the dock, akin to Hoboken, Staten Island and the old Oakland Mole. It should not be a 30 minute transfer between these two transportation facilities, requiring a long uphill walk or shuttle ride. For transit to be used it must be convenient, direct and with minimal time loss at transfers.
	2-Landisde-Project Design-Ops		Also the anti-environment imposed cap on ferry trips needs to be lifted. This is insane, cap car trips on the freeway, not mass transit trips that take cars off the road. Jonathan Winslow
N/A, Individual	2-Landside-Project Design-Ops 3-Enviro Studies	Commenter does not support building the parking structure and encourages that other multimodal transportation to be utilized instead such as more direct bike and pedestrian connections.	My name is Odin Palen, and I often use the Larkspur Ferry, as a Larkspur resident and student at Redwood High School. In the face of climate change and the need to create sustainable transportation options, Golden Gate Feymust make it easy for people to arrive at the terminal by active and public transportation. Currently, it is served by an hourly bus that is untimed to the ferry schedule (route 228) and the SMART train that drops people off far away from the terminal. Cyclists and pedestrians have to circumnavigate all the way around the massive parking lot. I urge the Bridge District to pursue environmentally friendly and efficient ways of allowing people to get to the ferry terminal, rather than expanding the parking. Expanding the parking lot simply encourages more people to drive (induced demand), while providing alternatives to driving for getting to the ferry would reduce parking demand.Some sustainable alternatives that should be considered:
	2-Landisde-Project Design-Ops		• Feeder shuttles that are timed to meet every ferry, 7 days a week. Corridors could include Sir Francis Drake Blvd, Magnolia Ave, and serving communities like Corte Madera, San Rafael, and San Anselmo. (low cost and high efficiency)
	2-Landisde-Project Design-Ops		• Relocating the SMART station to be in front of the ferry terminal, allowing for short 5-10 minute wait times between the train and the ferry. Currently, even with the SMART Connect shuttle, there is a 25-45 minute delay between ferries arriving and SMART train departing, or vice versa. Even though this is an expensive option, it is comparable to the large cost of building a parking garage. Additionally, this would be eligible for much more local/state/federal grant funding than a parking garage.
	2-Landisde-Project Design-Ops		• Making more direct bike and pedestrian connections, including shortening the crossing distances and removing the slip lane at the Sir Francis Drake/Ferry Terminal intersection.
	2-Landisde-Project Design-Ops 3-Enviro Studies		Marin County's new Countywide Transportation Plan will set into action large transit priority and bike path projects, which will increase their modeshare compared to driving greatly. For example, Sir Francis Drake Blvd is designated to become a Transit Priority Corridor, with possible bus lanes, traffic signal priority, and upgraded shelters that the feeder shuttles could use. Expanding the parking capacity would go against the state and county's climate goals for reducing Vehicle Miles Traveled by encouraging people to drive, rather than biking, walking, or taking transit to arrive at the ferry terminal. The parking garage idea is by far the most negatively environmentally impactful way to accomodate increased ferry demand. The EIR for this project needs to look at all methods of accomodating increased ferry demand, and there are much more cost-effective and sustainable methods to do this.
WTB/TAM	2-Landisde-Project Design-Ops	Commenter wants to make sure that bicycle parking is included as part of the project.	Dear Mr. Downing, Thank you for the meeting at the Golden Gate Bridge offices on October 31, 2024, with you, General Manager Mulligan, and Michael Hoffman. We appreciate the time you allowed us, and we were thoroughly impressed to learn all that each of you and all of you do. We understand that the official deadline for public comments on the EIR Scoping for the Larkspur Ferry Service and Parking Expansion Project was on October 31, 2024, the day we met. We submitted our first set of written comments in a letter dated October 14, 2024. We made additional comments in our meeting and wanted to document it with memorandum, which wehope conforms with the official comment period deadline of October 31, 2024. To accommodate these future bicycle-riding ferry passengers, any planned ferry terminal landside access expansion projects must include expanded landside bicycle parking, which in turn should be part of the project EIR. Thank you.
N/A, Individual	6 - Out of Scope	Commenter wants to know if there will be a future ferry route that connects the Marin area to the East Bay.	Options for getting from Marin to the East bay are slim: mostly just the personal auto. What about a ferry going across the bay!? Warmly Brita Ostrom, a Senior Marin Resident
N/A, Individual	1-Project 2-Landside-Project Design-Ops	Commenter has concerns that the ferry expansion is not well thought out. Commenter also wants the District to provide more bike infrastructure (ramps, place to lock bike, etc). Commenter wants to know if the ferry can be more efficient and faster while traveling and encourage more transit-friendly alternatives.	Comment 1. As an active user of the ferry service in Larkspur, commuting typically four days a week, I have concerns about the ferry expansion in that I am not convinced yet that the expansion is well thought out and really meets the needs of the commuters I see on the boat every single day. And the people that I saw here in this room tonight are not the people that I see riding the ferry. It feels like the presentation tonight is really focused around building a parking garage, and as a daily ferry commuter, that that's what I need in order to continue to use the service that the district provides. Rather than spending money on a parking garage, I would rather see this transit district focus at looking at other issues that I'm worried about as a daily active user of the ferry service.
Larkspur City Counti	2-Landisde-Project Design-Ops	Commenter does not support building the parking structure and encourages that other multimodal transportation to be utilized instead.	I am a long-time Larkspur resident and City Councilmember writing to express my concerns about expanding the parking at the Larkspur Ferry Terminal. I attended the May 14, 2024 information session and reviewed the demand forecasts, parking structure options and other information. 1. Demand forecasts do not warrant the building of another 2000+ spots of parking at the Ferry Terminal. Current ridership is still less than 50% of 2019 pre-covid levels. Many companies have adopted work from home policies, which reduce the number of commuters going into San Francisco each weekday. WFH policies do not appear to be temporary and will continue to be prevalent given advances in technology that facilitate online meetings.
	2-Landisde-Project Design-Ops		2. Expanding parking for single passenger drivers is a very expensive, backward-looking solution. We need to encourage riders to use other modes of transportation to reach the Ferry Terminal. Technology is improving extremely quickly. Self-driving cars or self-driving ride-sharing programs (e.g. Waymo) that do not require all-day parking are going to be available in the foreseeable future. By the time the parking lot is completed, technology advances will have deemed it obsolete and unnecessary. This would be a huge waste of taxpayer dollars.
	2-Landisde-Project Design-Ops		3. As this is an environmental review meeting, I find it ironic that GGBD is proposing a massive expansion of the parking lot in order to encourage riders to take the ferry rather than drive over the bridge. Honestly, that's like eating less cake in order to save room for ice cream. Are we really concerned about the environment here? If so, then we need to find & promote non-polluting, safe, and cost-effective ways of getting people to the ferry terminal. There are other solutions, and I encourage GGBD to seriously consider those alternative solutions.
Greenbrae Boardwalk	3-EIR & Env. Studies 4-Vessel and Wake 5-Marsh, Bulkhead, revetment	Commenter has concerns over environmental harms due to the parking structure. The primary concern is the marsh erosion. Commenter suggests that policies and infrastructure that promote car pooling, bike routes, and other multimodal transportation would be more beneficial than the project.	TO THE LARKSPUR FERRY EXPANSION PROJECT: We share the concerns of Marin Audubon Society about the potential effects of the increase in the number of ferries and consequent increased wave action on the Corte Madera Creek shoreline and marshes. There is the potential for increased erosion of the marshes, already a serious and longstanding issue that threatens the marsh ecosystems. Moreover, the new ferries will use a new design with only partially predictable effects. Decades ago a revetment was placed on the marsh shore to allow the operation of high speed ferry transit while protecting the shoreline. The need for the revetment will only increase with increased ferry traffic. According to the California State Lands Commission the revetment is currently being overtopped by the sea level rise of 4" in the 30 years since it was designed and installed. It should be updated immediately to continue to function and to meet the added burden of increased ferry trips and larger ferries.
	2-Landisde-Project Design-Ops 3-Enviro Studies		There are also environmental harms that may be caused by the larger, muttistory parking lot. The new parking lot will affect the ground beneath the lot, as well as the appearance of the area, notably by significantly increasing light pollution at night affecting residents of the Greenbrae Boardwalk just across the creek where we live
	2-Landisde-Project Design-Ops		Finally, increased ferry ridership accomodated by increased parking will only exacerbate the already extreme vehicle congestion on Sir Francis Drake Blvd. where it passes under Highway 101 and goes to the Richmond-San Rafael Bridge. A better solution to accomodate increased ferry ridership is to make it possible for passengers to avoid car trips to the ferry terminal through policies and infrastructure promoting car pools, bicycle routes, shuttles and other public transportation options.
Greenbrae Boardwalk Resident	4-Vessel and Wake	Commenter suggests that the project team analyze and determine the operations that increase the sediment load in the water column in Corte Madera creek and the wake wash and resulting erosion of the marsh shoreline adjacent to the Greenbrae Boardwalk results in increased sediment deposits in the area of the boat docks on such shoreline. Commenter is worried of the boat ducks being unusable due to sediment accumulation on the shoreline.	I respectfully submit that the scope of the environmental considerations to be studied in connection with the expansion of ferry operations include determining the extent to which such operations (a) increase the sediment load in the water column in Corte Madera creek; and (b) the wake wash and resulting erosion of the marsh shoreline adjacent to the Greenbrae Boardwalk results in increased sediment deposits in the area of the boat docks on such shoreline. I am a homeowner and boat owner on the Greenbrae Boardwalk and many of the boat docks on the Boardwalk are largely unusable due to the accumulation of sediment along the shoreline
Greenbrae Boardwalk Resident	3-EIR & Env. Studies 4-Vessel and Wake 5-Marsh, Bulkhead, revetment	Commenter has concerns over shoreline erosion and the loss of the mitigation marsh.	Dear District Staff: As homeowners along the Greenbrae Boardwalk we are affected by shoreline erosion related to the wake of Larkspur ferryboats and have concerns for potential impacts of expanded service. We also have concerns for the continued efficacy of the revetment the District placed along our shoreline some 30 years ago. In our case at 129 Greenbrae Boardwalk we note an area devoid of marsh grasses (cordgrass) behind the rock revetment and a similar void behind the bulkhead placed on the meander adjacent to our property — both possible signs of erosion or loss of marsh health. We ask the District to assess the revetment along the boardwalk and develop options for restoring or enhancing the marsh it protects. In addition, the revetment was not designed to accommodate sea levels that are anticipated. We ask the District to investigate options for adapting the revetment to deal with SLR. We also have concerns about the loss of the Mitigation Marsh on the northern shore of Corte Madera Creek adjacent to the Larkspur Ferry Terminal. This marsh is eroding dramatically. We ask the District to develop a plan to stem or reverse this erosion
	4-Vessel and Wake		We also have concerns for the retreat of the CMER marshes at their eastern face. We ask the District to study the ferry impacts on this marsh which is high value habitat for several listed or endangered species. We ask the District to investigate methods to stem this retreat while maintaining habitat on this valuable marsh.
	3-EIR & Env. Studies		A garage structure on the parking lot would affect our views, levels of back ground noise and night lighting. We ask the District to investigate ways to mitigate increased levels of noise and lighting for residents of the Greenbrae Boardwalk.
	2-Landisde-Project Design-Ops		Also, the additional parking will provide an incentive for more trips to the Ferry Terminal.
	2-Landisde-Project Design-Ops 3-Enviro Studies		We would like the District to investigate methods to reduce such auto use, such as the potential for each way fare collection on the Golden Gate Bridge. We believe this would reduce northbound traffic on 101 as well as on Sir Francis Drake Blvd.
Greenbrae Boardwalk Resident	1-Project	Commenter wants to know the status of their question regarding the LFEP.	Who will read my questions regarding the LFEP and when will they read them?
N/A, Individual	2-Landisde-Project Design-Ops	Commenter suggests considering multimodal transportation options instead of the parking structure due to potential increase in ferry ridership.	Before incresaing congestion (auto) with a large parking structure, increase alternatives- shuttles, ride share, etc. "Assuming" a large jump in ridership by 2040 is a jump - always surprise (aka coup). Supporting autos is counter to public transit + public ferries.
N/A, Individual	2-Landisde-Project Design-Ops 3-Enviro Studies	Commenter wants clarification on whether the baseline condition is pre-2020 or current year.	I hope your "baseline" condition will be existing conditions as of Fall 2024 vs. ferry usage pre-pandemic)
N/A, Individual	1-Project 4-Vessel and Wake	Commenter suggests using lighter colored photos in the project presentation to better visibility for viewers.	The presentation found little "wake and shoreline erosion." please present the wake ways in a much lighter photo. Weneed to be able ot see key "shore-land" marks to comment on where "new additiona;" WG guages should face. These photos are dark.
N/A, Individual	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment	Commenter wants to know if a shoreline erosion analysis was done.	Marsh protection; the underway CEQA technical studies for wake and shoreline erosion- where of the shoreline is the analysis
N/A, Individual	2-Landisde-Project Design-Ops 3-Enviro Studies	Commenter wants to understand how light pollution will be mitigated from the parking decks, primarily from the vehicle headlights and lot structure lighting.	How will light pollution be mitigated from parking decks?
	2-Landisde-Project Design-Ops 3-Enviro Studies		How will the decks and structure be designed to minimize headlights from vehicles and parking lot lighting from escaping the structure?
	2-Landisde-Project Design-Ops		Can the face of the structure facing the Greenbrae Boardwalk not be an eyesore?
N/A, Individual	2-Landisde-Project Design-Ops	Commenter wants to know if there will be a multimodal station to allow residents liiving on the Corte Madera side to access the ferry. Commenter also wants to know more about the minimization measures utilized to mitigate project impacts.	If this is going to be a multimodal hub can there be a small dock on the Corte Madera Creek side so people living along side the creek can use dingys and other small craft to access the ferry?
	2-Landisde-Project Design-Ops		Is the intent to use the upper deck o fthe parking structure as a vertical heliport (evtol) one day? If so, waht is being done now in the design of the structure to plan and accomodate that use?
	3-EIR & Env. Studies		And what features will be used to minimize the noise, light and other impacts? Will that require another EIR/CEQA process?
N/A, Individual	2-Landisde-Project Design-Ops	Commenter does not believe that adding a parking structure will alleviate traffic congestion and suggest encouraging those to use public transit and/or bikes and increasing existing parking fares to fund multimodal transportation.	I just read another piece about plans to add more parking to support added ferry demand in coming years. Please reconsider and consider committing to no new parking instead. More parking will only beget more traffic. We should encourage people to use bikes or public transit. Increasing parking fares to encourage modal shift or pay for additional last mile options is a better path forward.
N/A, Individual	1-Project 2-Landisde-Project Design-Ops	Commenter thinks that the existing parking price is too cheap and by increasing the parking price, the additional funds can be utilized other Ferry-related items. Commenter also suggests developing transit-oriented housing in addition to the parking lots and improve bike path connection to the ferry terminal.	1) The parking is too cheap. I just paid $10 on board for a beer, and yet parking on Sundays is free! $2 during the week is also too low if demand is surpassing supply. Instead, apply the same logic to parking as you do to beer and almost everything else: let the level of demand set the price. If $2 is all the market will bear, fine, but that doesn't seem true.
	1-Project 2-Landisde-Project Design-Ops		2) The extra money from increasing parking fees can go toward improving the experience in other ways, including lowering the cost of tickets.
	1-Project 2-Landisde-Project Design-Ops		3) Alternately, take a page from BART and build high-density, transit-oriented housing on your parking lots. The demand is certainly there. And those residents would be an ideal base of future ridership. And as the climate changes, the need for mode shift away from cars will also increase.
	2-Landisde-Project Design-Ops 3-Enviro Studies		4) The bicycle connections to the ferry terminal really need some improvement. Marin has so many people on bicycles, and I think many more of them would be regular ferry riders if the routes (through San Rafael, for example) were not so dangerous.
N/A, Individual	2-Landisde-Project Design-Ops	Commenter has concerns over the visual impacts that the project may have to all reseidents living in the area. Commenter wants to make sure that all recreational activities can still be conducted safely.	Ron Downing, I write in opposition to siting the proposed garage along the Corte Madera Creek banks on the surface parking lot area. I live directly across from this area and enjoy the views of the trail, the vegetated berm, and the lovely soaring triangles of the terminal.
	2-Landisde-Project Design-Ops		1. How will a multistory cement garage structure directly across the creek impact my life?
	2-Landisde-Project Design-Ops		2. My home?
	2-Landisde-Project Design-Ops		3. The beauty of nature?
	3-EIR & Env. Studies		4. The sounds reflecting across the high and low tide waters?

Affiliation	Comment Category(s)	Comment Summary	Subcomment
N/A, Individual	3-EIR & Env. Studies	Commenter has concerns over the visual impacts that the project may have to all reseidents living in the area. Commenter wants to make sure that all recreational activities can still be conducted safely.	5. The sounds and air pollution of hundreds of cars exiting at ferry arrival circling in the garage, stopped by thick traffic on Sir Francis Drake? How will that negative impact me?
	2-Landside-Project Design-Ops		6. State Lands tells us we are already at 95th percentile worst traffic impacted area of California without the expansion of cars to the ferry, per Cal Enviro Screen 4.0 How much worse will this traffic impacts number be with this location garage on the surface main lot?
	2-Landside-Project Design-Ops		7. I love the ferry, I walk to the ferry and ride a bike to park in the secure terminal. Will the internal terminal locked area remain for securely parking a bike?
	2-Landside-Project Design-Ops		8. A large cement structure will remove the safety provided by "eyes on the street" on the SF Bay Trail that brings pedestrians and bicycles to the ferry and will make it far less safe and attractive to arrive at the ferry on foot and by bike. How will I then get to the ferry safely?
	2-Landside-Project Design-Ops 3-Enviro Studies		9. How is removing "eyes on the street" by building a garage by the creek pathway compatible with our climate goals of reducing VMT?
	2-Landside-Project Design-Ops		10. Ugh. No multistory garage on the south end of the main lot by the creek please- it will be absolutely overbearing.
	1-Project 2-Landside-Project Design-Ops		11. What has the District done to reduce vehicles on Sir Francis Drake and what will the District do to reduce access to the ferry by single occupancy vehicle and "ride share" which also induces more vehicles.
	6 - Out of Scope		12. Please identify toll plaza studies done to reduce GG to RSR Bridge car traffic on 101/ESFD intersection by charging GG tolls for both directions instead of only one way. Three crossings for the price of one to and from East Bay when leaving SF going north? What if it becomes three crossings for the price of two? Does that improve the possibility of getting to the ferry by car?
	6 - Out of Scope		13. What has the District's Board done to influence successfully building the missing direct connector of 101Nb to 580 Eb in 2030 rather than let local politics dictate that the direct connector fails to be built instead building a much needed but different local project?
	2-Landside-Project Design-Ops		14. Has the district considered selling the overflow parking lot under SMART to an affordable housing developer for a six story structure with the top three floors of apartments for people blending into the neighborhood and with the stipulation the developer builds and reserves the bottom three floors for car parking solely for the ferry? The district could potentially make a lot of money to support running feeder buses again.
	1-Project 2-Landside-Project Design-Ops		15. What new data methods has the District utilized to pinpoint private/washed origins of car drivers to the Larkspur Terminal, and projected more closely successful feeder bus routes and schedules? Parametrix provides this excellent tool for Safe Routes to Schools. Thank you for addressing my questions and comments in the EIR.
N/A, Individual	3-EIR & Env. Studies	Commenter suggests to add a new transportation modality termed Urban Air Mobility (UAM) as part of the CEQA analysis.	To GGH&T District - This email regards the district's Larkspur Service Expansion and Parking Study. I am following up after attending your 10-15-24 open house for the project and the CEQA study to be performed.
	2-Landside-Project Design-Ops		The Transportation Authority of Marin can be expected to take a leadership role with the policy discussions and required decisions alongside the county's board of supervisors. This activity will segue with similar UAM policy developments throughout the Bay Area. I am an advocate for UAM and related "Advanced Air Mobility" (AAM) coming to Marin and the Bay Area. Some of my consulting activity involves this exciting future mode of travel. The eVTOL use, that in Larkspur would offer an additional transportation modality, is destined to become a major aviation milestone serving commuters and the traveling public. Planning and policy creation for this new concept are underway on a regional basis for initial limited on-airport operations to commence by 2026 and on a broader basis that includes off-airport operations by the early 2030's. Please add to the project's CEQA study a new transportation modality termed "Urban Air Mobility" (UAM) and potential to accomodate a "Vertiport" facility that would involve electric air taxis that utilize vertical take off and landing (eVTOL) aircraft. The proposed parking structure proximate to the ferry landing may make an ideal location on its topmost level.
	1-Project		There's a 10-31-24 deadline to submit this request thus your acknowledgement of receipt is requested.
Greenbrae Boardwalk Resident	5-Marsh-Bulkhead-Revetment	Commenter has concerns of the marsh erosion and the potential visual impacts of the headlights from the parking structure going into their home.	Dear Mr. Downing, thank you so much for your efforts on the EIR and resolving some of the questions regarding the impacts of the increased Larkspur ferry service and parking facilities. I am a resident/owner on the Greenbrae Boardwalk - #119. I am directly across from the parking lot and also at the effect of the frequent wave action from the ferries. (Just to note I'm greatly in favor of the ferry and reducing car use as much as possible). My concerns are as follows: Remediating the marsh above the revetment/tide line at my home and along the boardwalk especially for the houses on the north side. A great deal of mud has accreted there as well as undergirding of the rock there.
	5-Marsh-Bulkhead-Revetment		The erosion of the marsh generally in and around Corte Madera Creek, and the marsh shorelines from Ferry wakes.
	3-EIR & Env. Studies		The impact of the possible new parking facility. The headlights at the parking lots are already flashing into my living and sleeping spaces as it is. A 3 or 4 level facility - even with a wall of a few feet at each level - would still -depending on the height of the vehicles flash - even more light into my home.
	2-Landside-Project Design-Ops		I strongly urge a solid wall on the south side of the parking facility. Ventilation can come from the other 3 sides. And if the solid wall could have some type of visual breakup-interest that would be welcome.
	5-Marsh-Bulkhead-Revetment		The health of the marsh, the erosion under my home, and the result of headlights and lighting at the parking facility must be addressed. I appreciate your help and attention to my/our comments. Many thanks, Dyanna Taylor
N/A, Individual	1-Project 2-Landside-Project Design-Ops	Commenter wants to know why the parking structure is being contructed first before fully accommodating personal mobility vehicle demand and mass transit linkage.	Dear Mr. Downing: Following are some questions for the Golden Gate Bridge, Highway and Transportation District ("GGB") to consider in connection with the Larkspur Ferry Expansion Project and EIR. Why Commit to Expanding Parking Before Fully Accommodating Personal Mobility Vehicle ("PMV") Demand and Mass Transit Linkage? Existing ferries have inadequate storage for bikes, scooters and other personal mobility vehicles, discouraging PMV usage. Until passengers who would prefer to opt for PMVs rather than drive cars to the ferry are fully accommodated, how can the need for additional car/truck parking be accurately assessed? Similarly, could money that would be spent to build and maintain a parking structure be invested instead in expanded shuttle services and better connection to SMART and the San Rafael Transit Hub which might offset the need for additional parking?
	1-Project		Why Commit to Expanding Parking Before Fully Accommodating Personal Mobility Vehicle ("PMV") Demand and Mass Transit Linkage?
	1-Project 2-Landside-Project Design-Ops		Existing ferries have inadequate storage for bikes, scooters and other personal mobility vehicles, discouraging PMV usage. Until passengers who would prefer to opt for PMVs rather than drive cars to the ferry are fully accommodated, how can the need for additional car/truck parking be accurately assessed? Similarly, could money that would be spent to build and maintain a parking structure be invested instead in expanded shuttle services and better connection to SMART and the San Rafael Transit Hub which might offset the need for additional parking?
	2-Landside-Project Design-Ops		Is ingress/egress travel of non-Larkspur-route ferries being included in trip counts?
	1-Project		GGB apparently uses Larkspur for overnight/weekend storage of its entire fleet and not just those vessels serving Larkspur. Are the move-outs and move-ins of those additional vessels being counted as trips? If not, why not?
	2-Landside-Project Design-Ops		What steps will GGB take to address aesthetics? The existing terminal and parking lot area does not match the natural and architectural beauty of its surroundings. For example, compare and contrast the GGB facility to the neighboring Wood Island property. A GGB commitment to plant trees as a visual barrier between the parking lot and surrounding homes, businesses and public spaces was abandoned. In addition to parked cars, there are shipping containers, heavy equipment and other random items and structures scattered across the
	3-EIR & Env. Studies		Parking lot lighting was recently made brighter and is unshielded to prevent light pollution. What steps will GGB take to ensure that, as it maintains and expands operations , the parking and terminal area will harmonize aesthetically with the surrounding hills, water, homes, businesses and public spaces? Will it commit to maintaining and improving the way its facilities look and visually blend with their surroundings?
	3-EIR & Env. Studies		What is the plan for mitigating air and water pollution? What measures will be taken to prevent, monitor and report discharges, odor leakage and other potential air and water emissions resulting from expanded vehicle parking, vessel fuel burning, sewage pump-out and other consequences of expanded (and existing) operations? Will GGB commit to ongoing monitoring, maintenance and expansion of measures as needed to ensure that it is meeting and exceeding all requirements in this regard?
	6 - Out of Scope		What Steps Will Be Taken To Mitigate 101/SFD Gridlock?
	2-Landside-Project Design-Ops		Expanding parking to encourage additional vehicle traffic to the terminal will exacerbate highway and surface street backups around the SFD/101 Interchange. GGB already contributes to this problem because of the location of its ferry parking lot and by failing to toll drivers who enter SF via the Bay Bridge but return by crossing both the GGB and the Richmond Bridge (thereby obtaining three toll bridge crossings for the price of two). Advances in tolling would readily allow the toll to be divided equally into
	4-Vessel and Wake		What Upgrades/Updating To Existing Shoreline Protection Measures Are Planned?
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		Will revetments or other shoreline and marsh protection measures be offered to properties which are not presently protected from erosion risk from existing and expanded ferry operations? Will existing protections be updated? Will all existing and new protective measures be monitored for effectiveness, maintained and adjusted as needed as long as operations continue?
N/A, Individual	2-Landside-Project Design-Ops	Commenter suggests the no-build option and consider multimodal improvement options including integrating with SMART, and bicycle parking.	To Whom It May Concern: I am writing to encourage the District to include a "No-Build + MultiModal Improvements" among the alternatives in the EIR for the Larkspur Ferry and Parking Expansion Project. Multi-modal improvements to consider are: Parking Demand Management Programs with both positive and negative incentives, Integration with SMART trains (scheduling, connecting shuttle, promotion),Feeder bus routes, Bicycle parking, Bike share, Use of the Multi-modal Pathway network radiating from the Ferry property, Multi-Modla Improvements expand the choices offered to Ferry users. A focus solely on motor vehicle parking puts blinders, on the fact that e-bikes are an increasingly popular transportation option. Costs to own and operate a motor vehicle are astronomical in comparison to what is required to own and operate an e-bike, especially when a, commuter vehicle sits unused for 8-9 hours per day (1). The EIR for this project should consider all the options to make travel to the Ferry easy and affordable. Respectfully submitted, Cheryl Longinotti, Corte Madera
Greenbrae Boardwalk Resident	2-Landside-Project Design-Ops 3-Enviro Studies	commenter has concerns about the light that would come from the parking structure and suggests that a wall would mitigate light and sound pollution. Commenter also supports the reduction of the ferry terminal structure. Commenter also has concerns about potential erosion.	1. With regard to the parking structure(s): • I am very concerned about the light emanating from the parking structure at the ferry landing, especially the creekside. During the community presentation I heard discussion of a solid southern (creekside) wall was indeed a possibility. Such a wall would certainly improve light and sound pollution for those of us on the Greenbrae Boardwalk. How do I make sure a solid southern wall is addressed by the EIR and design teams?
	2-Landside-Project Design-Ops		• I am not clear on how the construction of the parking structure by the SMART train terminal impacts the size and time of construction of the ferry terminal structure. I would support whichever option reduces the size of the ferry terminal structure. How this decision will be made and is there the opportunity for more community input?
	4-Vessel and Wake		2. With regard to the environmental impact: • What steps are being taken to be sure we do not see continued erosion? Though erosion was addressed in 1976. it is clear the efforts did not work as expected.
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		• My house was included in the initial revetment effort to stop erosion but the revetment has not been maintain and it is clearly failing in places. I want to be sure repair of the existing revetment is done and my property is brought up to the same level of revetment as my Greenbrae Boardwalk neighbors. What steps should I take?
Greenbrae Boardwalk Resident	2-Landside-Project Design-Ops 3-Enviro Studies	Commenter has several questions and concerns as it relates to the parking structure such as lighting impacts, visual impacts, noise and air quality impacts, and security.	Lighting • What are the District's preferences for location of the parking garage/s in order of priority? • What is the likely location of the parking structure? • What shielding or directional beams are available in your lighting plan? • What are the outcomes in LED studies being used to inform your lighting plan related to ambient light levels surrounding the garage? • Will lighting inside and surrounding the garage be on 24-7? • Will lighting inside the garage dim when there is no activity? • Will lighting inside and surrounding the garage brighten with motion? • What structural lighting shields will be in place to protect headlights from projecting across the Corte Madera Creek generated by all vehicles including trucks and busses able to access garage.
	2-Landside-Project Design-Ops		Views: • What steps will the District put in place to include Greenbrae Boardwalk residents in the design process related to aesthetics of the structure exterior and landscaping once a parking structure site has been determined. • How high will the structure be in each proposed location? • What materials will be used on the exterior surfaces of the structure?
	3-EIR & Env. Studies		Noise: • What steps will the District put in place to include Greenbrae Boardwalk residents in the processes: - related to noise generated by use once a parking structure site has been determined. - - of identifying the noise levels from the multistory garages measured along the length of the Greenbrae Boardwalk at peak traffic times - of identifying the noise levels from the multistory garages measured along the length of the Greenbrae Boardwalk at high tide • What noise protections will be put in place by the District?
	3-EIR & Env. Studies		Air Quality: • What steps will the District put in place to include Greenbrae Boardwalk residents in the design process related to air quality once a parking structure site has been determined.
	2-Landside-Project Design-Ops 3-Enviro Studies		• Cal Enviroscreen 4.0 shows this census tract of 6000 people already encountering a traffic impact measuring in the 95th percentile of worst traffic in California. What tracking methods will the District put in place to measure the anticipated increase in car trips from the current 3000 person trips to the 9000 person trips associated with the parking expansion? • Identify the air quality impacts from increased cars trips to the terminal. • Identify mitigation measures to offset the impact of increased car trips. • Identify the air quality impacts from increased cars trips to the terminal exacerbated by any architectural structures put in place to address other lighting, noise levels and/or aesthetic concerns. • Identify air quality impacts from 500 cars idling together to exit the terminal garage at peak traffic hours after ferry arrivals. • What mitigation will the District provide for the impact of idling traffic exiting terminal garage at peak traffic hours after ferry arrivals? • How often will these car trip tracking methods be implemented? • How often will these car trip tracking methods be analyzed and assessed for mitigation effectiveness? • What steps will the District put in place to include Greenbrae Boardwalk residents in the design process related to air quality once a parking structure site has been determined.
	2-Landside-Project Design-Ops		Security: • How will the addition of a parking garage create relatively isolated pedestrian corridors reducing the current high visibility "eyes on the street" factor and impact the safety of bicycles and pedestrians arriving at the ferry on the bike path? • What mitigations will the project provide to enhance safety of the bike path with lighting and cameras shielded from projecting into neighboring homes?
N/A, Individual	2-Landside-Project Design-Ops	Commenter has feedback on the Larkspur Ferry updates and Parking Study, primarily with the ferry passenger rider projections. Commenter believes that the projections are a bit high and that their calculations indicate a lower ridership projection. Commenter suggests a re-evaluation and review using more accurate projections.	Dear GGBHTD Project team, Please see my comments on the Larkspur Ferry Service updates and Parking Study: Ferry Passenger projections are likely overly optimistic Growth was flat from 2013-2019: Recommend reconsidering the projections on riders to downtown San Francisco due to hybrid working and a challenged San Francisco downtown office market. It's very possible that daily trips to SF may not return to 2019 levels by 2033 if not ever. As of 2024, downtown San Francisco has one of the worst return to office recovery rates of any large central business district in the USA. Aside from a dramatic shift to in 5 - day in person work in Downtown SF, the Larkspur Ferry would need to see a significant increase in potential passengers such as through residential housing/population growth, which seems unlikely. Marin and Sonoma's Housing Element's through 2031 have only approved ~7,500 housing units, it's very optimistic to assume a significant number of these residents will need to commute to San Francisco. There is no guarantee these units will be built - most municipalities are not on track for the construction of these units. Recommend the District review actual permits granted for projects in the current Housing Element planning period for a more realistic projection. Consider the US-101 San Francisco, Marin, Sonoma and San Mateo counties as a corridor of potential customer trips instead of looking at ferry ridership projections independently from bus and single occupant vehicle demand. How might better bus service (or other service) meet increased overall passenger demand on the corridor? The Bay Area is a large employment and social region not just with San Francisco as Marin/Sonoma resident's destination. How does lower ridership projections impact the need for a parking garage? Even if ridership matched or exceeded 2019 levels, could the District meet demand without building a parking structure? Assumptions on Mode of Arrival for future passengers to ferry terminal Projections are based on the 2018 survey, which is very outdated considering significant change in mobility technologies, services and improved bike/ped infrastructure since then.
	1-Project 2-Landside-Project Design-Ops		Consider the US-101 San Francisco, Marin, Sonoma and San Mateo counties as a corridor of potential customer trips instead of looking at ferry ridership projections independently from bus and single occupant vehicle demand. How might better bus service (or other service) meet increased overall passenger demand on the corridor? The Bay Area is a large employment and social region not just with San Francisco as Marin/Sonoma resident's destination.
	1-Project 2-Landside-Project Design-Ops		How does lower ridership projections impact the need for a parking garage? Even if ridership matched or exceeded 2019 levels, could the District meet demand without building a parking structure?
	1-Project 2-Landside-Project Design-Ops		Assumptions on Mode of Arrival for future passengers to ferry terminal Projections are based on the 2018 survey, which is very outdated considering significant change in mobility technologies, services and improved bike/ped infrastructure since then.
	1-Project 2-Landside-Project Design-Ops		SMART opened to Larkspur in late 2019. Evaluate how many SMART passengers, the new SMART Connect service, etc ride to the Ferry today. Forecast based on this and future SMART transit and bike/ped path improvements Suggest reevaluation and review of current passenger mode of arrival, and potential mode of arrivals given improved hypothetical choices
	1-Project 2-Landside-Project Design-Ops		Local agencies have improved bike/ped infrastructure significantly. On many weekdays the bike parking area at the Terminal is very full - this is clearly a popular mode and has the potential to expand with further improvements to the bike network within several miles of the Terminal and better bike parking for larger bikes such as e-bikes and cargo bikes (the latter is especially popular with families).
	1-Project 2-Landside-Project Design-Ops		E-bikes and e-scooters have become much more widespread in their use since 2018 (prices have come down significantly). E-bikes make getting to the Ferry much easier for passengers and are a popular choice because users do not get sweaty ahead of the work day.
	1-Project 2-Landside-Project Design-Ops		Evaluate the regional impact at key current congestion points of providing a significant increase in parking for future ridership demand Key intersections around Central Marin are already beyond capacity at rush hours (have a poor level of service - LOS). Sir Frances Drake Blvd at Ferry Terminal, US-101, the Hub in San Anselmo Downtown San Rafael (Central San Rafael offramp and adjacent streets) Terra Linda/Manuel T Freitas Parkway Evaluate if increased car parking will directly result in increased vehicle miles traveled (VMT). Evaluate alternatives to meeting future passenger demand without significant increase in VMT.

Affiliation	Comment Category(s)	Comment Summary	Subcomment
Transportation Solutions Defense and Education Fund (TRANSDEF)	2-Landside-Project Design-Ops	Commenter has concerns with the traffic congestions and suggests looking into transit alternatives instead.	I filed very extensive documentation the last two times the District tried to increase parking. Please check your files for previous comments from TRANSDEF. The points break down into the following: - LFT is located in a highly congested location. Adding more traffic is a bad idea. It is also contrary to CARB's directive to reduce VMT statewide by 25%. - An EIR should be studying transit alternatives instead of encouraging more single-occupant travel. —David
N/A, Individual	2-Landside-Project Design-Ops 3-Enviro Studies	Commenter wants the project team to consider several topics including traffic management, housing, alternative modes of transit to the ferry terminal, and EV charging (if the parking is built).	Dear Mr. Downing, Thank you for the opportunity to comment on the proposed Larkspur Ferry Service and Parking Expansion Project and to identify topics that should be included in EIR Scoping for the Project. While recognizing that ferry ridership may return to pre-pandemic levels and even exceed them at some point in the future, we believe that trying to address this issue through provision of additional parking while not addressing several other interrelated issues, is an inappropriate and much too narrow focus. In particular, any further study of increasing parking at the Larkspur Ferry terminal should consider and address the following:
	1-Project 2-Landside-Project Design-Ops		Traffic management: Traffic congestion on the Sir Francis Drake, Bellam, and Hwy 101 corridors connecting to Hwy 580 is terrible. Without first solving the traffic congestion problem, there is no point in providing additional parking for additional vehicles which will only exacerbate this congestion.
	2-Landside-Project Design-Ops		Housing: The Larkspur Landing area has been identified as a key location for additional housing to meet State housing mandates, particularly due to its proximity to major transportation facilities. Any consideration of additional parking structures at the Larkspur Landing ferry terminal should include additional housing, for example on top of the parking structures.
	1-Project 2-Landside-Project Design-Ops		Alternative modes of transit to the Ferry terminal: Rather than focusing on providing additional parking to support the outdated model of ferry riders driving personal vehicles solo to the ferry, more attention should be focused on providing alternative modes of transit to and from the ferry terminal. At a minimum, these should include parking demand management, SMART, feeder buses (including from the east bay), multi-use pathways, bike parking, bikeshare, bike lease, and carpooling. If parking is inadequate to meet demand, ferry riders will figure out other ways to get to the ferry. The District can make the search for alternate means of transit much more successful by providing ferry riders with a range of options other than private vehicles.
	2-Landside-Project Design-Ops		EV charging: By the time any additional parking is built, if it is built, we should be well on our way to transitioning to electric vehicles. Any additional parking facilities should be provided with extensive Level 2 EV charging, particularly to enable renters who typically can't charge at their residences to be able to charge their EVs while at work.
	2-Landside-Project Design-Ops		Overall, we believe that through a mix of parking demand management strategies and incentives, and encouragement of alternative modes for accessing the ferry terminal, the District can likely accommodate the forecast increase in ferry ridership without building any new parking structures. Thank you for taking these comments into consideration.
TAM	3-EIR & Enviro Studies 4-Vessel and Wake 5-Marsh, Bulkhead, Revetment	Commenter is letting the project team know that TAM's comments are attached.	Attn. Ron Downing: Please add my questions and comments below to the EIR Scoping questions for tonight's deadline. Thank you. my comments here regard the critical minor slough meanders and the ongoing survival of the primordial salt marsh. 1) The six meanders that nourish the CMER Heerdt Marsh pass under our elevated Greenbrae Boardwalk houses, and the health of these meanders is crucial to continuing natural vertical accretion of the entire primordial Heerdt salt marsh and also to the primordial salt marshes on our private properties as sea level continues to rise. The meanders function to feed a healthy marsh. They contribute to the continued viability of the salt marsh and our homes. Two scientific studies have shown that the overall Heerdt Marsh has successfully accreted vertically more than sea level rise to date. We need the meanders to assure this continues. The shoreline protection project permitted to the GGBHTD District by both USACE and BCDC in 1988 and 1989 with Lease PRC 7187 from State Lands recognized this need by installing bulkheads in the revetment to keep rock from falling into the six meander mouths, so the meanders would keep flowing into the CMER. That rock movement protection was the sole purpose of adding the bulkheads as per the permits. The bulkheads were not designed to prevent wave erosion.
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		2) Unfortunately the bulkheads' parallel smooth faces immediately accelerated waves from all sources including ferry inducing rapid erosion on private properties south of the shoreline ensuing from the District's project itself. It is well known now that irregular faces are much better at deflecting and dissipating wave action. The bulkheads however were and still are vertical planar faces. The waves to a viewer often appear to dance between the parallel faces.
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		3) The US ACE 1989 permit p 16 drawing attached appeared to have specified an irregular internal face to the parallel bulkheads. Please see the ACE 1989 attached drawing. Were the bulkheads built mistakenly smooth instead of broken up along the inside walls as appears?
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		4) Owners have had to take immediate defensive actions to protect their properties due to the impact of the bulkheads. Some of the actions taken are more, and some are less successful at preventing blockage of meander flow. Some of these responses to the bulkhead installation may be diminishing the health of the CMER in nearby areas. Was the District aware of the erosive conditions suddenly appearing south of the bulkheads and did they help any private property owners ameliorate the meander erosive conditions in the channel's on their private properties?
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		5) Monitoring was only stipulated by the permits to be done at the six meanders at the south end of the private properties at edge of the CMER. This was a mistake. The shoreline protection project should require monitoring of the meander health in the private properties including erosion going forward. How will the District provide for monitoring of the six channels on involved private properties?
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		6) The District needs to design and install a modification to the existing problematic bulkheads. This modification should reduce the wave action from the bulkheads, reduce the erosion of private properties along the meander channels, and allow for plentiful meander flows south of the shoreline protection through the private properties as well as through the CMER. Will the District consult with BCDC's architectural division to create a more successful hydrologic wave damping structure for the
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		7) Recent evidence provided by CSLC photos suggests the planar bulkheads may also be contributing to increased shoreline erosion on the downwave outsides of the bulkheads on the revetments. What will the District provide to study and if needed ameliorate the outsides of the bulkheads?
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		8) Will the District provide a structural hydrologist to help the property owners with meanders design and build proper channel adaptations south of the shoreline protection structure on their private properties?
	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		9) What will be the process for the District to work with all the landowners whose properties are impacted by these six meanders to design and install bulkhead modifications to diminish wave action, allow plentiful flow to the CMER, and stop the erosion on their private properties?
	5-Marsh-Bulkhead-Revetment		10) The survival of the primordial salt marsh here depends on these meanders being kept in good health: one meander is already languishing with its channel depth shrunk by half at the boundary with the CMER over the prior monitoring timeline to 2016. How soon can the District place bulkhead modifications? Thank you for your consideration, and for valuing the salt marshes. The salt marshes provide important services to the whole region and these salt marsh issues are important to the region.
TAM	1-Project	Commenter is letting the project team know that TAM's comments are attached.	Hi Ron, Thank you for the opportunity to comment on the Larkspur Ferry Notice of Preparation. Attached are TAM's comments for consideration. We look forward to continuing to work with you on this effort. Regards, Derek McGill, AICP
N/A, Individual	2-Landside-Project Design-Ops 3-Enviro Studies	Commenter has concerns with traffic congestion. Commenter also suggests using mudflat augmentation to protect the salt marsh. Commenter also wants project team to consider affordable housing opportunities.	Comment 1. From the State Lands Commission we learned that there are 6,000 residents living in the census tract surrounding the ferry, US 101, Sir Francis Drake Blvd. and in GreenBrae. We are in the 95 percentile of the worst traffic impacted area in California and have really bad air. This concerns me. What is the District doing to reduce the existing condition instead of adding more cars? Building parking structures creates induced demand for cars. So how will the District protect the 6,000 residents in this neighborhood from increased traffic from bringing more cars to the ferry? There are many other ways to get people to the ferry without a car which would be more beneficial.
	5-Marsh-Bulkhead-Revetment		Comment 2. Beneficial reuse of sediment. Please use mudflat augmentation in your programmatic EIR for the ferry to reuse ferry dredge spoils to beneficially protect the salt marsh with mudflat augmentation. Next, we need the ferry to protect the salt marsh from ongoing erosion now and with increased ferry trips. We already have from the California State Lands Commission, we already know we have multiple signs of erosion along the Corte Madera Creek, on the Greenbrae Boardwalk, on the marsh on the north side of the mouth of the creek, on the marsh on the south side of the creek, and all along the east-facing side of the Corte Madera Marsh scarp. How will the ferry District stop the erosion?
	2-Landside-Project Design-Ops		Comment 3. How will the ferry work to connect the Southern Segment, of the north-south greenway for all ages and abilities, walkers and bikers, to access the ferry from the south, from Corte Madera and Mill Valley. There's a missing (trail) segment. And I know a lot of people who are very athletic who use it.
	2-Landside-Project Design-Ops		Comment 4. Please consider affordable housing. Please consider placing the top three floors of housing, which you sell to a developer in the back lot by SMART with a condition that they build the bottom three floors parking for the ferry. Second, have you considered placing affordable housing apartments on the outside of the south outside of parking on the ferry terminal lot and have a developer own and develop the entire southwest and east-facing facades of a garage so the garage is behind them and the people live on the creek with the beautiful views.
N/A, Individual	2-Landside-Project Design-Ops 3-Enviro Studies	Commenter has concerns of noise and light as well as the carbon monoxide from the cars driving in the parking structure.	Comment 1. I'm concerned about the parking structure for two reasons. The amount of noise, that it will increase when cars are inside the building starting their engines and revving the engines. It makes a lot of noise and that, right now, that noise doesn't travel, but when you have three stories of cars within a building, that noise is amplified and echoes and will come across to those of us on the boardwalk in a disturbing manner.
	2-Landside-Project Design-Ops 3-Enviro Studies		Comment 2. Secondly, although I talked to the architect, I was concerned about headlights of cars going into the parking structure and across to our houses. The architect told me that that wouldn't happen because there were low walls that might block the headlights. I don't know if that's true or not.
	2-Landside-Project Design-Ops		Comment 3. A third concern is carbon monoxide that becomes very high within the parking structure. If the parking lot is ever built, I would hope that many tall evergreen trees can be planted so that when we look from our homes and our backyards, we will see trees and not a concrete parking structure.
N/A, Individual	6 - Out of Scope	Commenter suggest to a fare discount for SMART to the ferry riders and raise the parking fee of the parking garage. Commenter also suggests creating a parking structure with housing opportunities.	Comment 1. I wasn't aware about the additional parking structure and all that. Anyway, my idea was twofold, and the first is if the Golden Gate and SMART Train would work together. The first part would be asking basically SMART Train to give the total fare as a discount to the ferry rider. So, for example, somebody comes in by train to Larkspur from Santa Rosa, the fare costing $7, and as soon as he clicks in at the ferry, the cost will be zero. The same would happen in reverse when the ferry rider departs the ferry and takes a train back to Santa Rosa. To pay for this credit, Golden Gate, the owner of the parking garage should raise the parking fee substantially, I mean really substantially. And with this income, they should compensate SMART for the loss of revenue, so it's a win-win situation.
	2-Landside-Project Design-Ops		Comment 2. So about the parking structure, instead of having only a three- or four-level parking structure, my idea would be having the first level parking structure just for the people who take the ferry. Then there would be a second level which is only for people who live there. And living there, I mean, they would build maybe four or five stories of apartments for the whole surface, like a round or oval shape. And in the middle there would be like a park, but there would be people that would have apartments with views outside and inside as well. Because it's so large, it will provide light for everybody and probably for that surface, they could probably build at least between 400 and 600 apartments. It will be revenue for Golden Gate, and would take a lot of cars off the street. Because the parking structure will cost a lot of money and it's just for cars, I tried to think about how we can eliminate more people who are taking the car.
N/A, Individual	4-Vessel and Wake	Commenter has concerns with eroision and does not want a heliport option on the top of the parking structure.	Comment 1. The first comment is erosion, and erosion seems to be lost in the overall process to me. Over the years, we have seen about 30 yards of marsh get eroded. And it's clear at low tide, but the videos we have got over here are all taken at high tide, I noticed. And I'm just kind of wondering what steps are being taken to make sure that the erosion problems that we've had since 1974 don't happen -- don't become a larger problem – with the proposal for increased ferries.
	4-Vessel and Wake		Comment 2. One of the charts over there was talking about the new ferries. It says on the chart that there is no wake and no erosion from the new ferries, and I don't understand how you say "no." Like the guy that who was over there -- and I talked to him. He said it was kind of a new chart, and he wasn't too clear on it himself. It seems like kind of a misnomer or misleading.
	6 - Out of Scope		Comment 3. A couple things on this proposed parking structure as well. I overheard a conversation, they were talking about a heliport option on the top of it. But when you are living right across from this structure, the idea of helicopters, whether they be Waymo-type things or whatever doesn't sound too appealing to me at all, and I'm not sure how to get involved when that decision will be made.
	1-Project 2-Landside-Project Design-Ops		Comment 4. The two parking structures in general, the one in the main lot and the one near the SMART station. The overflow parking lot up by the SMART Train makes a lot of sense to me. It's up out of the way where no residences are and it's not going to bother anybody. It seems like that should be started first to me, and I don't know if I saw anything that said Do one, you know -- which was going to happen first or second, but he did mention that that was about half the problem, with about 600 spaces that could be accommodated in the overflow parking. How is the District going to determine which will be done first?
Greenbrae Boardwalk Resident	5-Marsh-Bulkhead-Revetment	Commenter has concerns with erosion and revetment. Commenter wants to protectt the marshland. There is also concerns with light pollution, safety, and noise level.	Comment 1. I am the recent owner of 101 Greenbrae Boardwalk of Greenbrae off of the channel-- in parallel to the Larkspur ferry. My house sits on the Corte Madera Straight, and I'm here because I am concerned on several issues. One is that, while I do support the increase in ferry -- ferry schedule, ferry routes, hopefully to decrease the amount of carbon footprint on land, I am concerned about the erosion and the revetment planned to ensure that my parts of the marsh -- and also my home happens to own the little substrate that is just parallel to the house too, so there's actually a little finger of water that goes through the creek, and so I am concerned the erosion process that might happen with the increase in ferry traffic. I purchased the home on June 24th of this year.
	5-Marsh-Bulkhead-Revetment		Comment 2. The other comment concerns revetment, which is the remediation process for making sure that the marsh will not continue to erode with the increase in ferry traffic. So, in addition to that, what I'm concerned about protecting the marshland itself -- so with erosion, there's loss of marsh. The marsh is actually a natural sponge for protecting -- for flooding, and so I am concerned about the natural habitat being lost with the erosion of the marsh as well. It's not just my home, it's all the natural animals and plants, flora, fauna. boardwalk too. There are 49 homes, my understanding is, and over 150 residents. We have noticed that over the last several years now that there's been a continuous erosion of the marshland, and that's one of the reasons why many of us chose to live on the boardwalk was to preserve the area. We want to try to do everything we can to make the land enjoyable for everybody and also for the flora and fauna that live there.
	3-EIR & Env. Studies		Comment 3. My home actually faces the Larkspur ferry, the Larkspur Landing, and so I'm concerned about the light pollution. It's really, really bright, and it doesn't seem to be modulated with time or day. It seems to be on all night long, so not only am I concerned about how that affects our side of the boardwalk, but I'm also concerned about how the light pollution affects the natural habitat of the surrounding habitat itself. And so I'd like to see some kind of remediation, whether or not the lights have to be on at night at all any certain time and to that level -- that level of brightness. And so -- really, to make it as low as possible.
	2-Landside-Project Design-Ops		Comment 4. I understand that there is discussion for putting a four-story parking lot, and I am concerned about that as well, the amount of construction and erosion around having an enclosed parking lot for that area. What I have seen, and I have only been there a few months, is that there are a lot of people who probably don't live there and are using that area as a hangout. I've seen cars doing wheelies and spin-outs and music and all sorts of vagaries, alcohol and throwing bottles that have happened just in the few months I've been there.
	2-Landside-Project Design-Ops 3-Enviro Studies		Comment 5. So I have a degree in public health and my background is a lot about safety and protection. While I appreciate all that, I am concerned about having both the increase in traffic and the increase in construction. And so what an increase in traffic also lends itself to is it's going to be an increase in pollution, and I'm worried about both the pollution in the air -- the particulate pollution in the air, and, we get a lot of what they call the onshore winds so a lot of the air quality I'm concerned about is going to be affected by the increase in cars that are coming to the ferry. In addition, I'm concerned the increase in noise levels with the number of cars that are going to be parked on the lot, so that's a concern I have too. Maybe if folks had shuttles to get to the Larkspur Landing ferry that would be better, decreasing the amount of traffic there. I want to make sure when we talk about traffic, I mean the traffic that goes to US 101, which has a ramp that connects to the Richmond Bridge, drops into the Larkspur Ferry itself which is chronically congested at this point.
	5-Marsh-Bulkhead-Revetment		Comment 6. So I would like to add to my earlier concern about the marshland erosion. One of the things that I heard from our meeting on October 3rd with the District was that they would ask us to establish or determine which sites they could use in order to measure the tidal change -- the water change and look at the erosive process. I would like to suggest that in addition to getting an expert in the marshland, is also to get someone who is also an expert in tidal control, sea changes and tidal time/seasonality. And an expert in structural engineering around these kinds of buildings that -- that are currently sitting on these kinds of supports or beams. I want to make sure they have a structural engineer that is an expert in understanding the marsh terrain. They are different, but they are the same people who build bridges, and embankments and can prevent lands eroding in canals, etc. Also, they are well versed in building reservoirs and other structures around wetlands, and wet areas.
	3-EIR & Env. Studies		Comment 7. I would like to understand more about the types of boats that are being used and how it's going to affect the wildlife itself, and if we could do a wildlife study, the actual types of boats, its effects on sea itself and the waterways and the animals and plants that live in that water. And finally, we want good mitigating measures to protect us, all of us who live here, the boardwalk, structures and flora and fauna.
N/A, Individual	1-Project 2-Landside-Project Design-Ops	Commenter has concerns that the ferry expansion is not well thought out. Commenter also wants the District to provide more bike infrastructure (ramps, place to lock bike, etc). Commenter wants to know if the ferry can be more efficient and faster while traveling and encourage more transit-friendly alternatives.	Comment 1. As an active user of the ferry service in Larkspur, commuting typically four days a week, I have concerns about the ferry expansion in that I am not convinced yet that the expansion is well thought out and really meets the needs of the commuters I see on the boat every single day. And the people that I saw here in this room tonight are not the people that I see riding the ferry. It feels like the presentation tonight is really focused around building a parking garage, and as a daily ferry commuter, that that's what I need in order to continue to use the service that the district provides. Rather than spending money on a parking garage, I would rather see this transit district focus at looking at other issues that I'm worried about as a daily
	1-Project		Comment 2. Consistency in loading and unloading of boats. Tiburon and Sausalito use floating docks but Larkspur uses the ramps. One of the slides talked about: we are going to replace the ferry fleet to be interchangeable, yet we don't have the same docks configured in the same way, so how can a boat be interchangeable when some are on the bottom loading and some are on the top loading, and should bike parking be on the top deck if boats are loaded on the bottom and vice versa, right?
	2-Landside-Project Design-Ops		Comment 3. As a biker myself who gets to the ferry terminal every single time via bike, I'm not sure that the District has really thought through how to incentivize bikers like myself. how do we make biking and connecting ferry service to the biking community more interconnected. I don't bring my e-bike on board the boat because it's just too heavy to lift up the stairs. So when I get to the ferry terminal I have to carry my bike up a set of stairs. I don't really have a ramp to utilize to get on the ferry the way everybody else is supposed to go from a biking perspective. So I leave my bike at the ferry, lock it and hope it's secure enough not to get stolen. So how do we think of other alternatives rather than building a parking garage? How do we get more bikers? How do we get more people to commute via transit?
	1-Project		Comment 4. Other things that I think about as a ferry commuter is: How do we design the boats to have less of a wake so that they can go faster in the Corte Madera channel? So what can we do differently with the design of the boats so they can go faster in the channel and provide a better service to commuters who don't want to be on a ferry for 30 minutes. There are other ferry companies that are building ferries with airfoils that provide no wake-out. Other areas that I have to call out is: How can we speed up the loading and disembarkation so that boats spend less time idling in a dock. I have been to York City and used the ferries there, they are much more efficient. They don't have just two doors that you offload from. They point the boat in, and passengers unload from the nose of the ferry to the dock. So having two doors for us to offload just -- it causes idling time. And, as a ferry commuter, I want to get on and off the boat as quickly as possible. I don't want to spend my time at the ferry terminal. I want to get in and out and on my way.
	2-Landside-Project Design-Ops		Comment 5. Could we not observe discounted fares for people who do not arrive via car or raise pricing on the parking fees to encourage more transit-friendly alternatives. So instead of paying $20-30 a month for parking, what if it was $50 a month for parking? Do we think more people would be incentivized at that point to walk or use public transit or use a bike to get there rather than trying to build a parking garage, especially a parking garage that is going to be probably, I guess, $40 million and then would be there forever, and I just feel it would be an eyesore.
	1-Project 2-Landside-Project Design-Ops		Comment 6. In all the presentations today, we talk about increased demand and increased riders. But where are those riders coming from? How far are people commuting to get on the ferry? Are they all coming from Corte Madera? Are they coming from Novato? Are they coming from San Rafael? And if you are finding that a thousand people a day are coming from San Rafael, why are we expanding service in Larkspur? Shouldn't we be exploring how to make service in San Rafael and connect to a new community via this transit district? I'm not convinced yet that building a parking garage is in the best future of this district and as well for the riders and the daily commuters that I see like myself every single day when I ride this ferry service.
Marin Audubon Society	5-Marsh-Bulkhead-Revetment	Commenter states concerns over the loss of tidal marsh habitat and wants the project team to thoroughly analyze the anticipated impacts to all marsh habitats due to the expansion.	Marin Audubon Society (MAS) appreciates the opportunity to comment on the project that proposes to increase the number of Ferry trips from the currently approved 42 by purchase of new ferries, and expanding the available parking. While the current use of the ferry is low, having declined significantly during COVID and not returned to pre COVID rates, the District is undertaking this project because it anticipates users will increase to beyond pre-COVID levels. Even though the District has had several public meetings, and a private meeting with MAS, there are still many questions, uncertainties and issues we want to see addressed. Our comments below focus on concerns about environmental and habitat impacts of the project. Our primary concern is loss of tidal marsh habitat that may be causeri, at least in part, fry the ferry wake and other impacts of the project.
	3-EIR & Env. Studies		Describe the CEQA process that is planned. We have been advised that the District is producing both a Programmatic EIR as well as a Project Specific EIR. This is unusual. Describe the process of certifying both a Project and Programmatic EIR.
	2-Landside-Project Design-Ops		For the Programmatic EIR, when and by what process will the decisions be made to begin implementing the project, i.e. construct new parking lots and add ferries? The triggers for both the ferry expansion and adding ferry trips should be clearly articulated. Will the decisions be based on an actual increase in ridership or a projected increase? What level of increased ridership will the District require? It seems to be expected that the ridership numbers will soon be restored to pre CEQA levels. What if it doesn't, especially now that the trend of more people worl-ing from home is only expected to increase / or may well increase?
	3-EIR & Env. Studies		EIR'S are required to address particular aspects included in a project description, including Bacl-ground information, project Setting and potential Biologicai impacts of a project and mitigation for the adverse impacts.

Affiliation	Comment Category(s)	Comment Summary	Subcomment
Marin Audubon Society	3-EIR & Env. Studies	Commenter states concerns over the loss of tidal marsh habitat and wants the project team to thoroughly analyze the anticipated impacts to all marsh habitats due to the expansion.	Dscription of the Project: Provide a complete description of the project. The project description is an important requirement of CEQA and forms the basis of the environmental review. Various publications of the District describe the project as a study. It also could be a plan. Describe how the study or a plan has the potential to cause on—the ground impacts to the environment. The project must be defined in sufficient detail to understand what will be done. The subsequent analyses should flow from the project description which could vary greatly depending on whether it is a study, plan or project.
	5-Marsh-Bulkhead-Revetment		Bacl‹ground: This discussion should explain the requirements of the permits that were issued for the current operation. What number of ferries are approved ? Is that number running now? What marsh loss acreage was anticipated and what acreage of mitigation marsh was required? What other marsh impacts besides loss were expected? Describe the mitigation. For the marsh loss, when it was completed, where it is located and whether it has successfully provided tidal marsh habit to replace the tidal marsh that has been lost?
	5-Marsh-Bulkhead-Revetment		Existing conditions. This section should describe all of the marshes along the shoreline including the Corte Madera Ecological Reserve owned by the CA Department of Fish and Wildlife. Triangle Marsh at the south end of Corte Madera Bay owned by Marin Audubon Society, marshes associated with the Greenbrae Boardwalk's marshes, and the sm,all marsh on the north side of Corte Madera Creek.
	2-Landisde-Project Design-Ops		Alternatives Analysis should include the No Project Alternative as required, the Preferred Alternative and a Reduced Project Alternative.
	5-Marsh-Bulkhead-Revetment		Biological Impacts: - Primarily Impacts to Tidal Marsh Habitats The CEQA document should thoroughly analyze anticipated impacts to all marsh habitats that could be impacted in any way by the project. The adverse impacts of all components of the project should be identified and mitigation for the impacts should be provided and described. tnctude a description ofthe tidal marshes atong the Corte Madera Shofeflne, specifically the Hee<dt, and Muzzi Marshes (Ecological Reserve), MAS's property at the south end of Corte Madera Bay and the small marsh on the north side of the mouth of Corte Madera Creek (known as the Mitigation marsh by the Greenbrae Boardwalk community). Describe in detail the importance of these marshes to endangered species, special status species, other resident species, and migratory species of the Pacific Flyway. The Heerdt Marsh in particular supports a high density large population of endangered Ridgeway Rails and other marshes in this complex do as well. Describe their importance for essential life futJctions for species, nesting, feeding, roosting, and migratory stop over and overwintering, in particular the Heerdt Marsh, one of the few marshes in the Bay that has never been diked.
	5-Marsh-Bulkhead-Revetment		Not identified in any of the materials the District has presented is the marsh owned by Marin Audubon at the south end of the Ecological Reserve, known as Triangle marsh, which includes the historic tidal marsh (shaped like a triangle) and a section of marsh restored by Marin Audubon in 2000. The MAS's owned marshes should be added to all District investigations, assessments, evaluations, analyses, and discussions of ferry wake impacts.
	5-Marsh-Bulkhead-Revetment		Describe the history of the marshes along the Corte IV) adera shoreline, particularly the District's history with the marshes and the significant loss of marsh.
	5-Marsh-Bulkhead-Revetment		Describe why it took so long for the District to complete its marsh mitigation, which was completed four years ago whereas the impacts began in 1976.
	5-Marsh-Bulkhead-Revetment		Describe the loss of marsh due to erosion all along the Corte Madera marshes. How much acreage of marsh loss has there been? Show comparison aerial photos showing the extent of marsh loss over the last 70 years.
	5-Marsh-Bulkhead-Revetment		The letter from Coastal Futures LLC to the Greenbrae Boardwall‹ Improvement Club includes a figure (Figure 4) shOw'* 8 ignificant marsh loss of approximately 2 feet of tidal marsh in the period from 2016 to 2023 ProvideanesGmateoltheGfespanofthemar5hvvithaconWnuedlossot2feetperyean What is the acreage loss with 2 feet eroded along the marsh face? Provide an estimate of how much of the marsh will remain under projected sea level rise scenarios in 2030 and 2050 as recently revised by the Ocean Protection Council.
	5-Marsh-Bulkhead-Revetment		There is concern that the wake produced by the ferries is contributing to erosion of the tidal marshes. The wake currently generated by operation of the ferries is described by the District as being very "small" The specific wave height should be identified, i.e. what does the district mean by "small"? If the wave height differs in different location, identify and discuss the differences in different locations and different tidal levels.
	5-Marsh-Bulkhead-Revetment		Compare the District's assessment of marsh loss with aerial images observations as well as scientific studies including the USGS Shoreline Retreat of Corte Madera Marshes 1853 to 2016 Open File Report 2020-1074. List and describe the findings of this and other studies that have been done of the ferry wal‹es.
	5-Marsh-Bulkhead-Revetment		We understand the District has tide gauges in the mudflat along the Corte Madera Marshes. Describe gauges and tke information they have produced. Show on a figure where they are located. Does the district plan to continue collecting data using gauges? Has the District considered using drone flyovers as providing more accurate information?
	5-Marsh-Bulkhead-Revetment		Ferry generated waves can be observed extending across the bay and reaching the Triangle Marsh Shoreline. The District has expressed the view that the shoreline erosion is tro m natural causes. The wakes from the ferry trips represent an increase in erosive force that should be considered, as a curnulati\ie impact (see cumulative impact analysis below).cumu lative increase
	5-Marsh-Bulkhead-Revetment		To better understand the impact of the ferry wake and determine the circumstances during which erosion takes place, we recommend the District augment its Wake and Shoreline Erosion Analysis to study additional factors: the number of daily ferry trips (both with catamarans and current ferries that service Tiburon and Sausalito), distance of the ferry generating the wake from the marsh edge, the depth of the 'water and tide elevation during wave generation, analysis of the wave height at which erosion impacts occur, identify the place on the marsh face at which erosion impacts occur, and photo verification. A critical component is where on the marsh face the waves hit. Tthe analysis should be subject to independent review.
	5-Marsh-Bulkhead-Revetment		Cumulative Impact Analysis: As the ferry wakes are in addition to the waves generated naturally, the cumulative impact analysis should include a study of how many waves are generated by ferry trips in additio\a to natural tidal cycle waves. to determine how much more erosion is caused by the trips vs the waves? What is the cumulative impact of these additional ferry-generated waves on erosion of the shoreline?
	5-Marsh-Bulkhead-Revetment		The tidal marsh at North Side of Corte Madera Creek mouth (Mitigation Marsh) has also been eroding since the ferries began operating, as reported by Boardwal k residents. To identify how much marsh been lost, show the historic shoreline and current shoreline on a figure and calculate the area lost. Discuss the possible cause for the loss of this marsh, including the concern of the Boardwalk residents that ferries turning around is causing the eros ion. What is the potential future loss of this tidal marsh under the proposed project? Would larger ferries pose more risk of erosion? Discuss the use of this marsh by endangered species. Have Ridgeway Rails been observed on this marsh in past and in recent years?
	5-Marsh-Bulkhead-Revetment		Discuss the possible impact of the project on the degradation of the shoreline protection along the Greenbrae Boardwalk. This area is also habitat. What is the impact on habitat and species of the ongoing degradation of the shoreline erosion control project from the proposed ferry expansion? ProvideanesGmateoltheGfespanofthemar5hvvithaconWnuedlossot2feetperyean What is the acreage loss with 2 feet eroded along the marsh face? Provide an estimate of how much of the marsh will remain under projected sea level rise scenarios in 2030 and 2050 as recently revised by the Ocean Protection Council.
	5-Marsh-Bulkhead-Revetment		There is concern that the wake produced by the ferries is contributing to erosion of the tidal marshes. The wake currently generated by operation of the ferries is described by the District as being very "small" The specific wave height should be identified, i.e. what does the district mean by "small"? If the wave height differs in different location, identify and discuss the differences in different locations and different tidal levels.
	5-Marsh-Bulkhead-Revetment		Compare the District's assessment of marsh loss with aerial images observations as well as scientific studies including the USGS Shoreline Retreat of Corte Madera Marshes 1853 to 2016 Open File Report 2020-1074. List and describe the findings of this and other studies that have been done of the ferry wal‹es.
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	5-Marsh-Bulkhead-Revetment		Would larger ferries pose more risk of erosion? Discuss the use of this marsh by endangered species. Have Ridgeway Rails been observed on this marsh in past and in recent years?
	5-Marsh-Bulkhead-Revetment		Construction of the mitigation marsh on the District's 72-acres. Marin Audubon Society and Marin Baylands Advocates urged the Bridge District to implement the mitigation for the impacts of the Ferry terminal construction and operation of the ferry service. We appreciate the District's time meeting with us to address our concerns. However, it was twenty years after the impacts began. To avoid this happening again, the District should complete all required mitigation before any increase in ferry trips or construction is initiated.
	2-Landisde-Project Design-Ops		Describe the new ferry that has been ordered. The design of the ferries the District is planning to purchase should be described in detail. Compare the length and width and weight and other factors with ferries currently in use. We understand the new ferries will be catamarans, will be longer and have a larger hull. Most of the ferries currently in use are also catamarans.
	2-Landisde-Project Design-Ops		Explain why the District purchased this model of ferries. How is this ferry design so different that it is expected to result in fewer impacts, no wake and erosion? What is the basis for the District's concluding that there will be "no wake" from a ferry that is larger, wider and longer than the ferries in currently use, and that is not currently in use anywhere? If they have not been used anywhere, what is the basis for the anticipated performance? Wil] they be in use in Europe shortly?
	2-Landisde-Project Design-Ops		Clarify the History and status of the new—design ferries. We understand the ferries are being ordered from and constructed in Europe. We were also told at the recent public meeting that ferries of this design have not actua \!v been used, but they may be during the time the EIR is being prepared. If that occurs, the EIR should provide relevant information, identify the location(s) where the new design has been used, the setting (i.e. 'whether there are tidal marshes in the vicinitv), and the nature of the wakes they produce, and any impacts, although there is likely to not be sufficient experience to show any impacts.
	2-Landisde-Project Design-Ops		What if the wakes from the new ferry do not prove to be nonexistent or are larger than current ferries? Will any additional orders be cancelled? Would the catamaran be returned?
	2-Landisde-Project Design-Ops		How many new boats have been ordered? When will the first one be delivered and be put into use? Will current in-use boats be retired as each new boat is delivered or would both be used? This would not reduce and possibly would expand wave-generated impacts? How much overlap is expected, i.e. length of time when both designs will be in use?
	2-Landisde-Project Design-Ops		With larger boats will a wide turning basin be needed? If so, define area, how and where would additional area be taken from? How much marsh would be removed or otherwise impacted from erosion and where? Describe mitigation for the loss of marsh and other impacts to marshes.
	3-EIR & Env. Studies		The parking lot expansion discussion should describe alternatives including phasing of the alternatives: constructing the North Parking Lot as an alternative alone, phasing of the main lot to the south lot, if possible, by adding one floor at a time so that visual impacts at minimum would be delayed.
	3-EIR & Env. Studies		Describe the foundation that will be needed to support the additional weight on bay mud from a multistory lot on the Bay? How deep is the bay mud in this area? Wilt piles be used for support? How deep? Describe noise and vibration impacts will be mitigated? Discuss any differences in the foundation construction under two-level and three-level scenarios?
	5-Marsh-Bulkhead-Revetment		Describe the impacts of additional weight on adjacent mudflats and marshes? What is the potential for a mud boil or mud wave? Describe the measures that would be taken to mitigate this impact.
Caltrans D4	2-Landisde-Project Design-Ops	Commenter states that the project should find measures to protect the shorelines, local communities and overall environment. Additionally, commenter wants to ensure that the project meets equitable access (ADA standards).	**Project Understanding** The proposed project will increase the Larkspur Ferry Terminal's capacity by adding more high-speed boats, potentially creating a new ferry route to 16th Street near San Francisco's Mission Bay and UC San Francisco medical center, and expanding parking on the main terminal parking lot and/or the north parking lot located in the Country Mart shopping center across Sir Francis Drake Boulevard. The project will include Transportation Demand Management easures such as shuttle buses, parking and ticket pricing strategies, and enhanced bicycle and pedestrian facilities. The project will also include improvements to the connection between the ferry terminal and the Sonoma-Marin Area Rail Transit (SMART) system's Larkspur station. The ferry terminal is located on San Francisco Bay and adjacent to US-101.
	2-Landisde-Project Design-Ops		**Travel Demand Analysis** With the enactment of Senate Bill (SB) 743, Caltrans is focused on maximizing efficiendevelopment patterns, innovative travel demand reduction strategies, and multimodal improvements. For more information on how Caltrans assesses Vehicle Miles Traveled (VMT) analysis for land use projects, please review Caltrans' Transportation Impact Study Guide (link). Caltrans looks forward to reviewing the VMT analysis in the DEIR when it is available.
	4-Vessel and Wake		**Climate Change/Sea Level Rise** In the 2020 Caltrans District 4 Adaptation Priorities Report (link), US-101 adjacent to the project location is identified as a high-priority Caltrans asset vulnerable to sea level rise, storm surge, and climate change impacts, including increased precipitation. Caltrans would like to be included in discussions, to stay informed as Caltrans is interested in engaging in multi-agency collaboration early and often, to find multi-benefit solutions that protect vulnerable shorelines, communities, infrastructure, and the environment. Please contact Lucius Wu, Caltrans Bay Area Climate Change Planning Coordinator, with any questions at d4_climateresilience@dot.ca.gov.
	3-EIR & Env. Studies		**Construction-Related Impacts** Potential impacts to the State Right-of-Way (ROW) from project-related temporary access points should be analyzed. Mitigation for significant impacts due to construction and noise should be identified. Project work that requires movement of oversized or excessive load vehicles on State roadways requires a transportation permit that is issued by Caltrans. To apply, please visit Caltrans Transportation Permits (link). Prior to construction, coordination may be required with Caltrans to develop a Transportation Management Plan (TMP) to reduce construction traffic impacts to the State Transportation Network (STN).
	3-EIR & Env. Studies		**Lead Agency** As the Lead Agency, the City of Berkeley is responsible for all project mitigation, including any needed improvements to the STN. The project's fair share contribution, financing, scheduling, implementation responsibilities and lead agency monitoring should be fully discussed for all proposed mitigation measures.
	3-EIR & Env. Studies		**Equitable Access** If any Caltrans facilities are impacted by the project, those facilities must meet American Disabilities Act (ADA) Standards after project completion. As well, the project must maintain bicycle and pedestrian access during construction. These access considerations support Caltrans' equity mission to provide a safe, sustainable, and equitable transportation network for all users.
Department of Fish and Wildlife	3-EIR & Env. Studies	Commenter states that the project would have impacts toward fish and/or wildlife and would assist the District in identifying and mitigating Project impacts on biological resources.	**SPECIAL STATUS SPECIES AND HABITATS** Protected species under the State and Federal Endangered Species Acts that could potentially be present near Project activities include: • Longfin smelt (Spirinchus thaleichthys), state-threatened, federally endangered Chinook salmon (Oncorhynchus tshawytscha), state and federally threatened (Central Valley Spring-run), state and federally endangered (Sacramento ver Winter-run), state species of special concern (Central Valley Late Fall Run, Central Valley Fall Run) • Steelhead (Oncorhynchus mykiss), federally threatened (Central California Coast evolutionary significant units) • Green sturgeon (Acipenser medirostris), federal threatened (Southern Distinct Population Segment) • White sturgeon (Acipenser transmontanus), state candidate threatened • Pacific lamprey (Endosphenus tridentatus), state species of special concern • California Ridgway's rail (Rallus obsoletus abeoletus), state and federally endangered, state fully protected • California black rail (Laterallus jamaicensis coturniculus), state threatened, state fully protected • Salt marsh harvest mouse (Reithrodontomys raviventris), state and federally endangered, state fully protected • Point Reyes salty bird's beak (Chloropyron maritimum), CRPR 1B.2 • Salt Marsh, California Sensitive Natural Community Fully protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except as follows: • Take is for necessary scientific research, • Efforts to recover a fully protected, endangered, or threatened species, live capture and relocation of a bird species for the protection of livestock, or • They are a covered species whose conservation and management is provided for in a Natural Community Conservation Plan (Fish & G. Code, §§ 3511, 4700, 5050, & 5515). Specified types of infrastructure projects may be eligible for an incidental take permit for unavoidable impacts to fully protected species if certain conditions are met (see Fish & G. Code § 2081.15). Project proponents should consult with the Department early in the project planning process. The Project has the potential to impact California Ridgeway's rail, California black rail, and salt marsh harvest mouse, as described above. Several species with important commercial/recreational fisheries value and habitat value for spawning and rearing could potentially be present near Project activities. These include: • Pacific herring (Clupea pallasii) • Eelgrass (Zostera marina) • California halibut (Paralichthys californicus) • Dungeness crab (Metacarcinus magister)
	5-Marsh-Bulkhead-Revetment		**I. Project Level Impacts and Other Considerations** Corte Madera Marsh State Marine Park and Ecological Reserve Comment: The proposed Project may be in conflict with the regulations set forth in California Code of Regulations Title 14 section 632, Marine Protected Areas, Marine Managed Areas, and Special Closures. The Corte Madera Marsh is protected as a State Marine Park (SMP) and an Ecological Reserve, both under the jurisdiction of the Department. Title 14 section 632(1)(a)(1)(B) states that within a SMP it is unlawful to injure, damage, take, or possess any living or nonliving marine resource for commercial purposes. Any human use that would compromise protection of the species of interest, natural community or habitat, or geological, cultural, or recreational features, may be restricted by the California Fish and Game Commission as specified in subsection 632(b), areas and special regulations for use. Title 14 section 632(b)(58) further defines the Corte Madera Marsh SMP. Permitted uses include: • Recreational hook and line take of species other than marine aquatic plants from shore. • Only lightweight, hand-carried boats may be launched or operated within the park. **Prohibited uses include:** • Swimming, wading, and diving within the park. The proposed increase in ferry vessel trips to the Larkspur ferry terminal may have impacts to the marine and terrestrial environments of the SMP and Ecological Reserve. Increased vessel wakes may exacerbate shoreline erosion and compromise protected species habitat within the SMP and Ecological Reserve. Specifically, habitat for state listed and fully protected rail species and the salt marsh harvest mouse could be reduced over time due to vessel wakes eroding the marsh interface with San Francisco Bay. Additionally, it is not clear if vessel operations transit through the SMP boundaries and whether current and proposed future daily vessel trips through the SMP would be consistent with SMP regulations. Additional information on the SMP can be found at https://wildlife.ca.gov/Conservation/Marine/MPAs/San-Francisco-Bay. Additional information on the Ecological Reserve can be found at https://wildlife.ca.gov/Lands/Places-to-Visit/Corte-Madera-Marsh-ER.
	4-Vessel and Wake		**Recommendation:** The Department recommends that the draft Environmental Impact Report (DEIR) includes analysis of the potential effects of increased vessel traffic and how vessel wakes may impact protected habitats and species adjacent to the Larkspur ferry terminal and how potential impacts could be avoided, minimized, and/or mitigated. Analysis should also examine how potential vessel wake impacts could be compounded in combination with projected sea level rise in San Francisco Bay. **Recommendation:** The Department recommends the DEIR include analysis of whether proposed Project is consistent with Department regulations specific to the SMP and Ecological Reserve. **Recommendation:** The Department recommends the District consult with the Department regarding any identified conflicts with SMP and the Ecological Reserve regulations.

Affiliation	Comment Category(s)	Comment Summary	Subcomment
Department of Fish and Wildlife	2-Landisde-Project Design-Ops	Commenter states that the project would have impacts toward fish and/or wildlife and would assist the District in identifying and mitigating Project impacts on biological resources.	**Parking Lot Expansion** Comment: It is unclear if the parking lot expansion would be in the footprint of the existing parking existing lot(s), or if the lot(s) will be expanding out of the footprint. The construction of the parking lot expansion could result in auditory and potential visual disturbances to nesting California Ridgway's rail and California black rail, if the project is within 700 feet of them. The project is adjacent to salt marsh, a California Sensitive Natural Community, which is documented by the California Natural Street and it is not clear if the DEIR will include analysis of the construction of a new terminal or just the addition of a new future ferry route. Recommendation: The Department recommends that the DEIR clarify whether construction, as part of the 16th Street ferry
	1-Project		**16th Street Ferry Terminal** Comment: The NOP describes potentially adding an additional ferry route to 16th Street in San Francisco. Currently there is no ferry terminal at the terminus of 16 Street and it is not clear if the DEIR will include analysis of the construction of a new terminal or just the addition of a new future ferry route. Recommendation: The Department recommends that the DEIR clarify whether construction, as part of the 16th Street ferry terminal installation, will be part of the Project.
	1-Project		**ENVIRONMENTAL DATA** CEQA requires that information developed in environmental impact reports and negative declarations be incorporated into a database which may be used to make subsequent or supplemental environmental determinations. (Pub. Resources Code, § 21003, subd. (e).) Accordingly, please report any special status species and natural communities detected during Project surveys to the California Natural Diversity Database (CNDDB). The CNNDB field survey form can be found at the following link: https://wildlife.ca.gov/Data/CNDDB/SubmittingData#44524420-pdf-field-survey-form. The completed form can be mailed electronically to CNDDB at the following email address: CNDDB@wildlife.ca.gov. The types of information reported to CNDDB can be found at the following link: https://wildlife.ca.gov/Data/CNDDB/Plants-and-Animals. **FILING FEES** The Project, as proposed, would have an impact on fish and/or wildlife, and assessment of filing fees is necessary. Fees are payable upon filing of the Notice of Determination by the Lead Agency and serve to help defray the cost of environmental review by the Department. Payment of the fee is required in order for the underlying project approval to be operative, vested, and final. (Cal. Code Regs, tit. 14, § 753.5; Fish & G. Code, § 711.4; Pub. Resources Code, § 21089.) **CONCLUSION** The Department appreciates the opportunity to comment on the NOP to assist the District in identifying and mitigating Project impacts on biological resources. Questions regarding this letter or further coordination should be directed Arn Aarreberg, Environmental Scientist, at (707) 791-4195 or R7CEQA@wildlife.ca.gov.
Greenbrae Improvement Club	1-Project 3-EIR & Enviro Studies	Commenter has several biological concerns including but not limited to increased erosion, marsh impacts, shoreline revetment, and mud and grass accretion. Commenter wants to have a better understanding of the biological impacts and the mitigation measures implemented.	On behalf of the Greenbrae Improvement Club (GIC) and on behalf of the owners of residents of the Greenbrae Boardwalk, we submit the attached documents to be taken as one document as our comments, questions, and concerns to be addressed in the EIR for the proposed Larkspur Ferry Expansion Project. Efforts to make it one document with all the attachments, while keeping the photos in a reasonable size, proved to challenging for me, so I incorporated by reference the separately attached report from Coastal Futures in the questions. In addition, we attach a map that labels the "Mitigation Marsh" that we referenced in the questions. We thought that providing a visual of its location could be helpful. We are sending this email to the email address for submittals per the District's scoping meeting notice. We also are sending it to an email address that we were asked to send it to in one of our zoom meetings with the District representatives. We would appreciate if someone would confirm receipt of this email and its attachments. We know the deadline is October 31, 2024, and want to make sure that you acknowledge receipt of a timely submittal. Thank you. If you have any questions, please don't hesitate to reach out to any one of us. I have included Laura Melendy, GIC's president, as well as neighbors who worked closely on the documents in the final days to get this to you. We look forward to hearing from you and maintaining open and transparent communications about the progress of this project. Thank you. All th best, Wanden and team !
	5-Marsh-Bulkhead-Revetment		1. Identify locations along the Greenbrae Boardwalk waterfront where the shoreline revetment has worked to mitigate wave energy. 2. Identify properties along the Greenbrae Boardwalk waterfront where the shoreline revetment has not performed as expected. 3. How does the District plan to address and repair the sections of revetment that are not performing as designed to avoid further damage caused by the failure? 3.a. Does the District intent to offer to install revetments or other erosion control measures adjacent to lots which opted out of District-installed revetments in the 1980's? 4. Identify locations along the Greenbrae Boardwalk waterfront where the bulkheads installed by the District have mitigated wave energy. 5. Identify properties along the Greenbrae Boardwalk waterfront where the bulkheads installed by the District have not mitigated wave energy and investigate why the bulkheads have not reduced wave action. 6. How does the District plan to address and repair any bulkheads that have not performed as the design intended to protect the shoreline and marsh? 9. Identify areas where the revetment has failed at the East end of the Greenbrae Boardwalk. What does the District plan to do to rebuild or redesign the revetment at the East end of the Greenbrae Boardwalk where the wave action has caused erosion around the revetment? 10. Identify specific properties along the Greenbrae Boardwalk where there are areas of loss of marsh along the shoreline since the revetment was installed. 11. What does the District plan to do to rebuild the marsh, or redesign the revetment to achieve the intended result of installing the revetment? 12. Identify specific properties along the Greenbrae Boardwalk shoreline that will require new revetment, or other design elements to ensure the shoreline is protected once the new boats are in service and SLR has increased. Throughout this document, we refer to the "new ferry" or "proposed ferry" or "new boats" and in so doing, we are referring to the new passenger-only 46 107. In addition to regular maintenance for the rock revetment, how will the District assess the feasibility of eventually removing and replacing the rock revetment with alternative adaptation strategies, such as nature-based solutions, or sand retention structures? CFR subchapter K ferry vessel that the District intends to use at the Larkspur Ferry Terminal. 130 a.) Identify the reasons and/or causes for the mud accretion over the riprap revetment in this photograph taken by the California State Lands scientists. b.) Identify all remedies needed at this location to address the deterioration of the revetment. c.) Identify all remedial steps that could be taken to rebuild the marsh behind the revetment, as was initially intended by the installation of rock. 131. a.) Identify the reasons and/or causes for the mud accretion over the riprap revetment in this photograph taken by the California State Lands scientists. b.) Identify all remedies needed at this location to address the deterioration of the revetment. c.) Identify all remedial steps that could be taken to rebuild the marsh behind the revetment, as was initially intended by the installation of rock. 132. a.) Identify the reasons and/or causes for the mud accretion over the riprap revetment in this photograph taken by the California State Lands scientists. b.) Identify all remedies needed at this location to address the deterioration of the revetment. c.) Identify all remedial steps that could be taken to rebuild the marsh behind the revetment, as was initially intended by the installation of rock. 133. a.) Identify the reasons and/or causes for the mud and grass accretion over the riprap revetment in this photograph taken by the California State Lands scientists. b.) Identify all remedies needed at this location to address the deterioration of the revetment. c.)Identify all remedial steps that could be taken to rebuild the marsh behind the revetment, as was initially intended by the installation of rock. 134 a.) Identify the reasons and/or causes for the conditions noted riprap revetment deterioration in this photograph taken by the California State Lands scientists. b.) Identify what remedies are needed at this location to address the functioning of the revetment and bulkhead to ensure rebuilding of the marsh and shoreline protection. 135 a.) Identify the reasons and/or causes for the mud and grass accretion over the riprap revetment in this photograph taken by the California State Lands scientists. b. Identify all remedies needed at this location to address the deterioration of the revetment. c.) Identify all remedial steps that could be taken to rebuild the marsh behind the revetment, as was initially intended by the installation of rock. Attached to this submittal is a PDF of a report to Laura Melendy, President of the Greenbrae Improvement Club (GIC), dated October 25, 2024 from Bob Battalio of Coastal Futures concerning the Proposed Larkspur Ferry Expansion Project. This report is incorporated herein and is referenced in questions 113-126.
	3-EIR & Enviro.Studies 5-Marsh, Bulkhead, Revetment		105. What types of monitoring will be recommended to determine ongoing impacts along the Corte Madera Creek due to the proposed increase in daily ferry trips, the longer vessels, displacement of water and wake action, coupled with Sea Level Rise? 108. Is the District willing to coordinate with the County of Marin and adjacent parcel owners to develop mid and long-term adaptation strategies for Greenbrae Boardwalk to protect its residents and residences from wake damage caused by increased trips, larger vessels and sea level rise? 113. The effectiveness of the revetment with sea level rise is a concern. With higher sea levels, the depth of water over the revetment will increase, and larger waves will be able to propagate into the marsh. The larger waves may erode the marsh. The revetment crest was designed to be at about the same elevation as the marsh. How will the District address this concern? 122. Please assess future function of the Greenbrae Boardwalk revetment with sea level rise and proposed changes to the ferry service. Consider alternatives such as raising the elevation of the revetment with additional rocks, mitigation of the outflanking as the east end of the revetment, and restoration of the eroded marsh near turning and berthing basins. 110. The combination of the above projected conditions could increase the likelihood of damage to structures along the Greenbrae Boardwalk from rising seas and flooding events. Many structures along the Greenbrae Boardwalk are at low elevation and the revetment will likely need reinforcement or replacement in the future to withstand higher levels of flood exposure. The existing riprap revetment will be insufficient for addressing these impacts, providing very minimal flood and erosion protection as water levels increase. The revetment is already being inundated with high tides, as evidenced by the mud accretion on top of the revetment and the waterline being higher and landward of the revetment. How does the District plan to address these concerns and potential damage? 13. Identify specific areas on the Corte Madera Ecological Reserve (CMER) eastern face that have been impacted by wave/wake action from the ferry. 15. Identify areas on the Mitigation Marsh that have been impacted by wave/wake action by the ferry. The area frequently referred to herein as the "Mitigation Marsh" is that land between the most southernly ferry boat dock and the north-eastern shore of Corte Madera Creek. 16. Identify specific areas of loss of marsh since the 1970's at the Mitigation Marsh on the northern shore of Corte Madera Creek. 26. Describe and report findings of each of the Larkspur Ferry Wake Impact Studies since 1973 performed by the District or others. 104. Based on the extensive loss of marsh due to the Larkspur Ferry wake over the past three decades, as evidenced by the over-topping of marsh due to the wake, it will be necessary to include monitoring and subsequent repairs to the shorelines to ensure the design intent of protecting the shorelines as sea levels rise and ferry trips expand. 115. Water jet 'prop wash' has been observed to reach the Greenbrae Boardwalk Marsh (observation by GIC) when ferries are maneuvering in the turning basin and berths. Erosion of the marsh between the terminal and the boardwalk (Figure 5 in the attached report) allows propagation of the wash. What will the District do to minimize this impact? 123. Develop measures to mitigate the jet wash and production of ferry generated waves toward the Greenbrae Boardwalk and surrounding marsh. 124. Ferry wake and wash assessment: Provide additional information about the boat wake study recently completed by GGBHTD. Conduct a peer review and verification processes to include additional wave monitoring and analysis. 128. Provide all wake studies for the Dorado and Delphinus currently in SF GGBHTD service which we were told at the 10/15 Scoping Meeting in Larkspur were the most similar to the new boat under construction for Larkspur service. 129. Describe any and all anticipated differences in wake generated by the new larger boat currently under construction for Larkspur
	5-Marsh-Bulkhead-Revetment		114. Marsh erosion is a concern with existing ferry operations. The mitigation marsh and other marshes adjacent to the Larkspur Ferry Terminal are eroding as indicated in the GGBHTD monitoring report (ESA 2016 25 year post-construction report). Erosion is also indicated by arial photography: Figure 4 in the attached report indicates erosion of about 2 feet per year between 2016 and 2023. Figure 5 shows the submerged crest of the rock revetment where the marsh edge was when the Larkspur ferry terminal was constructed in the 1970s. What will the District do to remedy the loss of marsh and to prevent further erosion of marsh? 117. Marsh erosion is occurring in the lee of the revetment in some areas. Figure 6 of the report indicates localized erosion of the marsh of up to 0.3 feet per year between 2016 and 2022. How will the District remedy this damage and eliminate further damage and erosion?
	4-Vessel and Wake		7. Identify design and construction methods that could be implemented to reverse shoreline loss on the Greenbrae Boardwalk waterfront from increased ferry trips. 8. Identify methods to ensure shoreline loss on the Greenbrae Boardwalk waterfront stops and is not increased from the combination of increased ferry trips and Sea Level Rise. 19. Identify specific areas of loss of shoreline at the CMER since the ferry service inception. 20. Identify methods to restore and protect the lost shoreline of the Corte Madera Ecological Reserve (CMER) eastern face. 106. What types of monitoring and continuous rebuilding of armor will be recommended to ensure that the design intent of all prior and anticipated shoreline protection along the Greenbrae Boardwalk shoreline to address ongoing erosion from the current vessels and the increased trips proposed with a larger tonnage vessel? 106. What types of monitoring and continuous rebuilding of armor will be recommended to ensure that the design intent of all prior and anticipated shoreline protection along the Mitigation Marsh and the CMER shoreline to address ongoing erosion from the current vessels and the increased trips proposed with a larger tonnage vessel? State Lands comments and concerns shared with Greenbrae Boardwalk: Attached hereto and incorporated herein by this reference this document are 6 photographs taken along the Greenbrae Boardwalk shoreline in 2022 by California State Lands scientists. We request that you respond to the conditions noted in each photo to describe the loss of marsh, failure of revetment and bulkheads as well as other conditions requiring resolution by the District in the EIR process. The questions related to those photos are attached and will begin the numbering of 130-135. In addition, an April 2024 State Land's draft Staff report included a number of concerns. Those concerns are outlined below as questions 107-112 to be addressed in the project's draft EIR.112. Is the District planning to coordinate with the County of Marin and adjacent parcel owners to develop mid and long-term adaptation strategies for Greenbrae Boardwalk to protect its residential structures? If so, how and what specifically will the District do to look at long term strategies to protect the Greenbrae Boardwalk shoreline?
	4-Vessel and Wake		125. Analysis of ferry waves and marsh erosion: Complete a robust assessment of wave generation and anticipated marsh erosion for existing and proposed ferry operations. 127. Conduct a sediment transport / sediment budget study to assess the net sediment flux to the marshes, and the effect of ferry operations, in particular boat wake, jet wash, and dredging.
	5-Marsh-Bulkhead-Revetment		14. If the marshes have not eroded or not been impacted by Larkspur Ferry wake, please identify all causes you attribute to the clear loss of marsh throughout the ferry terminal area. IF you believe that the loss of marsh is not solely attributed to the Larkspur Ferry (and other vessels using the Larkspur Ferry Terminal), please list all causes in order of causation for each question dealing with impacts from the Larkspur Ferry services now and with proposed increased trips and/or the new boats. 17. Describe all of the possible impacts due to the loss of the east end of the Mitigation Marsh on the entire Greenbrae Boardwalk shoreline. 18. Describe all the potential impacts of the loss of the east end of the Mitigation Marsh on the north shore of the Corte Madera Creek. 21. Identify methods to restore and protect the Mitigation Marsh on the northern shore of Corte Madera Creek. 22. Provide a baseline assessment of the plant and biological life of the CMER. Identify a regional response to SLR for the CMER marsh complex and adjacent built-up area. 23. What is the District planning to do to preserve and restore the mudflats and marsh face along the entire CMER? 24. Please investigate using Larkspur ferry dredge spoils for beneficial reuse by mudflat augmentation and mudflat recharge, utilizing shallow water placement in a berm below the entire eastern scarp from the Corte Madera Creek mouth to the Herdt Marsh, the Minke Marsh, Corte Madera town, and the Triangle Marsh as a nature-based solution to slow all these marsh faces from eroding. Please consider environmentally clearing this local beneficial reuse of dredge sediment as part of the ferry expansion EIR. 25. Please additionally investigate adding coarse beaches at the Corte Madera marsh scarps to stop further loss of primordial salt marsh face. 27. Identify the legal entity or entities that own the marsh to the south of the ferry entrance channel that we refer to as the "Mitigation Marsh" in this document and on the attached map. 39. What are they planning to do to preserve the mudflats and marsh facing? 116. Marsh erosion near the east end of the revetment at Greenbrae Boardwalk is progressing, and the outflanking of the east end of the revetment has increased. Figure 6 in the attached report indicates erosion of about 0.4 feet per year between 2016 and 2022. This erosion reduces the effectiveness of the revetment in preventing erosion along the boardwalk. How will the District remedy this damage and eliminate further damage and erosion? 120. An analysis of marsh erosion at the Corte Madera Ecological Reserve (CMER) states that the maintenance dredging of the Larkspur Ferry Terminal navigation channel, etc. may create a 'sediment sink' which may artificially reduce sediment supply to marshes, thereby contributing to marsh erosion (report prepared by BCDC 2013, CM Baylands). Please investigate and report on this concern and provide alternatives to address this increased sediment loss.
	4-Vessel and Wake		118. The GGBHTD wake study (undated GGBHTD Wake and Shoreline Erosion Analysis Overview) indicates very small wave generation by ferries. This finding is difficult to understand given prior assessments that the ferries do produce waves, and that the waves increase the wave energy dissipated along the Marin shore and contribute to marsh erosion and that marsh erosion has increased as evidenced by the various reports referenced in the attached report.) How will the District undertake a more thorough and honest assessment of the wake impacts on the Greenbrae Boardwalk Shoreline, the Mitigation Marsh and the surrounding marshes?
	2-Landisde-Project Design-Ops		61. What is the District's plan for providing alternatives to single occupancy vehicles accessing the Larkspur terminal in the proposed expansion plans, and who will take fiscal responsibility for implementing these alternatives? 62. The 101/Sir Francis Drake junction is already well past capacity in the morning commute southbound and in the evening commute from 3-7pm making access to the ferry and nearby neighborhoods challenging. How many feeder buses did the District run prior? 63. What origins do the ferry passengers come from that could be served by new feeder buses? 66. Building more parking spaces creates induced demand for more cars: this runs counter to state and regional policies. How will the District mitigate this induced demand?
	2-Landisde-Project Design-Ops		69. What traffic studies will you call for to evaluate the effects of proposed parking structures at each of the proposed sites? 67. What are the District's preferences for the location of the parking garage/s in order of priority? 68. What is the likely location of the parking structure? 71. What elevation will the floors of the garages be on at each of the proposed sites? 72. What will be the access elevation to the terminal from the garage with the projected sea level rise of 0.8 feet? 73. What is the FEMA Base Flood Elevation of the parking area? 83 a. Will the District design the proposed parking structure on the terminal site with a solid wall on the south side facing the Boardwalk and creek? 84. How high will the structure be in each proposed location? 85. What materials will be used on the exterior surfaces of the structure?

Affiliation	Comment Category(s)	Comment Summary	Subcomment
Greenbrae Improvement Club	2-Landisde-Project Design-Ops	Commenter has several biological concerns including but not limited to increased erosion, marsh impacts, shoreline revetment, and mud and grass accretion. Commenter wants to have a better understanding of the biological impacts and the mitigation measures implemented.	The imposition of a 3-4 story parking garage along the creek will directly affect Greenbrae Boardwalk properties in many ways: 74. What steps will the District put in place to include Greenbrae Boardwalk residents in the design process related to lighting plans and options once a parking structure site has been determined. 75. What is your lighting plan to date? 76. What color (cool to warm) lighting elements are planned? 77. What shielding or directional beams are available in your lighting plan? 78. What are the outcomes in LED studies being used to inform your lighting plan related to ambient light levels surrounding the garage? 79. Will lighting inside and surrounding the garage be on 24-7? 80. Will the lighting inside the garage dim when there is no activity? 81. Brighten with motion? 82. What structural lighting shields will be in place to protect headlights from projecting across the Corte Madera Creek generated by all vehicles including trucks and buses able to access garage. 83. What steps will the District put in place to include Greenbrae Boardwalk residents in the design process related to aesthetics of the structure exterior and landscaping once a parking structure site has been determined.
	3-EIR & Env. Studies		56. We request measurements to be taken from the Greenbrae Boardwalk to determine noise levels for all boats as they exit the Larkspur Terminal and the turning basin at high tide and in low tide. 57. We request measurements to be taken from the Greenbrae Boardwalk to determine noise levels for these boats being serviced for regular maintenance and repairs at the Larkspur Terminal overnight. 86. What steps will the District put in place to include Greenbrae Boardwalk residents in the design process related to noise generated by use once a parking structure site has been determined. 87. Identify the noise levels from the multistory garages measured along the length of the Greenbrae Boardwalk at peak traffic times 88. Identify the noise levels from the multistory garages measured along the length of the Greenbrae Boardwalk at high tide 89. Identify the noise levels from the multistory garages measured from the surrounding neighbors at peak traffic times. 90. Identify the noise levels from the multistory garages measured from the surrounding neighbors at high tide. 91. What noise protections will be put in place by the District?
	6 - Out of Scope		37. What is the method to determine the actual impacts along the Corte Madera Creek and eastern shore of the CMER once the ferry is in operation? 111. As identified in the State Land's Commission's report Shoreline Adaptation and the Public Trust, alternative strategies can include nature-based strategies to stabilize the bank with native mash vegetation. A combination of these strategies, concurrently and/or sequenced in phases, is likely needed and should be included in this Larkspur Ferry Expansion EIR. Is the District planning to include these issues in its EIR?
	2-Landisde-Project Design-Ops		41. How are Project Alternatives for the new ferry boat to be defined and when?
	2-Landisde-Project Design-Ops		102. How will the addition of a parking garage create relatively isolated pedestrian corridors reducing the current high visibility "eyes on the street" factor and impact the safety of bicycles and pedestrians arriving at the ferry on the bike path? 103. What mitigations will the project provide to enhance safety of the bike path with lighting and cameras shielded from projecting into neighboring homes? 119. The information provided about the project implies that additional ferry trips are needed to meet commuter demand, which implies that greater marsh erosion may occur. How will the District address this concern and ensure that there is no further erosion? The study should include: • A review and summary of prior pertinent work; • Quantification of existing and proposed ferry generated waves; • Effects of ferry generated waves on marshes, including wave induced erosion; • Field measurements with more than one method in order to assess instrument and other method uncertainties; • Calculated wave generation for comparison with field data; • Visual (video, photographs, etc.) verification of field data; • Mitigation measures; and, • Reporting
	3-EIR & Env. Studies		46. What protocols are in place to test for air and water impacts of sewage discharge or transfer of sewage off all boats? 52. What is the air quality impact of these boats being docked at the Larkspur Terminal? 92. What steps will the District put in place to include Greenbrae Boardwalk residents in the design process related to air quality once a parking structure site has been determined. 94. Identify the air quality impacts from increased cars trips to the terminal. 93. Cal Enviroscreen 4.0 shows this census tract of 6000 people already encountering a traffic impact measuring in the 95th percentile of worst traffic in California. What tracking methods will the District put in place to measure the anticipated increase in car trips from the current 3000 person trips to the 9000 person trips associated with the parking expansion? 95. Identify mitigation measures to offset the impact of increased car trips. 96. Identify the air quality impacts from increased cars trips to the terminal exacerbated by any architectural structures put in place to address other lighting, noise levels and/or aesthetic concerns. 97. Identify air quality impacts from 500 cars idling together to exit the terminal garage at peak traffic hours after ferry arrivals. 98. What mitigation will the District provide for the impact of idling traffic exiting terminal garage at peak traffic hours after ferry arrivals? 99. How often will these car trip tracking methods be implemented? 100. How often will these car trip tracking methods be analyzed and assessed for mitigation effectiveness 101. What steps will the District put in place to include Greenbrae Boardwalk residents in the design process related to air quality once a parking structure site has been determined.
	4-Vessel and Wake		28. Describe the effects of the proposed new ferry's size, weight, and displacement on the turning basin at the entrance of the Corte Madera Creek and how those effects differ from impact of Spaulding and Catamaran vessels currently in operation at the Larkspur Ferry Terminal. 29. Describe the shoaling anticipated as the new proposed ferry slows down. If you do not know at this time, how do you intend to incorporate the anticipated shoaling due to the new proposed ferry and how will the District's responsibilities to minimize damage be assessed? 32c. Describe how the speed is monitored. 33. Please provide all reports and/or logs on ferry entrance and departure speeds for the period of January 1, 2023, and October 31, 2024. 34. At what channel marker is a catamaran supposed to stop planing in the channel? 35. What is the minimum speed for the new ferry for the captain to maintain control of the boat? 36. What are the anticipated shoaling impacts of the new ferry particularly at low tide along the eastern face of the CMER? 38. If actual impacts exceed those anticipated, what will trigger protocols for slowing speed, or other mitigation to reduce ferry wake impacts? What other methods of mitigation will be proposed in any alternative analysis for this EIR? 47. What changes to the existing protections (in terms of frequency, discharge volume, manner of transfer) will be required with the new boat? 70. The Greenbrae Boardwalk is categorized "AE" by the recent study to account for both bay and river influences, with a BFE of 10'. It does not account for SLR. Current County rules ask for a floor of 13'. At what BFE level will the structures at the ferry be built? 126. The following parameters are proposed for consideration while we anticipate the GGBHTD and their consultants shall determine the appropriate scope and allow further public input and please provide responses to each of the following: Consider a range of parameters pertinent to wave generation, to include: a.) Vessel characteristics (hull shape, displacement including passenger and fuel); b.) Vessel operations (speed, route), environmental conditions (tide and depth); c.) Environmental conditions (tide, depth); d.) Proximity to shore locations; e.) Range of shore locations including near the shore at Greenbrae Boardwalk; f.) Wave transformations (e.g. refraction, shoaling, dissipation) between generation and shore locations; and, g.) Tests of anticipated worse case conditions within operational range in terms of wave generation such as increased speed, modified routes, heavy loads and frequent ferries.
	3-EIR & Env. Studies		45. What procedures are in place for the discharge of sewage off all the boats? 53. What is the water quality impact of these boats being docked at the Larkspur Terminal? 64. The terminal parking lot site is on marsh fill. What studies will be conducted to determine the effects of increased vibration on the surrounding habitat and marshes during construction? 65. What studies will be conducted to determine the effects of increased vibration over time on the surrounding habitat and marshes from the use of the garages?
	6 - Out of Scope		40. Who is/who are project lead/s at GGBHTD ("District")? 42. Who is leading technical studies and what other technical studies are planned? 48. Are the Spaulding boats or catamarans for Sausalito and other locations docking overnight in Larkspur? If so, how many, what type of vessel and how often? Are these trips included in dock overnight in Larkspur? 49. What is the maximum number of boats allowed to dock overnight in Larkspur? Will that change with the new boat(s). What is the maximum number of nights boats will be allowed to dock overnight in Larkspur? 51. How many trips a day are currently coming into the Larkspur terminal for non-Larkspur commuter boats? 58. Will repairs to all boats docked at the Larkspur Terminal be allowed to take place during evening and nighttime hours? 59. Will regular maintenance occur during the evening and nighttime hours for all boats docked at the Larkspur Terminal? 60. How will the new boat impact on the current docking facilities (structurally, lighting, servicing and maintenance requirements)? 121. Please provide all information about wave studies concerning the Larkspur ferry and use of the Larkspur terminal by boats serving other areas, but docking at the Larkspur terminal. In each report how the data were collected and whether the data were verified by alternative means, and precisely where any measurements were taken.
	1-Project		43. When will the District release for public distribution any and all analysis and data on studies now underway specifically for Wake and Shoreline Erosion Analysis? 44. When will the District release for public distribution any and all analysis and data on studies now underway specifically for Aquatic Resources Delineation?
	4-Vessel and Wake		54. We request turbidity studies be conducted in the turning basin and all along the length of the Corte Madera creek to determine silt and sediment movement, currently and with the new boat. 55. We request projections based on current turbidity studies conducted in the turning basin and all along the length of the Corte Madera creek to determine silt and sediment movement by increased trips proposed and by the new catamaran to be acquired by GGBHTD.
	4-Vessel and Wake		109. The Marin Shoreline Sea Level Rise Vulnerability Assessment: Bay Waterfront Adaptation & Vulnerability Evaluation (2017, County of Marin) determined that 78 percent of the parcels in the Greenbrae Boardwalk, as well as the Ross Valley, could experience increased tidal flooding. This would put approximately 1,200 homes at risk along the Creek. Wakes created by ferries might exacerbate these predicted impacts since wave run up would increase as the ferry wake comes into the area and further erodes the shorelines.
N/A, Individual	4-Vessel and Wake 5-Marsh, Bulkhead, Revetment	Commenter has several questions concerning biological resources, hydrology, GHG emissions/air quality, etc.	**Hydrology, Water Quality, Geology, and Soils** The energy produced by ferry wakes are known to potentially erode shoreline marshes and change shoreline morphology and adjacent mudflats. What modeling techniques and tools will be used to analyze these impacts? What is the wave energy generated by current ferry service? What is projected wave energy generated by service expansion and fleet conversion? Will wave energy in wakes produced by the proposed expansion increase? How will this be mitigated? What is wind wave energy along Corte Madera shoreline marshes and mudflats? How might expanding ferry service amplify combined impacts from projected rising sea levels and any wind wave effects along shorelines and adjacent mudflats? How does predominant wind speed and direction along Corte Madera shorelines contribute to Baylands erosion? Will ferry speeds be seasonally managed, for example, during winter when increased water levels due to storm surges and king tides are more likely to accelerate shoreline erosion? How will new vessels, increased speed and increased trips impact sediment suspension and redistribution in the Bay? Will sediment due to shoreline erosion increase in the Bay? Will increased sediment accumulate in the ferry channel? Will the ferry channel require more frequent dredging? How has historic shoreline erosion adapted to current vessels and levels of service and how might service expansion change that? Will there likely be increased wake and turbulence impacts related to shoreline erosion or changes in shoreline morphology due to fleet conversion, increased speeds and ferry trips? How will the shape, size and weight of new vessels, when filled to capacity, impact wave generation and erosion over space and time? How might fleet and service changes contribute to marine debris?
	3-EIR & Enviro Studies 4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		**Biological resources** How will fleet conversion, increased ferry speeds and increased service trips impact the behavior of resident and migratory waterbirds and shorebirds and or preclude waterbird use of open water habitats periodically and/or extensively over time? How will marsh and mudflat dependent species be impacted? How will fleet conversion, increased speeds and service trips impact marine mammal behavior, increase species disturbance, and the likelihood of marine mammal strikes? How will fleet conversion, increased speeds and increased trips impact state and federally listed species in the Bay? How will marsh and mudflat habitats along the shoreline be protected from impacts due to fleet conversion, increased speeds and trips? What impacts will any needed changes to the ferry channel have on open water and Baylands ecosystems?
	3-EIR & Env. Studies		**Greenhouse Gas Emissions and Air Quality** How will increased ferry service impact energy use, specifically for increased ferry trips, increased speeds and fleet conversion? How will ferry service expansion contribute to GHG emissions both specifically and the transportation network systemwide? How will expanded ferry service trips, increased speeds, and fleet conversion impact air quality and pollution levels?
	3-EIR & Env. Studies		**Noise** How will noise from increased ferry fleet or service trip changes impact local communities and wildlife? What impacts would increased dredging have on benthic, bay and Baylands species?
	3-EIR & Env. Studies		**Aesthetics** How will impacts from increased lighting for the parking structures be mitigated to protect water and shore species and nearby communities?
	2-Landisde-Project Design-Ops		**Recreation** How will ferry speed and trip increases impact kayakers and canoers recreating on the Bay?
	2-Landisde-Project Design-Ops		**Land Use and Planning (Permitting)** Will the expansion of ferry service and fleet conversion require permits from the Bay Conservation and Development Commission (BCDC), US Fish and Wildlife Service (FWS), and/or California Department of Fish and Wildlife (CDFW)? Will permits be required from the state or regional Water Quality Control Board for ferry service and potential parking lot expansion? Do the plans conflict with not only Larkspur and County planning documents but also existing Baylands restoration plans?
	4-Vessel and Wake		**Cumulative impacts** How will changes in Larkspur's fleet and expansion of service trips contribute to cumulative impacts of increased ferry system activity and ferry route expansion around the Bay? Monitoring impacts from expanded ferry service Will monitoring include on-site observation and measurement, as well as remote sensing and GIS data collection to monitor cumulative changes to shoreline morphology, shoreline retreat and erosion and amount of sediment loss in order to timely adapt mitigations? How will contributions to cumulative impacts from the project be measured and monitored?
	2-Landisde-Project Design-Ops 3-Enviro Studies		**Expanding Parking** Greenhouse Gas Emissions and Air Quality How will proposed parking expansion impact energy use, carbon footprint of ferry service, and GHG emissions, both specifically and transportation network wide? How will increased parking contribute to local traffic congestion, access, and emergency service access times? How will building new parking structures impact VMTs, local congestion and related emissions from stalled traffic both on Highway 101 on- and off-ramps and on Sir Francis Drake? What will be associated air quality impacts from increased auto parking? How will increased parking contribute to mode shift or not? How will adding the parking structures increase or decrease the carbon footprint of ferry service as a transportation mode? How will new parking structures, and associated increased traffic to and from them, impact level of service on Sir Francis Drake, safety at intersections, and safety and comfort using bicycle and pedestrian infrastructure along Sir Francis Drake?
	3-EIR & Env. Studies		**Aesthetics** What will be the visual and aesthetic impacts from the parking structures to those who currently live in the communities near the ferry and to those in nearby approved developments? How will those be mitigated?

Affiliation	Comment Category(s)	Comment Summary	Subcomment
N/A, Individual	3-EIR & Env. Studies	Commenter has several questions concerning biological resources, hydrology, GHG emissions/air quality, etc.	**Noise** How will noise from heavier car traffic to and from expanded parking, impact local communities and wildlife?
	3-EIR & Env. Studies		**Hydrology** What will the impacts from new parking structures on stormwater infrastructure be? Will impacts require expanding or building new stormwater and drainage infrastructure that will filter runoff before it enters the Bay?
	3-EIR & Env. Studies		**Hazards** How will the project increase or decrease impacts from projected sea level rise?
	3-EIR & Enviro Studies 4-Vessel and Wake 5-Marsh, Bulkhead, Revetment		**Mitigation Measures** (What protective mitigation measures will ensure Baylands ecosystem and wildlife conservation?) In considering mitigations for significant or unavoidable impacts, please consider ones that would restore living shorelines near the Larkspur ferry terminal with nature-based solutions that may dissipate wave energy, retain sediment to stabilize eroding shorelines, possibly reduce flooding from large storm events, and increase and support biodiversity in the marsh and mudflat ecosystems nearby. Even better would be to make environmental improvements a part of the projects, as the District prepares for the future, versus creating new environmental burdens.
N/A, Individual	2-Landisde-Project Design-Ops	Commenter states that they are not supportive of the parking structure, stating that the construction of the structure would not provide any long-term benefits.	Greetings: I have been a Larkspur resident since 1995 and a big advocate of the Larkspur Ferry--it was, bar none, the best way to commute to downtown SF! I have reviewed your demand forecasts, parking structure options and other project materials for your 2600 space car parking project. You have asked for comments by 31OCT24. I cannot support building 2600 spaces of structured parking where there is no near term demand for the following reasons:
	2-Landisde-Project Design-Ops		1. The ferry terminal needs to be moved to the harbor at San Quentin per the Vision Plan now that San Quentin is being transformed to a rehabilitation center: The 2012 SMART plan ID'd the present ferry terminal lot as the preferred location for 300DU of housing. Marin County [and California] needs housing more than it needs a parking structure that will have 16hrs per week of peak utilization.
	6 - Out of Scope		2. The environmental review materials did not discuss the fact that he GGB District will save $7M every five years by not having to dredge the channel if the terminal is moved to the harbor at San Quentin: GGB District Ferry service from Larkspur Landing is a valuable part of our public transit infrastructure. We need to make the hard decisions necessary to both increase the long-term benefits and current value of this infrastructure--much like the Golden Gate Bridge itself has for almost 100 years.
	1-Project		Attached please find the materials used in determining my decision. Thank you for considering my comments.
N/A, Individual	6 - Out of Scope	Commenter is providing his experience with the previous Ferry terminal design.	Hello People of GGT, I moved to Marin in 1981 and started taking the Larkspur Ferry to San Francisco at that time. I still take the ferry to work. Obviously I have seen a lot. In 1981, when you disembarked from the ferry, there was an overhang under which 8 or 10 feeder busses awaited us. I lived in San Rafael and took one of the busses. At some point after, I returned to the ferry after working for a time in The Peninsula. I was shocked to see that the overhang and all the feeder busses were gone – replaced by a few parking spots. WTF? I asked about it at the time but never got an answer. Net net: Those who originally designed the Larkspur Ferry site, got it right! Dig out their plans and just update them for a new century.

Appendix B. Air Quality and Greenhouse Gas Modeling Files

Appendix B1. Construction and Operation Emission Summaries
Appendix B2. CalEEMod Output Files
Appendix B3. CT-EMFAC Output Files
Appendix B4. Health Risk Assessment and PM 2.5 Concentration Evaluation

Appendix B1. Construction and Operation Emission Summaries

Summary of Criteria Pollutants Emissions

Daily Construction Emissions - Unmitigated

		Average Daily Emissions (lb/day)						
	Construction Phase	**ROG**	**NOx**	**CO**	**PM_{10} Exhaust**	**PM10 dust**	**$PM_{2.5}$ Exhaust**	**PM2.5 Dust**
	Construction Year 2033	0.365	3.316	5.256	0.072	3.598	0.067	0.527
North Lot Construction	Construction Year 2034	5.222	4.615	8.340	0.084	3.108	0.078	0.432
	Construction Year 2037	1.445	13.532	18.242	0.322	11.999	0.302	1.834
	Construction Year 2038	1.076	9.376	15.412	0.234	5.525	0.219	0.909
	Construction Year 2039	21.827	7.211	12.215	0.113	3.644	0.105	0.644
Main Lot Construction HP	Construction Year 2040	4.396	0.985	1.723	0.010	0.423	0.010	0.081
	Construction Year 2037	1.208	11.240	15.907	0.255	12.511	0.240	1.785
	Construction Year 2038	1.006	8.346	14.585	0.211	5.142	0.197	0.814
	Construction Year 2039	21.824	7.042	12.124	0.111	3.421	0.103	0.610
Main Lot Construction ACP	Construction Year 2040	4.396	0.983	1.722	0.010	0.420	0.010	0.081
BAAQMD CEQA Thresholds		**54**	**54**	**NA**	**82**	**Best management practices**	**84**	**Best management practices**
Exceeding Threshold?		**No**	**No**	**NA**	**No**	**No**	**No**	**No**

Annual Construction Emissions - Unmitigated

		Annual Emissions (ton/year)						
	Construction Phase	**ROG**	**NOx**	**CO**	**PM_{10} Exhaust**	**PM10 dust**	**$PM_{2.5}$ Exhaust**	**PM2.5 Dust**
	Construction Year 2033	0.067	0.605	0.959	0.013	0.657	0.012	0.096
North Lot Construction	Construction Year 2034	0.953	0.842	1.522	0.015	0.567	0.014	0.079
	Construction Year 2037	0.264	2.470	3.329	0.059	2.190	0.055	0.335
	Construction Year 2038	0.196	1.711	2.813	0.043	1.008	0.040	0.166
	Construction Year 2039	3.983	1.316	2.229	0.021	0.665	0.019	0.118
Main Lot Construction HP	Construction Year 2040	0.802	0.180	0.314	0.002	0.077	0.002	0.015
	Construction Year 2041	0.220	2.051	2.903	0.047	2.283	0.044	0.326
	Construction Year 2042	0.184	1.523	2.662	0.038	0.938	0.036	0.149
	Construction Year 2043	3.983	1.285	2.213	0.020	0.624	0.019	0.111
Main Lot Construction ACP	Construction Year 2044	0.802	0.179	0.314	0.002	0.077	0.002	0.015

Annual Onsite Emissions - Unmitigated

		Annual Emissions (ton/year)						
	Construction Phase	**ROG**	**NOx**	**CO**	**PM_{10} Exhaust**	**PM10 dust**	**$PM_{2.5}$ Exhaust**	**PM2.5 Dust**
	Construction Year 2033	0.047	0.368	0.600	0.011	0.101	0.010	0.018
	Construction Year 2034	0.937	0.633	1.230	0.014	0.068	0.013	0.007
North Lot Construction	**Average Emissions**	**0.492**	**0.500**	**0.915**	**0.012**	**0.084**	**0.011**	**0.012**
	Construction Year 2037	0.230	1.434	2.423	0.047	0.187	0.043	0.052
	Construction Year 2038	0.170	1.114	2.186	0.035	0.102	0.033	0.011
	Construction Year 2039	3.960	1.012	1.753	0.018	0.112	0.016	0.013
Main Lot Construction HP	Construction Year 2040	0.799	0.154	0.248	0.002	0.017	0.002	0.002
	Average Emissions	**1.290**	**0.929**	**1.652**	**0.025**	**0.105**	**0.023**	**0.019**
	Construction Year 2037	0.193	1.109	2.130	0.035	0.185	0.033	0.051
	Construction Year 2038	0.160	1.026	2.111	0.032	0.101	0.030	0.011
	Construction Year 2039	3.960	1.012	1.752	0.018	0.112	0.016	0.013
Main Lot Construction ACP	Construction Year 2040	0.799	0.154	0.248	0.002	0.017	0.002	0.002
	Average Emissions	**1.278**	**0.825**	**1.560**	**0.022**	**0.103**	**0.020**	**0.019**

Daily Construction Emissions - Mitigated

		Average Daily Emissions (lb/day)						
	Construction Phase	**ROG**	**NOx**	**CO**	**PM_{10} Exhaust**	**PM10 dust**	**$PM_{2.5}$ Exhaust**	**PM2.5 Dust**
	Construction Year 2033	0.23	2.07	6.59	0.03	3.60	0.03	0.53
North Lot Construction	Construction Year 2034	5.05	2.62	10.27	0.04	3.11	0.04	0.43
	Construction Year 2037	0.892	9.951	26.088	0.164	11.999	0.162	1.834
	Construction Year 2038	0.648	6.504	21.070	0.115	5.525	0.113	0.909
	Construction Year 2039	21.630	5.603	17.472	0.068	3.644	0.067	0.644
Main Lot Construction HP	Construction Year 2040	4.377	0.816	2.556	0.008	0.423	0.008	0.081
	Construction Year 2037	0.769	8.788	22.966	0.149	12.511	0.147	1.785
	Construction Year 2038	0.608	5.772	20.022	0.105	5.142	0.103	0.814
	Construction Year 2039	21.628	5.434	17.381	0.066	3.421	0.065	0.610
Main Lot Construction ACP	Construction Year 2040	4.377	0.814	2.555	0.008	0.420	0.008	0.081
BAAQMD CEQA Thresholds		**54**	**54**	**NA**	**82**	**Best management practices**	**84**	**Best management practices**
Exceeding Threshold?		**No**	**No**	**NA**	**No**	**No**	**No**	**No**

Annual Construction Emissions - Mitigated

		Annual Emissions (ton/year)						
	Construction Phase	**ROG**	**NOx**	**CO**	**PM_{10} Exhaust**	**PM10 dust**	**$PM_{2.5}$ Exhaust**	**PM2.5 Dust**
	Construction Year 2033	0.042	0.378	1.202	0.006	0.657	0.006	0.096
North Lot Construction	Construction Year 2034	0.922	0.478	1.875	0.007	0.567	0.007	0.079
	Construction Year 2037	0.163	1.816	4.761	0.030	2.190	0.030	0.335
	Construction Year 2038	0.118	1.187	3.845	0.021	1.008	0.021	0.166
	Construction Year 2039	3.948	1.023	3.189	0.012	0.665	0.012	0.118
Main Lot Construction HP	Construction Year 2040	0.799	0.149	0.466	0.001	0.077	0.001	0.015
	Construction Year 2041	0.140	1.604	4.191	0.027	2.283	0.027	0.326
	Construction Year 2042	0.111	1.053	3.654	0.019	0.938	0.019	0.149
	Construction Year 2043	3.947	0.992	3.172	0.012	0.624	0.012	0.111
Main Lot Construction ACP	Construction Year 2044	0.799	0.149	0.466	0.001	0.077	0.001	0.015

Annual Onsite Emissions - Mitigated

		Annual Emissions (ton/year)						
	Construction Phase	**ROG**	**NOx**	**CO**	**PM_{10} Exhaust**	**PM10 dust**	**$PM_{2.5}$ Exhaust**	**PM2.5 Dust**
	Construction Year 2033	0.022	0.140	0.843	0.004	0.101	0.004	0.018
	Construction Year 2034	0.906	0.269	1.583	0.006	0.068	0.006	0.007
North Lot Construction	**Average Emissions**	**0.464**	**0.204**	**1.213**	**0.005**	**0.084**	**0.005**	**0.012**
	Construction Year 2037	0.129	0.780	3.855	0.018	0.187	0.017	0.052
	Construction Year 2038	0.092	0.590	3.218	0.014	0.102	0.013	0.011
	Construction Year 2039	3.924	0.719	2.712	0.009	0.112	0.009	0.013
Main Lot Construction HP	Construction Year 2040	0.795	0.123	0.400	0.001	0.017	0.001	0.002
	Average Emissions	**1.235**	**0.553**	**2.546**	**0.011**	**0.105**	**0.010**	**0.019**
	Construction Year 2037	0.113	0.661	3.418	0.016	0.185	0.016	0.051
	Construction Year 2038	0.088	0.556	3.103	0.013	0.101	0.013	0.011
	Construction Year 2039	3.924	0.718	2.712	0.009	0.112	0.009	0.013
Main Lot Construction ACP	Construction Year 2040	0.795	0.123	0.400	0.001	0.017	0.001	0.002
	Average Emissions	**1.230**	**0.515**	**2.408**	**0.010**	**0.103**	**0.010**	**0.019**

Operation Emissions - Total from Vehicle Trips

General	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5
	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	ton/year	ton/year	ton/year	ton/year	ton/year
2025	4.56	6.74	81.54	14.26	2.51	0.82	1.22	14.76	2.58	0.45
2035 No Build	7.01	7.31	122.12	31.07	5.35	1.27	1.32	22.10	5.62	0.97
2035 Alt1	5.62	5.16	106.14	30.48	5.20	1.02	0.93	19.21	5.52	0.94
2035 Alt2	6.70	7.03	116.71	29.76	5.13	1.21	1.27	21.12	5.39	0.93
2035 Alt3	5.23	4.80	98.33	28.43	4.86	0.95	0.87	17.80	5.15	0.88
2050 No Build	18.39	16.88	347.82	99.65	17.00	3.33	3.06	62.96	18.04	3.08
2050 Alt1	14.01	12.86	265.00	75.92	12.95	2.54	2.33	47.97	13.74	2.34
2050 Alt2	12.07	11.09	226.74	65.72	11.24	2.18	2.01	41.04	11.90	2.03
2050 Alt3	12.32	11.32	232.10	66.96	11.44	2.23	2.05	42.01	12.12	2.07

Operation Emissions - Total from Ferry Operation

General	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5
	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	ton/year	ton/year	ton/year	ton/year	ton/year
2025	313.88	2165.74	2667.94	125.55	125.55	56.81	392.00	482.90	22.72	22.72
2035 No Build	28.12	261.14	749.28	1.00	1.00	5.09	47.27	135.62	0.18	0.18
2035 Alt1	28.12	261.14	749.28	1.00	1.00	5.09	47.27	135.62	0.18	0.18
2035 Alt2	28.12	261.14	749.28	1.00	1.00	5.09	47.27	135.62	0.18	0.18
2035 Alt3	28.12	261.14	749.28	1.00	1.00	5.09	47.27	135.62	0.18	0.18
2050 No Build	28.12	261.14	749.28	1.00	1.00	5.09	47.27	135.62	0.18	0.18
2050 Alt1	47.63	442.26	1268.95	1.70	1.70	8.62	80.05	229.68	0.31	0.31
2050 Alt2	47.63	442.26	1268.95	1.70	1.70	8.62	80.05	229.68	0.31	0.31
2050 Alt3	47.63	442.26	1268.95	1.70	1.70	8.62	80.05	229.68	0.31	0.31

Total Operation Emissions

General	ROG	NOx	CO	PM10	PM2.5	ROG	NOx	CO	PM10	PM2.5
	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	ton/year	ton/year	ton/year	ton/year	ton/year
2025	318.43	2172.48	2749.48	139.81	128.06	57.64	393.22	497.66	25.31	23.18
2035 No Build	35.13	268.46	871.40	32.07	6.36	6.36	48.59	157.72	5.80	1.15
2035 Alt1	33.74	266.30	855.42	31.49	6.21	6.11	48.20	154.83	5.70	1.12
2035 Alt2	34.83	268.18	865.99	30.76	6.14	6.30	48.54	156.74	5.57	1.11
2035 Alt3	33.35	265.95	847.61	29.44	5.86	6.04	48.14	153.42	5.33	1.06
2050 No Build	46.51	278.02	1097.10	100.65	18.01	8.42	50.32	198.58	18.22	3.26
2050 Alt1	61.64	455.12	1533.95	77.62	14.65	11.16	82.38	277.64	14.05	2.65
2050 Alt2	59.69	453.35	1495.68	67.42	12.94	10.80	82.06	270.72	12.20	2.34
2050 Alt3	59.95	453.58	1501.04	68.66	13.14	10.85	82.10	271.69	12.43	2.38

Net Change of Operation Emissions

General	ROG	NOx	CO	PM10	PM2.5
	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
2035 No Build	-283.30	-1904.02	-1878.08	-107.74	-121.70
2035 Alt1	-284.69	-1906.17	-1894.06	-108.33	-121.85
2035 Alt2	-283.60	-1904.30	-1883.49	-109.05	-121.93
2035 Alt3	-285.08	-1906.53	-1901.87	-110.37	-122.20
2050 No Build	-271.92	-1894.45	-1652.38	-39.16	-110.06
2050 Alt1	-256.79	-1717.36	-1215.53	-62.19	-113.41
2050 Alt2	-258.74	-1719.13	-1253.80	-72.39	-115.12
2050 Alt3	-258.48	-1718.90	-1248.44	-71.15	-114.92
BAAQMD CEQA Thresholds	**54**	**54**	**NA**	**82**	**54**
Exceeding Threshold?	**No**	**No**	**No**	**No**	**No**

Summary of GHG Emissions

Direct GHG Emissions - Construction

		CO2	CH4	N2O	CO2e
		metric tons/year	metric tons/year	metric tons/year	metric tons/year
	Construction Year 2033	388.38	0.02	0.03	396.94
	Construction Year 2034	479.33	0.02	0.03	488.36
North Lot Construction	Sub Total	*867.71*	*0.04*	*0.05*	*885.30*
	Construction Year 2037	1757.90	0.08	0.14	1802.82
	Construction Year 2038	1297.67	0.05	0.09	1327.12
	Construction Year 2039	894.12	0.03	0.05	910.83
	Construction Year 2040	114.22	0.00	0.00	115.81
Main Lot Construction HP	*Sub Total*	*4063.91*	*0.17*	*0.29*	*4156.57*
	Construction Year 2037	1486.52	0.08	0.12	1524.83
	Construction Year 2038	1149.84	0.05	0.08	1173.99
	Construction Year 2039	863.58	0.03	0.05	878.90
Main Lot Construction ACP	Construction Year 2040	113.85	0.00	0.00	115.42
	Sub Total	*3613.78*	*0.15*	*0.25*	*3693.13*
Total Construction with Main Lot HP		**4931.61**	**0.21**	**0.35**	**5041.87**
Total Construction with Main Lot ACP		**4481.49**	**0.20**	**0.31**	**4578.43**

Operation GHG - Direct GHG Emissions - Vehicle Trips

	CO2	CH4	N2O	CO2e	CO2	CH4	N2O	CO2e
	metric tons/day	metric tons/day	metric tons/day	metric tons/day	metric tons/year	metric tons/year	metric tons/year	metric tons/year
2025	14.6	0.00	0.1	14.7	5,290.7	1.8	31.8	5,337.1
2035 No Build	26.2	0.01	0.1	26.4	9,487.1	2.5	46.3	9,544.1
2035 Alt1	24.0	0.00	0.1	24.1	8,682.7	1.6	38.3	8,724.8
2035 Alt2	25.1	0.01	0.1	25.2	9,076.4	2.4	44.6	9,131.1
2050 No Build	78.5	0.01	0.3	78.9	28,430.7	5.3	125.0	28,567.9
2050 Alt1	59.8	0.01	0.3	60.1	21,661.1	4.1	95.2	21,765.7
2050 Alt2	51.4	0.01	0.2	51.6	18,604.6	3.5	83.5	18,696.3

Operation GHG - Direct GHG Emissions - Ferry Trips

	CO2	CH4	N2O	CO2e
	metric tons/year	metric tons/year	metric tons/year	metric tons/year
2025	33,967.8	21.7	0.6	34,724.1
2035 No Build	21,374.5	13.6	0.4	21,850.4
2035 Alt1	21,374.5	13.6	0.4	21,850.4
2035 Alt2	21,374.5	13.6	0.4	21,850.4
2050 No Build	21,374.5	13.6	0.4	21,850.4
2050 Alt1	36,198.7	23.1	0.6	37,004.7
2050 Alt2	36,198.7	23.1	0.6	37,004.7

Indirect GHG Emissions from Energy Consumption of Parking Structures

	CO2	CH4	N2O	CO2e
Emission Factors (lb/Mwh)	203.983	0.033	0.004	206.0
North Structure Electricity Consumptions (metric tons/year)	60.515	0.010	0.001	61.103
Main Structure Electricity Consumptions (metric tons/year) Alt 1 Alt 3	285.754	0.046	0.006	288.533
Main Structure Electricity Consumptions (metric tons/year) Alt 2	233.434	0.038	0.005	235.704
Total Energy Emissions (metric tons/year) Alt1, Alt 3	**346.269**	**0.056**	**0.007**	**349.636**
Total Energy Emissions (metric tons/year) Alt2	**293.949**	**0.048**	**0.006**	**296.808**

Note:

Energy Consumption

North Structure	654,025	kwh/year	248,868	SF
Main Structure Alt 1	3,088,339	kwh/year	1,175,167	SF
Main Structure Alt 2	2,522,880	kwh/year	960,000	SF

Energy consumption rates are obtained from CalEEMod default for Bay Area:

2.628 kwh/SF

	CO2	CH4	N2O
GWP	1	28	265

Total GHG Emissions

		CO2	CH4	N2O	CO2e
		metric tons/year	metric tons/year	metric tons/year	metric tons/year
Construction	North Lot	867.7	0.0	0.1	885.3
	Main Lot with HP	4,063.9	0.2	0.3	4,156.6
	Main Lot with ACP	3,613.8	0.2	0.3	3,693.1
Operation	2025	39,258.6	23.5	32.4	40,061.2
	2035 No Build	30,861.6	16.1	46.7	31,394.5
	2035 Alt1	30,403.4	15.3	38.7	30,924.8
	2035 Alt2	30,744.8	16.1	44.9	31,278.3
	2050 No Build	49,805.2	19.0	125.3	50,418.3
	2050 Alt1	58,153.8	27.2	95.8	59,067.1
	2050 Alt2	55,097.3	26.6	84.1	55,997.8
Net Change from 2025 Existing Condition	2035 No Build	-8,396.9	-7.4	14.3	-8,666.8
	2035 Alt1	-4,791.2	-8.0	6.6	-4,979.9
	2035 Alt2	-8,513.8	-7.4	12.5	-8,782.9
	2050 No Build	10,546.6	-4.5	93.0	10,357.1
	2050 Alt1	18,895.2	3.7	63.5	19,005.9
	2050 Alt2	15,838.7	3.1	51.7	15,936.6
Net Change Compared to No Build	2035 No Build	NA	NA	NA	NA
	2035 Alt1	-458.2	-0.8	-8.0	-469.7
	2035 Alt2	-116.8	-0.1	-1.8	-116.1
	2050 No Build	NA	NA	NA	NA
	2050 Alt1	8,348.6	8.2	-29.5	8,648.8
	2050 Alt2	5,292.1	7.6	-41.2	5,579.5

Ferry Emissions

Total Daily crossings with large event Special Service and operating hours

	Min. Crossing per day	Max. crossing per day	Average Crossing (per day)	Hours per Crossing	Hours docking/Maneuvering	Hours per day	Average engine load
Existing	50	74	62	0.58	0.17	46.5	42%
No Build, Alt 1, 2, and 3 in 2035	48	76	62	0.58	0.17	46.5	42%
No Build 2050	48	76	62	0.58	0.17	46.5	42%
Alt 1,2, 3 in 2050	90	120	105	0.58	0.17	78.75	42%

Note:
Annual operating hours were estimated based on 362 days per year.
Engine load factors were based on EPA default load factors for harbor craft https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1014J1S.pdf

Emission Calculations

Rating	7290	hp	(Assumed the same average HP for both No Build and Alternatives 1,2, and 3)
Days of operation	362		

Existing

	POC	NOx	CO	PM10	PM2.5	CO2	CH4	N2O	CO2e
Engine Emission Factor (g/hp-hr)	1.00	6.90	8.50	0.40	0.40	659.07	0.42	0.01	673.74
Emissions per hour (lb/hr)	6.75	46.58	57.38	2.70	2.70	4,448.70	2.84	0.07	4,547.75
No Build emissions per day (lb/day)	313.88	2,165.74	2,667.94	125.55	125.55	206,864.52	131.90	3.44	211,470.44
No Build 1 emissions per year (ton/year)	56.81	392.00	482.90	22.72	22.72	37,442.48	23.87	0.62	38,276.15

Note: Emission factors assumed that the engines are Tier 1 on average.

No Build and Alt 1, 2, 3 2035

	POC	NOx	CO	PM10	PM2.5	CO2	CH4	N2O	CO2e
Engine Emission Factor (g/hp-hr)	0.14	1.30	3.73	0.01	0.01	648.00	0.41	0.01	662.43
Emissions per hour (lb/hr)	0.95	8.78	25.18	0.03	0.03	4,374.02	2.79	0.07	4,471.41
No Build emissions per day with anticipated fuel usage reduction (lb/day)	28.12	261.14	749.28	1.00	1.00	130,170.86	83.00	2.17	133,069.17
No Build 1 emissions per year with anticipated fuel usage reduction (ton/year)	5.09	47.27	135.62	0.18	0.18	23,560.93	15.02	0.39	24,085.52

Note: Emission factors assumed that the engines are Marine Engine Tier 4 with DPF

No Build 2050

	POC	NOx	CO	PM10	PM2.5	CO2	CH4	N2O	CO2e
Engine Emission Factor (g/hp-hr)	0.14	1.30	3.73	0.01	0.01	648.00	0.41	0.01	662.43
Emissions per hour (lb/hr)	0.95	8.78	25.18	0.03	0.03	4,374.02	2.79	0.07	4,471.41
No Build emissions per day with anticipated fuel usage reduction (lb/day)	28.12	261.14	749.28	1.00	1.00	130,170.86	83.00	2.17	133,069.17
No Build 1 emissions per year with anticipated fuel usage reduction (ton/year)	5.09	47.27	135.62	0.18	0.18	23,560.93	15.02	0.39	24,085.52

Note: Emission factors assumed that the engines are Marine Engine Tier 4 with DPF

Alternatives 1, 2, 3 2050

	POC	NOx	CO	PM10	PM2.5	CO2	CH4	N2O	CO2e
Engine Emission Factor (g/hp-hr)	0.14	1.30	3.73	0.01	0.01	648.00	0.41	0.01	662.43
Emissions per hour (lb/hr)	0.95	8.78	25.18	0.03	0.03	4,374.02	2.79	0.07	4,471.41
Alt 1,2,3 emissions per day with anticipated fuel usage reduction (lb/day)	47.63	442.26	1,268.95	1.70	1.70	220,450.65	140.56	3.67	225,359.08
Alt 1,2,3 emissions per year with anticipated fuel usage reduction (ton/year)	8.62	80.05	229.68	0.31	0.31	39,901.57	25.44	0.66	40,789.99

Note: Emission factors assumed that the engines are Marine Engine Tier 4 with DPF

Note
diesel density (lb/gal) 7.08 (SDS of No. 2 Diesel Fuel, bulk density)

	new engines 2035 and 2050		Existing Engines	
diesel	3230	g/gallon	3230	g/gallon
fuel consumption	205	g/kwh	208.5	g/kwh
	462.68	gallons/hr	470.58	gallons/hr
	0.0635	gallons/hp-hr	0.0646	gallons/hp-hr
Fuel Consumption scaling factor for improved operation efficiency	0.64		1	
Hourly fuel consumption	124	gallons/hr	198	gallons/hr

Note: Fuel consumption scaling factor represent the fuel usage reduction due to improved ship design and engine performance. It is anticipated that the fuel consumption by the ferries will be reduced by 30%.

GWP

CO2	1
CH4	28
N2O	265

Source: IPCC AR5.

GHG Emission Factors Post 2035

CO2	CH4	N2O	CO2e
kg/gallon Diesel	g/gallon Diesel	g/gallon Diesel	g/gallon Diesel
10.21	6.51	0.17	10437.33
g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr
648.003	0.413	0.011	662.431

GHG Emission Factors Tier 1 for Existing Condition

CO2	CH4	N2O	CO2e
kg/gallon Diesel	g/gallon Diesel	g/gallon Diesel	g/gallon Diesel
10.21	6.51	0.17	10437.33
g/hp-hr	g/hp-hr	g/hp-hr	g/hp-hr
659.067	0.420	0.011	673.741

Ferry Emissions - Daily

General	ROG	NOx	CO	PM10	PM2.5	**CO2**	CH4	N2O	CO2e
	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day
2025	313.875	2165.738	2667.938	125.550	125.550	206,864.52	131.90	3.44	211,470.44
2035 No Build	28.123	261.144	749.282	1.004	1.004	130,170.86	83.00	2.17	133,069.17
2035 Alt1	28.123	261.144	749.282	1.004	1.004	130,170.86	83.00	2.17	133,069.17
2035 Alt2	28.123	261.144	749.282	1.004	1.004	130,170.86	83.00	2.17	133,069.17
2035 Alt3	28.123	261.144	749.282	1.004	1.004	130,170.86	83.00	2.17	133,069.17
2050 No Build	28.123	261.144	749.282	1.004	1.004	130,170.86	83.00	2.17	133,069.17
2050 Alt1	47.628	442.260	1268.946	1.701	1.701	220,450.65	140.56	3.67	225,359.08
2050 Alt2	47.628	442.260	1268.946	1.701	1.701	220,450.65	140.56	3.67	225,359.08
2050 Alt3	47.628	442.260	1268.946	1.701	1.701	220,450.65	140.56	3.67	225,359.08

Ferry Emissions - Annual

General	ROG	NOx	CO	PM10	PM2.5	CO2	CH4	N2O	CO2e
	ton/year	ton/year	ton/year	ton/year	ton/year	metric ton/year	metric ton/year	metric ton/year	metric ton/year
2025	56.811	391.998	482.897	22.725	22.725	33,967.82	21.66	0.57	34,724.12
2035 No Build	5.090	47.267	135.620	0.182	0.182	21,374.47	13.63	0.36	21,850.38
2035 Alt1	5.090	47.267	135.620	0.182	0.182	21,374.47	13.63	0.36	21,850.38
2035 Alt2	5.090	47.267	135.620	0.182	0.182	21,374.47	13.63	0.36	21,850.38
2035 Alt3	5.090	47.267	135.620	0.182	0.182	21,374.47	13.63	0.36	21,850.38
2050 No Build	5.090	47.267	135.620	0.182	0.182	21,374.47	13.63	0.36	21,850.38
2050 Alt1	8.621	80.049	229.679	0.308	0.308	36,198.70	23.08	0.60	37,004.68
2050 Alt2	8.621	80.049	229.679	0.308	0.308	36,198.70	23.08	0.60	37,004.68
2050 Alt3	8.621	80.049	229.679	0.308	0.308	36,198.70	23.08	0.60	37,004.68

Vehicle Trips Emissions

Daily Trips & VMT

	Daily VMT	Daily VMT Transit	Total Daily VMT
2025	52,032	0	52,032
2035 No Build	112,121	195	112,316
2035 Alt1	109,956	195	110,151
2035 Alt2	107,100	286	107,386
2035 Alt3	101,796	459	102,255
2050 No Build	360,512	195	360,707
2050 Alt1	274,456	364	274,820
2050 Alt2	234,552	1,406	235,958
2050 Alt3	240,240	960	241,200

Note: Non-ferry driving trips refer to the unmet demand due to ferry capacity or parking constraints, and it's assumed 100% of these riders would drive to San Francisco.

VMT Distribution

Freeway	Arterial	Local
53%	40%	7%

Vehicle Emissions

General	ROG	NOx	CO	PM10	PM2.5	
	pounds/day	pounds/day	pounds/day	pounds/day	pounds/day	
2025	4.557	6.739	81.543	14.263	2.511	
2035 No Build	7.007	7.311	122.122	31.067	5.354	
2035 Alt1	5.619	5.159	106.142	30.481	5.203	
2035 Alt2	6.705	7.035	116.705	29.756	5.131	
2035 Alt3	5.226	4.802	98.328	28.434	4.859	
2050 No Build	18.391	16.879	347.821	99.650	17.002	
2050 Alt1	14.012	12.860	265.001	75.923	12.954	
2050 Alt2	12.065	11.090	226.736	65.719	11.235	
2050 Alt3	12.319	11.317	232.098	66.962	11.439	

Emissions are modeled using CT-EMFAC

CT-EMFAC Input

	Total Trip Distance (for EMFAC) Miles	Trip Distance Freeway (meters)	Trip Distance Arterial (meters)	Trip Distance local (meters)	# trips (for EMFAC)	Truck1 %
2025	9.6	8188.32	6179.87	1081.48	5420	0.00%
2035 No Build	10.2	8700.09	6566.11	1149.07	11011	0.17%
2035 Alt1	10.2	8700.09	6566.11	1149.07	10799	0.18%
2035 Alt2	10.2	8700.09	6566.11	1149.07	10528	0.27%
2035 Alt3	10.2	8700.09	6566.11	1149.07	10025	0.45%
2050 No Build	11.6	9894.22	7467.34	1306.78	31095	0.05%
2050 Alt1	11.6	9894.22	7467.34	1306.78	23691	0.13%
2050 Alt2	11.6	9894.22	7467.34	1306.78	20341	0.60%
2050 Alt3	11.6	9894.22	7467.34	1306.78	20793	0.40%

1609.34 meters/miles

Appendix B2. CalEEMod Output Files

Larkspur North Construction unmtg and mtg Custom Report

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5.7. Construction Paving
5.8. Construction Electricity Consumption and Emissions Factors
5.18. Vegetation

5.18.1. Land Use Change
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5.18.1.2. Mitigated
5.18.1. Biomass Cover Type
5.18.1.1. Unmitigated
5.18.1.2. Mitigated
5.18.2. Sequestration
5.18.2.1. Unmitigated
5.18.2.2. Mitigated
8. User Changes to Default Data
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8.3. Land Use
8.4. Construction
8.4.2. Off-Road Equipment
8.4.4. Dust from Material Movement
8.4.6. Trips and VMT
8.4.7. On-Road Fugitive Dust
8.4.8. Architectural Coatings
8.4.9. Paving

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Larkspur North Construction unmtg and mtg
Construction Start Date	3/1/2033
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.90000
Precipitation (days)	7.60000
Location	Larkspur Ferry Terminal, Larkspur, CA 94939, USA
County	Marin
City	Larkspur
Air District	Bay Area AQMD
Air Basin	San Francisco Bay Area
TAZ	905
EDFZ	2
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.45

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Unenclosed Parking Structure	1.02000	Acre	1.02000	248,868	0.00000	0.00000	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

Sector	#	Measure Title
Construction	C-5	Use Advanced Engine Tiers

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	28.7791	28.1719	20.6581	39.3804	0.10886	0.37144	10.6796	11.0510	0.34419	1.60801	1.95220	—	13,278.8	13,278.8	0.52992	0.69519	9.35400	13,508.5
Mit.	27.7474	27.3967	12.3176	50.0677	0.10889	0.18697	10.6796	10.8666	0.18402	1.60801	1.79203	—	13,281.6	13,281.6	0.53003	0.69521	9.35400	13,511.4
% Reduced	4%	3%	40%	-27%	—	50%	—	2%	47%	—	8%	—	> -0.5%	> -0.5%	—	—	—	> -0.5%
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Unmit.	1.32910	0.97545	9.08236	14.6418	0.04604	0.19432	9.11823	9.31255	0.18122	1.34335	1.49589	—	6,377.87	6,377.87	0.32237	0.43788	0.15784	6,516.57
Mit.	0.86340	0.61555	5.51552	18.2397	0.04605	0.08622	9.11823	9.20445	0.08491	1.34335	1.40121	—	6,378.33	6,378.33	0.32239	0.43788	0.15784	6,517.04
% Reduced	35%	37%	39%	-25%	—	56%	—	1%	53%	—	6%	—	> -0.5%	> -0.5%	—	—	—	> -0.5%
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	5.36529	5.22237	4.61469	8.34032	0.02361	0.08373	3.59771	3.66957	0.07774	0.52703	0.59404	—	2,894.96	2,894.96	0.12595	0.16948	0.99181	2,949.53
Mit.	5.14283	5.05421	2.61917	10.2722	0.02361	0.04049	3.59771	3.62906	0.03986	0.52703	0.55790	—	2,895.16	2,895.16	0.12596	0.16948	0.99181	2,949.73
% Reduced	4%	3%	43%	-23%	—	52%	—	1%	49%	—	6%	—	> -0.5%	> -0.5%	—	—	—	> -0.5%
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.97916	0.95308	0.84218	1.52211	0.00431	0.01528	0.65658	0.66970	0.01419	0.09618	0.10841	—	479.293	479.293	0.02085	0.02806	0.16421	488.329
Mit.	0.93857	0.92239	0.47800	1.87467	0.00431	0.00739	0.65658	0.66230	0.00728	0.09618	0.10182	—	479.327	479.327	0.02085	0.02806	0.16421	488.362
% Reduced	4%	3%	43%	-23%	—	52%	—	1%	49%	—	6%	—	> -0.5%	> -0.5%	> -0.5%	—	—	> -0.5%

2.2. Construction Emissions by Year

2.2.1. Total Construction Emissions by Year, Unmitigated

Includes both onsite and offsite emissions.

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	1.34880	0.98874	8.86473	15.2725	0.04604	0.19432	9.11823	9.31255	0.18122	1.31467	1.49589	—	6,463.36	6,463.36	0.32060	0.43658	6.07402	6,607.55
2034	28.7791	28.1719	20.6581	39.3804	0.10886	0.37144	10.6796	11.0510	0.34419	1.60801	1.95220	—	13,278.8	13,278.8	0.52992	0.69519	9.35400	13,508.5
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	1.32910	0.97545	9.08236	14.6418	0.04604	0.19432	9.11823	9.31255	0.18122	1.34335	1.49589	—	6,377.87	6,377.87	0.32237	0.43788	0.15784	6,516.57
2034	0.81675	0.59161	6.05617	9.81615	0.03119	0.12665	6.43340	6.56005	0.11806	0.82905	0.94711	—	4,046.24	4,046.24	0.21006	0.28027	0.08074	4,135.09
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.49521	0.36453	3.31648	5.25578	0.01658	0.07186	3.59771	3.66957	0.06701	0.52703	0.59404	—	2,345.68	2,345.68	0.11800	0.16029	0.99181	2,397.39
2034	5.36529	5.22237	4.61469	8.34032	0.02361	0.08373	3.10756	3.19129	0.07774	0.43211	0.50985	—	2,894.96	2,894.96	0.12595	0.16948	0.92180	2,949.53
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.09038	0.06653	0.60526	0.95918	0.00303	0.01311	0.65658	0.66970	0.01223	0.09618	0.10841	—	388.354	388.354	0.01954	0.02654	0.16421	396.915
2034	0.97916	0.95308	0.84218	1.52211	0.00431	0.01528	0.56713	0.58241	0.01419	0.07886	0.09305	—	479.293	479.293	0.02085	0.02806	0.15261	488.329

2.2.2. Onsite Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.83290	0.69576	5.46178	9.48776	0.02295	0.16422	1.07369	1.13712	0.15112	0.24972	0.31437	—	2,452.13	2,452.13	0.10169	0.02572	0.05076	2,462.39

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2034	28.1411	27.7752	16.3604	31.6478	0.06687	0.34102	1.05984	1.40086	0.31377	0.12542	0.43919	—	6,957.40	6,957.40	0.28324	0.06907	0.13912	6,985.21
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.83260	0.69559	5.46498	9.48879	0.02295	0.16422	1.62510	1.74615	0.15112	0.33354	0.44494	—	2,452.18	2,452.18	0.10169	0.02576	0.00147	2,462.40
2034	0.54571	0.45536	3.87660	7.10451	0.01643	0.10776	0.75033	0.85809	0.09918	0.07632	0.17550	—	1,771.84	1,771.84	0.07420	0.01940	0.00085	1,779.47
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.30659	0.25538	2.01390	3.28651	0.00823	0.06084	0.55173	0.61257	0.05599	0.09626	0.15226	—	878.467	878.467	0.03699	0.01047	0.01203	882.524
2034	5.21210	5.13521	3.46824	6.74208	0.01375	0.07510	0.37343	0.44853	0.06911	0.03946	0.10857	—	1,437.82	1,437.82	0.05925	0.01524	0.01394	1,443.86
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.05595	0.04661	0.36754	0.59979	0.00150	0.01110	0.10069	0.11179	0.01022	0.01757	0.02779	—	145.440	145.440	0.00612	0.00173	0.00199	146.112
2034	0.95121	0.93718	0.63295	1.23043	0.00251	0.01371	0.06815	0.08186	0.01261	0.00720	0.01981	—	238.048	238.048	0.00981	0.00252	0.00231	239.047

2.2.3. Offsite Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.51589	0.29298	3.40295	5.78470	0.02309	0.03011	8.20725	8.23736	0.03011	1.15142	1.18153	—	4,011.23	4,011.23	0.21892	0.41086	6.02326	4,145.16
2034	0.63801	0.39674	4.29769	7.73267	0.04200	0.03042	9.61976	9.65019	0.03042	1.48259	1.51302	—	6,321.36	6,321.36	0.24668	0.62612	9.21488	6,523.33
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2033	0.49650	0.27985	3.61737	5.15299	0.02309	0.03011	8.20725	8.23736	0.03011	1.15142	1.18153	—	3,925.68	3,925.68	0.22068	0.41212	0.15652	4,054.17
2034	0.27104	0.13625	2.17957	2.71164	0.01475	0.01889	5.68307	5.70196	0.01889	0.75273	0.77162	—	2,274.41	2,274.41	0.13586	0.26086	0.07988	2,355.62
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.18863	0.10915	1.30258	1.96927	0.00834	0.01102	3.04598	3.05700	0.01102	0.43076	0.44179	—	1,467.21	1,467.21	0.08101	0.14982	0.97978	1,514.86
2034	0.15318	0.08716	1.14646	1.59824	0.00986	0.00863	2.73413	2.74276	0.00863	0.39264	0.40127	—	1,457.13	1,457.13	0.06671	0.15424	0.90787	1,505.67
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.03442	0.01992	0.23772	0.35939	0.00152	0.00201	0.55589	0.55790	0.00201	0.07861	0.08063	—	242.914	242.914	0.01341	0.02480	0.16221	250.803
2034	0.02796	0.01591	0.20923	0.29168	0.00180	0.00158	0.49898	0.50055	0.00158	0.07166	0.07323	—	241.245	241.245	0.01104	0.02554	0.15031	249.281

2.2.4. Total Construction Emissions by Year, Mitigated

Includes both onsite and offsite emissions.

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.88310	0.62884	5.29790	18.8704	0.04605	0.08622	9.11823	9.20445	0.08491	1.31467	1.39958	—	6,463.82	6,463.82	0.32062	0.43658	6.07402	6,608.01
2034	27.7474	27.3967	12.3176	50.0677	0.10889	0.18697	10.6796	10.8666	0.18402	1.60801	1.79203	—	13,281.6	13,281.6	0.53003	0.69521	9.35400	13,511.4
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.86340	0.61555	5.51552	18.2397	0.04605	0.08622	9.11823	9.20445	0.08491	1.34335	1.40121	—	6,378.33	6,378.33	0.32239	0.43788	0.15784	6,517.04
2034	0.48828	0.33989	3.29248	12.4092	0.03119	0.05571	6.43340	6.48910	0.05523	0.82905	0.88427	—	4,046.26	4,046.26	0.21006	0.28027	0.08074	4,135.11

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.32266	0.23068	2.06920	6.58642	0.01658	0.03134	3.59771	3.62906	0.03088	0.52703	0.55790	—	2,345.84	2,345.84	0.11801	0.16029	0.99181	2,397.55
2034	5.14283	5.05421	2.61917	10.2722	0.02361	0.04049	3.10756	3.14805	0.03986	0.43211	0.47197	—	2,895.16	2,895.16	0.12596	0.16948	0.92180	2,949.73
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.05889	0.04210	0.37763	1.20202	0.00303	0.00572	0.65658	0.66230	0.00564	0.09618	0.10182	—	388.381	388.381	0.01954	0.02654	0.16421	396.941
2034	0.93857	0.92239	0.47800	1.87467	0.00431	0.00739	0.56713	0.57452	0.00728	0.07886	0.08613	—	479.327	479.327	0.02085	0.02806	0.15261	488.362

2.2.5. Onsite Construction Emissions by Year, Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.36720	0.33587	1.89495	13.0857	0.02296	0.05611	1.07369	1.08629	0.05481	0.24972	0.26212	—	2,452.59	2,452.59	0.10170	0.02572	0.05076	2,462.85
2034	27.1094	26.9999	8.01992	42.3350	0.06689	0.15655	1.05984	1.21639	0.15360	0.12542	0.27902	—	6,960.21	6,960.21	0.28336	0.06910	0.13912	6,988.03
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.36690	0.33570	2.59507	13.0867	0.02296	0.05611	1.62510	1.66338	0.05481	0.33354	0.37145	—	2,452.65	2,452.65	0.10170	0.02576	0.00147	2,462.87
2034	0.21725	0.20363	1.11291	9.69761	0.01643	0.03682	0.75033	0.78714	0.03634	0.07632	0.11266	—	1,771.85	1,771.85	0.07420	0.01940	0.00085	1,779.49
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.13404	0.12153	0.76662	4.61714	0.00824	0.02032	0.55173	0.57205	0.01985	0.09626	0.11612	—	878.629	878.629	0.03700	0.01047	0.01203	882.686
2034	4.98965	4.96705	1.47271	8.67393	0.01375	0.03186	0.37343	0.40529	0.03123	0.03946	0.07070	—	1,438.02	1,438.02	0.05925	0.01524	0.01394	1,444.06

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.02446	0.02218	0.13991	0.84263	0.00150	0.00371	0.10069	0.10440	0.00362	0.01757	0.02119	—	145.467	145.467	0.00613	0.00173	0.00199	146.139
2034	0.91061	0.90649	0.26877	1.58299	0.00251	0.00581	0.06815	0.07397	0.00570	0.00720	0.01290	—	238.081	238.081	0.00981	0.00252	0.00231	239.081

2.2.6. Offsite Construction Emissions by Year, Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.51589	0.29298	3.40295	5.78470	0.02309	0.03011	8.20725	8.23736	0.03011	1.15142	1.18153	—	4,011.23	4,011.23	0.21892	0.41086	6.02326	4,145.16
2034	0.63801	0.39674	4.29769	7.73267	0.04200	0.03042	9.61976	9.65019	0.03042	1.48259	1.51302	—	6,321.36	6,321.36	0.24668	0.62612	9.21488	6,523.33
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.49650	0.27985	3.61737	5.15299	0.02309	0.03011	8.20725	8.23736	0.03011	1.15142	1.18153	—	3,925.68	3,925.68	0.22068	0.41212	0.15652	4,054.17
2034	0.27104	0.13625	2.17957	2.71164	0.01475	0.01889	5.68307	5.70196	0.01889	0.75273	0.77162	—	2,274.41	2,274.41	0.13586	0.26086	0.07988	2,355.62
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.18863	0.10915	1.30258	1.96927	0.00834	0.01102	3.04598	3.05700	0.01102	0.43076	0.44179	—	1,467.21	1,467.21	0.08101	0.14982	0.97978	1,514.86
2034	0.15318	0.08716	1.14646	1.59824	0.00986	0.00863	2.73413	2.74276	0.00863	0.39264	0.40127	—	1,457.13	1,457.13	0.06671	0.15424	0.90787	1,505.67
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2033	0.03442	0.01992	0.23772	0.35939	0.00152	0.00201	0.55589	0.55790	0.00201	0.07861	0.08063	—	242.914	242.914	0.01341	0.02480	0.16221	250.803
2034	0.02796	0.01591	0.20923	0.29168	0.00180	0.00158	0.49898	0.50055	0.00158	0.07166	0.07323	—	241.245	241.245	0.01104	0.02554	0.15031	249.281

3. Construction Emissions Details

3.1. Phase 1 Site Prep (2033)

3.1.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.29042	0.24356	2.67855	2.37803	0.00872	0.05762	—	0.05762	0.05301	—	0.05301	—	927.034	927.034	0.03760	0.00752	—	930.216
Demolition	—	—	—	—	—	—	0.54793	0.54793	—	0.08297	0.08297	—	—	—	—	—	—	—
Onsite truck	0.00052	0.00032	0.00919	0.00536	0.00010	0.00000	0.00348	0.00348	0.00000	0.00084	0.00084	—	10.1442	10.1442	0.00020	0.00117	0.00044	10.4984
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01194	0.01001	0.11008	0.09773	0.00036	0.00237	—	0.00237	0.00218	—	0.00218	—	38.0973	38.0973	0.00155	0.00031	—	38.2280
Demolition	—	—	—	—	—	—	0.02252	0.02252	—	0.00341	0.00341	—	—	—	—	—	—	—
Onsite truck	0.00002	0.00001	0.00037	0.00021	< 0.000005	0.00000	0.00014	0.00014	0.00000	0.00003	0.00003	—	0.41672	0.41672	0.00001	0.00005	0.00030	0.43156

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00218	0.00183	0.02009	0.01784	0.00007	0.00043	—	0.00043	0.00040	—	0.00040	—	6.30744	6.30744	0.00026	0.00005	—	6.32909
Demolition	—	—	—	—	—	—	0.00411	0.00411	—	0.00062	0.00062	—	—	—	—	—	—	—
Onsite truck	< 0.000005	< 0.000005	0.00007	0.00004	< 0.000005	0.00000	0.00003	0.00003	0.00000	0.00001	0.00001	—	0.06899	0.06899	< 0.000005	0.00001	0.00005	0.07145

3.1.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10759	0.10494	0.11023	1.53706	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	595.010	595.010	0.00529	0.00265	0.03149	595.962
Vendor	0.00815	0.00444	0.17815	0.07037	0.00309	0.00000	0.10817	0.10817	0.00000	0.02627	0.02627	—	304.988	304.988	0.00370	0.03445	0.01377	315.359
Hauling	0.09630	0.02201	1.09871	0.70343	0.00596	0.01101	3.17440	3.18540	0.01101	0.35628	0.36728	—	755.154	755.154	0.07383	0.12106	0.02313	793.098
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00435	0.00428	0.00446	0.06262	0.00000	0.00000	0.02889	0.02889	0.00000	0.00677	0.00677	—	24.5585	24.5585	0.00022	0.00011	0.02151	24.6179
Vendor	0.00034	0.00019	0.00717	0.00283	0.00013	0.00000	0.00443	0.00443	0.00000	0.00107	0.00107	—	12.5327	12.5327	0.00015	0.00142	0.00941	12.9677
Hauling	0.00401	0.00092	0.04440	0.02874	0.00024	0.00045	0.12790	0.12836	0.00045	0.01438	0.01483	—	31.0225	31.0225	0.00303	0.00498	0.01585	32.5968

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00079	0.00078	0.00081	0.01143	0.00000	0.00000	0.00527	0.00527	0.00000	0.00124	0.00124	—	4.06595	4.06595	0.00004	0.00002	0.00356	4.07577
Vendor	0.00006	0.00004	0.00131	0.00052	0.00002	0.00000	0.00081	0.00081	0.00000	0.00020	0.00020	—	2.07493	2.07493	0.00003	0.00023	0.00156	2.14696
Hauling	0.00073	0.00017	0.00810	0.00524	0.00004	0.00008	0.02334	0.02343	0.00008	0.00262	0.00271	—	5.13613	5.13613	0.00050	0.00082	0.00262	5.39677

3.1.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11815	0.11221	2.00257	4.80836	0.00872	0.02568	—	0.02568	0.02551	—	0.02551	—	926.904	926.904	0.03760	0.00752	—	930.085
Demolition	—	—	—	—	—	—	0.54793	0.54793	—	0.08297	0.08297	—	—	—	—	—	—	—
Onsite truck	0.00052	0.00032	0.00919	0.00536	0.00010	0.00000	0.00348	0.00348	0.00000	0.00084	0.00084	—	10.1442	10.1442	0.00020	0.00117	0.00044	10.4984
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00486	0.00461	0.08230	0.19760	0.00036	0.00106	—	0.00106	0.00105	—	0.00105	—	38.0920	38.0920	0.00155	0.00031	—	38.2227
Demolition	—	—	—	—	—	—	0.02252	0.02252	—	0.00341	0.00341	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00002	0.00001	0.00037	0.00021	< 0.00005	0.00000	0.00014	0.00014	0.00000	0.00003	0.00003	—	0.41672	0.41672	0.00001	0.00005	0.00030	0.43156
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00089	0.00084	0.01502	0.03606	0.00007	0.00019	—	0.00019	0.00019	—	0.00019	—	6.30656	6.30656	0.00026	0.00005	—	6.32820
Demolition	—	—	—	—	—	—	0.00411	0.00411	—	0.00062	0.00062	—	—	—	—	—	—	—
Onsite truck	< 0.00005	< 0.00005	0.00007	0.00004	< 0.00005	0.00000	0.00003	0.00003	0.00000	0.00001	0.00001	—	0.06899	0.06899	< 0.00005	0.00001	0.00005	0.07145

3.1.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10759	0.10494	0.11023	1.53706	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	595.010	595.010	0.00529	0.00265	0.03149	595.962
Vendor	0.00815	0.00444	0.17815	0.07037	0.00309	0.00000	0.10817	0.10817	0.00000	0.02627	0.02627	—	304.988	304.988	0.00370	0.03445	0.01377	315.359
Hauling	0.09630	0.02201	1.09871	0.70343	0.00596	0.01101	3.17440	3.18540	0.01101	0.35628	0.36728	—	755.154	755.154	0.07383	0.12106	0.02313	793.098
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00435	0.00428	0.00446	0.06262	0.00000	0.00000	0.02889	0.02889	0.00000	0.00677	0.00677	—	24.5585	24.5585	0.00022	0.00011	0.02151	24.6179
Vendor	0.00034	0.00019	0.00717	0.00283	0.00013	0.00000	0.00443	0.00443	0.00000	0.00107	0.00107	—	12.5327	12.5327	0.00015	0.00142	0.00941	12.9677

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.00401	0.00092	0.04440	0.02874	0.00024	0.00045	0.12790	0.12836	0.00045	0.01438	0.01483	—	31.0225	31.0225	0.00303	0.00498	0.01585	32.5968
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00079	0.00078	0.00081	0.01143	0.00000	0.00000	0.00527	0.00527	0.00000	0.00124	0.00124	—	4.06595	4.06595	0.00004	0.00002	0.00356	4.07577
Vendor	0.00006	0.00004	0.00131	0.00052	0.00002	0.00000	0.00081	0.00081	0.00000	0.00020	0.00020	—	2.07493	2.07493	0.00003	0.00023	0.00156	2.14696
Hauling	0.00073	0.00017	0.00810	0.00524	0.00004	0.00008	0.02334	0.02343	0.00008	0.00262	0.00271	—	5.13613	5.13613	0.00050	0.00082	0.00262	5.39677

3.2. Phase 2 Earthwork (2033)

3.2.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.27536	0.23084	1.64814	1.95910	0.00534	0.06298	—	0.06298	0.05794	—	0.05794	—	559.602	559.602	0.02270	0.00454	—	561.523
Dust From Material Movement	—	—	—	—	—	—	0.32298	0.32298	—	0.17331	0.17331	—	—	—	—	—	—	—
Onsite truck	0.00015	0.00008	0.00194	0.00110	0.00002	0.00000	0.00077	0.00077	0.00000	0.00019	0.00019	—	2.25271	2.25271	0.00004	0.00026	0.00378	2.33511
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.27536	0.23084	1.64814	1.95910	0.00534	0.06298	—	0.06298	0.05794	—	0.05794	—	559.602	559.602	0.02270	0.00454	—	561.523
Dust From Material Movement	—	—	—	—	—	—	0.32298	0.32298	—	0.17331	0.17331	—	—	—	—	—	—	—
Onsite truck	0.00011	0.00007	0.00204	0.00119	0.00002	0.00000	0.00077	0.00077	0.00000	0.00019	0.00019	—	2.25426	2.25426	0.00004	0.00026	0.00010	2.33299
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02640	0.02214	0.15804	0.18786	0.00051	0.00604	—	0.00604	0.00556	—	0.00556	—	53.6605	53.6605	0.00218	0.00044	—	53.8446
Dust From Material Movement	—	—	—	—	—	—	0.03097	0.03097	—	0.01662	0.01662	—	—	—	—	—	—	—
Onsite truck	0.00001	0.00001	0.00019	0.00011	< 0.000005	0.00000	0.00007	0.00007	0.00000	0.00002	0.00002	—	0.21607	0.21607	< 0.000005	0.00002	0.00016	0.22377
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00482	0.00404	0.02884	0.03428	0.00009	0.00110	—	0.00110	0.00101	—	0.00101	—	8.88411	8.88411	0.00036	0.00007	—	8.91459
Dust From Material Movement	—	—	—	—	—	—	0.00565	0.00565	—	0.00303	0.00303	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	< 0.000005	< 0.000005	0.00003	0.00002	< 0.000005	0.00000	0.00001	0.00001	0.00000	< 0.000005	< 0.000005	—	0.03577	0.03577	< 0.000005	< 0.000005	0.00003	0.03705

3.2.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.11111	0.10935	0.08466	1.86247	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	638.468	638.468	0.00441	0.00265	1.21375	640.581
Vendor	0.00287	0.00117	0.04195	0.01756	0.00077	0.00000	0.02704	0.02704	0.00000	0.00657	0.00657	—	76.2366	76.2366	0.00093	0.00861	0.13241	78.9583
Hauling	0.07973	0.01900	0.85098	0.56595	0.00484	0.00894	2.57920	2.58814	0.00894	0.28947	0.29842	—	613.181	613.181	0.05999	0.09799	0.72246	644.604
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10759	0.10494	0.11023	1.53706	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	595.010	595.010	0.00529	0.00265	0.03149	595.962
Vendor	0.00204	0.00111	0.04454	0.01759	0.00077	0.00000	0.02704	0.02704	0.00000	0.00657	0.00657	—	76.2469	76.2469	0.00093	0.00861	0.00344	78.8396
Hauling	0.07824	0.01788	0.89270	0.57154	0.00484	0.00894	2.57920	2.58814	0.00894	0.28947	0.29842	—	613.562	613.562	0.05999	0.09836	0.01880	644.392
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01015	0.00998	0.01040	0.14612	0.00000	0.00000	0.06742	0.06742	0.00000	0.01580	0.01580	—	57.3033	57.3033	0.00051	0.00025	0.05018	57.4417
Vendor	0.00020	0.00011	0.00418	0.00165	0.00007	0.00000	0.00258	0.00258	0.00000	0.00063	0.00063	—	7.31073	7.31073	0.00009	0.00083	0.00549	7.56451
Hauling	0.00761	0.00175	0.08417	0.05448	0.00046	0.00086	0.24249	0.24334	0.00086	0.02727	0.02812	—	58.8135	58.8135	0.00575	0.00943	0.03004	61.7981
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00185	0.00182	0.00190	0.02667	0.00000	0.00000	0.01230	0.01230	0.00000	0.00288	0.00288	—	9.48721	9.48721	0.00008	0.00004	0.00831	9.51013

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00004	0.00002	0.00076	0.00030	0.00001	0.00000	0.00047	0.00047	0.00000	0.00011	0.00011	—	1.21038	1.21038	0.00001	0.00014	0.00091	1.25239
Hauling	0.00139	0.00032	0.01536	0.00994	0.00008	0.00016	0.04425	0.04441	0.00016	0.00498	0.00513	—	9.73725	9.73725	0.00095	0.00156	0.00497	10.2314

3.2.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.08745	0.08066	0.52131	2.90242	0.00534	0.01216	—	0.01216	0.01196	—	0.01196	—	559.602	559.602	0.02270	0.00454	—	561.523
Dust From Material Movement	—	—	—	—	—	—	0.32298	0.32298	—	0.17331	0.17331	—	—	—	—	—	—	—
Onsite truck	0.00015	0.00008	0.00194	0.00110	0.00002	0.00000	0.00077	0.00077	0.00000	0.00019	0.00019	—	2.25271	2.25271	0.00004	0.00026	0.00378	2.33511
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.08745	0.08066	0.52131	2.90242	0.00534	0.01216	—	0.01216	0.01196	—	0.01196	—	559.602	559.602	0.02270	0.00454	—	561.523
Dust From Material Movement	—	—	—	—	—	—	0.32298	0.32298	—	0.17331	0.17331	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00011	0.00007	0.00204	0.00119	0.00002	0.00000	0.00077	0.00077	0.00000	0.00019	0.00019	—	2.25426	2.25426	0.00004	0.00026	0.00010	2.33299
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00839	0.00773	0.04999	0.27831	0.00051	0.00117	—	0.00117	0.00115	—	0.00115	—	53.6605	53.6605	0.00218	0.00044	—	53.8446
Dust From Material Movement	—	—	—	—	—	—	0.03097	0.03097	—	0.01662	0.01662	—	—	—	—	—	—	—
Onsite truck	0.00001	0.00001	0.00019	0.00011	< 0.000005	0.00000	0.00007	0.00007	0.00000	0.00002	0.00002	—	0.21607	0.21607	< 0.000005	0.00002	0.00016	0.22377
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00153	0.00141	0.00912	0.05079	0.00009	0.00021	—	0.00021	0.00021	—	0.00021	—	8.88411	8.88411	0.00036	0.00007	—	8.91459
Dust From Material Movement	—	—	—	—	—	—	0.00565	0.00565	—	0.00303	0.00303	—	—	—	—	—	—	—
Onsite truck	< 0.000005	< 0.000005	0.00003	0.00002	< 0.000005	0.00000	0.00001	0.00001	0.00000	< 0.000005	< 0.000005	—	0.03577	0.03577	< 0.000005	< 0.000005	0.00003	0.03705

3.2.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.11111	0.10935	0.08466	1.86247	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	638.468	638.468	0.00441	0.00265	1.21375	640.581
Vendor	0.00287	0.00117	0.04195	0.01756	0.00077	0.00000	0.02704	0.02704	0.00000	0.00657	0.00657	—	76.2366	76.2366	0.00093	0.00861	0.13241	78.9583
Hauling	0.07973	0.01900	0.85098	0.56595	0.00484	0.00894	2.57920	2.58814	0.00894	0.28947	0.29842	—	613.181	613.181	0.05999	0.09799	0.72246	644.604
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10759	0.10494	0.11023	1.53706	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	595.010	595.010	0.00529	0.00265	0.03149	595.962
Vendor	0.00204	0.00111	0.04454	0.01759	0.00077	0.00000	0.02704	0.02704	0.00000	0.00657	0.00657	—	76.2469	76.2469	0.00093	0.00861	0.00344	78.8396
Hauling	0.07824	0.01788	0.89270	0.57154	0.00484	0.00894	2.57920	2.58814	0.00894	0.28947	0.29842	—	613.562	613.562	0.05999	0.09836	0.01880	644.392
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01015	0.00998	0.01040	0.14612	0.00000	0.00000	0.06742	0.06742	0.00000	0.01580	0.01580	—	57.3033	57.3033	0.00051	0.00025	0.05018	57.4417
Vendor	0.00020	0.00011	0.00418	0.00165	0.00007	0.00000	0.00258	0.00258	0.00000	0.00063	0.00063	—	7.31073	7.31073	0.00009	0.00083	0.00549	7.56451
Hauling	0.00761	0.00175	0.08417	0.05448	0.00046	0.00086	0.24249	0.24334	0.00086	0.02727	0.02812	—	58.8135	58.8135	0.00575	0.00943	0.03004	61.7981
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00185	0.00182	0.00190	0.02667	0.00000	0.00000	0.01230	0.01230	0.00000	0.00288	0.00288	—	9.48721	9.48721	0.00008	0.00004	0.00831	9.51013
Vendor	0.00004	0.00002	0.00076	0.00030	0.00001	0.00000	0.00047	0.00047	0.00000	0.00011	0.00011	—	1.21038	1.21038	0.00001	0.00014	0.00091	1.25239
Hauling	0.00139	0.00032	0.01536	0.00994	0.00008	0.00016	0.04425	0.04441	0.00016	0.00498	0.00513	—	9.73725	9.73725	0.00095	0.00156	0.00497	10.2314

3.3. Phase 3 Foundation (2033)

3.3.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.27703	0.23204	1.46686	2.36979	0.00644	0.05030	—	0.05030	0.04627	—	0.04627	—	671.593	671.593	0.02724	0.00545	—	673.898
Dust From Material Movement	—	—	—	—	—	—	0.15795	0.15795	—	0.08627	0.08627	—	—	—	—	—	—	—
Onsite truck	0.00051	0.00028	0.00677	0.00384	0.00008	0.00000	0.00270	0.00270	0.00000	0.00066	0.00066	—	7.88447	7.88447	0.00015	0.00091	0.01324	8.17290
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.27703	0.23204	1.46686	2.36979	0.00644	0.05030	—	0.05030	0.04627	—	0.04627	—	671.593	671.593	0.02724	0.00545	—	673.898
Dust From Material Movement	—	—	—	—	—	—	0.15795	0.15795	—	0.08627	0.08627	—	—	—	—	—	—	—
Onsite truck	0.00040	0.00025	0.00715	0.00417	0.00008	0.00000	0.00270	0.00270	0.00000	0.00066	0.00066	—	7.88992	7.88992	0.00015	0.00091	0.00034	8.16545
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.10019	0.08392	0.53048	0.85702	0.00233	0.01819	—	0.01819	0.01673	—	0.01673	—	242.877	242.877	0.00985	0.00197	—	243.711
Dust From Material Movement	—	—	—	—	—	—	0.05712	0.05712	—	0.03120	0.03120	—	—	—	—	—	—	—
Onsite truck	0.00015	0.00010	0.00253	0.00143	0.00003	0.00000	0.00097	0.00097	0.00000	0.00024	0.00024	—	2.85218	2.85218	0.00006	0.00033	0.00207	2.95378
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01828	0.01531	0.09681	0.15641	0.00043	0.00332	—	0.00332	0.00305	—	0.00305	—	40.2111	40.2111	0.00163	0.00033	—	40.3491
Dust From Material Movement	—	—	—	—	—	—	0.01042	0.01042	—	0.00569	0.00569	—	—	—	—	—	—	—
Onsite truck	0.00003	0.00002	0.00046	0.00026	0.00001	0.00000	0.00018	0.00018	0.00000	0.00004	0.00004	—	0.47221	0.47221	0.00001	0.00005	0.00034	0.48903

3.3.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.11111	0.10935	0.08466	1.86247	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	638.468	638.468	0.00441	0.00265	1.21375	640.581
Vendor	0.00841	0.00343	0.12284	0.05143	0.00226	0.00000	0.07920	0.07920	0.00000	0.01923	0.01923	—	223.264	223.264	0.00271	0.02522	0.38777	231.235

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.10002	0.02384	1.06750	0.70995	0.00608	0.01122	1.73844	1.74966	0.01122	0.21385	0.22506	—	769.197	769.197	0.07525	0.12292	0.90629	808.615
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10759	0.10494	0.11023	1.53706	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	595.010	595.010	0.00529	0.00265	0.03149	595.962
Vendor	0.00597	0.00325	0.13043	0.05152	0.00226	0.00000	0.07920	0.07920	0.00000	0.01923	0.01923	—	223.294	223.294	0.00271	0.02522	0.01008	230.888
Hauling	0.09815	0.02243	1.11984	0.71696	0.00608	0.01122	1.73844	1.74966	0.01122	0.21385	0.22506	—	769.676	769.676	0.07525	0.12339	0.02358	808.350
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03827	0.03763	0.03923	0.55109	0.00000	0.00000	0.25427	0.25427	0.00000	0.05958	0.05958	—	216.115	216.115	0.00191	0.00096	0.18926	216.637
Vendor	0.00219	0.00124	0.04619	0.01821	0.00082	0.00000	0.02851	0.02851	0.00000	0.00692	0.00692	—	80.7463	80.7463	0.00098	0.00912	0.06065	83.5493
Hauling	0.03600	0.00828	0.39822	0.25776	0.00220	0.00406	0.61710	0.62116	0.00406	0.07613	0.08019	—	278.248	278.248	0.02721	0.04462	0.14212	292.368
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00698	0.00687	0.00716	0.10057	0.00000	0.00000	0.04640	0.04640	0.00000	0.01087	0.01087	—	35.7803	35.7803	0.00032	0.00016	0.03133	35.8668
Vendor	0.00040	0.00023	0.00843	0.00332	0.00015	0.00000	0.00520	0.00520	0.00000	0.00126	0.00126	—	13.3685	13.3685	0.00016	0.00151	0.01004	13.8325
Hauling	0.00657	0.00151	0.07268	0.04704	0.00040	0.00074	0.11262	0.11336	0.00074	0.01389	0.01463	—	46.0671	46.0671	0.00451	0.00739	0.02353	48.4049

3.3.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.14824	0.13097	0.76801	3.38268	0.00645	0.01873	—	0.01873	0.01795	—	0.01795	—	672.038	672.038	0.02726	0.00545	—	674.344
Dust From Material Movement	—	—	—	—	—	—	0.15795	0.15795	—	0.08627	0.08627	—	—	—	—	—	—	—
Onsite truck	0.00051	0.00028	0.00677	0.00384	0.00008	0.00000	0.00270	0.00270	0.00000	0.00066	0.00066	—	7.88447	7.88447	0.00015	0.00091	0.01324	8.17290
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.14824	0.13097	0.76801	3.38268	0.00645	0.01873	—	0.01873	0.01795	—	0.01795	—	672.038	672.038	0.02726	0.00545	—	674.344
Dust From Material Movement	—	—	—	—	—	—	0.15795	0.15795	—	0.08627	0.08627	—	—	—	—	—	—	—
Onsite truck	0.00040	0.00025	0.00715	0.00417	0.00008	0.00000	0.00270	0.00270	0.00000	0.00066	0.00066	—	7.88992	7.88992	0.00015	0.00091	0.00034	8.16545
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05361	0.04736	0.27775	1.22332	0.00233	0.00678	—	0.00678	0.00649	—	0.00649	—	243.038	243.038	0.00986	0.00197	—	243.872
Dust From Material Movement	—	—	—	—	—	—	0.05712	0.05712	—	0.03120	0.03120	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00015	0.00010	0.00253	0.00143	0.00003	0.00000	0.00097	0.00097	0.00000	0.00024	0.00024	—	2.85218	2.85218	0.00006	0.00033	0.00207	2.95378
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00978	0.00864	0.05069	0.22326	0.00043	0.00124	—	0.00124	0.00118	—	0.00118	—	40.2378	40.2378	0.00163	0.00033	—	40.3759
Dust From Material Movement	—	—	—	—	—	—	0.01042	0.01042	—	0.00569	0.00569	—	—	—	—	—	—	—
Onsite truck	0.00003	0.00002	0.00046	0.00026	0.00001	0.00000	0.00018	0.00018	0.00000	0.00004	0.00004	—	0.47221	0.47221	0.00001	0.00005	0.00034	0.48903

3.3.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.11111	0.10935	0.08466	1.86247	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	638.468	638.468	0.00441	0.00265	1.21375	640.581
Vendor	0.00841	0.00343	0.12284	0.05143	0.00226	0.00000	0.07920	0.07920	0.00000	0.01923	0.01923	—	223.264	223.264	0.00271	0.02522	0.38777	231.235
Hauling	0.10002	0.02384	1.06750	0.70995	0.00608	0.01122	1.73844	1.74966	0.01122	0.21385	0.22506	—	769.197	769.197	0.07525	0.12292	0.90629	808.615
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10759	0.10494	0.11023	1.53706	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	595.010	595.010	0.00529	0.00265	0.03149	595.962
Vendor	0.00597	0.00325	0.13043	0.05152	0.00226	0.00000	0.07920	0.07920	0.00000	0.01923	0.01923	—	223.294	223.294	0.00271	0.02522	0.01008	230.888

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.09815	0.02243	1.11984	0.71696	0.00608	0.01122	1.73844	1.74966	0.01122	0.21385	0.22506	—	769.676	769.676	0.07525	0.12339	0.02358	808.350
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03827	0.03763	0.03923	0.55109	0.00000	0.00000	0.25427	0.25427	0.00000	0.05958	0.05958	—	216.115	216.115	0.00191	0.00096	0.18926	216.637
Vendor	0.00219	0.00124	0.04619	0.01821	0.00082	0.00000	0.02851	0.02851	0.00000	0.00692	0.00692	—	80.7463	80.7463	0.00098	0.00912	0.06065	83.5493
Hauling	0.03600	0.00828	0.39822	0.25776	0.00220	0.00406	0.61710	0.62116	0.00406	0.07613	0.08019	—	278.248	278.248	0.02721	0.04462	0.14212	292.368
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00698	0.00687	0.00716	0.10057	0.00000	0.00000	0.04640	0.04640	0.00000	0.01087	0.01087	—	35.7803	35.7803	0.00032	0.00016	0.03133	35.8668
Vendor	0.00040	0.00023	0.00843	0.00332	0.00015	0.00000	0.00520	0.00520	0.00000	0.00126	0.00126	—	13.3685	13.3685	0.00016	0.00151	0.01004	13.8325
Hauling	0.00657	0.00151	0.07268	0.04704	0.00040	0.00074	0.11262	0.11336	0.00074	0.01389	0.01463	—	46.0671	46.0671	0.00451	0.00739	0.02353	48.4049

3.4. Phase 4 Super Structureng Construction (2033)

3.4.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.54987	0.46177	3.92999	7.07376	0.01616	0.11348	—	0.11348	0.10440	—	0.10440	—	1,739.53	1,739.53	0.07056	0.01411	—	1,745.50
Onsite truck	0.00007	0.00004	0.00097	0.00055	0.00001	0.00000	0.00039	0.00039	0.00000	0.00009	0.00009	—	1.12635	1.12635	0.00002	0.00013	0.00189	1.16756

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.54987	0.46177	3.92999	7.07376	0.01616	0.11348	—	0.11348	0.10440	—	0.10440	—	1,739.53	1,739.53	0.07056	0.01411	—	1,745.50
Onsite truck	0.00006	0.00004	0.00102	0.00060	0.00001	0.00000	0.00039	0.00039	0.00000	0.00009	0.00009	—	1.12713	1.12713	0.00002	0.00013	0.00005	1.16649
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.16464	0.13826	1.17669	2.11798	0.00484	0.03398	—	0.03398	0.03126	—	0.03126	—	520.838	520.838	0.02113	0.00423	—	522.625
Onsite truck	0.00002	0.00001	0.00030	0.00017	< 0.000005	0.00000	0.00012	0.00012	0.00000	0.00003	0.00003	—	0.33734	0.33734	0.00001	0.00004	0.00024	0.34936
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03005	0.02523	0.21475	0.38653	0.00088	0.00620	—	0.00620	0.00570	—	0.00570	—	86.2306	86.2306	0.00350	0.00070	—	86.5265
Onsite truck	< 0.000005	< 0.000005	0.00005	0.00003	< 0.000005	0.00000	0.00002	0.00002	0.00000	0.00001	0.00001	—	0.05585	0.05585	< 0.000005	0.00001	0.00004	0.05784

3.4.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.11111	0.10935	0.08466	1.86247	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	638.468	638.468	0.00441	0.00265	1.21375	640.581

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.01681	0.00687	0.24568	0.10286	0.00452	0.00000	0.15840	0.15840	0.00000	0.03847	0.03847	—	446.529	446.529	0.00542	0.05044	0.77554	462.470
Hauling	0.16843	0.04014	1.79762	1.19553	0.01023	0.01889	4.81814	4.83703	0.01889	0.54865	0.56754	—	1,295.30	1,295.30	0.12672	0.20699	1.52615	1,361.68
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10759	0.10494	0.11023	1.53706	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	595.010	595.010	0.00529	0.00265	0.03149	595.962
Vendor	0.01193	0.00651	0.26086	0.10304	0.00452	0.00000	0.15840	0.15840	0.00000	0.03847	0.03847	—	446.589	446.589	0.00542	0.05044	0.02016	461.775
Hauling	0.16528	0.03778	1.88577	1.20734	0.01023	0.01889	4.81814	4.83703	0.01889	0.54865	0.56754	—	1,296.10	1,296.10	0.12672	0.20778	0.03971	1,361.23
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03168	0.03116	0.03248	0.45626	0.00000	0.00000	0.21051	0.21051	0.00000	0.04933	0.04933	—	178.927	178.927	0.00158	0.00079	0.15669	179.359
Vendor	0.00363	0.00206	0.07648	0.03015	0.00135	0.00000	0.04721	0.04721	0.00000	0.01147	0.01147	—	133.703	133.703	0.00162	0.01510	0.10043	138.345
Hauling	0.05019	0.01155	0.55520	0.35937	0.00306	0.00566	1.41466	1.42031	0.00566	0.16142	0.16707	—	387.931	387.931	0.03794	0.06221	0.19815	407.617
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00578	0.00569	0.00593	0.08327	0.00000	0.00000	0.03842	0.03842	0.00000	0.00900	0.00900	—	29.6233	29.6233	0.00026	0.00013	0.02594	29.6949
Vendor	0.00066	0.00038	0.01396	0.00550	0.00025	0.00000	0.00862	0.00862	0.00000	0.00209	0.00209	—	22.1361	22.1361	0.00027	0.00250	0.01663	22.9045
Hauling	0.00916	0.00211	0.10132	0.06559	0.00056	0.00103	0.25818	0.25921	0.00103	0.02946	0.03049	—	64.2263	64.2263	0.00628	0.01030	0.03281	67.4856

3.4.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.21296	0.20295	1.06201	9.65883	0.01616	0.03694	—	0.03694	0.03642	—	0.03642	—	1,739.55	1,739.55	0.07056	0.01411	—	1,745.52
Onsite truck	0.00007	0.00004	0.00097	0.00055	0.00001	0.00000	0.00039	0.00039	0.00000	0.00009	0.00009	—	1.12635	1.12635	0.00002	0.00013	0.00189	1.16756
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.21296	0.20295	1.06201	9.65883	0.01616	0.03694	—	0.03694	0.03642	—	0.03642	—	1,739.55	1,739.55	0.07056	0.01411	—	1,745.52
Onsite truck	0.00006	0.00004	0.00102	0.00060	0.00001	0.00000	0.00039	0.00039	0.00000	0.00009	0.00009	—	1.12713	1.12713	0.00002	0.00013	0.00005	1.16649
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06376	0.06077	0.31798	2.89198	0.00484	0.01106	—	0.01106	0.01090	—	0.01090	—	520.844	520.844	0.02113	0.00423	—	522.631
Onsite truck	0.00002	0.00001	0.00030	0.00017	< 0.000005	0.00000	0.00012	0.00012	0.00000	0.00003	0.00003	—	0.33734	0.33734	0.00001	0.00004	0.00024	0.34936
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01164	0.01109	0.05803	0.52779	0.00088	0.00202	—	0.00202	0.00199	—	0.00199	—	86.2316	86.2316	0.00350	0.00070	—	86.5275
Onsite truck	< 0.000005	< 0.000005	0.00005	0.00003	< 0.000005	0.00000	0.00002	0.00002	0.00000	0.00001	0.00001	—	0.05585	0.05585	< 0.000005	0.00001	0.00004	0.05784

3.4.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.11111	0.10935	0.08466	1.86247	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	638.468	638.468	0.00441	0.00265	1.21375	640.581
Vendor	0.01681	0.00687	0.24568	0.10286	0.00452	0.00000	0.15840	0.15840	0.00000	0.03847	0.03847	—	446.529	446.529	0.00542	0.05044	0.77554	462.470
Hauling	0.16843	0.04014	1.79762	1.19553	0.01023	0.01889	4.81814	4.83703	0.01889	0.54865	0.56754	—	1,295.30	1,295.30	0.12672	0.20699	1.52615	1,361.68
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10759	0.10494	0.11023	1.53706	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	595.010	595.010	0.00529	0.00265	0.03149	595.962
Vendor	0.01193	0.00651	0.26086	0.10304	0.00452	0.00000	0.15840	0.15840	0.00000	0.03847	0.03847	—	446.589	446.589	0.00542	0.05044	0.02016	461.775
Hauling	0.16528	0.03778	1.88577	1.20734	0.01023	0.01889	4.81814	4.83703	0.01889	0.54865	0.56754	—	1,296.10	1,296.10	0.12672	0.20778	0.03971	1,361.23
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03168	0.03116	0.03248	0.45626	0.00000	0.00000	0.21051	0.21051	0.00000	0.04933	0.04933	—	178.927	178.927	0.00158	0.00079	0.15669	179.359
Vendor	0.00363	0.00206	0.07648	0.03015	0.00135	0.00000	0.04721	0.04721	0.00000	0.01147	0.01147	—	133.703	133.703	0.00162	0.01510	0.10043	138.345
Hauling	0.05019	0.01155	0.55520	0.35937	0.00306	0.00566	1.41466	1.42031	0.00566	0.16142	0.16707	—	387.931	387.931	0.03794	0.06221	0.19815	407.617
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00578	0.00569	0.00593	0.08327	0.00000	0.00000	0.03842	0.03842	0.00000	0.00900	0.00900	—	29.6233	29.6233	0.00026	0.00013	0.02594	29.6949
Vendor	0.00066	0.00038	0.01396	0.00550	0.00025	0.00000	0.00862	0.00862	0.00000	0.00209	0.00209	—	22.1361	22.1361	0.00027	0.00250	0.01663	22.9045
Hauling	0.00916	0.00211	0.10132	0.06559	0.00056	0.00103	0.25818	0.25921	0.00103	0.02946	0.03049	—	64.2263	64.2263	0.00628	0.01030	0.03281	67.4856

3.5. Phase 4 Super Structureng Construction (2034)

3.5.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.54067	0.45405	3.81709	7.06461	0.01616	0.10732	—	0.10732	0.09873	—	0.09873	—	1,739.53	1,739.53	0.07056	0.01411	—	1,745.50
Onsite truck	0.00006	0.00004	0.00090	0.00052	0.00001	0.00000	0.00039	0.00039	0.00000	0.00009	0.00009	—	1.07311	1.07311	0.00002	0.00013	0.00169	1.11411
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.54067	0.45405	3.81709	7.06461	0.01616	0.10732	—	0.10732	0.09873	—	0.09873	—	1,739.53	1,739.53	0.07056	0.01411	—	1,745.50
Onsite truck	0.00006	0.00004	0.00095	0.00057	0.00001	0.00000	0.00039	0.00039	0.00000	0.00009	0.00009	—	1.07395	1.07395	0.00002	0.00013	0.00004	1.11331
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.22537	0.18926	1.59108	2.94474	0.00674	0.04473	—	0.04473	0.04116	—	0.04116	—	725.089	725.089	0.02941	0.00588	—	727.577
Onsite truck	0.00002	0.00001	0.00039	0.00023	< 0.000005	0.00000	0.00016	0.00016	0.00000	0.00004	0.00004	—	0.44745	0.44745	0.00001	0.00005	0.00030	0.46414
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.04113	0.03454	0.29037	0.53742	0.00123	0.00816	—	0.00816	0.00751	—	0.00751	—	120.047	120.047	0.00487	0.00097	—	120.459

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	< 0.00005	< 0.00005	0.00007	0.00004	< 0.00005	0.00000	0.00003	0.00003	0.00000	0.00001	0.00001	—	0.07408	0.07408	< 0.00005	0.00001	0.00005	0.07684

3.5.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10494	0.10318	0.08378	1.78574	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	630.553	630.553	0.00441	0.00265	1.05297	632.504
Vendor	0.01211	0.00669	0.22182	0.09292	0.00452	0.00000	0.15840	0.15840	0.00000	0.03847	0.03847	—	424.812	424.812	0.00542	0.05044	0.69153	440.669
Hauling	0.15820	0.03069	1.73466	1.14909	0.01023	0.01889	4.81814	4.83703	0.01889	0.54865	0.56754	—	1,261.03	1,261.03	0.12593	0.20699	1.33572	1,327.20
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10406	0.10141	0.10935	1.45505	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	587.656	587.656	0.00529	0.00265	0.02727	588.604
Vendor	0.01193	0.00651	0.23718	0.09726	0.00452	0.00000	0.15840	0.15840	0.00000	0.03847	0.03847	—	424.877	424.877	0.00542	0.05044	0.01790	440.061
Hauling	0.15505	0.02833	1.83304	1.15933	0.01023	0.01889	4.81814	4.83703	0.01889	0.54865	0.56754	—	1,261.87	1,261.87	0.12514	0.20778	0.03471	1,326.95
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.04227	0.04154	0.03602	0.60173	0.00000	0.00000	0.29307	0.29307	0.00000	0.06867	0.06867	—	246.012	246.012	0.00184	0.00110	0.18923	246.576
Vendor	0.00497	0.00271	0.09660	0.03971	0.00188	0.00000	0.06573	0.06573	0.00000	0.01596	0.01596	—	177.086	177.086	0.00226	0.02102	0.12419	183.532
Hauling	0.06561	0.01214	0.75061	0.48094	0.00426	0.00787	1.96943	1.97730	0.00787	0.22472	0.23259	—	525.782	525.782	0.05249	0.08628	0.24038	553.047
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00771	0.00758	0.00657	0.10982	0.00000	0.00000	0.05348	0.05348	0.00000	0.01253	0.01253	—	40.7301	40.7301	0.00030	0.00018	0.03133	40.8234

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00091	0.00050	0.01763	0.00725	0.00034	0.00000	0.01200	0.01200	0.00000	0.00291	0.00291	—	29.3187	29.3187	0.00037	0.00348	0.02056	30.3858
Hauling	0.01197	0.00222	0.13699	0.08777	0.00078	0.00144	0.35942	0.36086	0.00144	0.04101	0.04245	—	87.0492	87.0492	0.00869	0.01428	0.03980	91.5632

3.5.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.21221	0.20232	1.05340	9.65771	0.01616	0.03638	—	0.03638	0.03590	—	0.03590	—	1,739.55	1,739.55	0.07056	0.01411	—	1,745.52
Onsite truck	0.00006	0.00004	0.00090	0.00052	0.00001	0.00000	0.00039	0.00039	0.00000	0.00009	0.00009	—	1.07311	1.07311	0.00002	0.00013	0.00169	1.11411
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.21221	0.20232	1.05340	9.65771	0.01616	0.03638	—	0.03638	0.03590	—	0.03590	—	1,739.55	1,739.55	0.07056	0.01411	—	1,745.52
Onsite truck	0.00006	0.00004	0.00095	0.00057	0.00001	0.00000	0.00039	0.00039	0.00000	0.00009	0.00009	—	1.07395	1.07395	0.00002	0.00013	0.00004	1.11331
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.08845	0.08433	0.43909	4.02562	0.00674	0.01516	—	0.01516	0.01496	—	0.01496	—	725.097	725.097	0.02941	0.00588	—	727.585
Onsite truck	0.00002	0.00001	0.00039	0.00023	< 0.000005	0.00000	0.00016	0.00016	0.00000	0.00004	0.00004	—	0.44745	0.44745	0.00001	0.00005	0.00030	0.46414

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01614	0.01539	0.08013	0.73468	0.00123	0.00277	—	0.00277	0.00273	—	0.00273	—	120.048	120.048	0.00487	0.00097	—	120.460
Onsite truck	< 0.00005	< 0.00005	0.00007	0.00004	< 0.00005	0.00000	0.00003	0.00003	0.00000	0.00001	0.00001	—	0.07408	0.07408	< 0.00005	0.00001	0.00005	0.07684

3.5.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10494	0.10318	0.08378	1.78574	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	630.553	630.553	0.00441	0.00265	1.05297	632.504
Vendor	0.01211	0.00669	0.22182	0.09292	0.00452	0.00000	0.15840	0.15840	0.00000	0.03847	0.03847	—	424.812	424.812	0.00542	0.05044	0.69153	440.669
Hauling	0.15820	0.03069	1.73466	1.14909	0.01023	0.01889	4.81814	4.83703	0.01889	0.54865	0.56754	—	1,261.03	1,261.03	0.12593	0.20699	1.33572	1,327.20
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10406	0.10141	0.10935	1.45505	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	587.656	587.656	0.00529	0.00265	0.02727	588.604
Vendor	0.01193	0.00651	0.23718	0.09726	0.00452	0.00000	0.15840	0.15840	0.00000	0.03847	0.03847	—	424.877	424.877	0.00542	0.05044	0.01790	440.061
Hauling	0.15505	0.02833	1.83304	1.15933	0.01023	0.01889	4.81814	4.83703	0.01889	0.54865	0.56754	—	1,261.87	1,261.87	0.12514	0.20778	0.03471	1,326.95
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.04227	0.04154	0.03602	0.60173	0.00000	0.00000	0.29307	0.29307	0.00000	0.06867	0.06867	—	246.012	246.012	0.00184	0.00110	0.18923	246.576
Vendor	0.00497	0.00271	0.09660	0.03971	0.00188	0.00000	0.06573	0.06573	0.00000	0.01596	0.01596	—	177.086	177.086	0.00226	0.02102	0.12419	183.532

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.06561	0.01214	0.75061	0.48094	0.00426	0.00787	1.96943	1.97730	0.00787	0.22472	0.23259	—	525.782	525.782	0.05249	0.08628	0.24038	553.047
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00771	0.00758	0.00657	0.10982	0.00000	0.00000	0.05348	0.05348	0.00000	0.01253	0.01253	—	40.7301	40.7301	0.00030	0.00018	0.03133	40.8234
Vendor	0.00091	0.00050	0.01763	0.00725	0.00034	0.00000	0.01200	0.01200	0.00000	0.00291	0.00291	—	29.3187	29.3187	0.00037	0.00348	0.02056	30.3858
Hauling	0.01197	0.00222	0.13699	0.08777	0.00078	0.00144	0.35942	0.36086	0.00144	0.04101	0.04245	—	87.0492	87.0492	0.00869	0.01428	0.03980	91.5632

3.6. Phase dust control (2033)

3.6.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00542	0.00163	0.05719	0.03982	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	31.9969	31.9969	0.00370	0.00511	0.03562	33.6493
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00525	0.00150	0.05997	0.04048	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	32.0420	32.0420	0.00370	0.00516	0.00093	33.6729
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00322	0.00092	0.03522	0.02400	0.00016	0.00026	0.43982	0.44008	0.00026	0.04472	0.04498	—	19.1719	19.1719	0.00222	0.00309	0.00925	20.1572
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00059	0.00017	0.00643	0.00438	0.00003	0.00005	0.08027	0.08031	0.00005	0.00816	0.00821	—	3.17413	3.17413	0.00037	0.00051	0.00153	3.33725

3.6.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.6.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00542	0.00163	0.05719	0.03982	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	31.9969	31.9969	0.00370	0.00511	0.03562	33.6493
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00525	0.00150	0.05997	0.04048	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	32.0420	32.0420	0.00370	0.00516	0.00093	33.6729
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00322	0.00092	0.03522	0.02400	0.00016	0.00026	0.43982	0.44008	0.00026	0.04472	0.04498	—	19.1719	19.1719	0.00222	0.00309	0.00925	20.1572
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00059	0.00017	0.00643	0.00438	0.00003	0.00005	0.08027	0.08031	0.00005	0.00816	0.00821	—	3.17413	3.17413	0.00037	0.00051	0.00153	3.33725

3.6.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.7. Phase dust control (2034)

3.7.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00516	0.00141	0.05551	0.03876	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	31.1817	31.1817	0.00366	0.00511	0.03118	32.8285
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00498	0.00128	0.05855	0.03933	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	31.2289	31.2289	0.00362	0.00516	0.00081	32.8574
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00244	0.00063	0.02739	0.01863	0.00013	0.00021	0.35070	0.35091	0.00021	0.03566	0.03587	—	14.8986	14.8986	0.00175	0.00244	0.00643	15.6765
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00045	0.00012	0.00500	0.00340	0.00002	0.00004	0.06400	0.06404	0.00004	0.00651	0.00655	—	2.46663	2.46663	0.00029	0.00040	0.00106	2.59542

3.7.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.7.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00516	0.00141	0.05551	0.03876	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	31.1817	31.1817	0.00366	0.00511	0.03118	32.8285
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00498	0.00128	0.05855	0.03933	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	31.2289	31.2289	0.00362	0.00516	0.00081	32.8574
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00244	0.00063	0.02739	0.01863	0.00013	0.00021	0.35070	0.35091	0.00021	0.03566	0.03587	—	14.8986	14.8986	0.00175	0.00244	0.00643	15.6765
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00045	0.00012	0.00500	0.00340	0.00002	0.00004	0.06400	0.06404	0.00004	0.00651	0.00655	—	2.46663	2.46663	0.00029	0.00040	0.00106	2.59542

3.7.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.8. Phase 5 Parking Lot Improvements (2034)

3.8.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.61135	0.51310	3.74837	6.16480	0.02002	0.10746	—	0.10746	0.09886	—	0.09886	—	2,145.24	2,145.24	0.08702	0.01740	—	2,152.61

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Demolition	—	—	—	—	—	—	0.28518	0.28518	—	0.04318	0.04318	—	—	—	—	—	—	—
Paving	0.07642	0.07642	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00083	0.00052	0.01256	0.00722	0.00015	0.00000	0.00541	0.00541	0.00000	0.00131	0.00131	—	15.0236	15.0236	0.00031	0.00182	0.02361	15.5976
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.04020	0.03374	0.24647	0.40536	0.00132	0.00707	—	0.00707	0.00650	—	0.00650	—	141.057	141.057	0.00572	0.00114	—	141.541
Demolition	—	—	—	—	—	—	0.01875	0.01875	—	0.00284	0.00284	—	—	—	—	—	—	—
Paving	0.00502	0.00502	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00005	0.00003	0.00086	0.00050	0.00001	0.00000	0.00035	0.00035	0.00000	0.00009	0.00009	—	0.98818	0.98818	0.00002	0.00012	0.00067	1.02504
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00734	0.00616	0.04498	0.07398	0.00024	0.00129	—	0.00129	0.00119	—	0.00119	—	23.3536	23.3536	0.00095	0.00019	—	23.4338
Demolition	—	—	—	—	—	—	0.00342	0.00342	—	0.00052	0.00052	—	—	—	—	—	—	—
Paving	0.00092	0.00092	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00001	0.00001	0.00016	0.00009	< 0.000005	0.00000	0.00006	0.00006	0.00000	0.00002	0.00002	—	0.16360	0.16360	< 0.000005	0.00002	0.00011	0.16971

3.8.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10494	0.10318	0.08378	1.78574	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	630.553	630.553	0.00441	0.00265	1.05297	632.504
Vendor	0.01256	0.00693	0.22993	0.09632	0.00468	0.00000	0.16419	0.16419	0.00000	0.03988	0.03988	—	440.354	440.354	0.00562	0.05228	0.71682	456.791
Hauling	0.09660	0.01874	1.05926	0.70169	0.00625	0.01153	1.78764	1.79918	0.01153	0.21990	0.23143	—	770.040	770.040	0.07690	0.12640	0.81565	810.446
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00667	0.00655	0.00568	0.09492	0.00000	0.00000	0.04623	0.04623	0.00000	0.01083	0.01083	—	38.8075	38.8075	0.00029	0.00017	0.02985	38.8965
Vendor	0.00081	0.00044	0.01580	0.00649	0.00031	0.00000	0.01075	0.01075	0.00000	0.00261	0.00261	—	28.9568	28.9568	0.00037	0.00344	0.02031	30.0108
Hauling	0.00632	0.00117	0.07230	0.04633	0.00041	0.00076	0.11538	0.11613	0.00076	0.01423	0.01499	—	50.6470	50.6470	0.00506	0.00831	0.02316	53.2733
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00122	0.00120	0.00104	0.01732	0.00000	0.00000	0.00844	0.00844	0.00000	0.00198	0.00198	—	6.42503	6.42503	0.00005	0.00003	0.00494	6.43975
Vendor	0.00015	0.00008	0.00288	0.00119	0.00006	0.00000	0.00196	0.00196	0.00000	0.00048	0.00048	—	4.79412	4.79412	0.00006	0.00057	0.00336	4.96862
Hauling	0.00115	0.00021	0.01320	0.00845	0.00007	0.00014	0.02106	0.02119	0.00014	0.00260	0.00274	—	8.38519	8.38519	0.00084	0.00138	0.00383	8.82000

3.8.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.24174	0.23419	2.21918	11.5533	0.02004	0.04659	—	0.04659	0.04639	—	0.04639	—	2,147.94	2,147.94	0.08713	0.01743	—	2,155.31
Demolition	—	—	—	—	—	—	0.28518	0.28518	—	0.04318	0.04318	—	—	—	—	—	—	—
Paving	0.07642	0.07642	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00083	0.00052	0.01256	0.00722	0.00015	0.00000	0.00541	0.00541	0.00000	0.00131	0.00131	—	15.0236	15.0236	0.00031	0.00182	0.02361	15.5976
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01590	0.01540	0.14592	0.75967	0.00132	0.00306	—	0.00306	0.00305	—	0.00305	—	141.234	141.234	0.00573	0.00115	—	141.719
Demolition	—	—	—	—	—	—	0.01875	0.01875	—	0.00284	0.00284	—	—	—	—	—	—	—
Paving	0.00502	0.00502	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00005	0.00003	0.00086	0.00050	0.00001	0.00000	0.00035	0.00035	0.00000	0.00009	0.00009	—	0.98818	0.98818	0.00002	0.00012	0.00067	1.02504
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00290	0.00281	0.02663	0.13864	0.00024	0.00056	—	0.00056	0.00056	—	0.00056	—	23.3830	23.3830	0.00095	0.00019	—	23.4632

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Demolition	—	—	—	—	—	—	0.00342	0.00342	—	0.00052	0.00052	—	—	—	—	—	—	—
Paving	0.00092	0.00092	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00001	0.00001	0.00016	0.00009	< 0.000005	0.00000	0.00006	0.00006	0.00000	0.00002	0.00002	—	0.16360	0.16360	< 0.000005	0.00002	0.00011	0.16971

3.8.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10494	0.10318	0.08378	1.78574	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	630.553	630.553	0.00441	0.00265	1.05297	632.504
Vendor	0.01256	0.00693	0.22993	0.09632	0.00468	0.00000	0.16419	0.16419	0.00000	0.03988	0.03988	—	440.354	440.354	0.00562	0.05228	0.71682	456.791
Hauling	0.09660	0.01874	1.05926	0.70169	0.00625	0.01153	1.78764	1.79918	0.01153	0.21990	0.23143	—	770.040	770.040	0.07690	0.12640	0.81565	810.446
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00667	0.00655	0.00568	0.09492	0.00000	0.00000	0.04623	0.04623	0.00000	0.01083	0.01083	—	38.8075	38.8075	0.00029	0.00017	0.02985	38.8965
Vendor	0.00081	0.00044	0.01580	0.00649	0.00031	0.00000	0.01075	0.01075	0.00000	0.00261	0.00261	—	28.9568	28.9568	0.00037	0.00344	0.02031	30.0108
Hauling	0.00632	0.00117	0.07230	0.04633	0.00041	0.00076	0.11538	0.11613	0.00076	0.01423	0.01499	—	50.6470	50.6470	0.00506	0.00831	0.02316	53.2733
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00122	0.00120	0.00104	0.01732	0.00000	0.00000	0.00844	0.00844	0.00000	0.00198	0.00198	—	6.42503	6.42503	0.00005	0.00003	0.00494	6.43975

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00015	0.00008	0.00288	0.00119	0.00006	0.00000	0.00196	0.00196	0.00000	0.00048	0.00048	—	4.79412	4.79412	0.00006	0.00057	0.00336	4.96862
Hauling	0.00115	0.00021	0.01320	0.00845	0.00007	0.00014	0.02106	0.02119	0.00014	0.00260	0.00274	—	8.38519	8.38519	0.00084	0.00138	0.00383	8.82000

3.9. Phase 6 MEP, Archt& finishrchitectural Coating (2034)

3.9.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.05782	0.88195	8.68203	18.3466	0.02972	0.12579	—	0.12579	0.11573	—	0.11573	—	2,972.77	2,972.77	0.12059	0.02412	—	2,982.97
Architectural Coatings	25.8458	25.8458	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00292	0.00184	0.04397	0.02528	0.00054	0.00000	0.01893	0.01893	0.00000	0.00460	0.00460	—	52.5826	52.5826	0.00108	0.00637	0.08265	54.5915
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19418	0.16189	1.59369	3.36773	0.00546	0.02309	—	0.02309	0.02124	—	0.02124	—	545.686	545.686	0.02214	0.00443	—	547.559

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Architectural Coatings	4.74430	4.74430	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00052	0.00032	0.00837	0.00490	0.00010	0.00000	0.00346	0.00346	0.00000	0.00084	0.00084	—	9.65533	9.65533	0.00020	0.00117	0.00654	10.0155
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03544	0.02955	0.29085	0.61461	0.00100	0.00421	—	0.00421	0.00388	—	0.00388	—	90.3445	90.3445	0.00366	0.00073	—	90.6546
Architectural Coatings	0.86584	0.86584	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00009	0.00006	0.00153	0.00089	0.00002	0.00000	0.00063	0.00063	0.00000	0.00015	0.00015	—	1.59855	1.59855	0.00003	0.00019	0.00108	1.65818

3.9.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10494	0.10318	0.08378	1.78574	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	630.553	630.553	0.00441	0.00265	1.05297	632.504
Vendor	0.04372	0.02415	0.80070	0.33542	0.01631	0.00000	0.57178	0.57178	0.00000	0.13887	0.13887	—	1,533.47	1,533.47	0.01958	0.18207	2.49624	1,590.71
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01862	0.01829	0.01586	0.26499	0.00000	0.00000	0.12906	0.12906	0.00000	0.03024	0.03024	—	108.338	108.338	0.00081	0.00049	0.08333	108.586
Vendor	0.00791	0.00431	0.15357	0.06313	0.00299	0.00000	0.10449	0.10449	0.00000	0.02537	0.02537	—	281.505	281.505	0.00359	0.03342	0.19742	291.752
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00340	0.00334	0.00290	0.04836	0.00000	0.00000	0.02355	0.02355	0.00000	0.00552	0.00552	—	17.9365	17.9365	0.00013	0.00008	0.01380	17.9776
Vendor	0.00144	0.00079	0.02803	0.01152	0.00055	0.00000	0.01907	0.01907	0.00000	0.00463	0.00463	—	46.6064	46.6064	0.00059	0.00553	0.03268	48.3028
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.9.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.72420	0.63736	4.63440	21.0522	0.02972	0.07314	—	0.07314	0.07087	—	0.07087	—	2,972.86	2,972.86	0.12059	0.02412	—	2,983.06
Architectural Coatings	25.8458	25.8458	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00292	0.00184	0.04397	0.02528	0.00054	0.00000	0.01893	0.01893	0.00000	0.00460	0.00460	—	52.5826	52.5826	0.00108	0.00637	0.08265	54.5915
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.13293	0.11699	0.85070	3.86438	0.00546	0.01343	—	0.01343	0.01301	—	0.01301	—	545.703	545.703	0.02214	0.00443	—	547.576
Architectural Coatings	4.74430	4.74430	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00052	0.00032	0.00837	0.00490	0.00010	0.00000	0.00346	0.00346	0.00000	0.00084	0.00084	—	9.65533	9.65533	0.00020	0.00117	0.00654	10.0155
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02426	0.02135	0.15525	0.70525	0.00100	0.00245	—	0.00245	0.00237	—	0.00237	—	90.3474	90.3474	0.00366	0.00073	—	90.6575
Architectural Coatings	0.86584	0.86584	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00009	0.00006	0.00153	0.00089	0.00002	0.00000	0.00063	0.00063	0.00000	0.00015	0.00015	—	1.59855	1.59855	0.00003	0.00019	0.00108	1.65818

3.9.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10494	0.10318	0.08378	1.78574	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	630.553	630.553	0.00441	0.00265	1.05297	632.504
Vendor	0.04372	0.02415	0.80070	0.33542	0.01631	0.00000	0.57178	0.57178	0.00000	0.13887	0.13887	—	1,533.47	1,533.47	0.01958	0.18207	2.49624	1,590.71

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01862	0.01829	0.01586	0.26499	0.00000	0.00000	0.12906	0.12906	0.00000	0.03024	0.03024	—	108.338	108.338	0.00081	0.00049	0.08333	108.586
Vendor	0.00791	0.00431	0.15357	0.06313	0.00299	0.00000	0.10449	0.10449	0.00000	0.02537	0.02537	—	281.505	281.505	0.00359	0.03342	0.19742	291.752
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00340	0.00334	0.00290	0.04836	0.00000	0.00000	0.02355	0.02355	0.00000	0.00552	0.00552	—	17.9365	17.9365	0.00013	0.00008	0.01380	17.9776
Vendor	0.00144	0.00079	0.02803	0.01152	0.00055	0.00000	0.01907	0.01907	0.00000	0.00463	0.00463	—	46.6064	46.6064	0.00059	0.00553	0.03268	48.3028
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Phase 1 Site Prep	Demolition	3/1/2033	3/21/2033	5.00000	15.0000	—
Phase 2 Earthwork	Grading	3/14/2033	4/30/2033	5.00000	35.0000	—
Phase 3 Foundation	Grading	5/1/2033	11/1/2033	5.00000	132.000	—
Phase 4 Super Structureng Construction	Building Construction	8/1/2033	8/1/2034	5.00000	262.000	—
Phase dust control	Building Construction	3/1/2033	9/1/2034	5.00000	394.000	—
Phase 5 Parking Lot Improvements	Paving	8/1/2034	9/1/2034	5.00000	24.0000	—
Phase 6 MEP, Archt& finishrchitectural Coating	Architectural Coating	6/1/2034	9/1/2034	5.00000	67.0000	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Tractors/Loaders/ Backhoes	Diesel	Average	1.000000	2.80000	262.000	0.37000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Excavators	Diesel	Average	1.000000	1.40000	268.000	0.38000
Phase 1 Site Prep	Other Construction Equipment	Diesel	Average	1.000000	0.90000	806.000	0.42000
Phase 1 Site Prep	Air Compressors	Diesel	Average	1.000000	1.40000	49.0000	0.48000
Phase 1 Site Prep	Cranes	Diesel	Average	1.000000	0.90000	164.000	0.29000
Phase 2 Earthwork	Tractors/Loaders/ Backhoes	Diesel	Average	1.000000	0.40000	262.000	0.37000
Phase 2 Earthwork	Excavators	Diesel	Average	1.000000	1.20000	380.000	0.38000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Average	1.000000	1.60000	354.000	0.40000
Phase 2 Earthwork	Air Compressors	Diesel	Average	1.000000	1.60000	49.0000	0.48000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Average	1.000000	1.10000	262.000	0.37000
Phase 3 Foundation	Rubber Tired Dozers	Diesel	Average	1.000000	0.80000	125.000	0.40000
Phase 3 Foundation	Air Compressors	Diesel	Average	1.000000	2.20000	49.0000	0.48000
Phase 3 Foundation	Cranes	Diesel	Average	1.000000	0.60000	505.000	0.29000
Phase 3 Foundation	Off-Highway Trucks	Diesel	Average	1.000000	0.60000	505.000	0.38000
Phase 3 Foundation	Graders	Diesel	Average	1.000000	1.10000	259.000	0.41000
Phase 3 Foundation	Rollers	Diesel	Average	1.000000	1.10000	131.000	0.38000
Phase 4 Super Structureng Construction	Cranes	Diesel	Average	1.000000	5.70000	505.000	0.29000
Phase 4 Super Structureng Construction	Forklifts	Diesel	Average	1.000000	4.30000	130.000	0.20000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Average	4.00000	4.10000	85.0000	0.31000
Phase 4 Super Structureng Construction	Air Compressors	Diesel	Average	1.000000	0.80000	49.0000	0.48000
Phase 4 Super Structureng Construction	Off-Highway Trucks	Diesel	Average	1.000000	0.50000	505.000	0.38000
Phase 5 Parking Lot Improvements	Tractors/Loaders/ Backhoes	Diesel	Average	1.000000	5.80000	262.000	0.37000
Phase 5 Parking Lot Improvements	Excavators	Diesel	Average	1.000000	1.50000	268.000	0.38000
Phase 5 Parking Lot Improvements	Other Construction Equipment	Diesel	Average	1.000000	0.60000	806.000	0.42000
Phase 5 Parking Lot Improvements	Air Compressors	Diesel	Average	1.000000	1.80000	49.0000	0.48000
Phase 5 Parking Lot Improvements	Pavers	Diesel	Average	1.000000	3.20000	225.000	0.42000
Phase 5 Parking Lot Improvements	Graders	Diesel	Average	1.000000	2.30000	259.000	0.41000
Phase 5 Parking Lot Improvements	Rollers	Diesel	Average	1.000000	6.70000	131.000	0.38000
Phase 6 MEP, Archt& finishrchitectural Coating	Cranes	Diesel	Average	1.000000	1.50000	505.000	0.29000
Phase 6 MEP, Archt& finishrchitectural Coating	Forklifts	Diesel	Average	3.00000	6.90000	130.000	0.20000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Average	7.00000	6.90000	85.0000	0.31000
Phase 6 MEP, Archt& finishrchitectural Coating	Air Compressors	Diesel	Average	3.00000	6.90000	49.0000	0.48000

5.2.2. Mitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	1.000000	2.80000	262.000	0.37000
Phase 1 Site Prep	Excavators	Diesel	Tier 4 Final	1.000000	1.40000	268.000	0.38000
Phase 1 Site Prep	Other Construction Equipment	Diesel	Tier 4 Final	1.000000	0.90000	806.000	0.42000
Phase 1 Site Prep	Air Compressors	Diesel	Average	1.000000	1.40000	49.0000	0.48000
Phase 1 Site Prep	Cranes	Diesel	Tier 4 Final	1.000000	0.90000	164.000	0.29000
Phase 2 Earthwork	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	1.000000	0.40000	262.000	0.37000
Phase 2 Earthwork	Excavators	Diesel	Tier 4 Final	1.000000	1.20000	380.000	0.38000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Tier 4 Final	1.000000	1.60000	354.000	0.40000
Phase 2 Earthwork	Air Compressors	Diesel	Average	1.000000	1.60000	49.0000	0.48000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	1.000000	1.10000	262.000	0.37000
Phase 3 Foundation	Rubber Tired Dozers	Diesel	Tier 4 Final	1.000000	0.80000	125.000	0.40000
Phase 3 Foundation	Air Compressors	Diesel	Average	1.000000	2.20000	49.0000	0.48000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 3 Foundation	Cranes	Diesel	Tier 4 Final	1.000000	0.60000	505.000	0.29000
Phase 3 Foundation	Off-Highway Trucks	Diesel	Average	1.000000	0.60000	505.000	0.38000
Phase 3 Foundation	Graders	Diesel	Tier 4 Final	1.000000	1.10000	259.000	0.41000
Phase 3 Foundation	Rollers	Diesel	Tier 4 Final	1.000000	1.10000	131.000	0.38000
Phase 4 Super Structureng Construction	Cranes	Diesel	Tier 4 Final	1.000000	5.70000	505.000	0.29000
Phase 4 Super Structureng Construction	Forklifts	Diesel	Tier 4 Final	1.000000	4.30000	130.000	0.20000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Tier 4 Final	4.00000	4.10000	85.0000	0.31000
Phase 4 Super Structureng Construction	Air Compressors	Diesel	Average	1.000000	0.80000	49.0000	0.48000
Phase 4 Super Structureng Construction	Off-Highway Trucks	Diesel	Average	1.000000	0.50000	505.000	0.38000
Phase 5 Parking Lot Improvements	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	1.000000	5.80000	262.000	0.37000
Phase 5 Parking Lot Improvements	Excavators	Diesel	Tier 4 Final	1.000000	1.50000	268.000	0.38000
Phase 5 Parking Lot Improvements	Other Construction Equipment	Diesel	Tier 4 Final	1.000000	0.60000	806.000	0.42000
Phase 5 Parking Lot Improvements	Air Compressors	Diesel	Average	1.000000	1.80000	49.0000	0.48000
Phase 5 Parking Lot Improvements	Pavers	Diesel	Tier 4 Final	1.000000	3.20000	225.000	0.42000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 5 Parking Lot Improvements	Graders	Diesel	Tier 4 Final	1.000000	2.30000	259.000	0.41000
Phase 5 Parking Lot Improvements	Rollers	Diesel	Tier 4 Final	1.000000	6.70000	131.000	0.38000
Phase 6 MEP, Archt& finishrchitectural Coating	Cranes	Diesel	Tier 4 Final	1.000000	1.50000	505.000	0.29000
Phase 6 MEP, Archt& finishrchitectural Coating	Forklifts	Diesel	Tier 4 Final	3.00000	6.90000	130.000	0.20000
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Tier 4 Final	7.00000	6.90000	85.0000	0.31000
Phase 6 MEP, Archt& finishrchitectural Coating	Air Compressors	Diesel	Average	3.00000	6.90000	49.0000	0.48000

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 1 Site Prep	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 1 Site Prep	Vendor	5.60000	25.0000	MHDT
Phase 1 Site Prep	Hauling	20.8000	12.0000	HHDT
Phase 1 Site Prep	Onsite truck	0.90000	5.00000	MHDT
Phase 2 Earthwork	Worker	40.0000	25.0000	LDA,LDT1,LDT2

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 2 Earthwork	Vendor	1.40000	25.0000	MHDT
Phase 2 Earthwork	Hauling	16.9000	12.0000	HHDT
Phase 2 Earthwork	Onsite truck	0.20000	5.00000	MHDT
Phase 3 Foundation	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 3 Foundation	Vendor	4.10000	25.0000	MHDT
Phase 3 Foundation	Hauling	21.2000	12.0000	HHDT
Phase 3 Foundation	Onsite truck	0.70000	5.00000	MHDT
Phase 4 Super Structureng Construction	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 4 Super Structureng Construction	Vendor	8.20000	25.0000	MHDT
Phase 4 Super Structureng Construction	Hauling	35.7000	12.0000	HHDT
Phase 4 Super Structureng Construction	Onsite truck	0.10000	5.00000	MHDT
Phase dust control	Worker	0.00000	0.00000	LDA,LDT1,LDT2
Phase dust control	Vendor	0.00000	0.00000	HHDT,MHDT
Phase dust control	Hauling	0.00000	20.0000	HHDT
Phase dust control	Onsite truck	2.00000	5.00000	HHDT
Phase 5 Parking Lot Improvements	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 5 Parking Lot Improvements	Vendor	8.50000	25.0000	MHDT
Phase 5 Parking Lot Improvements	Hauling	21.8000	12.0000	HHDT
Phase 5 Parking Lot Improvements	Onsite truck	1.40000	5.00000	MHDT

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	29.6000	25.0000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	0.00000	0.00000	HHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	4.90000	5.00000	MHDT

5.3.2. Mitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 1 Site Prep	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 1 Site Prep	Vendor	5.60000	25.0000	MHDT
Phase 1 Site Prep	Hauling	20.8000	12.0000	HHDT
Phase 1 Site Prep	Onsite truck	0.90000	5.00000	MHDT
Phase 2 Earthwork	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 2 Earthwork	Vendor	1.40000	25.0000	MHDT
Phase 2 Earthwork	Hauling	16.9000	12.0000	HHDT
Phase 2 Earthwork	Onsite truck	0.20000	5.00000	MHDT
Phase 3 Foundation	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 3 Foundation	Vendor	4.10000	25.0000	MHDT
Phase 3 Foundation	Hauling	21.2000	12.0000	HHDT
Phase 3 Foundation	Onsite truck	0.70000	5.00000	MHDT

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 4 Super Structureng Construction	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 4 Super Structureng Construction	Vendor	8.20000	25.0000	MHDT
Phase 4 Super Structureng Construction	Hauling	35.7000	12.0000	HHDT
Phase 4 Super Structureng Construction	Onsite truck	0.10000	5.00000	MHDT
Phase dust control	Worker	0.00000	0.00000	LDA,LDT1,LDT2
Phase dust control	Vendor	0.00000	0.00000	HHDT,MHDT
Phase dust control	Hauling	0.00000	20.0000	HHDT
Phase dust control	Onsite truck	2.00000	5.00000	HHDT
Phase 5 Parking Lot Improvements	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 5 Parking Lot Improvements	Vendor	8.50000	25.0000	MHDT
Phase 5 Parking Lot Improvements	Hauling	21.8000	12.0000	HHDT
Phase 5 Parking Lot Improvements	Onsite truck	1.40000	5.00000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	29.6000	25.0000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	0.00000	0.00000	HHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	4.90000	5.00000	MHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Phase 6 MEP, Archt& finishrchitectural Coating	0.00000	0.00000	300,000	49,000.0	0.00000

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (Ton of Debris)	Acres Paved (acres)
Phase 1 Site Prep	0.00000	0.00000	0.00000	568.000	0.00000
Phase 2 Earthwork	0.00000	3,700.00	0.92000	0.00000	0.00000
Phase 3 Foundation	7,407.00	0.00000	0.00000	0.00000	0.00000
Phase 5 Parking Lot Improvements	0.00000	0.00000	0.00000	473.000	0.70000

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	3	74%	74%
Water Demolished Area	2	36%	36%

5.7. Construction Paving

Phase Name	Land Use	Area Paved (acres)	% Asphalt
Phase 5 Parking Lot Improvements	Unenclosed Parking Structure	0.70000	100%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2033	0.00000	203.983	0.03300	0.00400
2034	0.00000	203.983	0.03300	0.00400

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1.2. Mitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.1.2. Mitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

5.18.2.2. Mitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

8. User Changes to Default Data

8.1. Justifications

Screen	Justification
Land Use	Project information
Construction: Construction Phases	project information

Screen	Justification
Construction: Off-Road Equipment	Project information
Construction: Dust From Material Movement	Project information
Construction: Trips and VMT	Project information
Construction: On-Road Fugitive Dust	project information
Construction: Architectural Coatings	Project information
Construction: Paving	Project information

8.3. Land Use

Model Parameter	Units	Default Value	New Value
Building Area	sq. ft	44,431.0	248,868
Landscape Area	sq. ft	—	0.00000
Special Landscape Area	sq. ft	—	0.00000

8.4. Construction

8.4.2. Off-Road Equipment

Phase Name	Equipment Type	Model Parameter	Default Value	New Value
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Number per Day	3.00000	1.000000
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Hours Per Day	8.00000	2.80000
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Horsepower	84.0000	262.000
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Number per Day	2.00000	1.000000

Phase Name	Equipment Type	Model Parameter	Default Value	New Value
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Hours Per Day	7.00000	0.40000
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Horsepower	84.0000	262.000
Phase 4 Super Structureng Construction	Cranes	Hours Per Day	6.00000	5.70000
Phase 4 Super Structureng Construction	Cranes	Horsepower	367.000	505.000
Phase 4 Super Structureng Construction	Forklifts	Hours Per Day	6.00000	4.30000
Phase 4 Super Structureng Construction	Forklifts	Horsepower	82.0000	130.000

8.4.4. Dust from Material Movement

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 2 Earthwork	Material Imported	Cubic Yards	—	0.00000
Phase 2 Earthwork	Material Exported	Cubic Yards	—	3,700.00
Phase 2 Earthwork	Total Acres Graded	acres	3.50000	0.92000
Phase 3 Foundation	Material Imported	Cubic Yards	—	7,407.00
Phase 3 Foundation	Material Exported	Cubic Yards	—	0.00000
Phase 3 Foundation	Total Acres Graded	acres	15.6750	0.00000

8.4.6. Trips and VMT

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 1 Site Prep	Worker	One-Way Trips per Day	12.5000	40.0000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 1 Site Prep	Worker	Miles per Trip	11.7000	25.0000
Phase 1 Site Prep	Vendor	One-Way Trips per Day	—	5.60000
Phase 1 Site Prep	Vendor	Miles per Trip	8.40000	25.0000
Phase 1 Site Prep	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 1 Site Prep	Hauling	One-Way Trips per Day	9.46667	20.8000
Phase 1 Site Prep	Hauling	Miles per Trip	20.0000	12.0000
Phase 1 Site Prep	Onsite truck	One-Way Trips per Day	—	0.90000
Phase 1 Site Prep	Onsite truck	Miles per Trip	—	5.00000
Phase 1 Site Prep	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 2 Earthwork	Worker	One-Way Trips per Day	10.00000	40.0000
Phase 2 Earthwork	Worker	Miles per Trip	11.7000	25.0000
Phase 2 Earthwork	Vendor	One-Way Trips per Day	—	1.40000
Phase 2 Earthwork	Vendor	Miles per Trip	8.40000	25.0000
Phase 2 Earthwork	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 2 Earthwork	Hauling	One-Way Trips per Day	13.2286	16.9000
Phase 2 Earthwork	Hauling	Miles per Trip	20.0000	12.0000
Phase 2 Earthwork	Onsite truck	One-Way Trips per Day	—	0.20000
Phase 2 Earthwork	Onsite truck	Miles per Trip	—	5.00000
Phase 2 Earthwork	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 3 Foundation	Worker	One-Way Trips per Day	17.5000	40.0000
Phase 3 Foundation	Worker	Miles per Trip	11.7000	25.0000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 3 Foundation	Vendor	One-Way Trips per Day	—	4.10000
Phase 3 Foundation	Vendor	Miles per Trip	8.40000	25.0000
Phase 3 Foundation	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 3 Foundation	Hauling	One-Way Trips per Day	7.01515	21.2000
Phase 3 Foundation	Hauling	Miles per Trip	20.0000	12.0000
Phase 3 Foundation	Onsite truck	One-Way Trips per Day	—	0.70000
Phase 3 Foundation	Onsite truck	Miles per Trip	—	5.00000
Phase 3 Foundation	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 4 Super Structureng Construction	Worker	One-Way Trips per Day	104.525	40.0000
Phase 4 Super Structureng Construction	Worker	Miles per Trip	11.7000	25.0000
Phase 4 Super Structureng Construction	Vendor	One-Way Trips per Day	40.7895	8.20000
Phase 4 Super Structureng Construction	Vendor	Miles per Trip	8.40000	25.0000
Phase 4 Super Structureng Construction	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 4 Super Structureng Construction	Hauling	One-Way Trips per Day	0.00000	35.7000
Phase 4 Super Structureng Construction	Hauling	Miles per Trip	20.0000	12.0000
Phase 4 Super Structureng Construction	Onsite truck	One-Way Trips per Day	—	0.10000
Phase 4 Super Structureng Construction	Onsite truck	Miles per Trip	—	5.00000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 4 Super Structureng Construction	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase dust control	Worker	One-Way Trips per Day	104.525	0.00000
Phase dust control	Worker	Miles per Trip	11.7000	0.00000
Phase dust control	Vendor	One-Way Trips per Day	40.7895	0.00000
Phase dust control	Vendor	Miles per Trip	8.40000	0.00000
Phase 5 Parking Lot Improvements	Worker	One-Way Trips per Day	17.5000	40.0000
Phase 5 Parking Lot Improvements	Worker	Miles per Trip	11.7000	25.0000
Phase 5 Parking Lot Improvements	Vendor	One-Way Trips per Day	—	8.50000
Phase 5 Parking Lot Improvements	Vendor	Miles per Trip	8.40000	25.0000
Phase 5 Parking Lot Improvements	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 5 Parking Lot Improvements	Hauling	One-Way Trips per Day	4.95833	21.8000
Phase 5 Parking Lot Improvements	Hauling	Miles per Trip	20.0000	12.0000
Phase 5 Parking Lot Improvements	Onsite truck	One-Way Trips per Day	—	1.40000
Phase 5 Parking Lot Improvements	Onsite truck	Miles per Trip	—	5.00000
Phase 5 Parking Lot Improvements	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	One-Way Trips per Day	41.8098	40.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	Miles per Trip	11.7000	25.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	One-Way Trips per Day	—	29.6000
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	Miles per Trip	8.40000	25.0000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	Miles per Trip	20.0000	0.00000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	One-Way Trips per Day	—	4.90000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	Miles per Trip	—	5.00000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	Vehicle Mix	HHDT	MHDT

8.4.7. On-Road Fugitive Dust

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 1 Site Prep	Hauling Trip Paved	%	100.0000	99.2000
Phase 1 Site Prep	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 2 Earthwork	Hauling Trip Paved	%	100.0000	99.2000
Phase 2 Earthwork	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 3 Foundation	Hauling Trip Paved	%	100.0000	99.6000
Phase 3 Foundation	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 4 Super Structureng Construction	Hauling Trip Paved	%	100.0000	99.3000
Phase 4 Super Structureng Construction	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase dust control	Onsite Truck Trip Paved	%	0.00000	80.0000
Phase 5 Parking Lot Improvements	Hauling Trip Paved	%	100.0000	99.6000

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 5 Parking Lot Improvements	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite Truck Trip Paved	%	0.00000	100.0000

8.4.8. Architectural Coatings

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 6 MEP, Archt& finishrchitectural Coating	Non-Residential Interior Area	sq ft	1,999.40	300,000
Phase 6 MEP, Archt& finishrchitectural Coating	Non-Residential Exterior Area	sq ft	222.156	49,000.0
Phase 6 MEP, Archt& finishrchitectural Coating	Parking Area	sq ft	2,665.87	0.00000

8.4.9. Paving

Phase Name	Land Use	Model Parameter	Units	Default Value	New Value
Phase 5 Parking Lot Improvements	Unenclosed Parking Structure	Area Paved	acres	1.02000	0.70000

Larkspur Main Lot Construction HP_Unmit and mitg Custom Report

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1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Larkspur Main Lot Construction HP_Unmit and mitg
Construction Start Date	3/2/2037
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.90000
Precipitation (days)	7.60000
Location	Larkspur Ferry Terminal, Larkspur, CA 94939, USA
County	Marin
City	Larkspur
Air District	Bay Area AQMD
Air Basin	San Francisco Bay Area
TAZ	905
EDFZ	2
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.45

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Unenclosed Parking Structure	10.00000	Acre	10.00000	1,175,167	0.00000	0.00000	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

Sector	#	Measure Title
Construction	C-5	Use Advanced Engine Tiers

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	50.0697	49.4599	41.9417	37.3080	0.27205	0.89929	71.0691	71.9684	0.86141	10.1897	11.0511	—	32,655.9	32,655.9	2.14995	4.27266	21.0823	34,003.9
Mit.	49.3623	48.9421	33.6486	48.5557	0.27207	0.52738	71.0691	71.5965	0.52738	10.1897	10.7170	—	32,658.2	32,658.2	2.15004	4.27268	21.0823	34,006.3
% Reduced	1%	1%	20%	-30%	—	41%	—	1%	39%	—	3%	—	> -0.5%	> -0.5%	—	—	—	> -0.5%
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Unmit.	49.1775	48.8514	28.3283	47.7793	0.20777	0.72427	13.3743	14.0986	0.67335	2.33897	3.01231	—	23,205.6	23,205.6	0.86912	1.45616	0.28543	23,661.6
Mit.	48.8666	48.6407	19.6002	67.5605	0.21065	0.34807	13.3743	13.7224	0.34028	2.33897	2.67924	—	23,517.0	23,517.0	0.88175	1.45869	0.28543	23,974.0
% Reduced	1%	< 0.5%	31%	-41%	-1%	52%	—	3%	49%	—	11%	—	-1%	-1%	-1%	> -0.5%	—	-1%
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	22.0693	21.8269	13.5322	18.2417	0.09274	0.32216	11.9992	12.3213	0.30174	1.83352	2.13526	—	10,487.7	10,487.7	0.49449	0.85885	2.55375	10,758.6
Mit.	21.7975	21.6303	9.95091	26.0884	0.09394	0.16443	11.9992	12.1636	0.16175	1.83352	1.99527	—	10,617.8	10,617.8	0.49976	0.85991	2.55375	10,889.1
% Reduced	1%	1%	26%	-43%	-1%	49%	—	1%	46%	—	7%	—	-1%	-1%	-1%	> -0.5%	—	-1%
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	4.02764	3.98342	2.46963	3.32911	0.01693	0.05879	2.18985	2.24864	0.05507	0.33462	0.38968	—	1,736.36	1,736.36	0.08187	0.14219	0.42280	1,781.20
Mit.	3.97805	3.94752	1.81604	4.76114	0.01714	0.03001	2.18985	2.21985	0.02952	0.33462	0.36414	—	1,757.90	1,757.90	0.08274	0.14237	0.42280	1,802.82
% Reduced	1%	1%	26%	-43%	-1%	49%	—	1%	46%	—	7%	—	-1%	-1%	-1%	> -0.5%	—	-1%

2.2. Construction Emissions by Year

2.2.1. Total Construction Emissions by Year, Unmitigated

Includes both onsite and offsite emissions.

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	4.79330	2.74832	41.9417	37.3080	0.27205	0.89929	71.0691	71.9684	0.86141	10.1897	11.0511	—	32,655.9	32,655.9	2.14995	4.27266	21.0823	34,003.9
2038	1.52828	1.08437	10.0845	17.0641	0.07393	0.25209	6.81548	7.06756	0.23603	1.08758	1.32361	—	8,645.81	8,645.81	0.35565	0.66539	4.29195	8,857.28
2039	50.0697	49.4599	17.7601	30.9105	0.11501	0.30838	8.79369	9.10207	0.28781	1.55755	1.84537	—	13,088.4	13,088.4	0.46664	0.85376	6.25260	13,360.7
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	3.43319	2.67997	18.6446	31.4527	0.13376	0.49040	12.1395	12.3269	0.45411	1.60011	1.78172	—	14,855.5	14,855.5	0.53375	0.79467	0.20059	15,105.8
2038	4.89756	3.72624	28.3283	47.7793	0.20777	0.72427	13.3743	14.0986	0.67335	2.33897	3.01231	—	23,205.6	23,205.6	0.86912	1.45616	0.28543	23,661.6
2039	49.1775	48.8514	11.1695	19.2642	0.07428	0.24497	6.81548	7.06045	0.22948	1.08758	1.31706	—	8,473.04	8,473.04	0.35662	0.64051	0.09774	8,672.93
2040	49.1617	48.8353	11.0280	19.1372	0.06296	0.11559	4.74412	4.85971	0.10696	0.91143	1.01839	—	7,058.44	7,058.44	0.20165	0.32947	0.08442	7,161.74
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.07603	1.44485	13.5322	18.2417	0.09274	0.32216	11.9992	12.3213	0.30174	1.83352	2.13526	—	10,487.7	10,487.7	0.49449	0.85885	2.55375	10,758.6
2038	1.47680	1.07632	9.37573	15.4117	0.06802	0.23403	5.52525	5.75927	0.21856	0.90855	1.12710	—	7,801.41	7,801.41	0.31188	0.56471	1.65177	7,979.14
2039	22.0693	21.8269	7.21136	12.2154	0.04516	0.11314	3.64385	3.75699	0.10544	0.64400	0.74944	—	5,135.70	5,135.70	0.17683	0.31717	1.08726	5,235.73
2040	4.42539	4.39597	0.98481	1.72296	0.00564	0.01041	0.42302	0.43342	0.00963	0.08145	0.09108	—	635.940	635.940	0.01815	0.02966	0.12658	645.358
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.37887	0.26368	2.46963	3.32911	0.01693	0.05879	2.18985	2.24864	0.05507	0.33462	0.38968	—	1,736.36	1,736.36	0.08187	0.14219	0.42280	1,781.20
2038	0.26952	0.19643	1.71107	2.81264	0.01241	0.04271	1.00836	1.05107	0.03989	0.16581	0.20570	—	1,291.61	1,291.61	0.05164	0.09349	0.27347	1,321.04
2039	4.02764	3.98342	1.31607	2.22930	0.00824	0.02065	0.66500	0.68565	0.01924	0.11753	0.13677	—	850.274	850.274	0.02928	0.05251	0.18001	866.834
2040	0.80763	0.80227	0.17973	0.31444	0.00103	0.00190	0.07720	0.07910	0.00176	0.01486	0.01662	—	105.287	105.287	0.00301	0.00491	0.02096	106.846

2.2.2. Onsite Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.87401	2.40238	14.4217	25.8051	0.07748	0.47402	4.13874	4.61276	0.43613	1.84008	2.27622	—	8,057.22	8,057.22	0.32497	0.09282	0.28543	8,093.29
2038	1.10360	0.92322	6.31286	12.6523	0.03400	0.20122	0.78372	0.98493	0.18516	0.08448	0.26964	—	3,632.37	3,632.37	0.14757	0.04259	0.10718	3,648.85
2039	49.4669	49.1574	13.3428	23.7623	0.05524	0.25751	1.02109	1.13236	0.23695	0.12283	0.33269	—	5,670.53	5,670.53	0.22888	0.07081	0.20136	5,697.55
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.87387	2.40174	14.4327	25.8142	0.07752	0.45402	3.10674	3.27247	0.41773	0.43594	0.58845	—	8,057.50	8,057.50	0.32493	0.09282	0.00742	8,093.29
2038	3.94049	3.29639	20.2225	38.3028	0.11130	0.63703	0.88234	1.51937	0.58610	0.10717	0.69327	—	11,651.3	11,651.3	0.46963	0.13094	0.00885	11,702.1
2039	48.8170	48.6202	9.43660	15.1282	0.03404	0.19410	1.02109	1.13236	0.17861	0.12283	0.26309	—	3,628.74	3,628.74	0.14752	0.04669	0.00401	3,645.11
2040	48.8122	48.6158	9.36410	15.1207	0.03329	0.10834	1.02109	1.12943	0.09971	0.12283	0.22254	—	3,283.81	3,283.81	0.13267	0.04463	0.00351	3,300.43
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	1.50763	1.26074	7.85581	13.2744	0.04062	0.25554	1.02705	1.28258	0.23511	0.28445	0.51956	—	4,253.27	4,253.27	0.17188	0.04790	0.05859	4,271.90
2038	1.11489	0.93266	6.10655	11.9757	0.03316	0.19372	0.55997	0.75369	0.17825	0.06182	0.24006	—	3,514.96	3,514.96	0.14238	0.04069	0.04462	3,530.69
2039	21.8259	21.6987	5.54584	9.60407	0.02238	0.09660	0.61404	0.71064	0.08889	0.07000	0.15889	—	2,281.12	2,281.12	0.09246	0.03022	0.03861	2,292.48
2040	4.39407	4.37638	0.84265	1.36100	0.00299	0.00975	0.09050	0.10025	0.00898	0.01091	0.01989	—	295.596	295.596	0.01194	0.00402	0.00527	297.097
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.27514	0.23009	1.43368	2.42258	0.00741	0.04664	0.18744	0.23407	0.04291	0.05191	0.09482	—	704.177	704.177	0.02846	0.00793	0.00970	707.261
2038	0.20347	0.17021	1.11444	2.18556	0.00605	0.03535	0.10220	0.13755	0.03253	0.01128	0.04381	—	581.941	581.941	0.02357	0.00674	0.00739	584.545

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2039	3.98323	3.96001	1.01212	1.75274	0.00408	0.01763	0.11206	0.12969	0.01622	0.01277	0.02900	—	377.666	377.666	0.01531	0.00500	0.00639	379.546
2040	0.80192	0.79869	0.15378	0.24838	0.00055	0.00178	0.01652	0.01830	0.00164	0.00199	0.00363	—	48.9393	48.9393	0.00198	0.00067	0.00087	49.1878

2.2.3. Offsite Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.70690	0.55222	30.9136	20.8292	0.22162	0.42527	66.9304	67.3557	0.42527	8.34958	8.77485	—	27,206.0	27,206.0	1.92803	4.21858	20.9996	28,532.3
2038	0.42469	0.16115	3.77159	4.41184	0.03993	0.05087	6.03176	6.08263	0.05087	1.00310	1.05397	—	5,013.44	5,013.44	0.20808	0.62280	4.18477	5,208.42
2039	0.60282	0.30246	4.41731	7.14819	0.05977	0.05087	7.96361	8.01448	0.05087	1.46181	1.51268	—	7,417.86	7,417.86	0.23776	0.78295	6.05123	7,663.17
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.55931	0.27822	4.21193	5.63845	0.05624	0.03638	9.03278	9.05442	0.03638	1.22870	1.26507	—	6,797.97	6,797.97	0.20882	0.70185	0.19317	7,012.54
2038	0.95707	0.42985	8.10584	9.47653	0.09648	0.08725	12.4920	12.5792	0.08725	2.23180	2.31904	—	11,554.3	11,554.3	0.39949	1.32523	0.27658	11,959.5
2039	0.39243	0.23121	3.88189	4.13595	0.04024	0.05087	6.03176	6.08263	0.05087	1.00310	1.05397	—	4,844.31	4,844.31	0.20910	0.59794	0.09374	5,027.81
2040	0.34947	0.21945	1.66386	4.01652	0.02967	0.00725	3.72303	3.73028	0.00725	0.78860	0.79585	—	3,774.62	3,774.62	0.06898	0.28484	0.08091	3,861.31
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.56840	0.18410	5.67644	4.96727	0.05213	0.06663	10.9721	11.0387	0.06663	1.54907	1.61570	—	6,234.45	6,234.45	0.32261	0.81096	2.49516	6,486.68
2038	0.36191	0.14365	3.26918	3.43601	0.03486	0.04031	4.96527	5.00558	0.04031	0.84673	0.88704	—	4,286.45	4,286.45	0.16951	0.52402	1.60715	4,448.45
2039	0.24337	0.12827	1.66553	2.61129	0.02278	0.01655	3.02981	3.04636	0.01655	0.57400	0.59055	—	2,854.58	2,854.58	0.08437	0.28694	1.04866	2,943.25

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2040	0.03132	0.01959	0.14216	0.36196	0.00264	0.00065	0.33252	0.33317	0.00065	0.07054	0.07119	—	340.344	340.344	0.00621	0.02564	0.12131	348.261
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.10373	0.03360	1.03595	0.90653	0.00951	0.01216	2.00241	2.01457	0.01216	0.28271	0.29487	—	1,032.18	1,032.18	0.05341	0.13426	0.41310	1,073.94
2038	0.06605	0.02622	0.59663	0.62707	0.00636	0.00736	0.90616	0.91352	0.00736	0.15453	0.16188	—	709.671	709.671	0.02806	0.08676	0.26608	736.492
2039	0.04441	0.02341	0.30396	0.47656	0.00416	0.00302	0.55294	0.55596	0.00302	0.10476	0.10778	—	472.608	472.608	0.01397	0.04751	0.17362	487.288
2040	0.00572	0.00358	0.02594	0.06606	0.00048	0.00012	0.06068	0.06080	0.00012	0.01287	0.01299	—	56.3478	56.3478	0.00103	0.00425	0.02008	57.6587

2.2.4. Total Construction Emissions by Year, Mitigated

Includes both onsite and offsite emissions.

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	3.22277	1.83902	33.6486	48.5557	0.27207	0.52738	71.0691	71.5965	0.52738	10.1897	10.7170	—	32,658.2	32,658.2	2.15004	4.27268	21.0823	34,006.3
2038	0.93314	0.62670	6.95908	22.7075	0.07393	0.12471	6.81548	6.94018	0.12303	1.08758	1.21062	—	8,645.87	8,645.87	0.35565	0.66539	4.29195	8,857.34
2039	49.3623	48.9421	13.4117	43.1610	0.12054	0.17735	8.79369	8.97103	0.17443	1.55755	1.73198	—	13,686.4	13,686.4	0.49090	0.85861	6.25260	13,960.8
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.24610	1.77066	12.6846	45.4676	0.13664	0.22740	12.1395	12.2587	0.22099	1.60011	1.71919	—	15,166.8	15,166.8	0.54638	0.79720	0.20059	15,418.2
2038	3.14296	2.38249	19.6002	67.5605	0.21065	0.34807	13.3743	13.7224	0.34028	2.33897	2.67924	—	23,517.0	23,517.0	0.88175	1.45869	0.28543	23,974.0
2039	48.8666	48.6407	9.23124	28.5027	0.07428	0.12374	6.81548	6.93922	0.12214	1.08758	1.20973	—	8,473.11	8,473.11	0.35663	0.64051	0.09774	8,672.99
2040	48.8566	48.6294	9.15129	28.3882	0.06849	0.08668	4.74412	4.83080	0.08515	0.91143	0.99657	—	7,657.64	7,657.64	0.22595	0.33433	0.08442	7,763.01

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	1.35818	0.89166	9.95091	26.0884	0.09394	0.16443	11.9992	12.1636	0.16175	1.83352	1.99527	—	10,617.8	10,617.8	0.49976	0.85991	2.55375	10,889.1
2038	0.91905	0.64806	6.50381	21.0696	0.06836	0.11457	5.52525	5.63982	0.11267	0.90855	1.02122	—	7,838.01	7,838.01	0.31337	0.56500	1.65177	8,015.86
2039	21.7975	21.6303	5.60349	17.4724	0.04761	0.06829	3.64385	3.71214	0.06718	0.64400	0.71118	—	5,400.52	5,400.52	0.18757	0.31931	1.08726	5,501.45
2040	4.39792	4.37745	0.81588	2.55573	0.00613	0.00780	0.42302	0.43082	0.00766	0.08145	0.08911	—	689.880	689.880	0.02034	0.03010	0.12658	699.484
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.24787	0.16273	1.81604	4.76114	0.01714	0.03001	2.18985	2.21985	0.02952	0.33462	0.36414	—	1,757.90	1,757.90	0.08274	0.14237	0.42280	1,802.82
2038	0.16773	0.11827	1.18695	3.84519	0.01247	0.02091	1.00836	1.02927	0.02056	0.16581	0.18637	—	1,297.67	1,297.67	0.05188	0.09354	0.27347	1,327.12
2039	3.97805	3.94752	1.02264	3.18872	0.00869	0.01246	0.66500	0.67747	0.01226	0.11753	0.12979	—	894.117	894.117	0.03105	0.05287	0.18001	910.828
2040	0.80262	0.79888	0.14890	0.46642	0.00112	0.00142	0.07720	0.07863	0.00140	0.01486	0.01626	—	114.218	114.218	0.00337	0.00498	0.02096	115.808

2.2.5. Onsite Construction Emissions by Year, Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	1.68692	1.49308	8.46163	39.8199	0.08035	0.19103	4.13874	4.24084	0.18461	1.84008	1.94218	—	8,368.53	8,368.53	0.33760	0.09535	0.28543	8,405.67
2038	0.50846	0.46555	3.18748	18.2957	0.03400	0.07384	0.78372	0.85755	0.07217	0.08448	0.15665	—	3,632.43	3,632.43	0.14757	0.04259	0.10718	3,648.92
2039	48.7595	48.6397	8.99439	36.0128	0.06076	0.12648	1.02109	1.10119	0.12356	0.12283	0.21930	—	6,268.59	6,268.59	0.25314	0.07566	0.20136	6,297.67
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2037	1.68679	1.49244	8.47262	39.8291	0.08040	0.19103	3.10674	3.20430	0.18461	0.43594	0.53338	—	8,368.80	8,368.80	0.33756	0.09535	0.00742	8,405.66
2038	2.18590	1.95263	11.4944	58.0840	0.11417	0.26083	0.88234	1.14317	0.25303	0.10717	0.36020	—	11,962.7	11,962.7	0.48226	0.13346	0.00885	12,014.5
2039	48.5061	48.4095	7.49837	24.3668	0.03883	0.08010	1.02109	1.10119	0.07851	0.12283	0.20134	—	3,888.82	3,888.82	0.15724	0.05155	0.00401	3,908.12
2040	48.5071	48.4100	7.48744	24.3717	0.03883	0.07943	1.02109	1.10053	0.07790	0.12283	0.20073	—	3,883.02	3,883.02	0.15697	0.04949	0.00351	3,901.70
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.78978	0.70755	4.27448	21.1212	0.04182	0.09780	1.02705	1.12485	0.09512	0.28445	0.37957	—	4,383.36	4,383.36	0.17716	0.04895	0.05859	4,402.43
2038	0.55714	0.50440	3.23463	17.6336	0.03349	0.07427	0.55997	0.63424	0.07236	0.06182	0.13418	—	3,551.55	3,551.55	0.14386	0.04098	0.04462	3,567.41
2039	21.5542	21.5020	3.93796	14.8611	0.02483	0.05174	0.61404	0.66578	0.05063	0.07000	0.12062	—	2,545.94	2,545.94	0.10320	0.03237	0.03861	2,558.20
2040	4.36660	4.35785	0.67371	2.19377	0.00349	0.00715	0.09050	0.09765	0.00701	0.01091	0.01792	—	349.536	349.536	0.01413	0.00446	0.00527	351.222
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.14413	0.12913	0.78009	3.85461	0.00763	0.01785	0.18744	0.20528	0.01736	0.05191	0.06927	—	725.715	725.715	0.02933	0.00810	0.00970	728.873
2038	0.10168	0.09205	0.59032	3.21812	0.00611	0.01355	0.10220	0.11575	0.01321	0.01128	0.02449	—	588.000	588.000	0.02382	0.00679	0.00739	590.625
2039	3.93364	3.92411	0.71868	2.71216	0.00453	0.00944	0.11206	0.12151	0.00924	0.01277	0.02201	—	421.509	421.509	0.01709	0.00536	0.00639	423.540
2040	0.79690	0.79531	0.12295	0.40036	0.00064	0.00130	0.01652	0.01782	0.00128	0.00199	0.00327	—	57.8697	57.8697	0.00234	0.00074	0.00087	58.1489

2.2.6. Offsite Construction Emissions by Year, Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.70690	0.55222	30.9136	20.8292	0.22162	0.42527	66.9304	67.3557	0.42527	8.34958	8.77485	—	27,206.0	27,206.0	1.92803	4.21858	20.9996	28,532.3

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2038	0.42469	0.16115	3.77159	4.41184	0.03993	0.05087	6.03176	6.08263	0.05087	1.00310	1.05397	—	5,013.44	5,013.44	0.20808	0.62280	4.18477	5,208.42
2039	0.60282	0.30246	4.41731	7.14819	0.05977	0.05087	7.96361	8.01448	0.05087	1.46181	1.51268	—	7,417.86	7,417.86	0.23776	0.78295	6.05123	7,663.17
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.55931	0.27822	4.21193	5.63845	0.05624	0.03638	9.03278	9.05442	0.03638	1.22870	1.26507	—	6,797.97	6,797.97	0.20882	0.70185	0.19317	7,012.54
2038	0.95707	0.42985	8.10584	9.47653	0.09648	0.08725	12.4920	12.5792	0.08725	2.23180	2.31904	—	11,554.3	11,554.3	0.39949	1.32523	0.27658	11,959.5
2039	0.39243	0.23121	3.88189	4.13595	0.04024	0.05087	6.03176	6.08263	0.05087	1.00310	1.05397	—	4,844.31	4,844.31	0.20910	0.59794	0.09374	5,027.81
2040	0.34947	0.21945	1.66386	4.01652	0.02967	0.00725	3.72303	3.73028	0.00725	0.78860	0.79585	—	3,774.62	3,774.62	0.06898	0.28484	0.08091	3,861.31
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.56840	0.18410	5.67644	4.96727	0.05213	0.06663	10.9721	11.0387	0.06663	1.54907	1.61570	—	6,234.45	6,234.45	0.32261	0.81096	2.49516	6,486.68
2038	0.36191	0.14365	3.26918	3.43601	0.03486	0.04031	4.96527	5.00558	0.04031	0.84673	0.88704	—	4,286.45	4,286.45	0.16951	0.52402	1.60715	4,448.45
2039	0.24337	0.12827	1.66553	2.61129	0.02278	0.01655	3.02981	3.04636	0.01655	0.57400	0.59055	—	2,854.58	2,854.58	0.08437	0.28694	1.04866	2,943.25
2040	0.03132	0.01959	0.14216	0.36196	0.00264	0.00065	0.33252	0.33317	0.00065	0.07054	0.07119	—	340.344	340.344	0.00621	0.02564	0.12131	348.261
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.10373	0.03360	1.03595	0.90653	0.00951	0.01216	2.00241	2.01457	0.01216	0.28271	0.29487	—	1,032.18	1,032.18	0.05341	0.13426	0.41310	1,073.94
2038	0.06605	0.02622	0.59663	0.62707	0.00636	0.00736	0.90616	0.91352	0.00736	0.15453	0.16188	—	709.671	709.671	0.02806	0.08676	0.26608	736.492
2039	0.04441	0.02341	0.30396	0.47656	0.00416	0.00302	0.55294	0.55596	0.00302	0.10476	0.10778	—	472.608	472.608	0.01397	0.04751	0.17362	487.288
2040	0.00572	0.00358	0.02594	0.06606	0.00048	0.00012	0.06068	0.06080	0.00012	0.01287	0.01299	—	56.3478	56.3478	0.00103	0.00425	0.02008	57.6587

3. Construction Emissions Details

3.1. Phase 1 Site Prep (2037)

3.1.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.00490	0.84391	8.48854	9.03420	0.03627	0.16529	—	0.16529	0.15207	—	0.15207	—	3,907.07	3,907.07	0.15849	0.03170	—	3,920.47
Demolition	—	—	—	—	—	—	2.32589	2.32589	—	0.35221	0.35221	—	—	—	—	—	—	—
Onsite truck	0.00441	0.00282	0.05979	0.03598	0.00088	0.00000	0.03091	0.03091	0.00000	0.00751	0.00751	—	74.0275	74.0275	0.00176	0.00864	0.09269	76.7397
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.00490	0.84391	8.48854	9.03420	0.03627	0.16529	—	0.16529	0.15207	—	0.15207	—	3,907.07	3,907.07	0.15849	0.03170	—	3,920.47
Demolition	—	—	—	—	—	—	2.32589	2.32589	—	0.35221	0.35221	—	—	—	—	—	—	—
Onsite truck	0.00441	0.00265	0.06261	0.03898	0.00088	0.00000	0.03091	0.03091	0.00000	0.00751	0.00751	—	74.1048	74.1048	0.00176	0.00864	0.00241	76.7266
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06332	0.05318	0.53489	0.56928	0.00229	0.01042	—	0.01042	0.00958	—	0.00958	—	246.199	246.199	0.00999	0.00200	—	247.044

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Demolition	—	—	—	—	—	—	0.14656	0.14656	—	0.02219	0.02219	—	—	—	—	—	—	—
Onsite truck	0.00028	0.00017	0.00388	0.00240	0.00006	0.00000	0.00194	0.00194	0.00000	0.00047	0.00047	—	4.66676	4.66676	0.00011	0.00054	0.00252	4.83434
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01156	0.00970	0.09762	0.10389	0.00042	0.00190	—	0.00190	0.00175	—	0.00175	—	40.7610	40.7610	0.00165	0.00033	—	40.9009
Demolition	—	—	—	—	—	—	0.02675	0.02675	—	0.00405	0.00405	—	—	—	—	—	—	—
Onsite truck	0.00005	0.00003	0.00071	0.00044	0.00001	0.00000	0.00035	0.00035	0.00000	0.00009	0.00009	—	0.77264	0.77264	0.00002	0.00009	0.00042	0.80038

3.1.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.12236	0.12125	0.07496	2.00951	0.00000	0.00000	0.88317	0.88317	0.00000	0.20701	0.20701	—	764.209	764.209	0.00441	0.00331	0.81968	766.125
Vendor	0.03439	0.01905	0.50742	0.22434	0.01323	0.00000	0.46361	0.46361	0.00000	0.11259	0.11259	—	1,066.93	1,066.93	0.01587	0.12117	1.39030	1,104.83
Hauling	0.15689	0.03517	1.81600	1.18933	0.01082	0.02164	7.68600	7.70764	0.02164	0.84456	0.86620	—	1,347.59	1,347.59	0.10910	0.21550	0.98718	1,415.53
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.12125	0.09149	0.10692	1.63363	0.00000	0.00000	0.88317	0.88317	0.00000	0.20701	0.20701	—	712.185	712.185	0.00551	0.00331	0.02124	713.329
Vendor	0.03439	0.01852	0.52646	0.22276	0.01323	0.00000	0.46361	0.46361	0.00000	0.11259	0.11259	—	1,067.15	1,067.15	0.01587	0.12117	0.03613	1,103.69

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.15419	0.03246	1.91970	1.20105	0.01172	0.02164	7.68600	7.70764	0.02164	0.84456	0.86620	—	1,348.67	1,348.67	0.10820	0.21550	0.02569	1,415.62
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00750	0.00563	0.00667	0.10245	0.00000	0.00000	0.05538	0.05538	0.00000	0.01298	0.01298	—	45.0731	45.0731	0.00035	0.00021	0.02230	45.1661
Vendor	0.00217	0.00117	0.03297	0.01454	0.00083	0.00000	0.02908	0.02908	0.00000	0.00706	0.00706	—	67.2367	67.2367	0.00100	0.00764	0.03778	69.5748
Hauling	0.00983	0.00216	0.11858	0.07523	0.00074	0.00136	0.47474	0.47610	0.00136	0.05225	0.05361	—	84.9452	84.9452	0.00688	0.01358	0.02691	89.1907
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00137	0.00103	0.00122	0.01870	0.00000	0.00000	0.01011	0.01011	0.00000	0.00237	0.00237	—	7.46236	7.46236	0.00006	0.00003	0.00369	7.47777
Vendor	0.00040	0.00021	0.00602	0.00265	0.00015	0.00000	0.00531	0.00531	0.00000	0.00129	0.00129	—	11.1318	11.1318	0.00017	0.00126	0.00626	11.5189
Hauling	0.00179	0.00039	0.02164	0.01373	0.00013	0.00025	0.08664	0.08689	0.00025	0.00954	0.00978	—	14.0636	14.0636	0.00114	0.00225	0.00446	14.7665

3.1.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.40161	0.39543	6.58397	19.8233	0.03627	0.09712	—	0.09712	0.09700	—	0.09700	—	3,907.86	3,907.86	0.15852	0.03170	—	3,921.27
Demolition	—	—	—	—	—	—	2.32589	2.32589	—	0.35221	0.35221	—	—	—	—	—	—	—
Onsite truck	0.00441	0.00282	0.05979	0.03598	0.00088	0.00000	0.03091	0.03091	0.00000	0.00751	0.00751	—	74.0275	74.0275	0.00176	0.00864	0.09269	76.7397

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.40161	0.39543	6.58397	19.8233	0.03627	0.09712	—	0.09712	0.09700	—	0.09700	—	3,907.86	3,907.86	0.15852	0.03170	—	3,921.27
Demolition	—	—	—	—	—	—	2.32589	2.32589	—	0.35221	0.35221	—	—	—	—	—	—	—
Onsite truck	0.00441	0.00265	0.06261	0.03898	0.00088	0.00000	0.03091	0.03091	0.00000	0.00751	0.00751	—	74.1048	74.1048	0.00176	0.00864	0.00241	76.7266
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02531	0.02492	0.41488	1.24914	0.00229	0.00612	—	0.00612	0.00611	—	0.00611	—	246.249	246.249	0.00999	0.00200	—	247.094
Demolition	—	—	—	—	—	—	0.14656	0.14656	—	0.02219	0.02219	—	—	—	—	—	—	—
Onsite truck	0.00028	0.00017	0.00388	0.00240	0.00006	0.00000	0.00194	0.00194	0.00000	0.00047	0.00047	—	4.66676	4.66676	0.00011	0.00054	0.00252	4.83434
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00462	0.00455	0.07572	0.22797	0.00042	0.00112	—	0.00112	0.00112	—	0.00112	—	40.7693	40.7693	0.00165	0.00033	—	40.9092
Demolition	—	—	—	—	—	—	0.02675	0.02675	—	0.00405	0.00405	—	—	—	—	—	—	—
Onsite truck	0.00005	0.00003	0.00071	0.00044	0.00001	0.00000	0.00035	0.00035	0.00000	0.00009	0.00009	—	0.77264	0.77264	0.00002	0.00009	0.00042	0.80038

3.1.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.12236	0.12125	0.07496	2.00951	0.00000	0.00000	0.88317	0.88317	0.00000	0.20701	0.20701	—	764.209	764.209	0.00441	0.00331	0.81968	766.125
Vendor	0.03439	0.01905	0.50742	0.22434	0.01323	0.00000	0.46361	0.46361	0.00000	0.11259	0.11259	—	1,066.93	1,066.93	0.01587	0.12117	1.39030	1,104.83
Hauling	0.15689	0.03517	1.81600	1.18933	0.01082	0.02164	7.68600	7.70764	0.02164	0.84456	0.86620	—	1,347.59	1,347.59	0.10910	0.21550	0.98718	1,415.53
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.12125	0.09149	0.10692	1.63363	0.00000	0.00000	0.88317	0.88317	0.00000	0.20701	0.20701	—	712.185	712.185	0.00551	0.00331	0.02124	713.329
Vendor	0.03439	0.01852	0.52646	0.22276	0.01323	0.00000	0.46361	0.46361	0.00000	0.11259	0.11259	—	1,067.15	1,067.15	0.01587	0.12117	0.03613	1,103.69
Hauling	0.15419	0.03246	1.91970	1.20105	0.01172	0.02164	7.68600	7.70764	0.02164	0.84456	0.86620	—	1,348.67	1,348.67	0.10820	0.21550	0.02569	1,415.62
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00750	0.00563	0.00667	0.10245	0.00000	0.00000	0.05538	0.05538	0.00000	0.01298	0.01298	—	45.0731	45.0731	0.00035	0.00021	0.02230	45.1661
Vendor	0.00217	0.00117	0.03297	0.01454	0.00083	0.00000	0.02908	0.02908	0.00000	0.00706	0.00706	—	67.2367	67.2367	0.00100	0.00764	0.03778	69.5748
Hauling	0.00983	0.00216	0.11858	0.07523	0.00074	0.00136	0.47474	0.47610	0.00136	0.05225	0.05361	—	84.9452	84.9452	0.00688	0.01358	0.02691	89.1907
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00137	0.00103	0.00122	0.01870	0.00000	0.00000	0.01011	0.01011	0.00000	0.00237	0.00237	—	7.46236	7.46236	0.00006	0.00003	0.00369	7.47777
Vendor	0.00040	0.00021	0.00602	0.00265	0.00015	0.00000	0.00531	0.00531	0.00000	0.00129	0.00129	—	11.1318	11.1318	0.00017	0.00126	0.00626	11.5189
Hauling	0.00179	0.00039	0.02164	0.01373	0.00013	0.00025	0.08664	0.08689	0.00025	0.00954	0.00978	—	14.0636	14.0636	0.00114	0.00225	0.00446	14.7665

3.2. Phase 2 Earthwork (2037)

3.2.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.07885	1.74681	10.9363	16.4184	0.04961	0.47358	—	0.47358	0.43569	—	0.43569	—	5,370.76	5,370.76	0.21786	0.04357	—	5,389.19
Dust From Material Movement	—	—	—	—	—	—	3.36793	3.36793	—	1.75879	1.75879	—	—	—	—	—	—	—
Onsite truck	0.00298	0.00190	0.04036	0.02429	0.00060	0.00000	0.02086	0.02086	0.00000	0.00507	0.00507	—	49.9686	49.9686	0.00119	0.00583	0.06256	51.7993
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.24491	0.20579	1.28839	1.93422	0.00584	0.05579	—	0.05579	0.05133	—	0.05133	—	632.720	632.720	0.02567	0.00513	—	634.891
Dust From Material Movement	—	—	—	—	—	—	0.39677	0.39677	—	0.20720	0.20720	—	—	—	—	—	—	—
Onsite truck	0.00035	0.00021	0.00489	0.00303	0.00007	0.00000	0.00245	0.00245	0.00000	0.00059	0.00059	—	5.88925	5.88925	0.00014	0.00069	0.00318	6.10073
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.04470	0.03756	0.23513	0.35299	0.00107	0.01018	—	0.01018	0.00937	—	0.00937	—	104.754	104.754	0.00425	0.00085	—	105.113
Dust From Material Movement	—	—	—	—	—	—	0.07241	0.07241	—	0.03781	0.03781	—	—	—	—	—	—	—
Onsite truck	0.00006	0.00004	0.00089	0.00055	0.00001	0.00000	0.00045	0.00045	0.00000	0.00011	0.00011	—	0.97503	0.97503	0.00002	0.00011	0.00053	1.01004

3.2.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09789	0.09700	0.05997	1.60761	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	611.367	611.367	0.00353	0.00265	0.65574	612.900
Vendor	0.02336	0.01294	0.34462	0.15237	0.00898	0.00000	0.31487	0.31487	0.00000	0.07647	0.07647	—	724.625	724.625	0.01078	0.08229	0.94425	750.362
Hauling	2.58565	0.44228	30.5090	19.0692	0.21264	0.42527	65.9090	66.3343	0.42527	8.10750	8.53277	—	25,870.0	25,870.0	1.91372	4.13364	19.3996	27,169.0
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01122	0.00842	0.00997	0.15324	0.00000	0.00000	0.08283	0.08283	0.00000	0.01941	0.01941	—	67.4136	67.4136	0.00052	0.00031	0.03335	67.5528
Vendor	0.00275	0.00148	0.04187	0.01846	0.00106	0.00000	0.03693	0.03693	0.00000	0.00897	0.00897	—	85.3736	85.3736	0.00127	0.00969	0.04798	88.3424
Hauling	0.30361	0.05110	3.73249	2.25152	0.02605	0.05010	7.62144	7.67154	0.05010	0.94026	0.99036	—	3,048.20	3,048.20	0.22545	0.48698	0.98868	3,199.94

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00205	0.00154	0.00182	0.02797	0.00000	0.00000	0.01512	0.01512	0.00000	0.00354	0.00354	—	11.1611	11.1611	0.00009	0.00005	0.00552	11.1841
Vendor	0.00050	0.00027	0.00764	0.00337	0.00019	0.00000	0.00674	0.00674	0.00000	0.00164	0.00164	—	14.1346	14.1346	0.00021	0.00161	0.00794	14.6261
Hauling	0.05541	0.00933	0.68118	0.41090	0.00475	0.00914	1.39091	1.40006	0.00914	0.17160	0.18074	—	504.664	504.664	0.03733	0.08062	0.16369	529.787

3.2.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.50831	0.50831	2.64323	27.6660	0.04963	0.10166	—	0.10166	0.10166	—	0.10166	—	5,373.11	5,373.11	0.21796	0.04359	—	5,391.55
Dust From Material Movement	—	—	—	—	—	—	3.36793	3.36793	—	1.75879	1.75879	—	—	—	—	—	—	—
Onsite truck	0.00298	0.00190	0.04036	0.02429	0.00060	0.00000	0.02086	0.02086	0.00000	0.00507	0.00507	—	49.9686	49.9686	0.00119	0.00583	0.06256	51.7993
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05988	0.05988	0.31139	3.25928	0.00585	0.01198	—	0.01198	0.01198	—	0.01198	—	632.996	632.996	0.02568	0.00514	—	635.168

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Dust From Material Movement	—	—	—	—	—	—	0.39677	0.39677	—	0.20720	0.20720	—	—	—	—	—	—	—
Onsite truck	0.00035	0.00021	0.00489	0.00303	0.00007	0.00000	0.00245	0.00245	0.00000	0.00059	0.00059	—	5.88925	5.88925	0.00014	0.00069	0.00318	6.10073
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01093	0.01093	0.05683	0.59482	0.00107	0.00219	—	0.00219	0.00219	—	0.00219	—	104.800	104.800	0.00425	0.00085	—	105.159
Dust From Material Movement	—	—	—	—	—	—	0.07241	0.07241	—	0.03781	0.03781	—	—	—	—	—	—	—
Onsite truck	0.00006	0.00004	0.00089	0.00055	0.00001	0.00000	0.00045	0.00045	0.00000	0.00011	0.00011	—	0.97503	0.97503	0.00002	0.00011	0.00053	1.01004

3.2.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09789	0.09700	0.05997	1.60761	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	611.367	611.367	0.00353	0.00265	0.65574	612.900
Vendor	0.02336	0.01294	0.34462	0.15237	0.00898	0.00000	0.31487	0.31487	0.00000	0.07647	0.07647	—	724.625	724.625	0.01078	0.08229	0.94425	750.362
Hauling	2.58565	0.44228	30.5090	19.0692	0.21264	0.42527	65.9090	66.3343	0.42527	8.10750	8.53277	—	25,870.0	25,870.0	1.91372	4.13364	19.3996	27,169.0

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01122	0.00842	0.00997	0.15324	0.00000	0.00000	0.08283	0.08283	0.00000	0.01941	0.01941	—	67.4136	67.4136	0.00052	0.00031	0.03335	67.5528
Vendor	0.00275	0.00148	0.04187	0.01846	0.00106	0.00000	0.03693	0.03693	0.00000	0.00897	0.00897	—	85.3736	85.3736	0.00127	0.00969	0.04798	88.3424
Hauling	0.30361	0.05110	3.73249	2.25152	0.02605	0.05010	7.62144	7.67154	0.05010	0.94026	0.99036	—	3,048.20	3,048.20	0.22545	0.48698	0.98868	3,199.94
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00205	0.00154	0.00182	0.02797	0.00000	0.00000	0.01512	0.01512	0.00000	0.00354	0.00354	—	11.1611	11.1611	0.00009	0.00005	0.00552	11.1841
Vendor	0.00050	0.00027	0.00764	0.00337	0.00019	0.00000	0.00674	0.00674	0.00000	0.00164	0.00164	—	14.1346	14.1346	0.00021	0.00161	0.00794	14.6261
Hauling	0.05541	0.00933	0.68118	0.41090	0.00475	0.00914	1.39091	1.40006	0.00914	0.17160	0.18074	—	504.664	504.664	0.03733	0.08062	0.16369	529.787

3.3. Phase 3 Foundation (2037)

3.3.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.85680	2.39289	14.1991	25.6658	0.07473	0.45358	—	0.45358	0.41729	—	0.41729	—	7,816.15	7,816.15	0.31706	0.06341	—	7,842.98

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Dust From Material Movement	—	—	—	—	—	—	0.01016	0.01016	—	0.00120	0.00120	—	—	—	—	—	—	—
Onsite truck	0.01262	0.00808	0.17115	0.10299	0.00252	0.00000	0.08847	0.08847	0.00000	0.02149	0.02149	—	211.904	211.904	0.00505	0.02474	0.26532	219.667
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.85680	2.39289	14.1991	25.6658	0.07473	0.45358	—	0.45358	0.41729	—	0.41729	—	7,816.15	7,816.15	0.31706	0.06341	—	7,842.98
Dust From Material Movement	—	—	—	—	—	—	0.01016	0.01016	—	0.00120	0.00120	—	—	—	—	—	—	—
Onsite truck	0.01262	0.00757	0.17922	0.11157	0.00252	0.00000	0.08847	0.08847	0.00000	0.02149	0.02149	—	212.125	212.125	0.00505	0.02474	0.00689	219.630
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.19080	0.99743	5.91859	10.6983	0.03115	0.18907	—	0.18907	0.17394	—	0.17394	—	3,258.01	3,258.01	0.13216	0.02643	—	3,269.19
Dust From Material Movement	—	—	—	—	—	—	0.00423	0.00423	—	0.00050	0.00050	—	—	—	—	—	—	—
Onsite truck	0.00526	0.00316	0.07344	0.04546	0.00105	0.00000	0.03671	0.03671	0.00000	0.00892	0.00892	—	88.3659	88.3659	0.00210	0.01031	0.04770	91.5390

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.21732	0.18203	1.08014	1.95244	0.00569	0.03450	—	0.03450	0.03174	—	0.03174	—	539.400	539.400	0.02188	0.00438	—	541.251
Dust From Material Movement	—	—	—	—	—	—	0.00077	0.00077	—	0.00009	0.00009	—	—	—	—	—	—	—
Onsite truck	0.00096	0.00058	0.01340	0.00830	0.00019	0.00000	0.00670	0.00670	0.00000	0.00163	0.00163	—	14.6300	14.6300	0.00035	0.00171	0.00790	15.1553

3.3.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.26918	0.26676	0.16491	4.42093	0.00000	0.00000	1.94298	1.94298	0.00000	0.45543	0.45543	—	1,681.26	1,681.26	0.00970	0.00728	1.80329	1,685.47
Vendor	0.09830	0.05445	1.45036	0.64125	0.03781	0.00000	1.32514	1.32514	0.00000	0.32183	0.32183	—	3,049.65	3,049.65	0.04537	0.34633	3.97394	3,157.96
Hauling	0.19498	0.02474	2.33705	1.40461	0.01819	0.03638	3.21030	3.24667	0.03638	0.45143	0.48781	—	2,180.60	2,180.60	0.15157	0.34824	1.65938	2,289.82
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.26676	0.20128	0.23523	3.59398	0.00000	0.00000	1.94298	1.94298	0.00000	0.45543	0.45543	—	1,566.81	1,566.81	0.01213	0.00728	0.04673	1,569.32
Vendor	0.09830	0.05293	1.50481	0.63671	0.03781	0.00000	1.32514	1.32514	0.00000	0.32183	0.32183	—	3,050.28	3,050.28	0.04537	0.34633	0.10327	3,154.73
Hauling	0.19425	0.02401	2.47189	1.40776	0.01843	0.03638	3.21030	3.24667	0.03638	0.45143	0.48781	—	2,180.88	2,180.88	0.15133	0.34824	0.04317	2,288.49

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10917	0.08188	0.09704	1.49100	0.00000	0.00000	0.80594	0.80594	0.00000	0.18885	0.18885	—	655.939	655.939	0.00505	0.00303	0.32452	657.294
Vendor	0.04098	0.02206	0.62347	0.27485	0.01576	0.00000	0.54989	0.54989	0.00000	0.13353	0.13353	—	1,271.29	1,271.29	0.01891	0.14436	0.71442	1,315.49
Hauling	0.08117	0.01021	1.01337	0.58599	0.00768	0.01516	1.31589	1.33105	0.01516	0.18577	0.20094	—	908.988	908.988	0.06318	0.14516	0.29922	954.123
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01992	0.01494	0.01771	0.27211	0.00000	0.00000	0.14708	0.14708	0.00000	0.03446	0.03446	—	108.598	108.598	0.00084	0.00050	0.05373	108.822
Vendor	0.00748	0.00403	0.11378	0.05016	0.00288	0.00000	0.10036	0.10036	0.00000	0.02437	0.02437	—	210.476	210.476	0.00313	0.02390	0.11828	217.795
Hauling	0.01481	0.00186	0.18494	0.10694	0.00140	0.00277	0.24015	0.24292	0.00277	0.03390	0.03667	—	150.493	150.493	0.01046	0.02403	0.04954	157.966

3.3.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.66972	1.48359	8.23903	39.6807	0.07761	0.19058	—	0.19058	0.18417	—	0.18417	—	8,127.46	8,127.46	0.32969	0.06594	—	8,155.35
Dust From Material Movement	—	—	—	—	—	—	0.01016	0.01016	—	0.00120	0.00120	—	—	—	—	—	—	—
Onsite truck	0.01262	0.00808	0.17115	0.10299	0.00252	0.00000	0.08847	0.08847	0.00000	0.02149	0.02149	—	211.904	211.904	0.00505	0.02474	0.26532	219.667

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.66972	1.48359	8.23903	39.6807	0.07761	0.19058	—	0.19058	0.18417	—	0.18417	—	8,127.46	8,127.46	0.32969	0.06594	—	8,155.35
Dust From Material Movement	—	—	—	—	—	—	0.01016	0.01016	—	0.00120	0.00120	—	—	—	—	—	—	—
Onsite truck	0.01262	0.00757	0.17922	0.11157	0.00252	0.00000	0.08847	0.08847	0.00000	0.02149	0.02149	—	212.125	212.125	0.00505	0.02474	0.00689	219.630
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.69599	0.61840	3.43427	16.5401	0.03235	0.07944	—	0.07944	0.07677	—	0.07677	—	3,387.77	3,387.77	0.13742	0.02748	—	3,399.39
Dust From Material Movement	—	—	—	—	—	—	0.00423	0.00423	—	0.00050	0.00050	—	—	—	—	—	—	—
Onsite truck	0.00526	0.00316	0.07344	0.04546	0.00105	0.00000	0.03671	0.03671	0.00000	0.00892	0.00892	—	88.3659	88.3659	0.00210	0.01031	0.04770	91.5390
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.12702	0.11286	0.62675	3.01857	0.00590	0.01450	—	0.01450	0.01401	—	0.01401	—	560.884	560.884	0.02275	0.00455	—	562.808

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Dust From Material Movement	—	—	—	—	—	—	0.00077	0.00077	—	0.00009	0.00009	—	—	—	—	—	—	—
Onsite truck	0.00096	0.00058	0.01340	0.00830	0.00019	0.00000	0.00670	0.00670	0.00000	0.00163	0.00163	—	14.6300	14.6300	0.00035	0.00171	0.00790	15.1553

3.3.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.26918	0.26676	0.16491	4.42093	0.00000	0.00000	1.94298	1.94298	0.00000	0.45543	0.45543	—	1,681.26	1,681.26	0.00970	0.00728	1.80329	1,685.47
Vendor	0.09830	0.05445	1.45036	0.64125	0.03781	0.00000	1.32514	1.32514	0.00000	0.32183	0.32183	—	3,049.65	3,049.65	0.04537	0.34633	3.97394	3,157.96
Hauling	0.19498	0.02474	2.33705	1.40461	0.01819	0.03638	3.21030	3.24667	0.03638	0.45143	0.48781	—	2,180.60	2,180.60	0.15157	0.34824	1.65938	2,289.82
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.26676	0.20128	0.23523	3.59398	0.00000	0.00000	1.94298	1.94298	0.00000	0.45543	0.45543	—	1,566.81	1,566.81	0.01213	0.00728	0.04673	1,569.32
Vendor	0.09830	0.05293	1.50481	0.63671	0.03781	0.00000	1.32514	1.32514	0.00000	0.32183	0.32183	—	3,050.28	3,050.28	0.04537	0.34633	0.10327	3,154.73
Hauling	0.19425	0.02401	2.47189	1.40776	0.01843	0.03638	3.21030	3.24667	0.03638	0.45143	0.48781	—	2,180.88	2,180.88	0.15133	0.34824	0.04317	2,288.49
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.10917	0.08188	0.09704	1.49100	0.00000	0.00000	0.80594	0.80594	0.00000	0.18885	0.18885	—	655.939	655.939	0.00505	0.00303	0.32452	657.294
Vendor	0.04098	0.02206	0.62347	0.27485	0.01576	0.00000	0.54989	0.54989	0.00000	0.13353	0.13353	—	1,271.29	1,271.29	0.01891	0.14436	0.71442	1,315.49

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.08117	0.01021	1.01337	0.58599	0.00768	0.01516	1.31589	1.33105	0.01516	0.18577	0.20094	—	908.988	908.988	0.06318	0.14516	0.29922	954.123
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01992	0.01494	0.01771	0.27211	0.00000	0.00000	0.14708	0.14708	0.00000	0.03446	0.03446	—	108.598	108.598	0.00084	0.00050	0.05373	108.822
Vendor	0.00748	0.00403	0.11378	0.05016	0.00288	0.00000	0.10036	0.10036	0.00000	0.02437	0.02437	—	210.476	210.476	0.00313	0.02390	0.11828	217.795
Hauling	0.01481	0.00186	0.18494	0.10694	0.00140	0.00277	0.24015	0.24292	0.00277	0.03390	0.03667	—	150.493	150.493	0.01046	0.02403	0.04954	157.966

3.4. Phase 3 Foundation (2038)

3.4.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.82445	2.36573	13.7310	25.5370	0.07473	0.43581	—	0.43581	0.40095	—	0.40095	—	7,816.14	7,816.14	0.31706	0.06341	—	7,842.96
Dust From Material Movement	—	—	—	—	—	—	0.01016	0.01016	—	0.00120	0.00120	—	—	—	—	—	—	—
Onsite truck	0.01262	0.00757	0.17165	0.10905	0.00252	0.00000	0.08847	0.08847	0.00000	0.02149	0.02149	—	202.651	202.651	0.00505	0.02474	0.00606	210.155

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.33164	0.27778	1.61225	2.99847	0.00878	0.05117	—	0.05117	0.04708	—	0.04708	—	917.746	917.746	0.03723	0.00745	—	920.896
Dust From Material Movement	—	—	—	—	—	—	0.00119	0.00119	—	0.00014	0.00014	—	—	—	—	—	—	—
Onsite truck	0.00148	0.00089	0.01944	0.01227	0.00030	0.00000	0.01034	0.01034	0.00000	0.00251	0.00251	—	23.7790	23.7790	0.00059	0.00290	0.01183	24.6712
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06052	0.05069	0.29424	0.54722	0.00160	0.00934	—	0.00934	0.00859	—	0.00859	—	151.943	151.943	0.00616	0.00123	—	152.465
Dust From Material Movement	—	—	—	—	—	—	0.00022	0.00022	—	0.00003	0.00003	—	—	—	—	—	—	—
Onsite truck	0.00027	0.00016	0.00355	0.00224	0.00005	0.00000	0.00189	0.00189	0.00000	0.00046	0.00046	—	3.93688	3.93688	0.00010	0.00048	0.00196	4.08460

3.4.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.25948	0.19401	0.23523	3.50667	0.00000	0.00000	1.94298	1.94298	0.00000	0.45543	0.45543	—	1,553.95	1,553.95	0.01213	0.00728	0.03953	1,556.46
Vendor	0.09830	0.05293	1.42163	0.62915	0.03781	0.00000	1.32514	1.32514	0.00000	0.32183	0.32183	—	2,909.11	2,909.11	0.04537	0.34633	0.09083	3,013.54
Hauling	0.17582	0.02401	2.41611	1.33525	0.01843	0.03638	3.19211	3.22848	0.03638	0.45143	0.48781	—	2,139.13	2,139.13	0.13289	0.34824	0.03745	2,246.27
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03018	0.02249	0.02705	0.40320	0.00000	0.00000	0.22702	0.22702	0.00000	0.05320	0.05320	—	183.256	183.256	0.00114	0.00085	0.07726	183.616
Vendor	0.01154	0.00622	0.16124	0.07227	0.00444	0.00000	0.15490	0.15490	0.00000	0.03761	0.03761	—	341.531	341.531	0.00533	0.04067	0.17712	353.960
Hauling	0.02070	0.00288	0.27891	0.15655	0.00214	0.00427	0.36854	0.37281	0.00427	0.05233	0.05660	—	251.150	251.150	0.01563	0.04089	0.07299	263.799
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00551	0.00411	0.00494	0.07358	0.00000	0.00000	0.04143	0.04143	0.00000	0.00971	0.00971	—	30.3400	30.3400	0.00019	0.00014	0.01279	30.3997
Vendor	0.00211	0.00113	0.02943	0.01319	0.00081	0.00000	0.02827	0.02827	0.00000	0.00686	0.00686	—	56.5444	56.5444	0.00088	0.00673	0.02932	58.6021
Hauling	0.00378	0.00052	0.05090	0.02857	0.00039	0.00078	0.06726	0.06804	0.00078	0.00955	0.01033	—	41.5808	41.5808	0.00259	0.00677	0.01208	43.6749

3.4.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	1.66499	1.47964	8.12828	39.6748	0.07761	0.18699	—	0.18699	0.18087	—	0.18087	—	8,127.45	8,127.45	0.32968	0.06594	—	8,155.34
Dust From Material Movement	—	—	—	—	—	—	0.01016	0.01016	—	0.00120	0.00120	—	—	—	—	—	—	—
Onsite truck	0.01262	0.00757	0.17165	0.10905	0.00252	0.00000	0.08847	0.08847	0.00000	0.02149	0.02149	—	202.651	202.651	0.00505	0.02474	0.00606	210.155
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19550	0.17373	0.95440	4.65849	0.00911	0.02196	—	0.02196	0.02124	—	0.02124	—	954.299	954.299	0.03871	0.00774	—	957.574
Dust From Material Movement	—	—	—	—	—	—	0.00119	0.00119	—	0.00014	0.00014	—	—	—	—	—	—	—
Onsite truck	0.00148	0.00089	0.01944	0.01227	0.00030	0.00000	0.01034	0.01034	0.00000	0.00251	0.00251	—	23.7790	23.7790	0.00059	0.00290	0.01183	24.6712
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03568	0.03171	0.17418	0.85017	0.00166	0.00401	—	0.00401	0.00388	—	0.00388	—	157.995	157.995	0.00641	0.00128	—	158.537
Dust From Material Movement	—	—	—	—	—	—	0.00022	0.00022	—	0.00003	0.00003	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00027	0.00016	0.00355	0.00224	0.00005	0.00000	0.00189	0.00189	0.00000	0.00046	0.00046	—	3.93688	3.93688	0.00010	0.00048	0.00196	4.08460

3.4.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.25948	0.19401	0.23523	3.50667	0.00000	0.00000	1.94298	1.94298	0.00000	0.45543	0.45543	—	1,553.95	1,553.95	0.01213	0.00728	0.03953	1,556.46
Vendor	0.09830	0.05293	1.42163	0.62915	0.03781	0.00000	1.32514	1.32514	0.00000	0.32183	0.32183	—	2,909.11	2,909.11	0.04537	0.34633	0.09083	3,013.54
Hauling	0.17582	0.02401	2.41611	1.33525	0.01843	0.03638	3.19211	3.22848	0.03638	0.45143	0.48781	—	2,139.13	2,139.13	0.13289	0.34824	0.03745	2,246.27
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03018	0.02249	0.02705	0.40320	0.00000	0.00000	0.22702	0.22702	0.00000	0.05320	0.05320	—	183.256	183.256	0.00114	0.00085	0.07726	183.616
Vendor	0.01154	0.00622	0.16124	0.07227	0.00444	0.00000	0.15490	0.15490	0.00000	0.03761	0.03761	—	341.531	341.531	0.00533	0.04067	0.17712	353.960
Hauling	0.02070	0.00288	0.27891	0.15655	0.00214	0.00427	0.36854	0.37281	0.00427	0.05233	0.05660	—	251.150	251.150	0.01563	0.04089	0.07299	263.799
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00551	0.00411	0.00494	0.07358	0.00000	0.00000	0.04143	0.04143	0.00000	0.00971	0.00971	—	30.3400	30.3400	0.00019	0.00014	0.01279	30.3997
Vendor	0.00211	0.00113	0.02943	0.01319	0.00081	0.00000	0.02827	0.02827	0.00000	0.00686	0.00686	—	56.5444	56.5444	0.00088	0.00673	0.02932	58.6021
Hauling	0.00378	0.00052	0.05090	0.02857	0.00039	0.00078	0.06726	0.06804	0.00078	0.00955	0.01033	—	41.5808	41.5808	0.00259	0.00677	0.01208	43.6749

3.5. Phase 4 Super Structureng Construction (2038)

3.5.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.09438	0.91890	6.20040	12.5789	0.03281	0.20078	—	0.20078	0.18471	—	0.18471	—	3,525.93	3,525.93	0.14303	0.02861	—	3,538.03
Onsite truck	0.00485	0.00291	0.06189	0.03803	0.00097	0.00000	0.03400	0.03400	0.00000	0.00826	0.00826	—	77.7868	77.7868	0.00194	0.00931	0.08975	80.7002
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.09438	0.91890	6.20040	12.5789	0.03281	0.20078	—	0.20078	0.18471	—	0.18471	—	3,525.93	3,525.93	0.14303	0.02861	—	3,538.03
Onsite truck	0.00485	0.00291	0.06596	0.04191	0.00097	0.00000	0.03400	0.03400	0.00000	0.00826	0.00826	—	77.8747	77.8747	0.00194	0.00951	0.00233	80.7584
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77528	0.65096	4.39245	8.91106	0.02324	0.14223	—	0.14223	0.13085	—	0.13085	—	2,497.82	2,497.82	0.10132	0.02026	—	2,506.40
Onsite truck	0.00344	0.00206	0.04508	0.02845	0.00069	0.00000	0.02398	0.02398	0.00000	0.00582	0.00582	—	55.1312	55.1312	0.00137	0.00673	0.02742	57.1998
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.14149	0.11880	0.80162	1.62627	0.00424	0.02596	—	0.02596	0.02388	—	0.02388	—	413.543	413.543	0.01678	0.00336	—	414.962
Onsite truck	0.00063	0.00038	0.00823	0.00519	0.00013	0.00000	0.00438	0.00438	0.00000	0.00106	0.00106	—	9.12760	9.12760	0.00023	0.00111	0.00454	9.47008

3.5.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14154	0.10714	0.08995	2.33470	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	909.551	909.551	0.00529	0.00397	0.83229	911.698
Vendor	0.03769	0.02029	0.50966	0.22961	0.01450	0.00000	0.50803	0.50803	0.00000	0.12338	0.12338	—	1,115.05	1,115.05	0.01739	0.13220	1.34113	1,156.22
Hauling	0.24546	0.03371	3.17199	1.84754	0.02543	0.05087	4.46392	4.51479	0.05087	0.63130	0.68217	—	2,988.84	2,988.84	0.18540	0.48663	2.01135	3,140.50
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14154	0.10582	0.12831	1.91273	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	847.608	847.608	0.00661	0.00397	0.02156	848.978
Vendor	0.03769	0.02029	0.54503	0.24120	0.01450	0.00000	0.50803	0.50803	0.00000	0.12338	0.12338	—	1,115.30	1,115.30	0.01739	0.13278	0.03482	1,155.34
Hauling	0.24423	0.03279	3.35953	1.85153	0.02574	0.05087	4.46392	4.51479	0.05087	0.63130	0.68217	—	2,989.22	2,989.22	0.18509	0.48663	0.05238	3,138.91
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09933	0.07403	0.08902	1.32689	0.00000	0.00000	0.74712	0.74712	0.00000	0.17507	0.17507	—	603.077	603.077	0.00375	0.00281	0.25427	604.263
Vendor	0.02670	0.01438	0.37296	0.16718	0.01027	0.00000	0.35829	0.35829	0.00000	0.08701	0.08701	—	789.986	789.986	0.01232	0.09406	0.40969	818.734
Hauling	0.17345	0.02366	2.34000	1.30991	0.01802	0.03604	3.10940	3.14544	0.03604	0.44152	0.47756	—	2,117.45	2,117.45	0.13134	0.34474	0.61581	2,224.08

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01813	0.01351	0.01625	0.24216	0.00000	0.00000	0.13635	0.13635	0.00000	0.03195	0.03195	—	99.8463	99.8463	0.00062	0.00047	0.04210	100.043
Vendor	0.00487	0.00262	0.06807	0.03051	0.00187	0.00000	0.06539	0.06539	0.00000	0.01588	0.01588	—	130.791	130.791	0.00204	0.01557	0.06783	135.551
Hauling	0.03166	0.00432	0.42705	0.23906	0.00329	0.00658	0.56747	0.57404	0.00658	0.08058	0.08715	—	350.568	350.568	0.02174	0.05708	0.10195	368.222

3.5.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49924	0.46123	3.07502	18.2222	0.03281	0.07340	—	0.07340	0.07172	—	0.07172	—	3,526.00	3,526.00	0.14303	0.02861	—	3,538.10
Onsite truck	0.00485	0.00291	0.06189	0.03803	0.00097	0.00000	0.03400	0.03400	0.00000	0.00826	0.00826	—	77.7868	77.7868	0.00194	0.00931	0.08975	80.7002
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49924	0.46123	3.07502	18.2222	0.03281	0.07340	—	0.07340	0.07172	—	0.07172	—	3,526.00	3,526.00	0.14303	0.02861	—	3,538.10
Onsite truck	0.00485	0.00291	0.06596	0.04191	0.00097	0.00000	0.03400	0.03400	0.00000	0.00826	0.00826	—	77.8747	77.8747	0.00194	0.00951	0.00233	80.7584
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.35367	0.32674	2.17839	12.9089	0.02324	0.05199	—	0.05199	0.05081	—	0.05081	—	2,497.87	2,497.87	0.10132	0.02026	—	2,506.44
Onsite truck	0.00344	0.00206	0.04508	0.02845	0.00069	0.00000	0.02398	0.02398	0.00000	0.00582	0.00582	—	55.1312	55.1312	0.00137	0.00673	0.02742	57.1998
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06454	0.05963	0.39756	2.35587	0.00424	0.00949	—	0.00949	0.00927	—	0.00927	—	413.551	413.551	0.01678	0.00336	—	414.970
Onsite truck	0.00063	0.00038	0.00823	0.00519	0.00013	0.00000	0.00438	0.00438	0.00000	0.00106	0.00106	—	9.12760	9.12760	0.00023	0.00111	0.00454	9.47008

3.5.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14154	0.10714	0.08995	2.33470	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	909.551	909.551	0.00529	0.00397	0.83229	911.698
Vendor	0.03769	0.02029	0.50966	0.22961	0.01450	0.00000	0.50803	0.50803	0.00000	0.12338	0.12338	—	1,115.05	1,115.05	0.01739	0.13220	1.34113	1,156.22
Hauling	0.24546	0.03371	3.17199	1.84754	0.02543	0.05087	4.46392	4.51479	0.05087	0.63130	0.68217	—	2,988.84	2,988.84	0.18540	0.48663	2.01135	3,140.50
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14154	0.10582	0.12831	1.91273	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	847.608	847.608	0.00661	0.00397	0.02156	848.978
Vendor	0.03769	0.02029	0.54503	0.24120	0.01450	0.00000	0.50803	0.50803	0.00000	0.12338	0.12338	—	1,115.30	1,115.30	0.01739	0.13278	0.03482	1,155.34
Hauling	0.24423	0.03279	3.35953	1.85153	0.02574	0.05087	4.46392	4.51479	0.05087	0.63130	0.68217	—	2,989.22	2,989.22	0.18509	0.48663	0.05238	3,138.91

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09933	0.07403	0.08902	1.32689	0.00000	0.00000	0.74712	0.74712	0.00000	0.17507	0.17507	—	603.077	603.077	0.00375	0.00281	0.25427	604.263
Vendor	0.02670	0.01438	0.37296	0.16718	0.01027	0.00000	0.35829	0.35829	0.00000	0.08701	0.08701	—	789.986	789.986	0.01232	0.09406	0.40969	818.734
Hauling	0.17345	0.02366	2.34000	1.30991	0.01802	0.03604	3.10940	3.14544	0.03604	0.44152	0.47756	—	2,117.45	2,117.45	0.13134	0.34474	0.61581	2,224.08
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01813	0.01351	0.01625	0.24216	0.00000	0.00000	0.13635	0.13635	0.00000	0.03195	0.03195	—	99.8463	99.8463	0.00062	0.00047	0.04210	100.043
Vendor	0.00487	0.00262	0.06807	0.03051	0.00187	0.00000	0.06539	0.06539	0.00000	0.01588	0.01588	—	130.791	130.791	0.00204	0.01557	0.06783	135.551
Hauling	0.03166	0.00432	0.42705	0.23906	0.00329	0.00658	0.56747	0.57404	0.00658	0.08058	0.08715	—	350.568	350.568	0.02174	0.05708	0.10195	368.222

3.6. Phase 4 Super Structureng Construction (2039)

3.6.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.07839	0.90546	5.98518	12.4285	0.03281	0.19366	—	0.19366	0.17817	—	0.17817	—	3,525.93	3,525.93	0.14303	0.02861	—	3,538.03
Onsite truck	0.00466	0.00291	0.05898	0.03628	0.00097	0.00000	0.03400	0.03400	0.00000	0.00826	0.00826	—	74.4877	74.4877	0.00194	0.00931	0.07879	77.3901
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	1.07839	0.90546	5.98518	12.4285	0.03281	0.19366	—	0.19366	0.17817	—	0.17817	—	3,525.93	3,525.93	0.14303	0.02861	—	3,538.03
Onsite truck	0.00485	0.00291	0.06208	0.04016	0.00097	0.00000	0.03400	0.03400	0.00000	0.00826	0.00826	—	74.5789	74.5789	0.00194	0.00951	0.00204	77.4624
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.31022	0.26047	1.72176	3.57532	0.00944	0.05571	—	0.05571	0.05125	—	0.05125	—	1,014.31	1,014.31	0.04114	0.00823	—	1,017.79
Onsite truck	0.00140	0.00078	0.01752	0.01105	0.00028	0.00000	0.00974	0.00974	0.00000	0.00236	0.00236	—	21.4390	21.4390	0.00056	0.00268	0.00978	22.2610
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05662	0.04754	0.31422	0.65250	0.00172	0.01017	—	0.01017	0.00935	—	0.00935	—	167.930	167.930	0.00681	0.00136	—	168.507
Onsite truck	0.00025	0.00014	0.00320	0.00202	0.00005	0.00000	0.00178	0.00178	0.00000	0.00043	0.00043	—	3.54947	3.54947	0.00009	0.00044	0.00162	3.68556

3.6.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13625	0.10185	0.08863	2.26062	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	902.954	902.954	0.00529	0.00397	0.69988	904.969
Vendor	0.03711	0.02029	0.47777	0.21279	0.01450	0.00000	0.50803	0.50803	0.00000	0.12338	0.12338	—	1,066.06	1,066.06	0.01739	0.13220	1.17737	1,107.07
Hauling	0.21972	0.03371	3.09354	1.74611	0.02543	0.05087	4.46392	4.51479	0.05087	0.63130	0.68217	—	2,936.14	2,936.14	0.18509	0.46120	1.74584	3,079.95

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13625	0.10053	0.12699	1.83469	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	841.467	841.467	0.00661	0.00397	0.01811	842.833
Vendor	0.03769	0.02029	0.49864	0.22439	0.01450	0.00000	0.50803	0.50803	0.00000	0.12338	0.12338	—	1,066.34	1,066.34	0.01739	0.13278	0.03047	1,106.37
Hauling	0.21849	0.03279	3.25626	1.75009	0.02574	0.05087	4.46392	4.51479	0.05087	0.63130	0.68217	—	2,936.50	2,936.50	0.18509	0.46120	0.04510	3,078.61
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03843	0.02816	0.02664	0.52588	0.00000	0.00000	0.30339	0.30339	0.00000	0.07109	0.07109	—	243.130	243.130	0.00152	0.00114	0.08679	243.595
Vendor	0.01084	0.00567	0.14244	0.06305	0.00417	0.00000	0.14549	0.14549	0.00000	0.03533	0.03533	—	306.709	306.709	0.00500	0.03803	0.14609	318.313
Hauling	0.06303	0.00961	0.92042	0.50275	0.00732	0.01463	1.26266	1.27729	0.01463	0.17929	0.19392	—	844.683	844.683	0.05325	0.13267	0.21659	885.768
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00701	0.00514	0.00486	0.09597	0.00000	0.00000	0.05537	0.05537	0.00000	0.01297	0.01297	—	40.2530	40.2530	0.00025	0.00019	0.01437	40.3299
Vendor	0.00198	0.00103	0.02600	0.01151	0.00076	0.00000	0.02655	0.02655	0.00000	0.00645	0.00645	—	50.7791	50.7791	0.00083	0.00630	0.02419	52.7003
Hauling	0.01150	0.00175	0.16798	0.09175	0.00134	0.00267	0.23044	0.23311	0.00267	0.03272	0.03539	—	139.847	139.847	0.00882	0.02197	0.03586	146.649

3.6.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49773	0.45996	3.05199	18.2207	0.03281	0.07243	—	0.07243	0.07083	—	0.07083	—	3,525.99	3,525.99	0.14303	0.02861	—	3,538.09

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00466	0.00291	0.05898	0.03628	0.00097	0.00000	0.03400	0.03400	0.00000	0.00826	0.00826	—	74.4877	74.4877	0.00194	0.00931	0.07879	77.3901
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49773	0.45996	3.05199	18.2207	0.03281	0.07243	—	0.07243	0.07083	—	0.07083	—	3,525.99	3,525.99	0.14303	0.02861	—	3,538.09
Onsite truck	0.00485	0.00291	0.06208	0.04016	0.00097	0.00000	0.03400	0.03400	0.00000	0.00826	0.00826	—	74.5789	74.5789	0.00194	0.00951	0.00204	77.4624
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.14318	0.13232	0.87797	5.24156	0.00944	0.02084	—	0.02084	0.02038	—	0.02038	—	1,014.33	1,014.33	0.04115	0.00823	—	1,017.81
Onsite truck	0.00140	0.00078	0.01752	0.01105	0.00028	0.00000	0.00974	0.00974	0.00000	0.00236	0.00236	—	21.4390	21.4390	0.00056	0.00268	0.00978	22.2610
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02613	0.02415	0.16023	0.95658	0.00172	0.00380	—	0.00380	0.00372	—	0.00372	—	167.933	167.933	0.00681	0.00136	—	168.510
Onsite truck	0.00025	0.00014	0.00320	0.00202	0.00005	0.00000	0.00178	0.00178	0.00000	0.00043	0.00043	—	3.54947	3.54947	0.00009	0.00044	0.00162	3.68556

3.6.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13625	0.10185	0.08863	2.26062	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	902.954	902.954	0.00529	0.00397	0.69988	904.969
Vendor	0.03711	0.02029	0.47777	0.21279	0.01450	0.00000	0.50803	0.50803	0.00000	0.12338	0.12338	—	1,066.06	1,066.06	0.01739	0.13220	1.17737	1,107.07
Hauling	0.21972	0.03371	3.09354	1.74611	0.02543	0.05087	4.46392	4.51479	0.05087	0.63130	0.68217	—	2,936.14	2,936.14	0.18509	0.46120	1.74584	3,079.95
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13625	0.10053	0.12699	1.83469	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	841.467	841.467	0.00661	0.00397	0.01811	842.833
Vendor	0.03769	0.02029	0.49864	0.22439	0.01450	0.00000	0.50803	0.50803	0.00000	0.12338	0.12338	—	1,066.34	1,066.34	0.01739	0.13278	0.03047	1,106.37
Hauling	0.21849	0.03279	3.25626	1.75009	0.02574	0.05087	4.46392	4.51479	0.05087	0.63130	0.68217	—	2,936.50	2,936.50	0.18509	0.46120	0.04510	3,078.61
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03843	0.02816	0.02664	0.52588	0.00000	0.00000	0.30339	0.30339	0.00000	0.07109	0.07109	—	243.130	243.130	0.00152	0.00114	0.08679	243.595
Vendor	0.01084	0.00567	0.14244	0.06305	0.00417	0.00000	0.14549	0.14549	0.00000	0.03533	0.03533	—	306.709	306.709	0.00500	0.03803	0.14609	318.313
Hauling	0.06303	0.00961	0.92042	0.50275	0.00732	0.01463	1.26266	1.27729	0.01463	0.17929	0.19392	—	844.683	844.683	0.05325	0.13267	0.21659	885.768
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00701	0.00514	0.00486	0.09597	0.00000	0.00000	0.05537	0.05537	0.00000	0.01297	0.01297	—	40.2530	40.2530	0.00025	0.00019	0.01437	40.3299
Vendor	0.00198	0.00103	0.02600	0.01151	0.00076	0.00000	0.02655	0.02655	0.00000	0.00645	0.00645	—	50.7791	50.7791	0.00083	0.00630	0.02419	52.7003
Hauling	0.01150	0.00175	0.16798	0.09175	0.00134	0.00267	0.23044	0.23311	0.00267	0.03272	0.03539	—	139.847	139.847	0.00882	0.02197	0.03586	146.649

3.7. Phase dust control (2037)

3.7.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00459	0.00141	0.05146	0.03624	0.00022	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	29.1663	29.1663	0.00287	0.00467	0.02011	30.6509
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00445	0.00128	0.05437	0.03682	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	29.2190	29.2190	0.00282	0.00467	0.00052	30.6828
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00271	0.00082	0.03171	0.02176	0.00016	0.00026	0.43838	0.43864	0.00026	0.04457	0.04484	—	17.4217	17.4217	0.00171	0.00279	0.00519	18.3009
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00049	0.00015	0.00579	0.00397	0.00003	0.00005	0.08000	0.08005	0.00005	0.00813	0.00818	—	2.88435	2.88435	0.00028	0.00046	0.00086	3.02993

3.7.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.7.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00459	0.00141	0.05146	0.03624	0.00022	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	29.1663	29.1663	0.00287	0.00467	0.02011	30.6509
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00445	0.00128	0.05437	0.03682	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	29.2190	29.2190	0.00282	0.00467	0.00052	30.6828
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00271	0.00082	0.03171	0.02176	0.00016	0.00026	0.43838	0.43864	0.00026	0.04457	0.04484	—	17.4217	17.4217	0.00171	0.00279	0.00519	18.3009
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00049	0.00015	0.00579	0.00397	0.00003	0.00005	0.08000	0.08005	0.00005	0.00813	0.00818	—	2.88435	2.88435	0.00028	0.00046	0.00086	3.02993

3.7.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.8. Phase dust control (2038)

3.8.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00437	0.00141	0.05057	0.03541	0.00022	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.6450	28.6450	0.00260	0.00467	0.01743	30.1202

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00419	0.00128	0.05348	0.03598	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.6989	28.6989	0.00256	0.00467	0.00045	30.1561
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00305	0.00098	0.03732	0.02545	0.00016	0.00031	0.52446	0.52478	0.00031	0.05334	0.05366	—	20.4769	20.4769	0.00186	0.00334	0.00538	21.5236
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00056	0.00018	0.00681	0.00464	0.00003	0.00006	0.09571	0.09577	0.00006	0.00973	0.00979	—	3.39018	3.39018	0.00031	0.00055	0.00089	3.56347

3.8.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.8.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00437	0.00141	0.05057	0.03541	0.00022	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.6450	28.6450	0.00260	0.00467	0.01743	30.1202
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00419	0.00128	0.05348	0.03598	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.6989	28.6989	0.00256	0.00467	0.00045	30.1561
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00305	0.00098	0.03732	0.02545	0.00016	0.00031	0.52446	0.52478	0.00031	0.05334	0.05366	—	20.4769	20.4769	0.00186	0.00334	0.00538	21.5236
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00056	0.00018	0.00681	0.00464	0.00003	0.00006	0.09571	0.09577	0.00006	0.00973	0.00979	—	3.39018	3.39018	0.00031	0.00055	0.00089	3.56347

3.8.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.9. Phase dust control (2039)

3.9.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00410	0.00141	0.04960	0.03457	0.00022	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.1749	28.1749	0.00256	0.00445	0.01513	29.5811
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00392	0.00128	0.05238	0.03514	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.2301	28.2301	0.00256	0.00445	0.00039	29.6216
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00287	0.00098	0.03650	0.02485	0.00016	0.00031	0.52446	0.52478	0.00031	0.05334	0.05366	—	20.1414	20.1414	0.00183	0.00318	0.00466	21.1397
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00052	0.00018	0.00666	0.00453	0.00003	0.00006	0.09571	0.09577	0.00006	0.00973	0.00979	—	3.33464	3.33464	0.00030	0.00053	0.00077	3.49992

3.9.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.9.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00410	0.00141	0.04960	0.03457	0.00022	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.1749	28.1749	0.00256	0.00445	0.01513	29.5811
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00392	0.00128	0.05238	0.03514	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.2301	28.2301	0.00256	0.00445	0.00039	29.6216
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00287	0.00098	0.03650	0.02485	0.00016	0.00031	0.52446	0.52478	0.00031	0.05334	0.05366	—	20.1414	20.1414	0.00183	0.00318	0.00466	21.1397
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00052	0.00018	0.00666	0.00453	0.00003	0.00006	0.09571	0.09577	0.00006	0.00973	0.00979	—	3.33464	3.33464	0.00030	0.00053	0.00077	3.49992

3.9.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.10. Phase dust control (2040)

3.10.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00388	0.00128	0.05150	0.03452	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	27.8113	27.8113	0.00229	0.00445	0.00034	29.1961
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00036	0.00012	0.00452	0.00308	0.00002	0.00004	0.06610	0.06614	0.00004	0.00672	0.00676	—	2.50060	2.50060	0.00021	0.00040	0.00051	2.62573
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00007	0.00002	0.00083	0.00056	< 0.000005	0.00001	0.01206	0.01207	0.00001	0.00123	0.00123	—	0.41400	0.41400	0.00003	0.00007	0.00008	0.43472

3.10.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.10.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00388	0.00128	0.05150	0.03452	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	27.8113	27.8113	0.00229	0.00445	0.00034	29.1961
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00036	0.00012	0.00452	0.00308	0.00002	0.00004	0.06610	0.06614	0.00004	0.00672	0.00676	—	2.50060	2.50060	0.00021	0.00040	0.00051	2.62573
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00007	0.00002	0.00083	0.00056	< 0.000005	0.00001	0.01206	0.01207	0.00001	0.00123	0.00123	—	0.41400	0.41400	0.00003	0.00007	0.00008	0.43472

3.10.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.11. Phase 5 Parking Lot Improvements (2039)

3.11.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.37418	0.31320	2.10557	3.80836	0.01139	0.04741	—	0.04741	0.04362	—	0.04362	—	1,188.81	1,188.81	0.04822	0.00964	—	1,192.89
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00190	0.00119	0.02413	0.01484	0.00040	0.00000	0.01391	0.01391	0.00000	0.00338	0.00338	—	30.4723	30.4723	0.00079	0.00381	0.03223	31.6596
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.37418	0.31320	2.10557	3.80836	0.01139	0.04741	—	0.04741	0.04362	—	0.04362	—	1,188.81	1,188.81	0.04822	0.00964	—	1,192.89
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00198	0.00119	0.02540	0.01643	0.00040	0.00000	0.01391	0.01391	0.00000	0.00338	0.00338	—	30.5096	30.5096	0.00079	0.00389	0.00083	31.6891
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.09885	0.08274	0.55627	1.00612	0.00301	0.01253	—	0.01253	0.01152	—	0.01152	—	314.070	314.070	0.01274	0.00255	—	315.148
Demolition	—	—	—	—	—	—	0.05577	0.05577	—	0.00845	0.00845	—	—	—	—	—	—	—
Paving	0.01502	0.01502	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00052	0.00029	0.00658	0.00415	0.00010	0.00000	0.00366	0.00366	0.00000	0.00089	0.00089	—	8.05453	8.05453	0.00021	0.00101	0.00367	8.36337
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01804	0.01510	0.10152	0.18362	0.00055	0.00229	—	0.00229	0.00210	—	0.00210	—	51.9979	51.9979	0.00211	0.00042	—	52.1763
Demolition	—	—	—	—	—	—	0.01018	0.01018	—	0.00154	0.00154	—	—	—	—	—	—	—
Paving	0.00274	0.00274	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00010	0.00005	0.00120	0.00076	0.00002	0.00000	0.00067	0.00067	0.00000	0.00016	0.00016	—	1.33352	1.33352	0.00003	0.00017	0.00061	1.38465

3.11.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09083	0.06790	0.05908	1.50708	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	601.970	601.970	0.00353	0.00265	0.46659	603.313
Vendor	0.01510	0.00826	0.19438	0.08657	0.00590	0.00000	0.20669	0.20669	0.00000	0.05020	0.05020	—	433.722	433.722	0.00708	0.05378	0.47901	450.405
Hauling	0.04500	0.01178	0.58292	0.36999	0.00362	0.00725	0.87795	0.88520	0.00725	0.11408	0.12132	—	435.387	435.387	0.03232	0.06856	0.24878	456.875
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09083	0.06702	0.08466	1.22312	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	560.978	560.978	0.00441	0.00265	0.01207	561.888
Vendor	0.01533	0.00826	0.20287	0.09129	0.00590	0.00000	0.20669	0.20669	0.00000	0.05020	0.05020	—	433.832	433.832	0.00708	0.05402	0.01240	450.120
Hauling	0.04379	0.01087	0.61464	0.37392	0.00393	0.00725	0.87795	0.88520	0.00725	0.11408	0.12132	—	435.763	435.763	0.03232	0.06856	0.00643	457.008
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02353	0.01724	0.01631	0.32197	0.00000	0.00000	0.18575	0.18575	0.00000	0.04352	0.04352	—	148.855	148.855	0.00093	0.00070	0.05314	149.140
Vendor	0.00405	0.00212	0.05322	0.02356	0.00156	0.00000	0.05436	0.05436	0.00000	0.01320	0.01320	—	114.596	114.596	0.00187	0.01421	0.05458	118.932
Hauling	0.01173	0.00303	0.15895	0.09815	0.00096	0.00192	0.22780	0.22972	0.00192	0.02970	0.03162	—	115.065	115.065	0.00854	0.01811	0.02834	120.705
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00429	0.00315	0.00298	0.05876	0.00000	0.00000	0.03390	0.03390	0.00000	0.00794	0.00794	—	24.6447	24.6447	0.00015	0.00012	0.00880	24.6918
Vendor	0.00074	0.00039	0.00971	0.00430	0.00028	0.00000	0.00992	0.00992	0.00000	0.00241	0.00241	—	18.9727	18.9727	0.00031	0.00235	0.00904	19.6905
Hauling	0.00214	0.00055	0.02901	0.01791	0.00017	0.00035	0.04157	0.04192	0.00035	0.00542	0.00577	—	19.0503	19.0503	0.00141	0.00300	0.00469	19.9840

3.11.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19003	0.17481	1.58254	6.58859	0.01140	0.02605	—	0.02605	0.02578	—	0.02578	—	1,190.02	1,190.02	0.04827	0.00965	—	1,194.10
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00190	0.00119	0.02413	0.01484	0.00040	0.00000	0.01391	0.01391	0.00000	0.00338	0.00338	—	30.4723	30.4723	0.00079	0.00381	0.03223	31.6596
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19003	0.17481	1.58254	6.58859	0.01140	0.02605	—	0.02605	0.02578	—	0.02578	—	1,190.02	1,190.02	0.04827	0.00965	—	1,194.10
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00198	0.00119	0.02540	0.01643	0.00040	0.00000	0.01391	0.01391	0.00000	0.00338	0.00338	—	30.5096	30.5096	0.00079	0.00389	0.00083	31.6891
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05020	0.04618	0.41809	1.74063	0.00301	0.00688	—	0.00688	0.00681	—	0.00681	—	314.389	314.389	0.01275	0.00255	—	315.468
Demolition	—	—	—	—	—	—	0.05577	0.05577	—	0.00845	0.00845	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Paving	0.01502	0.01502	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00052	0.00029	0.00658	0.00415	0.00010	0.00000	0.00366	0.00366	0.00000	0.00089	0.00089	—	8.05453	8.05453	0.00021	0.00101	0.00367	8.36337
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00916	0.00843	0.07630	0.31766	0.00055	0.00126	—	0.00126	0.00124	—	0.00124	—	52.0507	52.0507	0.00211	0.00042	—	52.2293
Demolition	—	—	—	—	—	—	0.01018	0.01018	—	0.00154	0.00154	—	—	—	—	—	—	—
Paving	0.00274	0.00274	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00010	0.00005	0.00120	0.00076	0.00002	0.00000	0.00067	0.00067	0.00000	0.00016	0.00016	—	1.33352	1.33352	0.00003	0.00017	0.00061	1.38465

3.11.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09083	0.06790	0.05908	1.50708	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	601.970	601.970	0.00353	0.00265	0.46659	603.313
Vendor	0.01510	0.00826	0.19438	0.08657	0.00590	0.00000	0.20669	0.20669	0.00000	0.05020	0.05020	—	433.722	433.722	0.00708	0.05378	0.47901	450.405
Hauling	0.04500	0.01178	0.58292	0.36999	0.00362	0.00725	0.87795	0.88520	0.00725	0.11408	0.12132	—	435.387	435.387	0.03232	0.06856	0.24878	456.875
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09083	0.06702	0.08466	1.22312	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	560.978	560.978	0.00441	0.00265	0.01207	561.888

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.01533	0.00826	0.20287	0.09129	0.00590	0.00000	0.20669	0.20669	0.00000	0.05020	0.05020	—	433.832	433.832	0.00708	0.05402	0.01240	450.120
Hauling	0.04379	0.01087	0.61464	0.37392	0.00393	0.00725	0.87795	0.88520	0.00725	0.11408	0.12132	—	435.763	435.763	0.03232	0.06856	0.00643	457.008
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02353	0.01724	0.01631	0.32197	0.00000	0.00000	0.18575	0.18575	0.00000	0.04352	0.04352	—	148.855	148.855	0.00093	0.00070	0.05314	149.140
Vendor	0.00405	0.00212	0.05322	0.02356	0.00156	0.00000	0.05436	0.05436	0.00000	0.01320	0.01320	—	114.596	114.596	0.00187	0.01421	0.05458	118.932
Hauling	0.01173	0.00303	0.15895	0.09815	0.00096	0.00192	0.22780	0.22972	0.00192	0.02970	0.03162	—	115.065	115.065	0.00854	0.01811	0.02834	120.705
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00429	0.00315	0.00298	0.05876	0.00000	0.00000	0.03390	0.03390	0.00000	0.00794	0.00794	—	24.6447	24.6447	0.00015	0.00012	0.00880	24.6918
Vendor	0.00074	0.00039	0.00971	0.00430	0.00028	0.00000	0.00992	0.00992	0.00000	0.00241	0.00241	—	18.9727	18.9727	0.00031	0.00235	0.00904	19.6905
Hauling	0.00214	0.00055	0.02901	0.01791	0.00017	0.00035	0.04157	0.04192	0.00035	0.00542	0.00577	—	19.0503	19.0503	0.00141	0.00300	0.00469	19.9840

3.12. Phase 5 Parking Lot Improvements (2040)

3.12.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.37085	0.31040	2.06491	3.80519	0.01139	0.04601	—	0.04601	0.04233	—	0.04233	—	1,188.82	1,188.82	0.04822	0.00964	—	1,192.90
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00190	0.00103	0.02421	0.01579	0.00040	0.00000	0.01391	0.01391	0.00000	0.00338	0.00338	—	29.2559	29.2559	0.00079	0.00341	0.00073	30.2935
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03338	0.02794	0.18588	0.34254	0.00103	0.00414	—	0.00414	0.00381	—	0.00381	—	107.017	107.017	0.00434	0.00087	—	107.384
Demolition	—	—	—	—	—	—	0.01900	0.01900	—	0.00288	0.00288	—	—	—	—	—	—	—
Paving	0.00512	0.00512	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00017	0.00009	0.00214	0.00139	0.00004	0.00000	0.00125	0.00125	0.00000	0.00030	0.00030	—	2.63160	2.63160	0.00007	0.00031	0.00110	2.72604
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00609	0.00510	0.03392	0.06251	0.00019	0.00076	—	0.00076	0.00070	—	0.00070	—	17.7179	17.7179	0.00072	0.00014	—	17.7787
Demolition	—	—	—	—	—	—	0.00347	0.00347	—	0.00053	0.00053	—	—	—	—	—	—	—
Paving	0.00093	0.00093	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00003	0.00002	0.00039	0.00025	0.00001	0.00000	0.00023	0.00023	0.00000	0.00006	0.00006	—	0.43569	0.43569	0.00001	0.00005	0.00018	0.45133

3.12.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08730	0.06349	0.08466	1.19402	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	557.441	557.441	0.00353	0.00265	0.01012	558.328
Vendor	0.01510	0.00778	0.18990	0.08469	0.00590	0.00000	0.20669	0.20669	0.00000	0.05020	0.05020	—	415.325	415.325	0.00708	0.04789	0.01088	429.783
Hauling	0.04349	0.01087	0.60225	0.36335	0.00393	0.00725	0.87795	0.88520	0.00725	0.11408	0.12132	—	428.980	428.980	0.02839	0.06856	0.00560	450.127
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00778	0.00564	0.00548	0.10717	0.00000	0.00000	0.06329	0.06329	0.00000	0.01483	0.01483	—	50.3989	50.3989	0.00032	0.00024	0.01515	50.4929
Vendor	0.00136	0.00070	0.01697	0.00796	0.00053	0.00000	0.01852	0.01852	0.00000	0.00450	0.00450	—	37.3814	37.3814	0.00064	0.00431	0.01632	38.6983
Hauling	0.00400	0.00103	0.05305	0.03249	0.00033	0.00065	0.07762	0.07827	0.00065	0.01012	0.01077	—	38.5963	38.5963	0.00256	0.00617	0.00840	40.5078
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00142	0.00103	0.00100	0.01956	0.00000	0.00000	0.01155	0.01155	0.00000	0.00271	0.00271	—	8.34411	8.34411	0.00005	0.00004	0.00251	8.35968
Vendor	0.00025	0.00013	0.00310	0.00145	0.00010	0.00000	0.00338	0.00338	0.00000	0.00082	0.00082	—	6.18892	6.18892	0.00011	0.00071	0.00270	6.40694
Hauling	0.00073	0.00019	0.00968	0.00593	0.00006	0.00012	0.01417	0.01428	0.00012	0.00185	0.00197	—	6.39006	6.39006	0.00042	0.00102	0.00139	6.70653

3.12.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19026	0.17500	1.58172	6.58998	0.01140	0.02594	—	0.02594	0.02568	—	0.02568	—	1,190.03	1,190.03	0.04827	0.00965	—	1,194.11
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00190	0.00103	0.02421	0.01579	0.00040	0.00000	0.01391	0.01391	0.00000	0.00338	0.00338	—	29.2559	29.2559	0.00079	0.00341	0.00073	30.2935
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01713	0.01575	0.14239	0.59323	0.00103	0.00233	—	0.00233	0.00231	—	0.00231	—	107.126	107.126	0.00435	0.00087	—	107.494
Demolition	—	—	—	—	—	—	0.01900	0.01900	—	0.00288	0.00288	—	—	—	—	—	—	—
Paving	0.00512	0.00512	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00017	0.00009	0.00214	0.00139	0.00004	0.00000	0.00125	0.00125	0.00000	0.00030	0.00030	—	2.63160	2.63160	0.00007	0.00031	0.00110	2.72604
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00313	0.00288	0.02599	0.10826	0.00019	0.00043	—	0.00043	0.00042	—	0.00042	—	17.7359	17.7359	0.00072	0.00014	—	17.7968

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Demolition	—	—	—	—	—	—	0.00347	0.00347	—	0.00053	0.00053	—	—	—	—	—	—	—
Paving	0.00093	0.00093	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00003	0.00002	0.00039	0.00025	0.00001	0.00000	0.00023	0.00023	0.00000	0.00006	0.00006	—	0.43569	0.43569	0.00001	0.00005	0.00018	0.45133

3.12.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08730	0.06349	0.08466	1.19402	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	557.441	557.441	0.00353	0.00265	0.01012	558.328
Vendor	0.01510	0.00778	0.18990	0.08469	0.00590	0.00000	0.20669	0.20669	0.00000	0.05020	0.05020	—	415.325	415.325	0.00708	0.04789	0.01088	429.783
Hauling	0.04349	0.01087	0.60225	0.36335	0.00393	0.00725	0.87795	0.88520	0.00725	0.11408	0.12132	—	428.980	428.980	0.02839	0.06856	0.00560	450.127
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00778	0.00564	0.00548	0.10717	0.00000	0.00000	0.06329	0.06329	0.00000	0.01483	0.01483	—	50.3989	50.3989	0.00032	0.00024	0.01515	50.4929
Vendor	0.00136	0.00070	0.01697	0.00796	0.00053	0.00000	0.01852	0.01852	0.00000	0.00450	0.00450	—	37.3814	37.3814	0.00064	0.00431	0.01632	38.6983
Hauling	0.00400	0.00103	0.05305	0.03249	0.00033	0.00065	0.07762	0.07827	0.00065	0.01012	0.01077	—	38.5963	38.5963	0.00256	0.00617	0.00840	40.5078
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00142	0.00103	0.00100	0.01956	0.00000	0.00000	0.01155	0.01155	0.00000	0.00271	0.00271	—	8.34411	8.34411	0.00005	0.00004	0.00251	8.35968

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00025	0.00013	0.00310	0.00145	0.00010	0.00000	0.00338	0.00338	0.00000	0.00082	0.00082	—	6.18892	6.18892	0.00011	0.00071	0.00270	6.40694
Hauling	0.00073	0.00019	0.00968	0.00593	0.00006	0.00012	0.01417	0.01428	0.00012	0.00185	0.00197	—	6.39006	6.39006	0.00042	0.00102	0.00139	6.70653

3.13. Phase 6 MEP, Archt& finishrchitectural Coating (2039)

3.13.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77450	0.64480	7.16860	11.2135	0.01992	0.06341	—	0.06341	0.05834	—	0.05834	—	1,940.36	1,940.36	0.07871	0.01574	—	1,947.02
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00635	0.00397	0.08042	0.04947	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	101.574	101.574	0.00265	0.01270	0.10744	105.532
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77450	0.64480	7.16860	11.2135	0.01992	0.06341	—	0.06341	0.05834	—	0.05834	—	1,940.36	1,940.36	0.07871	0.01574	—	1,947.02
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00661	0.00397	0.08466	0.05476	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	101.699	101.699	0.00265	0.01296	0.00278	105.630
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.34254	0.28517	3.17046	4.95940	0.00881	0.02804	—	0.02804	0.02580	—	0.02580	—	858.163	858.163	0.03481	0.00696	—	861.108
Architectural Coatings	21.0516	21.0516	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00293	0.00164	0.03674	0.02317	0.00059	0.00000	0.02041	0.02041	0.00000	0.00496	0.00496	—	44.9463	44.9463	0.00117	0.00562	0.02050	46.6697
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06251	0.05204	0.57861	0.90509	0.00161	0.00512	—	0.00512	0.00471	—	0.00471	—	142.079	142.079	0.00576	0.00115	—	142.566
Architectural Coatings	3.84191	3.84191	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00053	0.00030	0.00670	0.00423	0.00011	0.00000	0.00373	0.00373	0.00000	0.00090	0.00090	—	7.44137	7.44137	0.00019	0.00093	0.00339	7.72669

3.13.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15895	0.11883	0.10340	2.63739	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	1,053.45	1,053.45	0.00617	0.00463	0.81653	1,055.80

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.05079	0.02778	0.65398	0.29127	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,459.25	1,459.25	0.02381	0.18096	1.61161	1,515.38
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15895	0.11729	0.14815	2.14047	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	981.711	981.711	0.00772	0.00463	0.02113	983.305
Vendor	0.05159	0.02778	0.68255	0.30715	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,459.62	1,459.62	0.02381	0.18175	0.04171	1,514.42
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06894	0.05051	0.04778	0.94325	0.00000	0.00000	0.54417	0.54417	0.00000	0.12751	0.12751	—	436.090	436.090	0.00273	0.00205	0.15567	436.924
Vendor	0.02282	0.01193	0.29977	0.13268	0.00878	0.00000	0.30619	0.30619	0.00000	0.07435	0.07435	—	645.452	645.452	0.01053	0.08003	0.30744	669.872
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01258	0.00922	0.00872	0.17214	0.00000	0.00000	0.09931	0.09931	0.00000	0.02327	0.02327	—	72.1997	72.1997	0.00045	0.00034	0.02577	72.3378
Vendor	0.00416	0.00218	0.05471	0.02421	0.00160	0.00000	0.05588	0.05588	0.00000	0.01357	0.01357	—	106.862	106.862	0.00174	0.01325	0.05090	110.905
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.13.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.64779	0.57251	5.75340	17.6719	0.02544	0.05361	—	0.05361	0.05229	—	0.05229	—	2,538.36	2,538.36	0.10297	0.02059	—	2,547.07
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00635	0.00397	0.08042	0.04947	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	101.574	101.574	0.00265	0.01270	0.10744	105.532
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.64779	0.57251	5.75340	17.6719	0.02544	0.05361	—	0.05361	0.05229	—	0.05229	—	2,538.36	2,538.36	0.10297	0.02059	—	2,547.07
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00661	0.00397	0.08466	0.05476	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	101.699	101.699	0.00265	0.01296	0.00278	105.630
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.28650	0.25320	2.54455	7.81573	0.01125	0.02371	—	0.02371	0.02312	—	0.02312	—	1,122.64	1,122.64	0.04554	0.00911	—	1,126.49
Architectural Coatings	21.0516	21.0516	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00293	0.00164	0.03674	0.02317	0.00059	0.00000	0.02041	0.02041	0.00000	0.00496	0.00496	—	44.9463	44.9463	0.00117	0.00562	0.02050	46.6697
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.05229	0.04621	0.46438	1.42637	0.00205	0.00433	—	0.00433	0.00422	—	0.00422	—	185.866	185.866	0.00754	0.00151	—	186.504
Architectural Coatings	3.84191	3.84191	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00053	0.00030	0.00670	0.00423	0.00011	0.00000	0.00373	0.00373	0.00000	0.00090	0.00090	—	7.44137	7.44137	0.00019	0.00093	0.00339	7.72669

3.13.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15895	0.11883	0.10340	2.63739	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	1,053.45	1,053.45	0.00617	0.00463	0.81653	1,055.80
Vendor	0.05079	0.02778	0.65398	0.29127	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,459.25	1,459.25	0.02381	0.18096	1.61161	1,515.38
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15895	0.11729	0.14815	2.14047	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	981.711	981.711	0.00772	0.00463	0.02113	983.305
Vendor	0.05159	0.02778	0.68255	0.30715	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,459.62	1,459.62	0.02381	0.18175	0.04171	1,514.42
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06894	0.05051	0.04778	0.94325	0.00000	0.00000	0.54417	0.54417	0.00000	0.12751	0.12751	—	436.090	436.090	0.00273	0.00205	0.15567	436.924

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.02282	0.01193	0.29977	0.13268	0.00878	0.00000	0.30619	0.30619	0.00000	0.07435	0.07435	—	645.452	645.452	0.01053	0.08003	0.30744	669.872
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01258	0.00922	0.00872	0.17214	0.00000	0.00000	0.09931	0.09931	0.00000	0.02327	0.02327	—	72.1997	72.1997	0.00045	0.00034	0.02577	72.3378
Vendor	0.00416	0.00218	0.05471	0.02421	0.00160	0.00000	0.05588	0.05588	0.00000	0.01357	0.01357	—	106.862	106.862	0.00174	0.01325	0.05090	110.905
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.14. Phase 6 MEP, Archt& finishrchitectural Coating (2040)

3.14.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77347	0.64391	7.14279	11.2125	0.01992	0.06189	—	0.06189	0.05694	—	0.05694	—	1,940.40	1,940.40	0.07871	0.01574	—	1,947.06
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00635	0.00344	0.08069	0.05265	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	97.5196	97.5196	0.00265	0.01138	0.00244	100.978

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06963	0.05796	0.64299	1.00934	0.00179	0.00557	—	0.00557	0.00513	—	0.00513	—	174.674	174.674	0.00709	0.00142	—	175.274
Architectural Coatings	4.28483	4.28483	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00057	0.00031	0.00712	0.00464	0.00012	0.00000	0.00415	0.00415	0.00000	0.00101	0.00101	—	8.77201	8.77201	0.00024	0.00102	0.00366	9.08679
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01271	0.01058	0.11735	0.18421	0.00033	0.00102	—	0.00102	0.00094	—	0.00094	—	28.9193	28.9193	0.00117	0.00023	—	29.0186
Architectural Coatings	0.78198	0.78198	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00010	0.00006	0.00130	0.00085	0.00002	0.00000	0.00076	0.00076	0.00000	0.00018	0.00018	—	1.45231	1.45231	0.00004	0.00017	0.00061	1.50442

3.14.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Worker	0.15278	0.11111	0.14815	2.08954	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	975.523	975.523	0.00617	0.00463	0.01771	977.074
Vendor	0.05079	0.02619	0.63890	0.28493	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,397.36	1,397.36	0.02381	0.16111	0.03660	1,446.00
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01361	0.00986	0.00959	0.18754	0.00000	0.00000	0.11076	0.11076	0.00000	0.02595	0.02595	—	88.1980	88.1980	0.00056	0.00042	0.02652	88.3626
Vendor	0.00457	0.00236	0.05708	0.02679	0.00179	0.00000	0.06232	0.06232	0.00000	0.01513	0.01513	—	125.769	125.769	0.00214	0.01450	0.05491	130.200
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00248	0.00180	0.00175	0.03423	0.00000	0.00000	0.02021	0.02021	0.00000	0.00474	0.00474	—	14.6022	14.6022	0.00009	0.00007	0.00439	14.6294
Vendor	0.00083	0.00043	0.01042	0.00489	0.00033	0.00000	0.01137	0.01137	0.00000	0.00276	0.00276	—	20.8225	20.8225	0.00035	0.00240	0.00909	21.5561
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.14.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.64896	0.57348	5.74932	17.6787	0.02545	0.05306	—	0.05306	0.05178	—	0.05178	—	2,538.40	2,538.40	0.10297	0.02059	—	2,547.12

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00635	0.00344	0.08069	0.05265	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	97.5196	97.5196	0.00265	0.01138	0.00244	100.978
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05842	0.05162	0.51755	1.59143	0.00229	0.00478	—	0.00478	0.00466	—	0.00466	—	228.506	228.506	0.00927	0.00185	—	229.290
Architectural Coatings	4.28483	4.28483	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00057	0.00031	0.00712	0.00464	0.00012	0.00000	0.00415	0.00415	0.00000	0.00101	0.00101	—	8.77201	8.77201	0.00024	0.00102	0.00366	9.08679
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01066	0.00942	0.09445	0.29044	0.00042	0.00087	—	0.00087	0.00085	—	0.00085	—	37.8318	37.8318	0.00153	0.00031	—	37.9616
Architectural Coatings	0.78198	0.78198	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00010	0.00006	0.00130	0.00085	0.00002	0.00000	0.00076	0.00076	0.00000	0.00018	0.00018	—	1.45231	1.45231	0.00004	0.00017	0.00061	1.50442

3.14.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15278	0.11111	0.14815	2.08954	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	975.523	975.523	0.00617	0.00463	0.01771	977.074
Vendor	0.05079	0.02619	0.63890	0.28493	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,397.36	1,397.36	0.02381	0.16111	0.03660	1,446.00
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01361	0.00986	0.00959	0.18754	0.00000	0.00000	0.11076	0.11076	0.00000	0.02595	0.02595	—	88.1980	88.1980	0.00056	0.00042	0.02652	88.3626
Vendor	0.00457	0.00236	0.05708	0.02679	0.00179	0.00000	0.06232	0.06232	0.00000	0.01513	0.01513	—	125.769	125.769	0.00214	0.01450	0.05491	130.200
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00248	0.00180	0.00175	0.03423	0.00000	0.00000	0.02021	0.02021	0.00000	0.00474	0.00474	—	14.6022	14.6022	0.00009	0.00007	0.00439	14.6294
Vendor	0.00083	0.00043	0.01042	0.00489	0.00033	0.00000	0.01137	0.01137	0.00000	0.00276	0.00276	—	20.8225	20.8225	0.00035	0.00240	0.00909	21.5561
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Phase 1 Site Prep	Demolition	3/2/2037	4/1/2037	5.00000	23.0000	—
Phase 2 Earthwork	Grading	4/2/2037	6/1/2037	5.00000	43.0000	—
Phase 3 Foundation	Grading	6/2/2037	3/1/2038	5.00000	195.000	—
Phase 4 Super Structureng Construction	Building Construction	1/4/2038	5/27/2039	5.00000	365.000	—
Phase dust control	Building Construction	3/2/2037	2/15/2040	5.00000	773.000	—
Phase 5 Parking Lot Improvements	Paving	8/19/2039	2/15/2040	5.00000	129.000	—
Phase 6 MEP, Archt& finishrchitectural Coating	Architectural Coating	5/20/2039	2/15/2040	5.00000	194.000	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Tractors/Loaders/ Backhoes	Diesel	Average	2.00000	5.20000	262.000	0.37000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Excavators	Diesel	Average	2.00000	5.50000	268.000	0.38000
Phase 1 Site Prep	Other Construction Equipment	Diesel	Average	1.000000	3.00000	806.000	0.42000
Phase 1 Site Prep	Air Compressors	Diesel	Average	1.000000	1.50000	49.0000	0.48000
Phase 1 Site Prep	Cranes	Diesel	Average	1.000000	1.20000	164.000	0.29000
Phase 1 Site Prep	Rollers	Diesel	Average	2.00000	1.20000	131.000	0.38000
Phase 2 Earthwork	Tractors/Loaders/ Backhoes	Diesel	Average	2.00000	4.40000	262.000	0.37000
Phase 2 Earthwork	Excavators	Diesel	Average	1.000000	7.30000	476.000	0.38000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Average	1.000000	7.30000	240.000	0.40000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Average	1.000000	4.40000	125.000	0.40000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Average	1.000000	4.40000	354.000	0.40000
Phase 2 Earthwork	Graders	Diesel	Average	1.000000	5.70000	259.000	0.41000
Phase 2 Earthwork	Rollers	Diesel	Average	2.00000	2.90000	131.000	0.38000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Average	2.00000	2.60000	262.000	0.37000
Phase 3 Foundation	Air Compressors	Diesel	Average	4.00000	5.80000	49.0000	0.48000
Phase 3 Foundation	Cranes	Diesel	Average	1.000000	1.80000	505.000	0.29000
Phase 3 Foundation	Off-Highway Trucks	Diesel	Average	2.00000	3.60000	505.000	0.38000
Phase 3 Foundation	Graders	Diesel	Average	1.000000	0.50000	259.000	0.41000
Phase 3 Foundation	Excavators	Diesel	Average	1.000000	2.50000	268.000	0.38000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Average	2.00000	3.40000	110.000	0.37000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 3 Foundation	Forklifts	Diesel	Average	2.00000	3.80000	130.000	0.20000
Phase 3 Foundation	Cranes	Diesel	Average	2.00000	4.00000	260.000	0.29000
Phase 3 Foundation	Other Construction Equipment	Diesel	Average	2.00000	3.90000	176.000	0.42000
Phase 3 Foundation	Cranes	Diesel	Average	2.00000	6.50000	450.000	0.29000
Phase 3 Foundation	Rollers	Diesel	Average	2.00000	3.20000	131.000	0.38000
Phase 4 Super Structureng Construction	Cranes	Diesel	Average	2.00000	6.30000	505.000	0.29000
Phase 4 Super Structureng Construction	Forklifts	Diesel	Average	2.00000	6.90000	130.000	0.20000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Average	3.00000	5.40000	85.0000	0.31000
Phase 4 Super Structureng Construction	Air Compressors	Diesel	Average	1.000000	2.10000	49.0000	0.48000
Phase 4 Super Structureng Construction	Off-Highway Trucks	Diesel	Average	1.000000	1.60000	505.000	0.38000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Average	1.000000	4.50000	25.0000	0.31000
Phase 5 Parking Lot Improvements	Tractors/Loaders/ Backhoes	Diesel	Average	1.000000	3.80000	262.000	0.37000
Phase 5 Parking Lot Improvements	Excavators	Diesel	Average	1.000000	0.40000	268.000	0.38000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 5 Parking Lot Improvements	Other Construction Equipment	Diesel	Average	1.000000	0.30000	806.000	0.42000
Phase 5 Parking Lot Improvements	Air Compressors	Diesel	Average	1.000000	3.70000	49.0000	0.48000
Phase 5 Parking Lot Improvements	Pavers	Diesel	Average	1.000000	0.20000	225.000	0.42000
Phase 5 Parking Lot Improvements	Graders	Diesel	Average	1.000000	2.30000	259.000	0.41000
Phase 5 Parking Lot Improvements	Forklifts	Diesel	Average	1.000000	0.20000	130.000	0.20000
Phase 5 Parking Lot Improvements	Rollers	Diesel	Average	2.00000	1.50000	131.000	0.38000
Phase 6 MEP, Archt& finishrchitectural Coating	Cranes	Diesel	Average	1.000000	2.10000	505.000	0.29000
Phase 6 MEP, Archt& finishrchitectural Coating	Forklifts	Diesel	Average	1.000000	0.80000	130.000	0.20000
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Average	3.00000	6.50000	85.0000	0.31000
Phase 6 MEP, Archt& finishrchitectural Coating	Air Compressors	Diesel	Average	3.00000	6.10000	49.0000	0.48000
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Average	6.00000	7.00000	25.0000	0.31000

5.2.2. Mitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	2.00000	5.20000	262.000	0.37000
Phase 1 Site Prep	Excavators	Diesel	Tier 4 Final	2.00000	5.50000	268.000	0.38000
Phase 1 Site Prep	Other Construction Equipment	Diesel	Tier 4 Final	1.000000	3.00000	806.000	0.42000
Phase 1 Site Prep	Air Compressors	Diesel	Average	1.000000	1.50000	49.0000	0.48000
Phase 1 Site Prep	Cranes	Diesel	Tier 4 Final	1.000000	1.20000	164.000	0.29000
Phase 1 Site Prep	Rollers	Diesel	Tier 4 Final	2.00000	1.20000	131.000	0.38000
Phase 2 Earthwork	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	2.00000	4.40000	262.000	0.37000
Phase 2 Earthwork	Excavators	Diesel	Tier 4 Final	1.000000	7.30000	476.000	0.38000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Tier 4 Final	1.000000	7.30000	240.000	0.40000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Tier 4 Final	1.000000	4.40000	125.000	0.40000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Tier 4 Final	1.000000	4.40000	354.000	0.40000
Phase 2 Earthwork	Graders	Diesel	Tier 4 Final	1.000000	5.70000	259.000	0.41000
Phase 2 Earthwork	Rollers	Diesel	Tier 4 Final	2.00000	2.90000	131.000	0.38000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	2.00000	2.60000	262.000	0.37000
Phase 3 Foundation	Air Compressors	Diesel	Average	4.00000	5.80000	49.0000	0.48000
Phase 3 Foundation	Cranes	Diesel	Tier 4 Final	2.00000	1.80000	505.000	0.29000
Phase 3 Foundation	Off-Highway Trucks	Diesel	Average	2.00000	3.60000	505.000	0.38000
Phase 3 Foundation	Graders	Diesel	Tier 4 Final	1.000000	0.50000	259.000	0.41000
Phase 3 Foundation	Excavators	Diesel	Tier 4 Final	1.000000	2.50000	268.000	0.38000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	2.00000	3.40000	110.000	0.37000
Phase 3 Foundation	Forklifts	Diesel	Tier 4 Final	2.00000	3.80000	130.000	0.20000
Phase 3 Foundation	Cranes	Diesel	Tier 4 Final	2.00000	4.00000	260.000	0.29000
Phase 3 Foundation	Other Construction Equipment	Diesel	Tier 4 Final	2.00000	3.90000	176.000	0.42000
Phase 3 Foundation	Cranes	Diesel	Tier 4 Final	2.00000	6.50000	450.000	0.29000
Phase 3 Foundation	Rollers	Diesel	Tier 4 Final	2.00000	3.20000	131.000	0.38000
Phase 4 Super Structureng Construction	Cranes	Diesel	Tier 4 Final	2.00000	6.30000	505.000	0.29000
Phase 4 Super Structureng Construction	Forklifts	Diesel	Tier 4 Final	2.00000	6.90000	130.000	0.20000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Average	2.00000	5.40000	85.0000	0.31000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Tier 4 Final	1.000000	5.40000	85.0000	0.31000
Phase 4 Super Structureng Construction	Air Compressors	Diesel	Average	1.000000	2.10000	49.0000	0.48000
Phase 4 Super Structureng Construction	Off-Highway Trucks	Diesel	Average	1.000000	1.60000	505.000	0.38000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Tier 4 Final	1.000000	4.50000	25.0000	0.31000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 5 Parking Lot Improvements	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	1.000000	3.80000	262.000	0.37000
Phase 5 Parking Lot Improvements	Excavators	Diesel	Tier 4 Final	1.000000	0.40000	268.000	0.38000
Phase 5 Parking Lot Improvements	Other Construction Equipment	Diesel	Tier 4 Final	1.000000	0.30000	806.000	0.42000
Phase 5 Parking Lot Improvements	Air Compressors	Diesel	Average	1.000000	3.70000	49.0000	0.48000
Phase 5 Parking Lot Improvements	Pavers	Diesel	Tier 4 Final	1.000000	0.20000	225.000	0.42000
Phase 5 Parking Lot Improvements	Graders	Diesel	Tier 4 Final	1.000000	2.30000	259.000	0.41000
Phase 5 Parking Lot Improvements	Forklifts	Diesel	Tier 4 Final	1.000000	0.20000	130.000	0.20000
Phase 5 Parking Lot Improvements	Rollers	Diesel	Tier 4 Final	2.00000	1.50000	131.000	0.38000
Phase 6 MEP, Archt& finishrchitectural Coating	Cranes	Diesel	Tier 4 Final	1.000000	2.10000	505.000	0.29000
Phase 6 MEP, Archt& finishrchitectural Coating	Forklifts	Diesel	Tier 4 Final	1.000000	0.80000	130.000	0.20000
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Tier 4 Final	6.00000	6.50000	85.0000	0.31000
Phase 6 MEP, Archt& finishrchitectural Coating	Air Compressors	Diesel	Average	3.00000	6.10000	49.0000	0.48000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Tier 4 Final	6.00000	7.00000	25.0000	0.31000

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 1 Site Prep	Worker	50.0000	25.0000	LDA,LDT1,LDT2
Phase 1 Site Prep	Vendor	24.0000	25.0000	MHDT
Phase 1 Site Prep	Hauling	40.9000	12.0000	HHDT
Phase 1 Site Prep	Onsite truck	8.00000	5.00000	MHDT
Phase 2 Earthwork	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 2 Earthwork	Vendor	16.3000	25.0000	MHDT
Phase 2 Earthwork	Hauling	385.800	25.0000	HHDT
Phase 2 Earthwork	Onsite truck	5.40000	5.00000	MHDT
Phase 3 Foundation	Worker	110.000	25.0000	LDA,LDT1,LDT2
Phase 3 Foundation	Vendor	68.6000	25.0000	MHDT
Phase 3 Foundation	Hauling	11.0000	75.0000	HHDT
Phase 3 Foundation	Onsite truck	22.9000	5.00000	MHDT
Phase 4 Super Structureng Construction	Worker	60.0000	25.0000	LDA,LDT1,LDT2

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 4 Super Structureng Construction	Vendor	26.3000	25.0000	MHDT
Phase 4 Super Structureng Construction	Hauling	13.9000	83.0000	HHDT
Phase 4 Super Structureng Construction	Onsite truck	8.80000	5.00000	MHDT
Phase dust control	Worker	0.00000	0.00000	LDA,LDT1,LDT2
Phase dust control	Vendor	0.00000	0.00000	HHDT,MHDT
Phase dust control	Hauling	0.00000	20.0000	HHDT
Phase dust control	Onsite truck	2.00000	5.00000	HHDT
Phase 5 Parking Lot Improvements	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 5 Parking Lot Improvements	Vendor	10.7000	25.0000	MHDT
Phase 5 Parking Lot Improvements	Hauling	13.7000	12.0000	HHDT
Phase 5 Parking Lot Improvements	Onsite truck	3.60000	5.00000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	70.0000	25.0000	LDA,LDT1,LDT2
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	36.0000	25.0000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	0.00000	0.00000	HHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	12.0000	5.00000	MHDT

5.3.2. Mitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 1 Site Prep	Worker	50.0000	25.0000	LDA,LDT1,LDT2
Phase 1 Site Prep	Vendor	24.0000	25.0000	MHDT
Phase 1 Site Prep	Hauling	40.9000	12.0000	HHDT
Phase 1 Site Prep	Onsite truck	8.00000	5.00000	MHDT
Phase 2 Earthwork	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 2 Earthwork	Vendor	16.3000	25.0000	MHDT
Phase 2 Earthwork	Hauling	385.800	25.0000	HHDT
Phase 2 Earthwork	Onsite truck	5.40000	5.00000	MHDT
Phase 3 Foundation	Worker	110.000	25.0000	LDA,LDT1,LDT2
Phase 3 Foundation	Vendor	68.6000	25.0000	MHDT
Phase 3 Foundation	Hauling	11.0000	75.0000	HHDT
Phase 3 Foundation	Onsite truck	22.9000	5.00000	MHDT
Phase 4 Super Structureng Construction	Worker	60.0000	25.0000	LDA,LDT1,LDT2
Phase 4 Super Structureng Construction	Vendor	26.3000	25.0000	MHDT
Phase 4 Super Structureng Construction	Hauling	13.9000	83.0000	HHDT
Phase 4 Super Structureng Construction	Onsite truck	8.80000	5.00000	MHDT
Phase dust control	Worker	0.00000	0.00000	LDA,LDT1,LDT2
Phase dust control	Vendor	0.00000	0.00000	HHDT,MHDT
Phase dust control	Hauling	0.00000	20.0000	HHDT

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase dust control	Onsite truck	2.00000	5.00000	HHDT
Phase 5 Parking Lot Improvements	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 5 Parking Lot Improvements	Vendor	10.7000	25.0000	MHDT
Phase 5 Parking Lot Improvements	Hauling	13.7000	12.0000	HHDT
Phase 5 Parking Lot Improvements	Onsite truck	3.60000	5.00000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	70.0000	25.0000	LDA,LDT1,LDT2
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	36.0000	25.0000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	0.00000	0.00000	HHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	12.0000	5.00000	MHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Phase 6 MEP, Archt& finishrchitectural Coating	0.00000	0.00000	91,200.0	1,267,000	0.00000

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (Ton of Debris)	Acres Paved (acres)
Phase 1 Site Prep	0.00000	0.00000	0.00000	3,697.00	0.00000
Phase 2 Earthwork	66,700.0	66,700.0	5.50000	0.00000	0.00000
Phase 3 Foundation	18,987.0	0.00000	5.50000	0.00000	0.00000
Phase 5 Parking Lot Improvements	0.00000	0.00000	0.00000	1,882.00	2.80000

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	3	74%	74%
Water Demolished Area	2	36%	36%

5.7. Construction Paving

Phase Name	Land Use	Area Paved (acres)	% Asphalt
Phase 5 Parking Lot Improvements	Unenclosed Parking Structure	2.80000	100%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2037	0.00000	203.983	0.03300	0.00400
2038	0.00000	203.983	0.03300	0.00400
2039	0.00000	203.983	0.03300	0.00400
2040	0.00000	203.983	0.03300	0.00400

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1.2. Mitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.1.2. Mitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

5.18.2.2. Mitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

8. User Changes to Default Data

8.1. Justifications

Screen	Justification
Land Use	Project information
Construction: Construction Phases	project information
Construction: Off-Road Equipment	Project information
Construction: Dust From Material Movement	Project information
Construction: Demolition	project information
Construction: Trips and VMT	Project information
Construction: On-Road Fugitive Dust	project information
Construction: Architectural Coatings	Project information

Screen	Justification
Construction: Paving	Project information

8.3. Land Use

Model Parameter	Units	Default Value	New Value
Building Area	sq. ft	435,600	1,175,167
Landscape Area	sq. ft	—	0.00000
Special Landscape Area	sq. ft	—	0.00000

8.4. Construction

8.4.2. Off-Road Equipment

Phase Name	Equipment Type	Model Parameter	Default Value	New Value
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Number per Day	3.00000	2.00000
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Hours Per Day	8.00000	5.20000
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Horsepower	84.0000	262.000
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Number per Day	3.00000	2.00000
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Hours Per Day	8.00000	4.40000
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Horsepower	84.0000	262.000
Phase 3 Foundation	Excavators	Hours Per Day	8.00000	2.50000
Phase 3 Foundation	Excavators	Horsepower	36.0000	268.000
Phase 4 Super Structureng Construction	Cranes	Number per Day	1.000000	2.00000

Phase Name	Equipment Type	Model Parameter	Default Value	New Value
Phase 4 Super Structureng Construction	Cranes	Hours Per Day	7.00000	6.30000
Phase 4 Super Structureng Construction	Cranes	Horsepower	367.000	505.000
Phase 4 Super Structureng Construction	Forklifts	Number per Day	3.00000	2.00000
Phase 4 Super Structureng Construction	Forklifts	Hours Per Day	8.00000	6.90000
Phase 4 Super Structureng Construction	Forklifts	Horsepower	82.0000	130.000

8.4.4. Dust from Material Movement

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 2 Earthwork	Material Imported	Cubic Yards	—	66,700.0
Phase 2 Earthwork	Material Exported	Cubic Yards	—	66,700.0
Phase 2 Earthwork	Total Acres Graded	acres	58.5875	5.50000
Phase 3 Foundation	Material Imported	Cubic Yards	—	18,987.0
Phase 3 Foundation	Material Exported	Cubic Yards	—	0.00000
Phase 3 Foundation	Total Acres Graded	acres	6.09375	5.50000

8.4.5. Demolition

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 5 Parking Lot Improvements	Material Demolished	Ton of Debris	473.000	1,882.00

8.4.6. Trips and VMT

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 1 Site Prep	Worker	One-Way Trips per Day	22.5000	50.0000
Phase 1 Site Prep	Worker	Miles per Trip	11.7000	25.0000
Phase 1 Site Prep	Vendor	One-Way Trips per Day	—	24.0000
Phase 1 Site Prep	Vendor	Miles per Trip	8.40000	25.0000
Phase 1 Site Prep	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 1 Site Prep	Hauling	One-Way Trips per Day	40.2174	40.9000
Phase 1 Site Prep	Hauling	Miles per Trip	20.0000	12.0000
Phase 1 Site Prep	Onsite truck	One-Way Trips per Day	—	8.00000
Phase 1 Site Prep	Onsite truck	Miles per Trip	—	5.00000
Phase 1 Site Prep	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 2 Earthwork	Worker	One-Way Trips per Day	22.5000	40.0000
Phase 2 Earthwork	Worker	Miles per Trip	11.7000	25.0000
Phase 2 Earthwork	Vendor	One-Way Trips per Day	—	16.3000
Phase 2 Earthwork	Vendor	Miles per Trip	8.40000	25.0000
Phase 2 Earthwork	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 2 Earthwork	Hauling	One-Way Trips per Day	387.791	385.800
Phase 2 Earthwork	Hauling	Miles per Trip	20.0000	25.0000
Phase 2 Earthwork	Onsite truck	One-Way Trips per Day	—	5.40000
Phase 2 Earthwork	Onsite truck	Miles per Trip	—	5.00000
Phase 2 Earthwork	Onsite truck	Vehicle Mix	HHDT	MHDT

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 3 Foundation	Worker	One-Way Trips per Day	57.5000	110.000
Phase 3 Foundation	Worker	Miles per Trip	11.7000	25.0000
Phase 3 Foundation	Vendor	One-Way Trips per Day	—	68.6000
Phase 3 Foundation	Vendor	Miles per Trip	8.40000	25.0000
Phase 3 Foundation	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 3 Foundation	Hauling	One-Way Trips per Day	12.1744	11.0000
Phase 3 Foundation	Hauling	Miles per Trip	20.0000	75.0000
Phase 3 Foundation	Onsite truck	One-Way Trips per Day	—	22.9000
Phase 3 Foundation	Onsite truck	Miles per Trip	—	5.00000
Phase 3 Foundation	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 4 Super Structureng Construction	Worker	One-Way Trips per Day	493.570	60.0000
Phase 4 Super Structureng Construction	Worker	Miles per Trip	11.7000	25.0000
Phase 4 Super Structureng Construction	Vendor	One-Way Trips per Day	192.610	26.3000
Phase 4 Super Structureng Construction	Vendor	Miles per Trip	8.40000	25.0000
Phase 4 Super Structureng Construction	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 4 Super Structureng Construction	Hauling	One-Way Trips per Day	0.00000	13.9000
Phase 4 Super Structureng Construction	Hauling	Miles per Trip	20.0000	83.0000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 4 Super Structureng Construction	Onsite truck	One-Way Trips per Day	—	8.80000
Phase 4 Super Structureng Construction	Onsite truck	Miles per Trip	—	5.00000
Phase 4 Super Structureng Construction	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase dust control	Worker	One-Way Trips per Day	493.570	0.00000
Phase dust control	Worker	Miles per Trip	11.7000	0.00000
Phase dust control	Vendor	One-Way Trips per Day	192.610	0.00000
Phase dust control	Vendor	Miles per Trip	8.40000	0.00000
Phase 5 Parking Lot Improvements	Worker	One-Way Trips per Day	22.5000	40.0000
Phase 5 Parking Lot Improvements	Worker	Miles per Trip	11.7000	25.0000
Phase 5 Parking Lot Improvements	Vendor	One-Way Trips per Day	—	10.7000
Phase 5 Parking Lot Improvements	Vendor	Miles per Trip	8.40000	25.0000
Phase 5 Parking Lot Improvements	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 5 Parking Lot Improvements	Hauling	One-Way Trips per Day	3.65116	13.7000
Phase 5 Parking Lot Improvements	Hauling	Miles per Trip	20.0000	12.0000
Phase 5 Parking Lot Improvements	Onsite truck	One-Way Trips per Day	—	3.60000
Phase 5 Parking Lot Improvements	Onsite truck	Miles per Trip	—	5.00000
Phase 5 Parking Lot Improvements	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	One-Way Trips per Day	197.428	70.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	Miles per Trip	11.7000	25.0000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	One-Way Trips per Day	—	36.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	Miles per Trip	8.40000	25.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	Miles per Trip	20.0000	0.00000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	One-Way Trips per Day	—	12.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	Miles per Trip	—	5.00000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	Vehicle Mix	HHDT	MHDT

8.4.7. On-Road Fugitive Dust

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 1 Site Prep	Hauling Trip Paved	%	100.0000	99.0000
Phase 1 Site Prep	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 2 Earthwork	Hauling Trip Paved	%	100.0000	99.6000
Phase 2 Earthwork	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 3 Foundation	Hauling Trip Paved	%	100.0000	99.8000
Phase 3 Foundation	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 4 Super Structureng Construction	Hauling Trip Paved	%	100.0000	99.8000

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 4 Super Structureng Construction	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase dust control	Onsite Truck Trip Paved	%	0.00000	80.0000
Phase 5 Parking Lot Improvements	Hauling Trip Paved	%	100.0000	99.7000
Phase 5 Parking Lot Improvements	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite Truck Trip Paved	%	0.00000	100.0000

8.4.8. Architectural Coatings

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 6 MEP, Archt& finishrchitectural Coating	Non-Residential Interior Area	sq ft	19,602.0	91,200.0
Phase 6 MEP, Archt& finishrchitectural Coating	Non-Residential Exterior Area	sq ft	2,178.00	1,267,000
Phase 6 MEP, Archt& finishrchitectural Coating	Parking Area	sq ft	26,136.0	0.00000

8.4.9. Paving

Phase Name	Land Use	Model Parameter	Units	Default Value	New Value
Phase 5 Parking Lot Improvements	Unenclosed Parking Structure	Area Paved	acres	10.00000	2.80000

Larkspur Main Lot Construction ACP Unmitg and mtg Custom Report

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1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Larkspur Main Lot Construction ACP Unmitg and mtg
Construction Start Date	3/2/2037
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.90000
Precipitation (days)	7.60000
Location	Larkspur Ferry Terminal, Larkspur, CA 94939, USA
County	Marin
City	Larkspur
Air District	Bay Area AQMD
Air Basin	San Francisco Bay Area
TAZ	905
EDFZ	2
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric
App Version	2022.1.1.45

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
Unenclosed Parking Structure	10.00000	Acre	10.00000	1,175,167	0.00000	0.00000	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

Sector	#	Measure Title
Construction	C-5	Use Advanced Engine Tiers

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	50.0301	49.4513	41.7917	36.3767	0.27050	0.89333	71.0691	71.9625	0.85592	10.1897	11.0456	—	32,488.0	32,488.0	2.14314	4.27130	21.0823	33,835.5
Mit.	49.3228	48.9335	33.5659	47.3781	0.27051	0.52419	71.0691	71.5933	0.52419	10.1897	10.7139	—	32,489.2	32,489.2	2.14319	4.27131	21.0823	33,836.7
% Reduced	1%	1%	20%	-30%	—	41%	—	1%	39%	—	3%	—	> -0.5%	> -0.5%	—	—	—	> -0.5%
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Unmit.	49.1757	48.8508	22.4802	42.3300	0.16921	0.56410	13.9058	14.4699	0.52431	2.11138	2.63569	—	19,097.8	19,097.8	0.75143	1.05618	0.19738	19,431.5
Mit.	48.8648	48.6401	16.2948	60.2275	0.16927	0.30593	13.9058	14.2117	0.29862	2.11138	2.41000	—	19,103.8	19,103.8	0.75167	1.05623	0.19738	19,437.6
% Reduced	1%	< 0.5%	28%	-42%	—	46%	—	2%	43%	—	9%	—	> -0.5%	> -0.5%	—	—	—	> -0.5%
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	22.0574	21.8243	11.2396	15.9070	0.07905	0.25503	12.5110	12.7660	0.23954	1.78501	2.02455	—	8,976.02	8,976.02	0.45515	0.73163	1.96135	9,207.39
Mit.	21.7857	21.6277	8.78818	22.9659	0.07907	0.14943	12.5110	12.6604	0.14697	1.78501	1.93198	—	8,978.66	8,978.66	0.45526	0.73165	1.96135	9,210.03
% Reduced	1%	1%	22%	-44%	—	41%	—	1%	39%	—	5%	—	> -0.5%	> -0.5%	—	—	—	> -0.5%
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	4.02548	3.98294	2.05122	2.90303	0.01443	0.04654	2.28326	2.32980	0.04372	0.32576	0.36948	—	1,486.08	1,486.08	0.07536	0.12113	0.32472	1,524.39
Mit.	3.97589	3.94705	1.60384	4.19128	0.01443	0.02727	2.28326	2.31053	0.02682	0.32576	0.35259	—	1,486.52	1,486.52	0.07537	0.12113	0.32472	1,524.83
% Reduced	1%	1%	22%	-44%	> -0.5%	41%	—	1%	39%	—	5%	—	> -0.5%	> -0.5%	> -0.5%	> -0.5%	—	> -0.5%

2.2. Construction Emissions by Year

2.2.1. Total Construction Emissions by Year, Unmitigated

Includes both onsite and offsite emissions.

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	4.75974	2.27415	41.7917	36.3767	0.27050	0.89333	71.0691	71.9625	0.85592	10.1897	11.0456	—	32,488.0	32,488.0	2.14314	4.27130	21.0823	33,835.5
2038	1.48469	1.07572	9.51787	16.7440	0.06772	0.24440	6.05840	6.30280	0.22834	0.97213	1.20047	—	8,012.29	8,012.29	0.32469	0.57028	3.76983	8,194.12
2039	50.0301	49.4513	17.2107	30.6086	0.10881	0.30070	8.03660	8.33730	0.28013	1.44210	1.72223	—	12,470.8	12,470.8	0.43572	0.76249	5.79723	12,714.7
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.69059	2.11798	13.1889	26.1823	0.10145	0.33141	12.1395	12.3244	0.30677	1.60011	1.77199	—	11,289.5	11,289.5	0.44101	0.48992	0.11505	11,446.6
2038	4.13381	3.16986	22.4802	42.3300	0.16921	0.56410	13.9058	14.4699	0.52431	2.11138	2.63569	—	19,097.8	19,097.8	0.75143	1.05618	0.19738	19,431.5
2039	49.1757	48.8508	11.1451	19.2502	0.06803	0.23728	6.05840	6.29568	0.22179	0.97213	1.19392	—	7,855.35	7,855.35	0.32571	0.54912	0.09718	8,027.22
2040	49.1599	48.8347	11.0044	19.1238	0.06266	0.11538	4.71230	4.82768	0.10675	0.90660	1.01334	—	7,033.45	7,033.45	0.20060	0.32603	0.08393	7,135.71
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	1.76299	1.20787	11.2396	15.9070	0.07905	0.25503	12.5110	12.7660	0.23954	1.78501	2.02455	—	8,976.02	8,976.02	0.45515	0.73163	1.96135	9,207.39
2038	1.36168	1.00617	8.34552	14.5854	0.05975	0.21068	5.14214	5.35282	0.19651	0.81402	1.01053	—	6,944.34	6,944.34	0.27995	0.46146	1.34679	7,090.20
2039	22.0574	21.8243	7.04154	12.1244	0.04330	0.11088	3.42113	3.53201	0.10317	0.60990	0.71308	—	4,951.23	4,951.23	0.16763	0.28996	1.02831	5,042.86
2040	4.42523	4.39592	0.98273	1.72175	0.00561	0.01039	0.42020	0.43059	0.00961	0.08102	0.09063	—	633.692	633.692	0.01806	0.02935	0.12585	643.015
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.32175	0.22044	2.05122	2.90303	0.01443	0.04654	2.28326	2.32980	0.04372	0.32576	0.36948	—	1,486.08	1,486.08	0.07536	0.12113	0.32472	1,524.39
2038	0.24851	0.18363	1.52306	2.66184	0.01090	0.03845	0.93844	0.97689	0.03586	0.14856	0.18442	—	1,149.71	1,149.71	0.04635	0.07640	0.22298	1,173.86
2039	4.02548	3.98294	1.28508	2.21270	0.00790	0.02024	0.62436	0.64459	0.01883	0.11131	0.13014	—	819.733	819.733	0.02775	0.04801	0.17025	834.903
2040	0.80760	0.80226	0.17935	0.31422	0.00102	0.00190	0.07669	0.07858	0.00175	0.01479	0.01654	—	104.915	104.915	0.00299	0.00486	0.02084	106.458

2.2.2. Onsite Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.30567	1.92814	10.8781	22.2805	0.06921	0.46806	4.13874	4.60679	0.43065	1.84008	2.27073	—	7,266.03	7,266.03	0.29458	0.07535	0.15799	7,296.01
2038	1.10283	0.92276	6.30302	12.6462	0.03384	0.20122	0.77831	0.97953	0.18516	0.08317	0.26833	—	3,619.99	3,619.99	0.14726	0.04111	0.09290	3,636.02
2039	49.4661	49.1570	13.3334	23.7566	0.05508	0.25751	1.02071	1.13197	0.23695	0.12274	0.33137	—	5,658.68	5,658.68	0.22857	0.06933	0.18883	5,685.24
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.30554	1.92774	10.2122	22.2855	0.06925	0.30839	3.10674	3.27001	0.28376	0.43594	0.58618	—	7,266.20	7,266.20	0.29454	0.07535	0.00411	7,296.02
2038	3.38503	2.83339	16.1438	34.8488	0.10287	0.49790	0.83838	1.33628	0.45811	0.09613	0.55424	—	10,852.2	10,852.2	0.43893	0.11195	0.00556	10,896.5
2039	48.8169	48.6202	9.43590	15.1278	0.03389	0.19410	1.02071	1.13197	0.17861	0.12274	0.26178	—	3,616.87	3,616.87	0.14722	0.04658	0.00398	3,632.79
2040	48.8122	48.6158	9.36342	15.1202	0.03328	0.10834	1.02071	1.12905	0.09971	0.12274	0.22245	—	3,283.00	3,283.00	0.13265	0.04453	0.00349	3,299.59
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	1.26590	1.05911	6.07561	11.6701	0.03695	0.19398	1.01105	1.20503	0.17848	0.28041	0.45889	—	3,899.30	3,899.30	0.15823	0.04041	0.03568	3,915.34
2038	1.04921	0.87803	5.62204	11.5667	0.03208	0.17738	0.55165	0.72904	0.16322	0.05975	0.22297	—	3,413.82	3,413.82	0.13859	0.03756	0.03458	3,428.51
2039	21.8257	21.6985	5.54287	9.60219	0.02233	0.09660	0.61239	0.70898	0.08889	0.06960	0.15849	—	2,277.49	2,277.49	0.09237	0.02977	0.03695	2,288.71
2040	4.39406	4.37638	0.84259	1.36096	0.00299	0.00975	0.09047	0.10022	0.00898	0.01090	0.01988	—	295.523	295.523	0.01194	0.00401	0.00524	297.021
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.23103	0.19329	1.10880	2.12979	0.00674	0.03540	0.18452	0.21992	0.03257	0.05118	0.08375	—	645.574	645.574	0.02620	0.00669	0.00591	648.229
2038	0.19148	0.16024	1.02602	2.11091	0.00585	0.03237	0.10068	0.13305	0.02979	0.01091	0.04069	—	565.196	565.196	0.02294	0.00622	0.00573	567.629

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2039	3.98319	3.95998	1.01157	1.75240	0.00408	0.01763	0.11176	0.12939	0.01622	0.01270	0.02892	—	377.064	377.064	0.01529	0.00493	0.00612	378.921
2040	0.80192	0.79869	0.15377	0.24838	0.00055	0.00178	0.01651	0.01829	0.00164	0.00199	0.00363	—	48.9271	48.9271	0.00198	0.00066	0.00087	49.1752

2.2.3. Offsite Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.70690	0.55222	30.9136	20.8292	0.22162	0.42527	66.9304	67.3557	0.42527	8.34958	8.77485	—	27,206.0	27,206.0	1.92803	4.21858	20.9996	28,532.3
2038	0.38187	0.15297	3.21486	4.09780	0.03388	0.04318	5.28009	5.32327	0.04318	0.88896	0.93214	—	4,392.30	4,392.30	0.17743	0.52917	3.67692	4,558.11
2039	0.56398	0.29428	3.87727	6.85202	0.05372	0.04318	7.21194	7.25512	0.04318	1.34767	1.39085	—	6,812.13	6,812.13	0.20715	0.69316	5.60841	7,029.48
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.38505	0.19024	2.97674	3.89675	0.03220	0.02302	9.03278	9.05442	0.02302	1.16417	1.18581	—	4,023.30	4,023.30	0.14648	0.41457	0.11095	4,150.61
2038	0.74878	0.33647	6.33642	7.48123	0.06634	0.06620	13.0674	13.1336	0.06620	2.01525	2.08145	—	8,245.64	8,245.64	0.31250	0.94424	0.19181	8,535.03
2039	0.35879	0.23067	3.31409	4.12247	0.03414	0.04318	5.28009	5.32327	0.04318	0.88896	0.93214	—	4,238.48	4,238.48	0.17849	0.50807	0.09320	4,394.43
2040	0.34777	0.21892	1.64095	4.00354	0.02939	0.00704	3.69160	3.69864	0.00704	0.78386	0.79090	—	3,750.46	3,750.46	0.06795	0.28149	0.08044	3,836.12
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.49709	0.14876	5.16394	4.23695	0.04210	0.06106	11.5000	11.5610	0.06106	1.50460	1.56565	—	5,076.72	5,076.72	0.29692	0.69121	1.92567	5,292.05
2038	0.31246	0.12814	2.72348	3.01875	0.02767	0.03329	4.59049	4.62378	0.03329	0.75427	0.78756	—	3,530.52	3,530.52	0.14136	0.42390	1.31221	3,661.69
2039	0.23174	0.12581	1.49867	2.52222	0.02097	0.01428	2.80874	2.82303	0.01428	0.54031	0.55459	—	2,673.75	2,673.75	0.07526	0.26019	0.99136	2,754.16

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2040	0.03117	0.01954	0.14014	0.36079	0.00262	0.00063	0.32973	0.33037	0.00063	0.07012	0.07075	—	338.169	338.169	0.00612	0.02534	0.12061	345.994
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.09072	0.02715	0.94242	0.77324	0.00768	0.01114	2.09874	2.10989	0.01114	0.27459	0.28573	—	840.509	840.509	0.04916	0.11444	0.31882	876.159
2038	0.05702	0.02339	0.49703	0.55092	0.00505	0.00608	0.83776	0.84384	0.00608	0.13765	0.14373	—	584.518	584.518	0.02340	0.07018	0.21725	606.235
2039	0.04229	0.02296	0.27351	0.46030	0.00383	0.00261	0.51260	0.51520	0.00261	0.09861	0.10121	—	442.669	442.669	0.01246	0.04308	0.16413	455.982
2040	0.00569	0.00357	0.02557	0.06584	0.00048	0.00012	0.06018	0.06029	0.00012	0.01280	0.01291	—	55.9877	55.9877	0.00101	0.00420	0.01997	57.2832

2.2.4. Total Construction Emissions by Year, Mitigated

Includes both onsite and offsite emissions.

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	3.20686	1.52420	33.5659	47.3781	0.27051	0.52419	71.0691	71.5933	0.52419	10.1897	10.7139	—	32,489.2	32,489.2	2.14319	4.27131	21.0823	33,836.7
2038	0.88955	0.61806	6.39250	22.3874	0.06772	0.11702	6.05840	6.17542	0.11535	0.97213	1.08748	—	8,012.35	8,012.35	0.32469	0.57028	3.76983	8,194.18
2039	49.3228	48.9335	12.8623	42.8591	0.11433	0.16966	8.03660	8.20627	0.16674	1.44210	1.60884	—	13,068.9	13,068.9	0.45998	0.76735	5.79723	13,314.8
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	1.83886	1.47847	9.91650	38.3921	0.10150	0.19253	12.1395	12.2574	0.18663	1.60011	1.71787	—	11,295.4	11,295.4	0.44125	0.48997	0.11505	11,452.6
2038	2.70128	2.08473	16.2948	60.2275	0.16927	0.30593	13.9058	14.2117	0.29862	2.11138	2.41000	—	19,103.8	19,103.8	0.75167	1.05623	0.19738	19,437.6
2039	48.8648	48.6401	9.20690	28.4888	0.06820	0.11605	6.05840	6.17445	0.11446	0.97213	1.08659	—	7,855.42	7,855.42	0.32571	0.54912	0.09718	8,027.28
2040	48.8548	48.6289	9.12771	28.3748	0.06820	0.08647	4.71230	4.79878	0.08493	0.90660	0.99153	—	7,632.66	7,632.66	0.22490	0.33089	0.08393	7,736.97

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	1.18747	0.76891	8.78818	22.9659	0.07907	0.14943	12.5110	12.6604	0.14697	1.78501	1.93198	—	8,978.66	8,978.66	0.45526	0.73165	1.96135	9,210.03
2038	0.84174	0.60828	5.77216	20.0221	0.05975	0.10508	5.14214	5.24722	0.10324	0.81402	0.91726	—	6,945.08	6,945.08	0.27998	0.46147	1.34679	7,090.95
2039	21.7857	21.6277	5.43366	17.3815	0.04575	0.06602	3.42113	3.48716	0.06491	0.60990	0.67481	—	5,216.05	5,216.05	0.17837	0.29210	1.02831	5,308.58
2040	4.39776	4.37739	0.81379	2.55452	0.00611	0.00778	0.42020	0.42798	0.00765	0.08102	0.08866	—	687.632	687.632	0.02025	0.02979	0.12585	697.140
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.21671	0.14033	1.60384	4.19128	0.01443	0.02727	2.28326	2.31053	0.02682	0.32576	0.35259	—	1,486.52	1,486.52	0.07537	0.12113	0.32472	1,524.83
2038	0.15362	0.11101	1.05342	3.65403	0.01090	0.01918	0.93844	0.95762	0.01884	0.14856	0.16740	—	1,149.84	1,149.84	0.04635	0.07640	0.22298	1,173.99
2039	3.97589	3.94705	0.99164	3.17212	0.00835	0.01205	0.62436	0.63641	0.01185	0.11131	0.12315	—	863.576	863.576	0.02953	0.04836	0.17025	878.897
2040	0.80259	0.79887	0.14852	0.46620	0.00111	0.00142	0.07669	0.07811	0.00140	0.01479	0.01618	—	113.845	113.845	0.00335	0.00493	0.02084	115.420

2.2.5. Onsite Construction Emissions by Year, Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	1.45394	1.28863	6.93265	34.4903	0.06926	0.16951	4.13874	4.23766	0.16362	1.84008	1.93900	—	7,271.98	7,271.98	0.29482	0.07540	0.15799	7,301.97
2038	0.50769	0.46509	3.17764	18.2896	0.03384	0.07384	0.77831	0.85214	0.07217	0.08317	0.15533	—	3,620.05	3,620.05	0.14726	0.04111	0.09290	3,636.08
2039	48.7588	48.6392	8.98501	36.0071	0.06061	0.12648	1.02071	1.10080	0.12356	0.12274	0.21799	—	6,256.74	6,256.74	0.25283	0.07418	0.18883	6,285.35
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2037	1.45381	1.28824	6.93976	34.4953	0.06930	0.16951	3.10674	3.20298	0.16362	0.43594	0.53206	—	7,272.14	7,272.14	0.29478	0.07540	0.00411	7,301.98
2038	1.95250	1.74826	9.95838	52.7463	0.10293	0.23973	0.83838	1.07812	0.23242	0.09613	0.32855	—	10,858.2	10,858.2	0.43917	0.11200	0.00556	10,902.5
2039	48.5060	48.4095	7.49767	24.3663	0.03882	0.08010	1.02071	1.10080	0.07851	0.12274	0.20124	—	3,887.97	3,887.97	0.15721	0.05145	0.00398	3,907.24
2040	48.5071	48.4100	7.48676	24.3712	0.03882	0.07943	1.02071	1.10014	0.07790	0.12274	0.20063	—	3,882.21	3,882.21	0.15695	0.04940	0.00349	3,900.85
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.69038	0.62015	3.62424	18.7290	0.03697	0.08837	1.01105	1.09943	0.08591	0.28041	0.36632	—	3,901.94	3,901.94	0.15834	0.04044	0.03568	3,917.98
2038	0.52928	0.48013	3.04868	17.0033	0.03208	0.07179	0.55165	0.62344	0.06994	0.05975	0.12970	—	3,414.56	3,414.56	0.13862	0.03757	0.03458	3,429.26
2039	21.5539	21.5019	3.93499	14.8593	0.02478	0.05174	0.61239	0.66413	0.05063	0.06960	0.12022	—	2,542.30	2,542.30	0.10311	0.03192	0.03695	2,554.43
2040	4.36660	4.35785	0.67366	2.19373	0.00349	0.00715	0.09047	0.09762	0.00701	0.01090	0.01792	—	349.463	349.463	0.01413	0.00445	0.00524	351.147
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.12599	0.11318	0.66142	3.41804	0.00675	0.01613	0.18452	0.20065	0.01568	0.05118	0.06685	—	646.011	646.011	0.02621	0.00669	0.00591	648.667
2038	0.09659	0.08762	0.55638	3.10311	0.00585	0.01310	0.10068	0.11378	0.01276	0.01091	0.02367	—	565.319	565.319	0.02295	0.00622	0.00573	567.752
2039	3.93360	3.92409	0.71814	2.71182	0.00452	0.00944	0.11176	0.12120	0.00924	0.01270	0.02194	—	420.907	420.907	0.01707	0.00528	0.00612	422.915
2040	0.79690	0.79531	0.12294	0.40036	0.00064	0.00130	0.01651	0.01782	0.00128	0.00199	0.00327	—	57.8576	57.8576	0.00234	0.00074	0.00087	58.1363

2.2.6. Offsite Construction Emissions by Year, Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	2.70690	0.55222	30.9136	20.8292	0.22162	0.42527	66.9304	67.3557	0.42527	8.34958	8.77485	—	27,206.0	27,206.0	1.92803	4.21858	20.9996	28,532.3

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
2038	0.38187	0.15297	3.21486	4.09780	0.03388	0.04318	5.28009	5.32327	0.04318	0.88896	0.93214	—	4,392.30	4,392.30	0.17743	0.52917	3.67692	4,558.11
2039	0.56398	0.29428	3.87727	6.85202	0.05372	0.04318	7.21194	7.25512	0.04318	1.34767	1.39085	—	6,812.13	6,812.13	0.20715	0.69316	5.60841	7,029.48
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.38505	0.19024	2.97674	3.89675	0.03220	0.02302	9.03278	9.05442	0.02302	1.16417	1.18581	—	4,023.30	4,023.30	0.14648	0.41457	0.11095	4,150.61
2038	0.74878	0.33647	6.33642	7.48123	0.06634	0.06620	13.0674	13.1336	0.06620	2.01525	2.08145	—	8,245.64	8,245.64	0.31250	0.94424	0.19181	8,535.03
2039	0.35879	0.23067	3.31409	4.12247	0.03414	0.04318	5.28009	5.32327	0.04318	0.88896	0.93214	—	4,238.48	4,238.48	0.17849	0.50807	0.09320	4,394.43
2040	0.34777	0.21892	1.64095	4.00354	0.02939	0.00704	3.69160	3.69864	0.00704	0.78386	0.79090	—	3,750.46	3,750.46	0.06795	0.28149	0.08044	3,836.12
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.49709	0.14876	5.16394	4.23695	0.04210	0.06106	11.5000	11.5610	0.06106	1.50460	1.56565	—	5,076.72	5,076.72	0.29692	0.69121	1.92567	5,292.05
2038	0.31246	0.12814	2.72348	3.01875	0.02767	0.03329	4.59049	4.62378	0.03329	0.75427	0.78756	—	3,530.52	3,530.52	0.14136	0.42390	1.31221	3,661.69
2039	0.23174	0.12581	1.49867	2.52222	0.02097	0.01428	2.80874	2.82303	0.01428	0.54031	0.55459	—	2,673.75	2,673.75	0.07526	0.26019	0.99136	2,754.16
2040	0.03117	0.01954	0.14014	0.36079	0.00262	0.00063	0.32973	0.33037	0.00063	0.07012	0.07075	—	338.169	338.169	0.00612	0.02534	0.12061	345.994
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2037	0.09072	0.02715	0.94242	0.77324	0.00768	0.01114	2.09874	2.10989	0.01114	0.27459	0.28573	—	840.509	840.509	0.04916	0.11444	0.31882	876.159
2038	0.05702	0.02339	0.49703	0.55092	0.00505	0.00608	0.83776	0.84384	0.00608	0.13765	0.14373	—	584.518	584.518	0.02340	0.07018	0.21725	606.235
2039	0.04229	0.02296	0.27351	0.46030	0.00383	0.00261	0.51260	0.51520	0.00261	0.09861	0.10121	—	442.669	442.669	0.01246	0.04308	0.16413	455.982
2040	0.00569	0.00357	0.02557	0.06584	0.00048	0.00012	0.06018	0.06029	0.00012	0.01280	0.01291	—	55.9877	55.9877	0.00101	0.00420	0.01997	57.2832

3. Construction Emissions Details

3.1. Phase 1 Site Prep (2037)

3.1.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.99102	0.83224	8.42646	8.64882	0.03562	0.16283	—	0.16283	0.14980	—	0.14980	—	3,837.60	3,837.60	0.15567	0.03113	—	3,850.77
Demolition	—	—	—	—	—	—	2.32589	2.32589	—	0.35221	0.35221	—	—	—	—	—	—	—
Onsite truck	0.00441	0.00282	0.05979	0.03598	0.00088	0.00000	0.03091	0.03091	0.00000	0.00751	0.00751	—	74.0275	74.0275	0.00176	0.00864	0.09269	76.7397
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.99102	0.83224	8.42646	8.64882	0.03562	0.16283	—	0.16283	0.14980	—	0.14980	—	3,837.60	3,837.60	0.15567	0.03113	—	3,850.77
Demolition	—	—	—	—	—	—	2.32589	2.32589	—	0.35221	0.35221	—	—	—	—	—	—	—
Onsite truck	0.00441	0.00265	0.06261	0.03898	0.00088	0.00000	0.03091	0.03091	0.00000	0.00751	0.00751	—	74.1048	74.1048	0.00176	0.00864	0.00241	76.7266
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06245	0.05244	0.53098	0.54499	0.00224	0.01026	—	0.01026	0.00944	—	0.00944	—	241.822	241.822	0.00981	0.00196	—	242.651

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Demolition	—	—	—	—	—	—	0.14656	0.14656	—	0.02219	0.02219	—	—	—	—	—	—	—
Onsite truck	0.00028	0.00017	0.00388	0.00240	0.00006	0.00000	0.00194	0.00194	0.00000	0.00047	0.00047	—	4.66676	4.66676	0.00011	0.00054	0.00252	4.83434
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01140	0.00957	0.09690	0.09946	0.00041	0.00187	—	0.00187	0.00172	—	0.00172	—	40.0363	40.0363	0.00162	0.00032	—	40.1737
Demolition	—	—	—	—	—	—	0.02675	0.02675	—	0.00405	0.00405	—	—	—	—	—	—	—
Onsite truck	0.00005	0.00003	0.00071	0.00044	0.00001	0.00000	0.00035	0.00035	0.00000	0.00009	0.00009	—	0.77264	0.77264	0.00002	0.00009	0.00042	0.80038

3.1.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.12236	0.12125	0.07496	2.00951	0.00000	0.00000	0.88317	0.88317	0.00000	0.20701	0.20701	—	764.209	764.209	0.00441	0.00331	0.81968	766.125
Vendor	0.03439	0.01905	0.50742	0.22434	0.01323	0.00000	0.46361	0.46361	0.00000	0.11259	0.11259	—	1,066.93	1,066.93	0.01587	0.12117	1.39030	1,104.83
Hauling	0.15689	0.03517	1.81600	1.18933	0.01082	0.02164	7.68600	7.70764	0.02164	0.84456	0.86620	—	1,347.59	1,347.59	0.10910	0.21550	0.98718	1,415.53
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.12125	0.09149	0.10692	1.63363	0.00000	0.00000	0.88317	0.88317	0.00000	0.20701	0.20701	—	712.185	712.185	0.00551	0.00331	0.02124	713.329
Vendor	0.03439	0.01852	0.52646	0.22276	0.01323	0.00000	0.46361	0.46361	0.00000	0.11259	0.11259	—	1,067.15	1,067.15	0.01587	0.12117	0.03613	1,103.69

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.15419	0.03246	1.91970	1.20105	0.01172	0.02164	7.68600	7.70764	0.02164	0.84456	0.86620	—	1,348.67	1,348.67	0.10820	0.21550	0.02569	1,415.62
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00750	0.00563	0.00667	0.10245	0.00000	0.00000	0.05538	0.05538	0.00000	0.01298	0.01298	—	45.0731	45.0731	0.00035	0.00021	0.02230	45.1661
Vendor	0.00217	0.00117	0.03297	0.01454	0.00083	0.00000	0.02908	0.02908	0.00000	0.00706	0.00706	—	67.2367	67.2367	0.00100	0.00764	0.03778	69.5748
Hauling	0.00983	0.00216	0.11858	0.07523	0.00074	0.00136	0.47474	0.47610	0.00136	0.05225	0.05361	—	84.9452	84.9452	0.00688	0.01358	0.02691	89.1907
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00137	0.00103	0.00122	0.01870	0.00000	0.00000	0.01011	0.01011	0.00000	0.00237	0.00237	—	7.46236	7.46236	0.00006	0.00003	0.00369	7.47777
Vendor	0.00040	0.00021	0.00602	0.00265	0.00015	0.00000	0.00531	0.00531	0.00000	0.00129	0.00129	—	11.1318	11.1318	0.00017	0.00126	0.00626	11.5189
Hauling	0.00179	0.00039	0.02164	0.01373	0.00013	0.00025	0.08664	0.08689	0.00025	0.00954	0.00978	—	14.0636	14.0636	0.00114	0.00225	0.00446	14.7665

3.1.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.39502	0.38885	6.54973	19.3360	0.03563	0.09580	—	0.09580	0.09568	—	0.09568	—	3,837.91	3,837.91	0.15568	0.03114	—	3,851.08
Demolition	—	—	—	—	—	—	2.32589	2.32589	—	0.35221	0.35221	—	—	—	—	—	—	—
Onsite truck	0.00441	0.00282	0.05979	0.03598	0.00088	0.00000	0.03091	0.03091	0.00000	0.00751	0.00751	—	74.0275	74.0275	0.00176	0.00864	0.09269	76.7397

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.39502	0.38885	6.54973	19.3360	0.03563	0.09580	—	0.09580	0.09568	—	0.09568	—	3,837.91	3,837.91	0.15568	0.03114	—	3,851.08
Demolition	—	—	—	—	—	—	2.32589	2.32589	—	0.35221	0.35221	—	—	—	—	—	—	—
Onsite truck	0.00441	0.00265	0.06261	0.03898	0.00088	0.00000	0.03091	0.03091	0.00000	0.00751	0.00751	—	74.1048	74.1048	0.00176	0.00864	0.00241	76.7266
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02489	0.02450	0.41272	1.21844	0.00224	0.00604	—	0.00604	0.00603	—	0.00603	—	241.841	241.841	0.00981	0.00196	—	242.671
Demolition	—	—	—	—	—	—	0.14656	0.14656	—	0.02219	0.02219	—	—	—	—	—	—	—
Onsite truck	0.00028	0.00017	0.00388	0.00240	0.00006	0.00000	0.00194	0.00194	0.00000	0.00047	0.00047	—	4.66676	4.66676	0.00011	0.00054	0.00252	4.83434
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00454	0.00447	0.07532	0.22236	0.00041	0.00110	—	0.00110	0.00110	—	0.00110	—	40.0395	40.0395	0.00162	0.00032	—	40.1769
Demolition	—	—	—	—	—	—	0.02675	0.02675	—	0.00405	0.00405	—	—	—	—	—	—	—
Onsite truck	0.00005	0.00003	0.00071	0.00044	0.00001	0.00000	0.00035	0.00035	0.00000	0.00009	0.00009	—	0.77264	0.77264	0.00002	0.00009	0.00042	0.80038

3.1.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.12236	0.12125	0.07496	2.00951	0.00000	0.00000	0.88317	0.88317	0.00000	0.20701	0.20701	—	764.209	764.209	0.00441	0.00331	0.81968	766.125
Vendor	0.03439	0.01905	0.50742	0.22434	0.01323	0.00000	0.46361	0.46361	0.00000	0.11259	0.11259	—	1,066.93	1,066.93	0.01587	0.12117	1.39030	1,104.83
Hauling	0.15689	0.03517	1.81600	1.18933	0.01082	0.02164	7.68600	7.70764	0.02164	0.84456	0.86620	—	1,347.59	1,347.59	0.10910	0.21550	0.98718	1,415.53
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.12125	0.09149	0.10692	1.63363	0.00000	0.00000	0.88317	0.88317	0.00000	0.20701	0.20701	—	712.185	712.185	0.00551	0.00331	0.02124	713.329
Vendor	0.03439	0.01852	0.52646	0.22276	0.01323	0.00000	0.46361	0.46361	0.00000	0.11259	0.11259	—	1,067.15	1,067.15	0.01587	0.12117	0.03613	1,103.69
Hauling	0.15419	0.03246	1.91970	1.20105	0.01172	0.02164	7.68600	7.70764	0.02164	0.84456	0.86620	—	1,348.67	1,348.67	0.10820	0.21550	0.02569	1,415.62
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00750	0.00563	0.00667	0.10245	0.00000	0.00000	0.05538	0.05538	0.00000	0.01298	0.01298	—	45.0731	45.0731	0.00035	0.00021	0.02230	45.1661
Vendor	0.00217	0.00117	0.03297	0.01454	0.00083	0.00000	0.02908	0.02908	0.00000	0.00706	0.00706	—	67.2367	67.2367	0.00100	0.00764	0.03778	69.5748
Hauling	0.00983	0.00216	0.11858	0.07523	0.00074	0.00136	0.47474	0.47610	0.00136	0.05225	0.05361	—	84.9452	84.9452	0.00688	0.01358	0.02691	89.1907
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00137	0.00103	0.00122	0.01870	0.00000	0.00000	0.01011	0.01011	0.00000	0.00237	0.00237	—	7.46236	7.46236	0.00006	0.00003	0.00369	7.47777
Vendor	0.00040	0.00021	0.00602	0.00265	0.00015	0.00000	0.00531	0.00531	0.00000	0.00129	0.00129	—	11.1318	11.1318	0.00017	0.00126	0.00626	11.5189
Hauling	0.00179	0.00039	0.02164	0.01373	0.00013	0.00025	0.08664	0.08689	0.00025	0.00954	0.00978	—	14.0636	14.0636	0.00114	0.00225	0.00446	14.7665

3.2. Phase 2 Earthwork (2037)

3.2.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.04529	1.71861	10.7863	15.4870	0.04806	0.46762	—	0.46762	0.43021	—	0.43021	—	5,202.89	5,202.89	0.21105	0.04221	—	5,220.75
Dust From Material Movement	—	—	—	—	—	—	3.36793	3.36793	—	1.75879	1.75879	—	—	—	—	—	—	—
Onsite truck	0.00298	0.00190	0.04036	0.02429	0.00060	0.00000	0.02086	0.02086	0.00000	0.00507	0.00507	—	49.9686	49.9686	0.00119	0.00583	0.06256	51.7993
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.24095	0.20247	1.27071	1.82450	0.00566	0.05509	—	0.05509	0.05068	—	0.05068	—	612.943	612.943	0.02486	0.00497	—	615.047
Dust From Material Movement	—	—	—	—	—	—	0.39677	0.39677	—	0.20720	0.20720	—	—	—	—	—	—	—
Onsite truck	0.00035	0.00021	0.00489	0.00303	0.00007	0.00000	0.00245	0.00245	0.00000	0.00059	0.00059	—	5.88925	5.88925	0.00014	0.00069	0.00318	6.10073
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.04397	0.03695	0.23191	0.33297	0.00103	0.01005	—	0.01005	0.00925	—	0.00925	—	101.480	101.480	0.00412	0.00082	—	101.828
Dust From Material Movement	—	—	—	—	—	—	0.07241	0.07241	—	0.03781	0.03781	—	—	—	—	—	—	—
Onsite truck	0.00006	0.00004	0.00089	0.00055	0.00001	0.00000	0.00045	0.00045	0.00000	0.00011	0.00011	—	0.97503	0.97503	0.00002	0.00011	0.00053	1.01004

3.2.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09789	0.09700	0.05997	1.60761	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	611.367	611.367	0.00353	0.00265	0.65574	612.900
Vendor	0.02336	0.01294	0.34462	0.15237	0.00898	0.00000	0.31487	0.31487	0.00000	0.07647	0.07647	—	724.625	724.625	0.01078	0.08229	0.94425	750.362
Hauling	2.58565	0.44228	30.5090	19.0692	0.21264	0.42527	65.9090	66.3343	0.42527	8.10750	8.53277	—	25,870.0	25,870.0	1.91372	4.13364	19.3996	27,169.0
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01122	0.00842	0.00997	0.15324	0.00000	0.00000	0.08283	0.08283	0.00000	0.01941	0.01941	—	67.4136	67.4136	0.00052	0.00031	0.03335	67.5528
Vendor	0.00275	0.00148	0.04187	0.01846	0.00106	0.00000	0.03693	0.03693	0.00000	0.00897	0.00897	—	85.3736	85.3736	0.00127	0.00969	0.04798	88.3424
Hauling	0.30361	0.05110	3.73249	2.25152	0.02605	0.05010	7.62144	7.67154	0.05010	0.94026	0.99036	—	3,048.20	3,048.20	0.22545	0.48698	0.98868	3,199.94

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00205	0.00154	0.00182	0.02797	0.00000	0.00000	0.01512	0.01512	0.00000	0.00354	0.00354	—	11.1611	11.1611	0.00009	0.00005	0.00552	11.1841
Vendor	0.00050	0.00027	0.00764	0.00337	0.00019	0.00000	0.00674	0.00674	0.00000	0.00164	0.00164	—	14.1346	14.1346	0.00021	0.00161	0.00794	14.6261
Hauling	0.05541	0.00933	0.68118	0.41090	0.00475	0.00914	1.39091	1.40006	0.00914	0.17160	0.18074	—	504.664	504.664	0.03733	0.08062	0.16369	529.787

3.2.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49240	0.49240	2.56048	26.4884	0.04807	0.09848	—	0.09848	0.09848	—	0.09848	—	5,204.07	5,204.07	0.21110	0.04222	—	5,221.93
Dust From Material Movement	—	—	—	—	—	—	3.36793	3.36793	—	1.75879	1.75879	—	—	—	—	—	—	—
Onsite truck	0.00298	0.00190	0.04036	0.02429	0.00060	0.00000	0.02086	0.02086	0.00000	0.00507	0.00507	—	49.9686	49.9686	0.00119	0.00583	0.06256	51.7993
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05801	0.05801	0.30165	3.12055	0.00566	0.01160	—	0.01160	0.01160	—	0.01160	—	613.082	613.082	0.02487	0.00497	—	615.186

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Dust From Material Movement	—	—	—	—	—	—	0.39677	0.39677	—	0.20720	0.20720	—	—	—	—	—	—	—
Onsite truck	0.00035	0.00021	0.00489	0.00303	0.00007	0.00000	0.00245	0.00245	0.00000	0.00059	0.00059	—	5.88925	5.88925	0.00014	0.00069	0.00318	6.10073
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01059	0.01059	0.05505	0.56950	0.00103	0.00212	—	0.00212	0.00212	—	0.00212	—	101.503	101.503	0.00412	0.00082	—	101.851
Dust From Material Movement	—	—	—	—	—	—	0.07241	0.07241	—	0.03781	0.03781	—	—	—	—	—	—	—
Onsite truck	0.00006	0.00004	0.00089	0.00055	0.00001	0.00000	0.00045	0.00045	0.00000	0.00011	0.00011	—	0.97503	0.97503	0.00002	0.00011	0.00053	1.01004

3.2.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09789	0.09700	0.05997	1.60761	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	611.367	611.367	0.00353	0.00265	0.65574	612.900
Vendor	0.02336	0.01294	0.34462	0.15237	0.00898	0.00000	0.31487	0.31487	0.00000	0.07647	0.07647	—	724.625	724.625	0.01078	0.08229	0.94425	750.362
Hauling	2.58565	0.44228	30.5090	19.0692	0.21264	0.42527	65.9090	66.3343	0.42527	8.10750	8.53277	—	25,870.0	25,870.0	1.91372	4.13364	19.3996	27,169.0

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01122	0.00842	0.00997	0.15324	0.00000	0.00000	0.08283	0.08283	0.00000	0.01941	0.01941	—	67.4136	67.4136	0.00052	0.00031	0.03335	67.5528
Vendor	0.00275	0.00148	0.04187	0.01846	0.00106	0.00000	0.03693	0.03693	0.00000	0.00897	0.00897	—	85.3736	85.3736	0.00127	0.00969	0.04798	88.3424
Hauling	0.30361	0.05110	3.73249	2.25152	0.02605	0.05010	7.62144	7.67154	0.05010	0.94026	0.99036	—	3,048.20	3,048.20	0.22545	0.48698	0.98868	3,199.94
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00205	0.00154	0.00182	0.02797	0.00000	0.00000	0.01512	0.01512	0.00000	0.00354	0.00354	—	11.1611	11.1611	0.00009	0.00005	0.00552	11.1841
Vendor	0.00050	0.00027	0.00764	0.00337	0.00019	0.00000	0.00674	0.00674	0.00000	0.00164	0.00164	—	14.1346	14.1346	0.00021	0.00161	0.00794	14.6261
Hauling	0.05541	0.00933	0.68118	0.41090	0.00475	0.00914	1.39091	1.40006	0.00914	0.17160	0.18074	—	504.664	504.664	0.03733	0.08062	0.16369	529.787

3.3. Phase 3 Foundation (2037)

3.3.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.29453	1.92253	10.0647	22.1907	0.06767	0.30795	—	0.30795	0.28332	—	0.28332	—	7,126.75	7,126.75	0.28909	0.05782	—	7,151.21

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Dust From Material Movement	—	—	—	—	—	—	0.01410	0.01410	—	0.00180	0.00180	—	—	—	—	—	—	—
Onsite truck	0.00656	0.00420	0.08894	0.05352	0.00131	0.00000	0.04597	0.04597	0.00000	0.01117	0.01117	—	110.116	110.116	0.00262	0.01286	0.13787	114.150
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.29453	1.92253	10.0647	22.1907	0.06767	0.30795	—	0.30795	0.28332	—	0.28332	—	7,126.75	7,126.75	0.28909	0.05782	—	7,151.21
Dust From Material Movement	—	—	—	—	—	—	0.01410	0.01410	—	0.00180	0.00180	—	—	—	—	—	—	—
Onsite truck	0.00656	0.00394	0.09313	0.05798	0.00131	0.00000	0.04597	0.04597	0.00000	0.01117	0.01117	—	110.231	110.231	0.00262	0.01286	0.00358	114.131
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.95643	0.80137	4.19526	9.24976	0.02821	0.12836	—	0.12836	0.11809	—	0.11809	—	2,970.64	2,970.64	0.12050	0.02410	—	2,980.84
Dust From Material Movement	—	—	—	—	—	—	0.00588	0.00588	—	0.00075	0.00075	—	—	—	—	—	—	—
Onsite truck	0.00273	0.00164	0.03817	0.02362	0.00055	0.00000	0.01908	0.01908	0.00000	0.00463	0.00463	—	45.9194	45.9194	0.00109	0.00536	0.02479	47.5683

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.17455	0.14625	0.76564	1.68808	0.00515	0.02343	—	0.02343	0.02155	—	0.02155	—	491.824	491.824	0.01995	0.00399	—	493.511
Dust From Material Movement	—	—	—	—	—	—	0.00107	0.00107	—	0.00014	0.00014	—	—	—	—	—	—	—
Onsite truck	0.00050	0.00030	0.00697	0.00431	0.00010	0.00000	0.00348	0.00348	0.00000	0.00085	0.00085	—	7.60248	7.60248	0.00018	0.00089	0.00410	7.87548

3.3.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.17130	0.16976	0.10494	2.81332	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	1,069.89	1,069.89	0.00617	0.00463	1.14755	1,072.57
Vendor	0.05130	0.02841	0.75690	0.33464	0.01973	0.00000	0.69154	0.69154	0.00000	0.16795	0.16795	—	1,591.51	1,591.51	0.02368	0.18074	2.07387	1,648.03
Hauling	0.16687	0.03740	1.93145	1.26494	0.01151	0.02302	5.87084	5.89386	0.02302	0.66852	0.69153	—	1,433.26	1,433.26	0.11604	0.22920	1.04993	1,505.51
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.16976	0.12809	0.14969	2.28708	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	997.058	997.058	0.00772	0.00463	0.02974	998.661
Vendor	0.05130	0.02762	0.78531	0.33228	0.01973	0.00000	0.69154	0.69154	0.00000	0.16795	0.16795	—	1,591.84	1,591.84	0.02368	0.18074	0.05389	1,646.34
Hauling	0.16399	0.03452	2.04173	1.27740	0.01247	0.02302	5.87084	5.89386	0.02302	0.66852	0.69153	—	1,434.40	1,434.40	0.11508	0.22920	0.02732	1,505.61

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06947	0.05210	0.06175	0.94882	0.00000	0.00000	0.51287	0.51287	0.00000	0.12018	0.12018	—	417.416	417.416	0.00322	0.00193	0.20651	418.278
Vendor	0.02138	0.01151	0.32537	0.14344	0.00822	0.00000	0.28697	0.28697	0.00000	0.06969	0.06969	—	663.441	663.441	0.00987	0.07534	0.37283	686.511
Hauling	0.06916	0.01519	0.83427	0.52926	0.00520	0.00959	2.39972	2.40931	0.00959	0.27381	0.28341	—	597.624	597.624	0.04837	0.09554	0.18933	627.494
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01268	0.00951	0.01127	0.17316	0.00000	0.00000	0.09360	0.09360	0.00000	0.02193	0.02193	—	69.1079	69.1079	0.00053	0.00032	0.03419	69.2506
Vendor	0.00390	0.00210	0.05938	0.02618	0.00150	0.00000	0.05237	0.05237	0.00000	0.01272	0.01272	—	109.840	109.840	0.00163	0.01247	0.06173	113.660
Hauling	0.01262	0.00277	0.15225	0.09659	0.00095	0.00175	0.43795	0.43970	0.00175	0.04997	0.05172	—	98.9436	98.9436	0.00801	0.01582	0.03134	103.889

3.3.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.44280	1.28302	6.79226	34.4005	0.06773	0.16907	—	0.16907	0.16317	—	0.16317	—	7,132.69	7,132.69	0.28933	0.05787	—	7,157.17
Dust From Material Movement	—	—	—	—	—	—	0.01410	0.01410	—	0.00180	0.00180	—	—	—	—	—	—	—
Onsite truck	0.00656	0.00420	0.08894	0.05352	0.00131	0.00000	0.04597	0.04597	0.00000	0.01117	0.01117	—	110.116	110.116	0.00262	0.01286	0.13787	114.150

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.44280	1.28302	6.79226	34.4005	0.06773	0.16907	—	0.16907	0.16317	—	0.16317	—	7,132.69	7,132.69	0.28933	0.05787	—	7,157.17
Dust From Material Movement	—	—	—	—	—	—	0.01410	0.01410	—	0.00180	0.00180	—	—	—	—	—	—	—
Onsite truck	0.00656	0.00394	0.09313	0.05798	0.00131	0.00000	0.04597	0.04597	0.00000	0.01117	0.01117	—	110.231	110.231	0.00262	0.01286	0.00358	114.131
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.60140	0.53480	2.83122	14.3392	0.02823	0.07047	—	0.07047	0.06802	—	0.06802	—	2,973.12	2,973.12	0.12060	0.02412	—	2,983.32
Dust From Material Movement	—	—	—	—	—	—	0.00588	0.00588	—	0.00075	0.00075	—	—	—	—	—	—	—
Onsite truck	0.00273	0.00164	0.03817	0.02362	0.00055	0.00000	0.01908	0.01908	0.00000	0.00463	0.00463	—	45.9194	45.9194	0.00109	0.00536	0.02479	47.5683
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.10976	0.09760	0.51670	2.61690	0.00515	0.01286	—	0.01286	0.01241	—	0.01241	—	492.234	492.234	0.01997	0.00399	—	493.923

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Dust From Material Movement	—	—	—	—	—	—	0.00107	0.00107	—	0.00014	0.00014	—	—	—	—	—	—	—
Onsite truck	0.00050	0.00030	0.00697	0.00431	0.00010	0.00000	0.00348	0.00348	0.00000	0.00085	0.00085	—	7.60248	7.60248	0.00018	0.00089	0.00410	7.87548

3.3.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.17130	0.16976	0.10494	2.81332	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	1,069.89	1,069.89	0.00617	0.00463	1.14755	1,072.57
Vendor	0.05130	0.02841	0.75690	0.33464	0.01973	0.00000	0.69154	0.69154	0.00000	0.16795	0.16795	—	1,591.51	1,591.51	0.02368	0.18074	2.07387	1,648.03
Hauling	0.16687	0.03740	1.93145	1.26494	0.01151	0.02302	5.87084	5.89386	0.02302	0.66852	0.69153	—	1,433.26	1,433.26	0.11604	0.22920	1.04993	1,505.51
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.16976	0.12809	0.14969	2.28708	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	997.058	997.058	0.00772	0.00463	0.02974	998.661
Vendor	0.05130	0.02762	0.78531	0.33228	0.01973	0.00000	0.69154	0.69154	0.00000	0.16795	0.16795	—	1,591.84	1,591.84	0.02368	0.18074	0.05389	1,646.34
Hauling	0.16399	0.03452	2.04173	1.27740	0.01247	0.02302	5.87084	5.89386	0.02302	0.66852	0.69153	—	1,434.40	1,434.40	0.11508	0.22920	0.02732	1,505.61
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06947	0.05210	0.06175	0.94882	0.00000	0.00000	0.51287	0.51287	0.00000	0.12018	0.12018	—	417.416	417.416	0.00322	0.00193	0.20651	418.278
Vendor	0.02138	0.01151	0.32537	0.14344	0.00822	0.00000	0.28697	0.28697	0.00000	0.06969	0.06969	—	663.441	663.441	0.00987	0.07534	0.37283	686.511

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.06916	0.01519	0.83427	0.52926	0.00520	0.00959	2.39972	2.40931	0.00959	0.27381	0.28341	—	597.624	597.624	0.04837	0.09554	0.18933	627.494
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01268	0.00951	0.01127	0.17316	0.00000	0.00000	0.09360	0.09360	0.00000	0.02193	0.02193	—	69.1079	69.1079	0.00053	0.00032	0.03419	69.2506
Vendor	0.00390	0.00210	0.05938	0.02618	0.00150	0.00000	0.05237	0.05237	0.00000	0.01272	0.01272	—	109.840	109.840	0.00163	0.01247	0.06173	113.660
Hauling	0.01262	0.00277	0.15225	0.09659	0.00095	0.00175	0.43795	0.43970	0.00175	0.04997	0.05172	—	98.9436	98.9436	0.00801	0.01582	0.03134	103.889

3.4. Phase 3 Foundation (2038)

3.4.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	2.27583	1.90683	9.74523	22.1420	0.06767	0.29668	—	0.29668	0.27295	—	0.27295	—	7,126.74	7,126.74	0.28909	0.05782	—	7,151.20
Dust From Material Movement	—	—	—	—	—	—	0.01410	0.01410	—	0.00180	0.00180	—	—	—	—	—	—	—
Onsite truck	0.00656	0.00394	0.08920	0.05667	0.00131	0.00000	0.04597	0.04597	0.00000	0.01117	0.01117	—	105.308	105.308	0.00262	0.01286	0.00315	109.207

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.26722	0.22389	1.14425	2.59985	0.00795	0.03484	—	0.03484	0.03205	—	0.03205	—	836.799	836.799	0.03394	0.00679	—	839.671
Dust From Material Movement	—	—	—	—	—	—	0.00166	0.00166	—	0.00021	0.00021	—	—	—	—	—	—	—
Onsite truck	0.00077	0.00046	0.01010	0.00638	0.00015	0.00000	0.00537	0.00537	0.00000	0.00131	0.00131	—	12.3568	12.3568	0.00031	0.00151	0.00614	12.8204
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.04877	0.04086	0.20883	0.47447	0.00145	0.00636	—	0.00636	0.00585	—	0.00585	—	138.542	138.542	0.00562	0.00112	—	139.017
Dust From Material Movement	—	—	—	—	—	—	0.00030	0.00030	—	0.00004	0.00004	—	—	—	—	—	—	—
Onsite truck	0.00014	0.00008	0.00184	0.00116	0.00003	0.00000	0.00098	0.00098	0.00000	0.00024	0.00024	—	2.04580	2.04580	0.00005	0.00025	0.00102	2.12256

3.4.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.16513	0.12346	0.14969	2.23152	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	988.876	988.876	0.00772	0.00463	0.02516	990.474
Vendor	0.05130	0.02762	0.74190	0.32833	0.01973	0.00000	0.69154	0.69154	0.00000	0.16795	0.16795	—	1,518.16	1,518.16	0.02368	0.18074	0.04740	1,572.66
Hauling	0.15152	0.03452	2.00241	1.23233	0.01247	0.02302	5.85933	5.88235	0.02302	0.66852	0.69153	—	1,407.71	1,407.71	0.10261	0.22920	0.02370	1,478.60
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01921	0.01431	0.01721	0.25658	0.00000	0.00000	0.14447	0.14447	0.00000	0.03385	0.03385	—	116.617	116.617	0.00072	0.00054	0.04917	116.846
Vendor	0.00602	0.00324	0.08415	0.03772	0.00232	0.00000	0.08084	0.08084	0.00000	0.01963	0.01963	—	178.234	178.234	0.00278	0.02122	0.09243	184.720
Hauling	0.01802	0.00428	0.23039	0.14380	0.00135	0.00270	0.67463	0.67733	0.00270	0.07713	0.07983	—	165.209	165.209	0.01216	0.02691	0.04618	173.579
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00351	0.00261	0.00314	0.04683	0.00000	0.00000	0.02637	0.02637	0.00000	0.00618	0.00618	—	19.3073	19.3073	0.00012	0.00009	0.00814	19.3453
Vendor	0.00110	0.00059	0.01536	0.00688	0.00042	0.00000	0.01475	0.01475	0.00000	0.00358	0.00358	—	29.5086	29.5086	0.00046	0.00351	0.01530	30.5824
Hauling	0.00329	0.00078	0.04205	0.02624	0.00025	0.00049	0.12312	0.12361	0.00049	0.01408	0.01457	—	27.3523	27.3523	0.00201	0.00446	0.00765	28.7380

3.4.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	1.43844	1.27937	6.68520	34.3962	0.06773	0.16590	—	0.16590	0.16026	—	0.16026	—	7,132.68	7,132.68	0.28933	0.05787	—	7,157.16
Dust From Material Movement	—	—	—	—	—	—	0.01410	0.01410	—	0.00180	0.00180	—	—	—	—	—	—	—
Onsite truck	0.00656	0.00394	0.08920	0.05667	0.00131	0.00000	0.04597	0.04597	0.00000	0.01117	0.01117	—	105.308	105.308	0.00262	0.01286	0.00315	109.207
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.16890	0.15022	0.78496	4.03869	0.00795	0.01948	—	0.01948	0.01882	—	0.01882	—	837.497	837.497	0.03397	0.00679	—	840.371
Dust From Material Movement	—	—	—	—	—	—	0.00166	0.00166	—	0.00021	0.00021	—	—	—	—	—	—	—
Onsite truck	0.00077	0.00046	0.01010	0.00638	0.00015	0.00000	0.00537	0.00537	0.00000	0.00131	0.00131	—	12.3568	12.3568	0.00031	0.00151	0.00614	12.8204
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03082	0.02742	0.14325	0.73706	0.00145	0.00355	—	0.00355	0.00343	—	0.00343	—	138.657	138.657	0.00562	0.00112	—	139.133
Dust From Material Movement	—	—	—	—	—	—	0.00030	0.00030	—	0.00004	0.00004	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00014	0.00008	0.00184	0.00116	0.00003	0.00000	0.00098	0.00098	0.00000	0.00024	0.00024	—	2.04580	2.04580	0.00005	0.00025	0.00102	2.12256

3.4.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.16513	0.12346	0.14969	2.23152	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	988.876	988.876	0.00772	0.00463	0.02516	990.474
Vendor	0.05130	0.02762	0.74190	0.32833	0.01973	0.00000	0.69154	0.69154	0.00000	0.16795	0.16795	—	1,518.16	1,518.16	0.02368	0.18074	0.04740	1,572.66
Hauling	0.15152	0.03452	2.00241	1.23233	0.01247	0.02302	5.85933	5.88235	0.02302	0.66852	0.69153	—	1,407.71	1,407.71	0.10261	0.22920	0.02370	1,478.60
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01921	0.01431	0.01721	0.25658	0.00000	0.00000	0.14447	0.14447	0.00000	0.03385	0.03385	—	116.617	116.617	0.00072	0.00054	0.04917	116.846
Vendor	0.00602	0.00324	0.08415	0.03772	0.00232	0.00000	0.08084	0.08084	0.00000	0.01963	0.01963	—	178.234	178.234	0.00278	0.02122	0.09243	184.720
Hauling	0.01802	0.00428	0.23039	0.14380	0.00135	0.00270	0.67463	0.67733	0.00270	0.07713	0.07983	—	165.209	165.209	0.01216	0.02691	0.04618	173.579
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00351	0.00261	0.00314	0.04683	0.00000	0.00000	0.02637	0.02637	0.00000	0.00618	0.00618	—	19.3073	19.3073	0.00012	0.00009	0.00814	19.3453
Vendor	0.00110	0.00059	0.01536	0.00688	0.00042	0.00000	0.01475	0.01475	0.00000	0.00358	0.00358	—	29.5086	29.5086	0.00046	0.00351	0.01530	30.5824
Hauling	0.00329	0.00078	0.04205	0.02624	0.00025	0.00049	0.12312	0.12361	0.00049	0.01408	0.01457	—	27.3523	27.3523	0.00201	0.00446	0.00765	28.7380

3.5. Phase 4 Super Structureng Construction (2038)

3.5.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.09438	0.91890	6.20040	12.5789	0.03281	0.20078	—	0.20078	0.18471	—	0.18471	—	3,525.93	3,525.93	0.14303	0.02861	—	3,538.03
Onsite truck	0.00408	0.00245	0.05204	0.03198	0.00082	0.00000	0.02859	0.02859	0.00000	0.00694	0.00694	—	65.4117	65.4117	0.00163	0.00783	0.07547	67.8615
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.09438	0.91890	6.20040	12.5789	0.03281	0.20078	—	0.20078	0.18471	—	0.18471	—	3,525.93	3,525.93	0.14303	0.02861	—	3,538.03
Onsite truck	0.00408	0.00245	0.05547	0.03524	0.00082	0.00000	0.02859	0.02859	0.00000	0.00694	0.00694	—	65.4856	65.4856	0.00163	0.00799	0.00196	67.9105
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77528	0.65096	4.39245	8.91106	0.02324	0.14223	—	0.14223	0.13085	—	0.13085	—	2,497.82	2,497.82	0.10132	0.02026	—	2,506.40
Onsite truck	0.00289	0.00173	0.03791	0.02392	0.00058	0.00000	0.02016	0.02016	0.00000	0.00490	0.00490	—	46.3603	46.3603	0.00116	0.00566	0.02305	48.0998
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.14149	0.11880	0.80162	1.62627	0.00424	0.02596	—	0.02596	0.02388	—	0.02388	—	413.543	413.543	0.01678	0.00336	—	414.962
Onsite truck	0.00053	0.00032	0.00692	0.00437	0.00011	0.00000	0.00368	0.00368	0.00000	0.00089	0.00089	—	7.67548	7.67548	0.00019	0.00094	0.00382	7.96348

3.5.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14154	0.10714	0.08995	2.33470	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	909.551	909.551	0.00529	0.00397	0.83229	911.698
Vendor	0.03196	0.01721	0.43214	0.19469	0.01229	0.00000	0.43077	0.43077	0.00000	0.10462	0.10462	—	945.460	945.460	0.01475	0.11209	1.13715	980.369
Hauling	0.20838	0.02862	2.69277	1.56842	0.02159	0.04318	3.78952	3.83270	0.04318	0.53592	0.57911	—	2,537.29	2,537.29	0.15739	0.41311	1.70748	2,666.04
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14154	0.10582	0.12831	1.91273	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	847.608	847.608	0.00661	0.00397	0.02156	848.978
Vendor	0.03196	0.01721	0.46213	0.20452	0.01229	0.00000	0.43077	0.43077	0.00000	0.10462	0.10462	—	945.673	945.673	0.01475	0.11258	0.02953	979.621
Hauling	0.20734	0.02784	2.85197	1.57180	0.02185	0.04318	3.78952	3.83270	0.04318	0.53592	0.57911	—	2,537.61	2,537.61	0.15713	0.41311	0.04446	2,664.69
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09933	0.07403	0.08902	1.32689	0.00000	0.00000	0.74712	0.74712	0.00000	0.17507	0.17507	—	603.077	603.077	0.00375	0.00281	0.25427	604.263
Vendor	0.02264	0.01219	0.31624	0.14175	0.00871	0.00000	0.30380	0.30380	0.00000	0.07377	0.07377	—	669.836	669.836	0.01045	0.07976	0.34738	694.212
Hauling	0.14725	0.02009	1.98647	1.11201	0.01530	0.03059	2.63964	2.67023	0.03059	0.37481	0.40541	—	1,797.55	1,797.55	0.11150	0.29265	0.52278	1,888.07

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01813	0.01351	0.01625	0.24216	0.00000	0.00000	0.13635	0.13635	0.00000	0.03195	0.03195	—	99.8463	99.8463	0.00062	0.00047	0.04210	100.043
Vendor	0.00413	0.00222	0.05771	0.02587	0.00159	0.00000	0.05544	0.05544	0.00000	0.01346	0.01346	—	110.899	110.899	0.00173	0.01320	0.05751	114.935
Hauling	0.02687	0.00367	0.36253	0.20294	0.00279	0.00558	0.48173	0.48732	0.00558	0.06840	0.07399	—	297.605	297.605	0.01846	0.04845	0.08655	312.591

3.5.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49924	0.46123	3.07502	18.2222	0.03281	0.07340	—	0.07340	0.07172	—	0.07172	—	3,526.00	3,526.00	0.14303	0.02861	—	3,538.10
Onsite truck	0.00408	0.00245	0.05204	0.03198	0.00082	0.00000	0.02859	0.02859	0.00000	0.00694	0.00694	—	65.4117	65.4117	0.00163	0.00783	0.07547	67.8615
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49924	0.46123	3.07502	18.2222	0.03281	0.07340	—	0.07340	0.07172	—	0.07172	—	3,526.00	3,526.00	0.14303	0.02861	—	3,538.10
Onsite truck	0.00408	0.00245	0.05547	0.03524	0.00082	0.00000	0.02859	0.02859	0.00000	0.00694	0.00694	—	65.4856	65.4856	0.00163	0.00799	0.00196	67.9105
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.35367	0.32674	2.17839	12.9089	0.02324	0.05199	—	0.05199	0.05081	—	0.05081	—	2,497.87	2,497.87	0.10132	0.02026	—	2,506.44
Onsite truck	0.00289	0.00173	0.03791	0.02392	0.00058	0.00000	0.02016	0.02016	0.00000	0.00490	0.00490	—	46.3603	46.3603	0.00116	0.00566	0.02305	48.0998
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06454	0.05963	0.39756	2.35587	0.00424	0.00949	—	0.00949	0.00927	—	0.00927	—	413.551	413.551	0.01678	0.00336	—	414.970
Onsite truck	0.00053	0.00032	0.00692	0.00437	0.00011	0.00000	0.00368	0.00368	0.00000	0.00089	0.00089	—	7.67548	7.67548	0.00019	0.00094	0.00382	7.96348

3.5.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14154	0.10714	0.08995	2.33470	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	909.551	909.551	0.00529	0.00397	0.83229	911.698
Vendor	0.03196	0.01721	0.43214	0.19469	0.01229	0.00000	0.43077	0.43077	0.00000	0.10462	0.10462	—	945.460	945.460	0.01475	0.11209	1.13715	980.369
Hauling	0.20838	0.02862	2.69277	1.56842	0.02159	0.04318	3.78952	3.83270	0.04318	0.53592	0.57911	—	2,537.29	2,537.29	0.15739	0.41311	1.70748	2,666.04
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.14154	0.10582	0.12831	1.91273	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	847.608	847.608	0.00661	0.00397	0.02156	848.978
Vendor	0.03196	0.01721	0.46213	0.20452	0.01229	0.00000	0.43077	0.43077	0.00000	0.10462	0.10462	—	945.673	945.673	0.01475	0.11258	0.02953	979.621
Hauling	0.20734	0.02784	2.85197	1.57180	0.02185	0.04318	3.78952	3.83270	0.04318	0.53592	0.57911	—	2,537.61	2,537.61	0.15713	0.41311	0.04446	2,664.69

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09933	0.07403	0.08902	1.32689	0.00000	0.00000	0.74712	0.74712	0.00000	0.17507	0.17507	—	603.077	603.077	0.00375	0.00281	0.25427	604.263
Vendor	0.02264	0.01219	0.31624	0.14175	0.00871	0.00000	0.30380	0.30380	0.00000	0.07377	0.07377	—	669.836	669.836	0.01045	0.07976	0.34738	694.212
Hauling	0.14725	0.02009	1.98647	1.11201	0.01530	0.03059	2.63964	2.67023	0.03059	0.37481	0.40541	—	1,797.55	1,797.55	0.11150	0.29265	0.52278	1,888.07
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01813	0.01351	0.01625	0.24216	0.00000	0.00000	0.13635	0.13635	0.00000	0.03195	0.03195	—	99.8463	99.8463	0.00062	0.00047	0.04210	100.043
Vendor	0.00413	0.00222	0.05771	0.02587	0.00159	0.00000	0.05544	0.05544	0.00000	0.01346	0.01346	—	110.899	110.899	0.00173	0.01320	0.05751	114.935
Hauling	0.02687	0.00367	0.36253	0.20294	0.00279	0.00558	0.48173	0.48732	0.00558	0.06840	0.07399	—	297.605	297.605	0.01846	0.04845	0.08655	312.591

3.6. Phase 4 Super Structureng Construction (2039)

3.6.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.07839	0.90546	5.98518	12.4285	0.03281	0.19366	—	0.19366	0.17817	—	0.17817	—	3,525.93	3,525.93	0.14303	0.02861	—	3,538.03
Onsite truck	0.00392	0.00245	0.04960	0.03051	0.00082	0.00000	0.02859	0.02859	0.00000	0.00694	0.00694	—	62.6374	62.6374	0.00163	0.00783	0.06626	65.0780
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	1.07839	0.90546	5.98518	12.4285	0.03281	0.19366	—	0.19366	0.17817	—	0.17817	—	3,525.93	3,525.93	0.14303	0.02861	—	3,538.03
Onsite truck	0.00408	0.00245	0.05221	0.03377	0.00082	0.00000	0.02859	0.02859	0.00000	0.00694	0.00694	—	62.7141	62.7141	0.00163	0.00799	0.00171	65.1388
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.31022	0.26047	1.72176	3.57532	0.00944	0.05571	—	0.05571	0.05125	—	0.05125	—	1,014.31	1,014.31	0.04114	0.00823	—	1,017.79
Onsite truck	0.00117	0.00066	0.01474	0.00929	0.00023	0.00000	0.00819	0.00819	0.00000	0.00199	0.00199	—	18.0282	18.0282	0.00047	0.00225	0.00822	18.7195
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05662	0.04754	0.31422	0.65250	0.00172	0.01017	—	0.01017	0.00935	—	0.00935	—	167.930	167.930	0.00681	0.00136	—	168.507
Onsite truck	0.00021	0.00012	0.00269	0.00170	0.00004	0.00000	0.00149	0.00149	0.00000	0.00036	0.00036	—	2.98478	2.98478	0.00008	0.00037	0.00136	3.09923

3.6.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13625	0.10185	0.08863	2.26062	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	902.954	902.954	0.00529	0.00397	0.69988	904.969
Vendor	0.03146	0.01721	0.40510	0.18043	0.01229	0.00000	0.43077	0.43077	0.00000	0.10462	0.10462	—	903.924	903.924	0.01475	0.11209	0.99831	938.695
Hauling	0.18652	0.02862	2.62617	1.48231	0.02159	0.04318	3.78952	3.83270	0.04318	0.53592	0.57911	—	2,492.55	2,492.55	0.15713	0.39152	1.48208	2,614.64

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13625	0.10053	0.12699	1.83469	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	841.467	841.467	0.00661	0.00397	0.01811	842.833
Vendor	0.03196	0.01721	0.42280	0.19026	0.01229	0.00000	0.43077	0.43077	0.00000	0.10462	0.10462	—	904.155	904.155	0.01475	0.11258	0.02584	938.100
Hauling	0.18548	0.02784	2.76431	1.48569	0.02185	0.04318	3.78952	3.83270	0.04318	0.53592	0.57911	—	2,492.86	2,492.86	0.15713	0.39152	0.03829	2,613.50
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03843	0.02816	0.02664	0.52588	0.00000	0.00000	0.30339	0.30339	0.00000	0.07109	0.07109	—	243.130	243.130	0.00152	0.00114	0.08679	243.595
Vendor	0.00919	0.00481	0.12078	0.05346	0.00354	0.00000	0.12337	0.12337	0.00000	0.02996	0.02996	—	260.061	260.061	0.00424	0.03225	0.12387	269.900
Hauling	0.05351	0.00816	0.78137	0.42679	0.00621	0.01242	1.07190	1.08432	0.01242	0.15220	0.16463	—	717.069	717.069	0.04520	0.11263	0.18386	751.947
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00701	0.00514	0.00486	0.09597	0.00000	0.00000	0.05537	0.05537	0.00000	0.01297	0.01297	—	40.2530	40.2530	0.00025	0.00019	0.01437	40.3299
Vendor	0.00168	0.00088	0.02204	0.00976	0.00065	0.00000	0.02251	0.02251	0.00000	0.00547	0.00547	—	43.0560	43.0560	0.00070	0.00534	0.02051	44.6850
Hauling	0.00977	0.00149	0.14260	0.07789	0.00113	0.00227	0.19562	0.19789	0.00227	0.02778	0.03004	—	118.719	118.719	0.00748	0.01865	0.03044	124.493

3.6.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49773	0.45996	3.05199	18.2207	0.03281	0.07243	—	0.07243	0.07083	—	0.07083	—	3,525.99	3,525.99	0.14303	0.02861	—	3,538.09

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00392	0.00245	0.04960	0.03051	0.00082	0.00000	0.02859	0.02859	0.00000	0.00694	0.00694	—	62.6374	62.6374	0.00163	0.00783	0.06626	65.0780
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49773	0.45996	3.05199	18.2207	0.03281	0.07243	—	0.07243	0.07083	—	0.07083	—	3,525.99	3,525.99	0.14303	0.02861	—	3,538.09
Onsite truck	0.00408	0.00245	0.05221	0.03377	0.00082	0.00000	0.02859	0.02859	0.00000	0.00694	0.00694	—	62.7141	62.7141	0.00163	0.00799	0.00171	65.1388
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.14318	0.13232	0.87797	5.24156	0.00944	0.02084	—	0.02084	0.02038	—	0.02038	—	1,014.33	1,014.33	0.04115	0.00823	—	1,017.81
Onsite truck	0.00117	0.00066	0.01474	0.00929	0.00023	0.00000	0.00819	0.00819	0.00000	0.00199	0.00199	—	18.0282	18.0282	0.00047	0.00225	0.00822	18.7195
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02613	0.02415	0.16023	0.95658	0.00172	0.00380	—	0.00380	0.00372	—	0.00372	—	167.933	167.933	0.00681	0.00136	—	168.510
Onsite truck	0.00021	0.00012	0.00269	0.00170	0.00004	0.00000	0.00149	0.00149	0.00000	0.00036	0.00036	—	2.98478	2.98478	0.00008	0.00037	0.00136	3.09923

3.6.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13625	0.10185	0.08863	2.26062	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	902.954	902.954	0.00529	0.00397	0.69988	904.969
Vendor	0.03146	0.01721	0.40510	0.18043	0.01229	0.00000	0.43077	0.43077	0.00000	0.10462	0.10462	—	903.924	903.924	0.01475	0.11209	0.99831	938.695
Hauling	0.18652	0.02862	2.62617	1.48231	0.02159	0.04318	3.78952	3.83270	0.04318	0.53592	0.57911	—	2,492.55	2,492.55	0.15713	0.39152	1.48208	2,614.64
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.13625	0.10053	0.12699	1.83469	0.00000	0.00000	1.05981	1.05981	0.00000	0.24842	0.24842	—	841.467	841.467	0.00661	0.00397	0.01811	842.833
Vendor	0.03196	0.01721	0.42280	0.19026	0.01229	0.00000	0.43077	0.43077	0.00000	0.10462	0.10462	—	904.155	904.155	0.01475	0.11258	0.02584	938.100
Hauling	0.18548	0.02784	2.76431	1.48569	0.02185	0.04318	3.78952	3.83270	0.04318	0.53592	0.57911	—	2,492.86	2,492.86	0.15713	0.39152	0.03829	2,613.50
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03843	0.02816	0.02664	0.52588	0.00000	0.00000	0.30339	0.30339	0.00000	0.07109	0.07109	—	243.130	243.130	0.00152	0.00114	0.08679	243.595
Vendor	0.00919	0.00481	0.12078	0.05346	0.00354	0.00000	0.12337	0.12337	0.00000	0.02996	0.02996	—	260.061	260.061	0.00424	0.03225	0.12387	269.900
Hauling	0.05351	0.00816	0.78137	0.42679	0.00621	0.01242	1.07190	1.08432	0.01242	0.15220	0.16463	—	717.069	717.069	0.04520	0.11263	0.18386	751.947
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00701	0.00514	0.00486	0.09597	0.00000	0.00000	0.05537	0.05537	0.00000	0.01297	0.01297	—	40.2530	40.2530	0.00025	0.00019	0.01437	40.3299
Vendor	0.00168	0.00088	0.02204	0.00976	0.00065	0.00000	0.02251	0.02251	0.00000	0.00547	0.00547	—	43.0560	43.0560	0.00070	0.00534	0.02051	44.6850
Hauling	0.00977	0.00149	0.14260	0.07789	0.00113	0.00227	0.19562	0.19789	0.00227	0.02778	0.03004	—	118.719	118.719	0.00748	0.01865	0.03044	124.493

3.7. Phase dust control (2037)

3.7.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00459	0.00141	0.05146	0.03624	0.00022	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	29.1663	29.1663	0.00287	0.00467	0.02011	30.6509
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00445	0.00128	0.05437	0.03682	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	29.2190	29.2190	0.00282	0.00467	0.00052	30.6828
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00271	0.00082	0.03171	0.02176	0.00016	0.00026	0.43838	0.43864	0.00026	0.04457	0.04484	—	17.4217	17.4217	0.00171	0.00279	0.00519	18.3009
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00049	0.00015	0.00579	0.00397	0.00003	0.00005	0.08000	0.08005	0.00005	0.00813	0.00818	—	2.88435	2.88435	0.00028	0.00046	0.00086	3.02993

3.7.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.7.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00459	0.00141	0.05146	0.03624	0.00022	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	29.1663	29.1663	0.00287	0.00467	0.02011	30.6509
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00445	0.00128	0.05437	0.03682	0.00026	0.00044	0.74994	0.75038	0.00044	0.07623	0.07667	—	29.2190	29.2190	0.00282	0.00467	0.00052	30.6828
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00271	0.00082	0.03171	0.02176	0.00016	0.00026	0.43838	0.43864	0.00026	0.04457	0.04484	—	17.4217	17.4217	0.00171	0.00279	0.00519	18.3009
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00049	0.00015	0.00579	0.00397	0.00003	0.00005	0.08000	0.08005	0.00005	0.00813	0.00818	—	2.88435	2.88435	0.00028	0.00046	0.00086	3.02993

3.7.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.8. Phase dust control (2038)

3.8.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00437	0.00141	0.05057	0.03541	0.00022	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.6450	28.6450	0.00260	0.00467	0.01743	30.1202

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00419	0.00128	0.05348	0.03598	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.6989	28.6989	0.00256	0.00467	0.00045	30.1561
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00305	0.00098	0.03732	0.02545	0.00016	0.00031	0.52446	0.52478	0.00031	0.05334	0.05366	—	20.4769	20.4769	0.00186	0.00334	0.00538	21.5236
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00056	0.00018	0.00681	0.00464	0.00003	0.00006	0.09571	0.09577	0.00006	0.00973	0.00979	—	3.39018	3.39018	0.00031	0.00055	0.00089	3.56347

3.8.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.8.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00437	0.00141	0.05057	0.03541	0.00022	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.6450	28.6450	0.00260	0.00467	0.01743	30.1202
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00419	0.00128	0.05348	0.03598	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.6989	28.6989	0.00256	0.00467	0.00045	30.1561
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00305	0.00098	0.03732	0.02545	0.00016	0.00031	0.52446	0.52478	0.00031	0.05334	0.05366	—	20.4769	20.4769	0.00186	0.00334	0.00538	21.5236
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00056	0.00018	0.00681	0.00464	0.00003	0.00006	0.09571	0.09577	0.00006	0.00973	0.00979	—	3.39018	3.39018	0.00031	0.00055	0.00089	3.56347

3.8.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.9. Phase dust control (2039)

3.9.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00410	0.00141	0.04960	0.03457	0.00022	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.1749	28.1749	0.00256	0.00445	0.01513	29.5811
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00392	0.00128	0.05238	0.03514	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.2301	28.2301	0.00256	0.00445	0.00039	29.6216
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00287	0.00098	0.03650	0.02485	0.00016	0.00031	0.52446	0.52478	0.00031	0.05334	0.05366	—	20.1414	20.1414	0.00183	0.00318	0.00466	21.1397
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00052	0.00018	0.00666	0.00453	0.00003	0.00006	0.09571	0.09577	0.00006	0.00973	0.00979	—	3.33464	3.33464	0.00030	0.00053	0.00077	3.49992

3.9.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.9.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00410	0.00141	0.04960	0.03457	0.00022	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.1749	28.1749	0.00256	0.00445	0.01513	29.5811
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00392	0.00128	0.05238	0.03514	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	28.2301	28.2301	0.00256	0.00445	0.00039	29.6216
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00287	0.00098	0.03650	0.02485	0.00016	0.00031	0.52446	0.52478	0.00031	0.05334	0.05366	—	20.1414	20.1414	0.00183	0.00318	0.00466	21.1397
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00052	0.00018	0.00666	0.00453	0.00003	0.00006	0.09571	0.09577	0.00006	0.00973	0.00979	—	3.33464	3.33464	0.00030	0.00053	0.00077	3.49992

3.9.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.10. Phase dust control (2040)

3.10.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00388	0.00128	0.05150	0.03452	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	27.8113	27.8113	0.00229	0.00445	0.00034	29.1961
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00036	0.00012	0.00452	0.00308	0.00002	0.00004	0.06610	0.06614	0.00004	0.00672	0.00676	—	2.50060	2.50060	0.00021	0.00040	0.00051	2.62573
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00007	0.00002	0.00083	0.00056	< 0.000005	0.00001	0.01206	0.01207	0.00001	0.00123	0.00123	—	0.41400	0.41400	0.00003	0.00007	0.00008	0.43472

3.10.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.10.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00388	0.00128	0.05150	0.03452	0.00026	0.00044	0.74972	0.75016	0.00044	0.07623	0.07667	—	27.8113	27.8113	0.00229	0.00445	0.00034	29.1961
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00036	0.00012	0.00452	0.00308	0.00002	0.00004	0.06610	0.06614	0.00004	0.00672	0.00676	—	2.50060	2.50060	0.00021	0.00040	0.00051	2.62573
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00007	0.00002	0.00083	0.00056	< 0.000005	0.00001	0.01206	0.01207	0.00001	0.00123	0.00123	—	0.41400	0.41400	0.00003	0.00007	0.00008	0.43472

3.10.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.11. Phase 5 Parking Lot Improvements (2039)

3.11.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.37418	0.31320	2.10557	3.80836	0.01139	0.04741	—	0.04741	0.04362	—	0.04362	—	1,188.81	1,188.81	0.04822	0.00964	—	1,192.89
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00185	0.00116	0.02346	0.01443	0.00039	0.00000	0.01352	0.01352	0.00000	0.00328	0.00328	—	29.6258	29.6258	0.00077	0.00370	0.03134	30.7802
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.37418	0.31320	2.10557	3.80836	0.01139	0.04741	—	0.04741	0.04362	—	0.04362	—	1,188.81	1,188.81	0.04822	0.00964	—	1,192.89
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00193	0.00116	0.02469	0.01597	0.00039	0.00000	0.01352	0.01352	0.00000	0.00328	0.00328	—	29.6621	29.6621	0.00077	0.00378	0.00081	30.8089
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.09885	0.08274	0.55627	1.00612	0.00301	0.01253	—	0.01253	0.01152	—	0.01152	—	314.070	314.070	0.01274	0.00255	—	315.148
Demolition	—	—	—	—	—	—	0.05577	0.05577	—	0.00845	0.00845	—	—	—	—	—	—	—
Paving	0.01502	0.01502	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00051	0.00029	0.00640	0.00404	0.00010	0.00000	0.00356	0.00356	0.00000	0.00086	0.00086	—	7.83079	7.83079	0.00020	0.00098	0.00357	8.13105
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01804	0.01510	0.10152	0.18362	0.00055	0.00229	—	0.00229	0.00210	—	0.00210	—	51.9979	51.9979	0.00211	0.00042	—	52.1763
Demolition	—	—	—	—	—	—	0.01018	0.01018	—	0.00154	0.00154	—	—	—	—	—	—	—
Paving	0.00274	0.00274	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00009	0.00005	0.00117	0.00074	0.00002	0.00000	0.00065	0.00065	0.00000	0.00016	0.00016	—	1.29648	1.29648	0.00003	0.00016	0.00059	1.34619

3.11.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09083	0.06790	0.05908	1.50708	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	601.970	601.970	0.00353	0.00265	0.46659	603.313
Vendor	0.01467	0.00802	0.18893	0.08415	0.00573	0.00000	0.20090	0.20090	0.00000	0.04879	0.04879	—	421.561	421.561	0.00688	0.05228	0.46558	437.777
Hauling	0.04369	0.01144	0.56590	0.35919	0.00352	0.00704	0.85232	0.85935	0.00704	0.11075	0.11778	—	422.675	422.675	0.03137	0.06656	0.24152	443.535
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09083	0.06702	0.08466	1.22312	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	560.978	560.978	0.00441	0.00265	0.01207	561.888
Vendor	0.01490	0.00802	0.19718	0.08873	0.00573	0.00000	0.20090	0.20090	0.00000	0.04879	0.04879	—	421.669	421.669	0.00688	0.05251	0.01205	437.499
Hauling	0.04252	0.01056	0.59669	0.36300	0.00381	0.00704	0.85232	0.85935	0.00704	0.11075	0.11778	—	423.040	423.040	0.03137	0.06656	0.00624	443.665
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02353	0.01724	0.01631	0.32197	0.00000	0.00000	0.18575	0.18575	0.00000	0.04352	0.04352	—	148.855	148.855	0.00093	0.00070	0.05314	149.140
Vendor	0.00394	0.00206	0.05173	0.02290	0.00151	0.00000	0.05284	0.05284	0.00000	0.01283	0.01283	—	111.383	111.383	0.00182	0.01381	0.05305	115.597
Hauling	0.01139	0.00294	0.15431	0.09528	0.00093	0.00186	0.22115	0.22301	0.00186	0.02883	0.03069	—	111.705	111.705	0.00829	0.01758	0.02752	117.180
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00429	0.00315	0.00298	0.05876	0.00000	0.00000	0.03390	0.03390	0.00000	0.00794	0.00794	—	24.6447	24.6447	0.00015	0.00012	0.00880	24.6918
Vendor	0.00072	0.00038	0.00944	0.00418	0.00028	0.00000	0.00964	0.00964	0.00000	0.00234	0.00234	—	18.4408	18.4408	0.00030	0.00229	0.00878	19.1385
Hauling	0.00208	0.00054	0.02816	0.01739	0.00017	0.00034	0.04036	0.04070	0.00034	0.00526	0.00560	—	18.4941	18.4941	0.00137	0.00291	0.00456	19.4005

3.11.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19003	0.17481	1.58254	6.58859	0.01140	0.02605	—	0.02605	0.02578	—	0.02578	—	1,190.02	1,190.02	0.04827	0.00965	—	1,194.10
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00185	0.00116	0.02346	0.01443	0.00039	0.00000	0.01352	0.01352	0.00000	0.00328	0.00328	—	29.6258	29.6258	0.00077	0.00370	0.03134	30.7802
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19003	0.17481	1.58254	6.58859	0.01140	0.02605	—	0.02605	0.02578	—	0.02578	—	1,190.02	1,190.02	0.04827	0.00965	—	1,194.10
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00193	0.00116	0.02469	0.01597	0.00039	0.00000	0.01352	0.01352	0.00000	0.00328	0.00328	—	29.6621	29.6621	0.00077	0.00378	0.00081	30.8089
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05020	0.04618	0.41809	1.74063	0.00301	0.00688	—	0.00688	0.00681	—	0.00681	—	314.389	314.389	0.01275	0.00255	—	315.468
Demolition	—	—	—	—	—	—	0.05577	0.05577	—	0.00845	0.00845	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Paving	0.01502	0.01502	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00051	0.00029	0.00640	0.00404	0.00010	0.00000	0.00356	0.00356	0.00000	0.00086	0.00086	—	7.83079	7.83079	0.00020	0.00098	0.00357	8.13105
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00916	0.00843	0.07630	0.31766	0.00055	0.00126	—	0.00126	0.00124	—	0.00124	—	52.0507	52.0507	0.00211	0.00042	—	52.2293
Demolition	—	—	—	—	—	—	0.01018	0.01018	—	0.00154	0.00154	—	—	—	—	—	—	—
Paving	0.00274	0.00274	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00009	0.00005	0.00117	0.00074	0.00002	0.00000	0.00065	0.00065	0.00000	0.00016	0.00016	—	1.29648	1.29648	0.00003	0.00016	0.00059	1.34619

3.11.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09083	0.06790	0.05908	1.50708	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	601.970	601.970	0.00353	0.00265	0.46659	603.313
Vendor	0.01467	0.00802	0.18893	0.08415	0.00573	0.00000	0.20090	0.20090	0.00000	0.04879	0.04879	—	421.561	421.561	0.00688	0.05228	0.46558	437.777
Hauling	0.04369	0.01144	0.56590	0.35919	0.00352	0.00704	0.85232	0.85935	0.00704	0.11075	0.11778	—	422.675	422.675	0.03137	0.06656	0.24152	443.535
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.09083	0.06702	0.08466	1.22312	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	560.978	560.978	0.00441	0.00265	0.01207	561.888

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.01490	0.00802	0.19718	0.08873	0.00573	0.00000	0.20090	0.20090	0.00000	0.04879	0.04879	—	421.669	421.669	0.00688	0.05251	0.01205	437.499
Hauling	0.04252	0.01056	0.59669	0.36300	0.00381	0.00704	0.85232	0.85935	0.00704	0.11075	0.11778	—	423.040	423.040	0.03137	0.06656	0.00624	443.665
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02353	0.01724	0.01631	0.32197	0.00000	0.00000	0.18575	0.18575	0.00000	0.04352	0.04352	—	148.855	148.855	0.00093	0.00070	0.05314	149.140
Vendor	0.00394	0.00206	0.05173	0.02290	0.00151	0.00000	0.05284	0.05284	0.00000	0.01283	0.01283	—	111.383	111.383	0.00182	0.01381	0.05305	115.597
Hauling	0.01139	0.00294	0.15431	0.09528	0.00093	0.00186	0.22115	0.22301	0.00186	0.02883	0.03069	—	111.705	111.705	0.00829	0.01758	0.02752	117.180
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00429	0.00315	0.00298	0.05876	0.00000	0.00000	0.03390	0.03390	0.00000	0.00794	0.00794	—	24.6447	24.6447	0.00015	0.00012	0.00880	24.6918
Vendor	0.00072	0.00038	0.00944	0.00418	0.00028	0.00000	0.00964	0.00964	0.00000	0.00234	0.00234	—	18.4408	18.4408	0.00030	0.00229	0.00878	19.1385
Hauling	0.00208	0.00054	0.02816	0.01739	0.00017	0.00034	0.04036	0.04070	0.00034	0.00526	0.00560	—	18.4941	18.4941	0.00137	0.00291	0.00456	19.4005

3.12. Phase 5 Parking Lot Improvements (2040)

3.12.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.37085	0.31040	2.06491	3.80519	0.01139	0.04601	—	0.04601	0.04233	—	0.04233	—	1,188.82	1,188.82	0.04822	0.00964	—	1,192.90
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00185	0.00100	0.02353	0.01536	0.00039	0.00000	0.01352	0.01352	0.00000	0.00328	0.00328	—	28.4432	28.4432	0.00077	0.00332	0.00071	29.4520
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03338	0.02794	0.18588	0.34254	0.00103	0.00414	—	0.00414	0.00381	—	0.00381	—	107.017	107.017	0.00434	0.00087	—	107.384
Demolition	—	—	—	—	—	—	0.01900	0.01900	—	0.00288	0.00288	—	—	—	—	—	—	—
Paving	0.00512	0.00512	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00017	0.00009	0.00208	0.00135	0.00003	0.00000	0.00121	0.00121	0.00000	0.00029	0.00029	—	2.55850	2.55850	0.00007	0.00030	0.00107	2.65031
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00609	0.00510	0.03392	0.06251	0.00019	0.00076	—	0.00076	0.00070	—	0.00070	—	17.7179	17.7179	0.00072	0.00014	—	17.7787
Demolition	—	—	—	—	—	—	0.00347	0.00347	—	0.00053	0.00053	—	—	—	—	—	—	—
Paving	0.00093	0.00093	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00003	0.00002	0.00038	0.00025	0.00001	0.00000	0.00022	0.00022	0.00000	0.00005	0.00005	—	0.42359	0.42359	0.00001	0.00005	0.00018	0.43879

3.12.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08730	0.06349	0.08466	1.19402	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	557.441	557.441	0.00353	0.00265	0.01012	558.328
Vendor	0.01467	0.00757	0.18457	0.08231	0.00573	0.00000	0.20090	0.20090	0.00000	0.04879	0.04879	—	403.680	403.680	0.00688	0.04654	0.01057	417.733
Hauling	0.04222	0.01056	0.58467	0.35274	0.00381	0.00704	0.85232	0.85935	0.00704	0.11075	0.11778	—	416.455	416.455	0.02756	0.06656	0.00543	436.985
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00778	0.00564	0.00548	0.10717	0.00000	0.00000	0.06329	0.06329	0.00000	0.01483	0.01483	—	50.3989	50.3989	0.00032	0.00024	0.01515	50.4929
Vendor	0.00132	0.00068	0.01649	0.00774	0.00052	0.00000	0.01800	0.01800	0.00000	0.00437	0.00437	—	36.3334	36.3334	0.00062	0.00419	0.01586	37.6133
Hauling	0.00388	0.00100	0.05150	0.03154	0.00032	0.00063	0.07535	0.07599	0.00063	0.00983	0.01046	—	37.4694	37.4694	0.00248	0.00599	0.00815	39.3251
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00142	0.00103	0.00100	0.01956	0.00000	0.00000	0.01155	0.01155	0.00000	0.00271	0.00271	—	8.34411	8.34411	0.00005	0.00004	0.00251	8.35968
Vendor	0.00024	0.00012	0.00301	0.00141	0.00009	0.00000	0.00329	0.00329	0.00000	0.00080	0.00080	—	6.01540	6.01540	0.00010	0.00069	0.00263	6.22731
Hauling	0.00071	0.00018	0.00940	0.00576	0.00006	0.00012	0.01375	0.01387	0.00012	0.00179	0.00191	—	6.20349	6.20349	0.00041	0.00099	0.00135	6.51072

3.12.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.19026	0.17500	1.58172	6.58998	0.01140	0.02594	—	0.02594	0.02568	—	0.02568	—	1,190.03	1,190.03	0.04827	0.00965	—	1,194.11
Demolition	—	—	—	—	—	—	0.21110	0.21110	—	0.03197	0.03197	—	—	—	—	—	—	—
Paving	0.05687	0.05687	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00185	0.00100	0.02353	0.01536	0.00039	0.00000	0.01352	0.01352	0.00000	0.00328	0.00328	—	28.4432	28.4432	0.00077	0.00332	0.00071	29.4520
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01713	0.01575	0.14239	0.59323	0.00103	0.00233	—	0.00233	0.00231	—	0.00231	—	107.126	107.126	0.00435	0.00087	—	107.494
Demolition	—	—	—	—	—	—	0.01900	0.01900	—	0.00288	0.00288	—	—	—	—	—	—	—
Paving	0.00512	0.00512	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00017	0.00009	0.00208	0.00135	0.00003	0.00000	0.00121	0.00121	0.00000	0.00029	0.00029	—	2.55850	2.55850	0.00007	0.00030	0.00107	2.65031
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00313	0.00288	0.02599	0.10826	0.00019	0.00043	—	0.00043	0.00042	—	0.00042	—	17.7359	17.7359	0.00072	0.00014	—	17.7968

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Demolition	—	—	—	—	—	—	0.00347	0.00347	—	0.00053	0.00053	—	—	—	—	—	—	—
Paving	0.00093	0.00093	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00003	0.00002	0.00038	0.00025	0.00001	0.00000	0.00022	0.00022	0.00000	0.00005	0.00005	—	0.42359	0.42359	0.00001	0.00005	0.00018	0.43879

3.12.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.08730	0.06349	0.08466	1.19402	0.00000	0.00000	0.70654	0.70654	0.00000	0.16561	0.16561	—	557.441	557.441	0.00353	0.00265	0.01012	558.328
Vendor	0.01467	0.00757	0.18457	0.08231	0.00573	0.00000	0.20090	0.20090	0.00000	0.04879	0.04879	—	403.680	403.680	0.00688	0.04654	0.01057	417.733
Hauling	0.04222	0.01056	0.58467	0.35274	0.00381	0.00704	0.85232	0.85935	0.00704	0.11075	0.11778	—	416.455	416.455	0.02756	0.06656	0.00543	436.985
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00778	0.00564	0.00548	0.10717	0.00000	0.00000	0.06329	0.06329	0.00000	0.01483	0.01483	—	50.3989	50.3989	0.00032	0.00024	0.01515	50.4929
Vendor	0.00132	0.00068	0.01649	0.00774	0.00052	0.00000	0.01800	0.01800	0.00000	0.00437	0.00437	—	36.3334	36.3334	0.00062	0.00419	0.01586	37.6133
Hauling	0.00388	0.00100	0.05150	0.03154	0.00032	0.00063	0.07535	0.07599	0.00063	0.00983	0.01046	—	37.4694	37.4694	0.00248	0.00599	0.00815	39.3251
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00142	0.00103	0.00100	0.01956	0.00000	0.00000	0.01155	0.01155	0.00000	0.00271	0.00271	—	8.34411	8.34411	0.00005	0.00004	0.00251	8.35968

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00024	0.00012	0.00301	0.00141	0.00009	0.00000	0.00329	0.00329	0.00000	0.00080	0.00080	—	6.01540	6.01540	0.00010	0.00069	0.00263	6.22731
Hauling	0.00071	0.00018	0.00940	0.00576	0.00006	0.00012	0.01375	0.01387	0.00012	0.00179	0.00191	—	6.20349	6.20349	0.00041	0.00099	0.00135	6.51072

3.13. Phase 6 MEP, Archt& finishrchitectural Coating (2039)

3.13.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77450	0.64480	7.16860	11.2135	0.01992	0.06341	—	0.06341	0.05834	—	0.05834	—	1,940.36	1,940.36	0.07871	0.01574	—	1,947.02
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00635	0.00397	0.08042	0.04947	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	101.574	101.574	0.00265	0.01270	0.10744	105.532
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77450	0.64480	7.16860	11.2135	0.01992	0.06341	—	0.06341	0.05834	—	0.05834	—	1,940.36	1,940.36	0.07871	0.01574	—	1,947.02
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite truck	0.00661	0.00397	0.08466	0.05476	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	101.699	101.699	0.00265	0.01296	0.00278	105.630
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.34254	0.28517	3.17046	4.95940	0.00881	0.02804	—	0.02804	0.02580	—	0.02580	—	858.163	858.163	0.03481	0.00696	—	861.108
Architectural Coatings	21.0516	21.0516	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00293	0.00164	0.03674	0.02317	0.00059	0.00000	0.02041	0.02041	0.00000	0.00496	0.00496	—	44.9463	44.9463	0.00117	0.00562	0.02050	46.6697
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06251	0.05204	0.57861	0.90509	0.00161	0.00512	—	0.00512	0.00471	—	0.00471	—	142.079	142.079	0.00576	0.00115	—	142.566
Architectural Coatings	3.84191	3.84191	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00053	0.00030	0.00670	0.00423	0.00011	0.00000	0.00373	0.00373	0.00000	0.00090	0.00090	—	7.44137	7.44137	0.00019	0.00093	0.00339	7.72669

3.13.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15895	0.11883	0.10340	2.63739	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	1,053.45	1,053.45	0.00617	0.00463	0.81653	1,055.80

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.05079	0.02778	0.65398	0.29127	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,459.25	1,459.25	0.02381	0.18096	1.61161	1,515.38
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15895	0.11729	0.14815	2.14047	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	981.711	981.711	0.00772	0.00463	0.02113	983.305
Vendor	0.05159	0.02778	0.68255	0.30715	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,459.62	1,459.62	0.02381	0.18175	0.04171	1,514.42
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06894	0.05051	0.04778	0.94325	0.00000	0.00000	0.54417	0.54417	0.00000	0.12751	0.12751	—	436.090	436.090	0.00273	0.00205	0.15567	436.924
Vendor	0.02282	0.01193	0.29977	0.13268	0.00878	0.00000	0.30619	0.30619	0.00000	0.07435	0.07435	—	645.452	645.452	0.01053	0.08003	0.30744	669.872
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01258	0.00922	0.00872	0.17214	0.00000	0.00000	0.09931	0.09931	0.00000	0.02327	0.02327	—	72.1997	72.1997	0.00045	0.00034	0.02577	72.3378
Vendor	0.00416	0.00218	0.05471	0.02421	0.00160	0.00000	0.05588	0.05588	0.00000	0.01357	0.01357	—	106.862	106.862	0.00174	0.01325	0.05090	110.905
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.13.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.64779	0.57251	5.75340	17.6719	0.02544	0.05361	—	0.05361	0.05229	—	0.05229	—	2,538.36	2,538.36	0.10297	0.02059	—	2,547.07
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00635	0.00397	0.08042	0.04947	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	101.574	101.574	0.00265	0.01270	0.10744	105.532
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.64779	0.57251	5.75340	17.6719	0.02544	0.05361	—	0.05361	0.05229	—	0.05229	—	2,538.36	2,538.36	0.10297	0.02059	—	2,547.07
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00661	0.00397	0.08466	0.05476	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	101.699	101.699	0.00265	0.01296	0.00278	105.630
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.28650	0.25320	2.54455	7.81573	0.01125	0.02371	—	0.02371	0.02312	—	0.02312	—	1,122.64	1,122.64	0.04554	0.00911	—	1,126.49
Architectural Coatings	21.0516	21.0516	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00293	0.00164	0.03674	0.02317	0.00059	0.00000	0.02041	0.02041	0.00000	0.00496	0.00496	—	44.9463	44.9463	0.00117	0.00562	0.02050	46.6697
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.05229	0.04621	0.46438	1.42637	0.00205	0.00433	—	0.00433	0.00422	—	0.00422	—	185.866	185.866	0.00754	0.00151	—	186.504
Architectural Coatings	3.84191	3.84191	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00053	0.00030	0.00670	0.00423	0.00011	0.00000	0.00373	0.00373	0.00000	0.00090	0.00090	—	7.44137	7.44137	0.00019	0.00093	0.00339	7.72669

3.13.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15895	0.11883	0.10340	2.63739	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	1,053.45	1,053.45	0.00617	0.00463	0.81653	1,055.80
Vendor	0.05079	0.02778	0.65398	0.29127	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,459.25	1,459.25	0.02381	0.18096	1.61161	1,515.38
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15895	0.11729	0.14815	2.14047	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	981.711	981.711	0.00772	0.00463	0.02113	983.305
Vendor	0.05159	0.02778	0.68255	0.30715	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,459.62	1,459.62	0.02381	0.18175	0.04171	1,514.42
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06894	0.05051	0.04778	0.94325	0.00000	0.00000	0.54417	0.54417	0.00000	0.12751	0.12751	—	436.090	436.090	0.00273	0.00205	0.15567	436.924

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.02282	0.01193	0.29977	0.13268	0.00878	0.00000	0.30619	0.30619	0.00000	0.07435	0.07435	—	645.452	645.452	0.01053	0.08003	0.30744	669.872
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01258	0.00922	0.00872	0.17214	0.00000	0.00000	0.09931	0.09931	0.00000	0.02327	0.02327	—	72.1997	72.1997	0.00045	0.00034	0.02577	72.3378
Vendor	0.00416	0.00218	0.05471	0.02421	0.00160	0.00000	0.05588	0.05588	0.00000	0.01357	0.01357	—	106.862	106.862	0.00174	0.01325	0.05090	110.905
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.14. Phase 6 MEP, Archt& finishrchitectural Coating (2040)

3.14.1. Onsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.77347	0.64391	7.14279	11.2125	0.01992	0.06189	—	0.06189	0.05694	—	0.05694	—	1,940.40	1,940.40	0.07871	0.01574	—	1,947.06
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00635	0.00344	0.08069	0.05265	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	97.5196	97.5196	0.00265	0.01138	0.00244	100.978

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06963	0.05796	0.64299	1.00934	0.00179	0.00557	—	0.00557	0.00513	—	0.00513	—	174.674	174.674	0.00709	0.00142	—	175.274
Architectural Coatings	4.28483	4.28483	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00057	0.00031	0.00712	0.00464	0.00012	0.00000	0.00415	0.00415	0.00000	0.00101	0.00101	—	8.77201	8.77201	0.00024	0.00102	0.00366	9.08679
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01271	0.01058	0.11735	0.18421	0.00033	0.00102	—	0.00102	0.00094	—	0.00094	—	28.9193	28.9193	0.00117	0.00023	—	29.0186
Architectural Coatings	0.78198	0.78198	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00010	0.00006	0.00130	0.00085	0.00002	0.00000	0.00076	0.00076	0.00000	0.00018	0.00018	—	1.45231	1.45231	0.00004	0.00017	0.00061	1.50442

3.14.2. Offsite - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Worker	0.15278	0.11111	0.14815	2.08954	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	975.523	975.523	0.00617	0.00463	0.01771	977.074
Vendor	0.05079	0.02619	0.63890	0.28493	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,397.36	1,397.36	0.02381	0.16111	0.03660	1,446.00
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01361	0.00986	0.00959	0.18754	0.00000	0.00000	0.11076	0.11076	0.00000	0.02595	0.02595	—	88.1980	88.1980	0.00056	0.00042	0.02652	88.3626
Vendor	0.00457	0.00236	0.05708	0.02679	0.00179	0.00000	0.06232	0.06232	0.00000	0.01513	0.01513	—	125.769	125.769	0.00214	0.01450	0.05491	130.200
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00248	0.00180	0.00175	0.03423	0.00000	0.00000	0.02021	0.02021	0.00000	0.00474	0.00474	—	14.6022	14.6022	0.00009	0.00007	0.00439	14.6294
Vendor	0.00083	0.00043	0.01042	0.00489	0.00033	0.00000	0.01137	0.01137	0.00000	0.00276	0.00276	—	20.8225	20.8225	0.00035	0.00240	0.00909	21.5561
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.14.3. Onsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.64896	0.57348	5.74932	17.6787	0.02545	0.05306	—	0.05306	0.05178	—	0.05178	—	2,538.40	2,538.40	0.10297	0.02059	—	2,547.12

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Architectural Coatings	47.5989	47.5989	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00635	0.00344	0.08069	0.05265	0.00132	0.00000	0.04636	0.04636	0.00000	0.01126	0.01126	—	97.5196	97.5196	0.00265	0.01138	0.00244	100.978
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05842	0.05162	0.51755	1.59143	0.00229	0.00478	—	0.00478	0.00466	—	0.00466	—	228.506	228.506	0.00927	0.00185	—	229.290
Architectural Coatings	4.28483	4.28483	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00057	0.00031	0.00712	0.00464	0.00012	0.00000	0.00415	0.00415	0.00000	0.00101	0.00101	—	8.77201	8.77201	0.00024	0.00102	0.00366	9.08679
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01066	0.00942	0.09445	0.29044	0.00042	0.00087	—	0.00087	0.00085	—	0.00085	—	37.8318	37.8318	0.00153	0.00031	—	37.9616
Architectural Coatings	0.78198	0.78198	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Onsite truck	0.00010	0.00006	0.00130	0.00085	0.00002	0.00000	0.00076	0.00076	0.00000	0.00018	0.00018	—	1.45231	1.45231	0.00004	0.00017	0.00061	1.50442

3.14.4. Offsite - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.15278	0.11111	0.14815	2.08954	0.00000	0.00000	1.23644	1.23644	0.00000	0.28982	0.28982	—	975.523	975.523	0.00617	0.00463	0.01771	977.074
Vendor	0.05079	0.02619	0.63890	0.28493	0.01984	0.00000	0.69541	0.69541	0.00000	0.16889	0.16889	—	1,397.36	1,397.36	0.02381	0.16111	0.03660	1,446.00
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01361	0.00986	0.00959	0.18754	0.00000	0.00000	0.11076	0.11076	0.00000	0.02595	0.02595	—	88.1980	88.1980	0.00056	0.00042	0.02652	88.3626
Vendor	0.00457	0.00236	0.05708	0.02679	0.00179	0.00000	0.06232	0.06232	0.00000	0.01513	0.01513	—	125.769	125.769	0.00214	0.01450	0.05491	130.200
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00248	0.00180	0.00175	0.03423	0.00000	0.00000	0.02021	0.02021	0.00000	0.00474	0.00474	—	14.6022	14.6022	0.00009	0.00007	0.00439	14.6294
Vendor	0.00083	0.00043	0.01042	0.00489	0.00033	0.00000	0.01137	0.01137	0.00000	0.00276	0.00276	—	20.8225	20.8225	0.00035	0.00240	0.00909	21.5561
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

4. Operations Emissions Details

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.4. Soil Carbon Accumulation By Vegetation Type - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.5. Above and Belowground Carbon Accumulation by Land Use Type - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.6. Avoided and Sequestered Emissions by Species - Mitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Phase 1 Site Prep	Demolition	3/2/2037	4/1/2037	5.00000	23.0000	—
Phase 2 Earthwork	Grading	4/2/2037	6/1/2037	5.00000	43.0000	—
Phase 3 Foundation	Grading	6/2/2037	3/1/2038	5.00000	195.000	—
Phase 4 Super Structureng Construction	Building Construction	1/4/2038	5/27/2039	5.00000	365.000	—
Phase dust control	Building Construction	3/2/2037	2/15/2040	5.00000	773.000	—
Phase 5 Parking Lot Improvements	Paving	8/19/2039	2/15/2040	5.00000	129.000	—
Phase 6 MEP, Archt& finishrchitectural Coating	Architectural Coating	5/20/2039	2/15/2040	5.00000	194.000	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Tractors/Loaders/ Backhoes	Diesel	Average	2.00000	5.20000	262.000	0.37000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Excavators	Diesel	Average	2.00000	5.50000	268.000	0.38000
Phase 1 Site Prep	Other Construction Equipment	Diesel	Average	1.000000	3.00000	806.000	0.42000
Phase 1 Site Prep	Air Compressors	Diesel	Average	1.000000	1.50000	49.0000	0.48000
Phase 1 Site Prep	Cranes	Diesel	Average	1.000000	1.20000	164.000	0.29000
Phase 1 Site Prep	Rollers	Diesel	Average	1.000000	1.20000	131.000	0.38000
Phase 2 Earthwork	Tractors/Loaders/ Backhoes	Diesel	Average	2.00000	4.40000	262.000	0.37000
Phase 2 Earthwork	Excavators	Diesel	Average	1.000000	7.30000	476.000	0.38000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Average	1.000000	7.30000	240.000	0.40000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Average	1.000000	4.40000	125.000	0.40000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Average	1.000000	4.40000	354.000	0.40000
Phase 2 Earthwork	Graders	Diesel	Average	1.000000	5.70000	259.000	0.41000
Phase 2 Earthwork	Rollers	Diesel	Average	1.000000	2.90000	131.000	0.38000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Average	2.00000	6.20000	262.000	0.37000
Phase 3 Foundation	Air Compressors	Diesel	Average	3.00000	5.60000	49.0000	0.48000
Phase 3 Foundation	Cranes	Diesel	Average	1.000000	6.40000	505.000	0.29000
Phase 3 Foundation	Off-Highway Trucks	Diesel	Average	2.00000	3.60000	505.000	0.38000
Phase 3 Foundation	Graders	Diesel	Average	1.000000	0.50000	259.000	0.41000
Phase 3 Foundation	Excavators	Diesel	Average	1.000000	2.50000	268.000	0.38000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Average	2.00000	5.50000	110.000	0.37000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 3 Foundation	Forklifts	Diesel	Average	1.000000	3.70000	130.000	0.20000
Phase 3 Foundation	Bore/Drill Rigs	Diesel	Average	1.000000	3.70000	550.000	0.50000
Phase 3 Foundation	Rollers	Diesel	Average	2.00000	3.20000	131.000	0.38000
Phase 4 Super Structureng Construction	Cranes	Diesel	Average	2.00000	6.30000	505.000	0.29000
Phase 4 Super Structureng Construction	Forklifts	Diesel	Average	2.00000	6.90000	130.000	0.20000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Average	3.00000	5.40000	85.0000	0.31000
Phase 4 Super Structureng Construction	Air Compressors	Diesel	Average	1.000000	2.10000	49.0000	0.48000
Phase 4 Super Structureng Construction	Off-Highway Trucks	Diesel	Average	1.000000	1.60000	505.000	0.38000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Average	1.000000	4.50000	25.0000	0.31000
Phase 5 Parking Lot Improvements	Tractors/Loaders/ Backhoes	Diesel	Average	1.000000	3.80000	262.000	0.37000
Phase 5 Parking Lot Improvements	Excavators	Diesel	Average	1.000000	0.40000	268.000	0.38000
Phase 5 Parking Lot Improvements	Other Construction Equipment	Diesel	Average	1.000000	0.30000	806.000	0.42000
Phase 5 Parking Lot Improvements	Air Compressors	Diesel	Average	1.000000	3.70000	49.0000	0.48000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 5 Parking Lot Improvements	Pavers	Diesel	Average	1.000000	0.20000	225.000	0.42000
Phase 5 Parking Lot Improvements	Graders	Diesel	Average	1.000000	2.30000	259.000	0.41000
Phase 5 Parking Lot Improvements	Forklifts	Diesel	Average	1.000000	0.20000	130.000	0.20000
Phase 5 Parking Lot Improvements	Rollers	Diesel	Average	2.00000	1.50000	131.000	0.38000
Phase 6 MEP, Archt& finishrchitectural Coating	Cranes	Diesel	Average	1.000000	2.10000	505.000	0.29000
Phase 6 MEP, Archt& finishrchitectural Coating	Forklifts	Diesel	Average	1.000000	0.80000	130.000	0.20000
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Average	3.00000	6.50000	85.0000	0.31000
Phase 6 MEP, Archt& finishrchitectural Coating	Air Compressors	Diesel	Average	3.00000	6.10000	49.0000	0.48000
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Average	6.00000	7.00000	25.0000	0.31000

5.2.2. Mitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	2.00000	5.20000	262.000	0.37000
Phase 1 Site Prep	Excavators	Diesel	Tier 4 Final	2.00000	5.50000	268.000	0.38000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 1 Site Prep	Other Construction Equipment	Diesel	Tier 4 Final	1.000000	3.00000	806.000	0.42000
Phase 1 Site Prep	Air Compressors	Diesel	Average	1.000000	1.50000	49.0000	0.48000
Phase 1 Site Prep	Cranes	Diesel	Tier 4 Final	1.000000	1.20000	164.000	0.29000
Phase 1 Site Prep	Rollers	Diesel	Tier 4 Final	1.000000	1.20000	131.000	0.38000
Phase 2 Earthwork	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	2.00000	4.40000	262.000	0.37000
Phase 2 Earthwork	Excavators	Diesel	Tier 4 Final	1.000000	7.30000	476.000	0.38000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Tier 4 Final	1.000000	7.30000	240.000	0.40000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Tier 4 Final	1.000000	4.40000	125.000	0.40000
Phase 2 Earthwork	Rubber Tired Dozers	Diesel	Tier 4 Final	1.000000	4.40000	354.000	0.40000
Phase 2 Earthwork	Graders	Diesel	Tier 4 Final	1.000000	5.70000	259.000	0.41000
Phase 2 Earthwork	Rollers	Diesel	Tier 4 Final	1.000000	2.90000	131.000	0.38000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	2.00000	6.20000	262.000	0.37000
Phase 3 Foundation	Air Compressors	Diesel	Average	3.00000	5.60000	49.0000	0.48000
Phase 3 Foundation	Cranes	Diesel	Tier 4 Final	1.000000	6.40000	505.000	0.29000
Phase 3 Foundation	Off-Highway Trucks	Diesel	Average	2.00000	3.60000	505.000	0.38000
Phase 3 Foundation	Graders	Diesel	Tier 4 Final	1.000000	0.50000	259.000	0.41000
Phase 3 Foundation	Excavators	Diesel	Tier 4 Final	1.000000	2.50000	268.000	0.38000
Phase 3 Foundation	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	2.00000	5.50000	110.000	0.37000
Phase 3 Foundation	Forklifts	Diesel	Tier 4 Final	1.000000	3.70000	130.000	0.20000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 3 Foundation	Bore/Drill Rigs	Diesel	Tier 4 Final	1.000000	3.70000	550.000	0.50000
Phase 3 Foundation	Rollers	Diesel	Tier 4 Final	2.00000	3.20000	131.000	0.38000
Phase 4 Super Structureng Construction	Cranes	Diesel	Tier 4 Final	2.00000	6.30000	505.000	0.29000
Phase 4 Super Structureng Construction	Forklifts	Diesel	Tier 4 Final	2.00000	6.90000	130.000	0.20000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Average	2.00000	5.40000	85.0000	0.31000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Tier 4 Final	1.000000	5.40000	85.0000	0.31000
Phase 4 Super Structureng Construction	Air Compressors	Diesel	Average	1.000000	2.10000	49.0000	0.48000
Phase 4 Super Structureng Construction	Off-Highway Trucks	Diesel	Average	1.000000	1.60000	505.000	0.38000
Phase 4 Super Structureng Construction	Aerial Lifts	Diesel	Tier 4 Final	1.000000	4.50000	25.0000	0.31000
Phase 5 Parking Lot Improvements	Tractors/Loaders/ Backhoes	Diesel	Tier 4 Final	1.000000	3.80000	262.000	0.37000
Phase 5 Parking Lot Improvements	Excavators	Diesel	Tier 4 Final	1.000000	0.40000	268.000	0.38000
Phase 5 Parking Lot Improvements	Other Construction Equipment	Diesel	Tier 4 Final	1.000000	0.30000	806.000	0.42000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Phase 5 Parking Lot Improvements	Air Compressors	Diesel	Average	1.000000	3.70000	49.0000	0.48000
Phase 5 Parking Lot Improvements	Pavers	Diesel	Tier 4 Final	1.000000	0.20000	225.000	0.42000
Phase 5 Parking Lot Improvements	Graders	Diesel	Tier 4 Final	1.000000	2.30000	259.000	0.41000
Phase 5 Parking Lot Improvements	Forklifts	Diesel	Tier 4 Final	1.000000	0.20000	130.000	0.20000
Phase 5 Parking Lot Improvements	Rollers	Diesel	Tier 4 Final	2.00000	1.50000	131.000	0.38000
Phase 6 MEP, Archt& finishrchitectural Coating	Cranes	Diesel	Tier 4 Final	1.000000	2.10000	505.000	0.29000
Phase 6 MEP, Archt& finishrchitectural Coating	Forklifts	Diesel	Tier 4 Final	1.000000	0.80000	130.000	0.20000
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Tier 4 Final	6.00000	6.50000	85.0000	0.31000
Phase 6 MEP, Archt& finishrchitectural Coating	Air Compressors	Diesel	Average	3.00000	6.10000	49.0000	0.48000
Phase 6 MEP, Archt& finishrchitectural Coating	Aerial Lifts	Diesel	Tier 4 Final	6.00000	7.00000	25.0000	0.31000

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 1 Site Prep	Worker	50.0000	25.0000	LDA,LDT1,LDT2
Phase 1 Site Prep	Vendor	24.0000	25.0000	MHDT
Phase 1 Site Prep	Hauling	40.9000	12.0000	HHDT
Phase 1 Site Prep	Onsite truck	8.00000	5.00000	MHDT
Phase 2 Earthwork	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 2 Earthwork	Vendor	16.3000	25.0000	MHDT
Phase 2 Earthwork	Hauling	385.800	25.0000	HHDT
Phase 2 Earthwork	Onsite truck	5.40000	5.00000	MHDT
Phase 3 Foundation	Worker	70.0000	25.0000	LDA,LDT1,LDT2
Phase 3 Foundation	Vendor	35.8000	25.0000	MHDT
Phase 3 Foundation	Hauling	43.5000	12.0000	HHDT
Phase 3 Foundation	Onsite truck	11.9000	5.00000	MHDT
Phase 4 Super Structureng Construction	Worker	60.0000	25.0000	LDA,LDT1,LDT2
Phase 4 Super Structureng Construction	Vendor	22.3000	25.0000	MHDT
Phase 4 Super Structureng Construction	Hauling	11.8000	83.0000	HHDT
Phase 4 Super Structureng Construction	Onsite truck	7.40000	5.00000	MHDT
Phase dust control	Worker	0.00000	0.00000	LDA,LDT1,LDT2
Phase dust control	Vendor	0.00000	0.00000	HHDT,MHDT
Phase dust control	Hauling	0.00000	20.0000	HHDT

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase dust control	Onsite truck	2.00000	5.00000	HHDT
Phase 5 Parking Lot Improvements	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 5 Parking Lot Improvements	Vendor	10.4000	25.0000	MHDT
Phase 5 Parking Lot Improvements	Hauling	13.3000	12.0000	HHDT
Phase 5 Parking Lot Improvements	Onsite truck	3.50000	5.00000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	70.0000	25.0000	LDA,LDT1,LDT2
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	36.0000	25.0000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	0.00000	0.00000	HHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	12.0000	5.00000	MHDT

5.3.2. Mitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 1 Site Prep	Worker	50.0000	25.0000	LDA,LDT1,LDT2
Phase 1 Site Prep	Vendor	24.0000	25.0000	MHDT
Phase 1 Site Prep	Hauling	40.9000	12.0000	HHDT
Phase 1 Site Prep	Onsite truck	8.00000	5.00000	MHDT
Phase 2 Earthwork	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 2 Earthwork	Vendor	16.3000	25.0000	MHDT
Phase 2 Earthwork	Hauling	385.800	25.0000	HHDT

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 2 Earthwork	Onsite truck	5.40000	5.00000	MHDT
Phase 3 Foundation	Worker	70.0000	25.0000	LDA,LDT1,LDT2
Phase 3 Foundation	Vendor	35.8000	25.0000	MHDT
Phase 3 Foundation	Hauling	43.5000	12.0000	HHDT
Phase 3 Foundation	Onsite truck	11.9000	5.00000	MHDT
Phase 4 Super Structureng Construction	Worker	60.0000	25.0000	LDA,LDT1,LDT2
Phase 4 Super Structureng Construction	Vendor	22.3000	25.0000	MHDT
Phase 4 Super Structureng Construction	Hauling	11.8000	83.0000	HHDT
Phase 4 Super Structureng Construction	Onsite truck	7.40000	5.00000	MHDT
Phase dust control	Worker	0.00000	0.00000	LDA,LDT1,LDT2
Phase dust control	Vendor	0.00000	0.00000	HHDT,MHDT
Phase dust control	Hauling	0.00000	20.0000	HHDT
Phase dust control	Onsite truck	2.00000	5.00000	HHDT
Phase 5 Parking Lot Improvements	Worker	40.0000	25.0000	LDA,LDT1,LDT2
Phase 5 Parking Lot Improvements	Vendor	10.4000	25.0000	MHDT
Phase 5 Parking Lot Improvements	Hauling	13.3000	12.0000	HHDT
Phase 5 Parking Lot Improvements	Onsite truck	3.50000	5.00000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	70.0000	25.0000	LDA,LDT1,LDT2

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	36.0000	25.0000	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	0.00000	0.00000	HHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	12.0000	5.00000	MHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
Phase 6 MEP, Archt& finishrchitectural Coating	0.00000	0.00000	91,200.0	1,267,000	0.00000

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (Ton of Debris)	Acres Paved (acres)
Phase 1 Site Prep	0.00000	0.00000	0.00000	3,697.00	0.00000
Phase 2 Earthwork	66,700.0	66,700.0	5.50000	0.00000	0.00000
Phase 3 Foundation	23,587.0	26,861.0	5.50000	0.00000	0.00000
Phase 5 Parking Lot Improvements	0.00000	0.00000	0.00000	1,882.00	2.80000

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	3	74%	74%
Water Demolished Area	2	36%	36%

5.7. Construction Paving

Phase Name	Land Use	Area Paved (acres)	% Asphalt
Phase 5 Parking Lot Improvements	Unenclosed Parking Structure	2.80000	100%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2037	0.00000	203.983	0.03300	0.00400
2038	0.00000	203.983	0.03300	0.00400
2039	0.00000	203.983	0.03300	0.00400

Year	kWh per Year	CO2	CH4	N2O
2040	0.00000	203.983	0.03300	0.00400

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1.2. Mitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.1.2. Mitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

5.18.2.2. Mitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

8. User Changes to Default Data

8.1. Justifications

Screen	Justification
Land Use	Project information
Construction: Construction Phases	project information
Construction: Off-Road Equipment	Project information
Construction: Dust From Material Movement	Project information
Construction: Demolition	project information
Construction: Trips and VMT	Project information
Construction: On-Road Fugitive Dust	project information
Construction: Architectural Coatings	Project information
Construction: Paving	Project information

8.3. Land Use

Model Parameter	Units	Default Value	New Value
Building Area	sq. ft	435,600	1,175,167
Landscape Area	sq. ft	—	0.00000
Special Landscape Area	sq. ft	—	0.00000

8.4. Construction

8.4.2. Off-Road Equipment

Phase Name	Equipment Type	Model Parameter	Default Value	New Value
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Number per Day	3.00000	2.00000
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Hours Per Day	8.00000	5.20000
Phase 1 Site Prep	Tractors/Loaders/Backhoes	Horsepower	84.0000	262.000
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Number per Day	3.00000	2.00000
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Hours Per Day	8.00000	4.40000
Phase 2 Earthwork	Tractors/Loaders/Backhoes	Horsepower	84.0000	262.000
Phase 3 Foundation	Excavators	Hours Per Day	8.00000	2.50000
Phase 3 Foundation	Excavators	Horsepower	36.0000	268.000
Phase 4 Super Structureng Construction	Cranes	Number per Day	1.000000	2.00000
Phase 4 Super Structureng Construction	Cranes	Hours Per Day	7.00000	6.30000
Phase 4 Super Structureng Construction	Cranes	Horsepower	367.000	505.000

Phase Name	Equipment Type	Model Parameter	Default Value	New Value
Phase 4 Super Structureng Construction	Forklifts	Number per Day	3.00000	2.00000
Phase 4 Super Structureng Construction	Forklifts	Hours Per Day	8.00000	6.90000
Phase 4 Super Structureng Construction	Forklifts	Horsepower	82.0000	130.000

8.4.4. Dust from Material Movement

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 2 Earthwork	Material Imported	Cubic Yards	—	66,700.0
Phase 2 Earthwork	Material Exported	Cubic Yards	—	66,700.0
Phase 2 Earthwork	Total Acres Graded	acres	58.5875	5.50000
Phase 3 Foundation	Material Imported	Cubic Yards	—	23,587.0
Phase 3 Foundation	Material Exported	Cubic Yards	—	26,861.0
Phase 3 Foundation	Total Acres Graded	acres	6.09375	5.50000

8.4.5. Demolition

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 5 Parking Lot Improvements	Material Demolished	Ton of Debris	473.000	1,882.00

8.4.6. Trips and VMT

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 1 Site Prep	Worker	One-Way Trips per Day	20.0000	50.0000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 1 Site Prep	Worker	Miles per Trip	11.7000	25.0000
Phase 1 Site Prep	Vendor	One-Way Trips per Day	—	24.0000
Phase 1 Site Prep	Vendor	Miles per Trip	8.40000	25.0000
Phase 1 Site Prep	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 1 Site Prep	Hauling	One-Way Trips per Day	40.2174	40.9000
Phase 1 Site Prep	Hauling	Miles per Trip	20.0000	12.0000
Phase 1 Site Prep	Onsite truck	One-Way Trips per Day	—	8.00000
Phase 1 Site Prep	Onsite truck	Miles per Trip	—	5.00000
Phase 1 Site Prep	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 2 Earthwork	Worker	One-Way Trips per Day	20.0000	40.0000
Phase 2 Earthwork	Worker	Miles per Trip	11.7000	25.0000
Phase 2 Earthwork	Vendor	One-Way Trips per Day	—	16.3000
Phase 2 Earthwork	Vendor	Miles per Trip	8.40000	25.0000
Phase 2 Earthwork	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 2 Earthwork	Hauling	One-Way Trips per Day	387.791	385.800
Phase 2 Earthwork	Hauling	Miles per Trip	20.0000	25.0000
Phase 2 Earthwork	Onsite truck	One-Way Trips per Day	—	5.40000
Phase 2 Earthwork	Onsite truck	Miles per Trip	—	5.00000
Phase 2 Earthwork	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 3 Foundation	Worker	One-Way Trips per Day	40.0000	70.0000
Phase 3 Foundation	Worker	Miles per Trip	11.7000	25.0000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 3 Foundation	Vendor	One-Way Trips per Day	—	35.8000
Phase 3 Foundation	Vendor	Miles per Trip	8.40000	25.0000
Phase 3 Foundation	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 3 Foundation	Hauling	One-Way Trips per Day	32.3385	43.5000
Phase 3 Foundation	Hauling	Miles per Trip	20.0000	12.0000
Phase 3 Foundation	Onsite truck	One-Way Trips per Day	—	11.9000
Phase 3 Foundation	Onsite truck	Miles per Trip	—	5.00000
Phase 3 Foundation	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 4 Super Structureng Construction	Worker	One-Way Trips per Day	493.570	60.0000
Phase 4 Super Structureng Construction	Worker	Miles per Trip	11.7000	25.0000
Phase 4 Super Structureng Construction	Vendor	One-Way Trips per Day	192.610	22.3000
Phase 4 Super Structureng Construction	Vendor	Miles per Trip	8.40000	25.0000
Phase 4 Super Structureng Construction	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 4 Super Structureng Construction	Hauling	One-Way Trips per Day	0.00000	11.8000
Phase 4 Super Structureng Construction	Hauling	Miles per Trip	20.0000	83.0000
Phase 4 Super Structureng Construction	Onsite truck	One-Way Trips per Day	—	7.40000
Phase 4 Super Structureng Construction	Onsite truck	Miles per Trip	—	5.00000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 4 Super Structureng Construction	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase dust control	Worker	One-Way Trips per Day	493.570	0.00000
Phase dust control	Worker	Miles per Trip	11.7000	0.00000
Phase dust control	Vendor	One-Way Trips per Day	192.610	0.00000
Phase dust control	Vendor	Miles per Trip	8.40000	0.00000
Phase 5 Parking Lot Improvements	Worker	One-Way Trips per Day	22.5000	40.0000
Phase 5 Parking Lot Improvements	Worker	Miles per Trip	11.7000	25.0000
Phase 5 Parking Lot Improvements	Vendor	One-Way Trips per Day	—	10.4000
Phase 5 Parking Lot Improvements	Vendor	Miles per Trip	8.40000	25.0000
Phase 5 Parking Lot Improvements	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 5 Parking Lot Improvements	Hauling	One-Way Trips per Day	3.65116	13.3000
Phase 5 Parking Lot Improvements	Hauling	Miles per Trip	20.0000	12.0000
Phase 5 Parking Lot Improvements	Onsite truck	One-Way Trips per Day	—	3.50000
Phase 5 Parking Lot Improvements	Onsite truck	Miles per Trip	—	5.00000
Phase 5 Parking Lot Improvements	Onsite truck	Vehicle Mix	HHDT	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	One-Way Trips per Day	197.428	70.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Worker	Miles per Trip	11.7000	25.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	One-Way Trips per Day	—	36.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	Miles per Trip	8.40000	25.0000

Phase Name	Trip Type	Model Parameter	Default Value	New Value
Phase 6 MEP, Archt& finishrchitectural Coating	Vendor	Vehicle Mix	HHDT,MHDT	MHDT
Phase 6 MEP, Archt& finishrchitectural Coating	Hauling	Miles per Trip	20.0000	0.00000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	One-Way Trips per Day	—	12.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	Miles per Trip	—	5.00000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite truck	Vehicle Mix	HHDT	MHDT

8.4.7. On-Road Fugitive Dust

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 1 Site Prep	Hauling Trip Paved	%	100.0000	99.0000
Phase 1 Site Prep	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 2 Earthwork	Hauling Trip Paved	%	100.0000	99.6000
Phase 2 Earthwork	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 3 Foundation	Hauling Trip Paved	%	100.0000	99.3000
Phase 3 Foundation	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 4 Super Structureng Construction	Hauling Trip Paved	%	100.0000	99.8000
Phase 4 Super Structureng Construction	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase dust control	Onsite Truck Trip Paved	%	0.00000	80.0000
Phase 5 Parking Lot Improvements	Hauling Trip Paved	%	100.0000	99.7000

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 5 Parking Lot Improvements	Onsite Truck Trip Paved	%	0.00000	100.0000
Phase 6 MEP, Archt& finishrchitectural Coating	Onsite Truck Trip Paved	%	0.00000	100.0000

8.4.8. Architectural Coatings

Phase Name	Model Parameter	Units	Default Value	New Value
Phase 6 MEP, Archt& finishrchitectural Coating	Non-Residential Interior Area	sq ft	19,602.0	91,200.0
Phase 6 MEP, Archt& finishrchitectural Coating	Non-Residential Exterior Area	sq ft	2,178.00	1,267,000
Phase 6 MEP, Archt& finishrchitectural Coating	Parking Area	sq ft	26,136.0	0.00000

8.4.9. Paving

Phase Name	Land Use	Model Parameter	Units	Default Value	New Value
Phase 5 Parking Lot Improvements	Unenclosed Parking Structure	Area Paved	acres	10.00000	2.80000

Appendix B3. CT-EMFAC Output Files

Input Parameters

Project	Larkspur				
Scenario	**2050 No Build**	**2050 Alt1**	**2050 Alt2**	**2050 Alt3**	
Area	Marin (SF)	Marin (SF)	Marin (SF)	Marin (SF)	
Year	2050	2050	2050	2050	
Season	Annual	Annual	Annual	Annual	
# of Links	3	3	3	3	

Silt Loading Factor	CARB	
Freeway	0.015	g/m2
Major/Collector	0.032	g/m2
Local Urban	0.32	g/m2
Local Rural	0.32	g/m2
Precipitation Correction	CARB	
P	73	days
N	365	days
Number of hours	24	
Number of time periods	1	
Input File	C:\Users\hzhuang\OneDrive - Jacobs\Projects\Larkspur Ferry Terminal\EMFAC\Larkspur_travel_activity - Batch_Mode_ 2050.xlsx	

Total Emissions

General	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	Unit
$PM_{2.5}$	8.501E-03	6.477E-03	5.618E-03	5.719E-03	tons/day
PM_{10}	4.983E-02	3.796E-02	3.286E-02	3.348E-02	tons/day
NO_x	8.439E-03	6.430E-03	5.545E-03	5.658E-03	tons/day
CO	1.739E-01	1.325E-01	1.134E-01	1.160E-01	tons/day
HC	9.287E-03	7.076E-03	6.087E-03	6.217E-03	tons/day
TOG	9.963E-03	7.591E-03	6.535E-03	6.673E-03	tons/day
ROG	9.195E-03	7.006E-03	6.033E-03	6.160E-03	tons/day

MSATs					
1,3-Butadiene	1.110E-05	8.454E-06	7.261E-06	7.421E-06	tons/day
Acetaldehyde	2.861E-05	2.180E-05	2.007E-05	1.997E-05	tons/day
Acrolein	1.268E-06	9.664E-07	8.256E-07	8.457E-07	tons/day
Benzene	2.122E-04	1.617E-04	1.390E-04	1.420E-04	tons/day
Diesel PM	7.523E-06	5.732E-06	8.556E-06	7.260E-06	tons/day
Ethylbenzene	1.013E-04	7.718E-05	6.629E-05	6.776E-05	tons/day
Formaldehyde	7.213E-05	5.495E-05	4.985E-05	4.987E-05	tons/day
Naphthalene	9.190E-06	7.002E-06	6.000E-06	6.138E-06	tons/day
POM	2.194E-06	1.672E-06	1.455E-06	1.479E-06	tons/day
DEOG	1.954E-05	1.489E-05	3.236E-05	2.507E-05	tons/day

GHGs					
CO_2	8.657E+01	6.596E+01	5.665E+01	5.790E+01	tons/day
N_2O	1.277E-03	9.729E-04	8.533E-04	8.649E-04	tons/day
CH_4	6.485E-04	4.941E-04	4.230E-04	4.329E-04	tons/day
BC	3.790E-05	2.888E-05	2.567E-05	2.588E-05	tons/day
HFC	2.569E-06	1.958E-06	1.783E-06	1.781E-06	tons/day

CO2e					
CO_2	7.854E+01	5.984E+01	5.139E+01	5.253E+01	metric tons/day CO2e
N_2O	3.452E-01	2.630E-01	2.307E-01	2.338E-01	metric tons/day CO2e
CH_4	1.471E-02	1.121E-02	9.594E-03	9.818E-03	metric tons/day CO2e
BC	1.582E-02	1.205E-02	1.071E-02	1.080E-02	metric tons/day CO2e
HFC	3.333E-03	2.540E-03	2.313E-03	2.310E-03	metric tons/day CO2e
Total CO2e	7.892E+01	6.013E+01	5.165E+01	5.279E+01	metric tons/day CO2e

PM by Process					
$PM_{2.5}$ Running Exhaust	1.501E-04	1.144E-04	1.015E-04	1.024E-04	tons/day
$PM_{2.5}$ Tire Wear	7.966E-04	6.069E-04	5.214E-04	5.329E-04	tons/day
$PM_{2.5}$ Brake Wear	1.020E-03	7.771E-04	6.917E-04	6.970E-04	tons/day
$PM_{2.5}$ Road Dust	6.534E-03	4.978E-03	4.303E-03	4.387E-03	tons/day
PM_{10} Running Exhaust	1.629E-04	1.241E-04	1.100E-04	1.110E-04	tons/day
PM_{10} Tire Wear	3.186E-03	2.428E-03	2.086E-03	2.131E-03	tons/day
PM_{10} Brake Wear	2.914E-03	2.220E-03	1.976E-03	1.992E-03	tons/day
PM_{10} Road Dust	4.356E-02	3.319E-02	2.869E-02	2.925E-02	tons/day

General	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	Unit
$PM_{2.5}$	1.700E+01	1.295E+01	1.124E+01	1.144E+01	pounds/day
PM_{10}	9.965E+01	7.592E+01	6.572E+01	6.696E+01	pounds/day
NO_x	1.688E+01	1.286E+01	1.109E+01	1.132E+01	pounds/day
CO	3.478E+02	2.650E+02	2.267E+02	2.321E+02	pounds/day
HC	1.857E+01	1.415E+01	1.217E+01	1.243E+01	pounds/day
TOG	1.993E+01	1.518E+01	1.307E+01	1.335E+01	pounds/day
ROG	1.839E+01	1.401E+01	1.207E+01	1.232E+01	pounds/day

MSATs					
1,3-Butadiene	2.219E-02	1.691E-02	1.452E-02	1.484E-02	pounds/day
Acetaldehyde	5.723E-02	4.360E-02	4.015E-02	3.993E-02	pounds/day
Acrolein	2.537E-03	1.933E-03	1.651E-03	1.691E-03	pounds/day
Benzene	4.244E-01	3.234E-01	2.780E-01	2.840E-01	pounds/day
Diesel PM	1.505E-02	1.146E-02	1.711E-02	1.452E-02	pounds/day
Ethylbenzene	2.026E-01	1.544E-01	1.326E-01	1.355E-01	pounds/day
Formaldehyde	1.443E-01	1.099E-01	9.969E-02	9.973E-02	pounds/day
Naphthalene	1.838E-02	1.400E-02	1.200E-02	1.228E-02	pounds/day
POM	4.388E-03	3.343E-03	2.910E-03	2.959E-03	pounds/day
DEOG	3.909E-02	2.978E-02	6.472E-02	5.015E-02	pounds/day

GHGs					
CO_2	1.731E+05	1.319E+05	1.133E+05	1.158E+05	pounds/day
N_2O	2.554E+00	1.946E+00	1.707E+00	1.730E+00	pounds/day
CH_4	1.297E+00	9.882E-01	8.460E-01	8.658E-01	pounds/day
BC	7.580E-02	5.775E-02	5.134E-02	5.176E-02	pounds/day
HFC	5.139E-03	3.915E-03	3.565E-03	3.561E-03	pounds/day

PM by Process					
$PM_{2.5}$ Running Exhaust	3.002E-01	2.287E-01	2.030E-01	2.048E-01	pounds/day
$PM_{2.5}$ Tire Wear	1.593E+00	1.214E+00	1.043E+00	1.066E+00	pounds/day
$PM_{2.5}$ Brake Wear	2.040E+00	1.554E+00	1.383E+00	1.394E+00	pounds/day
$PM_{2.5}$ Road Dust	1.307E+01	9.957E+00	8.606E+00	8.774E+00	pounds/day
PM_{10} Running Exhaust	3.258E-01	2.482E-01	2.200E-01	2.221E-01	pounds/day
PM_{10} Tire Wear	6.373E+00	4.855E+00	4.171E+00	4.263E+00	pounds/day
PM_{10} Brake Wear	5.829E+00	4.441E+00	3.952E+00	3.983E+00	pounds/day
PM_{10} Road Dust	8.712E+01	6.638E+01	5.738E+01	5.849E+01	pounds/day

General	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3
$PM_{2.5}$	7.712E+03	5.876E+03	5.096E+03	5.189E+03
PM_{10}	4.520E+04	3.444E+04	2.981E+04	3.037E+04
NO_x	7.656E+03	5.833E+03	5.030E+03	5.133E+03
CO	1.578E+05	1.202E+05	1.028E+05	1.053E+05
HC	8.425E+03	6.419E+03	5.522E+03	5.640E+03
TOG	9.038E+03	6.886E+03	5.928E+03	6.053E+03
ROG	8.342E+03	6.356E+03	5.473E+03	5.588E+03

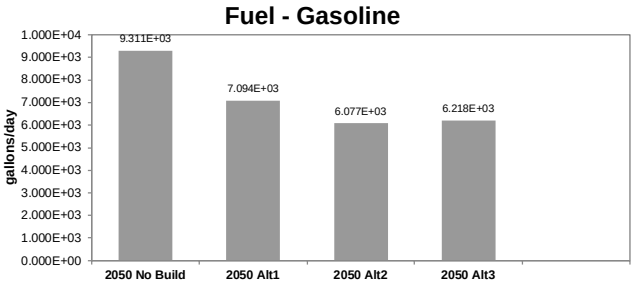
MSATs				
1,3-Butadiene	1.007E+01	7.669E+00	6.587E+00	6.732E+00
Acetaldehyde	2.596E+01	1.978E+01	1.821E+01	1.811E+01
Acrolein	1.151E+00	8.767E-01	7.490E-01	7.672E-01
Benzene	1.925E+02	1.467E+02	1.261E+02	1.288E+02
Diesel PM	6.825E+00	5.200E+00	7.762E+00	6.586E+00
Ethylbenzene	9.190E+01	7.002E+01	6.014E+01	6.147E+01
Formaldehyde	6.543E+01	4.985E+01	4.522E+01	4.524E+01
Naphthalene	8.337E+00	6.352E+00	5.443E+00	5.569E+00
POM	1.990E+00	1.517E+00	1.320E+00	1.342E+00
DEOG	1.773E+01	1.351E+01	2.935E+01	2.275E+01

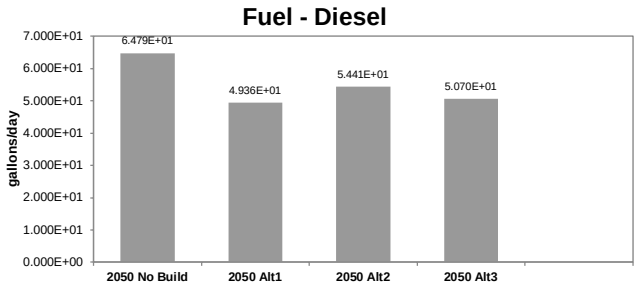
GHGs				
CO_2	7.854E+07	5.984E+07	5.139E+07	5.253E+07
N_2O	1.158E+03	8.826E+02	7.741E+02	7.847E+02
CH_4	5.883E+02	4.482E+02	3.837E+02	3.927E+02
BC	3.438E+01	2.620E+01	2.329E+01	2.348E+01
HFC	2.331E+00	1.776E+00	1.617E+00	1.615E+00

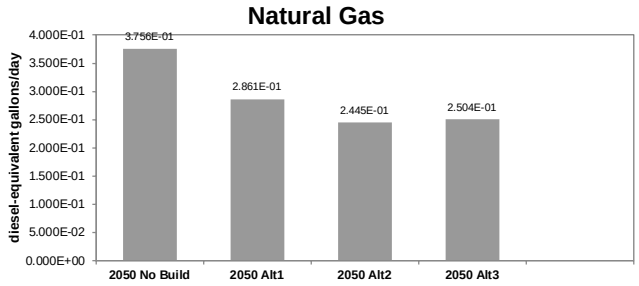
PM by Process				
$PM_{2.5}$ Running Exhaust	1.362E+02	1.038E+02	9.207E+01	9.290E+01
$PM_{2.5}$ Tire Wear	7.226E+02	5.506E+02	4.730E+02	4.834E+02
$PM_{2.5}$ Brake Wear	9.253E+02	7.050E+02	6.275E+02	6.323E+02
$PM_{2.5}$ Road Dust	5.928E+03	4.516E+03	3.904E+03	3.980E+03
PM_{10} Running Exhaust	1.478E+02	1.126E+02	9.980E+01	1.007E+02
PM_{10} Tire Wear	2.891E+03	2.202E+03	1.892E+03	1.934E+03
PM_{10} Brake Wear	2.644E+03	2.014E+03	1.793E+03	1.807E+03
PM_{10} Road Dust	3.952E+04	3.011E+04	2.603E+04	2.653E+04

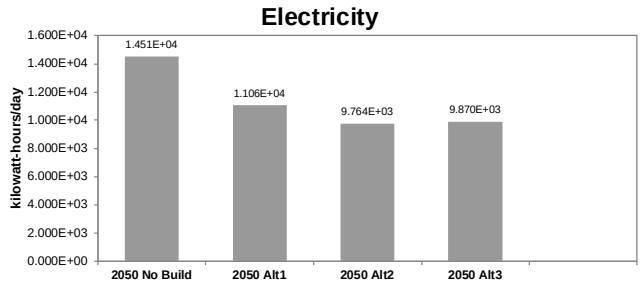
Total Consumption

Fuel/Electricity	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	Unit
Gasoline	9.311E+03	7.094E+03	6.077E+03	6.218E+03	gallons/day
Diesel	6.479E+01	4.936E+01	5.441E+01	5.070E+01	gallons/day
Natural Gas	3.756E-01	2.861E-01	2.445E-01	2.504E-01	diesel-equivalent gallons/day
Electricity	1.451E+04	1.106E+04	9.764E+03	9.870E+03	kilowatt-hours/day









PM2.5

			Emissions by Process (grams/day)					Emissions by Process (pounds/day)				% of Emissions by Process				% of Emissions by Vehicle Type		
Scenario	Link ID	Total (grams/day)	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Total (pounds/day)	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Non-Truck	Truck	Road Type
2050 No Build	1	1948.4	67.6	383.0	221.1	1276.7	4.3	0.1	0.8	0.5	2.8	3	20	11	66	100	0	Major/Collector
2050 No Build	2	2854.6	52.3	289.1	593.2	1920.0	6.3	0.1	0.6	1.3	4.2	2	10	21	67	100	0	Local Urban
2050 No Build	3	2908.9	16.2	50.6	110.9	2731.1	6.4	0.0	0.1	0.2	6.0	1	2	4	94	100	0	Local Urban
2050 Alt1	1	1484.5	51.5	291.8	168.5	972.7	3.3	0.1	0.6	0.4	2.1	3	20	11	66	100	0	Major/Collector
2050 Alt1	2	2174.9	39.9	220.2	452.0	1462.8	4.8	0.1	0.5	1.0	3.2	2	10	21	67	100	0	Local Urban
2050 Alt1	3	2216.3	12.4	38.5	84.5	2080.8	4.9	0.0	0.1	0.2	4.6	1	2	4	94	100	0	Local Urban
2050 Alt2	1	1294.3	45.5	250.7	157.3	840.8	2.9	0.1	0.6	0.3	1.9	4	19	12	65	98	2	Major/Collector
2050 Alt2	2	1885.4	35.5	189.2	396.2	1264.4	4.2	0.1	0.4	0.9	2.8	2	10	21	67	98	2	Local Urban
2050 Alt2	3	1916.7	11.0	33.1	74.0	1798.6	4.2	0.0	0.1	0.2	4.0	1	2	4	94	99	1	Local Urban
2050 Alt3	1	1315.0	46.0	256.2	155.6	857.1	2.9	0.1	0.6	0.3	1.9	3	19	12	65	98	2	Major/Collector
2050 Alt3	2	1919.9	35.8	193.4	401.7	1289.1	4.2	0.1	0.4	0.9	2.8	2	10	21	67	99	1	Local Urban
2050 Alt3	3	1953.6	11.1	33.8	75.0	1833.6	4.3	0.0	0.1	0.2	4.0	1	2	4	94	99	1	Local Urban

PM10

			Emissions by Process (grams/day)					Emissions by Process (pounds/day)				% of Emissions by Process				% of Emissions by Vehicle Type		
Scenario	Link ID	Total (grams/day)	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Total (pounds/day)	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Non-Truck	Truck	Road Type
2050 No Build	1	10748.3	73.4	1532.0	631.8	8511.1	23.7	0.2	3.4	1.4	18.8	1	14	6	79	100	0	Major/Collector
2050 No Build	2	15708.0	56.8	1156.2	1694.9	12800.0	34.6	0.1	2.5	3.7	28.2	0	7	11	81	100	0	Local Urban
2050 No Build	3	18744.4	17.6	202.3	317.0	18207.4	41.3	0.0	0.4	0.7	40.1	0	1	2	97	100	0	Local Urban
2050 Alt1	1	8189.0	55.9	1167.2	481.4	6484.5	18.1	0.1	2.6	1.1	14.3	1	14	6	79	100	0	Major/Collector
2050 Alt1	2	11967.8	43.3	880.9	1291.4	9752.2	26.4	0.1	1.9	2.8	21.5	0	7	11	81	100	0	Local Urban
2050 Alt1	3	14281.2	13.4	154.2	241.5	13872.1	31.5	0.0	0.3	0.5	30.6	0	1	2	97	100	0	Local Urban
2050 Alt2	1	7106.6	49.4	1002.8	449.4	5605.0	15.7	0.1	2.2	1.0	12.4	1	14	6	79	98	2	Major/Collector
2050 Alt2	2	10356.9	38.5	756.8	1132.0	8429.6	22.8	0.1	1.7	2.5	18.6	0	7	11	81	98	2	Local Urban
2050 Alt2	3	12346.4	11.9	132.4	211.4	11990.7	27.2	0.0	0.3	0.5	26.4	0	1	2	97	99	1	Local Urban
2050 Alt3	1	7233.6	49.9	1024.8	444.6	5714.3	15.9	0.1	2.3	1.0	12.6	1	14	6	79	99	1	Major/Collector
2050 Alt3	2	10553.8	38.8	773.4	1147.6	8593.9	23.3	0.1	1.7	2.5	18.9	0	7	11	81	99	1	Local Urban
2050 Alt3	3	12586.1	12.0	135.4	214.4	12224.3	27.7	0.0	0.3	0.5	27.0	0	1	2	97	99	1	Local Urban

NOx

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	4.349E-03	3.314E-03	2.857E-03	2.916E-03	
2	3.367E-03	2.565E-03	2.211E-03	2.257E-03	
3	7.230E-04	5.509E-04	4.763E-04	4.855E-04	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	8.698E+00	6.627E+00	5.715E+00	5.832E+00	
2	6.734E+00	5.131E+00	4.423E+00	4.514E+00	
3	1.446E+00	1.102E+00	9.525E-01	9.710E-01	

CO

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	7.825E-02	5.962E-02	5.103E-02	5.223E-02	
2	7.822E-02	5.960E-02	5.096E-02	5.218E-02	
3	1.744E-02	1.329E-02	1.137E-02	1.164E-02	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.565E+02	1.192E+02	1.021E+02	1.045E+02	
2	1.564E+02	1.192E+02	1.019E+02	1.044E+02	
3	3.488E+01	2.658E+01	2.274E+01	2.328E+01	

HC

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	3.969E-03	3.024E-03	2.600E-03	2.656E-03	
2	4.099E-03	3.123E-03	2.688E-03	2.745E-03	
3	1.219E-03	9.288E-04	7.992E-04	8.163E-04	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	7.939E+00	6.049E+00	5.200E+00	5.313E+00	
2	8.197E+00	6.245E+00	5.376E+00	5.490E+00	
3	2.438E+00	1.858E+00	1.598E+00	1.633E+00	

TOG

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	4.260E-03	3.246E-03	2.792E-03	2.852E-03	
2	4.395E-03	3.349E-03	2.885E-03	2.945E-03	
3	1.308E-03	9.962E-04	8.579E-04	8.759E-04	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	8.520E+00	6.491E+00	5.584E+00	5.704E+00	
2	8.790E+00	6.697E+00	5.770E+00	5.890E+00	
3	2.615E+00	1.992E+00	1.716E+00	1.752E+00	

ROG

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	3.883E-03	2.959E-03	2.546E-03	2.600E-03	
2	4.098E-03	3.122E-03	2.690E-03	2.746E-03	
3	1.214E-03	9.250E-04	7.967E-04	8.134E-04	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	7.766E+00	5.917E+00	5.091E+00	5.200E+00	
2	8.196E+00	6.245E+00	5.381E+00	5.492E+00	
3	2.428E+00	1.850E+00	1.593E+00	1.627E+00	

1,3-Butadiene

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	5.479E-06	4.174E-06	3.581E-06	3.662E-06	
2	4.279E-06	3.260E-06	2.804E-06	2.864E-06	
3	1.338E-06	1.020E-06	8.760E-07	8.952E-07	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.096E-02	8.348E-03	7.162E-03	7.323E-03	
2	8.559E-03	6.521E-03	5.608E-03	5.729E-03	
3	2.677E-03	2.039E-03	1.752E-03	1.790E-03	

Acetaldehyde

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.397E-05	1.065E-05	9.663E-06	9.665E-06	
2	1.116E-05	8.499E-06	7.959E-06	7.866E-06	
3	3.484E-06	2.655E-06	2.450E-06	2.435E-06	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	2.795E-02	2.129E-02	1.933E-02	1.933E-02	
2	2.231E-02	1.700E-02	1.592E-02	1.573E-02	
3	6.969E-03	5.310E-03	4.901E-03	4.870E-03	

Acrolein

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	6.260E-07	4.770E-07	4.075E-07	4.174E-07	
2	4.888E-07	3.724E-07	3.182E-07	3.259E-07	
3	1.536E-07	1.170E-07	9.995E-08	1.024E-07	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.252E-03	9.539E-04	8.149E-04	8.347E-04	
2	9.777E-04	7.449E-04	6.364E-04	6.518E-04	
3	3.071E-04	2.340E-04	1.999E-04	2.048E-04	

Benzene

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	9.538E-05	7.267E-05	6.242E-05	6.380E-05	
2	8.979E-05	6.841E-05	5.885E-05	6.011E-05	
3	2.705E-05	2.061E-05	1.772E-05	1.810E-05	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.908E-01	1.453E-01	1.248E-01	1.276E-01	
2	1.796E-01	1.368E-01	1.177E-01	1.202E-01	
3	5.410E-02	4.121E-02	3.544E-02	3.621E-02	

Diesel PM

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	4.209E-06	3.207E-06	4.339E-06	3.787E-06	
2	2.712E-06	2.067E-06	3.383E-06	2.800E-06	
3	6.022E-07	4.588E-07	8.348E-07	6.731E-07	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	8.418E-03	6.413E-03	8.678E-03	7.574E-03	
2	5.425E-03	4.133E-03	6.765E-03	5.600E-03	
3	1.204E-03	9.177E-04	1.670E-03	1.346E-03	

Ethylbenzene

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	4.392E-05	3.347E-05	2.873E-05	2.937E-05	
2	4.421E-05	3.368E-05	2.894E-05	2.957E-05	
3	1.317E-05	1.004E-05	8.622E-06	8.812E-06	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	8.785E-02	6.693E-02	5.746E-02	5.874E-02	
2	8.841E-02	6.736E-02	5.788E-02	5.915E-02	
3	2.635E-02	2.007E-02	1.724E-02	1.762E-02	

Formaldehyde

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	3.531E-05	2.690E-05	2.412E-05	2.424E-05	
2	2.805E-05	2.137E-05	1.966E-05	1.956E-05	
3	8.764E-06	6.677E-06	6.070E-06	6.067E-06	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	7.062E-02	5.381E-02	4.824E-02	4.848E-02	
2	5.611E-02	4.275E-02	3.932E-02	3.912E-02	
3	1.753E-02	1.335E-02	1.214E-02	1.213E-02	

Naphthalene

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	4.544E-06	3.462E-06	2.965E-06	3.034E-06	
2	3.543E-06	2.699E-06	2.315E-06	2.367E-06	
3	1.103E-06	8.407E-07	7.208E-07	7.372E-07	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	9.088E-03	6.924E-03	5.929E-03	6.067E-03	
2	7.086E-03	5.399E-03	4.630E-03	4.735E-03	
3	2.207E-03	1.681E-03	1.442E-03	1.474E-03	

POM

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.080E-06	8.231E-07	7.141E-07	7.269E-07	
2	8.473E-07	6.455E-07	5.643E-07	5.728E-07	
3	2.665E-07	2.030E-07	1.769E-07	1.798E-07	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	2.161E-03	1.646E-03	1.428E-03	1.454E-03	
2	1.695E-03	1.291E-03	1.129E-03	1.146E-03	
3	5.330E-04	4.061E-04	3.537E-04	3.595E-04	

DEOG

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	7.797E-06	5.940E-06	1.277E-05	9.916E-06	
2	8.912E-06	6.790E-06	1.528E-05	1.176E-05	
3	2.834E-06	2.159E-06	4.311E-06	3.402E-06	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.559E-02	1.188E-02	2.554E-02	1.983E-02	
2	1.782E-02	1.358E-02	3.056E-02	2.351E-02	
3	5.669E-03	4.319E-03	8.622E-03	6.804E-03	

CO2

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	4.737E+01	3.609E+01	3.098E+01	3.167E+01	
2	3.214E+01	2.449E+01	2.104E+01	2.150E+01	
3	7.068E+00	5.385E+00	4.632E+00	4.732E+00	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	9.473E+04	7.218E+04	6.195E+04	6.334E+04	
2	6.428E+04	4.897E+04	4.208E+04	4.300E+04	
3	1.414E+04	1.077E+04	9.265E+03	9.464E+03	

N2O

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	6.667E-04	5.080E-04	4.447E-04	4.511E-04	
2	5.046E-04	3.844E-04	3.375E-04	3.420E-04	
3	1.057E-04	8.055E-05	7.107E-05	7.187E-05	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.333E+00	1.016E+00	8.895E-01	9.022E-01	
2	1.009E+00	7.689E-01	6.750E-01	6.839E-01	
3	2.115E-01	1.611E-01	1.421E-01	1.437E-01	

CH4

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	3.221E-04	2.454E-04	2.100E-04	2.150E-04	
2	2.528E-04	1.926E-04	1.650E-04	1.688E-04	
3	7.357E-05	5.606E-05	4.802E-05	4.913E-05	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	6.443E-01	4.909E-01	4.200E-01	4.299E-01	
2	5.056E-01	3.852E-01	3.300E-01	3.376E-01	
3	1.471E-01	1.121E-01	9.604E-02	9.827E-02	

BC

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.895E-05	1.444E-05	1.278E-05	1.291E-05	
2	1.451E-05	1.105E-05	9.878E-06	9.939E-06	
3	4.440E-06	3.383E-06	3.009E-06	3.033E-06	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	3.791E-02	2.888E-02	2.556E-02	2.582E-02	
2	2.901E-02	2.210E-02	1.976E-02	1.988E-02	
3	8.881E-03	6.766E-03	6.018E-03	6.066E-03	

HFC

(tons/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.030E-06	7.847E-07	7.146E-07	7.138E-07	
2	1.192E-06	9.081E-07	8.269E-07	8.260E-07	
3	3.476E-07	2.649E-07	2.412E-07	2.409E-07	

(pounds/day)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	2.060E-03	1.569E-03	1.429E-03	1.428E-03	
2	2.384E-03	1.816E-03	1.654E-03	1.652E-03	
3	6.952E-04	5.297E-04	4.824E-04	4.818E-04	

Consumption - Gasoline (gallons/day)

(units)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	5.133E+03	3.911E+03	3.349E+03	3.427E+03	
2	3.437E+03	2.619E+03	2.245E+03	2.296E+03	
3	7.404E+02	5.641E+02	4.838E+02	4.948E+02	

Link ID					

Consumption - Diesel (gallons/day)

(units)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	3.437E+01	2.619E+01	2.831E+01	2.656E+01	
2	2.487E+01	1.895E+01	2.123E+01	1.967E+01	
3	5.542E+00	4.223E+00	4.869E+00	4.468E+00	

Link ID					

Consumption - Natural Gas (diesel-equivalent gallons/day)

(units)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	1.608E-01	1.225E-01	1.046E-01	1.072E-01	
2	1.668E-01	1.271E-01	1.086E-01	1.112E-01	
3	4.797E-02	3.655E-02	3.122E-02	3.198E-02	

Link ID					

Consumption - Electricity (kilowatt-hours/day)

(units)

Link ID	2050 No Build	2050 Alt1	2050 Alt2	2050 Alt3	
1	7.661E+03	5.837E+03	5.161E+03	5.214E+03	
2	5.743E+03	4.376E+03	3.858E+03	3.903E+03	
3	1.107E+03	8.433E+02	7.448E+02	7.529E+02	

Link ID					

Input Parameters

Project	Larkspur				
Scenario	**2025**	**2035 No Build**	**2035 Alt1**	**2035 Alt2**	**2035 Alt3**
Area	Marin (SF)	Marin (SF)	Marin (SF)	Marin (SF)	Marin (SF)
Year	2025	2035	2050	2035	2050
Season	Annual	Annual	Annual	Annual	Annual
# of Links	3	3	3	3	3

Silt Loading Factor	CARB	
Freeway	0.015	g/m2
Major/Collector	0.032	g/m2
Local Urban	0.32	g/m2
Local Rural	0.32	g/m2
Precipitation Correction	CARB	
P	73	days
N	365	days
Number of hours	24	
Number of time periods	1	
Input File	C:\Users\hzhuang\OneDrive - Jacobs\Projects\Larkspur Ferry Terminal\EMFAC\Larkspur_travel_activity - Batch_Mode_ 2025 and 2035.xlsx	

Total Emissions

General	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3	Unit
$PM_{2.5}$	1.256E-03	2.677E-03	2.601E-03	2.566E-03	2.430E-03	tons/day
PM_{10}	7.132E-03	1.553E-02	1.524E-02	1.488E-02	1.422E-02	tons/day
NO_x	3.369E-03	3.656E-03	2.579E-03	3.517E-03	2.401E-03	tons/day
CO	4.077E-02	6.106E-02	5.307E-02	5.835E-02	4.916E-02	tons/day
HC	2.403E-03	3.611E-03	2.837E-03	3.454E-03	2.637E-03	tons/day
TOG	2.582E-03	3.874E-03	3.044E-03	3.706E-03	2.830E-03	tons/day
ROG	2.278E-03	3.504E-03	2.810E-03	3.352E-03	2.613E-03	tons/day

MSATs						
1,3-Butadiene	3.800E-06	4.622E-06	3.389E-06	4.422E-06	3.146E-06	tons/day
Acetaldehyde	1.074E-05	1.269E-05	8.865E-06	1.237E-05	8.581E-06	tons/day
Acrolein	3.890E-07	5.222E-07	3.870E-07	4.988E-07	3.581E-07	tons/day
Benzene	6.187E-05	8.371E-05	6.482E-05	8.007E-05	6.022E-05	tons/day
Diesel PM	7.136E-06	6.895E-06	2.637E-06	7.219E-06	3.393E-06	tons/day
Ethylbenzene	2.665E-05	3.903E-05	3.094E-05	3.732E-05	2.873E-05	tons/day
Formaldehyde	2.660E-05	3.156E-05	2.228E-05	3.065E-05	2.137E-05	tons/day
Naphthalene	3.437E-06	3.887E-06	2.805E-06	3.717E-06	2.601E-06	tons/day
POM	8.421E-07	9.716E-07	6.719E-07	9.345E-07	6.289E-07	tons/day
DEOG	1.326E-05	1.768E-05	7.796E-06	2.024E-05	1.233E-05	tons/day

GHGs						
CO_2	1.611E+01	2.889E+01	2.644E+01	2.764E+01	2.455E+01	tons/day
N_2O	3.250E-04	4.733E-04	3.916E-04	4.553E-04	3.682E-04	tons/day
CH_4	2.203E-04	3.027E-04	1.979E-04	2.893E-04	1.834E-04	tons/day
BC	1.616E-05	1.886E-05	1.166E-05	1.819E-05	1.105E-05	tons/day
HFC	2.197E-05	1.125E-05	7.941E-07	1.081E-05	7.637E-07	tons/day

CO2e						
CO_2	1.462E+01	2.621E+01	2.399E+01	2.507E+01	2.227E+01	metric tons/day CO2e
N_2O	8.785E-02	1.280E-01	1.059E-01	1.231E-01	9.955E-02	metric tons/day CO2e
CH_4	4.997E-03	6.865E-03	4.489E-03	6.562E-03	4.160E-03	metric tons/day CO2e
BC	6.745E-03	7.871E-03	4.864E-03	7.589E-03	4.610E-03	metric tons/day CO2e
HFC	2.850E-02	1.459E-02	1.030E-03	1.403E-02	9.908E-04	metric tons/day CO2e
Total CO2e	1.474E+01	2.636E+01	2.410E+01	2.522E+01	2.238E+01	metric tons/day CO2e

PM by Process						
$PM_{2.5}$ Running Exhaust	6.426E-05	7.492E-05	4.615E-05	7.221E-05	4.370E-05	tons/day
$PM_{2.5}$ Tire Wear	1.149E-04	2.481E-04	2.433E-04	2.372E-04	2.259E-04	tons/day
$PM_{2.5}$ Brake Wear	1.508E-04	3.240E-04	3.138E-04	3.125E-04	2.976E-04	tons/day
$PM_{2.5}$ Road Dust	9.257E-04	2.030E-03	1.998E-03	1.944E-03	1.862E-03	tons/day
PM_{10} Running Exhaust	6.959E-05	8.119E-05	5.007E-05	7.823E-05	4.738E-05	tons/day
PM_{10} Tire Wear	4.595E-04	9.922E-04	9.731E-04	9.489E-04	9.037E-04	tons/day
PM_{10} Brake Wear	4.309E-04	9.258E-04	8.965E-04	8.928E-04	8.504E-04	tons/day
PM_{10} Road Dust	6.172E-03	1.353E-02	1.332E-02	1.296E-02	1.242E-02	tons/day

General	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3	Unit
$PM_{2.5}$	2.511E+00	5.354E+00	5.203E+00	5.131E+00	4.859E+00	pounds/day
PM_{10}	1.426E+01	3.107E+01	3.048E+01	2.976E+01	2.843E+01	pounds/day
NO_x	6.739E+00	7.311E+00	5.159E+00	7.035E+00	4.802E+00	pounds/day
CO	8.154E+01	1.221E+02	1.061E+02	1.167E+02	9.833E+01	pounds/day
HC	4.806E+00	7.222E+00	5.674E+00	6.908E+00	5.274E+00	pounds/day
TOG	5.165E+00	7.747E+00	6.088E+00	7.412E+00	5.661E+00	pounds/day
ROG	4.557E+00	7.007E+00	5.619E+00	6.705E+00	5.226E+00	pounds/day

MSATs						
1,3-Butadiene	7.599E-03	9.245E-03	6.777E-03	8.844E-03	6.293E-03	pounds/day
Acetaldehyde	2.148E-02	2.538E-02	1.773E-02	2.474E-02	1.716E-02	pounds/day
Acrolein	7.780E-04	1.044E-03	7.739E-04	9.976E-04	7.163E-04	pounds/day
Benzene	1.237E-01	1.674E-01	1.296E-01	1.601E-01	1.204E-01	pounds/day
Diesel PM	1.427E-02	1.379E-02	5.274E-03	1.444E-02	6.786E-03	pounds/day
Ethylbenzene	5.331E-02	7.806E-02	6.188E-02	7.464E-02	5.745E-02	pounds/day
Formaldehyde	5.320E-02	6.312E-02	4.455E-02	6.129E-02	4.274E-02	pounds/day
Naphthalene	6.874E-03	7.774E-03	5.611E-03	7.433E-03	5.203E-03	pounds/day
POM	1.684E-03	1.943E-03	1.344E-03	1.869E-03	1.258E-03	pounds/day
DEOG	2.651E-02	3.537E-02	1.559E-02	4.048E-02	2.465E-02	pounds/day

GHGs						
CO_2	3.222E+04	5.778E+04	5.288E+04	5.528E+04	4.910E+04	pounds/day
N_2O	6.499E-01	9.467E-01	7.833E-01	9.106E-01	7.365E-01	pounds/day
CH_4	4.407E-01	6.054E-01	3.958E-01	5.787E-01	3.668E-01	pounds/day
BC	3.233E-02	3.772E-02	2.331E-02	3.637E-02	2.210E-02	pounds/day
HFC	4.393E-02	2.250E-02	1.588E-03	2.163E-02	1.527E-03	pounds/day

PM by Process						
$PM_{2.5}$ Running Exhaust	1.285E-01	1.498E-01	9.230E-02	1.444E-01	8.739E-02	pounds/day
$PM_{2.5}$ Tire Wear	2.298E-01	4.961E-01	4.866E-01	4.744E-01	4.519E-01	pounds/day
$PM_{2.5}$ Brake Wear	3.016E-01	6.481E-01	6.275E-01	6.250E-01	5.952E-01	pounds/day
$PM_{2.5}$ Road Dust	1.851E+00	4.060E+00	3.996E+00	3.887E+00	3.725E+00	pounds/day
PM_{10} Running Exhaust	1.392E-01	1.624E-01	1.001E-01	1.565E-01	9.475E-02	pounds/day
PM_{10} Tire Wear	9.190E-01	1.984E+00	1.946E+00	1.898E+00	1.807E+00	pounds/day
PM_{10} Brake Wear	8.617E-01	1.852E+00	1.793E+00	1.786E+00	1.701E+00	pounds/day
PM_{10} Road Dust	1.234E+01	2.707E+01	2.664E+01	2.592E+01	2.483E+01	pounds/day

General	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3	Unit
$PM_{2.5}$	1.139E+03	2.429E+03	2.360E+03	2.327E+03	2.204E+03	grams/day
PM_{10}	6.470E+03	1.409E+04	1.383E+04	1.350E+04	1.290E+04	grams/day
NO_x	3.057E+03	3.316E+03	2.340E+03	3.191E+03	2.178E+03	grams/day
CO	3.699E+04	5.539E+04	4.815E+04	5.294E+04	4.460E+04	grams/day
HC	2.180E+03	3.276E+03	2.574E+03	3.133E+03	2.392E+03	grams/day
TOG	2.343E+03	3.514E+03	2.762E+03	3.362E+03	2.568E+03	grams/day
ROG	2.067E+03	3.178E+03	2.549E+03	3.041E+03	2.370E+03	grams/day

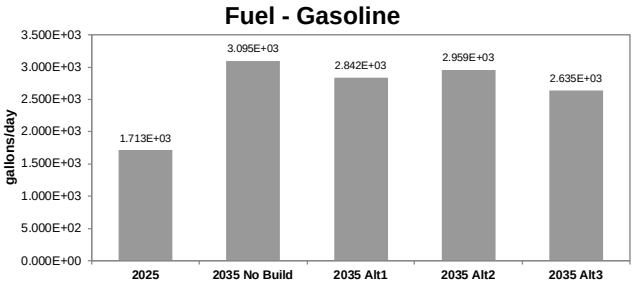
MSATs						
1,3-Butadiene	3.447E+00	4.193E+00	3.074E+00	4.012E+00	2.854E+00	grams/day
Acetaldehyde	9.742E+00	1.151E+01	8.042E+00	1.122E+01	7.785E+00	grams/day
Acrolein	3.529E-01	4.737E-01	3.510E-01	4.525E-01	3.249E-01	grams/day
Benzene	5.613E+01	7.594E+01	5.880E+01	7.264E+01	5.463E+01	grams/day
Diesel PM	6.473E+00	6.255E+00	2.392E+00	6.549E+00	3.078E+00	grams/day
Ethylbenzene	2.418E+01	3.541E+01	2.807E+01	3.386E+01	2.606E+01	grams/day
Formaldehyde	2.413E+01	2.863E+01	2.021E+01	2.780E+01	1.939E+01	grams/day
Naphthalene	3.118E+00	3.526E+00	2.545E+00	3.372E+00	2.360E+00	grams/day
POM	7.639E-01	8.814E-01	6.095E-01	8.477E-01	5.706E-01	grams/day
DEOG	1.203E+01	1.604E+01	7.072E+00	1.836E+01	1.118E+01	grams/day

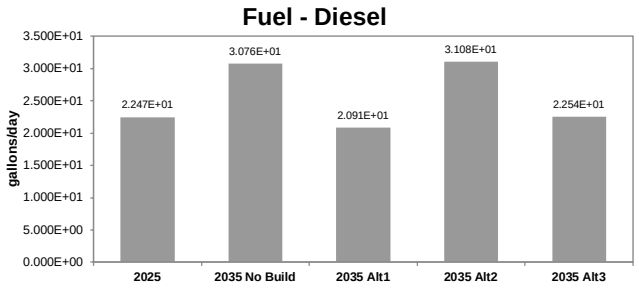
GHGs						
CO_2	1.462E+07	2.621E+07	2.399E+07	2.507E+07	2.227E+07	grams/day
N_2O	2.948E+02	4.294E+02	3.553E+02	4.130E+02	3.341E+02	grams/day
CH_4	1.999E+02	2.746E+02	1.796E+02	2.625E+02	1.664E+02	grams/day
BC	1.466E+01	1.711E+01	1.057E+01	1.650E+01	1.002E+01	grams/day
HFC	1.993E+01	1.021E+01	7.204E-01	9.809E+00	6.929E-01	grams/day

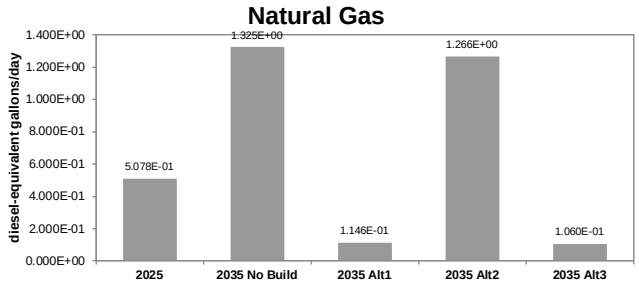
PM by Process						
$PM_{2.5}$ Running Exhaust	5.830E+01	6.797E+01	4.186E+01	6.551E+01	3.964E+01	grams/day
$PM_{2.5}$ Tire Wear	1.042E+02	2.250E+02	2.207E+02	2.152E+02	2.050E+02	grams/day
$PM_{2.5}$ Brake Wear	1.368E+02	2.940E+02	2.846E+02	2.835E+02	2.700E+02	grams/day
$PM_{2.5}$ Road Dust	8.398E+02	1.842E+03	1.813E+03	1.763E+03	1.690E+03	grams/day
PM_{10} Running Exhaust	6.313E+01	7.365E+01	4.542E+01	7.097E+01	4.298E+01	grams/day
PM_{10} Tire Wear	4.169E+02	9.001E+02	8.828E+02	8.608E+02	8.198E+02	grams/day
PM_{10} Brake Wear	3.909E+02	8.399E+02	8.133E+02	8.100E+02	7.714E+02	grams/day
PM_{10} Road Dust	5.599E+03	1.228E+04	1.208E+04	1.176E+04	1.126E+04	grams/day

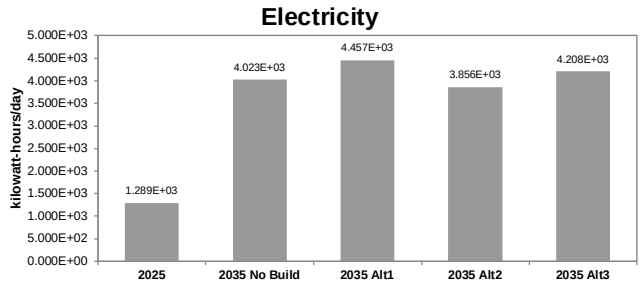
Total Consumption

Fuel/Electricity	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3	Unit
Gasoline	1.713E+03	3.095E+03	2.842E+03	2.959E+03	2.635E+03	gallons/day
Diesel	2.247E+01	3.076E+01	2.091E+01	3.108E+01	2.254E+01	gallons/day
Natural Gas	5.078E-01	1.325E+00	1.146E-01	1.266E+00	1.060E-01	diesel-equivalent gallons/day
Electricity	1.289E+03	4.023E+03	4.457E+03	3.856E+03	4.208E+03	kilowatt-hours/day









PM2.5

			Emissions by Process (grams/day)					Emissions by Process (pounds/day)				% of Emissions by Process				% of Emissions by Vehicle Type		
Scenario	Link ID	Total (grams/day)	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Total (pounds/day)	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Non-Truck	Truck	Road Type
2025	1	297.9	29.1	55.2	32.7	180.9	0.7	0.1	0.1	0.1	0.4	10	19	11	61	100	0	Major/Collector
2025	2	423.8	22.3	41.7	87.7	272.0	0.9	0.0	0.1	0.2	0.6	5	10	21	64	100	0	Local Urban
2025	3	417.5	6.8	7.3	16.4	386.9	0.9	0.0	0.0	0.0	0.9	2	2	4	93	100	0	Local Urban
2035 No Build	1	621.3	33.9	119.3	71.5	396.6	1.4	0.1	0.3	0.2	0.9	5	19	12	64	99	1	Major/Collector
2035 No Build	2	900.0	26.0	90.0	187.4	596.5	2.0	0.1	0.2	0.4	1.3	3	10	21	66	99	1	Local Urban
2035 No Build	3	907.4	8.0	15.8	35.1	848.5	2.0	0.0	0.0	0.1	1.9	1	2	4	94	99	1	Local Urban
2035 Alt1	1	596.8	20.8	117.0	68.7	390.4	1.3	0.0	0.3	0.2	0.9	3	20	12	65	99	1	Major/Collector
2035 Alt1	2	873.4	16.1	88.3	181.9	587.1	1.9	0.0	0.2	0.4	1.3	2	10	21	67	99	1	Local Urban
2035 Alt1	3	889.6	5.0	15.4	34.0	835.1	2.0	0.0	0.0	0.1	1.8	1	2	4	94	100	0	Local Urban
2035 Alt2	1	596.2	32.7	114.1	69.7	379.8	1.3	0.1	0.3	0.2	0.8	5	19	12	64	99	1	Major/Collector
2035 Alt2	2	862.4	25.1	86.1	180.1	571.1	1.9	0.1	0.2	0.4	1.3	3	10	21	66	99	1	Local Urban
2035 Alt2	3	868.9	7.7	15.1	33.7	812.4	1.9	0.0	0.0	0.1	1.8	1	2	4	94	99	1	Local Urban
2035 Alt3	1	559.2	19.6	108.6	67.1	363.9	1.2	0.0	0.2	0.1	0.8	4	19	12	65	98	2	Major/Collector
2035 Alt3	2	815.5	15.3	82.0	171.0	547.2	1.8	0.0	0.2	0.4	1.2	2	10	21	67	99	1	Local Urban
2035 Alt3	3	829.4	4.7	14.3	31.9	778.4	1.8	0.0	0.0	0.1	1.7	1	2	4	94	99	1	Local Urban

PM10

			Emissions by Process (grams/day)					Emissions by Process (pounds/day)				% of Emissions by Process				% of Emissions by Vehicle Type		
Scenario	Link ID	Total (grams/day)	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Total (pounds/day)	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Running Exhaust	Tire Wear	Brake Wear	Road Dust	Non-Truck	Truck	Road Type
2025	1	1551.6	31.5	220.9	93.3	1205.8	3.4	0.1	0.5	0.2	2.7	2	14	6	78	100	0	Major/Collector
2025	2	2255.1	24.2	166.7	250.7	1813.4	5.0	0.1	0.4	0.6	4.0	1	7	11	80	100	0	Local Urban
2025	3	2663.0	7.4	29.2	46.9	2579.6	5.9	0.0	0.1	0.1	5.7	0	1	2	97	100	0	Local Urban
2035 No Build	1	3362.4	36.7	477.1	204.3	2644.3	7.4	0.1	1.1	0.5	5.8	1	14	6	79	99	1	Major/Collector
2035 No Build	2	4900.6	28.2	360.1	535.5	3976.9	10.8	0.1	0.8	1.2	8.8	1	7	11	81	99	1	Local Urban
2035 No Build	3	5828.8	8.7	63.0	100.2	5656.9	12.9	0.0	0.1	0.2	12.5	0	1	2	97	100	0	Local Urban
2035 Alt1	1	3289.3	22.5	467.9	196.3	2602.6	7.3	0.0	1.0	0.4	5.7	1	14	6	79	99	1	Major/Collector
2035 Alt1	2	4804.5	17.5	353.1	519.8	3914.1	10.6	0.0	0.8	1.1	8.6	0	7	11	81	99	1	Local Urban
2035 Alt1	3	5732.0	5.4	61.8	97.2	5567.6	12.6	0.0	0.1	0.2	12.3	0	1	2	97	100	0	Local Urban
2035 Alt2	1	3222.5	35.4	456.2	199.2	2531.7	7.1	0.1	1.0	0.4	5.6	1	14	6	79	99	1	Major/Collector
2035 Alt2	2	4693.6	27.2	344.3	514.5	3807.5	10.3	0.1	0.8	1.1	8.4	1	7	11	81	99	1	Local Urban
2035 Alt2	3	5580.9	8.4	60.3	96.2	5416.1	12.3	0.0	0.1	0.2	11.9	0	1	2	97	99	1	Local Urban
2035 Alt3	1	3073.2	21.3	434.5	191.6	2425.8	6.8	0.0	1.0	0.4	5.3	1	14	6	79	98	2	Major/Collector
2035 Alt3	2	4481.3	16.6	327.9	488.6	3648.2	9.9	0.0	0.7	1.1	8.0	0	7	11	81	99	1	Local Urban
2035 Alt3	3	5343.2	5.1	57.4	91.3	5189.4	11.8	0.0	0.1	0.2	11.4	0	1	2	97	99	1	Local Urban

NOx

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.765E-03	1.895E-03	1.329E-03	1.823E-03	1.237E-03
2	1.325E-03	1.451E-03	1.029E-03	1.396E-03	9.576E-04
3	2.794E-04	3.100E-04	2.211E-04	2.982E-04	2.061E-04

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	3.530E+00	3.789E+00	2.659E+00	3.647E+00	2.474E+00
2	2.650E+00	2.902E+00	2.058E+00	2.792E+00	1.915E+00
3	5.589E-01	6.200E-01	4.422E-01	5.965E-01	4.122E-01

CO

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.867E-02	2.769E-02	2.388E-02	2.646E-02	2.213E-02
2	1.807E-02	2.729E-02	2.387E-02	2.608E-02	2.210E-02
3	4.035E-03	6.081E-03	5.322E-03	5.812E-03	4.931E-03

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	3.733E+01	5.538E+01	4.776E+01	5.293E+01	4.426E+01
2	3.614E+01	5.458E+01	4.774E+01	5.215E+01	4.421E+01
3	8.069E+00	1.216E+01	1.064E+01	1.162E+01	9.861E+00

HC

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.059E-03	1.560E-03	1.212E-03	1.492E-03	1.126E-03
2	1.037E-03	1.583E-03	1.252E-03	1.515E-03	1.164E-03
3	3.070E-04	4.677E-04	3.724E-04	4.474E-04	3.462E-04

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	2.119E+00	3.120E+00	2.425E+00	2.984E+00	2.253E+00
2	2.074E+00	3.167E+00	2.504E+00	3.030E+00	2.329E+00
3	6.140E-01	9.355E-01	7.449E-01	8.949E-01	6.924E-01

TOG

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.139E-03	1.674E-03	1.301E-03	1.601E-03	1.209E-03
2	1.114E-03	1.698E-03	1.343E-03	1.625E-03	1.249E-03
3	3.299E-04	5.019E-04	3.995E-04	4.802E-04	3.716E-04

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	2.278E+00	3.347E+00	2.603E+00	3.202E+00	2.419E+00
2	2.227E+00	3.396E+00	2.686E+00	3.250E+00	2.499E+00
3	6.598E-01	1.004E+00	7.991E-01	9.604E-01	7.431E-01

ROG

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	9.887E-04	1.490E-03	1.186E-03	1.425E-03	1.103E-03
2	9.955E-04	1.554E-03	1.252E-03	1.487E-03	1.165E-03
3	2.943E-04	4.595E-04	3.710E-04	4.396E-04	3.450E-04

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.977E+00	2.980E+00	2.373E+00	2.851E+00	2.205E+00
2	1.991E+00	3.108E+00	2.505E+00	2.974E+00	2.330E+00
3	5.886E-01	9.190E-01	7.420E-01	8.793E-01	6.901E-01

1,3-Butadiene

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.901E-06	2.298E-06	1.673E-06	2.198E-06	1.552E-06
2	1.458E-06	1.778E-06	1.307E-06	1.701E-06	1.215E-06
3	4.402E-07	5.468E-07	4.087E-07	5.232E-07	3.796E-07

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	3.803E-03	4.596E-03	3.345E-03	4.396E-03	3.104E-03
2	2.916E-03	3.555E-03	2.614E-03	3.402E-03	2.429E-03
3	8.804E-04	1.094E-03	8.175E-04	1.046E-03	7.592E-04

Acetaldehyde

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	5.276E-06	6.171E-06	4.316E-06	5.995E-06	4.142E-06
2	4.184E-06	4.984E-06	3.468E-06	4.877E-06	3.392E-06
3	1.278E-06	1.534E-06	1.080E-06	1.497E-06	1.047E-06

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.055E-02	1.234E-02	8.632E-03	1.199E-02	8.285E-03
2	8.368E-03	9.967E-03	6.937E-03	9.754E-03	6.784E-03
3	2.556E-03	3.069E-03	2.160E-03	2.995E-03	2.094E-03

Acrolein

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.984E-07	2.614E-07	1.910E-07	2.497E-07	1.768E-07
2	1.472E-07	1.996E-07	1.491E-07	1.907E-07	1.380E-07
3	4.339E-08	6.111E-08	4.685E-08	5.837E-08	4.336E-08

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	3.967E-04	5.229E-04	3.820E-04	4.995E-04	3.535E-04
2	2.945E-04	3.993E-04	2.983E-04	3.814E-04	2.760E-04
3	8.677E-05	1.222E-04	9.370E-05	1.167E-04	8.672E-05

Benzene

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	2.862E-05	3.793E-05	2.913E-05	3.628E-05	2.705E-05
2	2.557E-05	3.521E-05	2.743E-05	3.368E-05	2.549E-05
3	7.677E-06	1.057E-05	8.262E-06	1.011E-05	7.677E-06

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	5.724E-02	7.587E-02	5.826E-02	7.256E-02	5.410E-02
2	5.114E-02	7.041E-02	5.486E-02	6.736E-02	5.099E-02
3	1.535E-02	2.114E-02	1.652E-02	2.022E-02	1.535E-02

Diesel PM

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	3.991E-06	3.845E-06	1.433E-06	3.950E-06	1.743E-06
2	2.550E-06	2.479E-06	9.785E-07	2.644E-06	1.327E-06
3	5.951E-07	5.715E-07	2.251E-07	6.242E-07	3.236E-07

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	7.982E-03	7.690E-03	2.867E-03	7.901E-03	3.486E-03
2	5.099E-03	4.958E-03	1.957E-03	5.288E-03	2.653E-03
3	1.190E-03	1.143E-03	4.501E-04	1.248E-03	6.471E-04

Ethylbenzene

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.191E-05	1.706E-05	1.341E-05	1.631E-05	1.245E-05
2	1.137E-05	1.694E-05	1.350E-05	1.619E-05	1.254E-05
3	3.379E-06	5.035E-06	4.023E-06	4.814E-06	3.736E-06

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	2.381E-02	3.412E-02	2.683E-02	3.262E-02	2.490E-02
2	2.273E-02	3.387E-02	2.700E-02	3.239E-02	2.508E-02
3	6.759E-03	1.007E-02	8.046E-03	9.628E-03	7.472E-03

Formaldehyde

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.311E-05	1.542E-05	1.088E-05	1.493E-05	1.036E-05
2	1.033E-05	1.234E-05	8.689E-06	1.202E-05	8.406E-06
3	3.150E-06	3.800E-06	2.708E-06	3.693E-06	2.601E-06

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	2.623E-02	3.084E-02	2.176E-02	2.986E-02	2.073E-02
2	2.067E-02	2.469E-02	1.738E-02	2.405E-02	1.681E-02
3	6.300E-03	7.599E-03	5.415E-03	7.386E-03	5.202E-03

Naphthalene

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.699E-06	1.926E-06	1.387E-06	1.841E-06	1.285E-06
2	1.331E-06	1.500E-06	1.082E-06	1.434E-06	1.003E-06
3	4.077E-07	4.613E-07	3.369E-07	4.411E-07	3.124E-07

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	3.397E-03	3.852E-03	2.774E-03	3.682E-03	2.571E-03
2	2.661E-03	3.000E-03	2.163E-03	2.869E-03	2.007E-03
3	8.154E-04	9.226E-04	6.737E-04	8.823E-04	6.249E-04

POM

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	4.165E-07	4.792E-07	3.306E-07	4.603E-07	3.088E-07
2	3.255E-07	3.758E-07	2.597E-07	3.619E-07	2.437E-07
3	1.001E-07	1.167E-07	8.162E-08	1.123E-07	7.642E-08

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	8.329E-04	9.584E-04	6.612E-04	9.206E-04	6.176E-04
2	6.511E-04	7.515E-04	5.194E-04	7.238E-04	4.874E-04
3	2.001E-04	2.334E-04	1.632E-04	2.245E-04	1.528E-04

DEOG

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	5.965E-06	7.351E-06	3.097E-06	8.373E-06	4.869E-06
2	5.585E-06	7.942E-06	3.604E-06	9.159E-06	5.803E-06
3	1.706E-06	2.391E-06	1.095E-06	2.711E-06	1.655E-06

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.193E-02	1.470E-02	6.194E-03	1.675E-02	9.737E-03
2	1.117E-02	1.588E-02	7.208E-03	1.832E-02	1.161E-02
3	3.412E-03	4.783E-03	2.190E-03	5.422E-03	3.310E-03

CO2

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	8.822E+00	1.580E+01	1.446E+01	1.512E+01	1.343E+01
2	5.974E+00	1.072E+01	9.816E+00	1.026E+01	9.117E+00
3	1.314E+00	2.360E+00	2.159E+00	2.259E+00	2.007E+00

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.764E+04	3.161E+04	2.893E+04	3.023E+04	2.685E+04
2	1.195E+04	2.145E+04	1.963E+04	2.052E+04	1.823E+04
3	2.629E+03	4.720E+03	4.319E+03	4.518E+03	4.014E+03

N2O

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.701E-04	2.473E-04	2.044E-04	2.377E-04	1.920E-04
2	1.279E-04	1.868E-04	1.548E-04	1.797E-04	1.456E-04
3	2.695E-05	3.930E-05	3.247E-05	3.786E-05	3.064E-05

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	3.403E-01	4.945E-01	4.088E-01	4.755E-01	3.840E-01
2	2.557E-01	3.735E-01	3.096E-01	3.594E-01	2.912E-01
3	5.390E-02	7.861E-02	6.493E-02	7.572E-02	6.127E-02

CH4

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.105E-04	1.521E-04	9.830E-05	1.454E-04	9.107E-05
2	8.601E-05	1.184E-04	7.716E-05	1.132E-04	7.153E-05
3	2.382E-05	3.216E-05	2.246E-05	3.074E-05	2.082E-05

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	2.210E-01	3.042E-01	1.966E-01	2.907E-01	1.821E-01
2	1.720E-01	2.369E-01	1.543E-01	2.264E-01	1.431E-01
3	4.765E-02	6.431E-02	4.492E-02	6.148E-02	4.164E-02

BC

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	8.101E-06	9.460E-06	5.824E-06	9.112E-06	5.506E-06
2	6.186E-06	7.210E-06	4.466E-06	6.960E-06	4.247E-06
3	1.876E-06	2.192E-06	1.366E-06	2.114E-06	1.295E-06

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.620E-02	1.892E-02	1.165E-02	1.822E-02	1.101E-02
2	1.237E-02	1.442E-02	8.932E-03	1.392E-02	8.494E-03
3	3.751E-03	4.383E-03	2.731E-03	4.228E-03	2.590E-03

HFC

(tons/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	8.805E-06	4.510E-06	3.183E-07	4.334E-06	3.061E-07
2	1.019E-05	5.219E-06	3.684E-07	5.016E-06	3.543E-07
3	2.972E-06	1.522E-06	1.074E-07	1.463E-06	1.033E-07

(pounds/day)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.761E-02	9.019E-03	6.367E-04	8.669E-03	6.123E-04
2	2.038E-02	1.044E-02	7.368E-04	1.003E-02	7.085E-04
3	5.944E-03	3.044E-03	2.149E-04	2.926E-03	2.067E-04

Consumption - Gasoline (gallons/day)

(units)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	9.417E+02	1.705E+03	1.567E+03	1.630E+03	1.452E+03
2	6.336E+02	1.143E+03	1.049E+03	1.093E+03	9.731E+02
3	1.376E+02	2.466E+02	2.260E+02	2.358E+02	2.097E+02

Link ID					

Consumption - Diesel (gallons/day)

(units)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	1.195E+01	1.619E+01	1.104E+01	1.629E+01	1.176E+01
2	8.571E+00	1.188E+01	8.058E+00	1.204E+01	8.771E+00
3	1.955E+00	2.694E+00	1.809E+00	2.747E+00	2.002E+00

Link ID					

Consumption - Natural Gas (diesel-equivalent gallons/day)

(units)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	2.291E-01	5.985E-01	4.905E-02	5.716E-01	4.540E-02
2	2.089E-01	5.445E-01	5.089E-02	5.201E-01	4.710E-02
3	6.988E-02	1.821E-01	1.463E-02	1.739E-01	1.354E-02

Link ID					

Consumption - Electricity (kilowatt-hours/day)

(units)

Link ID	2025	2035 No Build	2035 Alt1	2035 Alt2	2035 Alt3
1	6.844E+02	2.124E+03	2.353E+03	2.036E+03	2.223E+03
2	5.070E+02	1.591E+03	1.763E+03	1.525E+03	1.663E+03
3	9.771E+01	3.073E+02	3.399E+02	2.946E+02	3.210E+02

Link ID					

Appendix B4. Health Risk Assessment and PM 2.5 Concentration Evaluation

Summary of PM2.5 Risk

	Unmitigated	Mitigated
	PM2.5 (ug/m3)	PM2.5 (ug/m3)
Construction North Lot	0.26	0.20
Construction Main Lot with HP	0.19	0.14
Construction Main Lot with ACP	0.16	0.13
BAAQMD Threshold	0.3	0.3

Summary of Cancer and Chronic Risk

	Unmitigated			Mitigated		
	Cancer Risk Resident	Cancer Risk Worker	Chronic HI	Cancer Risk Resident	Cancer Risk Worker	Chronic HI
Construciton with HP	16.67	1.33	0.023	6.93	0.42	0.009
Construciton with ACP	14.33	1.05	0.023	6.57	0.31	0.009
BAAQMD Threshold	10	10	1	10	10	1

PM2.5 - Unmitigated

North Lot

Total modeled emissions =		1	g/s
Modeled Max Impact @ 1 g/s (annual)		320.30	µg/m3

PM2.5 Emissions 2033	0.028	tons/year
PM2.5 Emissions 2034	0.020	tons/year

PM2.5 Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
0.000799	320.30	0.26
0.000570	320.30	0.18

Main Lot HP

Total modeled emissions =		1	g/s
Modeled Max Impact @ 1 g/s (annual)		68.11	µg/m3

PM2.5 Emissions 2037	0.095	tons/year
PM2.5 Emissions 2038	0.044	tons/year
PM2.5 Emissions 2039	0.029	tons/year
PM2.5 Emissions 2040	0.004	tons/year

Construction Year	PM2.5 Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
2037	0.0027	68.11	0.19
2038	0.0013	68.11	0.09
2039	0.0008	68.11	0.06
2040	0.0001	68.11	0.01

Main Lot ACP

Total modeled emissions =		1	g/s
Modeled Max Impact @ 1 g/s (annual)		68.11	µg/m3

PM2.5 Emissions 2037	0.0837	tons/year
PM2.5 Emissions 2038	0.0407	tons/year
PM2.5 Emissions 2039	0.0289	tons/year
PM2.5 Emissions 2040	0.0036	tons/year

Construction Year	PM2.5 Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
2037	0.0024	68.11	0.16
2038	0.0012	68.11	0.08
2039	0.0008	68.11	0.06
2040	0.0001	68.11	0.01

PM2.5 Mitigated

North Lot

Total modeled emissions =		1	g/s
Modeled Max Impact @ 1 g/s (annual)		320.30	µg/m3

PM2.5 Emissions 2033	0.021	tons/year
PM2.5 Emissions 2034	0.013	tons/year

PM2.5 Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
0.000610	320.30	0.20
0.000371	320.30	0.12

Main Lot HP

Total modeled emissions =		1	g/s
Modeled Max Impact @ 1 g/s (annual)		68.11	µg/m3

PM2.5 Emissions 2037	0.069	tons/year
PM2.5 Emissions 2038	0.024	tons/year
PM2.5 Emissions 2039	0.022	tons/year
PM2.5 Emissions 2040	0.003	tons/year

Construction Year	PM2.5 Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
2037	0.001993	68.11	0.14
2038	0.000704	68.11	0.05
2039	0.000633	68.11	0.04
2040	0.000094	68.11	0.01

Main Lot ACP

Total modeled emissions =		1	g/s
Modeled Max Impact @ 1 g/s (annual)		68.11	µg/m3

PM2.5 Emissions 2037	0.067	tons/year
PM2.5 Emissions 2038	0.024	tons/year
PM2.5 Emissions 2039	0.022	tons/year
PM2.5 Emissions 2040	0.003	tons/year

Construction Year	PM2.5 Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
2037	0.001923	68.11	0.13
2038	0.000681	68.11	0.05
2039	0.000631	68.11	0.04
2040	0.000094	68.11	0.01

Cancer Impacts due to Construction Diesel Particulate Matter - North Lot Unmitigated

Year	2033	2034
DPM (ton/year)	0.01110	0.01371

DPM Emissions	0.0124	tons/year

DPM Emission Rate in (g/s)	PMI Unit Impact GLC ($\mu g/m^3$)/(g/s)	PMI GLC ($\mu g/m^3$)
0.000357	320.300000	0.114297

DPM Emission Rate in (g/s)	Resident Unit Impact GLC ($\mu g/m^3$)/(g/s)	Resident GLC ($\mu g/m^3$)
0.000357	58.720000	0.020954

DPM Emission Rate in (g/s)	Worker Unit Impact GLC ($\mu g/m^3$)/(g/s)	Worker GLC ($\mu g/m^3$)
0.000357	320.300000	0.114297

Total modeled emissions =	1	g/s

Modeled Max Impact @ 1 g/s (annual)		
PMI Impact =	320.30	µg/m3
Residential Impact =	58.72	µg/m3
Worker Impact =	320.30	µg/m3

Calculated Impacts based on Model Output @ 1 g/s

Unit PMI Impact =	320.3	µg/m3
Unit Residential Max Impact =	58.7	µg/m3
Unit Worker Max Impact =	320.3	µg/m3

Calculated concentrations based on model output and CalEEMod emissions

Maximum annual impact of annualized project emissions

PMI	0.11430	$\mu g/m^3$	Diesel PM
MEIR	0.02095	$\mu g/m^3$	Diesel PM
Sensitive	0.02095	$\mu g/m^3$	Diesel PM
MEIW	0.11430	$\mu g/m^3$	Diesel PM

Demolition and Construction HRA per the 2015 OEHHA Guidance

Residential Calculation Procedure for Cancer Risks

4 years old when main lot starts

PMI	born in 203	born in 2034	Born in 2033	born in 2032	born in 2031																									
Age when Exposure Ends	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	3.96E-05	1.20E-04	1.20E-04	9.45E-05	9.45E-05	9.45E-05	9.45E-05	9.45E-05	9.45E-05	9.45E-05	8.17E-05	8.17E-05	8.17E-05	8.17E-05	8.17E-05	8.17E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05	3.68E-05
Risk per year	1.32E-06	1.60E-05	1.60E-05	3.21E-06	3.21E-06	3.21E-06	3.21E-06	3.21E-06	3.21E-06	3.21E-06	2.77E-06	2.77E-06	2.77E-06	2.77E-06	2.77E-06	2.77E-06	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07	4.22E-07
Rolling 2-year Risk [a]		1.73E-05	3.33E-05	1.92E-05	6.41E-06	6.41E-06	6.41E-06	6.41E-06	6.41E-06	6.41E-06	5.98E-06	5.55E-06	5.55E-06	5.55E-06	5.55E-06	5.55E-06	3.20E-06	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07	8.43E-07
2-year Cumulative Risk per Million		17.30	33.27	19.18	6.41	6.41	6.41	6.41	6.41	6.41	5.98	5.55	5.55	5.55	5.55	5.55	3.20	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84

MEIR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	7.26E-06	2.19E-05	2.19E-05	1.73E-05	1.73E-05	1.73E-05	1.73E-05	1.73E-05	1.73E-05	1.73E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06
Risk	2.42E-07	2.93E-06	2.93E-06	5.88E-07	5.88E-07	5.88E-07	5.88E-07	5.88E-07	5.88E-07	5.88E-07	5.09E-07	5.09E-07	5.09E-07	5.09E-07	5.09E-07	5.09E-07	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08
Rolling 2-year Risk [a]		3.17E-06	6.10E-06	3.52E-06	1.18E-06	1.18E-06	1.18E-06	1.18E-06	1.18E-06	1.18E-06	1.10E-06	1.02E-06	1.02E-06	1.02E-06	1.02E-06	1.02E-06	5.86E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07
2-year Cumulative Risk per Million		3.17	6.10	3.52	1.18	1.18	1.18	1.18	1.18	1.18	1.10	1.02	1.02	1.02	1.02	1.02	0.59	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

MESR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	7.26E-06	2.19E-05	2.19E-05	1.73E-05	1.73E-05	1.73E-05	1.73E-05	1.73E-05	1.73E-05	1.73E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	1.50E-05	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06	6.74E-06
Risk	2.42E-07	2.93E-06	2.93E-06	5.88E-07	5.88E-07	5.88E-07	5.88E-07	5.88E-07	5.88E-07	5.88E-07	5.09E-07	5.09E-07	5.09E-07	5.09E-07	5.09E-07	5.09E-07	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08	7.73E-08
Rolling 2-year Risk [a]		3.17E-06	6.10E-06	3.52E-06	1.18E-06	1.18E-06	1.18E-06	1.18E-06	1.18E-06	1.18E-06	1.10E-06	1.02E-06	1.02E-06	1.02E-06	1.02E-06	1.02E-06	5.86E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07	1.55E-07
2-year Cumulative Risk per Million		3.17	6.10	3.52	1.18	1.18	1.18	1.18	1.18	1.18	1.10	1.02	1.02	1.02	1.02	1.02	0.59	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15

Worker Calculation Procedure for Cancer Risks

MEIW

Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Dose (mg/kg/day)	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05	1.79E-05
Risk	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07	2.81E-07
Rolling 2-year Risk [a]	2.81E-07	5.62E-07	8.43E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07	5.62E-07
2-year Cumulative Risk per Million	0.28	0.56	0.84	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56

Note:

[a] Cancer risk was summed on a 5-year rolling basis to conservatively mirror the duration of project construction.

Cancer Impacts due to Construction Diesel Particulate Matter - North Lot Mitigated

Year	2033	2034
DPM (ton/year)	0.00371	0.00581

DPM Emissions	0.0048	tons/year

Total modeled emissions =	1	g/s

Calculated concentrations based on model output and CalEEMod emissions

Maximum annual impact of annualized project emissions

PMI	0.04387	µg/m^3	Diesel PM
MEIR	0.00804	µg/m^3	Diesel PM
Sensitive	0.00804	µg/m^3	Diesel PM
MEIW	0.04387	µg/m^3	Diesel PM

DPM Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
0.000137	320.30	0.043874

DPM Emission Rate in (g/s)	Resident Unit Impact GLC (µg/m^3)/(g/s)	Resident GLC (µg/m^3)
0.000137	58.72	0.008043

DPM Emission Rate in (g/s)	Worker Unit Impact GLC (µg/m^3)/(g/s)	Worker GLC (µg/m^3)
0.000137	320.30	0.043874

Modeled Max Impact @ 1 g/s (annual)		
PMI Impact =	320.30	µg/m3
Residential Impact =	58.72	µg/m3
Worker Impact =	320.30	µg/m3

Calculated Impacts based on Model Output @ 1 g/s

Unit PMI Impact =	320.3	µg/m3
Unit Residential Max Impact =	58.7	µg/m3
Unit Worker Max Impact =	320.3	µg/m3

Demolition and Construction HRA per the 2015 OEHHA Guidance

Residential Calculation Procedure for Cancer Risks

4 years old when main lot starts

PMI	born in 203	born in 2034	Born in 2033	born in 2032	born in 2031																									
Age when Exposure Ends	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	1.52E-05	4.59E-05	4.59E-05	3.63E-05	3.63E-05	3.63E-05	3.63E-05	3.63E-05	3.63E-05	3.63E-05	3.14E-05	3.14E-05	3.14E-05	3.14E-05	3.14E-05	3.14E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05	1.41E-05
Risk per year	5.08E-07	6.13E-06	6.13E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.23E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.07E-06	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07	1.62E-07
Rolling 2-year Risk [a]	NA	6.64E-06	1.28E-05	7.36E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.46E-06	2.30E-06	2.13E-06	2.13E-06	2.13E-06	2.13E-06	2.13E-06	1.23E-06	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07	3.24E-07
2-year Cumulative Risk per Million	NA	6.64	12.77	7.36	2.46	2.46	2.46	2.46	2.46	2.46	2.30	2.13	2.13	2.13	2.13	2.13	1.23	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32

MEIR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	2.79E-06	8.42E-06	8.42E-06	6.65E-06	6.65E-06	6.65E-06	6.65E-06	6.65E-06	6.65E-06	6.65E-06	5.75E-06	5.75E-06	5.75E-06	5.75E-06	5.75E-06	5.75E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06
Risk	9.31E-08	1.12E-06	1.12E-06	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	1.95E-07	1.95E-07	1.95E-07	1.95E-07	1.95E-07	1.95E-07	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08
Rolling 2-year Risk [a]	NA	1.22E-06	2.34E-06	1.35E-06	4.51E-07	4.51E-07	4.51E-07	4.51E-07	4.51E-07	4.51E-07	4.21E-07	3.91E-07	3.91E-07	3.91E-07	3.91E-07	3.91E-07	2.25E-07	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08
2-year Cumulative Risk per Million	NA	1.22	2.34	1.35	0.45	0.45	0.45	0.45	0.45	0.45	0.42	0.39	0.39	0.39	0.39	0.39	0.22	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

MESR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	2.79E-06	8.42E-06	8.42E-06	6.65E-06	6.65E-06	6.65E-06	6.65E-06	6.65E-06	6.65E-06	6.65E-06	5.75E-06	5.75E-06	5.75E-06	5.75E-06	5.75E-06	5.75E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06	2.59E-06
Risk	9.31E-08	1.12E-06	1.12E-06	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	2.26E-07	1.95E-07	1.95E-07	1.95E-07	1.95E-07	1.95E-07	1.95E-07	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08	2.97E-08
Rolling 2-year Risk [a]	NA	1.22E-06	2.34E-06	1.35E-06	4.51E-07	4.51E-07	4.51E-07	4.51E-07	4.51E-07	4.51E-07	4.21E-07	3.91E-07	3.91E-07	3.91E-07	3.91E-07	3.91E-07	2.25E-07	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08	5.93E-08
2-year Cumulative Risk per Million	NA	1.22	2.34	1.35	0.45	0.45	0.45	0.45	0.45	0.45	0.42	0.39	0.39	0.39	0.39	0.39	0.22	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06

Worker Calculation Procedure for Cancer Risks

MEIW

Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Dose (mg/kg/day)	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06	6.86E-06
Risk	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07
Rolling 2-year Risk [a]	1.08E-07	2.16E-07	3.23E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07	2.16E-07
2-year Cumulative Risk per Million	0.11	0.22	0.32	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22

Note:

[a] Cancer risk was summed on a 5-year rolling basis to conservatively mirror the duration of project construction.

Cancer Impacts due to Construction Diesel Particulate Matter - Main HP Unmitigated

Year	2037	2038	2039	2040
Onsite DPM (ton/year)	0.0466	0.0354	0.0176	0.0018

DPM Emissions		
	0.0253	tons/year

Total modeled emissions =	1	g/s

Calculated concentrations based on model output and CalEEMod emissions

Maximum annual impact of annualized project emissions

PMI	0.0497	µg/m^3	Diesel PM
MEIR	0.0497	µg/m^3	Diesel PM
Sensitive	0.0497	µg/m^3	Diesel PM
MEIW	0.0497	µg/m^3	Diesel PM

DPM Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
0.000729	68.11	0.049668

Modeled Max Impact @ 1 g/s (annual)		
PMI Impact =	68.11	µg/m3
Residential Impact =	68.11	µg/m3
Worker Impact =	68.11	µg/m3

DPM Emission Rate in (g/s)	Resident Unit Impact GLC (µg/m^3)/(g/s)	Resident GLC (µg/m^3)
0.000729	68.11	0.049668

Calculated Impacts based on Model Output @ 1 g/s

Unit PMI Impact =	68.1	µg/m3
Unit Residential Max Impact =	68.1	µg/m3
Unit Worker Max Impact =	68.1	µg/m3

Demolition and Construction HRA per the 2015 OEHHA Guidance

Residential Calculation Procedure for Cancer Risks

DPM Emission Rate in (g/s)	Worker Unit Impact GLC (µg/m^3)/(g/s)	Worker GLC (µg/m^3)
0.000729	68.11	0.049668

PMI	born in 2040 2040	born in 2039 2040	born in 2038 2040	born in 2037 2040	born in 2036 2040	born in 2035 2040	born in 2034 2040	born in 2033 2040	born in 2032 2040	born in 2031 2040	2040	2040	2040	2040

Age when Exposure Ends	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	1.72E-05	5.20E-05	5.20E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05
Risk per year	5.75E-07	6.94E-06	6.94E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07
Rolling 4-year Risk [a]		7.52E-06	1.45E-05	1.59E-05	1.67E-05	1.11E-05	5.57E-06	5.57E-06	5.57E-06	5.57E-06	5.39E-06	5.20E-06	5.01E-06	4.82E-06	4.82E-06	4.82E-06	3.80E-06	2.78E-06	1.76E-06	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07
4-year Cumulative Risk per Million		7.52	14.46	15.85	16.67	11.12	5.57	5.57	5.57	5.57	5.39	5.20	5.01	4.82	4.82	4.82	3.80	2.78	1.76	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73

MEIR		7.52	14.46	15.85	16.67	11.12	5.57	6.64 12.21	12.77 18.35	7.36 12.94	2.46 7.85	2.46 7.66	2.46 7.47	2.46 7.28	2.46 7.28	2.46 7.28	2.30 6.10	2.13 4.91	2.13 3.89	2.13 2.86	2.13 2.86	2.13 2.86	1.23 1.96	0.32 1.06	0.32 1.06	0.32 1.06	0.32 1.06	0.32 1.06	0.32 1.06	0.32 1.06	0.32 1.06

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	1.72E-05	5.20E-05	5.20E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05
Risk	5.75E-07	6.94E-06	6.94E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07
Rolling 4-year Risk a		7.52E-06	1.45E-05	1.59E-05	1.67E-05	1.11E-05	5.57E-06	5.57E-06	5.57E-06	5.57E-06	5.39E-06	5.20E-06	5.01E-06	4.82E-06	4.82E-06	4.82E-06	3.80E-06	2.78E-06	1.76E-06	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07
4-year Cumulative Risk per Million		7.52	14.46	15.85	16.67	11.12	5.57	5.57	5.57	5.57	5.39	5.20	5.01	4.82	4.82	4.82	3.80	2.78	1.76	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73

MESR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	1.72E-05	5.20E-05	5.20E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	4.11E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	3.55E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05	1.60E-05
Risk	5.75E-07	6.94E-06	6.94E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.39E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.21E-06	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07	1.83E-07
Rolling 4-year Risk a		7.52E-06	1.45E-05	1.59E-05	1.67E-05	1.11E-05	5.57E-06	5.57E-06	5.57E-06	5.57E-06	5.39E-06	5.20E-06	5.01E-06	4.82E-06	4.82E-06	4.82E-06	3.80E-06	2.78E-06	1.76E-06	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07	7.33E-07
4-year Cumulative Risk per Million		7.52	14.46	15.85	16.67	11.12	5.57	5.57	5.57	5.57	5.39	5.20	5.01	4.82	4.82	4.82	3.80	2.78	1.76	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73

Worker Calculation Procedure for Cancer Risks

MEIW

Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Dose (mg/kg/day)	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06	7.77E-06
Risk	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07	1.22E-07
Rolling 4-year Risk a	1.22E-07	2.44E-07	3.66E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07	4.88E-07
4-year Cumulative Risk per Million	0.12	0.24	0.37	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49

Note:

[a] Cancer risk was summed on a 4-year rolling basis to conservatively mirror the duration of project construction.

Cancer Impacts due to Construction Diesel Particulate Matter - Main HP Mitigated

Year	2037	2038	2039	2040
Onsite DPM (ton/year)	0.0178	0.0136	0.0094	0.0013

DPM Emissions		
	0.0105	tons/year

Total modeled emissions =	1	g/s

Calculated concentrations based on model output and CalEEMod emissions

Maximum annual impact of annualized project emissions

PMI	0.0206	µg/m^3	Diesel PM
MEIR	0.0206	µg/m^3	Diesel PM
Sensitive	0.0206	µg/m^3	Diesel PM
MEIW	0.0206	µg/m^3	Diesel PM

DPM Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
0.000303	68.11	0.020646

Modeled Max Impact @ 1 g/s (annual)		
PMI Impact =	68.11	µg/m3
Residential Impact =	68.11	µg/m3
Worker Impact =	68.11	µg/m3

DPM Emission Rate in (g/s)	Resident Unit Impact GLC (µg/m^3)/(g/s)	Resident GLC (µg/m^3)
0.000303	68.11	0.020646

Calculated Impacts based on Model Output @ 1 g/s

Unit PMI Impact =	68.1	µg/m3
Unit Residential Max Impact =	68.1	µg/m3
Unit Worker Max Impact =	68.1	µg/m3

Demolition and Construction HRA per the 2015 OEHHA Guidance

Residential Calculation Procedure for Cancer Risks

DPM Emission Rate in (g/s)	Worker Unit Impact GLC (µg/m^3)/(g/s)	Worker GLC (µg/m^3)
0.000303	68.11	0.020646

PMI

		born in 2040	born in 2039	born in 2038	born in 2037	born in 2036	born in 2035	born in 2034	born in 2033	born in 2032	born in 2031																				
		2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040																
Age when Exposure Ends	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	7.16E-06	2.16E-05	2.16E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06
Risk per year	2.39E-07	2.89E-06	2.89E-06	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08
Rolling 4-year Risk [a]		3.12E-06	6.01E-06	6.59E-06	6.93E-06	4.62E-06	2.32E-06	2.32E-06	2.32E-06	2.32E-06	2.24E-06	2.16E-06	2.08E-06	2.00E-06	2.00E-06	2.00E-06	1.58E-06	1.15E-06	7.30E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07
4-year Cumulative Risk per Million		3.12	6.01	6.59	6.93	4.62	2.32	2.32	2.32	2.32	2.24	2.16	2.08	2.00	2.00	2.00	1.58	1.15	0.73	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

MEIR

		3.12	6.01	6.59	6.93	4.62	2.32	6.64 8.96	12.77 15.09	7.36 9.68	2.46 4.70	2.46 4.62	2.46 4.54	2.46 4.47	2.46 4.47	2.46 4.47	2.30 3.88	2.13 3.28	2.13 2.86	2.13 2.43	2.13 2.43	2.13 2.43	1.23 1.53	0.32 0.63	0.32 0.63	0.32 0.63	0.32 0.63	0.32 0.63	0.32 0.63	0.32 0.63	0.32 0.63
Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	7.16E-06	2.16E-05	2.16E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06
Risk	2.39E-07	2.89E-06	2.89E-06	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08
Rolling 4-year Risk a		3.12E-06	6.01E-06	6.59E-06	6.93E-06	4.62E-06	2.32E-06	2.32E-06	2.32E-06	2.32E-06	2.24E-06	2.16E-06	2.08E-06	2.00E-06	2.00E-06	2.00E-06	1.58E-06	1.15E-06	7.30E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07
4-year Cumulative Risk per Million		3.12	6.01	6.59	6.93	4.62	2.32	2.32	2.32	2.32	2.24	2.16	2.08	2.00	2.00	2.00	1.58	1.15	0.73	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

MESR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	7.16E-06	2.16E-05	2.16E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.71E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	1.48E-05	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06	6.64E-06
Risk	2.39E-07	2.89E-06	2.89E-06	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.79E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	5.01E-07	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08	7.62E-08
Rolling 4-year Risk a		3.12E-06	6.01E-06	6.59E-06	6.93E-06	4.62E-06	2.32E-06	2.32E-06	2.32E-06	2.32E-06	2.24E-06	2.16E-06	2.08E-06	2.00E-06	2.00E-06	2.00E-06	1.58E-06	1.15E-06	7.30E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07	3.05E-07
4-year Cumulative Risk per Million		3.12	6.01	6.59	6.93	4.62	2.32	2.32	2.32	2.32	2.24	2.16	2.08	2.00	2.00	2.00	1.58	1.15	0.73	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

Worker Calculation Procedure for Cancer Risks

MEIW

Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Dose (mg/kg/day)	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06	3.23E-06
Risk	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08	5.07E-08
Rolling 4-year Risk a	5.07E-08	1.01E-07	1.52E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07	2.03E-07
4-year Cumulative Risk per Million	0.05	0.10	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

Note:

[a] Cancer risk was summed on a 4-year rolling basis to conservatively mirror the duration of project construction.

Cancer Impacts due to Construction Diesel Particulate Matter - Main ACP Unmitigated

Year	2037	2038	2039	2040
Onsite DPM (ton/year)	0.0354	0.0324	0.0176	0.0018

DPM Emissions		
	0.0218	tons/year

Total modeled emissions =	1	g/s

Modeled Max Impact @ 1 g/s (annual)		
PMI Impact =	68.11	µg/m3
Residential Impact =	68.11	µg/m3
Worker Impact =	68.11	µg/m3

Calculated concentrations based on model output and CalEEMod emissions

Maximum annual impact of annualized project emissions

PMI	0.04270	µg/m^3	Diesel PM
MEIR	0.04270	µg/m^3	Diesel PM
Sensitive	0.04270	µg/m^3	Diesel PM
MEIW	0.04270	µg/m^3	Diesel PM

DPM Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
0.000627	68.11	0.042704

DPM Emission Rate in (g/s)	Resident Unit Impact GLC (µg/m^3)/(g/s)	Resident GLC (µg/m^3)
0.000627	68.11	0.042704

DPM Emission Rate in (g/s)	Worker Unit Impact GLC (µg/m^3)/(g/s)	Worker GLC (µg/m^3)
0.000627	68.11	0.042704

Calculated Impacts based on Model Output @ 1 g/s

Unit PMI Impact =	68.1	µg/m3
Unit Residential Max Impact =	68.1	µg/m3
Unit Worker Max Impact =	68.1	µg/m3

Demolition and Construction HRA per the 2015 OEHHA Guidance

Residential Calculation Procedure for Cancer Risks

PMI

Age when Exposure Ends	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	1.48E-05	4.47E-05	4.47E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05
Risk per year	4.94E-07	5.97E-06	5.97E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
Rolling 4-year Risk [a]		6.46E-06	1.24E-05	1.36E-05	1.43E-05	9.56E-06	4.79E-06	4.79E-06	4.79E-06	4.79E-06	4.63E-06	4.47E-06	4.31E-06	4.15E-06	4.15E-06	4.15E-06	3.27E-06	2.39E-06	1.51E-06	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07
4-year Cumulative Risk per Million		6.46	12.43	13.63	14.33	9.56	4.79	4.79	4.79	4.79	4.63	4.47	4.31	4.15	4.15	4.15	3.27	2.39	1.51	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63

MEIR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	1.48E-05	4.47E-05	4.47E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05
Risk	4.94E-07	5.97E-06	5.97E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
Rolling 4-year Risk [a]		6.46E-06	1.24E-05	1.36E-05	1.43E-05	9.56E-06	4.79E-06	4.79E-06	4.79E-06	4.79E-06	4.63E-06	4.47E-06	4.31E-06	4.15E-06	4.15E-06	4.15E-06	3.27E-06	2.39E-06	1.51E-06	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07
4-year Cumulative Risk per Million		6.46	12.43	13.63	14.33	9.56	4.79	4.79	4.79	4.79	4.63	4.47	4.31	4.15	4.15	4.15	3.27	2.39	1.51	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63

MESR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	1.48E-05	4.47E-05	4.47E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.53E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	3.05E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05	1.37E-05
Risk	4.94E-07	5.97E-06	5.97E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.20E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.04E-06	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07	1.58E-07
Rolling 4-year Risk [a]		6.46E-06	1.24E-05	1.36E-05	1.43E-05	9.56E-06	4.79E-06	4.79E-06	4.79E-06	4.79E-06	4.63E-06	4.47E-06	4.31E-06	4.15E-06	4.15E-06	4.15E-06	3.27E-06	2.39E-06	1.51E-06	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07	6.30E-07
4-year Cumulative Risk per Million		6.46	12.43	13.63	14.33	9.56	4.79	4.79	4.79	4.79	4.63	4.47	4.31	4.15	4.15	4.15	3.27	2.39	1.51	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63

Worker Calculation Procedure for Cancer Risks

MEIW

Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Dose (mg/kg/day)	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06	6.68E-06
Risk	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07	1.05E-07
Rolling 4-year Risk a	1.05E-07	2.10E-07	3.15E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07	2.10E-07
4-year Cumulative Risk per Million	0.10	0.21	0.31	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21

Note:

[a] Cancer risk was summed on a 5-year rolling basis to conservatively mirror the duration of project construction.

Cancer Impacts due to Construction Diesel Particulate Matter - Main ACP Mitigated

Year	2037	2038	2039	2040
Onsite DPM (ton/year)	0.0161	0.0131	0.0094	0.0013

DPM Emissions		
	0.0100	tons/year

Total modeled emissions =	1	g/s

Modeled Max Impact @ 1 g/s (annual)		
PMI Impact =	68.11	µg/m3
Residential Impact =	68.11	µg/m3
Worker Impact =	68.11	µg/m3

Calculated concentrations based on model output and CalEEMod emissions

Maximum annual impact of annualized project emissions

PMI	0.01958	µg/m^3	Diesel PM
MEIR	0.01958	µg/m^3	Diesel PM
Sensitive	0.01958	µg/m^3	Diesel PM
MEIW	0.01958	µg/m^3	Diesel PM

DPM Emission Rate in (g/s)	PMI Unit Impact GLC (µg/m^3)/(g/s)	PMI GLC (µg/m^3)
0.000288	68.11	0.019582

DPM Emission Rate in (g/s)	Resident Unit Impact GLC (µg/m^3)/(g/s)	Resident GLC (µg/m^3)
0.000288	68.11	0.019582

DPM Emission Rate in (g/s)	Worker Unit Impact GLC (µg/m^3)/(g/s)	Worker GLC (µg/m^3)
0.000288	68.11	0.019582

Calculated Impacts based on Model Output @ 1 g/s

Unit PMI Impact =	68.1	µg/m3
Unit Residential Max Impact =	68.1	µg/m3
Unit Worker Max Impact =	68.1	µg/m3

Demolition and Construction HRA per the 2015 OEHHA Guidance

Residential Calculation Procedure for Cancer Risks

PMI

Age when Exposure Ends	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	6.79E-06	2.05E-05	2.05E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06
Risk per year	2.27E-07	2.74E-06	2.74E-06	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08
Rolling 4-year Risk [a]		2.96E-06	5.70E-06	6.25E-06	6.57E-06	4.39E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.12E-06	2.05E-06	1.98E-06	1.90E-06	1.90E-06	1.90E-06	1.50E-06	1.10E-06	6.92E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07
4-year Cumulative Risk per Million		2.96	5.70	6.25	6.57	4.39	2.20	2.20	2.20	2.20	2.12	2.05	1.98	1.90	1.90	1.90	1.50	1.10	0.69	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29

MEIR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	6.79E-06	2.05E-05	2.05E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06
Risk	2.27E-07	2.74E-06	2.74E-06	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08
Rolling 4-year Risk [a]		2.96E-06	5.70E-06	6.25E-06	6.57E-06	4.39E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.12E-06	2.05E-06	1.98E-06	1.90E-06	1.90E-06	1.90E-06	1.50E-06	1.10E-06	6.92E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07
4-year Cumulative Risk per Million		2.96	5.70	6.25	6.57	4.39	2.20	2.20	2.20	2.20	2.12	2.05	1.98	1.90	1.90	1.90	1.50	1.10	0.69	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29

MESR

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Dose (mg/kg/day)	6.79E-06	2.05E-05	2.05E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.62E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	1.40E-05	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06	6.30E-06
Risk	2.27E-07	2.74E-06	2.74E-06	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	5.49E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	4.75E-07	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08	7.22E-08
Rolling 4-year Risk [a]		2.96E-06	5.70E-06	6.25E-06	6.57E-06	4.39E-06	2.20E-06	2.20E-06	2.20E-06	2.20E-06	2.12E-06	2.05E-06	1.98E-06	1.90E-06	1.90E-06	1.90E-06	1.50E-06	1.10E-06	6.92E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07	2.89E-07
4-year Cumulative Risk per Million		2.96	5.70	6.25	6.57	4.39	2.20	2.20	2.20	2.20	2.12	2.05	1.98	1.90	1.90	1.90	1.50	1.10	0.69	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29

Worker Calculation Procedure for Cancer Risks

MEIW

Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Dose (mg/kg/day)	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06	3.06E-06
Risk	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08	4.81E-08
Rolling 4-year Risk a	4.81E-08	9.63E-08	1.44E-07	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08	9.63E-08
4-year Cumulative Risk per Million	0.05	0.10	0.14	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10

Note:

[a] Cancer risk was summed on a 5-year rolling basis to conservatively mirror the duration of project construction.

Total Cumulative Cancer Risk with HP - Unmitigated

PMI

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	17.30	12.77	7.36	2.46	2.46	2.46	2.46	2.46	2.46	2.30	2.13	2.13	2.13	2.13	2.13	1.23	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Risks from 4-year Exposure from Main Lot HP (per million)	NA	3.12	14.46	15.85	16.67	11.12	5.57	5.57	5.57	5.57	5.39	5.20	5.01	4.82	4.82	4.82	3.80	2.78	1.76	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Total Cumulative Risk with HP (per Million)	NA	3.12	14.46	15.85	16.67	11.12	5.57	22.87	18.35	12.94	7.85	7.66	7.47	7.28	7.28	7.28	6.10	4.91	3.89	2.86	2.86	2.86	1.96	1.06	1.06	1.06	1.06	1.06	1.06	1.06	1.06

MEIR

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	3.17	6.10	3.52	1.18	1.18	1.18	1.18	1.18	1.18	1.10	1.02	1.02	1.02	1.02	1.02	0.59	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Risks from 4-year Exposure from Main Lot HP (per million)	NA	7.52	14.46	15.85	16.67	11.12	5.57	5.57	5.57	5.57	5.39	5.20	5.01	4.82	4.82	4.82	3.80	2.78	1.76	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Total Cumulative Risk with HP (per Million)	NA	7.52	14.46	15.85	16.67	11.12	5.57	8.75	11.67	9.09	6.56	6.37	6.19	6.00	6.00	6.00	4.90	3.80	2.77	1.75	1.75	1.75	1.32	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89

MESR

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	3.17	6.10	3.52	1.18	1.18	1.18	1.18	1.18	1.18	1.10	1.02	1.02	1.02	1.02	1.02	0.59	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Risks from 4-year Exposure from Main Lot HP (per million)	NA	7.52	14.46	15.85	16.67	11.12	5.57	5.57	5.57	5.57	5.39	5.20	5.01	4.82	4.82	4.82	3.80	2.78	1.76	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73
Total Cumulative Risk with HP (per Million)	NA	7.52	14.46	15.85	16.67	11.12	5.57	8.75	11.67	9.09	6.56	6.37	6.19	6.00	6.00	6.00	4.90	3.80	2.77	1.75	1.75	1.75	1.32	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89

Worker Calculation Procedure for Cancer Risks

MEIW

Age when Exposure Ends at 2040	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Risks from 2-year Exposure from North Lot (per million)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.84	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Risks from 4-year Exposure from Main Lot HP (per million)	0.12	0.24	0.37	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Total Cumulative Risk with HP (per Million)	0.12	0.24	0.37	0.49	0.49	0.49	0.49	1.05	1.33	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.05

Total Cumulative Cancer Risk with HP - Mitigated

PMI

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	6.64	12.77	7.36	2.46	2.46	2.46	2.46	2.46	2.46	2.30	2.13	2.13	2.13	2.13	2.13	1.23	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Risks from 4-year Exposure from Main Lot HP (per million)	NA	3.12	6.01	6.59	6.93	4.62	2.32	2.32	2.32	2.32	2.24	2.16	2.08	2.00	2.00	2.00	1.58	1.15	0.73	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total Cumulative Risk with HP (per Million)	NA	3.12	6.01	6.59	6.93	4.62	2.32	8.96	15.09	9.68	4.70	4.62	4.54	4.47	4.47	4.47	3.88	3.28	2.86	2.43	2.43	2.43	1.53	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63

MEIR

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	1.22	2.34	1.35	0.45	0.45	0.45	0.45	0.45	0.45	0.42	0.39	0.39	0.39	0.39	0.39	0.22	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Risks from 4-year Exposure from Main Lot HP (per million)	NA	3.12	6.01	6.59	6.93	4.62	2.32	2.32	2.32	2.32	2.24	2.16	2.08	2.00	2.00	2.00	1.58	1.15	0.73	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total Cumulative Risk with HP (per Million)	NA	3.12	6.01	6.59	6.93	4.62	2.32	3.53	4.66	3.67	2.69	2.61	2.53	2.46	2.46	2.46	2.00	1.55	1.12	0.70	0.70	0.70	0.53	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

MESR

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	1.22	2.34	1.35	0.45	0.45	0.45	0.45	0.45	0.45	0.42	0.39	0.39	0.39	0.39	0.39	0.22	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Risks from 4-year Exposure from Main Lot HP (per million)	NA	3.12	6.01	6.59	6.93	4.62	2.32	2.32	2.32	2.32	2.24	2.16	2.08	2.00	2.00	2.00	1.58	1.15	0.73	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Total Cumulative Risk with HP (per Million)	NA	3.12	6.01	6.59	6.93	4.62	2.32	3.53	4.66	3.67	2.69	2.61	2.53	2.46	2.46	2.46	2.00	1.55	1.12	0.70	0.70	0.70	0.53	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Worker Calculation Procedure for Cancer Risks

MEIW

Age when Exposure Ends at 2040	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Risks from 2-year Exposure from North Lot (per million)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Risks from 4-year Exposure from Main Lot HP (per million)	0.05	0.10	0.15	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Total Cumulative Risk with HP (per Million)	0.05	0.10	0.15	0.20	0.20	0.20	0.20	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42

Total Cumulative Cancer Risk with ACP (per Million) - Unmitigated

PMI

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	17.30	33.27	19.18	6.41	6.41	6.41	6.41	6.41	6.41	5.98	5.55	5.55	5.55	5.55	5.55	3.20	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Risks from 4-year Exposure from Main Lot ACP (per million	NA	6.46	12.43	13.63	14.33	9.56	4.79	4.79	4.79	4.79	4.63	4.47	4.31	4.15	4.15	4.15	3.27	2.39	1.51	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Total Cumulative Risk with HP (per Million)	NA	6.46	12.43	13.63	14.33	9.56	4.79	22.09	38.07	23.97	11.04	10.88	10.72	10.56	10.56	10.56	9.25	7.94	7.06	6.18	6.18	6.18	3.83	1.47	1.47	1.47	1.47	1.47	1.47	1.47	1.47

MEIR

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	3.17	6.10	3.52	1.18	1.18	1.18	1.18	1.18	1.18	1.10	1.02	1.02	1.02	1.02	1.02	0.59	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Risks from 4-year Exposure from Main Lot ACP (per million	NA	6.46	12.43	13.63	14.33	9.56	4.79	4.79	4.79	4.79	4.63	4.47	4.31	4.15	4.15	4.15	3.27	2.39	1.51	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Total Cumulative Risk with HP (per Million)	NA	6.46	12.43	13.63	14.33	9.56	4.79	7.96	10.89	8.31	5.81	5.65	5.48	5.32	5.32	5.32	4.36	3.41	2.53	1.65	1.65	1.65	1.22	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78

MESR

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	3.17	6.10	3.52	1.18	1.18	1.18	1.18	1.18	1.18	1.10	1.02	1.02	1.02	1.02	1.02	0.59	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Risks from 4-year Exposure from Main Lot ACP (per million	NA	6.46	12.43	13.63	14.33	9.56	4.79	4.79	4.79	4.79	4.63	4.47	4.31	4.15	4.15	4.15	3.27	2.39	1.51	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
Total Cumulative Risk with HP (per Million)	NA	6.46	12.43	13.63	14.33	9.56	4.79	7.96	10.89	8.31	5.81	5.65	5.48	5.32	5.32	5.32	4.36	3.41	2.53	1.65	1.65	1.65	1.22	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78

Worker Calculation Procedure for Cancer Risks

MEIW

Age when Exposure Ends at 2040	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Risks from 2-year Exposure from North Lot (per million)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.84	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Risks from 4-year Exposure from Main Lot ACP (per million	0.10	0.21	0.31	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Total Cumulative Risk with HP (per Million)	0.10	0.21	0.31	0.21	0.21	0.21	0.21	0.77	1.05	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77

Total Cumulative Cancer Risk with ACP (per Million) - Mitigated

PMI

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	6.64	12.77	7.36	2.46	2.46	2.46	2.46	2.46	2.46	2.30	2.13	2.13	2.13	2.13	2.13	1.23	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Risks from 4-year Exposure from Main Lot ACP (per million	NA	2.96	5.70	6.25	6.57	4.39	2.20	2.20	2.20	2.20	2.12	2.05	1.98	1.90	1.90	1.90	1.50	1.10	0.69	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Total Cumulative Risk with HP (per Million)	NA	2.96	5.70	6.25	6.57	4.39	2.20	8.84	14.97	9.56	4.59	4.51	4.44	4.36	4.36	4.36	3.79	3.23	2.82	2.42	2.42	2.42	1.52	0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61

MEIR

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	1.22	2.34	1.35	0.45	0.45	0.45	0.45	0.45	0.45	0.42	0.39	0.39	0.39	0.39	0.39	0.22	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Risks from 4-year Exposure from Main Lot ACP (per million	NA	2.96	5.70	6.25	6.57	4.39	2.20	2.20	2.20	2.20	2.12	2.05	1.98	1.90	1.90	1.90	1.50	1.10	0.69	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Total Cumulative Risk with HP (per Million)	NA	2.96	5.70	6.25	6.57	4.39	2.20	3.41	4.54	3.55	2.57	2.50	2.43	2.35	2.35	2.35	1.92	1.49	1.08	0.68	0.68	0.68	0.51	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35

MESR

Age when Exposure Ends at 2040	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Risks from 2-year Exposure from North Lot (per million)	NA	0.00	0.00	0.00	0.00	0.00	0.00	1.22	2.34	1.35	0.45	0.45	0.45	0.45	0.45	0.45	0.42	0.39	0.39	0.39	0.39	0.39	0.22	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Risks from 4-year Exposure from Main Lot ACP (per million	NA	2.96	5.70	6.25	6.57	4.39	2.20	2.20	2.20	2.20	2.12	2.05	1.98	1.90	1.90	1.90	1.50	1.10	0.69	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
Total Cumulative Risk with HP (per Million)	NA	2.96	5.70	6.25	6.57	4.39	2.20	3.41	4.54	3.55	2.57	2.50	2.43	2.35	2.35	2.35	1.92	1.49	1.08	0.68	0.68	0.68	0.51	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35

Worker Calculation Procedure for Cancer Risks

MEIW

Age when Exposure Ends at 2040	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Risks from 2-year Exposure from North Lot (per million)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Risks from 4-year Exposure from Main Lot ACP (per million	0.05	0.10	0.14	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Total Cumulative Risk with HP (per Million)	0.05	0.10	0.14	0.10	0.10	0.10	0.10	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31

Chronic Impacts due to Construction Diesel Particulate Matter - Unmitigated
Calculation Procedure for Chronic Hazard Index

North Lot

Receptor Type	Pollutant	Maximum Annual Modeled Concentration ($\mu g/m^3$) [a]	REL ($\mu g/m^3$) [b]	Chronic Hazard Index
PMI	Diesel PM	0.1143	5.0	0.023
MEIR	Diesel PM	0.0210	5.0	0.004
MESR	Diesel PM	0.0210	5.0	0.004
MEIW	Diesel PM	0.1143	5.0	0.023

Main Lot with HP

Receptor Type	Pollutant	Maximum Annual Modeled Concentration ($\mu g/m^3$) [a]	REL ($\mu g/m^3$) [b]	Chronic Hazard Index
PMI	Diesel PM	0.0497	5.0	0.010
MEIR	Diesel PM	0.0497	5.0	0.010
MESR	Diesel PM	0.0497	5.0	0.010
MEIW	Diesel PM	0.0497	5.0	0.010

Main Lot with ACP

Receptor Type	Pollutant	Maximum Annual Modeled Concentration ($\mu g/m^3$) [a]	REL ($\mu g/m^3$) [b]	Chronic Hazard Index
PMI	Diesel PM	0.0427	5.0	0.009
MEIR	Diesel PM	0.0427	5.0	0.009
MESR	Diesel PM	0.0427	5.0	0.009
MEIW	Diesel PM	0.0427	5.0	0.009

Notes:

[a] Maximum Annual Modeled Concentrations taken from Appendix C, Table 1.

[b] REL taken from the *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values* (OEHHA & ARB, 2025).
https://ww2.arb.ca.gov/sites/default/files/classic/toxics/healthval/contable09252025.pdf

Chronic Impacts due to Construction Diesel Particulate Matter -Mitigated
Calculation Procedure for Chronic Hazard Index

North Lot

Receptor Type	Pollutant	Maximum Annual Modeled Concentration ($\mu g/m^3$) [a]	REL ($\mu g/m^3$) [b]	Chronic Hazard Index
PMI	Diesel PM	0.0439	5.0	0.0088
MEIR	Diesel PM	0.0080	5.0	0.0016
MESR	Diesel PM	0.0080	5.0	0.0016
MEIW	Diesel PM	0.0439	5.0	0.0088

Main Lot with HP

Receptor Type	Pollutant	Maximum Annual Modeled Concentration ($\mu g/m^3$) [a]	REL ($\mu g/m^3$) [b]	Chronic Hazard Index
PMI	Diesel PM	0.0206	5.0	0.0041
MEIR	Diesel PM	0.0206	5.0	0.0041
MESR	Diesel PM	0.0206	5.0	0.0041
MEIW	Diesel PM	0.0206	5.0	0.0041

Main Lot with ACP

Receptor Type	Pollutant	Maximum Annual Modeled Concentration ($\mu g/m^3$) [a]	REL ($\mu g/m^3$) [b]	Chronic Hazard Index
PMI	Diesel PM	0.0196	5.0	0.0039
MEIR	Diesel PM	0.0196	5.0	0.0039
MESR	Diesel PM	0.0196	5.0	0.0039
MEIW	Diesel PM	0.0196	5.0	0.0039

Notes:

[a] Maximum Annual Modeled Concentrations taken from Appendix C, Table 1.

[b] REL taken from the *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values* (OEHHA & ARB, 2025).
https://ww2.arb.ca.gov/sites/default/files/classic/toxics/healthval/contable09252025.pdf

Residential Constants for Cancer Risk

Dose Constants

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
BR/BW	361	1090	1090	861	861	861	861	861	861	861	745	745	745	745	745	745	335	335	335	335	335	335	335	335	335	335	335	335	335	335	335
A	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Conversion	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001

Note: EF adjusted based on construction exposure duration

Risk Constants

Age	0 (3rd tri)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
CPF (Diesel PM)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
ASF	10	10	10	3	3	3	3	3	3	3	3	3	3	3	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ED	0.25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AT	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70
FAH	0.85	0.85	0.85	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73

Worker Constants for Cancer Risk

Dose Constants

Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
WAF [a]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
BR/BW	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230
A	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
EF	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Conversion	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001	0.000001

Note: EF adjusted based on construction exposure duration

Risk Constants

Age	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
CPF (Diesel PM)	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
ASF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
ED	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AT	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70

Notes:

[a] Conservatively assumes construction activities occur 24 hours per day, 7 days per week.

AERSCREEN 21112 / AERMOD 24142 09/08/26
10:20:53

TITLE: Site 1

********** AREA PARAMETERS **********

SOURCE EMISSION RATE:	1.0000	g/s	7.937	lb/hr
AREA EMISSION RATE:	0.139E-03	g/(s-m2)	0.110E-02	lb/(hr-m2)
AREA HEIGHT:	1.30	meters	4.27	feet
AREA SOURCE LONG SIDE:	120.00	meters	393.70	feet
AREA SOURCE SHORT SIDE:	60.00	meters	196.85	feet
INITIAL VERTICAL DIMENSION:	1.21	meters	3.97	feet
RURAL OR URBAN:	URBAN			
POPULATION:	12620			
FLAGPOLE RECEPTOR HEIGHT:	1.50	meters	4.92	feet
INITIAL PROBE DISTANCE =	1000.	meters	3281.	feet

********** BUILDING DOWNWASH PARAMETERS **********

BUILDING DOWNWASH NOT USED FOR NON-POINT SOURCES

********** FLOW SECTOR ANALYSIS **********

25 meter receptor spacing: 1. meters - 1000. meters

MAXIMUM IMPACT RECEPTOR

Zo SECTOR	SURFACE ROUGHNESS	1-HR CONC (ug/m3)	RADIAL (deg)	DIST (m)	TEMPORAL PERIOD
1*	1.000	3203.	0	50.0	WIN

* = worst case diagonal

********** MAKEMET METEOROLOGY PARAMETERS **********

MIN/MAX TEMPERATURE: 279.3 / 296.5 (K)

MINIMUM WIND SPEED: 0.5 m/s

ANEMOMETER HEIGHT: 10.000 meters

SURFACE CHARACTERISTICS INPUT: AERMET SEASONAL TABLES

DOMINANT SURFACE PROFILE: Urban
DOMINANT CLIMATE TYPE: Wet Conditions
DOMINANT SEASON: Winter

ALBEDO: 0.35
BOWEN RATIO: 0.50

ROUGHNESS LENGTH: 1.000 (meters)

SURFACE FRICTION VELOCITY (U*) ADJUSTED

METEOROLOGY CONDITIONS USED TO PREDICT OVERALL MAXIMUM IMPACT

YR	MO	DY	JDY	HR
10	01	04	4	01

H0	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O LEN	Z0	BOWEN	ALBEDO	REF WS
-5.98	0.111	-9.000	0.020	-999.	85.	20.8	1.000	0.50	0.35	0.50

HT	REF TA	HT
10.0	296.5	2.0

********** AERSCREEN AUTOMATED DISTANCES **********

OVERALL MAXIMUM CONCENTRATIONS BY DISTANCE

DIST (m)	MAXIMUM 1-HR CONC (ug/m3)	DIST (m)	MAXIMUM 1-HR CONC (ug/m3)
1.00	2712.	525.00	98.29
25.00	2998.	550.00	92.17
50.00	3203.	575.00	86.68
75.00	2007.	600.00	81.74
100.00	1112.	625.00	77.27
125.00	776.2	650.00	73.22
150.00	587.2	675.00	69.51
175.00	466.4	700.00	66.11
200.00	383.5	725.00	62.99
225.00	323.7	749.99	61.41
250.00	278.1	775.00	60.01
275.00	242.9	800.00	58.69
300.00	214.9	825.00	57.43
325.00	191.9	850.00	56.24
350.00	172.9	875.00	55.11
375.00	157.0	900.00	54.02
400.00	143.5	924.99	52.99
425.00	131.9	950.00	52.01
450.00	121.8	975.00	51.07
475.00	112.9	1000.00	50.17
500.00	105.2		

********** AERSCREEN MAXIMUM IMPACT SUMMARY **********

3-hour, 8-hour, and 24-hour scaled
concentrations are equal to the 1-hour concentration as referenced in
SCREENING PROCEDURES FOR ESTIMATING THE AIR QUALITY
IMPACT OF STATIONARY SOURCES, REVISED (Section 4.5.4)
Report number EPA-454/R-92-019
http://www.epa.gov/scram001/guidance_permit.htm
under Screening Guidance

	MAXIMUM	SCALED	SCALED	SCALED	SCALED

CALCULATION PROCEDURE	1-HOUR CONC (ug/m3)	3-HOUR CONC (ug/m3)	8-HOUR CONC (ug/m3)	24-HOUR CONC (ug/m3)	ANNUAL CONC (ug/m3)
FLAT TERRAIN	3268.	3268.	3268.	3268.	N/A
DISTANCE FROM SOURCE	61.00 meters				
IMPACT AT THE AMBIENT BOUNDARY	2712.	2712.	2712.	2712.	N/A
DISTANCE FROM SOURCE	1.00 meters				

AERSCREEN 21112 / AERMOD 24142 09/08/26
10:25:53

TITLE: Site 2

********** AREA PARAMETERS **********

SOURCE EMISSION RATE:	1.0000	g/s	7.937	lb/hr
AREA EMISSION RATE:	0.192E-04	g/(s-m2)	0.153E-03	lb/(hr-m2)
AREA HEIGHT:	1.30	meters	4.27	feet
AREA SOURCE LONG SIDE:	260.00	meters	853.02	feet
AREA SOURCE SHORT SIDE:	200.00	meters	656.17	feet
INITIAL VERTICAL DIMENSION:	1.21	meters	3.97	feet
RURAL OR URBAN:	URBAN			
POPULATION:	12620			
FLAGPOLE RECEPTOR HEIGHT:	1.50	meters	4.92	feet
INITIAL PROBE DISTANCE =	1000.	meters	3281.	feet

********** BUILDING DOWNWASH PARAMETERS **********

BUILDING DOWNWASH NOT USED FOR NON-POINT SOURCES

********** FLOW SECTOR ANALYSIS **********
25 meter receptor spacing: 1. meters - 1000. meters

MAXIMUM IMPACT RECEPTOR

Zo SECTOR	SURFACE ROUGHNESS	1-HR CONC (ug/m3)	RADIAL (deg)	DIST (m)	TEMPORAL PERIOD
1*	1.000	681.1	35	150.0	WIN

* = worst case diagonal

********** MAKEMET METEOROLOGY PARAMETERS **********

MIN/MAX TEMPERATURE: 279.3 / 296.5 (K)

MINIMUM WIND SPEED: 0.5 m/s

ANEMOMETER HEIGHT: 10.000 meters

SURFACE CHARACTERISTICS INPUT: AERMET SEASONAL TABLES

DOMINANT SURFACE PROFILE: Urban
DOMINANT CLIMATE TYPE: Average Moisture
DOMINANT SEASON: Winter

ALBEDO: 0.35
BOWEN RATIO: 1.50

ROUGHNESS LENGTH: 1.000 (meters)

SURFACE FRICTION VELOCITY (U*) ADJUSTED

METEOROLOGY CONDITIONS USED TO PREDICT OVERALL MAXIMUM IMPACT

YR	MO	DY	JDY	HR
10	01	04	4	01

H0	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O LEN	Z0	BOWEN	ALBEDO	REF WS
-5.98	0.111	-9.000	0.020	-999.	85.	20.8	1.000	1.50	0.35	0.50

HT	REF TA	HT
10.0	296.5	2.0

********** AERSCREEN AUTOMATED DISTANCES **********

OVERALL MAXIMUM CONCENTRATIONS BY DISTANCE

DIST (m)	MAXIMUM 1-HR CONC (ug/m3)	DIST (m)	MAXIMUM 1-HR CONC (ug/m3)
1.00	535.1	525.00	91.26
25.00	568.0	550.00	85.90
50.00	597.8	575.00	81.10
75.00	623.5	600.00	76.74
100.00	646.2	625.00	72.74
125.00	666.3	650.00	69.12
150.00	681.1	675.00	65.76
175.00	456.9	700.00	62.72
200.00	344.3	725.00	59.92
225.00	285.1	750.00	57.28
250.00	241.2	775.00	54.84
275.00	210.1	800.00	52.60
300.00	186.7	825.00	50.50
325.00	168.0	850.00	48.54
350.00	152.7	875.00	46.73
375.00	140.2	900.00	45.24
400.00	129.2	925.00	44.58
425.00	119.6	950.00	43.94
450.00	111.2	975.00	43.34
475.00	103.8	1000.00	42.74
500.00	97.16		

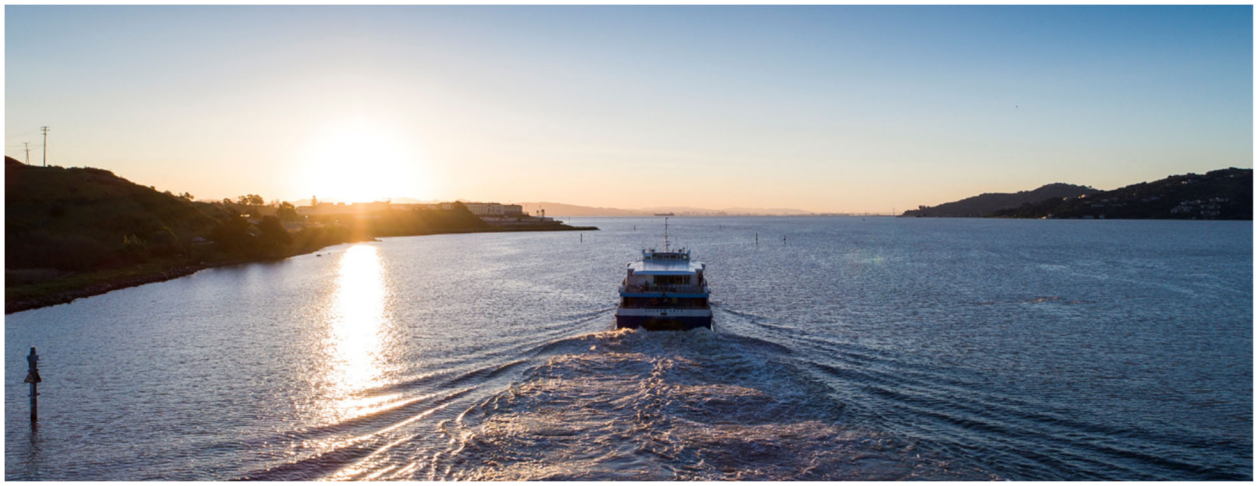
********** AERSCREEN MAXIMUM IMPACT SUMMARY **********

3-hour, 8-hour, and 24-hour scaled
concentrations are equal to the 1-hour concentration as referenced in
SCREENING PROCEDURES FOR ESTIMATING THE AIR QUALITY
IMPACT OF STATIONARY SOURCES, REVISED (Section 4.5.4)
Report number EPA-454/R-92-019
http://www.epa.gov/scram001/guidance_permit.htm
under Screening Guidance

	MAXIMUM	SCALED	SCALED	SCALED	SCALED

CALCULATION PROCEDURE	1-HOUR CONC (ug/m3)	3-HOUR CONC (ug/m3)	8-HOUR CONC (ug/m3)	24-HOUR CONC (ug/m3)	ANNUAL CONC (ug/m3)
FLAT TERRAIN	682.9	682.9	682.9	682.9	N/A
DISTANCE FROM SOURCE	155.00 meters				
IMPACT AT THE AMBIENT BOUNDARY	535.1	535.1	535.1	535.1	N/A
DISTANCE FROM SOURCE	1.00 meters				

Larkspur Ferry Service Expansion and Parking Project



Natural Environment Study

Golden Gate Bridge, Highway and Transportation District
Marin County, California

October 2026

GOLDEN GATE BRIDGE
HIGHWAY & TRANSPORTATION DISTRICT

Revised Draft Natural Environment Study

Larkspur Ferry Service Expansion and Parking Project

Golden Gate Bridge, Highway and Transportation District

Marin County, California

October 2026

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Executive Summary

The Larkspur Ferry Service Expansion and Parking Project (Project) is being implemented by the Golden Gate Bridge, Highway and Transportation District (District) to increase ferry ridership and reduce traffic congestion on United States Highway 101 in Marin and Sonoma Counties and in the Larkspur Landing area. The Project will accommodate increases in ridership with adequate parking, transit connectivity (bus and rail), and active transportation, resulting in an overall reduction in traffic backup and congestion in the area.

Increased ferry crossings will be accommodated by providing additional parking, with the likelihood of constructing one or more new parking garages. The size of the structures and number of parking stalls will depend on passenger forecasts. Two District-owned sites are being considered for parking garages: (1) the main parking lot adjacent to the ferry terminal, and (2) the overflow parking lot in the Larkspur Landing shopping center, across Sir Francis Drake Boulevard.

The new parking garage(s) will require modification to the existing landside access and circulation configuration. Depending on the location, the parking garage(s) will require construction activities including staging areas for equipment storage and excavation for new utilities, pile driving, and elevator shaft(s). Construction work is anticipated to only occur during the day.

This Natural Environment Study provides technical information to determine the extent to which the Project may impact plants, animals, and natural communities in the biological study area (BSA). The BSA established for the Project is 44.51 acres and includes the Project footprint (the existing parking lots and pedestrian improvements) and a 350-foot buffer encompassing Triangle Marsh (a small saltmarsh immediately adjacent to the ferry terminal), landscaped areas, oak woodlands, and portions of Corte Madera Creek and San Francisco Bay. The study area for assessing operational impacts to marine mammals was expanded to include the ferry corridor from the Larkspur to Downtown San Francisco Terminal (herein referred to as the ferry route).

Technical studies conducted for the Project relevant to this Natural Environment Study include the following:

- Aquatic Resources Delineation
- Special-Status Plant and Animal Species Habitat Assessment
- Ferry Wake Wash and Shoreline Erosion Analysis

ES.1 Resource Impact Summary

The following resources have a moderate to high potential to occur within the BSA or along ferry routes and could have the potential for impacts from construction and operation of the Project:

- California Ridgway's rail (*Rallus longirostris obsoletus*)
- California black rail (*Laterallus jamaicensis coturniculus*)
- Salt marsh harvest mouse (*Reithrodontomys raviventris*)[1]
- Marine mammals

[1] The salt marsh harvest mouse were determined to have a low potential to occur. However, given their listing status and that presence in the BSA cannot be ruled out, salt marsh harvest mouse are included in the analysis.

- California sea lion (*Zalphus californianus)*
- Common bottlenose dolphin (*Tursiops truncatus)*
- Gray whale (*Eschrichtius robustus*)
- Harbor seal (*Phoca vitulina richardii*)
- Harbor porpoise (*Phocoena phocoena)*
- Humpback whale (*Megaptera novaengliae*)

ES.2 Natural Communities of Special Concern

Construction will only occur on existing hardscape. No ground disturbance will occur to any natural vegetation communities, wetlands, or waters in the BSA. A special-status species plant habitat assessment was performed within the BSA. The marsh, which is characterized as *Sarcocornia pacifica - Distichlis spicata* alliance, is a California sensitive natural community.

Jacobs conducted a *Ferry Wake Wash and Shoreline Erosion Analysis* (Jacobs 2023; Jacobs 2026) to evaluate baseline (existing) conditions. It was concluded that the existing ferry wakes do not impact marsh habitat, erode existing mudflats, or increase background levels of turbidity in mudflat waters. Based on modeling completed for the future Liwa-class vessels, wake height would be smaller but wake energy at both 10 and 30 knots arrival and departure would have up to 18% and 30% less energy, respectively. It is anticipated that changes in fleet composition and an increase in trips would not substantially modify these conditions to the extent that significant impacts would occur.

No natural communities are expected to be disturbed or impacted by construction or operation of the Project.

ES.3 Special-Status Wildlife Species Occurrences

As mentioned previously, construction will occur on existing hardscape only and the changes in the fleet and proposed change in the fleet and an increase in ferry traffic is not expected to impact Corte Madera Marsh. Therefore, habitat used by special-status species will not be directly affected.

Small-diameter (12- to 14-inch) concrete piles are expected to be impact-driven on land within the existing ferry terminal parking area, approximately 100 feet or more from the nearest waters. Based on the pile diameter and the distance from the Bay, pile driving associated with this Project is not expected to result in meaningful transmission of underwater sound to adjacent waters. Therefore, there are no expected impacts to fish or other in-water organisms from construction noise, specifically pile driving. Fish and other in-water organisms presumedly have adjusted to the baseline conditions of ferries migrating through the BSA and along the ferry route, and a change in the fleet and an increase in ferry traffic throughout the route is not expected to significantly change baseline conditions and will not negatively affect fish or other in-water organisms.

ES.3.1 California Ridgway's Rail and California Black Rail

It is unlikely that California Ridgway's rail or California black rail will be nesting within the BSA due to lack of suitable dense vegetation in Triangle Marsh. Known populations and suitable nesting salt marsh habitat are present in the Corte Madera Marsh approximately 1,000 feet south of the Project across Corte Madera Creek. Pile driving will not occur within 700 feet of the rail habitat at Corte Madera Marsh. For this reason, it is presumed that the noise from construction will attenuate to a level that will not disturb nesting birds in Corte Madera Marsh. The proposed avoidance and minimization measures (AMMs) will further reduce potential impacts on rails. Pre-construction surveys will also be conducted to confirm that rails are not nesting within the noise disturbance distance during construction.

Therefore, pile driving and other Project-related noise are not anticipated to cause a significant disturbance to California Ridgway's rail or California black rail.

ES.3.2 Salt Marsh Harvest Mouse

A California Natural Diversity Database occurrence from 1945 documented the salt marsh harvest mouse in Triangle Marsh (CDFW 2026b). However, this marsh was surveyed in 1988 and no mice were found. Habitat in this area is considered low quality due to the area being too small, with too much tidal influence and no escape cover. The chance of the salt marsh harvest mouse occurring within the BSA is low but cannot be ruled out completely. Surveys for salt marsh harvest mouse are typically only allowed for research purposes due to their Fully Protected species status under California Department of Fish and Wildlife regulations and thus were not conducted for this study. Potential presence of salt marsh harvest mouse is determined by habitat suitability and potential for occurrence.

Potentially suitable habitat for this species will not be directly impacted by the Project. If mice are present in nearby marshlands, the proposed AMMs will reduce potential negative impacts on mice. For these reasons, the Project is not expected to impact the salt marsh harvest mouse.

ES.3.3 Marine Mammals

California sea lions and harbor seals were determined to have a high potential to occur along the ferry route (that is, central San Francisco Bay at a distance from the ferry terminals) as foragers and in transit, as well as within the BSA. They are not expected to haul out near the Larkspur Ferry Terminal.

Common bottlenose dolphins, gray and humpback whales, and harbor porpoises were determined to have a moderate potential to occur as foragers or in transit in central portions of the ferry route (that is, central San Francisco Bay at a distance from the ferry terminals). Habitat for these species in the BSA and near the Larkspur and San Francisco Ferry Terminals is marginal or absent.

ES.3.3.1 Potential Construction Impacts

Based on the scope of the Project, no meaningful transmission of underwater sound to adjacent waters is expected during construction and throughout new operations. Additionally, there are no haul-out areas where pinnipeds (California sea lions and harbor seals) will be exposed to airborne noise. As a result, no adverse hydroacoustic or terrestrial noise effects are anticipated.

The Project is not expected to result in temporary or permanent threshold shifts of marine mammals during construction and is not expected to require an Incidental Harassment Authorization or letter of authorization from National Oceanic and Atmospheric Administration (NOAA) Fisheries (formerly National Marine Fisheries Service).

ES.3.3.2 Potential Operations Impacts

The increase in ferry operations expected in 2050 could impact marine mammals directly due to increased collision risk (vessels-strike) or indirectly through behavioral disturbance. Of the species potentially present, harbor porpoises, common bottlenose dolphins, and pinnipeds are generally at lower risk because they are more agile and capable of maneuvering away from the vessel and spend less time at the surface. In contrast, cetaceans (gray and humpback whales) are bigger, slower, and less agile, and spend longer periods of time at or near the surface. They are also more likely to be observed foraging in central San Francisco Bay, which makes them less likely to detect and avoid an approaching vessel.

The increase in traffic from the increased ferry service is minimal compared to existing conditions, and the operations will not substantially increase collision risk to a level that threatens population statuses. Given the baseline soundscape in San Francisco Bay and the protocols that District ferries follow, behavioral impacts from vessel noise on marine mammals are expected to be insignificant.

Project operations will add to the cumulative risk of vessel-strike on marine mammals and anthropogenic noise to the existing soundscape; however, **the cumulative effects are not substantial, would not threaten existing populations, and are thus insignificant**. As a result, the Project will not require an Incidental Harassment Authorization from NOAA Fisheries pursuant to the Marine Mammal Protection Act Section 101(a)(5)(D).

ES.4 Avoidance and Minimization Measures

General and species-specific AMMs will be implemented to reduce potential effects on special-status species. These measures will include minimizing the area of impact, implementing an environmental education program for construction personnel, conducting pre-construction surveys for nesting birds and rails, noise abatement, and using other construction-site best management practices.

ES.5 Compensatory Mitigation

Pursuant to the procedures of the California Environmental Quality Act, the Project's potential to affect species designated as candidate, sensitive, or special-status in local or regional plans, policies, or regulations, or listed by the California Department of Fish and Wildlife, NOAA Fisheries, or U.S. Fish and Wildlife Service have been analyzed. The Project is not expected to result in take of species listed under the Federal or California Endangered Species Acts. Given the existing conditions, scope of work, and proposed AMM, the Project is not expected to result in Level A or B harassment to marine mammals. For all these reasons, no compensatory mitigation is proposed.

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Acronyms and Abbreviations

Abbreviation	Definition
°C	degree(s) Celsius
°F	degree(s) Fahrenheit
AMM	avoidance and minimization measure
BSA	biological study area
Caltrans	California Department of Transportation
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CT	condition threatened
dB	decibel
District	Golden Gate Bridge, Highway and Transportation District
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ENP	Eastern North Pacific
ESU	Evolutionarily Significant Unit
FDR	federally delisted (recovered)
FE	federally endangered
FESA	Federal Endangered Species Act
FGC	California Fish and Game Code
FHWA	Federal Highway Administration

Abbreviation	Definition
FP	fully protected
FT	federally threatened
IHA	Incidental Harassment Authorization
MMPA	Marine Mammal Protection Act
NES	Natural Environment Study
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
SE	state endangered
SMART	Sonoma–Marin Area Rail Transit
SSC	state species of special concern
ST	state threatened
TDM	transportation demand management
TNC	transportation network company
U.S.C.	U.S. Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

1. Introduction

The Larkspur Ferry Service Expansion and Parking Project (Project) is being implemented by the Golden Gate Bridge, Highway and Transportation District (District) along the San Francisco Bay (Figure 1-1). The Project will relieve congestion within the United States Highway 101 (US 101) corridor, meet increasing demand for ferry service from Larkspur and Marin County to existing and planned ferry terminals in San Francisco and the greater Bay Area, and develop parking solutions to accommodate additional passengers accessing current and expanded ferry service.

This Natural Environment Study (NES) provides technical information to determine the extent to which the Project may impact plants, animals, and natural communities in the biological study area (BSA) and along the ferry route (Figure 1-2). The NES evaluates special-status species, potential jurisdictional wetlands and waters of the United States and State of California, and protected natural plant communities. The findings provide a basis for subsequent Project impact decisions.

1.1 Project Location

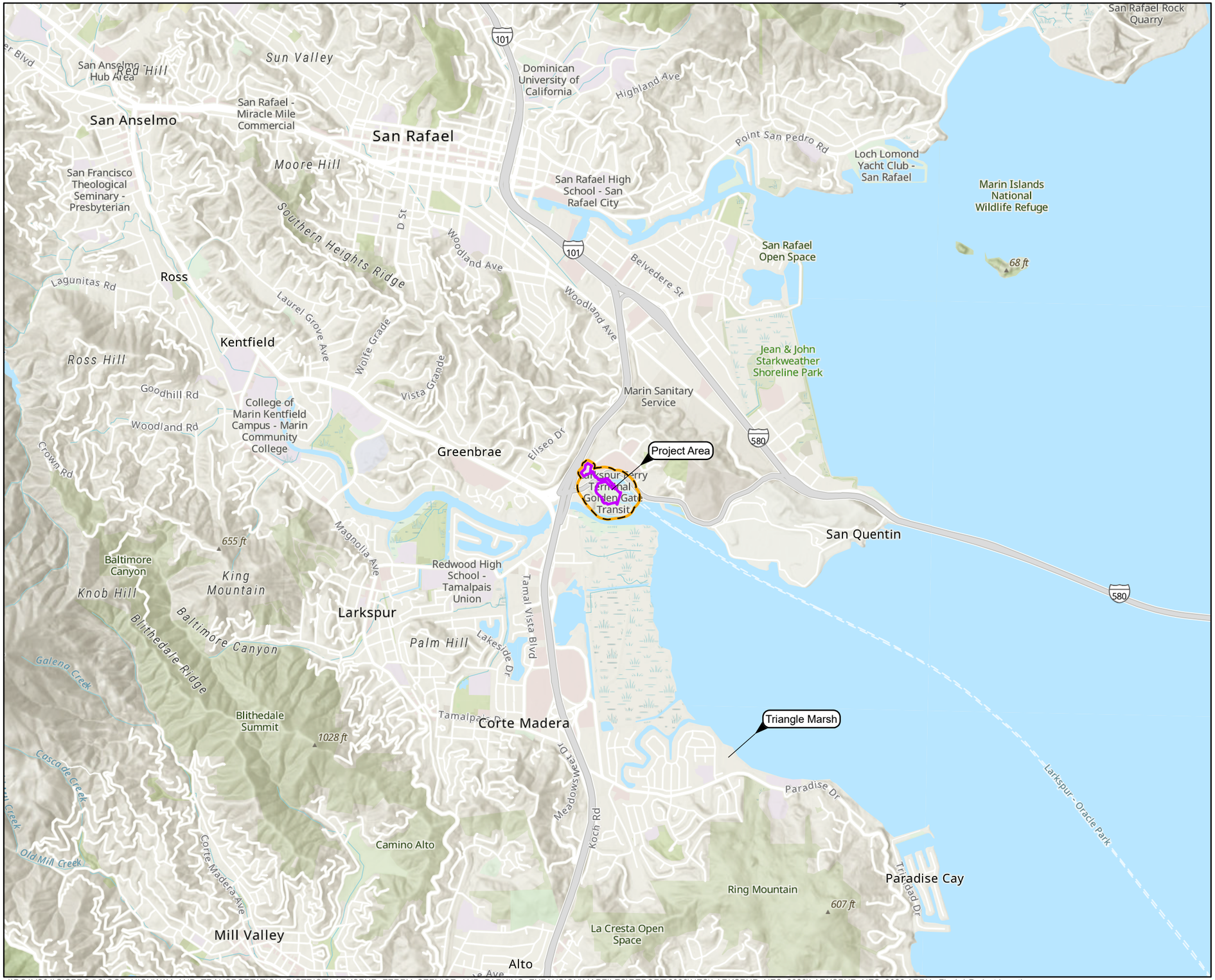
The Project site includes the Larkspur Ferry Terminal and associated facilities, located along the central San Francisco Bay near Sir Francis Drake Boulevard in Marin County, California, at latitude 37°56'40.2"N and longitude 122°30'31.4"W. The terminal is adjacent to San Francisco Bay wetlands and tidal areas and is bordered by a mix of transportation, commercial, and open-space land uses. The BSA is within the U.S. Geological Survey (USGS) 7.5-minute San Rafael topographic quadrangle and located within the City of Larkspur.

1.2 Purpose and Need

The purpose of this Project is to relieve traffic, meet increasing demand for ferry services, and develop parking and landside access solutions. Increased ferry crossings to meet new passenger demand will be accommodated by increased parking and multimodal access, with the likelihood of new parking garage(s). Two sites are under consideration for these parking garages: one site is the main parking lot adjacent to the ferry terminal; the other site is the overflow parking lot, also owned by the District, located in the Larkspur Landing shopping center across Sir Francis Drake Boulevard.

The new parking garages(s) will require modifying the existing landside access and circulation configuration. Depending on the location, the parking garages(s) construction activities will include staging areas for equipment storage and excavation for new utilities, pile driving, and elevator shaft(s).

Construction work is anticipated to only occur during the day.



LEGEND

- Biological Study Area (44.51 acres)
- Project Footprint (9.69 acres)

Service Layer Credits: World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Hillshade: Esri, NASA, NGA, USGS, FEMA
World Hillshade: Esri, CGIAR, USGS

N

0 3,000 6,000

Feet

Figure 1-1
Project Location
Larkspur Ferry Service and Parking Expansion Project
Golden Gate Bridge, Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2026\NES\LARKSPUR_NES_2026\LARKSPUR_NES_2026.APRX Fig 1-1 Project Location

1.3 Project Description

1.3.1 Existing Setting

The Larkspur Ferry Terminal provides regular and special-event ferry service and is supported by multimodal access and two surface parking lots, the Main Lot and North Lot. The Main Lot and North Lot provide 2,023 parking spaces and frequently reached capacity before the COVID-19 pandemic. Riders arrive via a mix of driving, drop-off by personal vehicles and transportation network company (TNCs) (such as app-based services), bus transit, walking from the nearby Sonoma–Marin Area Rail Transit (SMART) station via the Cal Park Hill Pathway, and regional bicycle and pedestrian routes. Ferry service includes up to 42 weekday crossings, with additional trips during events and for maintenance operations and deadhead movements. Overall, the terminal is a key regional mobility hub in the Bay Area but is constrained by parking, limited transit connections, and indirect pedestrian and bicyclist connections, which limit the terminal's ability to accommodate forecasted ferry ridership growth.

1.3.2 Existing Larkspur Ferry Terminal

The Larkspur Ferry Terminal serves as the base for Golden Gate Ferry operations, offering regular ferry service to Bay Area locations, including the San Francisco Ferry Building, Oracle Park, and the Chase Center. It was constructed between 1975 and 1976 on the site of the former Hutchinson's Rock Quarry and opened on December 11, 1976. Designed by architect Jacques de Brer, the terminal has an 18,000-square-foot, open-air "space frame" canopy. The terminal is accessible and includes amenities for passengers, such as a covered waiting area, restrooms, and bicycle racks accommodating up to 80 bicycles in the paid area and up to 60 at bicycle racks in the unpaid area. Immediately outside the terminal building is a pickup and drop-off area for bus transit, private vehicles, and TNCs and a surface parking lot to serve ferry passengers who choose to drive and park.

1.3.3 Existing Landside Facilities

Landside facilities include the Main Lot and North Lot, which are surface lots and together provide 2,023 parking spaces, inclusive of parking spaces intended for ferry riders with accessibility requirements (Figure 1-2). The standard parking stalls have substandard dimensions compared with the current guidelines from the City of Larkspur. The Main Lot has 1,751 parking spaces, and the North Lot has 185 parking spaces.

The Main Lot is accessed from Sir Francis Drake Boulevard. The parking lot is an approximate hexagon shape, consistent with the original terminal design and surrounding areas (Figure 1-3). A circulator road around the edge of the Main Lot provides internal access to all parking aisles, connects to the ferry terminal's pickup and drop-off area, and leads to a designated staff parking area southwest of the Main Lot. Before the COVID-19 pandemic, the Main Lot regularly reached full capacity by mid-morning on weekdays, resulting in overflow demand.

The North Lot is located to the north of the Main Lot and is accessed from Larkspur Landing Circle. It is intended to serve as an overflow car park once the Main Lot is filled.





LEGEND

- Biological Study Area (44.51 acres)
- Project Footprint (9.69 acres)
- ADA Parking
- Bike Hub
- North Lot 2035
- Ramp
- Pickup and Drop off Stalls
- Pedestrian Improvements

Service Layer Credits: World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
Bing Maps Hybrid: © 2026 Microsoft Corporation © 2026 Maxar ©CNES (2026) Distribution Airbus DS © 2026 TomTom
World Hillshade: Esri, CGIAR, USGS

N

0 170 340
Feet

Figure 1-2
Project Elements and BSA
Larkspur Ferry Service and Parking Expansion Project
Golden Gate Bridge, Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2026\NES\LARKSPUR_NES_2026\LARKSPUR_NES_2026.APRX Fig 1-2 Project elements and BSA



Figure 1-3. Layout of Existing North Lot (Left) and Main Lot (Right) Surface Parking (not to scale)

1.3.4 Project Summary

The two proposed Project alternatives under consideration include increasing ferry service to future demand forecasts and constructing parking garages on the Main Lot and on the North Lot and a mix of additional improvements including defined pickup and drop-off area by providing designated loading and unloading areas for fixed-route transit, TNCs, and personal vehicles; enhanced bicycle storage facilities using a modular, flexible design; improving pedestrian connections; and implement a dedicated shuttle service dedicated between the SMART train station and the ferry terminal.

The new parking garages would require modification to the existing landside access and circulation configuration. Depending on the location, the construction activities would include staging areas for equipment storage and excavation for new utilities, pile driving, and elevator shafts. Each parking garage would require 18 to 36 months to construct. Construction work is anticipated to only occur during the day.

The Main Lot parking garage's first level would be constructed at a raised elevation of approximately 1 to 5 feet, sufficient to accommodate forecast sea-level rise. Raising the parking garage will be accomplished by putting the garage on walls; the areas within the walls and beneath the first level would either be filled with import material or foam or would be left empty. The approximate 100-foot area between the water and the wall would remain at the existing elevation.

1.3.5 Project Details

The Project will enable expansion of ferry service levels up to 76 daily revenue trips in 2050, commensurate with demand, and is projected to accommodate approximately 8,800 southbound riders during the morning peak, sufficient to meet ferry ridership demand without constraints. To meet the anticipated ridership, the Project includes phased construction of parking garages on the Main and North Lots, with no anticipated limitations on parking availability once fully built out.

Pending additional Board approval from the District and funding availability, Phase I will be construction of the North Lot parking garage (approximately 850 stalls) with an estimated construction duration of up to 18 months and a completion date of 2035. Phase II will also depend on Board approval, future funding availability, and ferry ridership demand patterns, and it includes construction of the Main Lot parking garage (up to 3,597 stalls), which has an estimated construction duration of up to 36 months; construction could begin as early as 2037 and be complete by 2040. The parking garage will be designed to optimize space, minimize visual impact, and support multimodal access.

Phase I and Phase II also incorporate transportation demand management (TDM) measures to support increases in transit, bicycle, and pedestrian access.

1.3.6 Existing Ferry Service Levels

The District operates 33 regular service crossings between Larkspur and San Francisco on weekdays and 15 crossings on weekends and holidays as of September 2026. The services are operated using a fleet of catamarans and monohull vessels (Spaulding-class vessels), with capacity ranging from 400 passengers to 750 passengers.

In addition to regular service, the District also runs special service to serve games at Oracle Park, currently consisting of two crossings per game during the entire season from March through September.

Deadhead trips and maintenance trips are estimated to be up to 10 trips and 2 trips, respectively. Therefore, including deadhead trips and maintenance trips, a typical weekday may have between 40 to 52 trips.

Before 2019, the District operated up to 42 regular service crossings between Larkspur and San Francisco on weekdays, 2 crossings for special events, and up to 18 crossings for large special events. Therefore, a typical weekday may have had between 50 to 56 trips. The 2019 conditions are considered the baseline for this analysis.

1.3.7 Existing Access and Connectivity

Ferry riders access the Larkspur Ferry Terminal via a range of modes, including driving, transit, walking, bicycling, and rail. The estimated mode share in 2018 and 2024, the most recent year for which data are available, is shown on Figure 1-4. Changes in mode share are largely attributable to the commencement of SMART service in 2019; accordingly, SMART mode share increased from 0% in 2018 to 8% in 2024. Other changes include a 6% decrease in drive-and-park trips (associated with greater parking availability in 2024) and a 3.5% decrease in bus use.

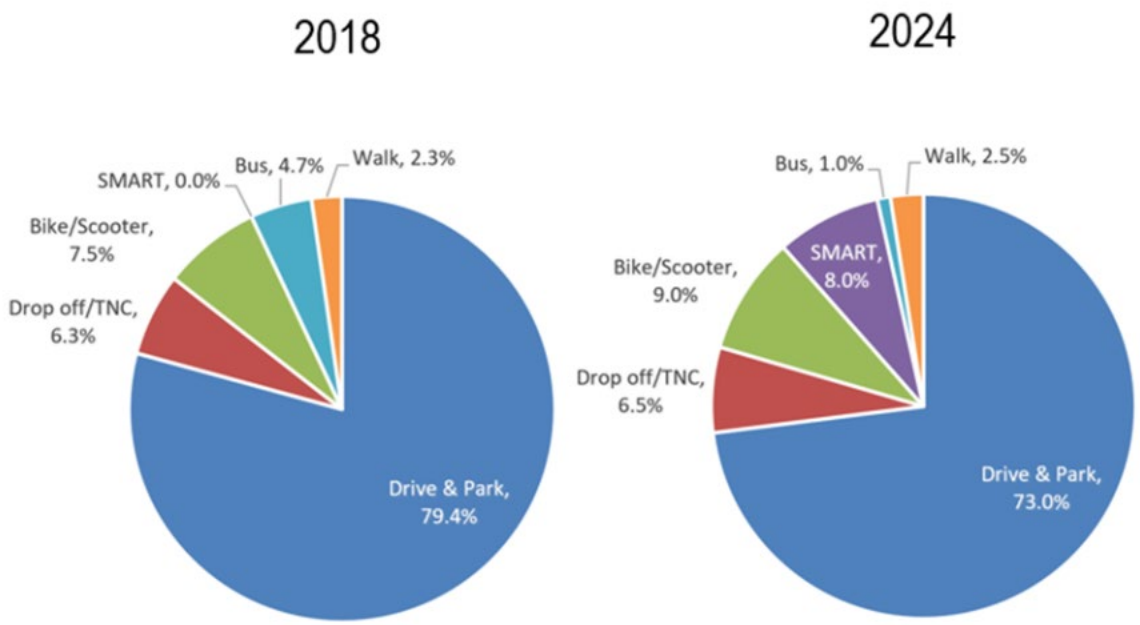


Figure 1-4. Mode of Arrival to Larkspur Ferry Service

1.3.8 Existing Drive and Park

Parking payment at both the Main Lot and North Lot is $2 per day or $20 for a 30-day permit as of October 2025. Payment is required between 5 AM and 1 PM on weekdays; parking is free after 1 PM on weekdays, weekends, or holidays.

1.3.9 Existing Pickup and Drop-Off

Curb space in front of the ferry terminal is provided for bus passenger pickup and drop-off. This curb space is also used informally for pickup and drop-off by private vehicles and TNCs.

1.3.10 Existing Transit – Bus and SMART

Currently, regular bus transit routes serving the Larkspur Ferry Terminal directly include Golden Gate Transit Route 132, which operates between San Anselmo and San Francisco. Marin Transit also operates three fixed bus routes connecting to the ferry—Routes 17, 29M, and 228—which provide pickup and drop-off just outside the Main Lot on Sir Francis Drake Boulevard.

SMART's Larkspur Station is located approximately 0.3 mile from the ferry terminal, connected by the Cal Park Hill Pathway, a paved multi-use trail. The SMART system currently spans from Larkspur to Windsor in Sonoma County. As of 2025, trains operate on approximately 32-minute headways, improving schedule flexibility and enhancing connections to ferry departures throughout the day. SMART also provides weekend service. The provided service level offers flexibility in travel throughout the day and improves connections between the ferry terminal and regional facilities such as the San Rafael Transit Center.

1.3.11 Existing Non-Motorized Modes

The ferry terminal is served by sidewalks and pedestrian crossings at nearby major intersections, including the intersection of Sir Francis Drake Boulevard and Larkspur Landing Circle. A pedestrian and bicycle footbridge over Sir Francis Drake Boulevard provides access to the commercial land uses along Larkspur Landing Circle.

The Cal Park Hill Pathway, part of the Marin County North-South Greenway, provides an additional crossing over Sir Francis Drake Boulevard and connects to the shared-use paths serving the ferry terminal from the west. This crossing provides a bicycle connection to the SMART station but is less frequently used by pedestrians because of its indirect route.

1.3.12 Existing Transportation Demand Management

Additional TDM measures incorporated into Project Build Alternatives to encourage mode shift to active transportation and transit may include the following:

- Increasing the parking fee by 2035, in line with inflation and to offset a portion of parking garage construction costs (by 2050, depending on ferry ridership demands, the parking fee will be further increased to offset a portion of feeder shuttle operation costs)
- Adding more spaces for preferential carpool parking on the ground floor of the Main Lot parking garage, which will be located closer to the ferry terminal building
- Increasing active participation in the Marin Commutes regional carpool matching program

1.3.13 Project Landside Changes

There are two Build Alternatives being considered for the Project. Alternatives 1 and 2 occupy the same footprint and are essentially the same with the exception of (1) Alternative 2 includes additional TDM measures that fully address projected ridership demand with one less parking level in the Main Lot, and (2) Main Lot parking garage height (Alternative 1 is a five-level garage, and Alternative 2 is a four-level garage). Construction of the Build Alternatives would occur in phases, with Phase I consisting of TDM and transit improvements along with a parking garage on the North Lot and Phase II including further TDM and transit improvements and a parking garage on the Main Lot. Construction of parking garages is contingent on funding availability and future demand, which is discussed in greater detail in Section 2.3.4.

To meet the forecast ferry ridership and the associated parking demands, the Project would construct a parking garage on the North Lot in Phase I, with a six-story structure. The Main Lot parking garage would follow in Phase II, with an elongated hexagon shaped, four-level structure with TDM measures or a five-level structure only, depending on which Build Alternative is approved by the District for construction after consideration of the environmental impacts. Once fully built out, there will be either 4,108 or 4,848 parking space, depending on the selected Build Alternative, which will be up to an additional 2,625 spaces compared to existing conditions. An appropriate number will be accessible parking spaces, in line with parking requirements of the City of Larkspur.

1.3.14 Project Characteristics, Circulation, and Pickup and Drop-Off

1.3.14.1 Ferry Service Levels

The unconstrained ferry ridership is forecast to be approximately 3,800 riders in the southbound direction in the weekday morning peak in 2035 (7,500 daily trips) with the North Lot open. To serve this forecast

ridership demand, the number of ferry revenue trips is proposed to be up to 42 trips per day, at the same number of approved ferry revenue trips.

The unconstrained ferry ridership is forecast to be approximately 8,800 riders in the southbound direction in the weekday morning peak in 2050 (17,600 daily trips) with the South Lot open. The Project proposes up to 76 ferry revenue trips per day with Liwa-class vessels to serve the forecast ferry ridership. The number of ferry riders is not anticipated to be constrained by the number of trips.

Up to four special event crossings are forecast, including crossings to serve Oracle Park or Chase Center events. Up to six additional deadhead trips are forecast, including the runs returning to Larkspur in the morning and heading to San Francisco in the afternoon to support additional peak revenue services. The maximum number of large event special service trips and maintenance trips are anticipated to be the same as existing.

2. Study Methods

To prepare this NES, various databases, historical records, and other scientific literature were reviewed to develop the environmental baseline. BSA was established before conducting field studies. The BSA for the Project encompasses the Project footprint, including the Project work area, limits of impacts, and all potential construction and set down zones, with a 350-foot foot buffer to capture direct and potential indirect impacts (Figure 1-2). This buffer encompasses Triangle Marsh, landscaped areas, oak woodlands, and portions of Corte Madera Creek and San Francisco Bay. The study area for assessing operational impacts to marine mammals was expanded to include the ferry corridor from the Larkspur to Downtown San Francisco Terminal (herein referred to as the ferry route). Biologists conducted general field surveys of the BSA to assess existing natural resources and identified the following:

- Plant community and habitat types
- Aquatic resources (that is, wetlands and other waters)
- Factors indicating the potential presence of special-status species
- The need for further in-depth or protocol-level surveys

2.1 Regulatory Requirements

Project implementation could affect natural resources within the jurisdiction of the following federal and state agencies:

- National Oceanic and Atmospheric Administration (NOAA) Fisheries (formerly National Marine Fisheries Service) (Santa Rosa Office)
- California Department of Fish and Wildlife (CDFW) (Bay Delta Region [Region 3])
- U.S. Fish and Wildlife Service (USFWS) (Sacramento Office)
- San Francisco Bay Conservation and Development Commission

Federal regulatory requirements and laws that apply to the Project include the following:

- National Environmental Policy Act, 42 *United States Code* (U.S.C.) Section 4321
- Federal Endangered Species Act (FESA), 16 U.S.C. Section 1531
- Migratory Bird Treaty Act, 16 U.S.C. Section 703 to 712
- Magnuson-Stevens Act, 16 U.S.C. Section 1801 to 1884
- Bald and Golden Eagle Protection Act, 16 U.S.C. Section 668 et seq.
- Executive Order 11990, Protection of Wetlands, 42 *Code of Federal Regulations* (CFR) 26921
- Executive Order 13112, Invasive Species, 64 CFR 6183
- Marine Mammal Protection Act (MMPA)

Applicable state laws and regulations include the following:

- California Environmental Quality Act (CEQA), *Public Resources Code* Section 21000 et seq.
- California Endangered Species Act of 1984 (CESA), California Fish and Game Code (FGC) Section 2050 et seq.
- Native Plant Protection Act of 1977, FGC Sections 1900 to 1913
- Protection of Migratory Birds, FGC Sections 3503, 3515, and 3800)

2.2 Database and Literature Review

Jacobs biologists conducted a literature review to investigate the potential presence of sensitive resources, special-status species, and critical habitats within the BSA and vicinity. A regional list of special-status wildlife and plant species was developed by querying databases, and each species was then evaluated to determine its potential to occur within the BSA. The following databases were queried:

- The species list from the USFWS Sacramento Office generated on March 6, 2026, for the boundary of the Project and areas which may be affected by the Project (Appendix A).
- The California Native Plant Society (CNPS) Inventory of Rare and Endangered Plants of California database was searched on March 6, 2026, for the USGS 7.5-minute San Rafael map and the surrounding eight quadrangles (Appendix A). These species are included in Table 3-4 in Section 3.3.
- The CDFW California Natural Diversity Database (CNDDB) was queried for all occurrence records within 2 miles of the BSA (Figures 2-1 and 2-2) on March 6, 2026. These species are included in Tables 3-4 and 3-5 in Section 3.3.
- An official NOAA Fisheries Species List generated on March 6, 2026, for the USGS 7.5-minute San Rafael map (Appendix A).
- The NOAA Fisheries California Species List Tool was queried for the USGS 7.5-minute San Rafael, San Quentin, and San Francisco North maps (NOAA Fisheries 2026e).
- The National Wetlands Inventory database (USFWS 2026) was reviewed to identify the presence of waters and wetlands in the BSA and to identify potential habitat for special-status aquatic species.
- The Natural Resources Conservation Service (NRCS) Web Soil Survey was reviewed, and maps were created (NRCS 2026) for wetlands analysis and potential habitat for special-status plant species analysis.
- The California State Clearinghouse CEQAnet database was reviewed for projects in the City of Larkspur between March 2026 and March 2027 for the cumulative impact analysis.

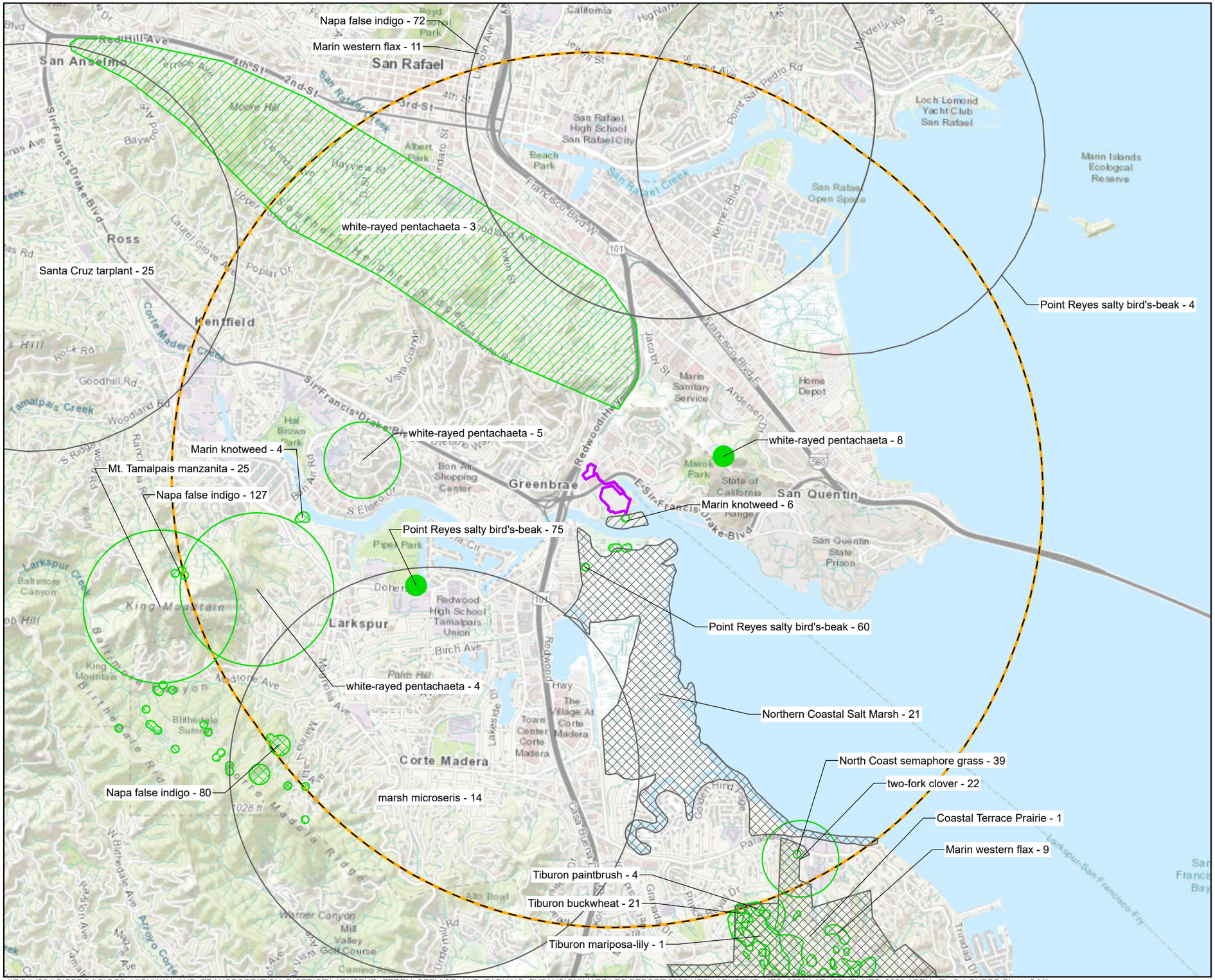
The result of the special-status species evaluations, including species potential for occurrence, is provided in Tables 3-3 through 3-5 in Section 3.3, and Appendix A. The determination of potential impacts to sensitive resources evaluated for this NES are provided in Sections 4.3 through 4.6.

2.3 Technical Studies

Technical studies were conducted during the preparation of this NES. Studies included surveys of protected resources and special-status species; these are described in the following subsections.

2.3.1 Aquatic Resource Delineation

An aquatic resource delineation was conducted for all waters of the U.S., including wetlands, occurring within the BSA. This delineation was conducted according to the methods outlined in the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region Version 2.0* (USACE 2008). Jacobs biologists visited the site on July 2, 2021, to conduct the delineation. An aquatic resource delineation was conducted for the 43.69-acre study area, which encompasses the Project area, including potential work locations, staging areas, and access routes. The delineation study area contained 4.68 acres of wetlands and 10.14 acres of non-wetland water. The survey report is included in Appendix B.



LEGEND

- Project Footprint (9.69 acres)
- 2-Miles from Project Footprint

CNDDB Plant Occurances

- Plant (specific bounded area with an 80-meter radius)
- Plant (specific, noncircular bounded area)
- Plant (nonspecific, bounded area)
- Plant (nonspecific, circular feature)
- Multiple (specific, noncircular bounded area)
- Multiple (nonspecific, bounded area)
- Multiple (nonspecific, circular feature)

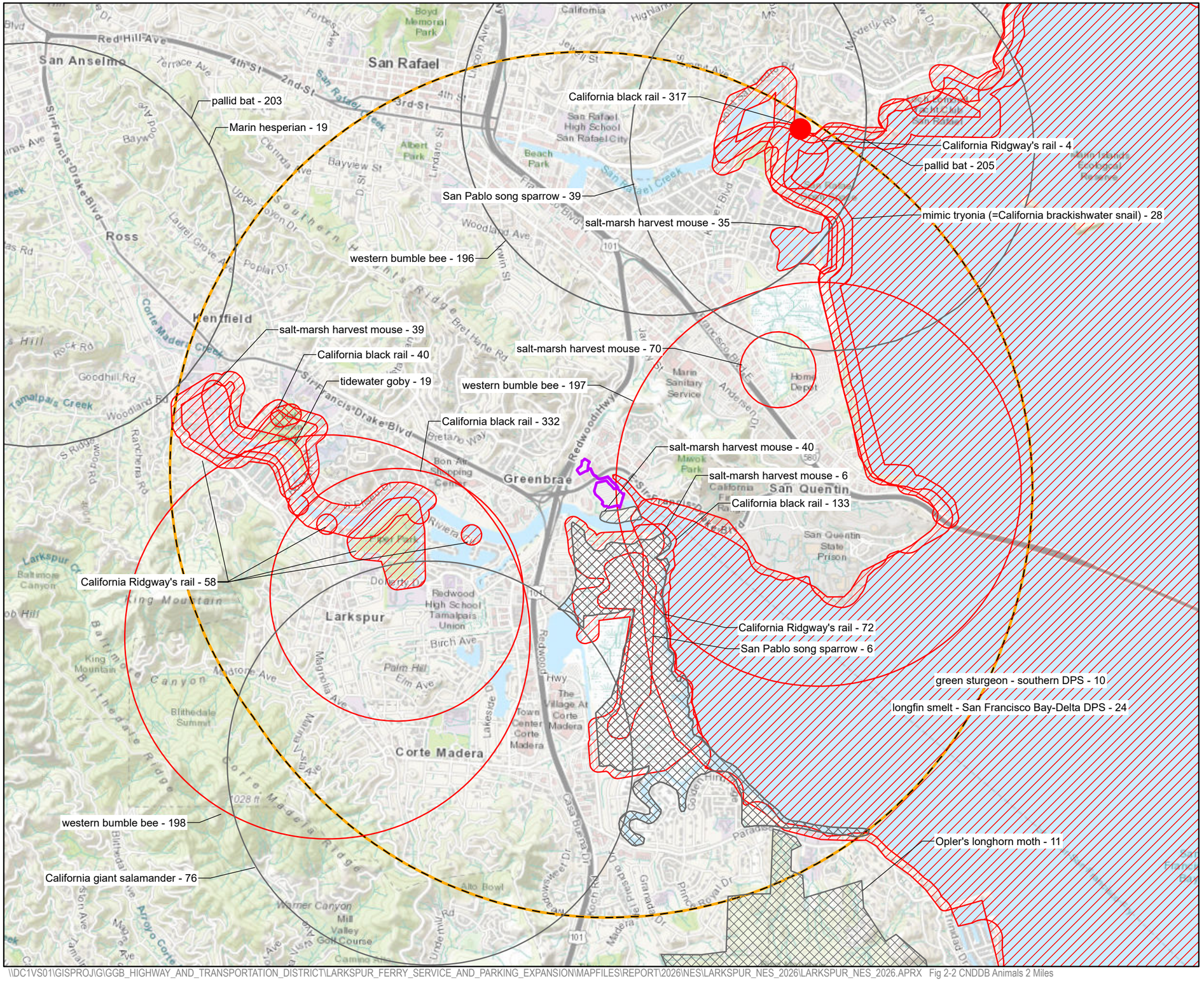
Note:
CNDDB version May 2026.
The occurrences shown on this map represent the known locations of the species listed here as of the date of this version. There may be additional occurrences or additional species within this area which have not yet been surveyed and/or mapped. Lack of information in the CNDDB about a species or an area can never be used as proof that no special status species occur in an area

Service Layer Credits: World Topographic Map: County of Marin, Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
World Hillshade: Esri, CGIAR, USGS

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Feet

Figure 2-1
CNDDB Plants 2 Miles
Larkspur Ferry Service and Parking Expansion Project
Golden Gate Bridge, Highway and Transportation District
Marin County, California





LEGEND

- Project Footprint (9.69 acres)
- 2-Miles from Project Footprint

CNDDB Occurrences

- Animal (specific bounded area with an 80-meter radius)
- Animal (specific, noncircular bounded area)
- Animal (nonspecific, bounded area)
- Animal (nonspecific, circular feature)
- Multiple (specific, noncircular bounded area)
- Multiple (nonspecific, bounded area)
- Multiple (nonspecific, circular feature)

Note:
CNDDB version May 2026.
The occurrences shown on this map represent the known locations of the species listed here as of the date of this version. There may be additional occurrences or additional species within this area which have not yet been surveyed and/or mapped. Lack of information in the CNDDB about a species or an area can never be used as proof that no special status species occur in an area

Service Layer Credits: World Topographic Map: County of Marin, Bureau of Land Management, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
World Hillshade: Esri, CGIAR, USGS

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Feet

Figure 2-2
CNDDB Animals 2 Miles
Larkspur Ferry Service and Parking Expansion Project
Golden Gate Bridge, Highway and Transportation District
Marin County, California

2.3.2 Plant Surveys

Jacobs biologists conducted a habitat assessment and plant inventory within the BSA on July 2, 2021, and again on March 18, 2026. All plant species encountered during site visits were identified to the extent necessary to determine whether they met the criteria as a federally or state-listed rare, threatened, or endangered species under FESA, CESA, CNPS, or CEQA. One rare (1B.2) plant, Point Reyes bird's beak (*Cordylanthus maritimus* ssp. *Palustris)*, was observed within Triangle Marsh during the 2021 survey. No federally or state-listed plant species or any other species of special concern were identified within the BSA during the 2026 survey. The observed plant list is included in Appendix C.

2.3.3 Ferry Wake Wash and Shoreline Erosion Analysis

The effects of existing ferry wakes on shoreline erosion were analyzed using numerical simulations validated by field measurements recorded from July 8 to 14, 2021 (Jacobs 2023). The area of interest consisted of the Corte Madera Channel, the mudflat and tidal marsh (Corte Madera Ecological Reserve) marsh to the southwest, the shoreline to the northeast of the Corte Madera Channel, docking facilities at the Greenbrae Boardwalk Community, and the Paradise Cay Yacht Harbor. Modeling for the new Liwa-class vessels was also completed in 2026. The relevant reports are included in Appendix D.

2.4 Survey Dates and Personnel

Table 2-1 summarizes the personnel and survey dates for each field study.

Table 2-1. Survey Dates and Personnel

Survey Type	Date	Objective	Personnel
Wetland Delineation	July 2, 2021	Delineate all waters of the U.S., including wetlands, occurring within the BSA	Jacobs biologists Kevin Fisher and Stephanie Owens
Ferry Wake Wash and Shoreline Erosion Analysis	July 8 to 14, 2021	Determine impacts due to ferry wake on receiving environment including shorelines	Jacobs senior principal engineer Claudio Fassardi
Habitat Assessment and Plant Inventory	March 18, 2026	Assess habitat in the BSA	Jacobs biologists Pim Laulikitnont-Lee and Annabel Li

2.5 Agency Coordination and Professional Contacts

There has been no correspondence with resource agencies to date.

2.6 Limitations that May Influence Results

Protocol-level surveys for special-status wildlife species were not performed. Each species' potential to occur was based on their known and expected ranges, historic observations, contemporary sightings, and presence of suitable habitat.

3. Environmental Setting

This section describes the physical and biological conditions of the BSA.

3.1 Terminology

The following terms are used to describe the Project:

- Project Footprint: The Project footprint consists of the areas of the Project's permanent and temporary direct impacts, including construction access, staging, and laydown areas (Figure 1-2).
- Biological Study Area: Encompasses the area within the Project footprint and a 350-foot-wide buffer (Figure 1-2). The BSA consists of an 11.51-acre area that encompasses the proposed parking garage footprints, bike parking, pedestrian improvements, the North Lot, adjacent marshes, and a portion of the San Francisco Bay.
- Project Buffer: The 350-foot buffer encompasses Triangle Marsh (a small saltmarsh immediately adjacent to the ferry terminal), landscaped areas, oak woodlands, and portions of Corte Madera Creek and San Francisco Bay.
- Ferry Route: The corridor from the Larkspur to Downtown San Francisco Terminals. The ferry route was considered to address the operational impacts of the Project on marine mammals.

3.2 Physical and Biological Conditions in the Biological Study Area

3.2.1 Regional Setting

The BSA lies on the eastern flank of Marin County along the northern San Francisco Bay, within the California Coast Ranges. It is characterized by a Mediterranean climate with cool, wet winters and warm, dry summers. The regional ecological setting includes a mosaic of oak woodland, mixed evergreen forest, chaparral, and coastal scrub on upland slopes, transitioning to tidal marsh, riparian corridors, and bay shoreline habitats at lower elevations. The biodiversity of the area is shaped by steep topography, marine influence, varied soils derived from Franciscan Complex geology, and a natural disturbance regime historically influenced by fire, all within a highly urbanized but still ecologically connected Bay Area landscape. Representative site photos are included in Appendix E.

3.2.2 Topography

The BSA is situated along the San Francisco Bay shoreline with elevations ranging from approximately -15 feet in the Larkspur Ferry Navigation Channel turning basin to 45 feet on Wood Island (Figure 1-2). The mouth of Corte Madera Creek and the Corte Madera Channel are situated along the western and southern boundaries of the study area. The Larkspur Ferry Navigation Channel within the eastern portion of the study area is dredged to maintain a depth of -13 feet, deepening to -15 feet in the turning basin at the channel's terminus. The majority of the central and northern portions of the BSA are developed for the ferry terminal, roads, and commercial real estate.

3.2.3 Geology and Soils

The BSA is underlain by marine and nonmarine (continental) sedimentary rocks of the Pleistocene era (about 2 million to 11,000 years ago) to the Holocene era (past 11,000 years) (CGS 2021). Soil series mapped within the BSA are shown on Figure 3-1 and summarized in Table 3-1. Four different types of soil occur within the BSA.

Table 3-1. Mapped Soil Series within or Adjacent to the Biological Study Area

Type/Series	Texture	Landscape Position and Parent Material	Drainage and Permeability	NRCS Hydric Soils List
Saurin-Bonnydoon complex, 15% to 30% slopes	Clay loam	On hills, formed in residuum weathered from sandstone and shale.	Somewhat excessively drained; high permeability	No
Tocaloma-Saurin association, steep	Clay Loam	On hills, formed in residuum weathered from sandstone and shale.	Well drained; high permeability	Yes
Xerorthents, fill	Silty clay loam	On tidal flats and valley floors, formed in earth spread deposits derived from igneous, metamorphic, and sedimentary rock.	Well to somewhat excessively drained; medium to very rapid runoff; moderate or moderately slow permeability	Yes
Xerorthents-Urban land complex, 0% to 9% slopes	N/A	On tidal flats and valley floors, formed in earth spread deposits.	N/A	Yes

Source: Web Soil Survey 2.0 (NRCS 2026)

3.2.4 Climate and Hydrology

The climate in the BSA vicinity consists of hot dry summers and cool moist winters with precipitation occurring mostly during winter (McNab et al. 2007). Monthly temperatures vary, with an average high of 67.7 degrees Fahrenheit (°F) in July and an average low of 48.7°F in January. Mean annual precipitation is 36.4 inches (WRCC 2021).

The hydrology of the study area is primarily influenced by tides in San Francisco Bay. Precipitation and fluvial hydrology have a negligible effect on the distribution of aquatic resources in the study area. The San Francisco Bay experiences mixed semi-diurnal tides, with a daily pattern of two high tides of different heights and two low tides of different heights (Conomos et al. 1985). NOAA operates a tidal station approximately 500 feet west of the study area. Tidal datums for this station are provided in Table 3-2.

Table 3-2. Tidal Datums at Corte Madera Creek (Station ID: 9414874)

Datum	Elevation (feet)
Mean Higher High Water	5.80
Mean High Water	5.20
Mean Sea Level	3.10
Mean Low Water	1.08
Mean Lower Low Water	0.00

Source: Tides & Currents (NOAA 2021). San Francisco, San Francisco Bay (Station ID 99414290) is the control tide station for the Corte Madera Creek station.

3.2.5 Vegetation Types

Outside of the developed parking lots and roadways, the vegetated areas of the BSA consist of landscaped (1.99 acres), patches of *Quercus agrifolia* (2.18 acres) on the western side of the BSA, rock and sparsely vegetation tidal zones (0.11 acre), ruderal land (0.56 acre), and marshland consisting of *Sarcocornia pacifica and Distichlis spicata* (4.69 acres) (Figure 3-1). An additional 9.19 acres of estuarine waters of the San Francisco Bay fall within the BSA.

3.3 Regional Species and Habitats of Concern

Tables 3-3 through 3-5 identify the special-status plant and wildlife species included on the CNDDB, USFWS, CNPS, and NOAA Fisheries species lists that have potential to occur in the BSA and along the ferry route. Figures 2-1 and 2-2 show CNDDB occurrences of these species within a 2-mile radius of the BSA. A complete list of species from the database searches is included in Appendix A.

Special-status plant species identified in Table 3-3 and Appendix A were evaluated for their potential to occur within the BSA. These plant species either were eliminated from further consideration, based on the absence of suitable habitat characteristics within the Project limits, or were not found during plant surveys. As reported in the observed plants list (Appendix C), no federally listed species were identified within the BSA. One rare plant (1B.2), Point Reyes bird's-beak (*Chloropyron maritimum* ssp. *palustre*), was observed.

Special-status wildlife species listed in Table 3-4 and Table 3-5 were evaluated for their potential to occur within the BSA (and along the ferry route, for marine reptiles and mammals). A species was not expected if: (1) suitable habitat was absent and (2) the BSA (or ferry route) was outside of the species' range.

The following special-status species have the potential or are known to occur in the BSA (or along the ferry route, as applicable):

- California sea lion (*Zalphus californianus*)
- Common bottlenose dolphin (*Tursiops truncatus*)
- Gray whale (*Eschrichtius robustus*)
- Harbor seal (*Phoca vitulina richardii*)
- Harbor porpoise (*Phocoena phocoena*)
- Humpback whale (*Megaptera novaengliae*)
- California Ridgway's rail (*Rallus longirostris obsoletus*)
- California black rail (*Laterallus jamaicensis coturniculus*)
- Salt marsh harvest mouse (*Reithrodontomys raviventris*)

Additional information on these species is detailed in Section 4. Designated critical habitat and Essential Fish Habitat (EFH) are also present within the BSA and ferry route as detailed in Section 4.4.3.1.





LEGEND

- Biological Study Area (44.51 acres)
- Project Footprint (9.69 acres)
- Mean High Tide

Vegetation Types

- California Annual and Perennial Grassland (1.33 AC)
- Developed (19.06 AC)
- Landscaped (1.99 AC)
- Quercus agrifolia (2.18 AC)
- Roadway (5.40 AC)
- Rock and Sparsely Vegetated Tidal Zone (0.11 AC)
- Ruderal (0.56 AC)
- Estuarine Waters (9.19 AC)
- Sarcocornia pacifica (Salicornia depressa) and Distichlis spicata (4.69 AC)

Note:
AC= acres

Service Layer Credits: World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
World Imagery: Microsoft, Vantor
Hybrid Reference Layer: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS

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Figure 3-1
Vegetation Types within the Footprint and BSA
Larkspur Ferry Service and Parking Expansion Project
Golden Gate Bridge, Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2026\NES\LARKSPUR_NES_2026\LARKSPUR_NES_2026.APRX Fig 3-1 Vegetation types

Table 3-3. Special-Status Plant Species with Potential to Occur in the Biological Study Area

Scientific Name	Common Name	Rare Plant Rank[a]	CESA List[b]	FESA List[b]	General Habitats[c]	Microhabitats and Notes	Potential to Occur
Abronia umbellata var. *breviflora*	Pink sand verbena	1B.2	–	–	Coastal dunes	Most occurrences have few plants	None. No suitable habitat present.
Agrostis blasdalei	Blasdale's bent grass	1B.2	–	–	Coastal bluff scrub	Coastal dunes and coastal prairie	None. No suitable habitat present.
Alopecurus aequalis var. *sonomensis*	Sonoma alopecurus	1B.1	–	E	Freshwater marshes and swamps and riparian scrub	Wet areas, marshes, and riparian banks with other wetland species. Two occurrences introduced in 1987 (485C, 485D), but both appear to have failed as of 1993	None. Outside of known species range.
Amorpha californica var. *napensis*	Napa false indigo	1B.2	–	–	Broadleafed upland forest (openings)	Chaparral and Cismontane woodland	None. No suitable habitat present.
Amsinckia lunaris	Bent-flowered fiddleneck	1B.2	–	–	Coastal bluff scrub	Cismontane woodland and valley and foothill grassland	None. No suitable habitat present.
Arctostaphylos franciscana	Franciscan manzanita	1B.1	–	E	Coastal scrub	Serpentinite soils	None. No suitable habitat present.
Arctostaphylos hookeri var. *ravenii*	Presidio manzanita	1B.1	E	E	Serpentinite outcrop, chaparral, coastal prairie, and coastal scrub	Known from only one extant native occurrence at the Presidio in San Francisco	None. Outside of known species range.
Arctostaphylos pallida	Pallid manzanita	1B.1	E	T	Siliceous shale, sandy or gravelly soils, broadleafed upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, and coastal scrub	Known from fewer than 10 occurrences in the Contra Costa Hills of the Diablo Range	None. Outside of known species range.
Arctostaphylos virgata	Marin manzanita	1B.1	T	T	Broadleafed upland forest, closed-cone coniferous forest, chaparral and North Coast coniferous forest	Sandstone or granitic soils	None. No suitable habitat present.
Arenaria paludicola	Marsh sandwort	1B.1	E	E	Sandy, openings, marshes and swamps (freshwater or brackish)	Known from only two natural occurrences in Black Lake Cyn and at Oso Flaco Lake	None. No suitable habitat present.
Astragalus pycnostachyus var. *pycnostachyus*	Coastal marsh milk-vetch	1B.2	–	–	Coastal dunes (mesic)	Coastal scrub, marshes, and swamps (coastal salt, streamsides)	None. No suitable habitat present.
Astragalus tener var. *tener*	Alkali milk-vetch	1B.2	–	–	Alkaline soils	Playas, valley and foothill grassland (adobe clay), and vernal pools	None. No suitable habitat present.
Blennosperma bakeri	Sonoma sunshine	1B.1	E	E	Vernal pools and valley and foothill grassland	Vernal pools and swales (10 to 110 meters)	None. No suitable habitat present.
Calochortus tiburonesis	Tiburon mariposa-lily	1B.1	T	T	Valley and foothill grassland	Serpentinite soils	None. No suitable habitat present.
Campanula californica	Swamp harebell	1B.2	–	–	Bogs and fens, closed-cone coniferous forest, coastal prairie, meadows and seeps, marshes and swamps (freshwater), and North Coast coniferous forest	Mesic soils	None. No suitable habitat present.
Castilleja ambigua var. *humboldtiensis*	Humboldt Bay owl's-clover	1B.2	–	–	Marshes and swamps	Coastal salt marsh	Low to Moderate. Although low-quality, suitable habitat is present in the BSA within Triangle Marsh. No impacts on salt marsh habitat are expected.
Castilleja affinis var. *neglecta*	Tiburon paintbrush	1B.2	T	E	Valley and foothill grassland	Serpentinite soils	None. No suitable habitat present.

Scientific Name	Common Name	Rare Plant Rank[a]	CESA List[b]	FESA List[b]	General Habitats[c]	Microhabitats and Notes	Potential to Occur
Ceanothus masonii	Mason's ceanothus	1B.2	–	–	Chaparral and rocky openings	Serpentinite soils. Known from approximately five occurrences	None. Outside of habitat range.
Chloropyron maritimum ssp. *Palustre*	Point Reyes salty bird's-beak	1B.2	–	–	Marshes and swamps	Coastal salt marsh	Present. Species was found during the July 2021 plant survey within Triangle Marsh. No impacts on marsh habitat is expected.
Chorizanthe cuspidata var. *cuspidata*	San Francisco Bay spineflower	1B.2	–	–	Coastal bluff scrub, coastal dunes, coastal prairie, coastal scrub	Sandy soils	None. No suitable habitat present.
Chorizanthe robusta var. *robusta*	Robust spineflower	1B.1	–	E	Chaparral (maritime), cismontane woodland (openings), coastal dunes and coastal scrub	Sandy or gravelly soils; most populations extirpated, and now known from only six extended occurrences	None. No suitable habitat present.
Chorizanthe valida	Sonoma spineflower	1B.1	E	E	Coastal prairie	Sandy soil (10 to 50 meters)	None. No suitable habitat present.
Cirsium andrewsii	Franciscan thistle	1B.2	–	–	Broadleafed upland forest, coastal bluff scrub, coastal prairie, and coastal scrub	Mesic, sometimes serpentinite soils	None. No suitable habitat present.
Cirsium hydrophilum var. *vaseyi*	Mount Tamalpais thistle	1B.2	–	–	Serpentinite seeps, broadleafed upland forest, chaparral, meadows, and seeps	Known from fewer than 20 occurrences on Mount Tamalpais	None. No suitable habitat present.
Clarkia franciscana	Presidio clarkia	1B.1	E	E	Coastal scrub, valley, and foothill grassland (serpentinite)	Known from fewer than five occurrences	None. No suitable habitat present.
Collinsia corymbosa	Round-headed Chinese-houses	1B.2	–	–	Coastal dunes	Scattered distribution	None. No suitable habitat present.
Collinsia multicolor	San Francisco Collinsia	1B.2	–	–	Closed-cone coniferous forest and coastal scrub	Sometimes serpentinite soils	None. No suitable habitat present.
Cordylanthus mollis ssp. *mollis*	Soft Bird's-Beak	1B.1	–	E	Marshes and swamps	Coastal salt Marsh	Low to Moderate. Although low-quality, suitable habitat is present in the BSA within Triangle Marsh.
Delphinium luteum	Yellow larkspur	1B.1	–	E	Chaparral, coastal prairie, and coastal scrub	Endemic to a couple of occurrences hanging on in Sonoma County; north-facing rocky slopes (0 to 100 meters)	None. No suitable habitat present.
Dirca occidentalis	Western leatherwood	1B.2	–	–	Broadleafed upland forest, closed-cone coniferous forest, chaparral, cismontane woodland, North Coast coniferous forest, riparian forest, and riparian woodland	Mesic soils	None. No suitable habitat present.
Eriogonum luteolum var. *caninum*	Tiburon buckwheat	1B.2	–	–	Chaparral, cismontane woodland, coastal prairie, valley, and foothill grassland	Serpentinite, sandy to gravelly soils	None. No suitable habitat present.
Erysimum concinnum	Bluff wallflower	1B.2	–	–	Coastal bluff scrub, coastal dunes, and coastal prairie	Largest occurrence known from Point Reyes; possibly of hybrid origin	None. No suitable habitat present.
Fissidens pauperculus	Minute pocket moss	1B.2	–	–	North Coast coniferous forest	Damp coastal soil	None. No suitable habitat present.
Fritillaria lanceolata var. *tristulis*	Marin checker-lily	1B.1	–	–	Coastal bluff scrub, coastal prairie, and coastal scrub	–	None. No suitable habitat present.
Fritillaria liliacea	Fragrant fritillary	1B.2	–	–	Cismontane woodland, coastal prairie, coastal scrub; and valley and foothill grassland	Often serpentinite soils	None. No suitable habitat present.

Scientific Name	Common Name	Rare Plant Rank[a]	CESA List[b]	FESA List[b]	General Habitats[c]	Microhabitats and Notes	Potential to Occur
Gilia capitala ssp. *Chamissonis*	Blue coast gilia	1B.1	–	–	Coastal dunes and coastal scrub	–	None. No suitable habitat present.
Gilia capitala ssp. *Tomentosa*	Woolly-headed gilia	1B.1	–	–	Coastal bluff scrub, and valley and foothill grassland	Serpentinite, rocky, outcrops	None. No suitable habitat present.
Gilia millefoliata	Dark-eyed gilia	1B.2	–	–	Coastal dunes	–	None. No suitable habitat present.
Helianthella castanea	Diablo helianthella	1B.2	–	–	Broadleafed upland forest, chaparral, cismontane woodland, coastal scrub, riparian woodland, valley and foothill grassland	Usually rocky, axonal soils; often in partial shade	None. No suitable habitat present.
Hemizonia congesta ssp. *Congesta*	Congested-headed hayfield tarplant	1B.2	–	–	Valley and foothill grassland	Sometimes roadsides	None. No suitable habitat present.
Hesperolinon congestun	Marin western flax	1B.1	T	T	Chaparral and valley and foothill grassland	Serpentinite soils	None. No suitable habitat present.
Holocarpha macradenia	Santa Cruz tarplant	1B.1	E	T	Often clay, sandy, coastal prairie, coastal scrub, valley and foothill grassland	All extant Contra Costa County. Occurrences are introduced and nearly half have failed; last remaining natural population in the San Francisco Bay Area extirpated by development in 1993	None. Outside of known species range.
Horkelia cuneate var. *sericea*	Kellogg's horkelia	1B.1	–	–	Closed-cone coniferous forest, chaparral (maritime), coastal dunes, and coastal scrub	Sandy or gravelly, openings	None. No suitable habitat present.
Horkelia marinensis	Point Reyes horkelia	1B.2	–	–	Coastal dunes, coastal prairie, and coastal scrub	Sandy soils	None. No suitable habitat present.
Horkelia tenuiloba	Thin-lobed horkelia	1B.2	–	–	Broadleafed upland forest, chaparral, and valley and foothill grassland	Mesic openings, sandy soils	None. No suitable habitat present.
Lasthenia californica ssp. *Macrantha*	Perennial goldfields	1B.2	–	–	Coastal bluff scrub, coastal dunes, and coastal scrub	Threatened by competition from non-native plants and recreational activities	None. No suitable habitat present.
Lasthenia conjungens	Contra Costa goldfields	1B.1	–	–	Coastal scrub, meadows and seeps, and marshes and swamps	Closed-cone coniferous forest (openings)	None. No suitable habitat present.
Layia carnosa	Beach Layia	1B.1	E	E	Coastal dunes and coastal scrub	Sandy soils	None. No suitable habitat present.
Leptosiphon croceus	Coast yellow leptosiphon	1B.1	–	–	Coastal bluff scrub	Coastal prairie	None. No suitable habitat present.
Leptosiphon rosaceus	Rose leptosiphon	1B.1	–	–	Coastal bluff scrub	Possibly threatened by competition and non-native plants	None. No suitable habitat present.
Lessingia germanorum	San Francisco lessingia	1B.1	E	E	Coastal scrub (remnant dunes)	Known from only four occurrences at the Presidio (San Francisco County), and one on San Bruno Mountain (San Mateo County)	None. No suitable habitat present.
Lessingia micradenia var. *micradenia*	Tamalpias lessingia	1B.2	–	–	Chaparral and valley and foothill grassland	Usually serpentinite, soils often roadsides; known from only four occurrences in the Mount Tamalpais area	None. No suitable habitat present.
Lilaeopsis masonii	Mason's lilaeopsis	1B.1	–	–	Riparian scrub	Marshes and swamps (brackish or freshwater)	None. No suitable habitat present.
Lilium maritimum	Coastal marsh milk-vetch	1B.1	–	–	Coastal dunes (mesic), and coastal scrub	Marshes and swamps (coastal salt, streamsides)	None. No suitable habitat present.

Scientific Name	Common Name	Rare Plant Rank[a]	CESA List[b]	FESA List[b]	General Habitats[c]	Microhabitats and Notes	Potential to Occur
Limnanthes vinculans	Sebastopol meadowfoam	1B.1	E	E	Mesic meadows, vernal pools, and valley and foothill grassland	Only known from Napa and Sonoma Counties; swales, wet meadows, and marshy areas in valley oak savanna; on poorly drained soils of clays and sandy loam (15 to 115 meters)	None. No suitable habitat present.
Microseris paludosa	Marsh microseris	1B.2	–	–	Closed-cone coniferous forest, cismontane woodland, coastal scrub, and valley and foothill grassland	–	None. No suitable habitat present.
Navarretia leucocephala ssp. *Bakeri*	Baker's navarretia	1B.1	–	–	Cismontane woodland, meadows and seeps, vernal pools, valley and foothill grassland, and lower montane coniferous forest	Vernal pools and swales; adobe or alkaline soils (5 to 1,740 meters)	None. No suitable habitat present.
Navarretia rosulata	Marin County navarretia	1B.2	–	–	Closed-cone coniferous forest and chaparral	Serpentinite and rocky soils	None. No suitable habitat present.
Pentachaeta bellidiflora	White-rayed pentachaeta	1B.1	E	E	Cismontane woodland, and valley and foothill grassland	Often serpentinite; historical occurrences lost to development	None. Outside of habitat range.
Phacelia insularis var. *continentis*	North coast phacelia	1B.2	–	–	Sandy, sometimes rocky, coastal bluff scrub, and coastal dunes	Known from fewer than 20 occurrences	None. Outside of habitat range.
Plagiobothrys chorisianus var. *chorisianus*	Choris' popcornflower	1B.2	–	–	Mesic	Chaparral, coastal prairie, and coastal scrub	None. Outside of habitat range.
Plagiobothrys diffusis	San Francisco popcornflower	1B.1	E	–	Coastal prairie	Valley and foothill grassland	None. No suitable habitat present.
Plagiobothrys strictus	Calistoga popcornflower	1B.1	T	E	Meadows and seeps, valley and foothill grassland, and vernal pools	Alkaline areas near thermal spring; known from only two extant occurrences near Calistoga	None. No suitable habitat present.
Pleuopogon hooverianus	North coast semaphore grass	1B.1	T	–	Broadleafed upland forest, meadows and seeps, and north coast coniferous forest	Open areas and mesic soils	Present. There is an extant occurrence of the species within the BSA. However, there will be no impact on vegetated areas. The species was not found during botanical surveys.
Rhynchospora californica	California beaked-rush	1B.1	–	–	Lower montane coniferous forest, meadows and seeps (seeps), and marshes and swamps (freshwater)	Bogs and fens	None. No suitable habitat present.
Sanicula maritima	Adobe sanicle	1B.1	–	–	Chaparral, coastal prairie, meadows and seeps, and valley and foothill grassland	Clay and serpentinite soils	None. No suitable habitat present.
Sidalcea calycosa ssp. *Rhizomata*	Point Reyes checkerbloom	1B.1	–	–	Marshes and swamps	Freshwater and near the coast	None. No suitable habitat present.
Silene verecunda ssp. *Verecunda*	San Francisco campion	1B.2	–	–	Coastal bluff scrub, chaparral, coastal prairie, coastal scrub, and valley and foothill grassland	Sandy soils	None. No suitable habitat present.
Stebbinsoseris decipiens	Santa Cruz microseris	1B.2	–	–	Broadleafed upland forest, closed-cone coniferous forest, chaparral, coastal prairie, coastal scrub, and valley and foothill grassland	Open areas, sometimes serpentinite soils	None. No suitable habitat present.
Streptanthus glandulosus ssp. *Niger*	Tiburon jewelflower	1B.1	E	E	Valley and foothill grassland	Serpentinite soils	None. No suitable habitat present.

Scientific Name	Common Name	Rare Plant Rank[a]	CESA List[b]	FESA List[b]	General Habitats[c]	Microhabitats and Notes	Potential to Occur
Streptanthus glandulosus ssp. *Pulchellus*	Mount Tamalpias thistle	1B.2	–	–	Chaparral and valley and foothill grassland	Serpentinite soils	None. No suitable habitat present.
Suaeda californica	California Seablite	1B.1	–	E	Marshes and swamps	Coastal salt; currently only known from fragmented populations in San Francisco Bay Area and Morro Bay	Low. Suitable habitat is disturbed, and species was not observed during botanical surveys.
Symphyotrichum lentum	Suisun Marsh aster	1B.2	–	–	Marshes and swamps	Brackish and freshwater	None. Outside of habitat range.
Trifolium amoenum	Two-fork clover	1B.1	–	E	Coastal bluff scrub and valley and foothill grassland	Sometimes serpentinite soils; rediscovered in 1993 by P. Conners near Occidental; only one plant found	None. No suitable habitat present.
Trifolium hydrophilum	Saline clover	1B.2	–	–	Marshes and swamps, valley and foothill grassland, and vernal pools	Mesic and alkaline soils	None. No suitable habitat present.
Triphysaria floribunda	San Francisco owl's clover	1B.2	–	–	Coastal prairie, coastal scrub and valley and foothill grassland	Usually serpentinite soils	None. No suitable habitat present.
Triquetrella californica	Coastal triquetrella	1B.2	–	–	Coastal bluff scrub and coastal scrub	–	None. No suitable habitat present.

Sources: Inventory of Rare and Endangered Plants (CNPS 2026); California Natural Diversity Database (CDFW 2026b); and Information for Planning and Conservation (USFWS 2026).

[a] CNPS rankings:

1A = Plants presumed extirpated in California and either rare or extinct elsewhere

1B = Plants rare, threatened, or endangered in California and elsewhere

.1 = Seriously threatened in California (over 80% of occurrences threatened/high degree and immediacy of threat)

.2 = Moderately threatened in California (20-80% occurrences threatened/moderate degree and immediacy of threat)

[b] CESA and FESA listings: E = Endangered; T = Threatened

[c] California Natural Diversity Database (CDFW 2026b).

Table 3-4. Special-Status Animal Species with Potential to Occur in the Biological Study Area

Scientific Name	Common Name	Federal[a] and State[b] Status	General Habitat Requirements	Microhabitat and Notes	Potential to Occur
Invertebrates					
Branchinecta conservatio	Conservancy Fairy Shrimp	FE/–	Endemic to the grasslands of the northern two-thirds of the Central Valley; found in large, turbid pools	Inhabit astatic pools located in swales formed by old, braided alluvium; filled by winter/spring rains, last until June	None. No suitable habitat is within the BSA for this species.
Callophrys mossii bayensis	San Bruno Elfin Butterfly	FE/–	Coastal, mountainous areas with grassy ground cover, mainly in the vicinity of San Bruno Mountain, San Mateo County	Colonies are located on steep, north-facing slopes within the fog belt. Larval host plant is *Sedum spathulifolium*	None. No suitable habitat is within the BSA for this species.
Euphydryas editha bayensis	Bay checkerspot butterfly	FT/–	Restricted to native grasslands on outcrops of serpentine soil in the vicinity of San Francisco Bay	*Plantago erecta* is the primary host plant; *Orthocarpus densiflorus* and *Orthocarpus purpurscens* are the secondary host plants	None. No suitable habitat is within the BSA for this species.
Lavinia symmetricus ssp.	Tomales roach	–/SSC	Tributaries to Tomales Bay	–	None. No suitable habitat is within the BSA for this species.
Plebejus icarioides missionensis	Mission Blue Butterfly	FE/–	Inhabits grasslands of the San Francisco Peninsula	Three larval host plants: *Lupinus albifrons*, *L. varicolor*, and *L. formosus*, of which *L. albifrons* is favored	None. No suitable habitat is within the BSA for this species.
Speyeria callippe callippe	Callippe Silverspot Butterfly	FE/–	Restricted to the northern coastal scrub of the San Francisco Peninsula	Hostplant is *Viola pedunculata*; most adults found on east-facing slopes; males congregate on hilltops in search of females	None. No suitable habitat is within the BSA for this species.
Speyeria zerene myrtleae	Myrtle's Silverspot Butterfly	FE/–	Restricted to the foggy, coastal dunes/hills of the Point Reyes peninsula; extirpated from coastal San Mateo County	Larval foodplant thought to be *Viola adunca*	None. No suitable habitat is within the BSA for this species.
Syncaris pacifica	California Freshwater Shrimp	FE/SE	Endemic to Marin, Napa, and Sonoma Counties; found in low elevation, low gradient streams where riparian cover is moderate to heavy	Shallow pools away from main streamflow; winter: undercut banks with exposed roots; summer: leafy branches touching water	None. No suitable habitat is within the BSA for this species.
Haliotis cracherodii	Black Abalone	FE/–	This species is increasingly rare within the San Francisco Bay	Occurs in rocky intertidal zones throughout the California coast	None. Suitable habitat is not present within the BSA.
Fish					
Acipenser medirostris	North American Green Sturgeon	FT/SSC	These are the most common marine species of sturgeon; abundance increases northward of Point Conception; spawns in the Sacramento River	Spawns at temperatures between 8°C to 14°C; preferred spawning substrate is large cobble, but can range from clean sand to bedrock	Moderate. Juveniles could feed and rear in tidal channel of Corte Madera Creek in BSA. Critical habitat includes Corte Madera Creek in the BSA. Although this species could occur within the BSA, sound and vibratory impacts from pile driving and other Project-related activities are not anticipated to impact any fish in the BSA.
Acipenser transmontanus	White Sturgeon	-/CS	Primarily reside in large rivers and their associated estuaries, including the Sacramento-San Joaquin system in California, the Fraser River (British Columbia), and the Columbia River and its tributaries (Washington, Oregon, and Idaho).	White Sturgeon in the Sacramento-San Joaquin system represent the southernmost spawning population of the species.	Moderate. Juveniles could feed and rear in tidal channel of Corte Madera Creek in BSA. Although this species could occur within the BSA, sound and vibratory impacts from pile driving and other Project-related activities are not anticipated to impact any fish in the BSA.

Scientific Name	Common Name	Federal[a] and State[b] Status	General Habitat Requirements	Microhabitat and Notes	Potential to Occur
Eucyclogobius newberryi	Tidewater goby	FE/SSC	Brackish water habitats along the California coast from Agua Hedionda lagoon, San Diego County to the mouth of the Smith River	Found in shallow lagoons and lower stream reaches, they need fairly still but not stagnant water and high oxygen levels	Not Expected. No suitable habitat is within the BSA for this species.
Hypomesus transpacificus	Delta smelt	FT/SE, SSC	Sacramento-San Joaquin Delta. Seasonally in Suisun Bay, Carquinez Strait, and San Pablo Bay	Seldom found at salinities greater than 10 parts per 1,000; most often at salinities less than 2 parts per 1,000	Not Expected. No suitable habitat is within the BSA for this species.
Oncorhynchus kisutch	Coho salmon (Central California Coast ESU)	FE/SE	Federal listing = populations between Punta Gorda and San Lorenzo River; state listing = populations south of Punta Gorda	Require beds of loose, silt-free, coarse gravel for spawning; also need cover, cool water and sufficient dissolved oxygen	Low. No suitable habitat is present in the BSA, and the species is extirpated from San Francisco and San Pablo bays and their tributaries. Critical habitat includes Corte Madera Creek in the BSA. Although this species could occur within the BSA, sound and vibratory impacts from pile driving and other Project-related activities are not anticipated to impact any fish in the BSA.
Oncorhynchus mykiss irideus	Steelhead (Central California Coast DPS)	FT/–	Central California Coast DPS: from Russian River, south to Soquel Creek and to, but not including, Pajaro River; also San Francisco and San Pablo Bay Basins	Require beds of loose, silt-free, coarse gravel for spawning; juveniles require deep water with overhead cover for protection from predators for over-summering habitat. Juvenile steelhead favor areas with cool, clear, fast-flowing riffles, ample riparian cover and undercut banks, and diverse and abundant invertebrate life	High. Suitable migration habitat for adults and juveniles (smolts) and potential rearing habitat for juveniles is present upstream of the BSA in Corte Madera Creek. Spawning habitat occurs upstream of the BSA in flowing, freshwater reaches of Corte Madera Creek and tributaries. Critical habitat includes Corte Madera Creek in the BSA. Although this species could occur within the BSA, sound and vibratory impacts from pile driving and other Project-related activities are not anticipated to impact any fish in the BSA.
Oncorhynchus mykiss irideus	Steelhead (Central Valley DPS)	FT/–	Central Valley DPS: populations in the Sacramento and San Joaquin rivers and their tributaries	Require beds of loose, silt-free, coarse gravel for spawning; juveniles require deep water with overhead cover for protection from predators for over-summering habitat. Juvenile steelhead favor areas with cool, clear, fast-flowing riffles, ample riparian cover and undercut banks, and diverse and abundant invertebrate life	Moderate. This DPS spawns in the mainstem and tributaries of the Sacramento and San Joaquin rivers. Strays of this DPS are common in the Bay Area watersheds. Although this species could occur within the BSA, sound and vibratory impacts from pile driving and other Project-related activities are not anticipated to impact any fish in the BSA.
Oncorhynchus tshawytscha	Chinook salmon (Sacramento River winter-run ESU)	FE/SE	Sacramento River winter-run: Sacramento River below Keswick Dam, spawns in the Sacramento River but not in tributary streams	Requires clean, cold water over gravel beds with water temperatures between 6 and 14°C for spawning	Low. This ESU spawns in the mainstem and tributaries of the Sacramento River. Species could occur in transit to or from spawning areas. Although this species could occur within the BSA, sound and vibratory impacts from pile driving and other Project-related activities are not anticipated to impact any fish in the BSA.
Oncorhynchus tshawytscha	Chinook salmon (Central Valley spring-run ESU)	FT/ST	Central Valley spring-run: adult numbers depend on pool depth and volume, amount of cover, and proximity to gravel; water temperatures more than 27°C are lethal to adults	Requires clean, cold water over gravel beds with water temperatures between 6 and 14°C for spawning	Low. This ESU spawns in the mainstem and tributaries of the Sacramento and San Joaquin rivers. Species could occur in transit to or from spawning areas. Although this species could occur within the BSA, sound and vibratory impacts from pile driving and other Project-related activities are not anticipated to impact any fish in the BSA.

Scientific Name	Common Name	Federal[a] and State[b] Status	General Habitat Requirements	Microhabitat and Notes	Potential to Occur
Pogonichthys macrolepidotus	Sacramento splittail	–/SSC	Endemic to the lakes and rivers of the Central Valley, but now confined to the Delta, Suisun Bay and associated marshes	Slow-moving river sections, dead end sloughs; requires flooded vegetation for spawning and foraging for young	Not Expected. No suitable habitat is within the BSA for this species, and it is outside of its known range.
Spirinchus thaleichthys	Longfin smelt	C/ST, SSC	Euryhaline, nektonic, and anadromous; found in open waters of estuaries, mostly in middle or bottom of water column	Prefer salinities of 15 to 30 parts per thousand but can be found in completely freshwater to almost pure seawater	Low. Species is known to occur in San Pablo and San Francisco bays. May occasionally be present in the BSA. Although this species could occur within the BSA, sound and vibratory impacts from pile driving and other Project-related activities are not anticipated to impact any fish in the BSA.
Thaleichthys pacificus	Eulachon	FT/–	Found in Klamath River, Mad River, Redwood Creek and in small numbers in Smith River and Humboldt Bay tributaries	Spawn in lower reaches of coastal rivers with moderate water velocities and bottom of pea-sized gravel sand and woody debris	Not Expected. No suitable habitat is within the BSA for this species, and it is outside of its known range.
Amphibians					
Rana boylii	Foothill yellow legged frog	–/SSC	Partly shaded, shallow streams and riffles with a rocky substrate in a variety of habitats	Need at least some cobble-sized substrate for egg-laying, and at least 15 weeks to attain metamorphosis	None. No suitable habitat is within the BSA for this species.
Rana draytonii	California red-legged frog	FT/SSC	Lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent vegetation	Requires 11 to 20 weeks of permanent water for larval development and have access to aestivation habitat	None. No suitable habitat is within the BSA for this species.
Reptiles					
Emys marmorata	Western pond turtle	–/SSC	A thoroughly aquatic turtle of ponds, marshes, rivers, streams and irrigation ditches, usually with aquatic vegetation, below 6,000-foot elevation	Need basking sites and suitable (sandy banks or grassy open fields) upland habitat up to 0.5 kilometer from water for egg-laying	None. No suitable habitat is within the BSA for this species.
Masticophis lateralis euryxanthus	Alameda whipsnake	FT/SE	Typically found in chaparral and scrub habitats, but will also use adjacent grassland, oak savanna, and woodland habitats	Mostly south-facing slopes and ravines, with rock outcrops, deep crevices, or abundant rodent burrows	None. No suitable habitat is within the BSA for this species.
Thamnophis sirtalis tetrataenia	San Francisco Garter Snake	FE/SE, FP	Vicinity of freshwater marshes, ponds, and slow-moving streams in San Mateo County and extreme northern Santa Cruz County	Prefers dense cover and water depths of at least 1 foot; upland areas near water are also very important	None. No suitable habitat is within the BSA for this species.
Birds					
Asia flammeus	Short-eared owl	–/SSC	Found in swamp lands, both fresh and salt; lowland meadows, and irrigated alfalfa fields	Tule patches/tall grass needed for nesting/daytime seclusion; nests on dry ground in depression concealed in vegetation	None. No suitable habitat is within the BSA for this species.
Athene cunicularia	Burrowing owl	–/SSC	Open, dry annual or perennial grasslands, and deserts and scrublands characterized by low-growing vegetation	Subterranean nester, dependent upon burrowing mammals, most notably, the California ground squirrel	None. No suitable habitat is within the BSA for this species.
Brachyramphus marmoratus	Marbled Murrelet	FT/SE	Feeds nearshore; nests inland along coast from Eureka to Oregon Border and Half Moon Bay to Santa Cruz	Nests in old-growth redwood-dominated forests, up to 6 miles inland, often in Douglas fir	None. No suitable habitat is within the BSA for this species.
Charadrius alexandrines nivosus	Western Snowy Plover	FT/SSC	Sandy beaches, salt pond levees, and shores of large alkali lakes	Needs sandy, gravelly, or friable soils for nesting	None. No suitable habitat is within the BSA for this species.

Scientific Name	Common Name	Federal[a] and State[b] Status	General Habitat Requirements	Microhabitat and Notes	Potential to Occur
Circus cyaneus	Northern harrier	–/SSC	Coastal salt and freshwater marsh; nest and forage in grasslands, from salt grass in desert sink to mountain ciénegas	Nests on ground in shrubby vegetation, usually at marsh edge; nest built of a large mound of sticks in wet areas	None. No suitable habitat is within the BSA for this species.
Coccyzus americanus	Yellow-billed Cuckoo	FT/SE	Riparian forest nester, along the broad, lower flood-bottoms of larger river systems	Nests in riparian jungles of willow, often mixed with cottonwoods, with lower story of blackberry, nettles, or wild grape	None. No suitable habitat is within the BSA for this species.
Cypseloides niger	Black swift	–/SSC	Coastal belt of Santa Cruz and Monterey Counties; central and southern Sierra Nevada; San Bernardino and San Jacinto Mountains	Breeds in small colonies on cliffs behind or adjacent to waterfalls in deep canyons and sea bluffs above the surf; forages widely	None. No suitable habitat is within the BSA for this species.
Elanus leucurus	White-tailed kite	–/FP	Rolling foothills and valley margins with scattered oaks and river bottomlands or marshes next to deciduous woodland	Open grasslands, meadows, or marshes for foraging close to isolated, dense-topped trees for nesting and perching	None. No suitable habitat is within the BSA for this species.
Geothlypis trichas sinuosa	Saltmarsh common yellowthroat	–/SSC	Resident of the San Francisco Bay region, in fresh and salt water marshes	Requires thick, continuous cover down to water surface for foraging; tall grasses, tule patches, and willows for nesting	None. No suitable habitat is within the BSA for this species but could occur in adjacent marshes.
Laterallus jamaicensis coturniculus	California black rail	–/ST, FP	Inhabits freshwater marshes, wet meadows, and shallow margins of saltwater marshes bordering larger bays	Needs water depths of about 1 inch that do not fluctuate during the year and dense vegetation for nesting habitat	High. This species has been found in the BSA (CDFW 2026b): however, the area of the BSA that could be negatively affected by noise contains low-quality habitat, and the California black rail are not expected to be present there.
Melospiza melodia pusillula	Alameda song sparrow	–/SSC	Resident of salt marshes bordering south arm of San Francisco Bay	Inhabits Salicornia marshes; nests low in *Grindelia* bushes (high enough to escape high tides) and in *Salicornia*	None. No suitable habitat is within the BSA for this species.
Melospiza melodia samuelis	San Pablo song sparrow	–/SSC	Resident of salt marshes along the north side of San Francisco and San Pablo bays	Inhabits tidal sloughs in the Salicornia marshes; nests in Grindelia bordering slough channels	None. No suitable habitat is within the BSA for this species.
Phoebastria albatrus	Short-tailed albatross	FE/SSC	Nest on sloping grassy terraces on two rugged, isolated, windswept islands in Japan	After breeding, short-tailed albatrosses move to feeding areas in the North Pacific	None. No suitable habitat is within the BSA for this species.
Rallus longirostris obsoletus	California Ridgway's rail	FE/SE, FP	Saltwater and brackish marshes traversed by tidal sloughs in the vicinity of San Francisco Bay	Associated with abundant growths of pickleweed, but feeds away from cover on invertebrates from mud-bottomed sloughs	Moderate. This species has been found in the BSA (CDFW 2026b), however, the area of the BSA that could be negatively affected by noise contains low-quality habitat, and the California Ridgeway's rail are not expected to be present there.
Riparia riparia	Bank swallow	–/ST	Colonial nester; nests primarily in riparian and other lowland habitats west of the desert	Requires vertical banks/cliffs with fine-textured/sandy soils near streams, rivers, lakes, and ocean to dig nesting hole	None. No suitable habitat is within the BSA for this species.
Setophaga petechial	Yellow warbler	–/SSC	Riparian plant associations in proximity to water; also nests in montane shrubbery in open conifer forests in the Cascade Range and the Sierra Nevada	Frequently found nesting and foraging in willow shrubs and thickets, and in other riparian plants including cottonwoods, sycamores, ash, and alders	None. No suitable habitat is within the BSA for this species.
Sternula antillarum	California least tern	FE/SE	Nests along the coast from the San Francisco Bay south to northern Baja California	Colonial breeder on bare or sparsely vegetated, flat substrates; sand beaches, alkali flats, landfills, or paved areas	None. No suitable habitat is within the BSA for this species.

Scientific Name	Common Name	Federal[a] and State[b] Status	General Habitat Requirements	Microhabitat and Notes	Potential to Occur
Strix occidentalis caurina	Northern spotted owl	FT/CT, SSC	Old-growth forests or mixed stands of old-growth and mature trees; occasionally in younger forests with patches of big trees	High multistory canopy dominated by big trees, many trees with cavities or broken tops, woody debris, and space under canopy	None. No suitable habitat is within the BSA for this species.
Mammals					
Antrozous pallidus	Pallid bat	–/SSC	Deserts, grasslands, shrublands, woodlands, and forests; most common in open, dry habitats with rocky areas for roosting	Roosts must protect bats from high temperatures; very sensitive to disturbance of roosting sites	None. No suitable habitat is within the BSA for this species.
Corynorhinus townsendii	Townsend's big-eared bat	–/CT, SSC	Throughout California in a wide variety of habitats; most common in mesic sites	Roosts in the open, hanging from walls and ceilings; roosting sites limiting; extremely sensitive to human disturbance	None. No suitable habitat is within the BSA for this species.
Microtus californicus sanpabloensis	San Pablo vole	FT/SSC	Saltmarshes of San Pablo Creek, on the south shore of San Pablo Bay	Constructs burrow in soft soil; feeds on grasses, sedges, and herbs; forms a network of runways leading from the burrow	None. No suitable habitat is within the BSA for this species.
Reithrodontomys raviventris	Salt marsh harvest mouse	FE/SE, FP	Only in the saline emergent wetlands of the San Francisco Bay and its tributaries	Pickleweed is the primary habitat; does not burrow, builds loosely organized nests; requires higher areas for flood escape	Low. An CNDDB occurrence from 1945 found the salt marsh harvest mouse in the Triangle Marsh; however, this location was surveyed in 1988 and no mice were found. Trapping surveys were not performed for this study. Potential habitat in this area is considered low quality due to the area being too small, too much tidal influence and no escape cover.
Lasiurus blossevillii	Western red bat	–	Roosts primarily in trees, 2 to 40 feet above ground, from sea level up through mixed conifer forests	–	None. No suitable habitat is within the BSA for this species.

[a] Federal status: FE = federally endangered; FT = federally threatened

[b] State status: CS = candidate species; CT = condition threatened; FP = fully protected; SE = state endangered; SSC = state species of special concern; ST = state threatened

°C = degree(s) Celsius

ESU = Evolutionarily Significant Unit

DPS = Distinct Population Segment

Table 3-5. Special-Status Marine Reptiles and Mammals with Potential to Occur in the Biological Study Area and Ferry Route

Scientific Name	Common Name	Federal[a] and State[b] Status	General Habitat Requirements	Microhabitat and Notes	Potential to Occur
Chelonia mydas	Green sea turtle (East Pacific DPS)	FT*/–	Adults remain in pelagic waters to feed prior to nesting in nearshore, coastal habitats.	Primarily found in subtropical and temperate waters. Presence in California is typically limited to Southern California.	Not Expected. Suitable habitat is absent from the BSA and along the ferry route.
Lepidochelys olivacea	Olive ridley sea turtle	FT*/–	Primarily pelagic but nest on beaches in nearshore, coastal habitats.	Those in the Eastern Pacific typically range from Southern California to Northern Chile.	Not Expected. Suitable habitat is absent from the BSA and along the ferry route.
Dermochelys coriacea	Leatherback sea turtle	FE*/–	Adults are highly pelagic and migratory (more so than other sea turtles). Nest in tropical coastal regions.	Adapted to a comparatively broader range of ocean temperatures than other sea turtles. Forage near the California coastline in summer and fall months, including areas adjacent to the Bay entrance where upwelling provides nutrients for prey.	Not Expected. Suitable habitat is absent from the BSA and along the ferry route.
Balaenoptera musculus	Blue whale	FE*/–	Offshore and along the continental shelf break near productive coastal upwelling features; occasionally found inshore.	Most populations migrate seasonally between summer feeding areas and winter breeding grounds. Along the U.S. West Coast, they winter off Mexico and Central America before traveling north along. There are biologically important feeding areas outside the Bay entrance that are of particular importance between July/August and November.	Not Expected. No suitable habitat is present within the BSA or along the ferry route.
Tursiops truncatus	Common bottlenose dolphin (California coastal stock)	–/–	Within a kilometer of the shoreline from central California south into Mexican waters.	Highly influenced by oceanographic conditions (including temperature).	Moderate Potential. Observations in the Bay are typically near the entrance or more central, open-water areas. Potential presence is limited to the central portions of the ferry route (that is, central San Francisco Bay, at a distance from the terminals) where they may be observed foraging or in transit. The BSA is within the latitudinal range of the species, but habitat is marginal.
Balaenoptera physalus	Fin whale	FE*/–	Deep, offshore waters of all major oceans, but may also be seen along the continental slope and occasionally nearshore.	Migrate in and out of feeding areas near the poles. Primarily in temperate and polar latitudes.	Not Expected. No suitable habitat is present within the BSA or along the ferry route.
Eschrichitius robustus	Gray whale (ENP DPS)	FDR/–_	Nearshore and along the continental shelf.	Highly migratory, transiting to and from winter feeding areas in the Arctic and the Gulf of California for pupping. Migration path includes waters directly outside the Bay and they have been known to enter the Bay in recent years.	Moderate Potential. Potential presence is limited to foraging, migratory transients in the central portions of the ferry route (that is, central San Francisco Bay, at a distance from the terminals). No suitable habitat is present within the BSA.
Megaptera novaeangliae	Humpback whale (Central America DPS)	FE*/–	Highly migratory, preferring nearshore and continental shelf habitats.	Breeds along the Pacific coast of Central America and feeds off the U.S. West Coast and southern British Columbia, including coastal waters outside of the entrance to the Bay between July and November.	Moderate Potential. Potential presence is limited to those foraging in central portions of the ferry route (that is, central San Francisco Bay, at a distance from the terminals). No suitable habitat is present within the BSA.
Megaptera novaeangliae	Humpback whale (Mexico DPS)	FT/–	Highly migratory, preferring nearshore and continental shelf habitats.	Breeds along the Pacific coast of Mexico and Revillagigedo Islands, transiting the Baja California Peninsula and feeds across California to the Aleutian Islands, Alaska.	Moderate Potential. Potential presence is limited to those foraging in central portions of the ferry route (that is, central San Francisco Bay, at a distance from the terminals). No suitable habitat is present within the BSA.

Scientific Name	Common Name	Federal[a] and State[b] Status	General Habitat Requirements	Microhabitat and Notes	Potential to Occur
Eubalaena japonica	North Pacific right whale	FP/FE	Highly pelagic	Generally scarce throughout its range and one of the rarest of all marine mammal species. May be present in warmer waters off Southern California during the winter.	Not Expected. No suitable habitat is present within the BSA or along the ferry route.
Physeter macrocephalus	Sperm whale	FE*/–	Highly pelagic, but potentially present along the continental shelf. One of the widest (global) distributions of any marine mammal.	Distribution is determined by food availability and suitable breeding conditions.	Not Expected. No suitable habitat is present within the BSA or along the ferry route.
Balaenoptera borealis	Sei whale	FE*/–	Continental shelf and slope.	Prefer temperate waters in mid-latitudes and typically in waters far from the coastline.	Not Expected. No suitable habitat is present within the BSA or along the ferry route.
Orcinus orca	Killer whale (Southern Resident DPS)	FE/–	Found in all oceans. Most abundant in colder waters like Antarctica, Norway, and Alaska, but also found in tropical and subtropical waters.	This DPS ranges from central California to southeast Alaska.	Not Expected. No suitable habitat is present within the BSA or the ferry route.
Zalophus californianus	California sea lion	–/–	Marine and Bay waters along the western coast of North America from Baja California, Mexico to British Columbia, Canada.	Nonbreeders are haul out on docks, manmade structures and beaches throughout the Bay. No breeding areas present in the Bay. Annual presence in the Bay but may peak in abundance in the summer and winter.	High Potential. Suitable foraging and transiting habitat exists in the BSA and along the ferry route.
Arctocephalus townsendi	Guadalupe fur seal	FT*/ ST, FP	Oceanic and continental slope species.	Currently restricted to the waters off Southern California and the Pacific coast of Mexico. Forages seasonally along the continental shelf and may be seen in rocky coastal habitats for breeding.	Not Expected. Species is absent from the northern portions of its historical range and no suitable habitat is present within the BSA or the ferry route.
Phocoena phocoena	Harbor porpoise (San Francisco-Russian River Stock)	–/–	Cool marine (nearshore and continental shelf) and bay waters throughout the North Pacific and North Atlantic Oceans.	The San Francisco-Russian River stock extends from Pigeon Point to Point Arena. Recently reoccupied San Francisco Bay with an annual presence, including the Central Bay.	Moderate Potential. Potential presence is limited those foraging or transiting in central portions of the ferry route (that is, central San Francisco Bay, at a distance from the terminals). The BSA is within the range of the species, but the habitat is marginal.
Mirounga angustirostris	Northern elephant seal	–/FP	Oceanic and continental slope waters. Longitudinal range extends from Alaska south to Baja California, Mexico.	Migrate four times annually between offshore feeding areas and coastal breeding sites. Nearby breeding occurs at Point Reyes National Seashore, the Farallon Islands, and Año Nuevo State Park between December and March. Seasonal presence in the Bay (spring to fall).	Low Potential. The BSA and ferry route is within the range of the species, but the habitat is marginal. They are generally considered rare visitors to the Bay.
Phoca vitulina richardii	Pacific harbor seal	–/–	Widely distributed throughout the northern Atlantic and Pacific oceans along coastal waters, river mouths, and bays.	Opportunistic, nearshore foragers that rely on seasonally abundant benthic and epibenthic schooling fish. Often seen on rocky islands, sandy beaches, mudflats, bays, and estuaries. Uses various intertidal substrates at low to medium tide levels for hauling out in the Bay and may be present throughout the Bay year-round.	High Potential. Suitable foraging and transiting habitat exists in the BSA and along the ferry route.
Enhydra lutris nereis	Southern sea otter	FT/FP	Nearshore marine environments along the California Coastline. Distributed from approximately Año Nuevo, San Mateo County to Point Sal, Santa Barbara County.	Relatively small home ranges. Heavily dependent on canopies of giant kelp and bull kelp for rafting and feeding. Rocky substrates provide habitat for their preferred invertebrate prey.	Not Expected. No suitable habitat is present within the BSA or along the ferry route. There are no nearby CNDDB records of this species within 5 miles.

Scientific Name	Common Name	Federal[a] and State[b] Status	General Habitat Requirements	Microhabitat and Notes	Potential to Occur
Eumetopias jubatus	Steller sea lion (Eastern DPS)	FDR/–	Primarily along the continental shelf but may forage in deeper continental slope and pelagic waters outside of breeding season.	Present in colder temperature to subarctic waters throughout the North Pacific. The eastern stock extends from Southeast Alaska to central California. Not regular visitors to the Bay.	Not Expected. No suitable habitat is present within the BSA or along the ferry route.

Sources: California Natural Diversity Database (CDFW 2026b), NOAA Fisheries species list (NOAA Fisheries 2026), Information for Planning and Conservation (USFWS 2026).

[a] Federal status: FDR = federally delisted (recovered); FE = endangered (any species in danger of extinction throughout all or a significant portion of its range); FT = threatened (any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range); * = Present on the NOAA Fisheries, West Coast Region, California Species List Tool and NOAA Official Species List for the San Rafael (37122-H5) USGS 7.5-minute quadrangle

[b] State status: FP = fully protected; ST = threatened (any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range); SSC = state species of special concern

ENP = Eastern North Pacific

4. Results: Biological Resources, Discussion of Impacts, and Mitigation

This chapter identifies Project-specific general avoidance and minimization measures (AMMs) and evaluates the direct and indirect impacts of the Project on natural communities of special concern and special-status species, based on literature reviews and field evaluations. Direct impacts are Project effects that are caused by or result from the proposed action and occur at the same time and place. Indirect impacts are Project effects that are caused by or will result from the proposed action and occur later in time, or outside the Project work area but are still reasonably certain to occur. A description of the proposed general AMMs and a discussion of potential Project impacts and proposed mitigation follow.

4.1 General Avoidance and Minimization Measures

To reduce potential impacts to sensitive biological resources, standard construction best management practices and AMMs will be incorporated into the Project. These measures will be communicated to the contractor through special provisions included in the contract bid solicitation package. These measures are described in Table 4-1.

Table 4-1. Standard Construction Best Management Practices and Noise Avoidance and Minimization Measures

Measure ID	Description
BIO-1	A qualified biologist will perform clearance surveys before construction.
BIO-2	To protect migratory birds and their nests, the following will be implemented: ▪ During the February 15 to September 15 nesting season, no more than 3 days before construction or any vegetation clearing, the Project area will be surveyed for migratory birds and their nests. If any active nest is found, appropriate buffers will be applied. ▪ No work will occur within 50 feet of nesting passerine birds or 300 feet of non-listed nesting raptors. ▪ Any nesting migratory birds or nongame birds near the Project footprint will be regularly monitored for signs of disturbance; work will be avoided in these areas until all birds have fledged.
BIO-3	All construction personnel will attend an environmental education program delivered by an agency-approved biologist before working on the Project site. The program will include an explanation of how to best avoid the incidental take of listed species known from the region with potential to occur in the BSA. This field meeting will include topics on species identification, life history, descriptions, and habitat requirements during various life stages. Emphasis will be placed on the importance of the habitat and life-stage requirements within the context of Project maps that show areas where AMMs will be implemented. The program will include an explanation of applicable federal and state laws protecting listed species, and the importance of compliance with various resource agency conditions.
BIO-4	Dust control measures will be implemented. These measures will consist of regular truck watering of construction access areas and disturbed soil areas, including using organic soil stabilizers, if required, to minimize airborne dust and soil particles generated from graded areas.

Measure ID	Description
	Regular truck watering will be a requirement of the construction contract. In addition, for disturbed soil areas, the use of an organic tackifier will be included in the construction contract to control dust emissions blowing off the right of way or out of the construction area during construction. Watering guidelines will be established to avoid excessive runoff that may flow into contiguous areas. Material stockpiles will be watered, sprayed with tackifier, or covered to minimize dust production and wind erosion. Dust control will be addressed during the environmental education session as well.
BIO-5	All food-related trash items, such as wrappers, cans, bottles, and food scraps, will be disposed of in closed containers and removed at least once daily from the Project footprint.
BIO-6	Dedicated fueling and refueling practices will be designated as part of the approved stormwater pollution prevention plan. Dedicated fueling areas will be protected from stormwater run-on and will be located at least 50 feet from downslope drainage facilities and water courses. Fueling must be performed on level-grade areas. Onsite fueling will only be used when and where it is impractical to send vehicles and equipment offsite for fueling. When fueling must occur onsite, the contractor will designate an area to be used, subject to the approval of the resident engineer representing the District. Drip pans or absorbent pads will be used during onsite vehicle and equipment fueling.
BIO-7	All grindings and asphaltic-concrete waste will be stored within previously disturbed areas absent of habitat and a minimum of 150 feet from any aquatic habitat, culvert, or drainage feature.
BIO-8	All surplus material resulting from construction activities must be properly disposed of off-site. Material will either be reused and fully contained within the Project limits or properly disposed of off-site.
BIO-9	To reduce the potential for noise effects resulting from Project construction activities, the following measures will be implemented during all phases of construction activities: ▪ Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment. All equipment must be equipped with sound-control devices that are no less effective than those provided on the original equipment. No equipment will have an unmuffled exhaust. ▪ Prohibit unnecessary idling (that is, greater than 5 minutes in duration) of internal combustion engines within 50 feet of residences. ▪ Locate all stationary noise-generating construction equipment, such as air compressors, portable power generators, or self-powered lighting systems, as far as practical from noise-sensitive receptors. ▪ Use “quiet” air compressors and other “quiet” equipment where such technology exists.
BIO-10	During construction, the contractor will install a noise blanket or other comparable noise reduction measures along the construction work limits nearest to the Marsh area.

Measure ID	Description
BIO-11	Construction lighting will be directed down toward the immediate vicinity of the active work area and will avoid light trespass into the adjacent natural areas through directional lighting, shielding, or other measures as needed.

Caltrans = California Department of Transportation

4.2 Natural Communities of Special Concern

No natural communities are expected to be disturbed or impacted by construction or operations of the Project. Construction will only occur on existing hardscape (Figure 1-2). No ground disturbance will occur to any natural vegetation, wetlands, or waters in the BSA.

The ferry wake wash studies (Jacobs 2023, 2026) (Appendix D) conducted for the Project evaluated baseline (existing) conditions; future operational conditions, including fleet composition and trip frequency, were not evaluated as a part of the baseline analysis. The following conclusions on baseline conditions are relevant to this NES:

- The ferry wakes do not have an impact on marsh habitat, including Corte Madera Marsh. Wind waves reaching this marsh are generally higher, last longer, and would otherwise have a greater impact than the existing ferry wakes.
- The ferry wakes generate shear stress that is lower than the mud critical sheer stress. Thus, the existing conditions do not erode existing mudflats.
- The wake-generated shear stress is not conducive to bottom sediment erosion and would not increase background levels of turbidity in mudflat waters. Consequently, benthic organisms would not be impacted.

Based on modeling completed for the future Liwa-class vessels, wake height would be smaller and wake energy at both 10 and 30 knots arrival and departure would have up to 18% and 30% less energy, respectively (Appendix D). It is anticipated that changes in fleet composition and an increase in trips would not substantially modify these conditions to the extent that significant impacts would occur.

4.3 Special-status Plant Species

A plant is considered to have special status if it meets at least one of the following criteria:

- Listed, proposed for listing, or a candidate for listing as threatened or endangered under FESA
- Listed, or a candidate for listing as rare, threatened, or endangered under CESA
- Listed in the *Special Plants, Bryophytes, and Lichens List* as defined by the CNDDB
- Ranked by the CNPS as 1 or 2 in the current online version of its *Inventory of Rare and Endangered Plants* (CNPS 2026)

A species was determined to have the potential to occur in the BSA if: (1) it historically occurred within or adjacent to the BSA, as documented in the CNDDB (CDFW 2026b) or Biogeographic Information and Observation System (CDFW 2026a); (2) its known or expected geographic range is within the vicinity of the Project area; or (3) its known or expected habitat is present within or near the BSA. A complete list of special-status species for the region is provided in Appendix A.

4.3.1 Survey Results

Jacobs biologists conducted a plant survey within the BSA on July 2, 2021, and on March 18, 2026. These surveys were not protocol-level and focused more on assessing the habitat and obtaining a plant inventory. One rare (1B.2) plant, Point Reyes bird's beak, was observed within Triangle Marsh during the 2021 survey. No federally or state-listed plant species or any other species of special concern were identified within the BSA during the 2026 survey. The observed plants list is included in Appendix C.

4.3.2 Project Impacts

All Project work will occur on existing hardscapes. No salt marsh, or any other vegetative community will be impacted. Therefore, no impacts are anticipated to special-status plant species.

4.4 Special-Status Wildlife Species

This section addresses the special-status wildlife species that have the potential or are known to occur in the BSA or along the ferry route.

4.4.1 California Ridgway's Rail and California Black Rail

The California Ridgway's rail and California black rail are evaluated together because their habitat associations, locations of potential occurrence, potential impacts, and AMMs are similar in the Project vicinity.

The California Ridgway's rail is federally and state-listed as endangered and is designated as a fully protected species under the FGC. Critical habitat has not been designated for this species. This secretive marsh bird currently occurs only in San Francisco Bay marshes. It formerly bred at several other locations, including Humboldt Bay (Humboldt County), Elkhorn Slough (Monterey County), and Morro Bay (San Luis Obispo County), but it is extirpated from all sites outside of the San Francisco Bay (USFWS 2013). The California Ridgway's rail was listed as endangered primarily because of habitat loss.

The California black rail is state-listed as threatened and is designated as a fully protected species under the FGC. The California black rail is a small rail that inhabits tidal salt and brackish marshes around San Francisco Bay, and freshwater marshes in some Central Valley locations. This small bird is very secretive and is most often seen during high tides when it is forced into high marshes. Little information is available regarding the biology of California black rail. Around San Francisco Bay, the species nests primarily in pickleweed dominated marshes with patches or borders of bulrush, often near the mouths of creeks. Nests are usually constructed of pickleweed and are placed directly on the ground or slightly above ground in vegetation. California black rail feed on terrestrial insects, aquatic invertebrates, and possibly seeds (Trulio and Evens 2000).

The California black rail and California Ridgway's rail are typically found in the intertidal zone and sloughs of salt and brackish marshes dominated by pickleweed, Pacific cordgrass (*Spartina foliosa*), gumplant (*Grindelia sp.*), saltgrass, jaumea (*Jaumea carnosa*), and adjacent upland refugia. Shrubby areas adjacent to or within these marshes are also important for predator avoidance at high tides. Although the California Ridgway's rail are typically found in tidal salt marshes, they have also been documented in brackish marshes.

Evens and Page (1983) concluded from research in a northern San Francisco Bay marsh that the California Ridgway's rail breeding season, including pair bonding and nest construction, may begin as early as February. The end of the breeding season is typically defined as the end of August, which corresponds with

the time when eggs (during renesting attempts) have hatched and young are mobile. The California Ridgway's rail builds a bowl-shaped platform nest of marsh vegetation and detritus (DeGroot 1927). The California Ridgway's rail typically feed on benthic invertebrates, but their diet is wide-ranging and includes seeds and occasionally small mammals such as the salt marsh harvest mouse (Trulio and Evens 2000).

Throughout the San Francisco estuary, the California Ridgway's rail population is impacted by a suite of mammalian and avian predators. At least 12 native and 3 non-native animal species are known to prey on various life stages of the California Ridgway's rail (Albertson 1995).

4.4.1.1 Survey Results

There are five CNDDB occurrences of the California Ridgway's rail and California black rail within 5 miles of the BSA (Figure 2-2). California Ridgway's rail and California black rail have been documented at both Triangle Marsh and Corte Madera Marsh. Protocol-level surveys for the California Ridgway's rail were conducted by the Invasive Spartina Project at Triangle Marsh as part of their annual California Ridgway's Rail Surveys for the San Francisco Estuary Invasive Spartina Project in 2026. Jacobs biologists Pim Laulikitnont-Lee and Annabel Li were present, and the surveys did not detect any individual California Ridgway's rail or California black rail within the BSA.

Triangle Marsh is in the southern portion of the BSA. The habitat within Triangle Marsh does not contain sufficiently dense enough vegetation cover to support nesting for these species. Although no nesting habitat has been confirmed within Triangle Marsh, individuals observed there are likely dispersing from the nearby Corte Madera Marsh across Corte Madera Creek and foraging within Triangle Marsh. This is consistent with the lack of sufficiently dense vegetation cover within Triangle Marsh to support nesting. Wetland vegetation, however, is present elsewhere in the BSA, as described in Section 3.2.1.

According to the *Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California, Volume 1* (USFWS 2013), California Ridgway's rails are "widespread and locally dominant in portions of Corte Madera Creek." California Ridgway's rail and California black rail occurring in Triangle Marsh and Corte Madera Marsh are not anticipated to enter the Project footprint because the Project footprint is developed hardscape.

It is unlikely that California Ridgway's rail or California black rail will be nesting within the BSA due to lack of suitable dense vegetation at Triangle Marsh. Known populations and suitable nesting salt marsh habitat are present in the Corte Madera Marsh approximately 300 feet south of the BSA (and approximately 750 feet south of the Project footprint) across Corte Madera Creek.

4.4.1.2 Project Impacts

USFWS considers these species sensitive to disturbance and seeks to minimize human intrusion into occupied marshes, particularly during the breeding season (USFWS 2013). Birds may be disrupted from normal behavior when noise levels are greater than 80 to 85 decibels (dB) (USFWS 2013). Project work will include pile driving, which could affect the California Ridgway's rail and California black rail via noise disturbance.

Several pieces of equipment that will be used during construction have a measured maximum noise level greater than 80 dB. For example, the Federal Highway Administration (FHWA) *Roadway Construction Noise Model User's Guide* (2006) lists impact pile driving at 95 to 101 dB at 50 feet from the point of impact. Noise attenuates over distance, and equipment louder than 80 dB (measured 50 feet away) typically attenuates 6 dB as the distance from the noise source doubles (that is, 80 dB at 50 feet will be 74 dB at 100 feet away, and 68 dB at 200 feet away). While the southern portion of the Project footprint is

approximately 300 feet south of the salt marsh habitat at Corte Madera Marsh, the loudest equipment (pile driving) will not occur within 700 feet of the rail habitat at Corte Madera Marsh. Therefore, it is presumed that construction noise will attenuate to a level that will not disturb nesting birds in Corte Madera Marsh. Therefore, pile driving and other Project-related noise are not anticipated to cause a significant disturbance to the California Ridgway's rail or California black rail.

There will be no impact on California Ridgway's rail or California black rail habitat because of this Project. If rails are within the noise disturbance distance during construction, noise abatement AMMs BIO-9 and BIO-10 (Table 4-1) will reduce potential impacts to below a take threshold.

4.4.1.3 Avoidance and Minimization Efforts

AMMs incorporated into the Project, and described in Section 4.1, will reduce construction impacts on the California Ridgway's rail and California black rail.

In addition to the AMMs outlined in Section 4.1, the following AMM will be implemented as deemed necessary by the Project biologist to avoid or minimize potential impacts on the California Ridgway's rail and California black rail:

- BIO-11: Conducting a California Ridgway's rail and California black rail pre-construction survey within 700 feet of pile driving activities.

4.4.1.4 Compensatory Mitigation

As a result of the AMMs outlined in Table 4-1 and the species-specific AMM, there will be no compensatory mitigation requirements for these species.

4.4.2 Salt Marsh Harvest Mouse

The salt marsh harvest mouse is federally and state-listed as endangered and is designated as a fully protected species under the California FGC. Critical habitat has not been designated for this species. This species is found only in saline and brackish wetlands of San Francisco Bay and its tributaries. Agriculture and urbanization have claimed much of the former historical tidal marshes, resulting in a 79% reduction in the extent of tidal marshes in these areas (Goals Project 1999). At present, the distribution of the northern subspecies, which is found in the Project vicinity, occurs only along Suisun and San Pablo Bays north of Point Pinole in Contra Costa County, and Point Pedro in Marin County.

Early descriptions of habitat for the salt marsh harvest mouse suggest that this species was restricted to the salt marshes of the San Francisco Bay (Dixon 1908). However, recent research including radio-tracking has demonstrated that the salt marsh harvest mouse also use brackish marshes, non-tidal managed wetlands, and some adjacent upland habitats (Smith 2019). The species also has a much broader diet than the pickleweed-focused diet previously assumed. When presented a variety of foods that were seasonally abundant, the diet of the salt marsh harvest mouse comprised 45 native and non-native plant species and a few invertebrates, with the two most commonly chosen plants being the non-native rabbits-foot grass (*Polypogon monspeliensis*) and fat hen (*Atriplex prostrata*) (Smith 2019). Salt marsh harvest mouse are highly dependent on cover, and open areas as small as 16 to 33 feet wide may act as barriers to movement (USFWS 1984; Geissel et al. 1988).

Most of the tidal marshes around the San Francisco Bay have been eliminated, and those remaining have lost the upper portion of their pickleweed zones as well as the higher zone of peripheral halophytes (salt-tolerant plant species that occur along the margins of marshes in less frequently inundated areas). Many

tidal salt marshes are small, isolated strip-like marshes along backshores against levees or other hardened structures that promote predation, inhibit further high marsh development, and are threatened by sea-level rise (Shellhammer 1989). As a result of habitat loss, degradation, and fragmentation, salt marsh harvest mouse populations are low. Despite the species' low populations, they are known to rapidly colonize restored areas. This species quickly moves into areas of appropriate habitat from nearby inhabited areas.

4.4.2.1 Survey Results

No salt marsh harvest mouse surveys have been conducted for this Project. Because of their Fully Protected status, trapping surveys are typically only performed for research purposes, and presence is therefore determined by habitat suitability, occurrence information and habitat range maps. There are four salt marsh harvest mouse occurrences within 2 miles of the BSA, with one identified in Triangle Marsh from a 1945 survey and another occurrence in Corte Madera Marsh where the salt marsh harvest mouse was found from surveys from the 1970s through the 1990s (CDFW 2026b). Triangle Marsh was resurveyed in 1988, and no salt marsh harvest mouse were found. Notes listed in this occurrence in CNDDB state that the area is too small—there is too much tidal coverage and no escape cover, suggesting that this area is considered low-quality habitat and there is low potential for presence.

4.4.2.2 Avoidance and Minimization Efforts

Even though the habitat quality is low, because of past occurrence information and the Project being within the range of the species, salt marsh harvest mouse presence in the BSA cannot be ruled out. AMMs incorporated into the Project, including the noise abatement AMMs BIO-10 and BIO-11 (refer to Section4.1), will reduce potential construction impacts on the salt marsh harvest mouse.

4.4.2.3 Project Impacts

Habitat for this species will not be directly impacted by the Project, but construction noise would produce elevated sound levels in adjacent salt marsh habitat. The hearing range of mice is reported to be between 1,000 to 91,000 hertz at 60 dB (Heffner and Heffner 2007; Rasmussen et al. 2009), whereas the majority of sound energy from impact pile driving is low energy at frequencies below 500 hertz (McKenzie Maxon 2000; DOSITS 2015). Thus, much of the sound generated from pile driving will likely be inaudible to mice. The noise abatement AMMs (BIO-10 and BIO-11) described in Section 4.1 will reduce potential negative impacts to mice. As a result, noise generated by Project activities, including pile driving, is not anticipated to significantly impact the salt marsh harvest mouse.

4.4.2.4 Compensatory Mitigation

Substantial adverse impacts on the salt marsh harvest mouse would not occur, and therefore there will be no compensatory mitigation requirements for this species.

4.4.3 Special-Status Fish Species

The fishes from Table 3-4 with a moderate or greater potential to occur are not further analyzed in this NES. Based on the pile diameter and the distance from the Bay, pile driving associated with this Project is not expected to result in meaningful transmission of underwater sound to adjacent waters (refer to Section 4.5.8, Construction, for more details). Therefore, there are no expected impacts to in-water organisms from construction noise, specifically pile driving (Ambaskar, pers. comm. 2026; Caltrans 2020).

4.4.3.1 Designated Critical Habitat and Essential Fish Habitat

Designated critical habitat for federally listed fish species and EFH, as defined under the Magnuson-Stevens Fishery Conservation and Management Act, occur within San Francisco Bay, including areas that encompass the BSA and along the ferry route between Larkspur and San Francisco (Figure 4-1).

Critical habitat designated for Central Valley Chinook salmon (*Oncorhynchus tshawytscha*), Central California Coast coho salmon (*Oncorhynchus kisutch*), Central Valley steelhead (*Oncorhynchus mykiss*), and green sturgeon (*Acipenser medirostris*; Southern DPS) is present within San Francisco Bay, including areas that encompass the BSA and ferry route.

EFH designated by the Pacific Fishery Management Council is also present within the BSA and ferry route, including habitats supporting groundfish, coastal pelagic species, and finfish. These habitats support important life history functions such as migration, foraging, rearing, and breeding. However, the Project does not include in-water construction or activities that would directly alter aquatic habitat. As described in the *Ferry Wake Wash and Shoreline Erosion Analysis*, ferry wakes under existing conditions do not result in sediment mobilization, measurable increases in turbidity, or habitat modification within Corte Madera Bay (Jacobs 2023) (Appendix D). Therefore, the Project is not expected to result in adverse effects to designated critical habitat or EFH.

4.5 Marine Mammals

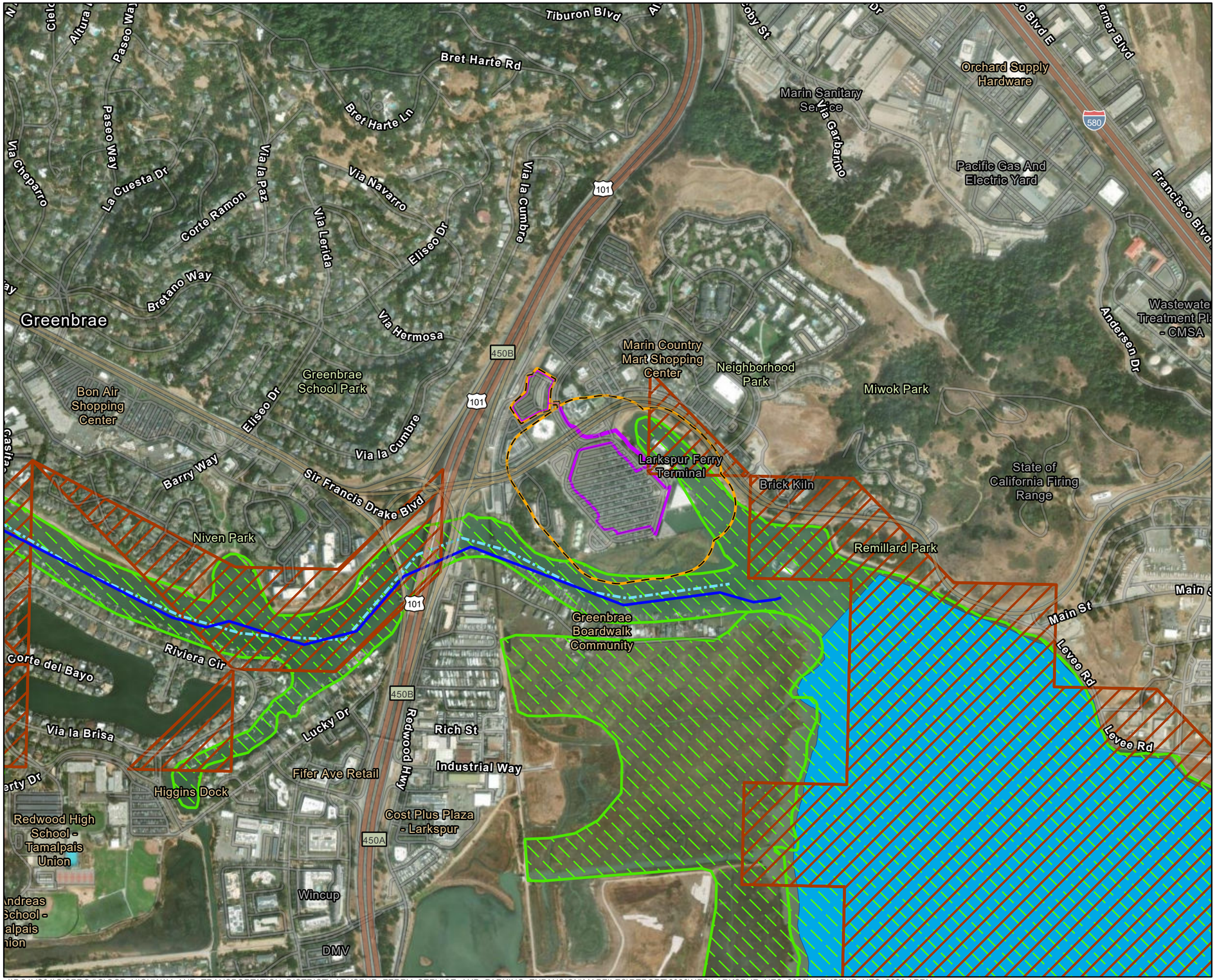
This section addresses marine mammals that have a moderate or high potential to occur along the ferry route and the BSA. These determinations were based on the species' known or expected ranges, historic observations and contemporary sightings (as available in scientific papers, environmental reports, and iNaturalist), and presence of suitable habitat. There were no Project-specific surveys, noise, or hydroacoustic analyses completed. A complete list of special-status marine mammals is included in Table 3-5.

4.5.1 California Sea Lion

California sea lions are otariid pinnipeds, protected throughout their range under the MMPA. California sea lions live in the shallow waters of the eastern North Pacific Ocean, ranging from Southeast Alaska to the Pacific coast of Central Mexico. The U.S. stock mainly breeds in the Channel Islands of Southern California from late June to early August, and a select few breed at Año Nuevo Island and the Farallon Islands (NOAA Fisheries 2025a). After the breeding season, males migrate up the California coastline.

California sea lions are the most abundant pinniped along the California coast. Their population is growing steadily with the implementation of the MMPA and is estimated at around 257,000 individuals (Carretta et al. 2024). From 1975 to 2014, the maximum population growth rate of the U.S. stock was 7% per year (NOAA Fisheries 2025a).

California sea lions are typically coastal, found within 10 miles of the shoreline. They frequently haul out on offshore rocks, sandy and cobble beaches, jetties, navigational buoys, and floating docks. California sea lions are opportunistic generalists, and eat a variety of prey, such as squid, anchovies, mackerel, rockfish, and sardines. They prefer schooling forage fish, but also feed on benthic species such as leopard sharks, shrimps, and crabs (NOAA Fisheries 2025a). California sea lions feed mainly offshore in coastal areas but are often observed in bays.





LEGEND

- Biological Study Area (44.51 acres)
- Project Footprint (9.69 acres)
- NMFS Essential Fish Habitat (Finfish, Coastal Pelagic Species, Groundfish)

NMFS Designated Critical Habitat

- Chinook Salmon
- Green Sturgeon
- Coho Salmon
- Steelhead

Source:
National ESA Critical Habitat Geodatabase, NOAA Fisheries Essential Fish Habitat, Essential Fish Habitat

Service Layer Credits:
World Imagery: Vantor
World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
World_Imagery: Vantor
Hybrid Reference Layer: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community
World Hillshade: Esri, CGIAR, USGS

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Feet

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Figure 4-1
Designated Critical Habitat and Essential Fish Habitat
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

Numbers peak in San Francisco Bay from November to March, after the breeding season. This is primarily driven by the presence of food. During anchovy and herring runs, they may be found exclusively feeding in North and Central San Francisco Bay (USFWS 1992, referenced in URS 2023). The most famous haul-out site in San Francisco is at Pier 39 in near Fisherman's Wharf, which is not along the ferry route and is more than 5 miles away from the Larkspur Ferry Terminal (TMMC n.d.). There are no other repeatedly used haul-out sites for California sea lions in the Bay (Allen 1999, referenced in URS 2023).

Survey Results

Based on a review of existing information, California sea lions were determined to have a high potential to occur along the ferry route as foragers and in transit, as well as within the open-water portions of the BSA. They are not expected to haul out near the Larkspur Ferry Terminal.

4.5.2 Common Bottlenose Dolphin

There are two genetically distinct common bottlenose dolphin stocks off California, an offshore stock and a small California Coastal stock, both of which are protected cetaceans under the MMPA. The dolphins in San Francisco Bay belong to the California Coastal stock (Carretta et al. 2024). They live within 1 mile of shore from Ensenada, Mexico, expanding northward along the California coast. The extent of the northern range used to be Point Conception; however, the northward expansion was triggered by the 1982 to 1983 El Niño. By 2001, common bottlenose dolphins were at the Golden Gate, spreading northward to Mendocino County by 2015 (Keener et al. 2023). They opportunistically move up and down the coast in an unpredictable manner (unfixed schedule); group sizes are typically small. Based on the number of individually identifiable animals documented during 2009 to 2011 surveys, the minimum population size is 346 animals (Weller et al. 2016). Common bottlenose dolphins are generalist piscivores, primarily eating schooling fish. They are high-frequency hearing specialists (NOAA Fisheries 2024, 2025b).

At least 84 individual common bottlenose dolphins have been identified in the San Francisco Bay (Keener et al. 2023). They do not appear to have a seasonal migration pattern, and observations are typically near the Bay entrance or central, open-water areas (iNaturalist 2026).

Survey Results

Based on a review of existing information, common bottlenose dolphins were determined to have a moderate potential to occur as foragers or in transit. Potential presence is limited to the central portions of the ferry route (that is, central San Francisco Bay, at a distance from the ferry terminals). Habitat in the BSA, and near the Larkspur and San Francisco Ferry Terminals, is marginal.

4.5.3 Gray Whale

Gray whales are large cetaceans. There are two stocks, including the ENP stock which is protected under the MMPA. ENP gray whales have one of the longest migrations of any mammal, roughly 12,000 miles roundtrip between summer feeding grounds in the Arctic (Bering, Chukchi, and Beaufort Seas) and winter calving grounds in Baja California, Mexico (Carretta et al. 2024; NOAA Fisheries 2026a). The typical southbound migration near the Bay Area is from mid-December through early February, and northbound migration is from mid-February through May. They often migrate within sight of land (Calambokidis et al. 2015; URS 2023). ENP gray whales were listed under FESA, but the population has recovered and they were delisted in 1994 (Carretta et al. 2024; NOAA Fisheries 2026a).

Gray whales are the only baleen whales that habitually bottom feeds. They roll onto one side to suction sediment from the seafloor, filtering amphipods, ghost shrimp, mysids, polychaete worms, and other benthic invertebrates. During migration, they may enter rivers and bays (such as San Francisco Bay) along the coast, either because they are disoriented or to forage (Slaathaug et al. 2026; URS 2023). Gray whales are low-frequency hearing specialists (NOAA Fisheries 2024, 2025b).

The use of San Francisco Bay is a recent and increasing phenomenon, rising in 2018 coincident with an unusual mortality event (NOAA Fisheries 2023). The working hypothesis is that nutritional stress in the Arctic is causing gray whales to use the Bay opportunistically as a feeding refuge (Slaathaug et al. 2026). Some animals have stayed inside the San Francisco Bay for weeks during their annual migration, and some return across multiple years (Slaathaug et al. 2026).

Survey Results

Based on a review of existing information, ENP gray whales were determined to have a moderate potential to occur as foragers or migratory transients. Potential presence is limited to in central portions of the ferry route (that is, central San Francisco Bay, at a distance from the ferry terminals). No suitable habitat is present in the BSA or near the Larkspur and San Francisco Ferry Terminals.

4.5.4 Harbor Porpoise

Harbor porpoises are a small, shy coastal cetacean protected under the MMPA. The Northern Pacific population ranges from Monterey Bay to the northern Sea of Japan. There are six stocks designated off California, Oregon, and Washington, all of which are found in shallow, cool productive waters. The San Francisco-Russian River stock extends from Pigeon Point to Point Arena. Based on analysis of long-term trends between 1986 and 2017, the population size of this stock is approximately 7,777 individuals (Carretta et al. 2024).

Harbor porpoises specialize in small schooling fish such as northern anchovy, Pacific herring, sardines, smelt, market squid, and small bottom fish (NOAA Fisheries 2026b). They have one of the highest mass-specific food intake rates of any cetacean, eating roughly 10% of their body weight every day (ADFG 2008; Wisniewska et al. 2016). They echolocate at high frequencies and have very high-frequency hearing (NOAA Fisheries 2024, 2025b).

Harbor porpoises were extirpated from the San Francisco Bay by the early 1940s due to WWII submarine nets across the Golden Gate, dredging, shoreline construction, and heavy contamination (Stern et al. 2017). Following the Clean Water Act and restoration efforts, harbor porpoises returned to San Francisco Bay around 2008. Harbor porpoises are now observed in San Francisco Bay all months of the year. They are frequently under and just inside the Golden Gate Bridge; however, they may also frequent waters near Alcatraz Island and along the Marin shoreline. Mating displays and births have been documented in late spring and summer, and group sizes average roughly two (Keener et al. 2018). Pods can be as large as 16 individuals (Stern et al. 2017).

Survey Results

Based on a review of existing information, harbor porpoises were determined to have a moderate potential to occur. Potential presence is limited to those foraging or transiting in central portions of the ferry route (that is, central San Francisco Bay, at a distance from ferry terminals). The habitat near the Larkspur and San Francisco Ferry Terminals is marginal.

4.5.5 Harbor Seal

The Pacific harbor seal is a phocid pinniped, protected throughout its range under the MMPA. They are distributed along the Pacific coast from Alaska to Baja California and are considered nonmigratory. Harbor seals typically stay within 15 to 31 miles of their natal area, but tracking data have shown they sometimes travel 62 to 486 miles from their tagging location, often to exploit seasonally available food or give birth to pups (NOAA Fisheries 2026c). The harbor seal population has increased since the 1980s, when statewide censuses were first conducted. Based on the most recent harbor seal counts from May to July of 2012 and the appropriate correction factors, the population in California is estimated to be 30,968 seals (Carretta et al. 2024).

Harbor seals are generalist piscivores. They mostly eat Pacific herring, northern anchovy, sole, flounder, sculpin, octopus, squid, lamprey, and salmonids in the San Francisco Bay. Harbor seals typically forage within a few miles of haul-outs (rest areas) and complete both shallow and deep dives while hunting, depending on the availability of prey.

Harbor seals haul out on rocks, reefs, beaches, and drifting glacial ice when they are not traveling or foraging at sea to regulate their body temperature, molt, interact with other seals, give birth, and nurse their pups (NOAA Fisheries 2026c). Harbor seals haul out in groups to avoid predators.

Harbor seals are the only pinniped that lives in the San Francisco Bay year-round. Active haul-out and pupping sites occur throughout the Bay in multiple locations, including Castro Rocks (near the Richmond-San Rafael Bridge), Little Alcatraz (rocky outcrops on the north side of Alcatraz Island), and Angel Island (URS 2023). There are no haul-out sites along the ferry route.

Survey Results

Based on a review of existing information, harbor seals were determined to have a high potential to occur along the ferry route as foragers and in transit, including the BSA. They are not expected to haul out near the Larkspur Ferry Terminal.

4.5.6 Humpback Whale

Humpback whales are highly migratory, large baleen cetaceans protected under the MMPA. They are found globally. All populations of humpback whales were originally listed as endangered in 1970 under the Endangered Species Conservation Act, then under FESA in 1973. There are two DPS that pass by San Francisco: the Mexico DPS (threatened) and the Central America DPS (endangered). Their feeding grounds overlap, but they use different breeding and calving grounds. The Mexico DPS breeds along the Pacific coast of Mexico and Revillagigedo Islands, and transit the Baja California Peninsula, feeding across California to the Aleutian Islands in Alaska. The Central America DPS breeds along the Pacific coast of Central America, and feeds along the U.S. West Coast and southern British Columbia (NOAA Fisheries 2026d). The Gulf of the Farallones, just outside the Golden Gate, is designated humpback whale critical habitat (extending inshore along the 15-meter isobath east to the Golden Gate Bridge). This critical habitat does not extend into the Bay itself (NOAA Fisheries 2021).

As baleen whales, humpbacks filter-feed on small prey such as krill and small schooling fish. They use multiple feeding strategies, including lunge-feeding at the surface and bubble-net feeding (NOAA Fisheries 2026d).

Historically, humpback whales will occasionally enter San Francisco Bay. Since 2016, they are more routinely entering to feed, particularly during anchovy aggregations. Abundance peaks June through

October, but they are typically observed April through November (and not in December to March, when most of the population is in breeding and calving grounds). There tends to be an increase in humpback presence in anchovy-rich years, which varies with ocean conditions (Markowitz et al. 2024).

Survey Results

Based on a review of existing information, humpback whales were determined to have a moderate potential to occur as foragers or in transit. Potential presence is limited to central portions of the ferry route (that is, central San Francisco Bay, at a distance from the ferry terminals). They typically are observed closer to the Golden Gate Bridge. No suitable habitat is present in the BSA, or near the Larkspur and San Francisco Ferry Terminals.

4.5.7 Project Impacts

Potential impacts on marine mammals may result from stressors associated with construction and operations. These stressors may cause impacts at different temporal scales (short-term and longer-term) and may be direct or indirect. Additionally, exposure differs spatially: marine mammals in the BSA and near the Larkspur Ferry Terminal may be exposed to stressors from construction or operations. Species whose presence is limited to the portion of the ferry route crossing the central San Francisco Bay and San Francisco Ferry Terminals will only be exposed to operational stressors.

The following background information must be considered to evaluate the potential impacts of the Project on marine mammals and understand how the Project will comply with the MMPA, including requirements related to harassment. This information is based on the MMPA as amended in 2025, and technical guidance developed by NOAA Fisheries for assessing effects of anthropogenic sound on marine mammal hearing (NOAA Fisheries 2024, 2025b). Under the MMPA, harassment is part of the broader definition of take. The MMPA defines two levels of harassment:

- Level A harassment: The act of pursuit, torment, or annoyance that could injure a marine mammal or marine mammal stock in the wild.
- Level B harassment: The act of pursuit, torment, or annoyance that could potentially disturb (but not injure) a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including but not limited to migration, breathing, nursing, breeding, feeding or sheltering (MMPA 2025).

From a hydroacoustic perspective, Level A harassment corresponds to distances at which temporary or permanent threshold shifts could occur, as follows:

- Temporary Threshold Shift: Temporary, reversible increase in the threshold of audibility at a specific frequency, or portion of an individual's hearing range above a previously established reference level. If hearing eventually returns to normal, it is considered a temporary threshold shift.
- Permanent Threshold Shift: Permanent, irreversible increase in the threshold of audibility at a specific frequency, or portion of an individual's hearing range above a previously established reference level. If hearing does not return to normal, it is considered a permanent threshold shift.

Project activities that risk Level A harassment are more strictly regulated and may require a letter of authorization, while activities that risk Level B harassment may require an Incidental Harassment Authorization (IHA). An IHA can be granted if NOAA Fisheries determines that the incidental take will have a negligible impact on the marine mammal species or stock and will serve as the Project's primary means to avoid and minimize potentially significant effects on marine mammals.

4.5.8 Construction

The primary potential stressor on marine mammals during construction would be from pile driving. Marine mammal hearing is based on the detection of sound pressure, and they produce and use sound (or vocalizations) for various biological functions including social interactions, foraging, orientation, and predator detection. The noise impacts (and the criteria for assessing auditory injury, which is provided by NOAA Fisheries) depend on the sound frequency relative to the hearing frequency of the animal, and the sounds source, intensity, energy, duration received by an animal and type (NOAA Fisheries 2025b). Cetaceans have highly developed acoustic abilities and can detect underwater sound at great distances. Anthropogenic sound sources, especially at higher pressure levels (greater than150 dB), can cause behavioral modifications (NOAA Fisheries 2024), including impaired foraging efficiency from masking (when noise is great enough to mask other sounds including sounds used for communication or location prey), altered prey movement, difficulty detecting prey, increased energy expenditure, and temporary or permanent threshold shifts (Southall et al. 2019, 2021).

For the Project, smaller-diameter (12- to 14-inch) concrete piles are expected to be impact-driven on land within the existing ferry terminal parking area, approximately 100 feet or more from the nearest waters. Impact pile driving methods produce impulsive sound sources. These impulsive sound sources are typically transient, brief (less than 1 minute), broadband, and have a high peak sound pressure with rapid rise and decay times (NOAA Fisheries 2025b). Concrete piles typically generate lower sound levels than steel pipe piles, often at an order of 10 to 20 dB lower (Ambaskar, pers. comm. 2026; Caltrans 2020). Sound pressure levels are also reduced when piles are driven on land versus in water (Molnar et al. 2020). No meaningful transmission of underwater sound to adjacent waters is expected due to the Project; there are also no haul-out areas where pinnipeds will be exposed to airborne noise. No hydroacoustic or noise analysis was needed as a result.

The Project is not expected to result in the onset of temporary or permanent threshold shifts of marine mammals during construction, and an IHA or letter of authorization from NOAA Fisheries is not expected to be required. Impacts of construction activities on marine mammals will be less than significant.

4.5.9 Operational Impacts

At the baseline condition, the Larkspur Ferry has up to 42 ferry revenue trips per weekday, which aligns with the approved service levels. There are also up to four special event crossings to serve Oracle Park or Chase Center events, and up to six deadhead trips that include runs returning to Larkspur in the morning and heading to San Francisco in the afternoon to support peak revenue services. The operating ferries have drafts of up to 6 feet, 6 inches, and transit at a maximum service speed of 36 knots (District 2026a). There will be an additional 24 to 34 ferry revenue trips per day due to the Project starting in 2050. The vessels in the replacement fleet (Liwa-class vessels) have a draft of 4 feet, 3 inches (District 2024), and transit at the same service speed as the existing ferries. The increase in ferry operations in 2050, up to 76 ferry revenue trips per day with Liwa-class vessels, could impact marine mammals directly by increased collision risk (vessels-strike) or indirectly through behavioral disturbance.

Collision Risk (Vessel-Strike)

Project impacts from collision exist along the entire ferry route. A vessel collision is defined as any impact between any part of a watercraft and a live marine animal and could result in physical trauma or death of the animal (Peel et al. 2018, referenced in Schoeman et al. 2020). Collision risk depends multiple factors. Larger vessels and those traveling faster pose greater threats because the vessel operator has less time to detect the animal and avoid them, and the force of impact is greater. Species- and animal-specific traits

such as dive patterns, time spent at the surface, and agility also affect collision risk. Animals resting, foraging, nursing, or socializing may be less attentive to approaching vessels and therefore have a reduced ability to avoid collision (Dukas 2002, referenced in Schoeman et al. 2020).

Collision risk is greatest along the portion of the ferry route that goes through central San Francisco Bay, at a distance from the terminals (assuming vessel speed is reduced when approaching or departing terminals). Of the species potentially present, harbor porpoises, common bottlenose dolphins, California sea lions, and harbor seals are generally at lower risk because they are more agile and capable of maneuvering away from the vessel and spend less time at the surface. In contrast, larger cetaceans such as gray and humpback whales are bigger in size, slower and less agile, and spend longer periods of time at or near the surface. They are also more likely to be foraging in central San Francisco Bay (Markowitz et al. 2024; Slaathaug et al. 2026). When foraging, their attention is on their prey, which makes them less likely to detect and avoid an approaching vessel (Markowitz et al. 2024; Slaathaug et al. 2026).

The Larkspur-San Francisco ferry route is a high-use, mixed traffic environment. The ferry route goes through one of the most heavily trafficked portions of central San Francisco Bay. There are frequently scheduled ferry services, continuous commercial ship traffic (for example, containers, oil tankers, bulk carriers), and regular movement of tugboats and recreational vessels. Vessel density is highest along the deep-water channels that extend from the Golden Gate to the Port of Oakland (Marine Traffic 2026). The ferry route crosses these channels. Given these existing conditions, marine mammals are already exposed to continuous vessel traffic, including high-speed ferries.

Considering that the ferry route is already heavily trafficked, the increase associated with the proposed Project is minimal compared to baseline conditions. The ferries proposed for 2050 would travel at the same maximum speed, a factor contributing to collision risk. While exact interactions between marine mammals and ferry traffic are difficult to predict, it is unlikely that operations would substantially increase collision risk to a level that threatens population statuses. The procedures outlined in Section 4.5.10 will sufficiently reduce collision risk such that the resulting **impacts on marine mammals remain insignificant,** even with an increase in ferry traffic of up to 80.95%**.**

Behavioral Impacts

Increased ferry operations will lead to more consistent wake activity, which may cause indirect behavioral impacts on marine mammals by resuspending sediment in shallow areas and impacting their ability to locate prey. The existing ferry wakes do not increase background levels of turbidity in mudflat waters. Based on modeling completed for the future Liwa-class vessels, wake height would be smaller but wake energy at both 10 and 30 knots arrival and departure would have up to 18% and 30 % less energy, respectively. It is anticipated that changes in fleet composition and an increase in trips would not substantially modify these conditions. **No behavioral impacts on marine mammals from wake activity are expected**.

Vessel noise can mask communication signals, reduce foraging efficiency, disrupt navigation, increase physiological stress, and cause animals to avoid otherwise suitable habitat (Southall et al. 2019, 2021). These behavioral disturbances are temporary and could lead to near-immediate avoidance of a ferry. Given the baseline soundscape in San Francisco Bay and the standard procedures outlined in Section 4.5.10, **behavioral impacts from vessel noise on marine mammals are expected to be insignificant.**

4.5.10 Avoidance and Minimization Efforts

Ferries operated by the District follow procedures developed with the Marine Mammal Center and the U.S. Coast Guard to minimize collision risk with whales and other marine mammals (District 2026b). These procedures include the following:

- Monitoring: The District will monitor whale reports for recent sightings and adjust ferry routes to steer clear of whales.
- Observers: Vessel staff will look out for signs of all marine mammals on each trip. The captain will reduce speed if a whale is spotted, change course if needed, and announce it to passengers.
- Reporting: Staff will report whale sightings with precise timing and location to local authorities.

The Larkspur Ferry will continue adhering to these practices, which will help confirm that impacts are less than significant.

4.5.11 Compensatory Mitigation

Given the existing conditions and scope of the proposed Project, the Project is not expected to result in Level A or B harassment to marine mammals. Therefore, no compensatory mitigation is proposed.

4.6 Cumulative Impacts

Cumulative impacts may result from past, current, and reasonably foreseeable future projects in the region. These projects will all undergo (or have undergone) separate environmental review and will require separate environmental permitting from regulatory agencies.

Project operations will add to the cumulative risk of vessel-strike on marine mammals and anthropogenic noise to the existing soundscape; however, **the cumulative effects are not substantial, would not threaten existing populations, and are thus insignificant**. Therefore, the Project will not require an IHA from NOAA Fisheries pursuant to MMPA Section 101(a)(5)(D).

This and similar projects could result in impacts on California Ridgeway's rail, California black rail, and salt marsh harvest mouse. Most current and future projects that could affect these species and their habitats are expected to be required to mitigate these impacts through CEQA, FESA, California FGC Section 1600 and 2050 to 2097, or Clean Water Act Sections 401 and 404 permitting processes. As a result, most projects in the region will mitigate their impacts on the California Ridgway's rail, California black rail, and salt marsh harvest mouse, minimizing cumulative impacts on the species. Additionally, with implementation of AMMs, this Project will not make a considerable contribution to cumulative impacts on these species.

5. Regulatory Requirements

5.1 California Endangered Species Act

The Project's effects to CESA-listed species are not expected to result in take of species. Therefore, CESA consultation is not expected.

5.2 Federal Endangered Species Act

The Project's effects to FESA-listed species are not expected to result in take of species or adverse effects to critical habitat. Therefore, FESA consultation is not expected.

5.3 California Coastal Act

The Project will not encroach into the Bay Area Coastal Development Commission's jurisdiction, and therefore consultation with Bay Area Coastal Development Commission is not required.

5.4 Marine Mammal Protection Act

The MMPA (16 U.S.C. 31 Sections 1361–1362, 1371-1389, 1401-1407, 1411-1418, 1421-1421h, and1423-1423h) established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part. With certain exceptions, it prohibits take (defined under statute to include harassment) of marine mammals in the nation's waters and the high seas. Congress amended the MMPA, under the incidental take program, and the FESA in 1986 to authorize incidental takings of depleted, endangered, or threatened marine mammals, provided the taking (defined under statute as actions which are or may be lethal, injurious, or harassing) was small in number and had a negligible impact on marine mammal populations.

Under MMPA Section 101(a)(5)(D), an IHA can be granted by NOAA Fisheries if it finds that incidental take will have a negligible impact on the species or stock or will not have an unmitigable adverse impact on the availability of the species or stock for subsistence uses (where applicable). NOAA Fisheries defines negligible impact as "an impact resulting from the specified activity that cannot be reasonably expected to, and will not be reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." IHAs include permissible methods of taking and requirements for mitigation and monitoring to confirm that takings result in the lowest practicable adverse impacts on affected marine mammal species or stocks.

The Project will comply with the MMPA. Because the individual and cumulative effects of the Project on marine mammals are not substantial, would not threaten existing populations and are thus insignificant, the Project would not require an IHA from NOAA Fisheries.

5.5 Wetlands and Other Waters Coordination Summary

An aquatic resource delineation was performed in July 2021 (Appendix B). Wetlands and waters were found within the BSA; however, all work will occur on existing hardscape. No impacts on wetlands or waters is anticipated, and therefore no permits under Clean Water Act Sections 404 or 401 are required.

5.6 Migratory Bird Treaty Act

The Migratory Bird Treaty Act implements international treaties between the U.S. and other nations. These treaties are devised to protect migratory birds and any of their parts, eggs, and nests from activities including hunting, pursuing, capturing, killing, selling, and shipping, unless expressly authorized in the regulations or by permit. As authorized by the Migratory Bird Treaty Act, USFWS issues permits to qualified applicants for the following types of activities: falconry, raptor propagation, scientific collection, special purposes (such as rehabilitation, education, migratory game bird propagation, and salvage), take of depredating birds, taxidermy, and waterfowl sale and disposal. Regulations governing migratory bird permits can be found in 50 CFR 13, General Permit Procedures; and 50 CFR 21, Migratory Bird Permits. Applicable AMMs will be implemented to avoid take of Migratory Bird Treaty Act species.

6. References

Albertson, J.D. 1995. "Ecology of the California Clapper Rail in South San Francisco Bay." Master's thesis. San Francisco State University, San Francisco, CA.

Alaska Department of Fish and Game (ADFG). 2008. *Harbor Porpoise*. Wildlife Notebook Series. https://www.adfg.alaska.gov/static/education/wns/harbor_porpoise.pdf.

Ambaskar, Adwait, Engineer, Illingworth and Rodkin. 2026. Personal communication with Rachel Cotroneo, Biologist, Jacobs. April 24.

Calambokidis, John, Gretchen H. Steiger, Corrie Curtice, Jolie Harrison, Megan C. Ferguson, Elizabeth Becker, Monica DeAngelis, and Sofie M. Van Parijs. 2015. "Biologically important areas for selected cetaceans within US waters-west coast region." *Aquatic Mammals*. Vol. 41, No. 1. pp. 39-53. https://doi.org/10.1578/AM.41.1.2015.39.

Carretta, J. V., E. M. Oleson, K. A. Forney, A L. Bradford, K. Yano, D. W. Weller, A. R. Lang, J. Baker, A. J. Orr, B. Hanson, J. E. Moore, M. Wallen, and R. L. Brownell, Jr. 2024. *U.S. Pacific marine mammal stock assessments: 2023*. NOAA Technical Memorandum NMFS-SWFSC-704. U.S. Department of Commerce. https://doi.org/10.25923/aqdn-f357.

California Department of Fish and Wildlife (CDFW). 2026a. "Biogeographic Information and Observation System (BIOS)." https://wildlife.ca.gov/Data/BIOS.

California Department of Fish and Wildlife (CDFW). 2026b. "California Natural Diversity Database." https://wildlife.ca.gov/Data/CNDDB.

California Geological Survey (CGS). 2021. Geologic Map of California. Accessed July 9, 2021. https://maps.conservation.ca.gov/cgs/gmc/.

California Native Plant Society (CNPS). 2026. Inventory of Rare and Endangered Plants of California. https://www.cnps.org/rare-plants/cnps-inventory-of-rare-plants.

California Department of Transportation (Caltrans). 2020. *Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish.*

DeGroot, D.S. 1927. "The California Clapper Rail: Its Nesting Habitats, Enemies, and Habitat." *Condor*. Vol. 29. pp. 259-270.

Discovery of Sound in the Sea (DOSITS). 2015. "Pile Driving." Accessed on September 14, 2015. http://www.dosits.org/audio/anthropogenicsounds/piledriving/.

Dixon, J. 1908. "A New Harvest Mouse from the Salt Marshes of San Francisco Bay, California." *Proceedings of the Biological Society of Washington*. https://www.biodiversitylibrary.org/page/3334100#page/249/mode/1up.

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*. Technical Report Y 87-1. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

Evens, J. and G. Page. 1983. *The Ecology of Clapper Rail Populations at Corte Madera Ecological Preserve with Recommendations for Management*. Marin Audubon Society.

Geissel, W., H. Shellhammer, and H.T. Harvey & Associates. 1988. "The Ecology of the Salt-marsh Harvest Mouse (Reithrodontomys raviventris) in a Diked Salt Marsh." *Journal of Mammalogy*. Vol. 69. pp. 696-703.

Goals Project. 1999. *Baylands Ecosystem Habitat Goals, a Report of Habitat Recommendations*. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, CA, and San Francisco Bay Regional Water Quality Control Board, Oakland, CA.

Golden Gate Bridge, Highway and Transportation District (District). 2024. *Liwa Class Ferry Design Program*. Presented to the Building and Operating Committee. Accessed May 5, 2026. https://www.goldengate.org/assets/1/25/2024-0926-bocomm-no3-liwaclassferrydesignprogrampres.pdf.

Golden Gate Bridge, Highway and Transportation District (District). 2026a. *Fleet - History & Research*. Accessed May 5, 2026. https://www.goldengate.org/ferry/history-research/fleet/.

Golden Gate Bridge, Highway and Transportation District (District). 2026b. *Protecting Marine Life - Riding the Ferry*. Accessed May 5, 2026. https://www.goldengate.org/ferry/riding-the-ferry/general-information/protecting-marine-life/.

Heffner H. E., and R.S. Heffner. 2007. "Hearing ranges of laboratory animals." *Journal of the American Association for Laboratory Animal Science.* Vol 46. pp. 20–22.

iNaturalist. 2026. Observations: Common Bottlenose Dolphin. Accessed May 4, 2026. https://www.inaturalist.org/observations?subview=map&taxon_id=41482.

Jacobs. 2023. *Larkspur Ferry Service and Parking Expansion Project, Ferry Wake Wash and Shoreline Erosion Analysis, Baseline Scenario Analysis. Draft*. Prepared for Golden Gate Bridge, Highway and Transportation District. September 8.

Keener, W., M. A. Webber, I. D. Szczepaniak, T. M. Markowitz, D N. Orbach. 2018. "The sex life of harbor porpoises (Phocoena phocoena): lateralized and aerial behavior." *Aquatic Mammals*. Vol. 44. pp. 620–632. https://doi.org/10.1578/AM.44.6.2018.620.

Keener, W., M. A. Webber, T. M. Markowitz, M. P. Cotter, D. Maldini, R. H. Defran, M. Rice, A. J. Debich, A. R. Lang, D. L. Kelly, A. G. Kesaris, M. Bearzi, K. Causey, D. Anderson, L. Shuster, and D. W. Weller. 2023. "Northern range expansion of California coastal bottlenose dolphins (Tursiops truncatus)." *Aquatic Mammals*. Vol. 49, No. 1. pp. 29–43. https://doi.org/10.1578/AM.49.1.2023.29.

Markowitz, T. M., W. Keener, M. A. Webber, A. R. Payne, R. S. Lane, J. A. Fahlbusch, and J. Calambokidis. 2024. "New urban habitat for endangered humpback whales: San Francisco Bay." *Aquatic Conservation: Marine and Freshwater Ecosystems.* Vol. 34, No. 3. p. e4107. https://doi.org/10.1002/aqc.4107.

Marine Traffic. 2026. "MarineTraffic: Global ship tracking intelligence." https://www.marinetraffic.com/en/ais/home/centerx:-122.4/centery:37.8/zoom:10.

McKenzie Maxon, C. 2000. *Offshore wind turbines construction*. Report No. 00.877, Odegaard&Danneskiold-Samsoe A/S. Accessed on September 14, 2015. http://tethys.pnnl.gov/sites/default/files/publications/ODS_2000.pdf.

McNab, W. H., D. T. Cleland, J. A. Freeouf, J. E. Keys, Jr., G. J. Nowacki, and C. A. Carpenter. 2007. *Description of ecological subregions: sections of the conterminous United States*. Gen. Tech. Report WO-76B. U.S. Department of Agriculture, Forest Service. 80 p.

Molnar, M., D. Buehler, R. Oestman, J. Reyff, K. Pommerenck, and B. Mitchell. 2020. *Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish*. CTHWANP-RT-20- 365.01.04. Prepared by the California Department of Transportation, Division of Environmental Analysis. October.

National Oceanic and Atmospheric Administration (NOAA). 2021. Tides & Currents. Accessed October 8, 2021. https://tidesandcurrents.noaa.gov/stationhome.html?id=9414874#info.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2021. "Endangered and Threatened Wildlife and Plants: Designating Critical Habitat for the Central America, Mexico, and Western North Pacific Distinct Population Segments of Humpback Whales." *Federal Register*. No. 86-075. April 20.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2023. "2019–2023 Eastern North Pacific Gray Whale Unusual Mortality Event along the West Coast." https://www.fisheries.noaa.gov/national/marine-life-distress/2019-2023-gray-whale-unusual-mortality-event-along-west-coast.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2024. *2024 Update to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 3.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts*. NOAA Technical Memorandum NMFS-OPR-71. https://www.fisheries.noaa.gov/s3/2024-11/Tech_Memo-Guidance_-3.0-_OCT-2024-508_OPR1.pdf.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2025a. California Sea Lion: Species directory. Accessed May 5, 2026. https://www.fisheries.noaa.gov/species/california-sea-lion.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2025b. *Summary of Marine Mammal Protection Act Acoustic Thresholds*. Prepared by the U.S. Department of the Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. https://www.fisheries.noaa.gov/s3/2025-09/MM-Acoustic-Thresholds-508-secure-SEPT-2025-OPR1.pdf.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2026a. Gray Whale: Species directory. Accessed May 5, 2026. https://www.fisheries.noaa.gov/species/gray-whale.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2026b. Harbor Porpoise: Species directory. Accessed May 5, 2026. https://www.fisheries.noaa.gov/species/harbor-porpoise.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2026c. Harbor Seal: Species directory. Accessed May 5, 2026. https://www.fisheries.noaa.gov/species/harbor-seal.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2026d. Humpback Whale: Species directory. Accessed May 5, 2026. https://www.fisheries.noaa.gov/species/humpback-whale.

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2026e. California Species List Tool. Queried for species within USGS 7.5-minute San Rafael topographic quadrangle map.Natural Resources Conservation Service (NRCS). 2026. Web Soil Survey 2.0. https://websoilsurvey.nrcs.usda.gov/app/.

Rasmussen, S., G. Glickman, R. Norinsky, F. W. Quimby, and R. J. Tolwani. 2009. "Construction Noise Decreases Reproductive Efficiency in Mice." *Journal of the American Association for Laboratory Animal Science*. Vol. 48, No. 4. pp. 363–370.

Schoeman, R. P., C. Patterson-Abrolat, and S. Pion. 2020. "A Global Review of Vessel Collisions with Marine Animals." *Frontiers in Marine Science*. Vol. 7. p. 292. https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2020.00292/full.

Shellhammer, H.S. 1989. "Salt Marsh Harvest Mice, Urban Development, and Rising Sea Levels." *Conservation Biology*. Vol. 3. pp. 59–65.

Slaathaug, J., R. S. Lane, T. M. Markowitz, W. Keener, M. A. Webber, A. Grimes, A. M. Wilken, J. E. O'Hern, P. J. Duignan, J. Calambokidis, and D. E. Crocker 2026. "Gray whales (*Eschrichtius robustus*) in San Francisco Bay experience high mortality and have limited affiliation to known foraging groups." *Frontiers in Marine Science*. Vol. 13. p. 1775666.

Smith, K. R. 2019. "Ecology and Conservation of the Salt Marsh Harvest Mouse in the Modern San Francisco Estuary." Ph.D. dissertation, University of California, Davis.

Southall, B. L., J. J. Finneran, C. Reichmuth, P. E. Nachtigall, D. R. Ketten, A. E. Bowles, W. T. Ellison, et al. 2019. "Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects." *Aquatic Mammals.* Vol. 45, No. 2. pp. 125–232. https://www.aquaticmammalsjournal.org/article/vol-45-iss-2-southall/.

Southall, B. L., D. P. Nowacek, A. E. Bowles, V. Senigaglia, L. Bejder, and P. L. Tyack. 2021. "Marine mammal noise exposure criteria: Assessing the severity of marine mammal behavioral responses to human noise." *Aquatic Mammals*. Vol. 47, No. 5. pp. 421–464. https://www.aquaticmammalsjournal.org/article/vol-47-iss-5-southall/.

Stern, S. J., W. Keener, I. D. Szczepaniak, and M. A. Webber. 2017. "Return of harbor porpoises (Phocoena phocoena) to San Francisco Bay." *Aquatic Mammals*. Vol. 43. pp. 691-702. https://www.aquaticmammalsjournal.org/article/vol-43-iss-6-stern/.

The Marine Mammal Center (TMMC). n.d. "California Sea Lion." https://www.marinemammalcenter.org/animal-care/learn-about-marine-mammals/pinnipeds/california-sea-lion.

Trulio, L. A., and J. G. Evens. 2000. "California Black Rail." In *Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife*. P. Olofson, ed. San Francisco Bay Area Wetlands Ecosystem Goals Project, San Francisco Bay Regional Water Quality Control Board. pp. 342–345.

URS Corporation (URS). 2023. *Final Program Environmental Impact Report. Expansion of Ferry Transit Service in the San Francisco Bay Area*. Prepared for Water Transit Authority.

U.S. Army Corps of Engineers (USACE). 2008. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region Version 2.0.*

U.S. Fish and Wildlife Service (USFWS). 1984. *Salt Marsh Harvest Mouse & California Clapper Rail Recovery Plan*.

U.S. Fish and Wildlife Service (USFWS). 2013. *Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California*.

U.S. Fish and Wildlife Service (USFWS). 2026. National Wetlands Inventory Map. http://www.fws.gov/wetlands/Data/Mapper.html.

Weller, D. W., G. S. Campbell, A. Debich, A. G. Kesaris, and R. H. Defran. 2016. *Mark-recapture abundance estimate of California coastal stock bottlenose dolphins: November 2009 to April 2011*. NOAA Technical Memorandum No. NOAA-TM-NMFS-SWFSC-563.

Western Regional Climate Center (WRCC). 2021. Climate Summary for San Rafael Civic Center, California Station (047880). Accessed April 9, 2021. Western Regional Climate Center

Wisniewska, D. M., M. Johnson, J. Teilmann, L. Rojano-Doñate, J. Shearer, S. Sveegaard, L. A. Miller, U. Siebert, and P. T. Madsen. 2016. "Ultra-high foraging rates of harbor porpoises make them vulnerable to anthropogenic disturbance." *Current Biology*. Vol. 26, No. 11. pp. 1441–1446.

Appendix A. USFWS, CNPS, CNDDB, and NOAA Fisheries Species Lists

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Quad IS (San Rafael (3712285) OR Bolinas (3712286) OR San Geronimo (3812216) OR Novato (3812215) OR Petaluma Point (3812214) OR San Quentin (3712284) OR San Francisco North (3712274) OR Point Bonita (3712275))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Accipiter cooperii Cooper's hawk	ABNKC12040	None	None	G5	S4	WL
Adela oplerella Opler's longhorn moth	IILEE0G040	None	None	G2	S2	
Alopecurus aequalis var. sonomensis Sonoma alopecurus	PMPOA07012	Endangered	None	G5T1	S1	1B.1
Amorpha californica var. napensis Napa false indigo	PDFAB08012	None	None	G4T2	S2	1B.2
Amsinckia lunaris bent-flowered fiddleneck	PDBOR01070	None	None	G3	S3	1B.2
Antrozous pallidus pallid bat	AMACC10010	None	None	G4	S3	SSC
Aplodontia rufa phaea Point Reyes mountain beaver	AMAFA01012	None	None	G5T2	S2	SSC
Arctostaphylos franciscana Franciscan manzanita	PDERI040J3	Endangered	None	GHC	S1	1B.1
Arctostaphylos montana ssp. montana Mt. Tamalpais manzanita	PDERI040J5	None	None	G3T3	S3	1B.3
Arctostaphylos montana ssp. ravenii Presidio manzanita	PDERI040J2	Endangered	Endangered	G3T1	S1	1B.1
Arctostaphylos virgata Marin manzanita	PDERI041K0	None	None	G2	S2	1B.2
Ardea alba great egret	ABNGA04040	None	None	G5	S4	
Ardea herodias great blue heron	ABNGA04010	None	None	G5	S4	
Arenaria paludicola marsh sandwort	PDCAR040L0	Endangered	Endangered	G1	S1	1B.1
Asio flammeus short-eared owl	ABNSB13040	None	None	G5	S3	SSC
Astragalus pycnostachyus var. pycnostachyus coastal marsh milk-vetch	PDFAB0F7B2	None	None	G2T2	S2	1B.2
Astragalus tener var. tener alkali milk-vetch	PDFAB0F8R1	None	None	G2T1	S1	1B.2
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S3	SSC
Bombus caliginosus obscure bumble bee	IIHYM24380	None	None	G4?	S1S2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Bombus occidentalis western bumble bee	IIHYM24250	None	Candidate Endangered	G2G3	S1	
Caecidotea tomalensis Tomales isopod	ICMAL01220	None	None	G2	S2S3	
Calamagrostis crassiglumis Thurber's reed grass	PMPOA17070	None	None	G3Q	S2	2B.1
Calicina diminua Marin blind harvestman	ILARAU8040	None	None	G1	S1	
Callophrys mossii marinensis Marin elfin butterfly	IILEPE2207	None	None	G4T1	S1	
Calochortus tiburonensis Tiburon mariposa-lily	PMLIL0D1C0	Threatened	Threatened	G1	S1	1B.1
Calystegia purpurata ssp. saxicola coastal bluff morning-glory	PDCON040D2	None	None	G4T2T3	S2S3	1B.2
Cardamine angulata seaside bittercress	PDBRA0K010	None	None	G4G5	S3	2B.1
Carex comosa bristly sedge	PMCYP032Y0	None	None	G5	S2	2B.1
Carex lyngbyei Lyngbye's sedge	PMCYP037Y0	None	None	G5	S3	2B.2
Carex praticola northern meadow sedge	PMCYP03B20	None	None	G5	S2	2B.2
Castilleja affinis var. neglecta Tiburon paintbrush	PDSCR0D013	Endangered	Threatened	G4G5T1T2	S1S2	1B.2
Ceanothus decornutus Nicasio ceanothus	PDRHA04440	None	None	G1	S1	1B.2
Ceanothus masonii Mason's ceanothus	PDRHA04200	None	Rare	G1	S1	1B.2
Charadrius nivosus nivosus western snowy plover	ABNNB03031	Threatened	None	G3T3	S2	SSC
Chloropyron maritimum ssp. palustre Point Reyes salty bird's-beak	PDSCR0J0C3	None	None	G4?T2	S2	1B.2
Chorizanthe cuspidata var. cuspidata San Francisco Bay spineflower	PDPGN04081	None	None	G2T1	S1	1B.2
Cicindela hirticollis gravida sandy beach tiger beetle	IICOL02101	None	None	G5T2	S2	
Circus hudsonius northern harrier	ABNKC11011	None	None	G5	S3	SSC
Cirsium andrewsii Franciscan thistle	PDAST2E050	None	None	G3	S3	1B.2
Cirsium hydrophilum var. vaseyi Mt. Tamalpais thistle	PDAST2E1G2	None	None	G2T1	S1	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Clarkia franciscana Presidio clarkia	PDONA050H0	Endangered	Endangered	G1	S1	1B.1
Coastal Brackish Marsh Coastal Brackish Marsh	CTT52200CA	None	None	G2	S2.1	
Coastal Terrace Prairie Coastal Terrace Prairie	CTT41100CA	None	None	G2	S2.1	
Collinsia corymbosa round-headed Chinese-houses	PDSCR0H060	None	None	G1	S1	1B.2
Collinsia multicolor San Francisco collinsia	PDSCR0H0B0	None	None	G2	S2	1B.2
Corynorhinus townsendii Townsend's big-eared bat	AMACC08010	None	None	G4	S2	SSC
Cypseloides niger black swift	ABNUA01010	None	None	G4	S2	SSC
Danaus plexippus pop. 1 monarch - California overwintering population	IILEPP2012	None	None	G4T2T3	S2S3	
Dicamptodon ensatus California giant salamander	AAAAH01020	None	None	G3	S2S3	SSC
Dirca occidentalis western leatherwood	PDTHY03010	None	None	G2	S2	1B.2
Egretta thula snowy egret	ABNGA06030	None	None	G5	S4	
Elanus leucurus white-tailed kite	ABNKC06010	None	None	G5	S3S4	FP
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Enhydra lutris nereis southern sea otter	AMAJF09012	Threatened	None	G4T2	S2	FP
Entosthodon kochii Koch's cord moss	NBMUS2P050	None	None	G1	S1	1B.3
Erethizon dorsatum North American porcupine	AMAFJ01010	None	None	G5	S3	
Eriogonum luteolum var. caninum Tiburon buckwheat	PDPGN083S1	None	None	G5T2	S2	1B.2
Eucyclogobius newberryi tidewater goby	AFCQN04010	Endangered	None	G3	S3	
Eumetopias jubatus Steller (=northern) sea-lion	AMAJC03010	Delisted	None	G3	S2	
Euphydryas editha bayensis Bay checkerspot butterfly	IILEPK4055	Threatened	None	G5T1	S1	
Falco peregrinus anatum American peregrine falcon	ABNKD06071	Delisted	Delisted	G4T4	S3S4	FP

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Fissidens pauperculus minute pocket moss	NBMUS2W0U0	None	None	G3?	S2	1B.2
Fritillaria lanceolata var. tristulis Marin checker lily	PMLIL0V0P1	None	None	G5T2	S2	1B.1
Fritillaria liliacea fragrant fritillary	PMLIL0V0C0	None	None	G2	S2	1B.2
Geothlypis trichas sinuosa saltmarsh common yellowthroat	ABPBX1201A	None	None	G5T3	S3	SSC
Gilia capitata ssp. chamissonis blue coast gilia	PDPLM040B3	None	None	G5T2	S2	1B.1
Gilia capitata ssp. tomentosa woolly-headed gilia	PDPLM040B9	None	None	G5T2	S2	1B.1
Gilia millefoliata dark-eyed gilia	PDPLM04130	None	None	G2	S2	1B.2
Gonidea angulata western ridged mussel	IMBIV19010	None	None	G3	S1S2	
Grindelia hirsutula var. maritima San Francisco gumplant	PDAST470D3	None	None	G5T1Q	S1	3.2
Helianthella castanea Diablo helianthella	PDAST4M020	None	None	G2	S2	1B.2
Hemizonia congesta ssp. congesta congested-headed hayfield tarplant	PDAST4R065	None	None	G5T2	S2	1B.2
Hesperolinon congestum Marin western flax	PDLIN01060	Threatened	Threatened	G1	S1	1B.1
Heteranthera dubia water star-grass	PMPON03010	None	None	G5	S2	2B.2
Holocarpha macradenia Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	G1	S1	1B.1
Horkelia cuneata var. sericea Kellogg's horkelia	PDROS0W043	None	None	G4T1?	S1?	1B.1
Horkelia marinensis Point Reyes horkelia	PDROS0W0B0	None	None	G2	S2	1B.2
Horkelia tenuiloba thin-lobed horkelia	PDROS0W0E0	None	None	G2	S2	1B.2
Hydrochara rickseckeri Ricksecker's water scavenger beetle	IICOL5V010	None	None	G2?	S2?	
Hypogymnia schizidiata island tube lichen	NLT0032640	None	None	G2G3	S2	1B.3
Kopsiopsis hookeri small groundcone	PDORO01010	None	None	G4?	S1S2	2B.3
Lasiurus blossevillii western red bat	AMACC05060	None	None	G4	S3	SSC

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Lasiurus cinereus hoary bat	AMACC05030	None	None	G3G4	S4	
Laterallus jamaicensis coturniculus California black rail	ABNME03041	None	Threatened	G3G4T1	S1	FP
Lavinia symmetricus ssp. 2 Tomales roach	AFCJB19022	None	None	G4T2T3	S2	SSC
Layia carnosa beach layia	PDAST5N010	Endangered	Endangered	G2	S2	1B.1
Leptosiphon rosaceus rose leptosiphon	PDPLM09180	None	None	G1	S1	1B.1
Lessingia germanorum San Francisco lessingia	PDAST5S010	Endangered	Endangered	G1	S1	1B.1
Lessingia micradenia var. micradenia Tamalpais lessingia	PDAST5S063	None	None	G2T2	S2	1B.2
Lichnanthe ursina bumblebee scarab beetle	IICOL67020	None	None	G2	S2	
Melospiza melodia pusillula Alameda song sparrow	ABPBXA301S	None	None	G5T2?	S2S3	SSC
Melospiza melodia samuelis San Pablo song sparrow	ABPBXA301W	None	None	G5T2	S2	SSC
Microcina tiburona Tiburon micro-blind harvestman	ILARA47060	None	None	G1	S1	
Microseris paludosa marsh microseris	PDAST6E0D0	None	None	G2	S2	1B.2
Microtus californicus sanpabloensis San Pablo vole	AMAFF11034	None	None	G5T1T2	S1S2	SSC
Mielichhoferia elongata elongate copper moss	NBMUS4Q022	None	None	G5	S3S4	4.3
Navarretia rosulata Marin County navarretia	PDPLM0C0Z0	None	None	G2	S2	1B.2
Northern Coastal Salt Marsh Northern Coastal Salt Marsh	CTT52110CA	None	None	G3	S3.2	
Nycticorax nycticorax black-crowned night heron	ABNGA11010	None	None	G5	S4	
Oncorhynchus kisutch pop. 4 coho salmon - central California coast ESU	AFCHA02034	Endangered	Endangered	G5T2T3Q	S2	
Oncorhynchus mykiss irideus pop. 8 steelhead - central California coast DPS	AFCHA0209G	Threatened	None	G5T2T3Q	S2S3	
Pentachaeta bellidiflora white-rayed pentachaeta	PDAST6X030	Endangered	Endangered	G1	S1	1B.1
Phalacrocorax auritus double-crested cormorant	ABNFD01020	None	None	G5	S4	WL

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Plagiobothrys chorisianus var. chorisianus Choris' popcornflower	PDBOR0V061	None	None	G3T1Q	S1	1B.2
Plagiobothrys diffusus San Francisco popcornflower	PDBOR0V080	None	Endangered	G1Q	S1	1B.1
Plagiobothrys glaber hairless popcornflower	PDBOR0V0B0	None	None	GX	SX	1A
Plebejus icarioides missionensis Mission blue butterfly	IILEPG801A	Endangered	None	G5T1	S1	
Pleuropogon hooverianus North Coast semaphore grass	PMPOA4Y070	None	Threatened	G2	S2	1B.1
Pogonichthys macrolepidotus Sacramento splittail	AFCJB34020	None	None	GNR	S3	SSC
Polemonium carneum Oregon polemonium	PDPLM0E050	None	None	G3G4	S2	2B.2
Polygonum marinense Marin knotweed	PDPGN0L1C0	None	None	G2Q	S2	3.1
Pomatiopsis binneyi robust walker	IMGASJ9010	None	None	G1	S1	
Quercus parvula var. tamalpaisensis Tamalpais oak	PDFAG051Q3	None	None	G4T2	S2	1B.3
Rallus obsoletus obsoletus California Ridgway's rail	ABNME05011	Endangered	Endangered	G3T1	S1	FP
Rana boylii foothill yellow-legged frog	AAABH01050	None	Endangered	G3	S3	SSC
Rana draytonii California red-legged frog	AAABH01022	Threatened	None	G2G3	S2S3	SSC
Reithrodontomys raviventris salt-marsh harvest mouse	AMAFF02040	Endangered	Endangered	G1G2	S1S2	FP
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S2	
Sanicula maritima adobe sanicle	PDAPI1Z0D0	None	Rare	G2	S2	1B.1
Scapanus latimanus insularis Angel Island mole	AMABB02032	None	None	G5T1	SH	
Serpentine Bunchgrass Serpentine Bunchgrass	CTT42130CA	None	None	G2	S2.2	
Sidalcea calycosa ssp. rhizomata Point Reyes checkerbloom	PDMAL11012	None	None	G5T2	S2	1B.2
Sidalcea hickmanii ssp. viridis Marin checkerbloom	PDMAL110A4	None	None	G3TH	SH	1B.1
Silene scouleri ssp. scouleri Scouler's catchfly	PDCAR0U1MC	None	None	G5T4T5	S2S3	2B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Silene verecunda ssp. verecunda San Francisco campion	PDCAR0U213	None	None	G5T1	S1	1B.2
Sorex ornatus sinuosus Suisun shrew	AMABA01103	None	None	G5T1T2Q	S1S2	SSC
Sorex vagrans halicoetes salt-marsh wandering shrew	AMABA01071	None	None	G5T1	S1	SSC
Spergularia macrotheca var. longistyla long-styled sand-spurrey	PDCAR0W062	None	None	G5T2	S2	1B.2
Speyeria callippe callippe callippe silverspot butterfly	IILEPJ6091	Endangered	None	G5T1	S1	
Spirinchus thaleichthys longfin smelt	AFCHB03010	Candidate	Threatened	G5	S1	
Stebbinsoseris decipiens Santa Cruz microseris	PDAST6E050	None	None	G2	S2	1B.2
Streptanthus batrachopus Tamalpais jewelflower	PDBRA2G050	None	None	G2	S2	1B.3
Streptanthus glandulosus ssp. niger Tiburon jewelflower	PDBRA2G0T0	Endangered	Endangered	G4T1	S1	1B.1
Streptanthus glandulosus ssp. pulchellus Mt. Tamalpais bristly jewelflower	PDBRA2G0J2	None	None	G4T2	S2	1B.2
Stygobromus hyporheicus Hypoheic amphipod	ICMAL05D80	None	None	G1	S1	
Symphyotrichum lentum Suisun Marsh aster	PDASTE8470	None	None	G2	S2	1B.2
Syncaris pacifica California freshwater shrimp	ICMAL27010	Endangered	Endangered	G2	S2	
Talanites ubicki Ubick's gnaphosid spider	ILARA98030	None	None	G1	S1	
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Thaleichthys pacificus eulachon	AFCHB04010	Threatened	None	G5	S2	
Trachusa gummifera San Francisco Bay Area leaf-cutter bee	IIHYM80010	None	None	G1	S1	
Trifolium amoenum two-fork clover	PDFAB40040	Endangered	None	G1	S1	1B.1
Trifolium hydrophilum saline clover	PDFAB400R5	None	None	G2	S2	1B.2
Triphysaria floribunda San Francisco owl's-clover	PDSCR2T010	None	None	G2?	S2?	1B.2
Triquetrella californica coastal triquetrella	NBMUS7S010	None	None	G2	S2	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Tryonia imitator	IMGASJ7040	None	None	G2	S2	
mimic tryonia (=California brackishwater snail)						
Vespericola marinensis	IMGASA4140	None	None	G2	S2	
Marin hesperian						
Zapus trinotatus orarius	AMAFH01031	None	None	G5T1T3Q	S1S3	SSC
Point Reyes jumping mouse						

Record Count: 148

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Quad IS (San Rafael (3712285))

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Acipenser medirostris pop. 1 green sturgeon - southern DPS	AFCAA01031	Threatened	None	G2T1	S1	SSC
Actinemys marmorata northwestern pond turtle	ARAAD02031	Proposed Threatened	None	G2	SNR	SSC
Adela oplerella Opler's longhorn moth	IILEE0G040	None	None	G2	S2	
Amorpha californica var. napensis Napa false indigo	PDFAB08012	None	None	G4T2	S2	1B.2
Amsinckia lunaris bent-flowered fiddleneck	PDBOR01070	None	None	G3	S3	1B.2
Antrozous pallidus pallid bat	AMACC10010	None	None	G4	S3	SSC
Arctostaphylos montana ssp. montana Mt. Tamalpais manzanita	PDERI040J5	None	None	G3T3	S3	1B.3
Arctostaphylos virgata Marin manzanita	PDERI041K0	None	None	G2	S2	1B.2
Ardea herodias great blue heron	ABNGA04010	None	None	G5	S4	
Bombus caliginosus obscure bumble bee	IIHYM24380	None	None	G2G3	S1S2	
Bombus occidentalis western bumble bee	IIHYM24252	None	Candidate Endangered	G3	S1	
Calamagrostis crassiglumis Thurber's reed grass	PMPOA17070	None	None	G5Q	S2	2B.1
Callophrys mossii marinensis Marin elfin butterfly	IILEPE2207	None	None	G4T1	S2	
Chloropyron maritimum ssp. palustre Point Reyes salty bird's-beak	PDSCR0J0C3	None	None	G4?T2	S2	1B.2
Chorizanthe cuspidata var. cuspidata San Francisco Bay spineflower	PDPGN04081	None	None	G2T1	S1	1B.2
Cirsium hydrophilum var. vaseyi Mt. Tamalpais thistle	PDAST2E1G2	None	None	G2T2	S2	1B.2
Coastal Brackish Marsh Coastal Brackish Marsh	CTT52200CA	None	None	G2	S2.1	
Coastal Terrace Prairie Coastal Terrace Prairie	CTT41100CA	None	None	G2	S2.1	
Corynorhinus townsendii Townsend's big-eared bat	AMACC08010	None	None	G4	S2	SSC
Dermatocarpon meiophyllizum silverskin lichen	NLTEST91L0	None	None	G3G5	S3	2B.3

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Dicamptodon ensatus California giant salamander	AAAAH01020	None	None	G3	S2S3	SSC
Dirca occidentalis western leatherwood	PDTHY03010	None	None	G2	S2	1B.2
Eriogonum luteolum var. caninum Tiburon buckwheat	PDPGN083S1	None	None	G5T2	S2	1B.2
Eucyclogobius newberryi tidewater goby	AFCQN04010	Endangered	None	G3	S3	SSC
Fissidens pauperculus minute pocket moss	NBMUS2W0U0	None	None	G3?	S2	1B.2
Fritillaria lanceolata var. tristulis Marin checker lily	PMLIL0V0P1	None	None	G5T2	S2	1B.1
Gilia millefoliata dark-eyed gilia	PDPLM04130	None	None	G2	S2	1B.2
Helianthella castanea Diablo helianthella	PDAST4M020	None	None	G2	S2	1B.2
Hemizonia congesta ssp. congesta congested-headed hayfield tarplant	PDAST4R0W1	None	None	G5T2	S2	1B.2
Hesperolinon congestum Marin western flax	PDLIN01060	Threatened	Threatened	G1	S1	1B.1
Holocarpha macradenia Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	G1	S1	1B.1
Horkelia tenuiloba thin-lobed horkelia	PDROS0W0E0	None	None	G2	S2	1B.2
Kopsiopsis hookeri small groundcone	PDORO01010	None	None	G4?	S1S2	2B.3
Lasiurus cinereus hoary bat	AMACC05032	None	None	G3G4	S4	
Laterallus jamaicensis coturniculus California black rail	ABNME03041	None	Threatened	G3T1	S2	FP
Lessingia micradenia var. micradenia Tamalpais lessingia	PDAST5S063	None	None	G2T2	S2	1B.2
Melospiza melodia samuelis San Pablo song sparrow	ABPBXA301W	None	None	G5T2	S2	SSC
Microseris paludosa marsh microseris	PDAST6E0D0	None	None	G2	S2	1B.2
Navarretia rosulata Marin County navarretia	PDPLM0C0Z0	None	None	G2	S2	1B.2
Northern Coastal Salt Marsh Northern Coastal Salt Marsh	CTT52110CA	None	None	G3	S3.2	
Oncorhynchus kisutch pop. 4 coho salmon - central California coast ESU	AFCHA02034	Endangered	Endangered	G5T2Q	S2	

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Pentachaeta bellidiflora white-rayed pentachaeta	PDAST6X030	Endangered	Endangered	G1	S1	1B.1
Plagiobothrys glaber hairless popcornflower	PDBOR0V0B0	None	None	GX	SX	1A
Pleuropogon hooverianus North Coast semaphore grass	PMPOA4Y070	None	Threatened	G2	S2	1B.1
Polygonum marinense Marin knotweed	PDPGN0L1C0	None	None	G2	S2	3.1
Pomatiopsis binneyi robust walker	IMGASJ9010	None	None	G1	S1	
Quercus parvula var. tamalpaisensis Tamalpais oak	PDFAG051Q3	None	None	G4T2	S2	1B.3
Rallus obsoletus obsoletus California Ridgway's rail	ABNME05011	Endangered	Endangered	G3T1	S2	FP
Rana boylii pop. 1 foothill yellow-legged frog - north coast DPS	AAABH01051	None	None	G3T4	S4	SSC
Reithrodontomys raviventris salt-marsh harvest mouse	AMAFF02040	Endangered	Endangered	G1G2	S3	FP
Serpentine Bunchgrass Serpentine Bunchgrass	CTT42130CA	None	None	G2	S2.2	
Sidalcea calycosa ssp. rhizomata Point Reyes checkerbloom	PDMAL11012	None	None	G5T2	S2	1B.2
Spirinchus thaleichthys pop. 2 longfin smelt - San Francisco Bay-Delta DPS	AFCHB03040	Endangered	Threatened	G5TNRQ	S1	
Stebbinsoseris decipiens Santa Cruz microseris	PDAST6E050	None	None	G2	S2	1B.2
Streptanthus batrachopus Tamalpais jewelflower	PDBRA2G050	None	None	G2	S2	1B.3
Streptanthus glandulosus ssp. pulchellus Mt. Tamalpais bristly jewelflower	PDBRA2G0J2	None	None	G4T2	S2	1B.2
Trachusa gummifera San Francisco Bay Area leaf-cutter bee	IIHYM80010	None	None	G1	S1	
Trifolium amoenum two-fork clover	PDFAB40040	Endangered	None	G1	S1	1B.1
Tryonia imitator mimic tryonia (=California brackishwater snail)	IMGASJ7040	None	None	G2	S2	
Vespericola marinensis Marin hesperian	IMGASA4140	None	None	G2	S2	

Record Count: 60

CALIFORNIA NATIVE PLANT SOCIETY

CNPS Rare Plant Inventory

Search Results

5 matches found. Click on scientific name for details

Search Criteria: , CRPR is one of [1A:1B:2A:2B] , Fed List is one of [FE:FT:FC] or State List is one of [CE:CT:CR:CC] , 9-Quad include [3712285]

▲ SCIENTIFIC NAME	COMMON NAME	FAMILY	LIFEFORM	BLOOMING PERIOD	FED LIST	STATE LIST	GLOBAL RANK	STATE RANK	CA RARE PLANT RANK	CA ENDEMIC	DATE ADDED	PHOTO
Hesperolinon congestum	Marin western flax	Linaceae	annual herb	Apr-Jul	FT	CT	G1	S1	1B.1	Yes	1974-01-01	 © 2009 Neal Kramer
Holocarpha macradenia	Santa Cruz tarplant	Asteraceae	annual herb	Jun-Oct	FT	CE	G1	S1	1B.1	Yes	1974-01-01	 © 2011 Dylan Neubauer
Pentachaeta bellidiflora	white-rayed pentachaeta	Asteraceae	annual herb	Mar-May	FE	CE	G1	S1	1B.1	Yes	1974-01-01	No Photo Available
Pleuropogon hooverianus	North Coast semaphore grass	Poaceae	perennial rhizomatous herb	Apr-Jun	None	CT	G2	S2	1B.1	Yes	1974-01-01	No Photo Available
Trifolium amoenum	two-fork clover	Fabaceae	annual herb	Apr-Jun	FE	None	G1	S1	1B.1	Yes	1974-01-01	No Photo Available

Showing 1 to 5 of 5 entries

Go to top

Suggested Citation:

California Native Plant Society, Rare Plant Program. 2026. Rare Plant Inventory (online edition, v9.5.1). Website https://www.rareplants.cnps.org [accessed 6 March 2026].
}

Outlook

Larkspur Ferry- NMFS Official Species List

From Cotroneo, Rachel <Rachel.Cotroneo@jacobs.com>
Date Fri 3/6/2026 10:35 AM
To NOAAA Official Species List Email <nmfs.wcrca.specieslist@noaa.gov>

Request confirmation of official species list for the Larkspur Ferry Service and Parking Expansion Project for Quad, Ran Rafael.

Quad Name San Rafael
Quad Number 37122-H5
ESA Anadromous Fish

SONCC Coho ESU (T) -
CCC Coho ESU (E) - X
CC Chinook Salmon ESU (T) -
CVSR Chinook Salmon ESU (T) - X
SRWR Chinook Salmon ESU (E) - X
NC Steelhead DPS (T) -
CCC Steelhead DPS (T) - X
SCCC Steelhead DPS (T) -
SC Steelhead DPS (E) -
CCV Steelhead DPS (T) - X
Eulachon (T) -
sDPS Green Sturgeon (T) - X
ESA Anadromous Fish Critical Habitat

SONCC Coho Critical Habitat -
CCC Coho Critical Habitat - X
CC Chinook Salmon Critical Habitat -
CVSR Chinook Salmon Critical Habitat -
SRWR Chinook Salmon Critical Habitat - X
NC Steelhead Critical Habitat -
CCC Steelhead Critical Habitat - X
SCCC Steelhead Critical Habitat -
SC Steelhead Critical Habitat -
CCV Steelhead Critical Habitat -
Eulachon Critical Habitat -
sDPS Green Sturgeon Critical Habitat - X
ESA Marine Invertebrates

Range Black Abalone (E) - X
Range White Abalone (E) -
ESA Marine Invertebrates Critical Habitat

Black Abalone Critical Habitat - X
ESA Sea Turtles

East Pacific Green Sea Turtle (T) - X
Olive Ridley Sea Turtle (T/E) - X
Leatherback Sea Turtle (E) - X
North Pacific Loggerhead Sea Turtle (E) -
ESA Whales

Blue Whale (E) - X
Fin Whale (E) - X
Humpback Whale (E) - X
Southern Resident Killer Whale (E) - X
North Pacific Right Whale (E) - X
Sei Whale (E) - X
Sperm Whale (E) - X
ESA Pinnipeds

Guadalupe Fur Seal (T) - X
Essential Fish Habitat

Coho EFH - X
Chinook Salmon EFH - X
Groundfish EFH - X
Coastal Pelagics EFH - X
Highly Migratory Species EFH -
MMPA Species (See list at left)

ESA and MMPA Cetaceans/Pinnipeds
See list at left and consult Monica DeAngelis
monica.deangelis@noaa.gov
562-980-3232

MMPA Cetaceans - X
MMPA Pinnipeds - X

Rachel Cotroneo, M.S. (she/her)
Jacobs
Biologist | Buildings and Infrastructure
510.219.7305

Outlook

[EXTERNAL] Federal ESA - - NOAA Fisheries Species List Re: Larkspur Ferry- NMFS Official Species List

From NMFS SpeciesList - NOAA Service Account <nmfs.wcrca.specieslist@noaa.gov>
Date Fri 3/6/2026 10:35 AM
To prvs=35252b460b=rachel.cotroneo@jacobs.com <prvs=35252b460b=rachel.cotroneo@jacobs.com>

This Message Is From an External Sender
This message came from outside your organization.

Please retain a copy of each email request that you send to NOAA at nmfs.wcrca.specieslist@noaa.gov as proof of your official Endangered Species Act SPECIES LIST. The email you send to NOAA should include the following information: your first and last name; email address; phone number; federal agency name (or delegated state agency such as Caltrans); mailing address; project title; brief description of the project; and a copy of a list of threatened or endangered species identified within specified geographic areas derived from the NOAA Fisheries, West Coast Region, California Species List Tool. You may only receive this instruction once per week. If you have questions, contact your local NOAA Fisheries liaison.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
Phone: (916) 414-6600 Fax: (916) 414-6713

In Reply Refer To: March 12, 2021
Consultation Code: 08ESMF00-2021-SLI-1279
Event Code: 08ESMF00-2021-E-03693
Project Name: Larkspur Ferry Terminal Expansion Project

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, under the jurisdiction of the U.S. Fish and Wildlife Service (Service) that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the Service under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Please follow the link below to see if your proposed project has the potential to affect other species or their habitats under the jurisdiction of the National Marine Fisheries Service:

http://www.nwr.noaa.gov/protected_species/species_list/species_lists.html

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to

utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

Project Summary

Consultation Code: 08ESMF00-2021-SLI-1279
Event Code: 08ESMF00-2021-E-03693
Project Name: Larkspur Ferry Terminal Expansion Project
Project Type: TRANSPORTATION
Project Description: Increase route and parking.
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@37.94464025,-122.50981674942295,14z



Counties: Marin County, California

Endangered Species Act Species

There is a total of 18 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Salt Marsh Harvest Mouse *Reithrodontomys raviventris*	Endangered

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/613

Birds

NAME	STATUS
California Clapper Rail *Rallus longirostris obsoletus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4240	Endangered
California Least Tern *Sterna antillarum browni* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/8104	Endangered
Marbled Murrelet *Brachyramphus marmoratus* Population: U.S.A. (CA, OR, WA) There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/4467	Threatened
Northern Spotted Owl *Strix occidentalis caurina* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/1123	Threatened
Short-tailed Albatross *Phoebastria (=Diomedea) albatrus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/433	Endangered
Western Snowy Plover *Charadrius nivosus nivosus* Population: Pacific Coast population DPS-U.S.A. (CA, OR, WA), Mexico (within 50 miles of Pacific coast) There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/8035	Threatened

Reptiles

NAME	STATUS
Green Sea Turtle *Chelonia mydas* Population: East Pacific DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened

Amphibians

NAME	STATUS
California Red-legged Frog *Rana draytonii* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/2891	Threatened

Fishes

NAME	STATUS
Delta Smelt *Hypomesus transpacificus* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/321	Threatened
Tidewater Goby *Eucyclogobius newberryi* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/57	Endangered

Insects

NAME	STATUS
Mission Blue Butterfly *Icaricia icarioides missionensis* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/6928	Endangered
Myrtle's Silverspot Butterfly *Speyeria zerene myrtleae* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6929	Endangered
San Bruno Elfin Butterfly *Callophrys mossii bayensis* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/3394	Endangered

Flowering Plants

NAME	STATUS
Marin Dwarf-flax *Hesperolinon congestum* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5363	Threatened
Santa Cruz Tarplant *Holocarpha macradenia* There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/6832	Threatened
Showy Indian Clover *Trifolium amoenum* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6459	Endangered
White-rayed Pentachaeta *Pentachaeta bellidiflora* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7782	Endangered

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
Phone: (916) 414-6600 Fax: (916) 414-6713

In Reply Refer To: 03/06/2026 01:11:36 UTC
Project Code: 2026-0059104
Project Name: Larkspur Ferry Service and Parking Expansion Project

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)

(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Note: IPaC has provided all available attachments because this project is in multiple field office jurisdictions.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Bald & Golden Eagles
- Migratory Birds
- Wetlands

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

This project's location is within the jurisdiction of multiple offices. However, only one species list document will be provided for all offices. The species and critical habitats in this document reflect the aggregation of those that fall in each of the affiliated office's jurisdiction. Other offices affiliated with the project:

San Francisco Bay-Delta Fish And Wildlife
650 Capitol Mall
Suite 8-300
Sacramento, CA 95814
(916) 930-5603

PROJECT SUMMARY

Project Code: 2026-0059104
Project Name: Larkspur Ferry Service and Parking Expansion Project
Project Type: Port Operations
Project Description: The Larkspur Ferry Service and Parking Expansion Project (project) is being implemented by the Golden Gate Bridge Highway and Transportation District (GGBHTD) to increase ferry ridership and reduce traffic congestion on Highway 101 in Marin and Sonoma counties and in the Larkspur Landing area. The project will accommodate increases in ridership with adequate parking, transit connectivity (bus and rail), and active transportation, for overall reduction in traffic backup and congestion in the area.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@37.93672775,-122.50333928865174,14z



Counties: Marin County, California

ENDANGERED SPECIES ACT SPECIES

There is a total of 20 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Salt Marsh Harvest Mouse *Reithrodontomys raviventris*	Endangered

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/613
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf

BIRDS

NAME	STATUS
California Least Tern *Sternula antillarum browni*	Endangered

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/8104
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf

California Ridgway's Rail *Rallus obsoletus obsoletus* — Endangered

No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/4240
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf

Marbled Murrelet *Brachyramphus marmoratus* — Threatened

Population: U.S.A. (CA, OR, WA)
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/4467
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf

Northern Spotted Owl *Strix occidentalis caurina* — Threatened

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/1123
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf

Western Snowy Plover *Charadrius nivosus nivosus* — Threatened

Population: Pacific Coast population DPS-U.S.A. (CA, OR, WA), Mexico (within 50 miles of Pacific coast)
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/8035
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf

REPTILES

NAME	STATUS
Green Sea Turtle *Chelonia mydas* Population: East Pacific DPS No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6199	Threatened
Northwestern Pond Turtle *Actinemys marmorata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1111 General project design guidelines: https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf	Proposed Threatened

AMPHIBIANS

NAME	STATUS
California Red-legged Frog *Rana draytonii* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2891 General project design guidelines: https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf	Threatened

FISHES

NAME	STATUS
Longfin Smelt *Spirinchus thaleichthys* Population: San Francisco Bay-Delta DPS There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/9011 General project design guidelines: https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf	Endangered
Tidewater Goby *Eucyclogobius newberryi* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/57 General project design guidelines: https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11271.pdf	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat.	Proposed Threatened

NAME	STATUS

Species profile: https://ecos.fws.gov/ecp/species/9743
General project design guidelines:
https://ipac.ecosphere.fws.gov/project/3OOLJLKBGJBCFP7BJP5ZAMUQOI/documents/generated/11238,11271.pdf

FLOWERING PLANTS

NAME	STATUS
California Seablite *Suaeda californica*	Endangered

Population:
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/6310

Marin Dwarf-flax *Hesperolinon congestum* — Threatened
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/5363

Santa Cruz Tarplant *Holocarpha macradenia* — Threatened
There is **final** critical habitat for this species. Your location does not overlap the critical habitat.
Species profile: https://ecos.fws.gov/ecp/species/6832

Showy Indian Clover *Trifolium amoenum* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/6459

Tiburon Jewelflower *Streptanthus niger* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/4187

Tiburon Mariposa Lily *Calochortus tiburonensis* — Threatened
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/2858

Tiburon Paintbrush *Castilleja affinis ssp. neglecta* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/2687

White-rayed Pentachaeta *Pentachaeta bellidiflora* — Endangered
No critical habitat has been designated for this species.
Species profile: https://ecos.fws.gov/ecp/species/7782

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

USFWS NATIONAL WILDLIFE REFUGE LANDS AND FISH HATCHERIES

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

BALD & GOLDEN EAGLES

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their habitats, should follow appropriate regulations and consider implementing appropriate avoidance and minimization measures, as described in the various links on this page.

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1. The Bald and Golden Eagle Protection Act of 1940.
2. The Migratory Birds Treaty Act of 1918.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

There are Bald Eagles and/or Golden Eagles in your project area.

Measures for Proactively Minimizing Eagle Impacts
For information on how to best avoid and minimize disturbance to nesting bald eagles, please review the National Bald Eagle Management Guidelines. You may employ the timing and activity-specific distance recommendations in this document when designing your project/ activity to avoid and minimize eagle impacts. For bald eagle information specific to Alaska, please refer to Bald Eagle Nesting and Sensitivity to Human Activity.

The FWS does not currently have guidelines for avoiding and minimizing disturbance to nesting Golden Eagles. For site-specific recommendations regarding nesting Golden Eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

If disturbance or take of eagles cannot be avoided, an incidental take permit may be available to authorize any take that results from, but is not the purpose of, an otherwise lawful activity. For assistance making this determination for Bald Eagles, visit the Do I Need A Permit Tool. For assistance making this determination for golden eagles, please consult with the appropriate Regional Migratory Bird Office or Ecological Services Field Office.

Ensure Your Eagle List is Accurate and Complete
If your project area is in a poorly surveyed area in IPaC, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information

on Migratory Birds and Eagles, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to bald or golden eagles on your list, see the "Probability of Presence Summary" below to see when these bald or golden eagles are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Golden Eagle *Aquila chrysaetos* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

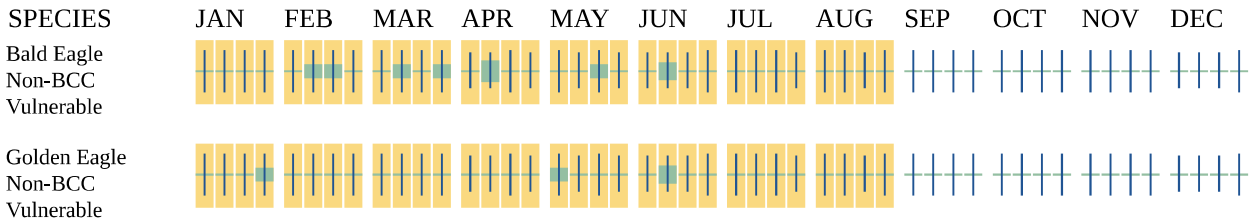
Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

■ probability of presence ■ breeding season | survey effort – no data



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

MIGRATORY BIRDS

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (Service).

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1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the "Probability of Presence Summary" below to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Allen's Hummingbird *Selasphorus sasin* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9637	Breeds Feb 1 to Jul 15

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Jan 1 to Aug 31
Belding's Savannah Sparrow *Passerculus sandwichensis beldingi* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/8	Breeds Apr 1 to Aug 15
Black Oystercatcher *Haematopus bachmani* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9591	Breeds Apr 15 to Oct 31
Black Scoter *Melanitta nigra* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10413	Breeds elsewhere
Black Swift *Cypseloides niger* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8878	Breeds Jun 15 to Sep 10
Black Tern *Chlidonias niger surinamenisis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3093	Breeds May 15 to Aug 20
Black Turnstone *Arenaria melanocephala* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10557	Breeds elsewhere
Brandt's Cormorant *Urile penicillatus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/11903	Breeds Apr 15 to Sep 15
Brown Pelican *Pelecanus occidentalis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/6034	Breeds Jan 15 to Sep 30

NAME	BREEDING SEASON
Bullock's Oriole *Icterus bullockii* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9458	Breeds Mar 21 to Jul 25
California Gull *Larus californicus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10955	Breeds Mar 1 to Jul 31
California Spotted Owl *Strix occidentalis occidentalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/7266	Breeds Mar 10 to Jun 15
Clark's Grebe *Aechmophorus clarkii* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10575	Breeds Jun 1 to Aug 31
Common Loon *gavia immer* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/4464	Breeds Apr 15 to Oct 31
Common Murre *Uria aalge* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10453	Breeds Apr 15 to Aug 15
Common Yellowthroat *Geothlypis trichas sinuosa* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/2084	Breeds May 20 to Jul 31
Double-crested Cormorant *phalacrocorax auritus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/3478	Breeds Apr 20 to Aug 31
Elegant Tern *Thalasseus elegans* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/8561	Breeds Apr 5 to Aug 5

NAME	BREEDING SEASON
Golden Eagle *Aquila chrysaetos* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds Jan 1 to Aug 31
Heermann's Gull *Larus heermanni* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/11955	Breeds Mar 15 to Aug 31
Lawrence's Goldfinch *Spinus lawrencei* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9464	Breeds Mar 20 to Sep 20
Long-eared Owl *asio otus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Long-tailed Duck *Clangula hyemalis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/7238	Breeds elsewhere
Marbled Godwit *Limosa fedoa* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9481	Breeds elsewhere
Northern Harrier *Circus hudsonius* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/8350	Breeds Apr 1 to Sep 15
Nuttall's Woodpecker *Dryobates nuttallii* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9410	Breeds Apr 1 to Jul 20
Oak Titmouse *Baeolophus inornatus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9656	Breeds Mar 15 to Jul 15
Olive-sided Flycatcher *Contopus cooperi* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3914	Breeds May 20 to Aug 31

NAME	BREEDING SEASON
Pomarine Jaeger *Stercorarius pomarinus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10458	Breeds elsewhere
Red Knot *Calidris canutus roselaari* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8880	Breeds elsewhere
Red Phalarope *Phalaropus fulicarius* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10469	Breeds elsewhere
Red-breasted Merganser *Mergus serrator* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10693	Breeds elsewhere
Red-necked Phalarope *Phalaropus lobatus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10467	Breeds elsewhere
Red-throated Loon *Gavia stellata* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/9589	Breeds elsewhere
Ring-billed Gull *Larus delawarensis* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10468	Breeds elsewhere
Santa Barbara Song Sparrow *Melospiza melodia graminea* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/5513	Breeds Mar 1 to Sep 5
Short-billed Dowitcher *Limnodromus griseus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9480	Breeds elsewhere

NAME	BREEDING SEASON
Surf Scoter *Melanitta perspicillata* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10463	Breeds elsewhere
Tricolored Blackbird *Agelaius tricolor* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3910	Breeds Mar 15 to Aug 10
Western Grebe *Aechmophorus occidentalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/6743	Breeds Jun 1 to Aug 31
Western Gull *Larus occidentalis* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/11969	Breeds Apr 21 to Aug 25
Western Screech-owl *Megascops kennicottii cardonensis* This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/11923	Breeds Mar 1 to Jun 30
White-winged Scoter *Melanitta fusca* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/10462	Breeds elsewhere
Willet *Tringa semipalmata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10669	Breeds elsewhere
Wrentit *Chamaea fasciata* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/10668	Breeds Mar 15 to Aug 10

PROBABILITY OF PRESENCE SUMMARY

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper

Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

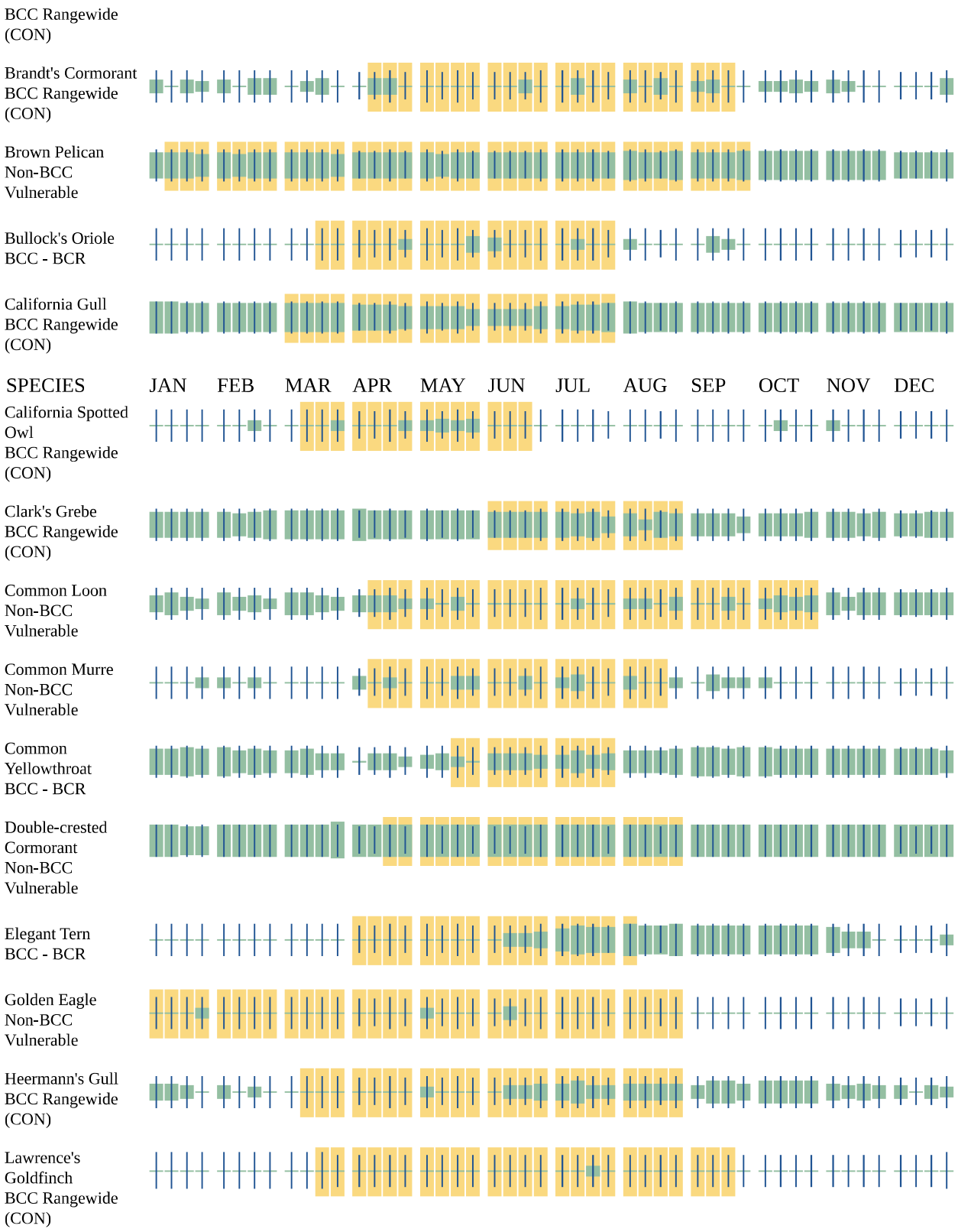
Green bars; the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during that week of the year.

Breeding Season (■)
Yellow bars; liberal estimate of the timeframe inside which the bird breeds across its entire range.

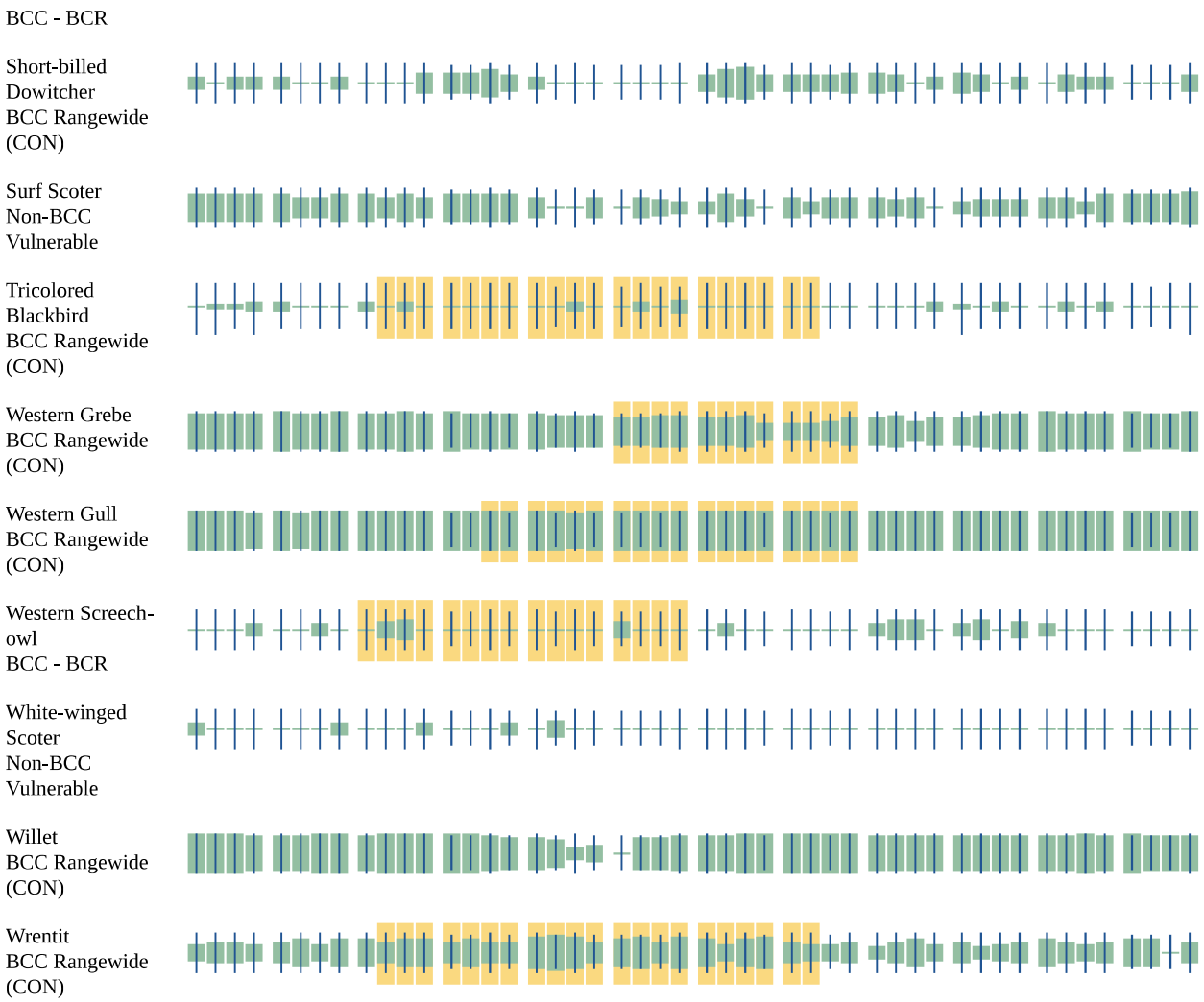
Survey Effort (|)
Vertical black lines; the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data (–)
A week is marked as having no data if there were no survey events for that week.




BCC Rangewide (CON)
Brandt's Cormorant BCC Rangewide (CON)
Brown Pelican Non-BCC Vulnerable
Bullock's Oriole BCC - BCR
California Gull BCC Rangewide (CON)
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
California Spotted Owl BCC Rangewide (CON)
Clark's Grebe BCC Rangewide (CON)
Common Loon Non-BCC Vulnerable
Common Murre Non-BCC Vulnerable
Common Yellowthroat BCC - BCR
Double-crested Cormorant Non-BCC Vulnerable
Elegant Tern BCC - BCR
Golden Eagle Non-BCC Vulnerable
Heermann's Gull BCC Rangewide (CON)
Lawrence's Goldfinch BCC Rangewide (CON)


Long-eared Owl
BCC Rangewide
(CON)
Long-tailed Duck
Non-BCC
Vulnerable
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Marbled Godwit
BCC Rangewide
(CON)
Northern Harrier
BCC - BCR
Nuttall's
Woodpecker
BCC - BCR
Oak Titmouse
BCC Rangewide
(CON)
Olive-sided
Flycatcher
BCC Rangewide
(CON)
Pomarine Jaeger
Non-BCC
Vulnerable
Red Knot
BCC Rangewide
(CON)
Red Phalarope
Non-BCC
Vulnerable
Red-breasted
Merganser
Non-BCC
Vulnerable
Red-necked
Phalarope
Non-BCC
Vulnerable
Red-throated Loon
Non-BCC
Vulnerable
Ring-billed Gull
Non-BCC
Vulnerable
SPECIES
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Santa Barbara Song
Sparrow



Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

WETLANDS

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

WETLAND INFORMATION WAS NOT AVAILABLE WHEN THIS SPECIES LIST WAS GENERATED. PLEASE VISIT HTTPS://WWW.FWS.GOV/WETLANDS/DATA/MAPPER.HTML OR CONTACT THE FIELD OFFICE FOR FURTHER INFORMATION.

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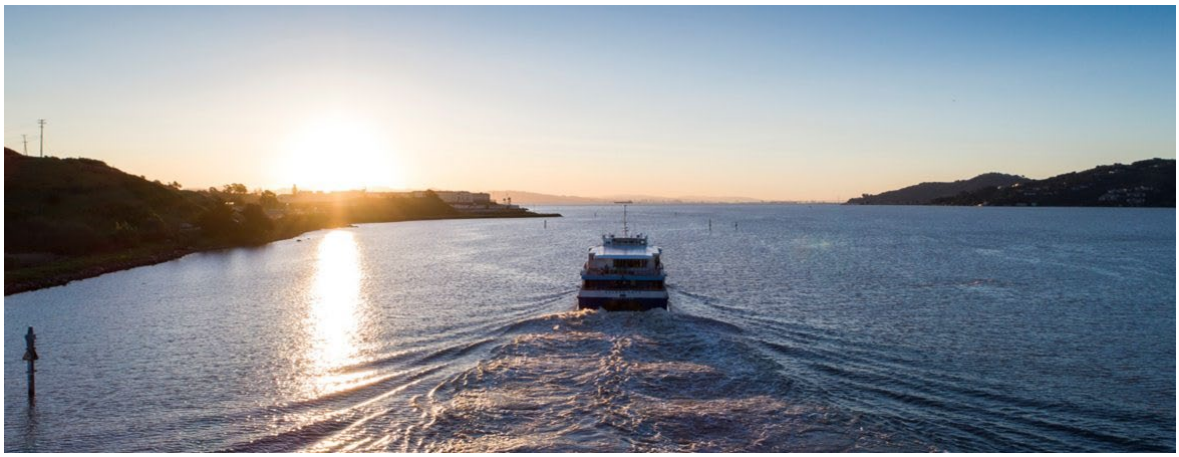
Appendix B. Aquatic Resource Delineation

Aquatic Resources Delineation Report

Document no: 261007154016_b98d303b
Revision: Draft

Golden Gate Bridge, Highway and Transportation District

Larkspur Ferry Service Expansion and Parking Project
March 31, 2026



Aquatic Resources Delineation Report

Client name:	Golden Gate Bridge, Highway and Transportation District		
Project name:	Larkspur Ferry Service Expansion and Parking Project		
Client reference:	*[Client reference]*	**Project no:**	*[Project number]*
Document no:	261007154016_b98d303b	**Project manager:**	*[Project manager]*
Revision:	Draft	**Prepared by:**	*[Prepared by]*
Date:	March 31, 2026	**File name:**	Document1

Document status: *[Document suitability – Delete row if not applicable]*

Document history and status

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Executive Summary

The Larkspur Ferry Service Expansion and Parking Project (Project) is being implemented by the Golden Gate Bridge, Highway and Transportation District to increase ferry ridership and reduce traffic congestion on United States Highway 101 in Marin and Sonoma counties and in the Larkspur Landing area. The Project will accommodate increases in ridership with adequate parking, transit connectivity (bus and rail), and active transportation, for overall reduction in traffic backup and congestion in the area.

An aquatic resource delineation was conducted for a 43.69-acre study area that encompasses the Project area, including potential work locations, staging areas, and access routes. This delineation was conducted in accordance with the U.S. Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987) and the Regional Supplement to the U.S. Corps of Engineers Wetland Delineation Manual: Arid West Region Version 2.0 (USACE 2008). The study area contained 4.68 acres of wetlands and 10.14 acres of non-wetland waters.

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Acronyms and Abbreviations

°F	degree(s) Fahrenheit
District	Golden Gate Bridge, Highway and Transportation District
ID	identification
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
Project	Larkspur Ferry Service Expansion and Parking Project
study area	aquatic resource study area
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

1. Introduction

The Larkspur Ferry Service Expansion and Parking Project (Project) is being implemented by the Golden Gate Bridge, Highway and Transportation District (District) along the San Francisco Bay (Figure 1-1). The purpose of the Project is to relieve congestion within the United States Highway (101) highway corridor, meet increasing demand for ferry service from Larkspur and Marin County to existing and planned ferry terminals in San Francisco and the greater Bay Area, and develop parking solutions that will accommodate additional passengers accessing current and expanded ferry service to San Francisco and the greater Bay Area.

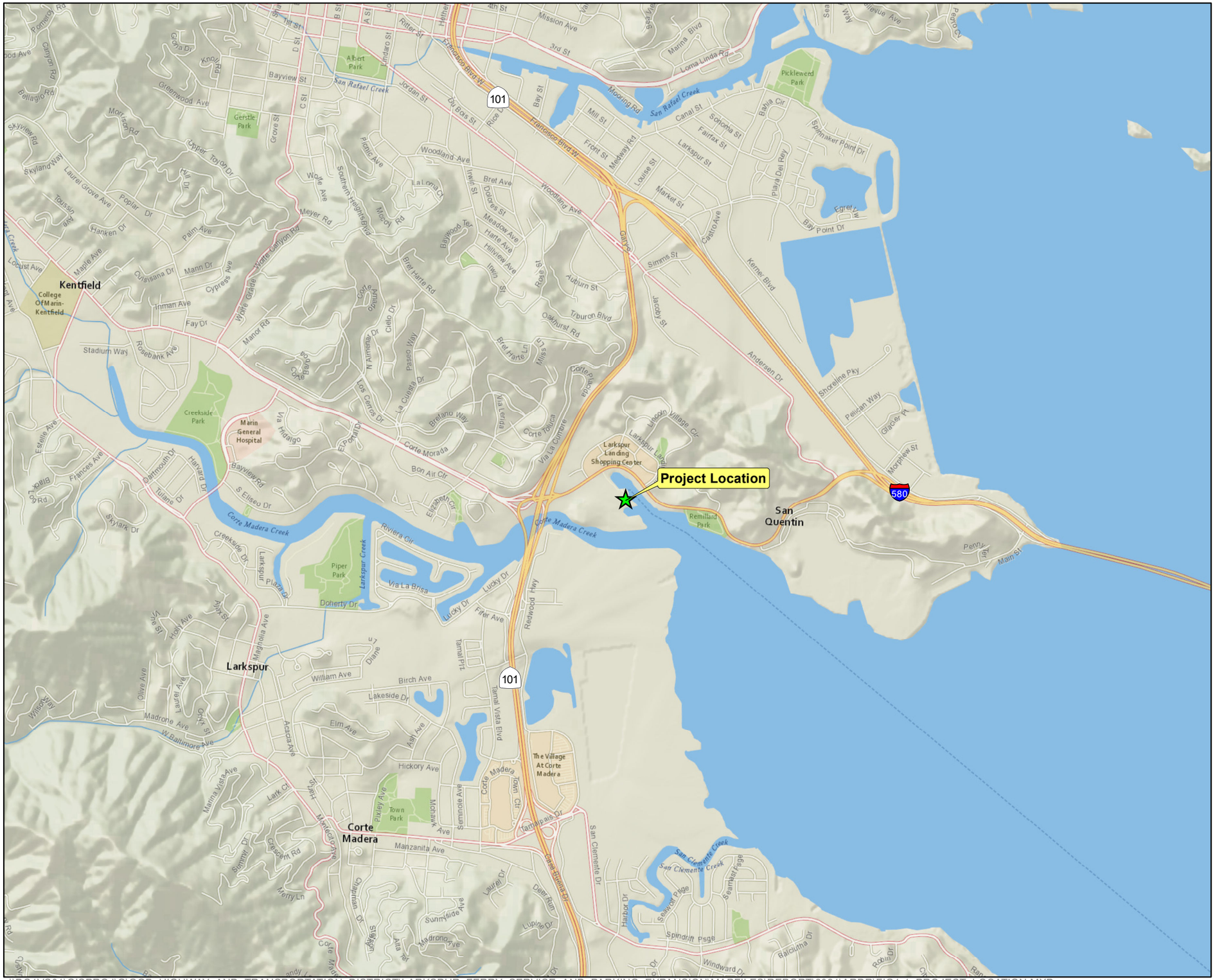
This report presents the methods and results of an aquatic resource delineation for a 43.69-acre aquatic resource study area (study area) (Figure 1-2) that encompasses the Project area, including potential work locations, access routes, and staging areas. A general description of the proposed Project is provided in this section. The environmental setting of the study area is described in Section 2. Survey methods and results are provided in Sections 3 and 4, respectively.

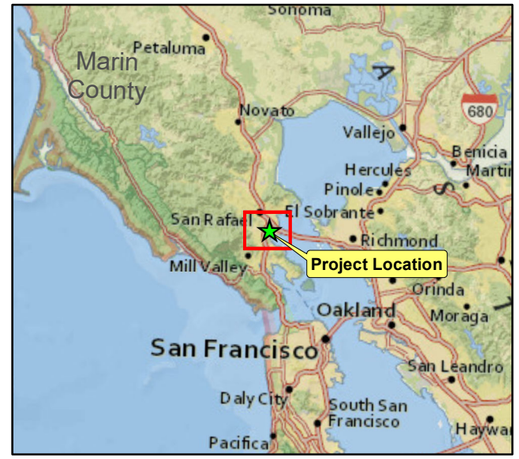
1.1 Project Overview

The purpose of this Project is to relieve traffic, meet increasing demand for ferry services, and develop parking solutions. Increased ferry crossings to meet new passenger demand will be accommodated by increased parking, with the likelihood of new parking structure(s). The size of the structure and number of parking stalls will be dependent on passenger forecasts. Two sites are under consideration for these parking structures: one site is the main parking lot adjacent to the ferry terminal; another site is the North parking lot, also owned by the District, which is adjacent to the Larkspur station for the Sonoma–Marin Area Rail Transit train and off of Larkspur Landing Circle, across Sir Francis Drake Boulevard.

The new parking garage(s) will require some modification to existing landside access and circulation configuration. Depending on the location, the parking garage(s) will require construction activities, including staging areas for equipment storage and some excavation for new utilities, pile driving, and the elevator shaft. The Project would require approximately one construction season to complete. Construction work is anticipated to only occur during the day; no night work would occur.

Figure 1-1 Project Location





LEGEND

★ Project Location

N

0 2,000 4,000

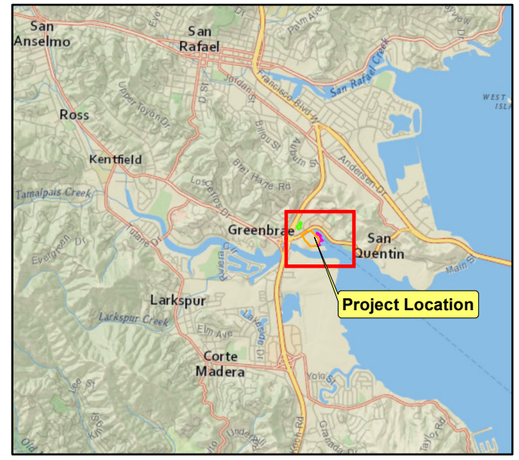
Feet

FIGURE 1-1
Project Location
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\ARDR\FIG1-1_PROJECT_LOCATION.MXD

Figure 1-2 Study Area





LEGEND

Study Area

N

0 300 600

Feet

FIGURE 1-2
Study Area
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\ARDR\FIG1-2_STUDY_AREA.MXD

2. Environmental Setting

2.1 Project Location

The Larkspur Ferry Terminal is located along the central San Francisco Bay near Sir Francis Drake Boulevard in Marin County, California, at latitude 37°56'40.2"N and longitude 122°30'31.4"W. The study area is within the San Rafael U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle.

2.2 Regional Setting

The Project is located within the Marin Hills Subsection, within the Central California Foothills and Coastal Mountains Ecoregion. The Mediterranean climate in this ecoregion consists of hot dry summers and cool moist winters. Vegetative cover consists mostly of chaparral and oak woodlands; grasslands occur in some low elevations and patches of pine are found at high elevations. Most of the region consists of open low mountains or foothills, but there are some areas of irregular plains and some narrow valleys. Large areas are ranchland and are grazed by domestic livestock. Relatively little land has been cultivated, although some valleys are major agricultural centers such as the Salinas Valley or the wine vineyard centers of Napa and Sonoma Valleys. Natural vegetation includes coast live oak woodlands, Coulter pine, and unique native stands of Monterey pine in the west, and blue oak, black oak, and grey pine woodlands in the east (Griffith et al. 2016).

The Marin Hills Ecological Subsection is on mountains and hills between San Francisco Bay and the San Andreas fault that are north of the Golden Gate. Elevations range from sea-level up to 2,604 feet. Soil temperature regimes are mostly mesic and thermic, with some isomesic. Soil moisture regimes are mostly xeric. Common vegetation includes coast live oak (*Quercus agrifolia*), annual grasslands, coastal scrub, and some tanoak (*Notholithocarpus densiflorus*) and Douglar-fir (*Pseudotsuga menziesii*) (Griffith et al. 2016).

2.3 Study Area Setting

2.3.1 Physical Conditions

The study area is situated along the San Francisco Bay shoreline with elevations ranging from approximately -15 feet[1] in the Larkspur Ferry Navigation Channel turning basin to 45 feet on Wood Island (Figure 1-2). The mouth of Corte Madera Creek and the Corte Madera Channel are situated along the western and southern boundaries of the study area. The Larkspur Ferry Navigation Channel within the eastern portion of the study area is dredged to maintain a depth of -13 feet and -15 feet in the turning basin at the channel's terminus. The majority of the central and northern portions of the study area are developed for the ferry terminal, roads, and commercial real estate.

2.3.2 Climate

The climate in the vicinity of the study area consists of hot dry summers and cool moist winters, with precipitation occurring mostly during winter (McNab et al. 2007). Monthly temperatures vary, with an average high of 67.7 degrees Fahrenheit (°F) in July and an average low of 48.7 °F in January. Mean annual precipitation is 36.4 inches (WRCC 2021).

[1] All elevations in this report are referenced to North American Vertical Datum 1988.

2.3.3 Hydrology

The hydrology of the study area is primarily influenced by tides in San Francisco Bay; precipitation and fluvial hydrology have a negligible effect on the distribution of aquatic resources in the study area. The San Francisco Bay experiences mixed semi-diurnal tides, a daily pattern of two high tides of different heights and two low tides of different heights (Conomos et al. 1985). The National Oceanic and Atmospheric Administration operates a tidal station approximately 500 feet west of the study area. Tidal datums for this station are provided in Table 2-1.

Table 2-1. Tidal Datums at Corte Madera Creek (Station ID: 9414874)

Datum	Elevation (feet)
Mean Higher High Water	5.80
Mean High Water	5.20
Mean Sea level	3.10
Mean Low Water	1.08
Mean Lower Low Water	0.00

Source: Tides & Currents (NOAA 2021). Note that San Francisco, San Francisco Bay (Station ID 99414290) is the control tide station for the Corte Madera Creek station.

ID = identification

2.3.4 Geology and Soils

The study area is underlain by marine and nonmarine (continental) sedimentary rocks of the Pleistocene era (about 2 million to 11 thousand years ago) to the Holocene era (past 11 thousand years) (CGS 2021). Soil series mapped within the study area are shown on Figure 2-1 and summarized in Table 2-2. As noted by the soil mapping and in the table, four different types of soil occur within the study area.

Table 2-2. Mapped Soil Series Within or Adjacent to the Study Area

Type/Series	Texture	Landscape Position and Parent Material	Drainage and Permeability	NRCS Hydric Soils List
Saurin-Bonnydoon complex, 15% to 30% slopes	Clay loam	On hills, formed in residuum weathered from sandstone and shale	Somewhat excessively drained; high permeability	No
Tocaloma-Saurin association, steep	Clay Loam	On hills, formed in residuum weathered from sandstone and shale	Well drained; high permeability	Yes
Xerorthents, fill	Silty clay loam	On tidal flats and valley floors, formed in earth spread deposits derived from igneous, metamorphic and sedimentary rock	Well to somewhat excessively drained; medium to very rapid runoff; moderate or moderately slow permeability.	Yes

Type/Series	Texture	Landscape Position and Parent Material	Drainage and Permeability	NRCS Hydric Soils List
Xerorthents-Urban land complex, 0% to 9% slopes		On tidal flats and valley floors, formed in earth spread deposits		Yes

Source: Web Soil Survey 2.0 (NRCS 2021a)

NRCS = Natural Resources Conservation Service

2.3.5 National Wetlands Inventory

Figure 2-2 provides a map showing aquatic resources in the study area identified by the National Wetlands Inventory (NWI) (USFWS 2021). The NWI identifies the Corte Madera Creek marsh in the southern portion of the study area as an estuarine and marine wetland habitat. The Cowardin classification assigned to the marsh in NWI is Estuarine, Intertidal, Emergent, Persistent, Regularly Flooded (E2EM1N). The NWI also identifies open water portions of Corte Madera Creek and San Francisco Bay as estuarine and marine deepwater habitat. The Cowardin classification assigned to the waters in NWI is Estuarine, Subtidal, Unconsolidated Bottom, Subtidal (E1UBL). Finally, the NWI identified a riverine feature along the western boundary of the ferry terminal in the study area. The Cowardin classification assigned to the feature in NWI is Riverine, Intermittent, Streambed, Temporary Flooded (R4SBA).

2.3.6 Vegetation Communities

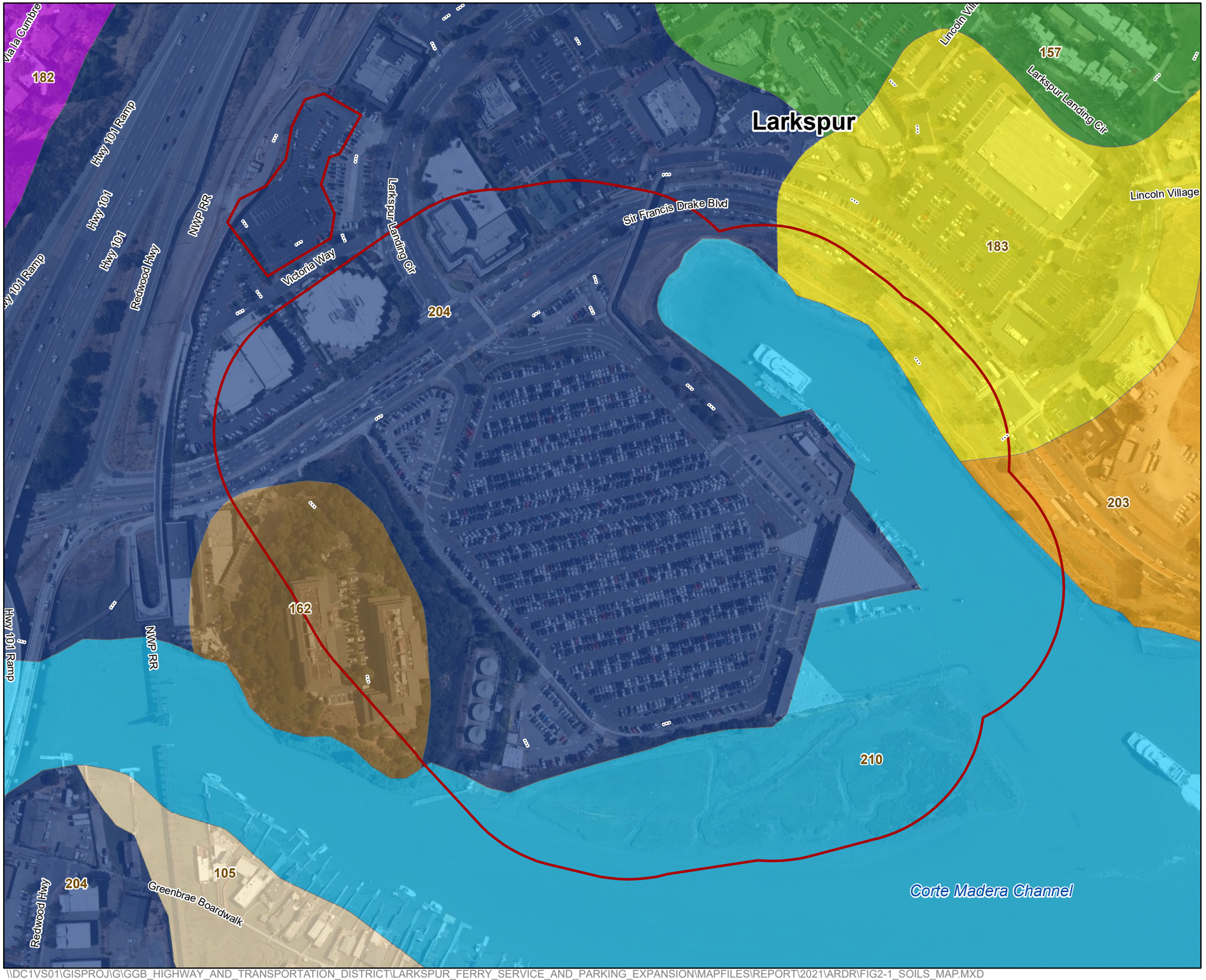
Vegetation communities in the study area include salt marsh, ruderal habitat, and oak woodland.

Salt marsh occurs in the southern portions of the study area and along the margins of tidal channels. Vegetation species common in the salt marsh habitat include pickleweed (*Sarcocornia pacifica*), saltgrass (*Distichlis spicata*), jaumea (*Jaumea carnosa*), gumplant (*Grindelia stricta*), and alkali heath (*Frankenia salina*). A population of Point Reyes bird's beak (*Chloropyron maritimum* ssp. *palustre*), a rare plant species, was observed in the marsh in the southern portion of the study area.

Ruderal habitat occurs in upland areas adjacent to salt marsh. Within the study area, vegetation consists of Harding grass (*Phalaris aquatica*), toyon (*Heteromeles arbutifolia*), fennel (*Foeniculum vulgare*), bromes (*bromus* sp.), ice plant (*Carpobrotus edulis*), perennial pepperweed (*Lepidium latifolium*), Russian thistle (*Salsola soda*), bull mallow (*Malva nicaeensis*), oats (*Avena* sp.), wild mustard (*Sinapis arvensis*), English plantain (*Plantago lanceolata*), bur clover (*Medicago polymorpha*), manzanita (*Arctostaphylos* sp.), and Spanish broom (*Spartium junceum*).

Oak woodland occurs on Wood Island. Trees within this habitat type include coast live oak (*Quercus agrifolia*), California buckeye (*Aesculus californica*), and coast redwood (*Sequoia sempervirens*). Vegetation in the understory includes Himalayan blackberry (*Rubus armeniacus*), poison oak (*Toxicodendron diversilobum*), pampas grass (*Cortaderia* spp.), coyote brush (*Baccharis pilularis*), and ivy (*Hedera* sp.)

Figure 2-1 Soils Map





LEGEND

- Study Area

Soil Map Unit

- 105: Blucher-Cole complex, 2 to 5 percent slopes
- 157: Pits, quarries
- 162: Saurin-Bonnydoon complex, 15 to 30 percent slopes
- 182: Tocaloma-McMullin-Urban land complex, 30 to 50 percent slopes
- 183: Tocaloma-Saurin association, steep
- 203: Xerorthents, fill
- 204: Xerorthents-Urban land complex, 0 to 9 percent slopes
- 210: Water

N

0 200 400
Feet

FIGURE 2-1
Soils Map
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\ARDR\FIG2-1_SOILS_MAP.MXD

Figure 2-2 National Wetland Inventory





LEGEND

- Study Area
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Riverine

N

0 200 400
Feet

FIGURE 2-2
National Wetlands Inventory
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\ARDR\FIG2-2_NWI.MXD

3. Methods

The aquatic resource delineation was conducted in accordance with the *U.S. Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) and the Arid West Supplement (USACE 2008).

3.1 Pre-Field Investigation

Prior to the field survey, available and relevant information pertaining to conditions within the study area were reviewed. The following materials were included in this data review:

- NRCS soil maps and descriptions (NRCS 2021b)
- NWI (USFWS 2021)

3.2 Field Data Collection and Methodology

Field data collection was conducted by Kevin Fisher and Stephanie Owens (Jacobs) on July 2, 2021.

Wetland sample points were established in locations where hydrophytic vegetation was dominant or the landform indicated the potential for wetlands to occur. At each sample point, vegetation species within a 1-meter radius of the sample point were identified by stratum. The wetland indicator status of plant species was determined using the 2016 Regional Wetland Plant List (Lichvar et al. 2016). The soil profile was examined to a depth of approximately 14 inches unless otherwise noted. Soils were characterized by evaluating texture and color within each distinct layer of the profile. Soil color was described using a Munsell Soil Color Chart (Munsell 2009). The vicinity of each sampling location was examined for evidence of wetland hydrology.

The boundaries of aquatic resources were mapped in the field with ArcGIS Collector using an Apple iPad and a Trimble R1 global positioning system receiver. Global positioning system data were imported into ESRI ArcGIS 10.6 software for developing aquatic resource maps. Topographic data (MarinMap 2021) were used in ArcGIS to refine the boundaries of aquatic resources in conjunction with the field-collected data. Cowardin classification codes were assigned to aquatic resources based on guidance from Cowardin et al. (1979).

4. Results

Figure 4-1 shows aquatic resources delineated in the 43.69-acre study area. Table 4-1 summarizes aquatic resources in the study area. Delineation data forms are included in Appendix A. Representative photographs of the study area are included in Appendix B. A copy of the Aquatic Resources Sheet of the Consolidated ORM Upload Workbook is provided in Appendix C.

Table 4-1. Aquatic Resources in the Study Area

Aquatic Resource ID	Cowardin Code	Latitude	Longitude	Area (Acres)
Wetland				
EM-1	E2EM	37.94586556	-122.5097075	0.20
EM-2	E2EM	37.94345162	-122.5090792	3.33
EM-3	E2EM	37.94313724	-122.5101714	1.15
Total Wetlands				4.68
Other Waters				
W-1	E1UB	37.94487684	-122.5084853	8.22
W-2	E1UB	37.94298619	-122.5099712	1.79
W-3	E2SB	37.94450279	-122.5116942	0.13
Total Waters				**10.14**

4.1 Wetlands

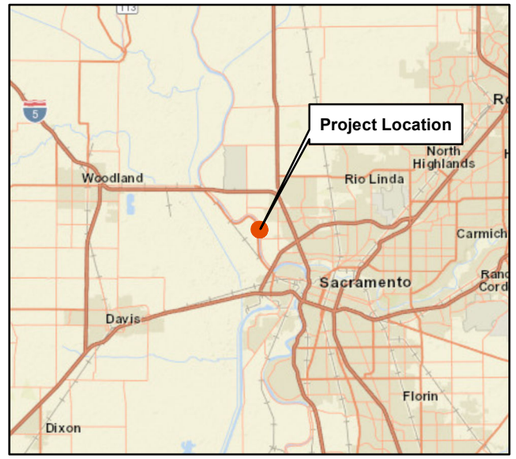
Estuarine wetlands were delineated in the southern portion of the study area and in narrow bands along the margins of tidal channels. Sample points were established in representative locations throughout the study area (Figure 4-1, SP-1A, SP-2A, and SP-3A). The wetland sample points were dominated by hydrophytes, had hydric soil indicators, and had evidence of wetland hydrology, including saturation. The paired upland sample points (Figure 4-1, SP-1B, SP-2B, and SP-3B) lacked hydric soils and indicators of wetland hydrology (Appendix A). The land-side boundary of the wetlands had strong correlation with the 7-foot contour; thus, this elevation was used in mapping the extent of aquatic resources. A total of 4.68 acres of wetlands was delineated within the study area. The Cowardian classification assigned to this aquatic resource is Estuarine, Intertidal, Emergent (E2EM) (Cowardin et al. 1979).

4.2 Other Waters

Non-wetland waters were delineated in open water portions of the Bay (W-1 and W-2) and along an intertidal channel (W-3) located in the western portion of the study area (Figure 4-1). The High Tide Line was distinguished along the shoreline by changes in vegetation cover or composition, water marks, and debris deposits (Appendix B, Photograph 6). The High Tide Line had strong correlation with the 7-foot contour; thus, this elevation was used in mapping the land-side extent of aquatic resources. A total of 10.14 acres of estuarine waters was delineated within the study area. The Cowardin classifications assigned to the open waters of the Bay are Estuarine, Subtidal, Unconsolidated Bottom (E1UB), and the Cowardin classifications assigned to the intertidal channel are Estuarine, Intertidal, Stream Bed (E2SB) (Cowardin et al. 1979).

Figure 4-1 Aquatic Resource Delineation Map





LEGEND

- Study Area (43.69 AC)
- Sample Point
- 1-foot Contour

Aquatic Resources

- Waters (10.14 AC)
- Wetland (4.68 AC)

AC = acres

Note: Contours are in feet, NAVD88

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Delineator: K. Fisher and S. Owens
Delineation Date: 7/2/21

N

0 200 400
Feet

FIGURE 4-1
Aquatic Resource Delineation Map
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\ARDR\FIG4-1_AQUATICRESOURCE.MXD

5. References

California Geological Survey (CGS). 2021. Geologic Map of California. Accessed July 9, 2021. https://maps.conservation.ca.gov/cgs/gmc/.

Conomos, T.J., R.E. Smith, and J.W. Gartner, 1985. "Environmental setting of San Francisco Bay." *Hydrobiologia*. Vol. 129. pp. 1-12.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* U.S. Fish and Wildlife Service Report No. FWS/OBS/-79/31. Washington, D.C.

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*. Technical Report Y 87-1. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

Griffith, G.E., J.M. Omernik, D.W. Smith, T.D. Cook, E. Tallyn, K. Moseley, and C.B. Johnson, 2016, Ecoregi of California (poster): U.S. Geological Survey Open-File Report 2016–1021, with map, scale 1:1,100,000, *http://dx.doi.org/10.3133/ofr20161021.*

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. *The National Wetland Plant List: 2016 wetland ratings. Phytoneuron*. Vol. 30. pp. 1-17. April 28.

MarinMap. 2021. 1-foot contours derived from 2019 LIDAR data. Accessed July 2021.

McNab, W.H., D.T. Cleland, J.A. Freeouf, J.E. Keys Jr., G.J. Nowacki, and C.A. Carpenter, C.A. 2007. Description of ecological subregions: sections of the conterminous United States [CD-ROM]. Gen. Tech. Report WO-76B. Washington, D.C.: U.S. Department of Agriculture, Forest Service. 80 p.

Munsell Soil-Color Charts (Munsell). 2009. Munsell Soil Color Charts. Year 2009 Revised Edition. Grand Rapids, Michigan.

National Oceanic and Atmospheric Administration (NOAA). 2021. Tides & Currents. Accessed October 8, 2021. https://tidesandcurrents.noaa.gov/stationhome.html?id=9414874#info.

Natural Resources Conservation Service (NRCS). 2021a. Web Soil Survey 2.0 National Cooperative Soil Survey. Accessed July 6, 2021. http://websoilsurvey.nrcs.usda.gov/app/.

Natural Resources Conservation Service (NRCS). 2021b. List of Hydric Soils. Accessed July 6, 2021.

U.S. Army Corps of Engineers (USACE). 2008. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (Version 2.0). ERDC/EL TR-08-28. U.S. Army Engineer Research and Development Center, Vicksburg, MS.U.S. Army Corps of Engineers (USACE). 2021. Antecedent Precipitation Tool, version 1.0. Written by Jason Deters.

U.S. Fish and Wildlife Service (USFWS). 2021. National Wetlands Inventory Map. August 2, 2021. http://www.fws.gov/wetlands/Data/Mapper.html.

U.S. Geological Survey (USGS). 2021a. The StreamStats Program for California. Accessed April 9, 2021. https://streamstats.usgs.gov/ss/.

U.S. Geological Survey (USGS). 2021b. StreamStats Data-Collection Station Report for USGS Station Number 11460000, CORTE MADERA C A ROSS CA. Accessed July 6, 2021. https://nwis.waterdata.usgs.gov/nwis/dv?site_no=11460000.

Western Regional Climate Center (WRCC). 2021. Climate Summary for San Rafael Civic Center, California Station (047880). Accessed April 9, 2021. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca2574.

Appendix A. Aquatic Resource Determination Datasheets

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: Larkspur Ferry Service and Parking Expansion City/County: Larkspur/Marin County Sampling Date: 07/02/2021

Applicant/Owner: Golden Gate Bridge Highway and Transportation District State: CA Sampling Point: SP-1A

Investigator(s): Kevin Fisher, Stephanie Owens Section, Township, Range:

Landform (hillslope, terrace, etc.): man-made berm Local relief (concave, convex, none): convex Slope (%): 0

Subregion (LRR): C - Mediterranean California Lat: 37.943674 Long: -122.508463 Datum: NAD 83

Soil Map Unit Name: Water NWI classification: E2EM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ◉ No ○

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ◉	No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Wetland Hydrology Present?	Yes ◉	No ○	

Remarks: Drier year than normal.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Sarcocornia pacifica*	75	Yes	OBL
2. *Distichlis spicata*	5	No	FAC
3.			
4.			
5.			
6.			
7.			
8.			
Total Cover:	80 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 20 % % Cover of Biotic Crust %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	75	x 1 =	75
FACW species		x 2 =	0
FAC species	5	x 3 =	15
FACU species		x 4 =	0
UPL species		x 5 =	0
Column Totals:	80 (A)		90 (B)

Prevalence Index = B/A = 1.12

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks:

SOIL

Sampling Point: SP-1A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-8.5	10YR 3/2	75	5YR 4/6	25		PL		
8.5-10	5Y 4/1	100						
10-12	10YR 3/2	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☒ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils:[4]

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☒ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☒ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☒ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches):

Water Table Present? Yes ◉ No ○ Depth (inches): 7

Saturation Present? (includes capillary fringe) Yes ◉ No ○ Depth (inches): 2

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: Larkspur Ferry Service and Parking Expansion City/County: Larkspur/Marin County Sampling Date: 07/02/2021

Applicant/Owner: Golden Gate Bridge Highway and Transportation District State: CA Sampling Point: SP-1B

Investigator(s): Kevin Fisher, Stephanie Owens Section, Township, Range:

Landform (hillslope, terrace, etc.): man-made berm Local relief (concave, convex, none): convex Slope (%): 0

Subregion (LRR): C - Mediterranean California Lat: 37.943741 Long: -122.508463 Datum: NAD 83

Soil Map Unit Name: Water NWI classification: E2EM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ◉ No ○

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ○	No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Wetland Hydrology Present?	Yes ○	No ◉	

Remarks: Drier year than normal.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Distichlis spicata*	85	Yes	FAC
2. *Phalaris aquatica*	5		FACU
3. *Foeniculum vulgare*	1		Not Listed
4. *Bromus diandrus*	1		Not Listed
5. *Bromus sp.*	1		
6.			
7.			
8.			
Total Cover:	93 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 7 % % Cover of Biotic Crust %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species		x 2 =	0
FAC species	85	x 3 =	255
FACU species	5	x 4 =	20
UPL species	2	x 5 =	10
Column Totals:	92 (A)		285 (B)

Prevalence Index = B/A = 3.10

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☐ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks:

SOIL

Sampling Point: SP-1B

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-12	10YR 3/1	99	7.5YR 5/8	1			loam	fill soil

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils:[4]

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes ○ No ◉

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches): _____

Water Table Present? Yes ○ No ◉ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes ○ No ◉ Depth (inches): _____

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: Larkspur Ferry Service and Parking Expansion City/County: Larkspur/Marin County Sampling Date: 07/02/2021

Applicant/Owner: Golden Gate Bridge Highway and Transportation District State: CA Sampling Point: SP-2A

Investigator(s): Kevin Fisher, Stephanie Owens Section, Township, Range:

Landform (hillslope, terrace, etc.): marsh plain/shoreline Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): C - Mediterranean California Lat: 37.945897 Long: -122.510128 Datum: NAD 83

Soil Map Unit Name: Xerorthents-Urban land complex NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ◉ No ○

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ◉	No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Wetland Hydrology Present?	Yes ◉	No ○	

Remarks: Drier year than normal.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Jaumea carnosa*	65	Yes	OBL
2. *Sarcocornia pacifica*	25	Yes	OBL
3. *Distichlis spicata*	10	No	FAC
4. *Spartina foliosa*	2	Yes	OBL
5.			
6.			
7.			
8.			
Total Cover:	102 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum % % Cover of Biotic Crust %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	92	x 1 =	92
FACW species		x 2 =	0
FAC species	10	x 3 =	30
FACU species		x 4 =	0
UPL species		x 5 =	0
Column Totals:	102 (A)		122 (B)

Prevalence Index = B/A = 1.20

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks:

SOIL

Sampling Point: SP-2A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-8	10YR 3/2	100					silt loam	
8-12	G1 4/10Y	100					silt loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☒ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils:[4]

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches):

Water Table Present? Yes ○ No ◉ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ◉ No ○ Depth (inches): 2

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: Larkspur Ferry Service and Parking Expansion City/County: Larkspur/Marin County Sampling Date: 07/02/2021

Applicant/Owner: Golden Gate Bridge Highway and Transportation District State: CA Sampling Point: SP-2B

Investigator(s): Kevin Fisher, Stephanie Owens Section, Township, Range:

Landform (hillslope, terrace, etc.): marsh plain/shoreline Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): C - Mediterranean California Lat: 37.945900 Long: -122.510186 Datum: NAD 83

Soil Map Unit Name: Xerorthents-Urban land complex NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ◉ No ○

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ○	No ◉	
Hydric Soil Present?	Yes ○	No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Wetland Hydrology Present?	Yes ○	No ◉	

Remarks: Drier year than normal.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *mowed grasses (avena sp.)*	90	Yes	UPL
2. *Foeniculum vulgare*	2		Not Listed
3. *Lepidium latifolium*	2		FAC
4.			
5.			
6.			
7.			
8.			
Total Cover:	94 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 6 % % Cover of Biotic Crust %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species		x 2 =	0
FAC species	2	x 3 =	6
FACU species		x 4 =	0
UPL species	92	x 5 =	460
Column Totals:	94 (A)		466 (B)

Prevalence Index = B/A = 4.96

Hydrophytic Vegetation Indicators:

- ◉ Dominance Test is >50%
- ◉ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ○ No ◉

Remarks: Mowed grasses

SOIL

Sampling Point: SP-2B

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-10	10YR 3/2	100						

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils:[4]

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ○ No ◉

Remarks: Angular gravel and cobble throughout soil profile (fill material).

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches):

Water Table Present? Yes ○ No ◉ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ○ No ◉ Depth (inches):

Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: Larkspur Ferry Service and Parking Expansion City/County: Larkspur/Marin County Sampling Date: 07/02/2021

Applicant/Owner: Golden Gate Bridge Highway and Transportation District State: CA Sampling Point: SP-3A

Investigator(s): Kevin Fisher, Stephanie Owens Section, Township, Range:

Landform (hillslope, terrace, etc.): shoreline Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): C - Mediterranean California Lat: 37.943300 Long: -122.510720 Datum: NAD 83

Soil Map Unit Name: Xerorthents-Urban land complex NWI classification: E2EM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ◉ No ○

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉	No ○	
Hydric Soil Present?	Yes ◉	No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Wetland Hydrology Present?	Yes ◉	No ○	

Remarks: Drier year than normal.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Sarcocornia pacifica*	50	Yes	OBL
2. *Grindelia stricta*	40	Yes	FACW
3. *Lepidium latifolium*	5	No	FAC
4.			
5.			
6.			
7.			
8.			
Total Cover:	95 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 5 % % Cover of Biotic Crust %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	50	x 1 =	50
FACW species	40	x 2 =	80
FAC species	5	x 3 =	15
FACU species		x 4 =	0
UPL species		x 5 =	0
Column Totals:	95 (A)		145 (B)

Prevalence Index = B/A = 1.53

Hydrophytic Vegetation Indicators:

- ☒ Dominance Test is >50%
- ☒ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks:

SOIL

Sampling Point: SP-3A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-3	10YR 3/2	100						
3-12	10YR 3/2	95	7.5YR 5/8	5				

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☒ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[4]:

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks: Fill soil, disturbed.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☒ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches):

Water Table Present? Yes ○ No ◉ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ◉ No ○ Depth (inches): 2

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM - Arid West Region

Project/Site: Larkspur Ferry Service and Parking Expansion City/County: Larkspur/Marin County Sampling Date: 07/02/2021

Applicant/Owner: Golden Gate Bridge Highway and Transportation District State: CA Sampling Point: SP-3B

Investigator(s): Kevin Fisher, Stephanie Owens Section, Township, Range:

Landform (hillslope, terrace, etc.): shoreline Local relief (concave, convex, none): none Slope (%): 0

Subregion (LRR): C - Mediterranean California Lat: 37.943328 Long: -122.510738 Datum: NAD 83

Soil Map Unit Name: Xerorthents-Urban land complex NWI classification: E2EM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ○ No ◉ (If no, explain in Remarks.)

Are Vegetation ☐ Soil ☐ or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ◉ No ○

Are Vegetation ☐ Soil ☐ or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ○	No ◉	
Hydric Soil Present?	Yes ○	No ◉	**Is the Sampled Area within a Wetland?** Yes ○ No ◉
Wetland Hydrology Present?	Yes ○	No ◉	

Remarks: Drier year than normal.

VEGETATION

Tree Stratum (Use scientific names.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
Total Cover:	%		
Sapling/Shrub Stratum			
1.			
2.			
3.			
4.			
5.			
Total Cover:	%		
Herb Stratum			
1. *Avena sp.*	45	Yes	UPL
2. *Mesembryanthemum sp.*	30		FACU
3. *Foeniculum vulgare*	2	No	Not Listed
4. *Distichlis spicata*	2	No	FAC
5. *Festuca perennis*	2	No	Not Listed
6.			
7.			
8.			
Total Cover:	81 %		
Woody Vine Stratum			
1.			
2.			
Total Cover:	%		

% Bare Ground in Herb Stratum 19 % % Cover of Biotic Crust %

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0.0 % (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	0
FACW species		x 2 =	0
FAC species	2	x 3 =	6
FACU species	30	x 4 =	120
UPL species	49	x 5 =	245
Column Totals:	81 (A)		371 (B)

Prevalence Index = B/A = 4.58

Hydrophytic Vegetation Indicators:

- ◉ Dominance Test is >50%
- ◉ Prevalence Index is ≤3.0[1]
- ☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present.

Hydrophytic Vegetation Present? Yes ○ No ◉

Remarks:

SOIL

Sampling Point: SP-3B

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture[3]	Remarks
0-12	10YR 3/2	100					sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix. [2]Location: PL=Pore Lining, RC=Root Channel, M=Matrix.

[3]Soil Textures: Clay, Silty Clay, Sandy Clay, Loam, Sandy Clay Loam, Sandy Loam, Clay Loam, Silty Clay Loam, Silt Loam, Silt, Loamy Sand, Sand.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5) (**LRR C**)
- ☐ 1 cm Muck (A9) (**LRR D**)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1)
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Vernal Pools (F9)

Indicators for Problematic Hydric Soils:[4]

- ☐ 1 cm Muck (A9) (**LRR C**)
- ☐ 2 cm Muck (A10) (**LRR B**)
- ☐ Reduced Vertic (F18)
- ☐ Red Parent Material (TF2)
- ☐ Other (Explain in Remarks)

[4]Indicators of hydrophytic vegetation and wetland hydrology must be present.

Restrictive Layer (if present):

Type:

Depth (inches):

Hydric Soil Present? Yes ○ No ◉

Remarks: Angular gravel (fill soil).

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (any one indicator is sufficient)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1) (**Nonriverine**)
- ☐ Sediment Deposits (B2) (**Nonriverine**)
- ☐ Drift Deposits (B3) (**Nonriverine**)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Salt Crust (B11)
- ☐ Biotic Crust (B12)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Plowed Soils (C6)
- ☐ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ☐ Water Marks (B1) (**Riverine**)
- ☐ Sediment Deposits (B2) (**Riverine**)
- ☐ Drift Deposits (B3) (**Riverine**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Thin Muck Surface (C7)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ○ No ◉ Depth (inches):

Water Table Present? Yes ○ No ◉ Depth (inches):

Saturation Present? (includes capillary fringe) Yes ○ No ◉ Depth (inches):

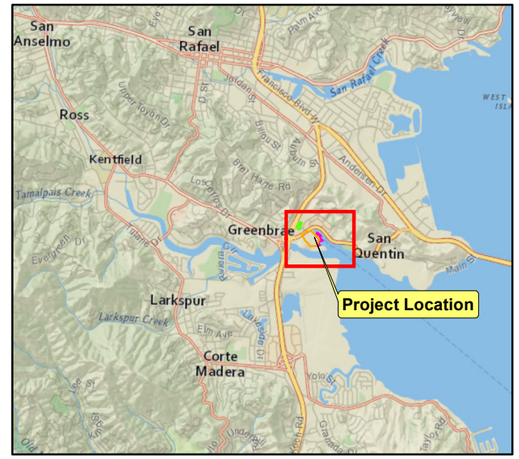
Wetland Hydrology Present? Yes ○ No ◉

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Appendix B. Representative Site Photographs





LEGEND

- Study Area
- Photo Location
- Photo Direction

N

0 300 600

Feet

FIGURE B-1
Photo Locations
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\ARDR\FIGB-1_PHOTOLOCATIONS.MXD



Photograph 1 (P1). Tidal channel at low tide with surrounding vegetation within the tidal marsh habitat in the southern portion of the study area.

[Photograph taken 7/2/2021, facing southwest]



Photograph 2 (P2). Location of SP-1a within tidal marsh looking north to the ferry terminal.

[Photograph taken 7/2/2021, facing north]



Photograph 3 (P3). The shovel marks the location of SP-2b, an upland sample point adjacent to tidal marsh.

[Photograph taken 7/2/2021, facing southeast]



Photograph 4 (P4). Rock and rubble along water's edge and no wetlands delineated. The High Tide Line (red arrows) was delineated based on the change in vegetation cover and debris deposits.

[Photograph taken 7/2/2021, facing southeast]



Photograph 5 (P5). Fringe wetland adjacent to open waters in the northern portion of the study area.

[Photograph taken 7/2/2021, facing south]



Photograph 6 (P6). Steep bank along the San Francisco Bay shoreline with concrete rubble. High Tide Line indicated by wrack deposits.

[Photograph taken 7/2/2021, facing south]



Photograph 7 (P7). Location of SP-3a within tidal marsh adjacent to tidal channel within southern portion of study area.

[Photograph taken 7/2/2021, facing east]



Photograph 8 (P8). Intertidal channel in the western portion of the study area.

[Photograph taken 7/2/2021, facing northwest]



Photograph 9 (P9). Intertidal channel adjacent to parking lot in the western portion of the study area.

[Photograph taken 7/2/2021, facing south]

Appendix C. Aquatic Resources Sheet of the Consolidated ORM Upload Workbook

Waters_Name	State	Cowardin_Code	HGM_Code	Meas_Type	Amount	Units	Waters_Type	Latitude	Longitude	Local_Waterway
W-1	CALIFORNIA	E1UB		Area	8.22	ACRE	DELINEATE	37.94487684	-122.50848531	
W-2	CALIFORNIA	E1UB		Area	1.79	ACRE	DELINEATE	37.94298619	-122.50997120	
W-3	CALIFORNIA	E2SB		Area	0.13	ACRE	DELINEATE	37.94450279	-122.51169420	
EM-1	CALIFORNIA	E2EM		Area	0.2	ACRE	DELINEATE	37.94586556	-122.50970750	
EM-2	CALIFORNIA	E2EM		Area	3.33	ACRE	DELINEATE	37.94345162	-122.50907920	
EM-3	CALIFORNIA	E2EM		Area	1.15	ACRE	DELINEATE	37.94313724	-122.51017140	

Appendix C. Observed Plants List

Family	Scientific Name	Common Name
Aizoaceae	*Carpobrotus edulis*	Iceplant
Amaranthaceae	*Salicornia pacifica*	Pickleweed
Anacardiaceae	*Toxicodendron diversilobum*	Poison oak
Apiaceae	*Foeniculum vulgare*	Fennel
Araliaceae	*Hedera canariensis*	Canary Islands ivy
Asteraceae	*Baccharis pilularis*	Coyote brush
	Carduus pycnocephalus	Italian thistle
	Grindelia stricta	Coastal gumweed
	Helminthotheca echioides	Bristly ox-tongue
	Jaumea carnosa	Marsh jaumea
	Sonchus asper	Prickly sow thistle
Brassicaceae	*Cardamine parviflora*	Sand bittercress
Cupressaceae	*Hesperocyparis macrocarpa*	Monterey cypress
	Sequoia sempervirens	Coast redwood
Cyperaceae	*Bolboschoenus maritimus*	Saltmarsh bulrush
Ericaceae	*Arctostaphylos hookeri*	Hooker's manzanita
	Arctostaphylos manzanita	Common manzanita
Fabaceae	*Genista monspessulana*	French broom
	Medicago polymorpha	Burclover
	Vicia sativa	Spring vetch
Fagaceae	*Quercus agrifolia*	Coast live oak
Frankeniaceae	*Frankenia salina*	Alkali heath
Geraniaceae	*Geranium dissectum*	Cutleaf geranium
Juncaginaceae	*Triglochin maritima*	Common arrow-grass
Lauraceae	*Umbellularia californica*	California bay laurel
Malvaceae	*Malvella leprosa*	Alkali-mallow
Myrsinaceae	*Lysimachia arvensis*	Scarlet pimpernel
Myrtaceae	*Leptospermum laevigatum*	Australian tea tree
Oleaceae	*Olea europaea*	Olive
Plantaginaceae	*Plantago lanceolata*	English plantain
Plumbaginaceae	*Limonium californicum*	Western marsh-rosemary

Family	Scientific Name	Common Name
Poaceae	*Avena barbata*	Slender wild oat
	Bromus diandrus	Ripgut grass
	Bromus hordeaceus	Soft chess
	Cortaderia selloana	Pampas grass
	Distichlis spicata	Salt grass
	Festuca perennis	Rye grass
	Holcus lanatus	Common velvet grass
	Pennisetum setaceum	Fountain grass
	Sporobolus foliosus	California cord grass
Polygonaceae	*Rumex crispus*	Curly dock
Proteaceae	*Grevillea robusta*	Silkoak
Rhamnaceae	*Ceanothus thyrsiflorus*	Blueblossom ceanothus
	Rhamnus alaternus	Italian buckhorn
Rosaceae	*Heteromeles arbutifolia*	Toyon
	Rubus ursinus	California blackberry

Appendix D. Ferry Wake Wash and Shoreline Erosion Analysis

D1. Baseline Scenario Analysis

D2. Corte Madera Creek Ferry Wake Study

D3. NAPA and LIWA Class Fast Ferry Wake Study

D1. Baseline Scenario Analysis

Larkspur Ferry Service and Parking Expansion Project

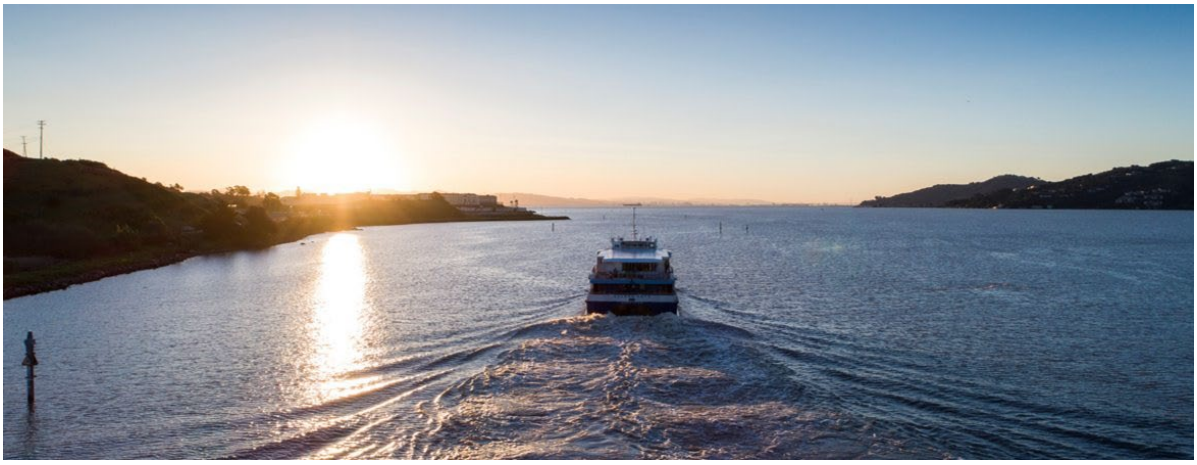
Ferry Wake Wash and Shoreline Erosion Analysis

Baseline Scenario Analysis

Final

July 21, 2023

Golden Gate Bridge Highway and Transportation District



Executive Summary

The impact of Golden Gate Bridge Highway and Transportation District (GGBHTD) (District) ferry wakes in the area of interest in the baseline (actual conditions) scenario was performed by means of numerical simulations validated with field measurements. The area of interest consists of the Corte Madera Channel and vicinity and, specifically, the mudflat and tidal marsh [Corte Madera Ecological Reserve (CMER) marsh] to the southwest, the shoreline to the northeast of the Corte Madera Channel, docking facilities at the Greenbrae Boardwalk Community and the Paradise Cay Yacht Harbor.

ES-1 Design Ferry

The District operates three monohull, displacement type ferries of the SPAULDING CLASS: the SONOMA, SAN FRANCISCO and MARIN; and four catamaran type ferries: the NAPA, GOLDEN GATE, DEL NORTE and MENDOCINO. The monohull ferries (hereinafter SPAULDING CLASS) produce wakes different than those produced by the catamaran type ferries (hereinafter fast ferries). Therefore, separate simulations and wake measurements were required for the two ferries. The SPAULDING CLASS ferries are the same and do not require any special distinction among them. However, among the fast ferries, the NAPA and GOLDEN GATE are sister ferries (i.e., same design) and the DEL NORTE and MENDOCINO are different. To simplify the analysis, a design fast ferry was selected to represent the four fast ferries. Numerical simulations of the fast ferry wakes showed no differences between the four fast ferries and that any of the four could be the design fast ferry candidate. Therefore, the NAPA was selected as the design fast ferry because it had the most trips during the field measurements and produced the most abundant data set.

ES-2 Measurements

The following measurements were performed in the field and collected from third parties from July 8 to 14, 2021:

- Ferry wakes, waves and water levels
- Ferry track data
- Ferry trim angle
- Water depths
- Regional wind speed and direction
- Regional and local water levels

Ferry wakes, waves and water levels were measured with four capacitance-type gauges installed at six locations shown in Figure 17. Because only four gauges were available two were moved during the period of the measurements. These locations were selected to measure primarily ferry wakes and waves based on the following criteria:

- WG1 as the ferries arrive and depart the Larkspur terminal and transit in the vicinity of the Corte Madera Creek Inlet (Greenbrae Boardwalk Community)
- WG2 as the ferries transit the Corte Madera Channel to and from the Larkspur terminal at relatively low velocity (e.g., 9 knots)
- WG3 as the fast ferries transit the Corte Madera Channel at high velocity (e.g., 38 knots)
- WG4 as the ferries transit offshore the Paradise Cay Yacht Harbor
- WG5 and WG6 to assess wakes and waves as they propagate over the mudflat

Ferry track data were acquired from the San Francisco Marine Exchange (SFME). For an area specified by Jacobs, the SFME extracted track data received from all District ferries Automatic Identification System (AIS) transponders that transited the specified area between July 8 and 14, 2021. Figure 22 shows the tracks of the 59 ferry roundtrips recorded between July 8 and 14, 2021. Table 2 shows the number of roundtrips by ferry from July 8 to 14, 2021, where the NAPA is the fast ferry with the most roundtrips.

Ferry trim (pitch) angle at speed could affect the wake formation and was important to determine the typical trim angle of the ferries at speed used in the numerical simulations. The SPAULDING CLASS was not available for these measurements, but Jacobs rode the NAPA on 2 trips and measured the trim angle relative to the horizontal with a handheld inclinometer. A trim angle of 1.5 degree bow down was selected for the numerical simulations.

Water depth could affect the generation and propagation of wakes, particularly in shallow water. Therefore, it was important to determine the water depth at the locations of the gauges and ferry tracks so that they could be reproduced in the numerical simulations. Jacobs performed spot soundings with a lead line and corrected the soundings with the tide measured at the National Oceanic and Atmospheric Administration (NOAA) station 9414290 (NOAA, 2021).

Wind will not affect the generation of wakes but may affect their propagation and transformation depending on its speed and direction. In this analysis, the effect of wind on wake propagation and transformation was not considered. However, wind as a mechanism of wave generation was considered to identify wind conditions and corresponding waves in the area of interest and to assess the relative importance of waves and ferry wakes. Because no site-specific wind data was available, unobstructed by terrain and landforms, wind speed and direction were acquired from nearby National Data Buoy Center (NDBC, 2021) station TIBC1 - Tiburon Pier from July 8 to 14, 2021.

Water levels affect water depths, and their accurate representation is important for the generation and transformation of wakes in the numerical simulations. Because no site-specific water level measurements were available in the area of interest, water levels measured at NOAA station 9414290 San Francisco were used to adjust the vertical offset in the raw water levels measured by the gauges and derive corresponding water levels referenced to the MLLW. The adjusted water levels were later used to determine water depths, also referenced to the MLLW, at the gauge locations.

ES-3 Wake Simulations

A hybrid approach consisting of using two different numerical models was used. OpenFOAM was used to define the design fast ferry draft and trim at speed, and to inform the selection of modeling parameters in FUNWAVE (2021), a fully nonlinear Boussinesq wave model used for the generation and propagation of wakes. Unlike OpenFOAM where the vessel is geometrically represented, FUNWAVE represents the vessel by a moving pressure disturbance described by a set of parameters. In FUNWAVE, ferry wakes were generated for selected ferry trips and propagated into the area of interest. OpenFOAM was not used for the SPAULDING CLASS ferry because the default parameters in FUNWAVE are adequate for this type of displacement type vessel.

ES-4 Wake Analysis

Not all wake measurements performed between July 8 and 14, 2021 were adequate for comparison with the numerically simulated wakes. In most cases, the metocean conditions present in the area of interest at the time of the ferry trips like wind, waves and currents, affected and distorted the measurements.

Numerically simulated wakes are free from those influences, so wakes measured free of those were required for reliable comparisons. The wake measurements were inspected to select the most suitable measurements for comparison.

The NAPA was the fast ferry with the most roundtrips (38) during the field measurements between July 8 and 14, 2021. It provided the most wake measurements and was selected as the design fast ferry. The 38 NAPA roundtrips were inspected, and it was determined that the wakes it generated on its 4th roundtrip on July 8, 2021, were almost wind, wave and current free. Consequently, wakes measured on that roundtrip were used for comparisons with the corresponding numerical simulations. Figure 33 and Figure 34 show the tracks of the NAPA 38 outbound and inbound trips between July 8 and 14, 2021, respectively, and its 4th trip tracks on July 8, 2021. Table 7 and Table 8 summarize corresponding ferry and metocean conditions at the gauge locations for those trips.

Considering that wake measurements for comparisons with simulations should be as free as possible of distortions due to wind, wave and current, the 12 roundtrips in 3 days, between July 9 and July 11, 2021, of the SPAULDING CLASS ferries were relatively few. Nevertheless, the MARIN and the SAN FRANCISCO corresponding 1st inbound trips, both on July 10, 2021, were suitable based on the inspection of wind, wave and water level data. Table 9 and Table 10 summarize corresponding ferry and metocean conditions at the gauge locations for those trips.

ES-5 Wake Impact Assessment

Among the various impacts that ferry traffic has, those due to wakes are some of the most critical. Wakes can erode the bottom and shorelines, damage shoreline protection and other coastal infrastructure, erode bottom sediment and increase turbidity affecting benthos organisms and bottom habitats, and impact passive boating. These impacts were assessed for the area of interest using the wakes derived for the representative trips selected.

Figure 58 shows key coastal features and activities in the area of interest that could be affected by ferry wakes. These include:

- CMER marsh
- Mudflat (erosion, turbidity and benthos)
- Natural shorelines
- Docks and boats at the Greenbrae Boardwalk Community and Paradise Cay Yacht Harbor
- Shoreline protection structures (e.g., bulkheads, seawalls, engineered revetments, jetties and breakwaters)
- Passive boating (rowing shells, kayaks, paddle boards, sailboats, canoes, etc.)

The following basis and criteria were used to assess the impact of ferry wakes:

1. Previous studies and investigations characterizing and assessing actual and historical site conditions and changes
2. Guidelines for boat basin wave agitation by the American Society of Civil Engineers (ASCE, 2012)
3. Shoreline protection design guidelines (USACE, 1995)
4. U.S. Rowing Safety Expectations Policy (2021)

Figure 59 and Figure 60 show summaries of the fast and SPAULDING CLASS ferries impacts. The following is concluded for the baseline scenario:

1. **CMER Marsh.** Ferry wakes have no impact on the CMER Marsh. The literature review performed as part of this study indicated that the Corte Madera shoreline has been retreating significantly since 1853. Wind waves reaching the CMER are generally higher than the ferry wakes, which are relatively negligible, and last longer.

2. **Mudflat Erosion.** The erodibility of the bottom is typically assessed by comparing the shear stress that the wake-generated flows will exert on the bottom sediment and the shear stress the bottom sediment can withstand (i.e., the critical shear stress). Based on previous investigations it was determined that the bottom sediment in Corte Madera Bay is silty clay, commonly known and San Francisco Bay Mud. Mud is a cohesive type of sediment with a high resistance to shear stress. Ferry wakes generate shear stresses that are lower than the mud critical shear stress and therefore do not erode the mudflat.

3. **Mudflat Water Turbidity.** Water turbidity is associated with sediment in suspension that reduces the penetration of light below the water surface, photosynthesis and productivity. The literature review performed as part of this study indicated the mudflat has naturally high background levels of suspended sediment. The analysis of the ferry wake-generated shear stresses showed that these would not be conducive to bottom sediment erosion and, consequently, would not cause an increase in background levels of turbidity on the mudflats, and in Corte Madera Bay in general.

4. **Mudflat Benthos.** Benthos (bottom organisms) in Corte Madera Bay are already adapted to the natural, historically high levels of turbidity and, therefore, the relatively minimal increases in turbidity that ferry wakes could generate would be inconsequential. Furthermore, because in the current conditions ferry wakes do not erode the mudflat bottom, benthos are not impacted.

5. **Natural Shorelines.** Other than the CMER shoreline, the Corte Madera Bay northern shoreline which runs approximately in the southeast-northwest direction from Point San Quentin to just southeast of the Larkspur terminal. Southeasterly winds are predominant in the winter but can also occur during other times of the year. During those times, the Corte Madera Bay northern shoreline would be exposed to the highest waves because, in addition to the potentially high speed and long duration (hours, days) winds, the approximately 12-mile fetch along which the wind would blow would be the longest. Typical wave heights at the Corte Madera Bay northern shore from this sector (110 to 135 degrees) are average 0.5 feet (6 inches) and extreme 3 feet (36 inches), both with periods in the range of 2 to 3 seconds. Relative to the waves, the ferry wakes at the Corte Madera Bay northern shore should have a relatively negligible or no impact on the natural shoreline. The peak and successive wakes in the ferry wake trains are similar to the expected southeasterly average wave (height and period) and are significantly smaller than the potential extreme wave. But most importantly, the duration of the ferry wake train is relatively ephemeral because it consists of a few wakes that decay in a couple of minutes or less, compared to the thousands of waves that would reach the shore in just one hour, or more.

6. **Docks and Boats.** The ferries do not generate wakes in the outbound or inbound directions at the Corte Madera Creek Inlet, resulting in no impacts to the boats and docks in the Greenbrae Boardwalk Community. Fast ferry and SPAULING CLASS ferry wakes have no impact on boats and docks at the Paradise Cay Yacht Harbor according to ASCE (2012) recommendations. An analysis of wind-generated waves showed that the SPAULDING CLASS ferry peak wake and wake trains are relatively ephemeral lasting only a few seconds and a couple of minutes, respectively, compared to hours of waves. For docks and boats at the Paradise Cay Yacht Harbor, waves are more relevant

than the ferry wakes.

7. **Shoreline Protection Structures.** Shoreline protection structures in Corte Madera Bay are the bulkhead and engineered revetment along the southern shoreline of Point San Quentin, and revetments and jetties protecting the Paradise Cay Yacht Harbor waterfront and basins. Assuming these have been designed to engineering standards which recommend design for extreme wave conditions with return periods of 50 to 100 years, the ferry wakes which are significantly lower than extreme waves would have no impact on the shoreline protection structures in Corte Madera Bay.

- **Passive Boating.** Passive boating refers to non-powered vessels such as rowing shells, kayaks, paddle boards, sailboats, canoes, etc. The most active source of passive boating activity within the area of interest is the Marin Rowing Association (MRA). The impact of fast ferry wakes on passive boating is moderate in the Corte Madera Channel and vicinity because wakes could be as high as the rowing shells freeboards. MRA rowers and passive boaters from the Greenbrae Boardwalk Community do not experience ferry wake impacts at the Corte Madera Creek Inlet and the ferry turning basin because the ferries do not generate wakes in that area. The same conclusion applies to passive boaters on the mudflat because wakes are significantly dissipated as they propagate over this area. At the Paradise Cay Yacht Harbor, fast ferry wakes are negligible for passive boating. But SPAULDING CLASS ferry wakes just offshore the north basin entrance channel result in moderate impact to passive boating. Due to their close proximity and similarities this conclusion applies to passive boating from both the north and south basins.

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Acronyms and Abbreviations

3D	3-dimensional
AIS	Automatic Identification System
ASCE	American Society of Civil Engineers
CFD	Computation Fluid Dynamics
CFL	Courant Friedrichs-Lewy
CM	Channel Marker
CMER	Corte Madera Ecological Reserve
DEM	Digital Elevation Model
District	Golden Gate Bridge, Highway and Transportation District
GGBHTD	Golden Gate Bridge, Highway and Transportation District
LCB	Longitudinal Center of Buoyancy
LCF	Longitudinal Center of Flotation
MLLW	Mean Lower Low Water
MRA	Marin Rowing Association
MSL	Mean Sea Level
NDBC	National Data Buoy Center
NOAA	National Oceanic and Atmospheric Administration
Project	Larkspur Ferry Service and Parking Expansion Project
PWA	Philip Williams & Associates
SFEI	San Francisco Estuary Institute
SFME	San Francisco Marine Exchange
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
VCB	Vertical Center of Buoyancy
WSE	Water Surface Elevations

1. Baseline Scenario Analysis

This appendix describes the approach used and analyses performed to assess the impact of GGBHTD (District) ferry wakes in the area of interest in the baseline (actual conditions) scenario. Generally, the area of interest consists of the Corte Madera Channel and vicinity and, specifically, the mudflat and tidal marsh [Corte Madera Ecological Reserve (CMER) marsh] to the southwest, the shoreline to the northeast of the Corte Madera Channel, docking facilities at the Greenbrae Boardwalk Community and the Paradise Cay Yacht Harbor.

2. Approach

Ferry wakes vary in time and space and depend on factors that are ferry and site specific. Numerical simulations were performed and validated with field measurements to determine the wake characteristics in the area of interest.

The District operates three monohull, displacement type ferries of the SPAULDING CLASS: the SONOMA, SAN FRANCISCO and MARIN; and four catamaran type ferries: the NAPA, GOLDEN GATE, DEL NORTE and MENDOCINO. Because of their design and how they are operated, the monohull ferries (hereinafter SPAULDING CLASS) produce wakes different than those produced by the catamaran type ferries (hereinafter fast ferries). Therefore, separate simulations and wake measurements were required for the two ferries. The SPAULDING CLASS ferries are the same and do not require any special distinction among them. However, among the fast ferries, the NAPA and GOLDEN GATE are sister ferries (i.e., same design) and the DEL NORTE and MENDOCINO are different. To simplify the analysis, a design fast ferry was selected to represent the four fast ferries. Numerical simulations of the fast ferry wakes showed no differences between the four fast ferries and that any of the four could be the design fast ferry candidate.

3. Design Fast Ferry

Drawings of the MENDOCINO and DEL NORTE were provided by the District and by Washington State Ferries for the NAPA and GOLDEN GATE (both Chinook Class, and formerly the Snohomish and the Chinook, respectively). The drawings were used to develop corresponding simplified 3-dimensional (3D) models for the numerical wake simulations. Because only the hull of the ferries below the deck is of interest for the wake simulations the superstructures above the decks were omitted. Figure 1 to Figure 3 show simplified 3D models of the ferries.

The numerical simulations of the fast ferry wakes were performed with OpenFOAM, an open-source Computation Fluid Dynamics (CFD) software widely use in engineering and science by both commercial and academic organizations. For more information about OpenFOAM please refer to OpenFOAM (2021).

Within the area of interest, shallow water requires the ferries to arrive and depart the Larkspur terminal through the approximately 2.5-mile long, 14-foot-deep mean lower low water (MLLW) Corte Madera Channel. Preliminary assessments and consultation with the District indicated that the fast ferries would transit the Corte Madera Channel at approximately 9 knots in the section of the channel between the Larkspur terminal and San Quentin, and at 36 knots beyond San Quentin. Therefore, each ferry was simulated at these two velocities, in 14 feet water depth, at their design draft and no trim.

Simulated profiles, animations and snapshots of the wakes were inspected to select the design fast ferry based on the largest wake criteria. Wake profiles were computed along sections as follows:

- At 36 knots:
  - cross sections at 20, 60 and 80 m behind the stern of the ferries
- At 9 knots
  - cross sections at 20, 60 and 80 m behind the stern of the ferries
  - longitudinal section at 30 m from the centerlines of the ferries

Figure 4, Figure 5 and Figure 6 show plan views of the MENDOCINO, NAPA/GOLDEN GATE and DEL NORTE wake patterns at 36 knots, respectively. Figure 7, Figure 8 and Figure 9 show corresponding cross-sectional profiles of the wakes at 20, 60 and 80 m behind the stern of the ferries, respectively. The following is noted:

- Wake patterns (plan view):
  - The dominant wake system for all ferries is divergent and, in general, patterns are similar.
  - NAPA/GOLDEN GATE and DEL NORTE wake patterns are nearly identical.
  - For all ferries, three "rooster tail" wakes are noted, two generated by hull depression approximately 10 m behind the hulls and the third one between 20 and 60 m behind the stern due to the confluence of the hull wakes.
  - Within the sterns and 20 m behind the sterns, the NAPA/GOLDEN GATE and DEL NORTE show deeper troughs and larger "rooster tail" wakes behind the hulls than the MENDOCINO.
  - Between 20 and 60 m behind the stern, all ferries show a "rooster tail" wake, which is relatively smaller for the MENDOCINO.
  - Between 60 and 80 m behind the stern, "rooster tail" wakes have dissipated and the wake patterns for all ferries are similar.

- Wake profiles (cross sections):
  - MENDOCINO wakes are smaller than the NAPA/GOLDEN GATE and DEL NORTE wakes within 20 m behind the ferry stern.
  - At 20 m behind the stern and within 10 m to each side of the centerline, the NAPA/GOLDEN GATE and DEL NORTE wakes are nearly identical while the MENDOCINO wake is smaller and in the order of 0.50 m versus approximately 1.3 m for the NAPA/GOLDEN GATE and DEL NORTE.
  - At 20 m behind the stern and beyond 10 m to each side of the centerline, the wakes of all ferries are similar.
  - At 60 m behind the stern, the wakes of all ferries are similar and approximately 0.50 m.
  - At 80 m behind the stern, the wakes of all ferries are similar and approximately 0.75 m.

Figure 10, Figure 11 and Figure 12 show plan views of the MENDOCINO, NAPA/GOLDEN GATE and DEL NORTE wake patterns at 9 knots, respectively. Figure 13, Figure 14 and Figure 15 show corresponding cross-sectional profiles of the wakes at 20, 60 and 80 m behind the stern of the ferries, respectively. The following is noted:

- Wake patterns (plan view):
  - The dominant wake system for all ferries is transverse and patterns are similar.
  - Wakes are relatively small due to the ferries' low velocity.

- Wake profiles (cross sections):
  - Within the sterns and 20 m behind the sterns, all wakes are similar and approximately less than 0.20 m, MENDOCINO wakes being marginally higher.
  - At 60 m behind the stern, the wakes of all ferries are similar and approximately 0.20 m. The area behind the ferries is relatively flat and the wakes result from the superposition of the divergent and transverse wake system at approximately 30 m to each side of the centerlines.
  - At 80 m behind the stern, the wakes of all ferries are similar and approximately 0.10 m. The area behind the ferries is relatively flat.

Based on the considerations above it was concluded that there is practically no difference in the fast ferry wakes and that any of these would be a good design fast ferry candidate. On this basis, it was decided to select the design fast ferry as the one with the most trips and measured wakes during the field measurements because it would produce the most abundant data set.

4. Measurements

The following measurements were performed in the field and collected from third parties from July 8 to 14, 2021:

- Ferry wakes, waves and water levels
- Ferry track data
- Ferry trim angle
- Water depths
- Regional wind speed and direction
- Regional and local water levels

4.1 Ferry Wakes, Waves and Water Levels

Ferry wakes, waves and water levels were measured with four Wave Logger III OSSI-010-010 capacitance-type gauges manufactured by Ocean Sensor Systems, Inc. These gauges consist of a self-grounding 4 meter (13.1 feet) long coaxial staff, a microprocessor, a compact flash card data logger, and 4 C size batteries all contained in a rugged waterproof enclosure. Figure 16 shows the Wave Logger III. The Wave Logger III is installed with the electronics enclosure above the water, and the coaxial staff vertically into the water.

Figure 17 shows the six locations selected for the measurements. These locations were selected to measure primarily ferry wakes and waves based on the following criteria:

- WG1 as the ferries arrive and depart the Larkspur terminal and transit in the vicinity of the Corte Madera Creek Inlet (Greenbrae Boardwalk Community)
- WG2 as the ferries transit the Corte Madera Channel to and from the Larkspur terminal at relatively low velocity (e.g., 9 knots)
- WG3 as the fast ferries transit the Corte Madera Channel at high velocity (e.g., 38 knots)
- WG4 as the ferries transit offshore the Paradise Cay Yacht Harbor
- WG5 and WG6 to assess wakes and waves as they propagate over the mudflat

The gauges' electronics enclosure and staff were attached with mounting hardware to a rigid PVC pipes. These were attached with plastic tie-wraps to channel marker (CM) piles at WG1, WG2, WG3 and WG4 and inserted on metal poles purposely installed on the mudflat at WG5 and WG6. Figure 18 shows examples of

the installation on a channel marker pile and pole in the mudflat. Because only four gauges were available, two were moved during the period of the measurements. Table 1 summarizes the particulars of the installation.

The capacitance-type gauge used measured the instantaneous elevation of the water surface on the staff relative to the bottom of the staff. The gauges were set to measure continuously at a 10 Hz rate (10 samples per second) and with the middle of the staff length at approximately the Mean Sea Level (MSL) so it could be fully submerged in the expected approximately 6-foot tidal range plus wakes or waves. Records in the order of seconds or minutes correspond to wakes and waves given that in such short periods changes due to the tide are negligible. Figure 19 shows an example of a wakes and waves record due to the passage of the NAPA by WG3. In the area of interest, where wakes and waves are typically significantly smaller than the tide range, records in the order of hours or days correspond to the tide. Figure 20 shows an example of the raw water level measurements and tidal variations at WG2, relative to the staff bottom. These measurements were adjusted to refer the measurements to the MLLW. The computation of wave statistics like the significant wave height, typically computed from records that range from 20 to 60 minutes, requires the removal of the tidal variations from the record. Figure 21 shows the significant wave heights (H_s) measured at the gauges' locations, computed as $\mathrm{H_s} = 4\,\sigma(\eta)$ where $\sigma(-)$ is the standard deviation of a 20-minute water surface elevation (η) record.

Table 1. Gauge locations and water depths and start and end dates/times of measurements.

Gauge	Location	Latitude	Longitude	Water Depth[a]	Start Date/Time	End Date/Time
WG1	Corte Madera Creek Inlet, Corte Madera Channel CM 15	37.942397	-122.504464	4.52	7/8/2021 0:00	7/12/2021 10:30
WG2	Corte Madera Channel CM 11	37.938585	-122.497535	7.58	7/8/2021 9:00	7/14/2021 12:25
WG3	Corte Madera Channel CM 5	37.930753	-122.476890	11.80	7/8/2021 7:55	7/14/2021 12:45
WG4	Paradise Cay Yacht Harbor Channel CM 1	37.915853	-122.472501	8.34	7/8/2021 8:20	7/12/2021 11:45
WG5	Mudflat	37.926696	-122.495601	0.41	7/12/2021 12:15	7/14/2021 13:50
WG6	Mudflat	37.932883	-122.501527	0.29	7/12/2021 12:30	7/14/2021 13:00

[a] in feet relative to MLLW.

4.2 Ferry Tracks

Ferry track data were acquired from the San Francisco Marine Exchange (SFME). For an area specified by Jacobs, the SFME extracted track data received from all District ferries Automatic Identification System (AIS) transponders that transited the specified area between July 8 and 14, 2021. Track data received from the SFME were very detailed, but Jacobs only used time histories (date/time) of latitude and

longitude, velocity and heading. Figure 22 shows the tracks of the 59 ferry roundtrips recorded between July 8 and 14, 2021. Table 2 shows the number of roundtrips by ferry from July 8 to 14, 2021, where the NAPA is the fast ferry with the most roundtrips.

The analysis described in Section 3 to identify the design fast ferry indicated that there is practically no difference in the fast ferry wakes and that any of these would be a good design fast ferry candidate. On this basis, it was decided to select the design fast ferry as the one with the most trips and measured wakes during the field measurements because it would produce the most abundant data set. Therefore, the NAPA/GOLDEN GATE was selected as the design fast ferry.

Table 2. Number of roundtrips by ferry from July 8 to 14, 2021.

Ferry	Date							Total
	7/8	7/9	7/10	7/11	7/12	7/13	7/14	
NAPA	7	7	2	1	7	7	7	38
DEL NORTE	3	1	-	-	2	2	1	9
MARIN	-	1	3	1	-	-	-	5
SAN FRANCISCO	-	2	1	3	-	-	-	6
SONOMA	-	-	-	1	-	-	-	1
Total	10	11	6	6	9	9	8	59

4.3 Ferry Trim Angle

Ferry trim (pitch) angle at speed could affect the wake formation and therefore it was important to determine the typical trim angle of the ferries at speed to be used in the numerical simulations. The SPAULDING CLASS was not available for these measurements, but Jacobs rode the NAPA on 2 trips and measured the trim angle relative to the horizontal with a handheld inclinometer (the onboard inclinometer was out of order). Figure 23 shows the results of the measurements. A trim angle of 1.5 deg bow down was selected for the numerical simulations.

4.4 Water Depths

Water depth could affect the generation and propagation of wakes, particularly in shallow water. Therefore, it was important to determine the water depth at the locations of the gauges and ferry tracks so that they could be reproduced in the numerical simulations. Jacobs performed spot soundings with a lead line and corrected the soundings with the tide measured at the National Oceanic and Atmospheric Administration (NOAA) station 9414290 (NOAA, 2021). Table 3 lists the locations, dates and times of the soundings, water levels and depths.

Table 3. Locations, dates and times of the soundings, water levels and depths.

Location	Date	Time	Water Level[a]	Water Depth[b]		Water Depth[c]	
				@ Location	@ Mid Channel[d]	@ Location	@ Mid Channel[d]
WG1	7/14/2021	12:20	1.98	6.50	12.83	4.52	10.85
WG2	7/14/2021	12:35	2.25	9.83	14.33	7.58	12.08
WG3	7/14/2021	12:50	2.53	14.33	14.42	11.80	11.89
WG4	7/14/2021	13:05	2.83	11.17		8.34	
WG5	7/6/2021	12:18	4.09	4.5		0.41	
WG6	7/6/2021	11:37	4.21	4.5		0.29	

[a] in feet, at the time of the sounding relative to the MLLW.

[b] in feet, at the time of sounding relative to the still water level.

[c] in feet, relative to the MLLW

[d] Corte Madera Channel

4.5 Regional Wind Speed and Direction

Wind will not affect the generation of wakes but may affect their propagation and transformation depending on its speed and direction. In this analysis, the effect of wind on wake propagation and transformation was not considered. However, wind as a mechanism of wave generation was considered to identify wind conditions and corresponding waves in the area of interest and to assess the relative importance of waves and ferry wakes. Because no site-specific wind data was available, unobstructed by terrain and landforms, wind speed and direction were acquired from nearby National Data Buoy Center (NDBC, 2021) station TIBC1 - Tiburon Pier from July 8 to 14, 2021. The Tiburon Pier wind station is located approximately 5 miles to the southeast of the Larkspur terminal on the eastern shore of the Tiburon Peninsula. Figure 24 and Figure 25 show the time histories of wind speed and direction, respectively.

4.6 Regional and Local Water Levels

Water levels affect water depths, and their accurate representation is important for the generation and transformation of wakes in the numerical simulations. Because no site-specific water level measurements were available in the area of interest, water levels measured at NOAA station 9414290 San Francisco were used to adjust the vertical offset in the raw water levels measured by the gauges and derive corresponding water levels referenced to the MLLW. The adjusted water levels were later used to determine water depths, also referenced to the MLLW, at the gauge locations. Figure 26 to Figure 31 show NOAA station 9414290 San Francisco and adjusted water level time histories at WG1 to WG6, respectively. The mismatch between the amplitudes and timing of the peaks is expected because the gauges and NOAA station 9414290 San Francisco are at different locations within a hydraulically complex water body.

5. Wake Simulations

The original plan was to use OpenFOAM to simulate the generation of ferry wakes and their propagation into the area of interest. Preliminary simulations showed that computational resources and computational time requirements for that approach were impractical, so a hybrid approach was used. The hybrid approach consisted of using OpenFOAM to define the design fast ferry draft and trim at speed, and to inform the selection of modeling parameters in FUNWAVE (2021), a fully nonlinear Boussinesq wave model used for the generation and propagation of wakes. Unlike OpenFOAM where the vessel is geometrically represented, FUNWAVE represents the vessel by a moving pressure disturbance described by a set of parameters. In FUNWAVE, ferry wakes were generated for selected ferry trips and propagated into the area of interest. OpenFOAM was not used for the SPAULDING CLASS ferry because the default parameters in FUNWAVE are adequate for this type of displacement type vessel.

In OpenFOAM, the vessel model is fixed at a user selected flotation (i.e., draft and trim). Wakes highly depend on the accuracy of the geometric model of the vessel and its flotation at speed. Therefore, to achieve a good agreement between simulated and measured wakes the geometry of the NAPA/GOLDEN GATE model needed to be verified, and draft and trim at speed (i.e., the dynamic flotation) defined.

Table 4 lists the hydrostatic parameters of the NAPA/GOLDEN GATE corresponding to the Jacobs model developed from drawings provided by Washington State Ferries and those provided by Kirilloff & Associates (2009). For the 1.52 m (5 feet) design draft (at rest, fully loaded,), the hydrostatics of the Jacobs model closely matched those corresponding to Kirilloff & Associates (2009). Therefore, it was concluded that the NAPA/GOLDEN GATE model used in OpenFOAM was an accurate representation of the ferry.

Sensitivity simulations were performed at 39 knots in representative location of the Corte Madera Channel (e.g., water depth 12 feet MLLW) to define the trim angle that would produce the smallest wakes (i.e., least resistance). Trim angles ranged from 1 degree bow up to -2.5 degrees bow down in 0.5 degrees increments. No significant differences were found in the wakes. For consistency with the measurements described in Section 4.3, findings by Stumbo et al. (2009) and Stumbo (2021, pers. comm.), a 1.5 degree bow down trim angle was adopted.

During the field measurements, the ferries were not at their design, fully loaded displacement and draft. Due to the COVID-19 pandemic, ferry ridership was significantly reduced. For the NAPA/GOLDEN GATE fast ferry, the draft (and displacement) used in the numerical simulations was based on a 50% of passenger capacity being transported (225 passengers) and results of simulations to determine the hydrodynamic lift generated on the hull at the service velocity (e.g., 39 knots). Table 5 lists the NAPA/GOLDEN GATE displacements and drafts for different loading (floating) conditions. Given the uncertainties in actual ferry velocity, number of passengers, aerodynamic lift at speed due to air funneled through the hulls, fuel, water and waste holding tanks loads, etc. a 1.4 m (4.59 feet) design draft was adopted. It is noted that more accurate displacement and trim estimates could have been possible by reading the draft marks on the NAPA. This was not possible because, while the mark's sizes and spacings on the NAPA are correct (6-inch high, 6 inch apart, bottom of the number represents the draft), the marks, as noted on site by Jacobs, are not correctly numbered (Stumbo, pers. comm. 2021).

The draft used in the SPAULDING CLASS ferry simulations was the 6-foot design draft, given that, for this displacement type hull with a relatively large waterplane area, changes in passenger loading would result in negligible draft changes.

In FUNWAVE the moving vessel is represented by a moving pressure source that is specified by the vessel length, beam and draft and its transit through time by the time series of the vessel track. FUNWAVE implements four types of pressure sources functions for vessel wake generation, all of which feature parameters representing the shape of the submerged portion of the vessel. The OpenFOAM simulation results were used to provide a first estimate for the FUNWAVE parameters used. This was achieved by analyzing the pressure distribution on the hulls from OpenFOAM. Then the FUNWAVE parameters that best produced that distribution were selected. Finally, FUNWAVE simulations were performed to find, by comparing simulated and measured wakes, the pressure source type and the set of parameters that would achieve the best agreement between these wakes. Table 6 lists the FUNWAVE parameters selected for the Type II pressure source used.

It is noted that, in FUNWAVE, the target shape of a vessel is initially prescribed based on the hydrostatic momentum balance. When the vessel is moving, the pressure-induced surface displacement at the vessel location deviates from the target shape, resulting in a dynamic form adjusting to flow conditions (Malej and Shi, 2021).

In FUNWAVE, to efficiently simulate the generation and propagation of the design fast ferry and the SPAULDING CLASS ferry wakes, the area of interest was discretized in the three domains shown in Figure 32. In OpenFOAM and FUNWAVE model bathymetries were developed from the following sources.

- 2015 post-dredge bathymetric survey (eTrac 2015)
- 2018-2019 LIDAR survey, U.S. Geological Survey (USGS 2019)
- 2010 bathymetry survey and Digital Elevation Model (DEM) of Corte Madera Bay (USGS 2011)
- Coastal DEM of San Francisco Bay (National Oceanic and Atmospheric Administration 2010)

A grid spacing of 0.5 m was used in the FUNWAVE model. This grid size was selected based on sensitivity tests with grid sizes of 1.0, 0.5 and 0.25 m. An adaptive time step is implemented in FUNWAVE, following the Courant-Friedrichs-Lewy (CFL) criterion where a Courant number of 0.5 was used. A minimum time step of 0.1 sec was also specified.

Table 4. NAPA/GOLDEN GATE fast ferry hydrostatics.

Parameter	**Jacobs (OpenFOAM model)[a]**		**Kirilloff & Associates[b]**
Draft	1.52 m	5 feet	5 feet
Longitudinal Center of Flotation (LCF)[c]	16.23 m	53.23 feet	53.93 feet
Longitudinal Center of Buoyancy (LCB)[c]	16.58 m	54.21 feet	52.14 feet
Vertical Center of Buoyancy (VCB)[d]	1 m	3.27 feet	3.17 feet
Displacement	190,304 kg	187.3 LT	186.71 LT

[a] design, at rest, fully loaded

[b] Kirilloff & Associates (2009)

[c] from transom datum (Advanced Multihull Design,1997)

[d] from keel (Advanced Multihull Design,1997)

Table 5. NAPA/GOLDEN GATE fast ferry displacements and drafts for different loading conditions.

Condition	Displacement		Draft	
At rest, fully loaded[a]	190, 304 kg	187.3 LT	1.53 m	5.01 feet
At rest, 50% passengers	172,304 kg	169.58 LT	1.43 m	4.69 feet
At 39 knots, 50% passengers[b]	157,304 kg	154.82 LT	1.35 m	4.42 feet

[a] design

[b] assumes 15,000 kg hydrodynamic lift

Table 6. FUNWAVE parameters for the Type II pressure source used in the simulations.

Parameter	NAPA Outbound	NAPA Inbound	SPAULDING CLASS Outbound	SPAULDING CLASS Inbound
a	16	16	16	16
b	2	2	2	2
c	25	50	50	80

6. Wake Analysis

Not all wake measurements performed between July 8 and 14, 2021 were adequate for comparison with the numerically simulated wakes. In most cases, the metocean conditions present in the area of interest at the time of the ferry trips, like wind, waves and currents, affected and distorted the measurements. Numerically simulated wakes are free from those influences, so wakes measured free of those were required for reliable comparisons. The wake measurements were inspected to select the most suitable measurements for comparison.

6.1 Fast Ferry

The NAPA was the fast ferry with the most roundtrips (38) during the field measurements between July 8 and 14, 2021. It provided the most wake measurements and was selected as the design fast ferry. The 38 NAPA roundtrips were inspected, and it was determined that the wakes it generated on its 4th roundtrip on July 8, 2021, were almost wind, wave and current free. Consequently, wakes measured on that roundtrip were used for comparisons with the corresponding numerical simulations. Figure 33 and Figure 34 show the tracks of the NAPA 38 outbound and inbound trips between July 8 and 14, 2021, respectively, and its 4th trip tracks on July 8, 2021. Table 7 and Table 8 summarize corresponding ferry and metocean conditions at the gauge locations for those trips.

Table 7. Ferry and metocean conditions at gauge locations for NAPA 4th outbound trip on July 8, 2021.

	WG1	WG2	WG3	WG4
AIS Time	12:38	12:41	12:44	12:46
Elapsed Time (minutes)[a]	+3	+6	+9	+11
Ferry Velocity (knots)	6.4	10	38.8	34.3
Water Level (feet, MLLW)	4.57	4.5	4.56	4.42
Water Depth (feet)[b]	15.4	16.6	16.5	12.8
Wind Speed (knots)	6	6	7	7
Wave Height at WG (inches)	2.1	2.1	2.6	1.1
Wake Height at WG (inches)	0	$7^{m,s}$	$16^{m,s}$	$2^{m,s}$
Current	slack tide, no current			

[a] relative to NAPA departure from Larkspur terminal at 12:35

[b] from still water level at Corte Madera (mid) Channel

[m] measured, [s] simulated

Table 8. Ferry and metocean conditions at gauge locations for NAPA 4th inbound trip on July 8, 2021.

	WG4	WG3	WG2	WG1
AIS Time	13:41	13:43	13:47	13:50
Elapsed Time (minutes)[a]	-11	-9	-5	-2
Ferry Velocity (knots)	31.3	39.5	9.9	7
Water Level (feet, MLLW)	4.49	4.6	4.63	4.57
Water Depth (feet)[b]	12.8	16.5	16.7	15.6
Wind Speed (knots)	5	5	5	5
Wave Height at WG (inches)	1.7	1.9	1.2	2.6
Wake Height at WG (inches)	3^{m}, 2^{s}	10^{m}, 17^{s}	4^{m}, 8^{s}	0
Current	slack tide, no current			

[a] relative to NAPA arrival at Larkspur terminal at 13:52

[b] from still water level at Corte Madera (mid) Channel

[m] measured, [s] simulated

Figure 35 shows a summary of the NAPA peak wake heights at the gauge locations, which are representative of the wakes in their immediate vicinity. Where measured and simulated peak wake heights differ, the peak wake height reported is the one that is consistent in both ferry transit directions. The following is noted:

- Except at WG3 (Corte Madera Channel CM 5), where the fast ferries transit at approximately 40 knots, wakes at the other gauge locations are very small, in the order of a few inches, or have fully dissipated for both outbound and inbound ferry transit directions.
- At WG1 (Corte Madera Channel CM 15 and Corte Madera Creek Inlet):
  - Based on observations, when a fast ferry departs (outbound), it turns from an in-bow berthing position to a bow-out for departure and does not generate any wakes as it completes this maneuver and speeds up.
  - When a fast ferry arrives (inbound), it slows down from approximately 10 knots at WG2 to 7 knots (or less) at WG1 and the propagating wake train dissipates to negligible wakes by the time it arrives at WG1. No wakes are expected at the Greenbrae Boardwalk Community.
- At WG2 (Corte Madera Channel CM 11) wakes are in the order of 7 to 8 inches in both transit directions.
- At WG3 (Corte Madera Channel CM 5) wakes are in the order of 16 to 17 inches in both transit directions. This is expected given the relatively close distance from the ferry track to WG3 (approximately 130 feet) and the high ferry velocity which could be approximately 40 knots.
- At WG4 (Paradise Cay Yacht Harbor Channel CM 1), the wakes that arrive after propagating approximately 0.8 miles from the ferry track have significantly decreased and are negligible, in the order of 2 inches in the outbound and 3 inches in the inbound transit directions.
- At WG5 and WG6, wakes that arrive after propagating over the mudflat for approximately 0.5 miles from the ferry track have significantly decreased and are negligible, in both transit directions.

The following figures show comparisons between measured and simulated wakes. Gauge and AIS times may not match. In all cases, the measured wakes were band-pass filtered at cutoff frequencies between 0.16 and 2 Hz (0.5 to 6.25 seconds) to remove spurious wave components and the tide.

Figure 36 shows NAPA parameters and wake pattern during its passage by WG2 on its 4th outbound trip on July 8, 2021, and corresponding simulated and measured water surface elevations. The measured 7-inch peak wake height is closely matched by the simulated wake and, generally, the wake pattern and periods show good agreement. The measured wake, however, appears to dissipate more quickly.

Figure 37 shows NAPA parameters and wake pattern during its passage offshore the mudflat on its 4th outbound trip on July 8, 2021, and corresponding simulated water surface elevations at WG5 and WG6. The wakes on the mudflat are negligible, essentially ripples and likely very small to be simulated. No measurements were performed at these locations for this trip.

Figure 38 shows NAPA parameters and wake pattern during its passage by WG3 on its 4th outbound trip on July 8, 2021, and corresponding simulated and measured water surface elevations. The measured 16-inch peak wake height is closely matched by the simulated wake and, generally, the wake pattern and periods show good agreement.

Figure 39 shows NAPA parameters and wake pattern during its passage offshore WG4 on its 4th outbound trip on July 8, 2021, and corresponding simulated and measured WSE. The measured and simulated wakes arriving at WG4 are approximately 2 inches. These are essentially ripples and likely very small to be measured or simulated.

Figure 40 shows NAPA parameters and wake pattern during its passage offshore WG4 on its 4th inbound trip on July 8, 2021, and corresponding simulated and measured WSE. The measured wakes arriving at

WG4 are approximately 3 to 4 inches and simulated wakes 2 inches. These are essentially ripples and likely very small to be measured or simulated.

Figure 41 shows NAPA parameters and wake pattern during its passage by WG3 on its 4th inbound trip on July 8, 2021, and corresponding simulated and measured water surface elevations. The measured 10-inch peak wake height is smaller than the corresponding simulated 17-inch wake, however, the wake pattern and periods show good agreement.

Figure 42 shows NAPA parameters and wake pattern during its passage offshore the mudflat on its 4th inbound trip on July 8, 2021, and corresponding simulated water surface elevations at WG5 and WG6. Wakes on the mudflat are approximately 2 inches or less, essentially ripples and likely very small to be simulated. No measurements were performed at these locations for this trip.

Figure 43 shows NAPA parameters and wake pattern during its passage by WG2 on its 4th inbound trip on July 8, 2021, and corresponding simulated and measured water surface elevations. The measured 4-inch peak wake height is smaller than the corresponding 8-inch simulated wake, however, the wake pattern and periods show good agreement. The measured wake, however, appears to dissipate more quickly.

Figure 44 shows NAPA parameters and wake pattern during its passage by WG1 on its 4th inbound trip on July 8, 2021, and corresponding simulated and measured water surface elevations. The measured wakes are negligible, but the simulated peak wake height is 7 inches. The raw wake measurements at WG1 were inspected and confirmed that the wakes were negligible. These wakes are likely very small to be measured or simulated.

6.2 SPAULDING CLASS Ferry

Considering that wake measurements for comparisons with simulations should be as free as possible of distortions due to wind, wave and current, the 12 roundtrips in 3 days, between July 9 and July 11, 2021, of the SPAULDING CLASS ferries were relatively few. Nevertheless, the MARIN and the SAN FRANCISCO corresponding 1st inbound trips, both on July 10, 2021, were suitable based on the inspection of wind, wave and water level data. Table 9 and Table 10 summarize corresponding ferry and metocean conditions at the gauge locations for those trips.

Table 9. Ferry and metocean conditions at gauge locations for MARIN 1st outbound trip on July 10, 2021.

	WG1	WG2	WG3	WG4
AIS Time	11:37	11:39	11:46	11:51
Elapsed Time (minutes)[a]	+4	+6	+13	+18
Ferry Velocity (knots)	5.8	9.7	10.0	10.5
Water Level (feet, MLLW)	3.17	3.12	3.13	3.42
Water Depth (feet)[b]	14.0	15.2	15.0	11.8
Wind Speed (knots)	11.1	11.1	14.0	11.1
Wave Height at WG (inches)	2.7	2.5	4.4	3.4
Wake Height at WG (inches)	0	4^{m}, 14^{s}	5^{m}, 10^{s}	7^{m}, 0^{s}
Current	flood tide, head current			

[a] relative to the MARIN departure from Larkspur terminal at 11:33

[b] from still water level at Corte Madera (mid) Channel

[m] measured, [s] simulated

Table 10. Ferry and metocean conditions at gauge locations for SAN FRANCISCO 1st inbound trip on July 10, 2021.

	WG4	WG3	WG2	WG1
AIS Time	18:56	19:02	19:09	19:12
Elapsed Time (minutes)[a]	-18	-12	-5	-2
Ferry Velocity (knots)	12.2	10.2	9.9	6.9
Water Level (feet, MLLW)	3.48	3.29	3.47	3.43
Water Depth (feet)[b]	11.8	15.2	15.6	14.3
Wind Speed (knots)	4.1	-	-	-
Wave Height at WG (inches)	3.8	2.9	4.6	1.4
Wake Height at WG (inches)	12^{m}, 0^{s}	5^{m}, 6^{s}	8^{m}, 7^{s}	0^{m}, 4^{s}
Current	slack tide, no current			

[a] relative to the SAN FRANCISCO arrival at Larkspur terminal at 19:14

[b] from still water level at Corte Madera (mid) Channel

- no measurements available

[m] measured, [s] simulated

Figure 45 shows a summary of the SPAULDING CLASS ferries peak wake heights at the gauge locations, which are representative of the wakes in their immediate vicinity. Only the measured wakes are reported

because, while in most cases simulated wakes matched the measured magnitudes, the pattern was not well matched. The following is noted:

- Except at WG4 (Paradise Cay Yacht Harbor Channel CM 1), where the SPAULDING CLASS ferries transit at approximately 18 knots and at 0.8 miles offshore, wakes at the other gauge locations are very small, in the order of a few inches, or have fully dissipated for both outbound and inbound ferry transit directions.
- At WG3 and WG2, where the SPAULDING CLASS ferries transit at approximately 10 knots in both transit directions, a water level drawdown of approximately 4 inches (0.10 m) in noted. At certain vessel velocities, this is typical and produced by the acceleration of the flow around displacement type vessels in shallow channels.
- At WG1, the water level drawdown is also noted, however, very small due to the vessel's relatively low transit velocity (e.g., 6 to 7 knots).
- The water level drawdown is a localized effect, restricted around the vessel and it does not propagate away from the vessel. Therefore, it was not accounted for in the estimation of the wake height.
- At WG1 (Corte Madera Channel CM 15 and Corte Madera Creek Inlet):
  - Based on observations, when a SPAULDING CLASS ferry departs (outbound), it turns from an in-bow berthing position to a bow-out for departure and does not generate any wakes as it completes this maneuver and speeds up.
  - When a SPAULDING CLASS ferry arrives (inbound), it slows down from approximately 10 knots at WG2 to 7 knots (or less) at WG1 and the propagating wake train dissipates to negligible wakes by the time it arrives at WG1. No wakes are expected at the Greenbrae Boardwalk Community.
- At WG2 (Corte Madera Channel CM 11) wakes are in the order of 4 inches in the outbound and 8 inches in the inbound transit directions. The difference could be related to wakes reflected from the shore to the east.
- At WG3 (Corte Madera Channel CM 5) wakes are in the order of 5 inches in both transit directions.
- At WG4 (Paradise Cay Yacht Harbor Channel CM 1), the wakes that arrive after propagating approximately 0.8 miles from the ferry track have decreased are in the order of 7 inches in the outbound and 12 inches in the inbound transit directions. Inbound wakes are larger because, when the SPAULDING CLASS ferry approaches the Paradise Cay Yacht Harbor area from the southeast, it does so at approximately 18 knots and generates wakes larger than when in the outbound direction where it approaches from the northwest at approximately 10 knots.
- At WG5 and WG6, wakes that arrive after propagating over the mudflat for approximately 0.5 miles from the ferry track have significantly decreased and are negligible, in both transit directions.

The following figures show comparisons between measured and simulated wakes. Gauge and AIS times may not match. In all cases, the measured wakes were band-pass filtered at cutoff frequencies between 0.16 and 2 Hz (0.5 to 6.25 seconds) to remove spurious wave components and the tide.

Figure 48 shows MARIN parameters and wake pattern during its passage by WG2 on its 1st outbound trip on July 10, 2021, and corresponding simulated and measured water surface elevations. The measured peak wake height is 4 inches. The simulated wakes are higher, with a peak of approximately 14 inches, and do not dissipate as quickly as the measured wake. Furthermore, the simulation does not reproduce the 4-inch (0.10 m) drawdown.

Figure 49 shows MARIN parameters and wake pattern during its passage offshore the mudflat on its 1st outbound trip on July 10, 2021, and corresponding simulated water surface elevations at WG5 and WG6. The wakes on the mudflat are negligible, essentially ripples and likely very small to be simulated. No measurements were performed at these locations for this trip.

Figure 50 shows MARIN parameters and wake pattern during its passage by WG3 on its 1st outbound trip on July 10, 2021, and corresponding simulated and measured water surface elevations. The measured peak wake height is 5 inches. The simulated wakes are higher, with a peak of approximately 10 inches, and do not dissipate as quickly as the measured wake. Furthermore, the simulation does not reproduce the 4-inch (0.10 m) drawdown.

Figure 51 shows MARIN parameters and wake pattern during its passage offshore WG4 on its 1st outbound trip on July 8, 2021, and corresponding simulated and measured WSE. The measured peak wake arriving at WG4 is approximately 7 inches, while the simulation shows no wakes. According to the simulation, the wake train arrives at WG4 when the MARIN is approximately abeam of WG4 at 11:52:16 (AIS time) and 11:51:33 (WG time), this suggests that WG time lags the AIS time by approximately 43 seconds. The record shows small WSE changes up to 6 minutes before and after the passage of the MARIN. Wakes measured at 11:47:45, when the MARIN was just past WG3, were similar to those when the wake train was supposed to have arrived at WG4 suggesting that waves could be a significant component of the measurement. A similar wake set is measured at 11:52:50 (WG time) when the MARIN had already passed WG4 by over 1 minute.

Figure 52 shows SAN FRANCISCO parameters and wake pattern during its passage offshore WG4 on its 1st inbound trip on July 10, 2021, and corresponding simulated and measured WSE. The simulation indicates that the wakes arrive at WG4 when the SAN FRANCISCO is close to WG3. The measured peak wake is approximately 12 inches, while the simulation shows no wakes. Approximately 7 minutes before the estimated arrival of the SAN FRANCISCO wakes, a peak 14-inch-high wake was measured, but likely unrelated to the SAN FRANCISCO which had not passed yet passed by WG4. Being the Paradise Cay Yacht Harbor home of many powerboats, it is reasonable to assume that wakes similar to the SPAULDING CLASS ferries could be caused by those vessels entering or leaving the harbor.

Figure 53 shows SAN FRANCISCO parameters and wake pattern during its passage by WG3 on its 1st inbound trip on July 10, 2021, and corresponding simulated and measured water surface elevations. The measured peak wake height is 5 inches. The simulated wakes are similar, with a peak of approximately 6 inches, and dissipate faster than the measured wake. Furthermore, the simulation does not reproduce the 4-inch (0.10 m) drawdown.

Figure 54 shows SAN FRANCISCO parameters and wake pattern during its passage offshore the mudflat on its 1st inbound trip on July 10, 2021, and corresponding simulated water surface elevations at WG5 and WG6. The wakes on the mudflat are negligible, essentially ripples and likely very small to be simulated. No measurements were performed at these locations for this trip.

Figure 55 shows SAN FRANCISO parameters and wake pattern during its passage by WG2 on its 1st inbound trip on July 10, 2021, and corresponding simulated and measured water surface elevations. The measured peak wake height is 8 inches while the corresponding simulated wake is 7 inches. The simulated wakes dissipate faster than the measured wake. The record shows WSE changes of similar magnitude as the wakes after 1 and 2 minutes after the passage of the vessel, suggesting possible reflections from the shore to the east. Furthermore, the simulation does not reproduce the 4-inch (0.10 m) drawdown.

Figure 56 shows SAN FRANCISCO parameters during its passage by WG1 on its 1st inbound trip on July 10, 2021, and corresponding simulated and measured water surface elevations. The measured and simulated wakes are negligible, essentially ripples and likely very small to be simulated.

The measured and simulated wakes were compared against measurements performed by Philip Williams & Associates (PWA, 1993) in November 1989 and September 1992. Figure 57 shows MARIN and SAN FRANCISCO peak wake heights measured at the Corte Madera Channel CM 11 (WG2) and CM 5 (WG3) on their 1st outbound and inbound trips, respectively, on July 10, 2021, and measured by PWA (1993) at CM 7. To account for differences in velocity and water depth, the comparison is based on the Froude Number (F) computed as $F = V/\sqrt{g\ d}$ where V is the ferry velocity, g is the gravity acceleration and d is the water depth.

MARIN and SAN FRANCISCO wakes are lower than the wakes measured by PWA (1993) by approximately 50 percent. The discrepancy could be explained by how wakes, velocities and water depths were measured. The MARIN and SAN FRANCISCO wakes were measured more accurately with a sensor in relatively low wave conditions whereas PWA (1993) wakes were estimated from video recordings in unknown wave conditions. In this analysis, F was computed using the water depth derived from in-situ soundings and measured water levels, and the velocity was provided by the ferries' AIS system, while in PWA's (1993) it is unknow how these parameters were derived. Finally, it is unknown if PWA (1993) included the water level drawdown in their estimates. The water level drawdown is a localized effect, restricted around the vessel and it does not propagate away from the vessel. Therefore, it was not included in the estimation of the MARIN and SAN FRANCISCO wake heights.

7. Wake Impact Assessment

Among the various impacts that ferry traffic has, those due to wakes are some of the most critical. Wakes can erode the bottom and shorelines, damage shoreline protection and other coastal infrastructure, erode bottom sediment and increase turbidity affecting benthos organisms and bottom habitats, and impact passive boating. These impacts were assessed for the area of interest using the wakes derived for the representative trips analyzed in the Section 6.

Figure 58 shows key coastal features and activities in the area of interest that could be affected by ferry wakes. These include:

- CMER marsh
- Mudflat (erosion, turbidity and benthos)
- Natural shorelines
- Docks and boats at the Greenbrae Boardwalk Community and Paradise Cay Yacht Harbor
- Shoreline protection structures (e.g., bulkheads, seawalls, engineered revetments, jetties and breakwaters)
- Passive boating (rowing shells, kayaks, paddle boards, sailboats, canoes, etc.)

The following basis and criteria were used to assess the impact of ferry wakes:

1. Previous studies and investigations characterizing and assessing actual and historical site conditions and changes
2. Guidelines for boat basin wave agitation by the American Society of Civil Engineers (ASCE, 2012)
3. Shoreline protection design guidelines (USACE, 1995)
4. U.S. Rowing Safety Expectations Policy (2021)

Figure 59 and Figure 60 show summaries of the fast and SPAULDING CLASS ferries impacts, respectively, and the following sections provide the basis and conclusions of the assessment.

7.1 CMER Marsh

The analysis in Section 6 and results summarized in Figure 35 and Figure 45 show that, for the representative ferry trips summarized in Table 7 to Table 10, ferry wakes would not reach the CMER marsh scarp and, consequently, will not erode it. An approximate elevation of the toe of the marsh scarp can be inferred from the field investigation of Lacy and Hoover (2011) where the location of a pressure sensor installed at the edge of the marsh is described at 0.64 m (2.1 feet) MLLW. Considering that the mean sea level is at 0.95 m (3.12 feet) MLLW and that ferry wakes in this analysis occurred at water levels in the 3- to 4-foot MLLW range, it can be concluded that most of the time the mudflat is underwater and ferry wakes dissipate due to fluid-mudflat interaction before reaching the marsh scarp.

Lacy and Hoover (2011), however, noted that ferry wakes reached the marsh edge (at a pressure sensor location) during their field investigation in “mid” and “high” tide elevations. Wakes in the order of 1 foot recorded during “mid” tide were larger than those recorded during “high” tide suggesting that the water level may have overtopped the marsh crest during “high” tide and that the higher wakes recorded at “mid” tide were a result of wakes reflecting from the nearly vertical marsh scarp and combining with the incoming wakes. Lacy and Hoover (2011) also noted that the largest recorded ferry wakes at the marsh edge were not larger than the waves that persisted for several hours during the three February 2010 storms they analyzed.

A definite determination about the vulnerability of the CMER marsh to ferry wakes cannot be made without an analysis of the evolution of the site conditions and processes that have affected it through time. In the most recent and comprehensive of such analyses the USGS (Carkin et al., 2020) noted that the Corte Madera shoreline has retreated significantly during the 163-year period from 1853 to 2016. Figure 61 shows the CMER historical shorelines, adapted from Carkin et al. (2020). Total shoreline retreat during that period ranged from about 70 to 150 m, which corresponds to a long-term rate of 0.4 to 0.9 m/year, depending on the location along the highly irregular shoreline. Carkin et al. (2020) also noted evidence of high retreat rates due to strong human-influenced effects, like the Muzzi dike borrow canal, and hypothesized that the relatively high retreat rates in the central part of the CMER are likely due to greater exposure and focusing of wave energy reflection or refraction within Corte Madera Bay. Finally, they noted that the ferry wakes have not resulted in a higher shoreline retreat rate in the unprotected Corte Madera Creek shoreline (Greenbrae Boardwalk Community) than in the bay-facing section of the marsh in that area.

A similar conclusion was reached by Brady and Associates (1995). Resulting from their Larkspur Ferry Acquisition Initial Study/Environmental Assessment they noted that the marshes in Corte Madera Bay have been continuously eroding over the last 140 years (to 1992) at a rate of about 1.6 to 2.3 feet/year (0.5 m/year to 0.7 m/year) and that wave energy is the primary factor of marsh erosion. Furthermore, Brady and Associates (1995) noted that, at the time of their study, the retreat rate at CMER was the same as it was before Larkspur Ferry service began in 1976. The retreat rates estimated by Brady and Associates (1995) are very similar to those estimated by Carkin et al. (2020).

Recognizing the historical retreat of the CMER marsh, and to mitigate the erosion effects of waves and enhance the shoreline resilience in the face of sea level rise/climate change, the Marin Community Foundation funded in 2017 the development of a conceptual design to reduce the rate of salt marsh scarp retreat caused by wave erosion and long-term sediment deficits by using methods analog to regional salt

marsh-fringing barrier beaches (Baye, 2020). As part of that project, the San Francisco Estuary Institute (SFEI) conducted two drone surveys over a roughly 80-acre area to investigate change along the marsh edge over a one-year timespan (SFEI and Baye, 2020). SFEI estimated marsh sediment loss from the scarp retreat from 2018-2019 to be about 30,000 metric tons, and estimated average marsh scarp retreat rates over time periods 1993-2010 and 2010-2018 similar to those of the USGS (Carkin et al., 2020) (1992-2016). The differences among corresponding long-term marsh scarp retreat rates by SFEI and USGS are less than 1 m/year.

CMER marsh erosion due to waves is significant and cannot be underestimated. The wave climate in Corte Madera Bay is southerly in the summer and southeasterly in the winter. Because Corte Madera Bay is generally oriented towards the southeast, the CMER marsh is somewhat protected from waves generated by summer sea breezes, but is directly exposed to the southeast, which is the orientation of the longest wind fetch and also the direction from which the strongest winds blow during winter storms. Therefore, the erosive mechanism for the CMER marsh is the waves generated by wind mainly from within the north to southeast sector in the winter months.

Brady and Associates (1995) found that, among all sources, wind and storm waves were found to have the most significant impact on the erosion of natural shoreline by contributing more than 90 percent of the total onshore wave energy. For example, at mean tide levels, a 10-year return period southeasterly storm would generate 5.8-foot-high waves. These waves may last for several hours, their ramp up and down in a few days, and would produce significantly more erosion than the much lower, relatively ephemeral, representative ferry wakes measured and simulated in this analysis and shown in Figure 35 and Figure 45.

To bring the relevance of waves and ferry wakes into perspective, time histories of wind and waves measured between July 8 and 14, 2021, and estimates of ferry wakes at the times of their transit by a gauge location are shown in Figure 62 to Figure 67. Greyed areas represent the time between 18:00 and 6:00 when the last ferry trips of the day are typically completed, and when wind and waves generally die down. In all cases, the wind speed and direction correlated well with wave height. The wave height reported is the significant wave height, which is a statistical wave height equal to the average of the highest one-third of the waves in a record. It is noted that the highest wave height in a record could be as high as twice the significant wave height.

Figure 62 shows wind, wave height and estimates of fast ferry wakes at the Corte Madera Creek Inlet (WG1). No wakes reached that location regardless of ferry transit direction. Waves were negligible but present all the time reaching peaks in the range of 6 to 10 inches.

Figure 63 shows wind, wave height and estimates of fast ferry wakes at the Paradise Cay Yacht Harbor (WG4). Outbound and inbound wakes were negligible in the 2 to 3-inch range, and generally lower than the waves that reached 6 to 9 inches.

Figure 64 shows wind, wave height and estimates of fast ferry wakes on the south area of the mudflat (WG5). In the outbound ferry direction, no wakes reached that location, while the 2-inch inbound wakes were generally lower than the waves that reached 6 to 8 inches.

Figure 65 shows wind, wave height and estimates of fast ferry wakes on the north area of the mudflat (WG6). Wakes for outbound and inbound ferry directions did not reach that location. Waves were present all the time and reached 6 to 8 inches.

Figure 66 shows wind, wave height and estimates of SPAULDING CLASS ferry wakes at the Corte Madera Creek Inlet (WG1). No wakes reached that location regardless of ferry transit direction. Waves were negligible but present all the time reaching peaks in the range of 6 to 10 inches.

Figure 67 shows wind, wave height and estimates of SPAULDING CLASS ferry wakes at the Paradise Cay Yacht Harbor (WG4). Wakes for the ferry in the outbound direction were 7 inches, and 12 inches in the inbound direction. Waves were consistently lower than the ferry wakes in the 2 to 6-inch range, with a peak at 9 inches.

It is concluded that, in the current conditions, ferry wakes have no impact on the CMER Marsh.

7.2 Mudflat

The mudflat fronting the CMER Marsh is an extensive shallow area where ferry wakes propagate towards the CMER Marsh and dissipate. In that process, depending on height and period, water depth (level) and bottom sediment, wake-generated flows could penetrate down to the bottom eroding it, increasing turbidity and affecting benthos organisms and bottom habitats.

The erodibility of the bottom is typically assessed by comparing the shear stress that the wake-generated flows will exert on the bottom sediment and the shear stress the bottom sediment can withstand (i.e., τ_c = critical shear stress). In both cases, knowledge of the bottom sediment type is important for this assessment. Figure 68 shows the location (S1) of a bottom sediment sample in Corte Madera Bay taken by Lacy and Hoover (2011), which is considered the most recent and relevant for this analysis due to its location. Bottom sediment characteristics may change with location and time, but in the absence of mudflat-wide samples, the sediment sampled by Lacy and Hoover (2011) in 0.5 m (1.6 feet) MLLW water depth could be considered representative of the whole mudflat.

The S1 sample grain size analysis performed by Lacy and Hoover (2011) showed that the sediment is predominantly silt (67 percent), with some clay (27 percent) and a small sand fraction (6 percent) characterizing it as silty clay. PWA (1993 and 1995) also characterized the bottom sediment in Corte Madera Bay as silty clay (and clayey silt) commonly known as San Francisco Bay Mud. Mud is a cohesive type of sediment with a high resistance to shear stress. Mud critical shear stress (τ_c) is difficult to determine and requires a detailed knowledge of the sediment physical, biological and chemical parameters. Typical values of mud τ_c range between 0.1 to 0.25 N/m^2 although values as high as 0.7 N/m^2 are common in mudflats that are exposed to the atmosphere (El-Shaarawi and Piegorsch, 2012), as is the case in Corte Madera Bay. The actual τ_c of Corte Madera Bay mud is unknown; however, modeling work performed by Hao (2010) and van der Wegen and Jaffe (2012) suggests τ_c = 0.3 to 0.8 N/m^2 and τ_c = 0.35 N/m^2, respectively. For consistency with previous studies, conservativism and due to the lack of better knowledge of Corte Madera Bay bottom sediment mud τ_c = 0.35 N/m^2 was adopted for this analysis.

The shear stress that wake-generated flows will exert on the bottom sediment depend on the bottom roughness and this is related to the sediment grain size. The analysis performed by Lacy and Hoover (2011) showed that the Corte Madera Bay sediment has a bimodal distribution, with the largest peak at 0.04 mm and the smallest at 0.004 to 0.006 mm. A nominal d_{50} = 0.04 mm grain size diameter was selected and used with the formula by Swart (1974) with bottom roughness 2*d_{50} to compute the wake-generated shear stresses on the bottom for the ferry trips and conditions described in Section 6.

7.2.1 Fast Ferry Shear Stresses

Peak shear stresses were computed for the fast ferry trips and conditions listed in Table 7 and Table 8, and the corresponding spatial distribution of simulated peak wakes and water depth. The horizontal amplitude of the wake-generated water particle velocity was calculated based on linear wave theory for a wake period of 3 seconds derived from zero up-crossing analysis of the fast ferry wake measurements.

Figure 69 and Figure 70 show maps of the peak shear stresses generated by the NAPA on its 4th outbound and inbound trips on July 8, 2021, respectively. Considering that τ_c = 0.35 N/m^2 is the shear stress above which the bottom sediment would be eroded and that the generated peak shear stresses for both fast ferry inbound and outbound directions were lower, **it can be concluded that, in the current conditions, fast ferry wakes do not erode the mudflat.**

Figure 69 shows an area at each side of the Corte Madera Channel at Point San Quentin where τ_c was exceeded. The relatively high shear stresses in that area are associated with the combination of ferry velocity and water depth. Wakes in shallow water are characterized by the depth Froude Number $F_h = \frac{V}{\sqrt{g\,h}}$ where V is the ferry velocity, g is the gravity acceleration and h is the water depth. The inspection of the ferry track showed that the NAPA transited that area at 16.2 knots which translates to F_h = 1.18 which is just past the critical F_h = 1 where wakes are expected to be the maximum. This combined with the channel bank slopes and shallow mudflat to provide conditions for the ferry wakes to shoal and achieve shear stresses higher than elsewhere in the area of interest. Figure 70 shows the effect of ferry velocity since, in the same area at Point San Quentin, the NAPA transited slower at 9.9 knots which translated to F_h = 0.72 and peak shear stresses not higher than τ_c.

7.2.2 SPAULDING CLASS Ferry Shear Stresses

Peak shear stresses were computed for the SPAULDING CLASS ferry trips and conditions listed in Table 9 and Table 10, and the corresponding spatial distribution of simulated peak wakes and water depth. It is noted that the simulated wakes at WG2 and WG3 in the outbound direction were higher than measured in which case the simulated peak wakes and resulting shear stress are conservative. The horizontal amplitude of the wake-generated water particle velocity was calculated based on linear wave theory for a wake period of 2.5 seconds derived from zero up-crossing analysis of the SPAULDING CLASS ferry wake measurements.

Figure 71 and Figure 72 show maps of the peak shear stresses generated by the SPAULDING CLASS ferry on its 1st outbound (MARIN) and inbound (SAN FRANCISCO) trips on July 10, 2021, respectively. Considering that τ_c = 0.35 N/m^2 is the shear stress above which the bottom sediment would be eroded and that the generated peak shear stresses for both ferry inbound and outbound directions were lower, **it can be concluded that, in the current conditions, the SPAULDING CLASS ferry wakes do not erode the mudflat**.

For the SPAULDING CLASS ferry in the in the outbound direction, Figure 71 shows a few small areas along the San Quentin Prison coastline where τ_c was exceeded at the Corte Madera Channel south bank. Ferry velocity and water depth combined to F_h = 0.77, which less than critical, still resulted on relatively high wakes that shoaled along the channel southern bank. This was not observed in Figure 72 for the inbound direction possibly because the ferry velocity in that area was slower, in the order of 8.5 to 9 knots versus 10 knots.

7.2.3 Water Turbidity

Water turbidity is associated with sediment in suspension that reduces the penetration of light below the water surface, photosynthesis and productivity. According to Baye (2020), the mudflat has naturally high background levels of suspended sediment during low to moderate wave activity, as well as during high wave activity. The analysis of the ferry wake-generated shear stresses showed that these would not be conducive to bottom sediment erosion and, consequently, would not cause an increase in background levels of turbidity on the mudflats, and in Corte Madera Bay in general. Similar conclusions were reached by Brady and Associates (1995) and Golden Gate Bridge Highway and Transportation District (GGBHTD, 1999). Therefore, it can be concluded that**, in the current conditions, ferry wakes do not impact the water turbidity.**

7.2.4 Benthos

Benthos (bottom organisms) in Corte Madera Bay are already adapted to the natural, historically high levels of turbidity and, therefore, the relatively minimal increases in turbidity that ferry wakes could generate would be inconsequential. **Furthermore, because in the current conditions ferry wakes do not erode the mudflat bottom, it can be concluded that benthos are not impacted.**

7.3 Natural Shorelines

The natural shorelines along the CMER Marsh and Corte Madera Creek were discussed in Section 7.1. The focus of this section is the Corte Madera Bay northern shoreline which runs approximately in the southeast-northwest direction from Point San Quentin to just southeast of the Larkspur terminal, as shown in Figure 73. This shoreline is not strictly a natural shoreline because while some sections are natural and unprotected from waves, several patches of non-engineered revetments are present. As opposed to an engineered revetment which consists of a filter layer, underlayers and armor layer; non-engineered revetments are built from dirt, concrete and asphalt slabs, bricks and other construction debris that do not offer adequate wave protection because are permeable structures that are transparent to water flows. The relatively large voids between its components only partially dissipate the hydrodynamic effects on the soil that is supposed to protect while, in fact, could exacerbate erosion because of the higher turbulence induced on the flow as it is funneled through the voids. The inadequate wave protection offered by the non-engineered revetments is evident at several locations along this shoreline, as shown in Figure 73. From this perspective, this shoreline can be classified as natural.

Southeasterly winds are predominant in the winter but can also occur during other times of the year. During those times, the Corte Madera Bay northern shoreline would be exposed to the highest waves because, in addition to the potentially high speed and long duration (hours, days) winds, the approximately 12-mile fetch along which the wind would blow would be the longest. Current wind climate statistics are not available for Corte Madera Bay. However, a cursory analysis of wind measurements at the Tiburon Pier (NDBC, 2021) showed that during 2021 the average and maximum wind speeds from the southeasterly sector (110 to 135 degrees) were approximately 5 and 27 knots, respectively. According to USACE (2008) formulae, these conditions would have resulted in wave heights of 0.5 feet (6 inches) and 3 feet (36 inches), both with periods in the range of 2 to 3 seconds, at the Corte Madera Bay northern shoreline.

Assuming that these conditions are representative of southeasterly winds and waves in any year**, it can be concluded that the fast and SPAULDING CLASS ferries wakes at the Corte Madera Bay northern shore (characterized by the measurements/simulations at WG2 shown in Figure 35 and Figure 45) should**

have a relatively negligible or no impact on the natural shoreline. The peak and successive wakes in the ferry wake trains are similar to the expected southeasterly average wave (height and period) and are significantly smaller than the potential extreme wave. But most importantly, the duration of the ferry wake train is relatively ephemeral because it consists of a few wakes that decay in a couple of minute or less, compared to the thousands of waves that would reach the shore in just one hour, or more.

7.4 Docks and Boats

ASCE (2012) provides guidelines for marina design so that wave conditions that could lead to physical dock and boat damage are minimized and user's safety is achieved. These guidelines were used to determine if the ferry wakes would result in noncompliant conditions.

The guidelines address scenarios such as wave events of once in 50 years and once in 1 year, but also the weekly environment which could be interpreted as that resulting from vessel wakes. It also addresses three levels of tolerance (excellent, good and moderate) based on aversion to risk and quality of berthing.

For the weekly environment, the recommended wake height is computed as:

$$H = A * [\, 0.5 - 0.25 \sin(\alpha) \,]$$

where α is the wave angle of incidence relative to the boat/dock centerline (e.g., 0 degrees for bow/stern seas, 90 degrees for beam seas) and A is a factor to account for the desired wave climate to achieve in the marina basin (e.g., A = 0.75 for excellent, 1 for good and 1.25 for moderate). Table 11 summarizes the recommended weekly wake heights for different conditions.

Table 11. Recommended weekly wake heights (ASCE, 2012).

	Wake Angle (deg)	Berthing Quality		
		Excellent	Good	Moderate
H (inches)	0	5	6	8
	45	3	4	5

At the Corte Madera Creek Inlet (WG1), the results of the wake measurements and simulations, summarized in Figure 35, indicate that the fast ferry would not generate wakes in the outbound or inbound directions **resulting in no impacts to boats and docks in the Greenbrae Boardwalk Community**.

At the Corte Madera Creek Inlet (WG1), the results of the wake measurements and simulations, summarized in Figure 45, indicate that the SPAULDING CLASS ferry would not generate wakes in the outbound or inbound directions, **resulting in no impacts to boats and docks in the Greenbrae Boardwalk Community**.

At the Paradise Cay Yacht Harbor north entrance channel (WG4), peak wakes due to the fast ferry summarized in Figure 35 are minimal, 2-inch (outbound) and 3-inch (inbound). As they propagate to the coast, these wakes would decay by diffraction as they turn around the entrance jetties **resulting in even smaller wakes and in no impact to boats and docks** per the recommendations in Table 11. Given the close proximity and similarities, **the same conclusions apply to fast ferry wakes penetrating into the south basin**.

At the Paradise Cay Yacht Harbor north entrance channel (WG4), the peak wake due to the SPAULDING CLASS ferry in the outbound direction is 7 inches (Figure 45) and Figure 74 shows that wakes propagate

approximately parallel to the coast. The wake train enters the Paradise Cay Yacht Harbor north and south basins significantly reduced as they decay due to diffraction turning around the entrance jetties into the basins, **resulting in no impacts to boats and docks** per the recommendations in Table 11.

At the Paradise Cay Yacht Harbor north entrance channel (WG4), the peak wake due to the SPAULDING CLASS ferry in the inbound direction is 12 inches (Figure 45) and Figure 74 shows that the wake train penetrates nearly aligned with the basins' main axis. Diffraction coefficients by Li et al. (2000), shown in Figure 75, indicate that these wakes would be mildly reduced by diffraction along their propagation line but significantly reduced to its sides as they enter the basins. Figure 52 shows that the wake train following the 12-inch peak wake, which lasts about 5 seconds, range between 4 and 8 inches and lasts a couple of minutes. These, on average and according to the recommendations in Table 11, result in good berthing quality. Consequently, **it can be concluded that wakes due to the SPAULDING CLASS ferry in the inbound direction have no impacts at the Paradise Cay Yacht Harbor**.

While the boats and docks at the Greenbrae Boardwalk Community are well protected, boats and docks just next to the Paradise Cay Yacht Harbor basins' entrances are exposed to waves. Just like for the Corte Madera Bay shorelines, the impact of waves at the Paradise Cay Yacht Harbor cannot be overlooked. Shown in Figure 76 are the wind and wave windows affecting the Paradise Cay Yacht Harbor basins. The north basin is affected by waves from the 60 to 135 degrees window, while the south basin by waves from a narrower 75 to 90 degrees window.

Wind from the 60 to 135 degrees window can blow over an average fetch of 8 miles. For this fetch and for the average (4 knots) and extreme (27 knots) wind speeds from this window derived from Tiburon Pier measurements during 2021 (NDBC, 2021) can develop waves in the range of 0.5 to 3 feet at the entrance of the north basin, according to USACE (2008) formulae. An analysis of the 2021 wind measurements at Tiburon Pier (NDBC, 2021) indicated that wind (and waves) from the 60 to 135 degrees window above the 4-knot average wind occur approximately 8% of the time throughout the year, meaning that waves of at least 0.5 feet at that location can occur approximately 4 weeks per year. While the peak wakes and wake trains of the SPAULDING CLASS ferry could be of similar magnitude, they will be ephemeral lasting only a few seconds or couple of minutes compared to hours of waves. Therefore, **it is concluded that the impact of wakes due to the SPAULDING CLASS ferry in the inbound direction on the boats and docks just next to the north basin entrance is significantly less than the impact of typical waves from the 60 to 135 degrees window due to their relatively ephemeral duration.**

Wind from the 75 to 90 degrees window can blow over an average fetch of 5 miles. For this fetch and for the average (2 knots) and extreme (16 knots) wind speeds from this window derived from Tiburon Pier measurements during 2021 (NDBC, 2021) can develop waves of up to 1 foot at the entrance of the south basin, according to USACE (2008) formulae. An analysis of the 2021 wind measurements at Tiburon Pier (NDBC, 2021) indicated that wind (and waves) from the 75 to 90 degrees window above the 2-knot average wind occur for less than 1% of the time throughout the year. While the peak wakes and wake trains of the SPAULDING CLASS ferry could be of similar magnitude and would be more frequent, they would be ephemeral lasting only a few seconds or couple of minutes compared to hours of waves. Consequently, **it is concluded that the impact of wakes due to the SPAULDING CLASS ferry in the inbound direction on the boats and docks just next to the south basin entrance is significantly less than the impact of typical waves from the 75 to 90 degrees window due to their relatively ephemeral duration.**

7.5 Shoreline Protection Structures

Shoreline protection structures (bulkheads, seawalls, engineered revetments, jetties and breakwaters) are high capital investment structures designed for service lives of 50 years or more. For this reason and to reduce maintenance costs, the standard engineering practice is to design these structures for extreme wave conditions with 50 to 100 years return periods (i.e., 50-year, 100-year event).

Shoreline protection structures in Corte Madera Bay are the bulkhead and engineered revetment along the southern shoreline of Point San Quentin, and revetments and jetties protecting the Paradise Cay Yacht Harbor waterfront and basins. An analysis to determine the extreme wave conditions that these structures would withstand was not performed. However, Brady and Associates (1995) 5.8-foot 10-year return period southeasterly wave estimate is sufficient to realize that these structures would withstand this and higher wave heights (likely up to the 100-year) if standard engineering practice was used in their design. Such practice, for example in USACE (1995), recommends that the design must successfully withstand (as a minimum) conditions which have a 50 percent probability of being exceeded during the structure's life. For a 100-year wave, which would be higher than the 5.8-foot 10-year wave, a structure design life of 70 years would yield a 50% probability of that wave occurring during the design life of the structure. Ferry wakes, summarized in Figure 35 and Figure 45 and which are significantly lower than the structures' design wave heights, **would have no impact on the shoreline protection structures in Corte Madera Bay**.

7.6 Passive Boating

Passive boating refers to non-powered vessels such as rowing shells, kayaks, paddle boards, sailboats, canoes, etc. The Marin Rowing Association (MRA), located just west of Highway 101 on the Corte Madera Creek, is the most active source of passive boating activity within the area of interest. MRA members row regularly in the area along the Corte Madera Channel as described in the MRA's rowing area map shown in Figure 77. Additional sources for passive boating could potentially include the Greenbrae Boardwalk Community and the Paradise Cay Yacht Harbor.

Because rowing shells are particularly vulnerable to waves and wakes and because flat water is ideal for rowing, MRA rowers go out early in the morning when the wind is generally calm and there are no waves. As the sea breeze and waves pick up during the day, choppy water develops, and rowing activity ceases or is reduced. However, ferries in the outbound and inbound directions generate wakes that could be potentially unsafe for rowing shells. Starting as early as 6:40 AM for departures from Larkspur and 7:15 AM from San Francisco (GGBHTD, 2022) MRA rowers (and other passive boaters) would encounter wakes in the Corte Madera Channel and vicinity every 10 to 60 minutes.

US Rowing (2021) recommends that if the approaching wake is higher than the gunwale, the shell should be turned parallel to the wake. If the wakes are lower than the gunwale and widely spaced, the rower(s) should continue to row without a course adjustment. Deep and closely spaced wakes that are lower than the gunwale may be taken at a 90-degree angle with the bow directly toward them. Considering that a typical rowing shell has a freeboard (distance from waterline to gunwale) of approximately 8 to 9 inches, the 7 to 17-inch fast ferry wakes along the Corte Madera Channel (at WG2 and WG3 shown in Figure 35) could be potentially unsafe for unaware rowers. SPAULDING CLASS ferry wakes, in the order of 4 to 8-inches (at WG2 and WG3 shown in Figure 45), are considered safe for rowing shells per US Rowing (2021) recommendations. In any case, an action to mitigate the impacts of ferry wakes appears to be in place by the MRA given its recommendation to rowers to meet at a point between the Corte Madera Channel and

the mudflat when a ferry is approaching (see Figure 77). Given these considerations **it is concluded that the impact of fast ferry wakes on passive boating is moderate in the Corte Madera Channel and vicinity**.

MRA rowers and passive boaters from the Greenbrae Boardwalk Community do not experience ferry wake impacts at the Corte Madera Creek Inlet and the ferry turning basin (WG1), because fast and SPAULDIG CLASS ferries do not generate wakes in that area. The same conclusion applies to passive boaters on the mudflat because wakes are significantly dissipated as they propagate over this area.

Due to is exposure to San Francisco Bay, typical wave conditions offshore the Paradise Cay Yacht Harbor would require seaworthy passive boating boats that should certainly also cope with ferry wakes. Fast ferry wakes in the range of 2 to 3 inches (see Figure 35) are negligible for passive boating. But SPAULDING CLASS ferry wakes of 7 to 12 inches (see Figure 45), just offshore the north basin entrance channel (WG4), **result in moderate impact to passive boating. Due to their close proximity and similarities this conclusion applies to passive boating from both the north and south basins**.

8. References

Advanced Multihull Designs (AMD). 1997. *Chinook Class AMD/D.C.I. 385. Hull Lines Plan. Drawing No. 4773-01-96.*

American Society of Civil Engineers (ASCE). 2012. *Planning and Design Guidelines for Small Craft Harbors*. Third Edition.

Brady and Associates. 1995. *Larkspur Ferry Acquisition, Initial Study/Environmental Assessment*. Golden Gate Bridge Highway and Transportation District. June.

Baye, P. 2020. *Conceptual Designs For Marsh-Fringing Beach Nourishment to Reduce Wave Erosion of Muzzi Marsh, Corte Madera Ecological Reserve, Marin County, California.* Task 3 Technical Memorandum for "New Life for Eroding Shorelines". San Francisco State University – Estuary & Ocean Science Center, Tiburon, California. September.

Carkin, B.A., Kayen, R.E. and F.L. Wong. 2020. *Shoreline Retreat of the Corte Madera Marshes, 1853 to 2016, Marin County, California*. U.S. Geological Survey, Open-File Report 2020-1074.

El-Shaarawi, A.H. and W.W. Piegorsch. 2012. *Encyclopedia of Environmetrics*. Wiley. November 28.

eTrac. 2015. *Larkspur Ferry Terminal Berths and Channel Maintenance Dredging.* November.

FUNWAVE. 2021. FUNWAVE Documentation. https://fengyanshi.github.io/build/html/index.html. Accessed 2021

Golden Gate Bridge Highway and Transportation District (GGBHTD). 1999. *Ferry Replacement Project Initial Study*. December.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2022. *Larkspur-San Francisco Ferry Schedule*. https://www.goldengate.org/ferry/route-schedule/larkspur-san-francisco/?backurl=%2Fferry%2Fschedules-maps%2F. Accessed 2022.

Hao, Y. 2010. *Wave Attenuation and Morphodynamic Modeling of Corte Madera Salt Marsh*. M.Sc. Thesis WSE-HECEPD.10-10. UNESCO-IHE Institute of Water Education and U.S. Geological Survey. May.

Kirilloff & Associates. 2009. *M/V Chinook Repowering Project. Hydrostatics. Golden Gate Bridge Ferry District*. Drawing No. 4773-843-006 Rev 01, pg. 2.

Lacy, J.R. and D.J. Hoover. 2011. *Wave Exposure of Corte Madera Marsh, Marin County, California - A Field Investigation*. Open-File Report 2011–1183. U.S. Geological Survey.

Li, Y.S., Liu, S.X., Yu, Y. X. and G. Z. Lai. 2000. *Numerical Modelling of Multi-directional Irregular Waves Through Breakwaters*. Applied Mathematical Modelling, 24(8-9), 551-574.

Marin Rowing Association (2022). *Course Map*. https://www.marinrowing.org/s/MRA-Map-Final-2-121118.pdf. Accessed 2022.

National Data Buoy Center (NDBC). 2021. *Station TIBC1 - Tiburon Pier, San Francisco Bay, CA*. https://www.ndbc.noaa.gov/station_page.php?station=tibc1. Accessed 2021.

National Oceanic and Atmospheric Administration (NOAA). 2010. *San Francisco Bay, California 1/3 arc-second NAVD88 Coastal Digital Elevation Model.* https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ngdc.mgg.dem:741. Accessed 2021.

National Oceanic and Atmospheric Administration (NOAA). 2021. *Tides & Currents. Station 9414290 San Francisco, CA.* https://tidesandcurrents.noaa.gov/noaatidepredictions.html?id=9414290. Accessed 2021.

OpenFOAM. 2021. The OpenFOAM Foundation. https://openfoam.org. Accessed 2021.

Philip Williams & Associates (PWA). 1993. *An Analysis of the Relative Effect of Ferry Wakes on Shoreline Erosion at the Corte Madera Ecologic Reserve*. Golden Gate Bridge, Highway and Transportation District. August.

Philip Williams & Associates (PWA). 1995. *An Assessment of the Impact of the Operation of an Additional Ferry on Shoreline Erosion in Marin County*. Golden Gate Bridge, Highway and Transportation District. April.

San Francisco Estuary Institute (SFEI) and P. Baye. 2020. *New Life for Eroding Shorelines: Beach and Marsh Edge Change in the San Francisco Estuary*. Publication #984, San Francisco Estuary Institute, Richmond, CA. Version 1.0. April.

Stumbo, S., Fox, K. and L. Elliott. 2000. *An Assessment of Wake Wash Reduction of Fast Ferries at Supercritical Froude Numbers and at Optimized Trim*. Marine Technology, Vol. 40, No. 5.

Stumbo, S. 2021. Personal communication (email) with Claudio Fassardi, Jacobs. September 29.

Swart, D.H. 1974. *Offshore Sediment Transport and Equilibrium Beach Profiles*. Publication 131, Delft Hydraulics.

U.S. Army Corps of Engineers (USACE). 1995. *Design of Coastal Revetments, Seawalls, and Bulkheads*. EM 1110-2-1614. June 30.

U.S. Army Corps of Engineers (USACE). 2008. *Coastal Engineering Manual – Part II. Meteorology and Wave Climate*. EM 1110-2-1100. August 1.

U.S. Geological Survey (USGS). 2019. *2018-2019 USGS Lidar: Northern California Wildfire - QL1*. https://www.fisheries.noaa.gov/inport/item/59131. Accessed 2021.

U.S. Geological Survey (USGS). 2011. *2010 Bathymetric Survey and Digital Elevation Model of Corte Madera Bay, California.* https://www.usgs.gov/publications/2010-bathymetric-survey-and-digital-elevation-model-corte-madera-bay-california. Accessed 2021.

U.S. Geological Survey (USGS). 2008. *Simulation of Flow, Sediment Transport, and Sediment Mobility of the Lower Coeur d'Alene River, Idaho*. Scientific Investigations Report 2008–5093.

U.S. Rowing. 2021. Safety Expectations Policy. https://usrowing.org/sports/2016/5/27/1135_132107060688980085.aspx. Accessed 2021.

van der Wegen, M. and B.E. Jaffe. 2012. *Modeling Wind Waves and Morphodynamics Near the Corte Madera Salt Marsh*. UNESCO-IHE Institute of Water Education and U.S. Geological Survey. October.

Figures

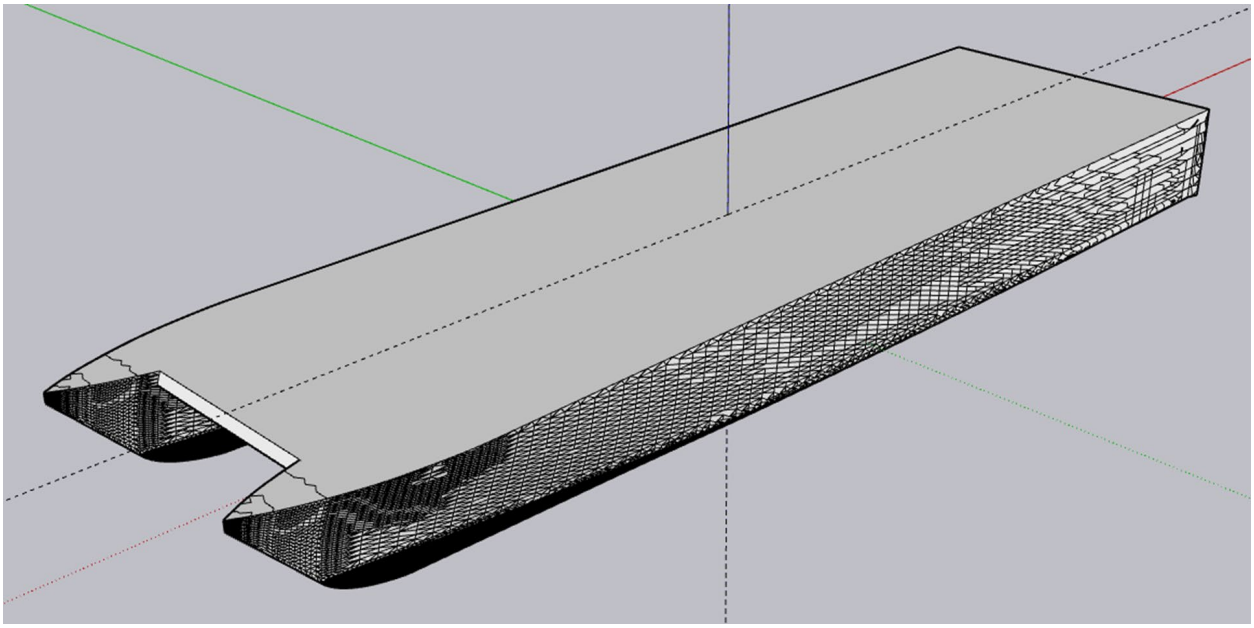


Figure 1. NAPA/GOLDEN GATE 3D model.

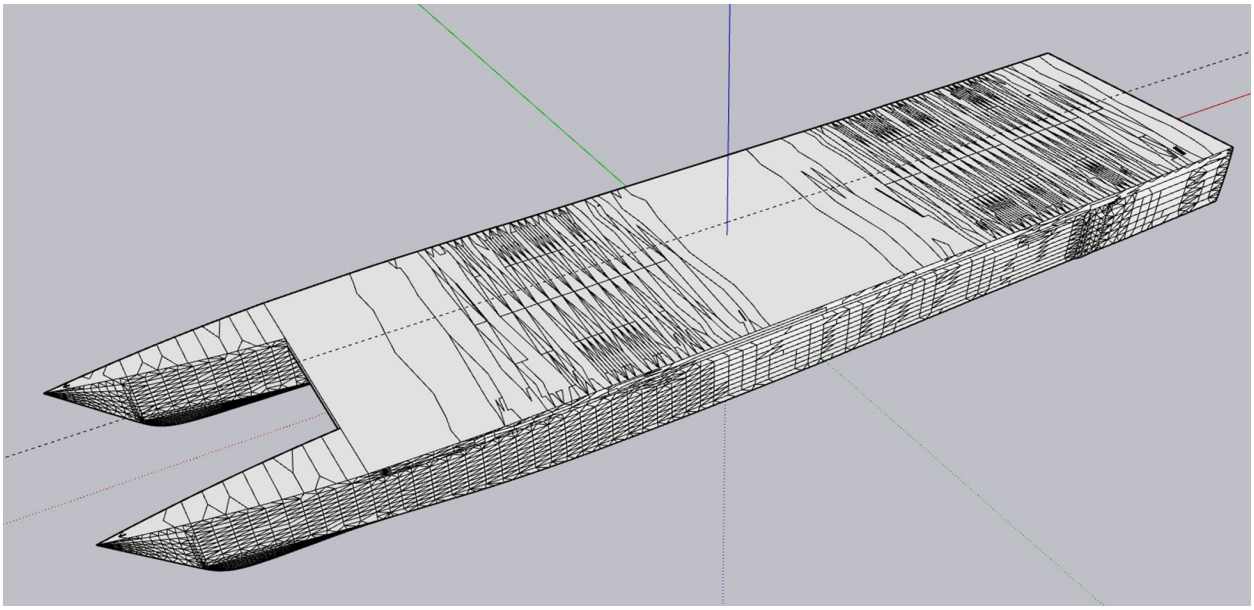


Figure 2. MENDOCINO 3D model.

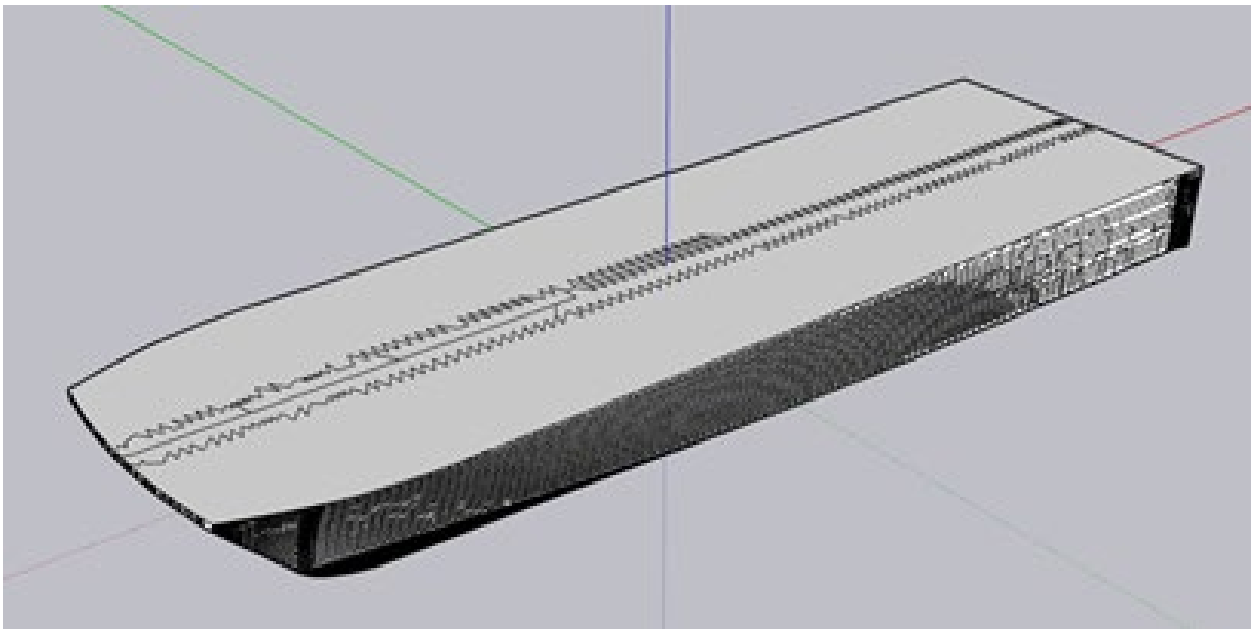


Figure 3. DEL NORTE 3D model.

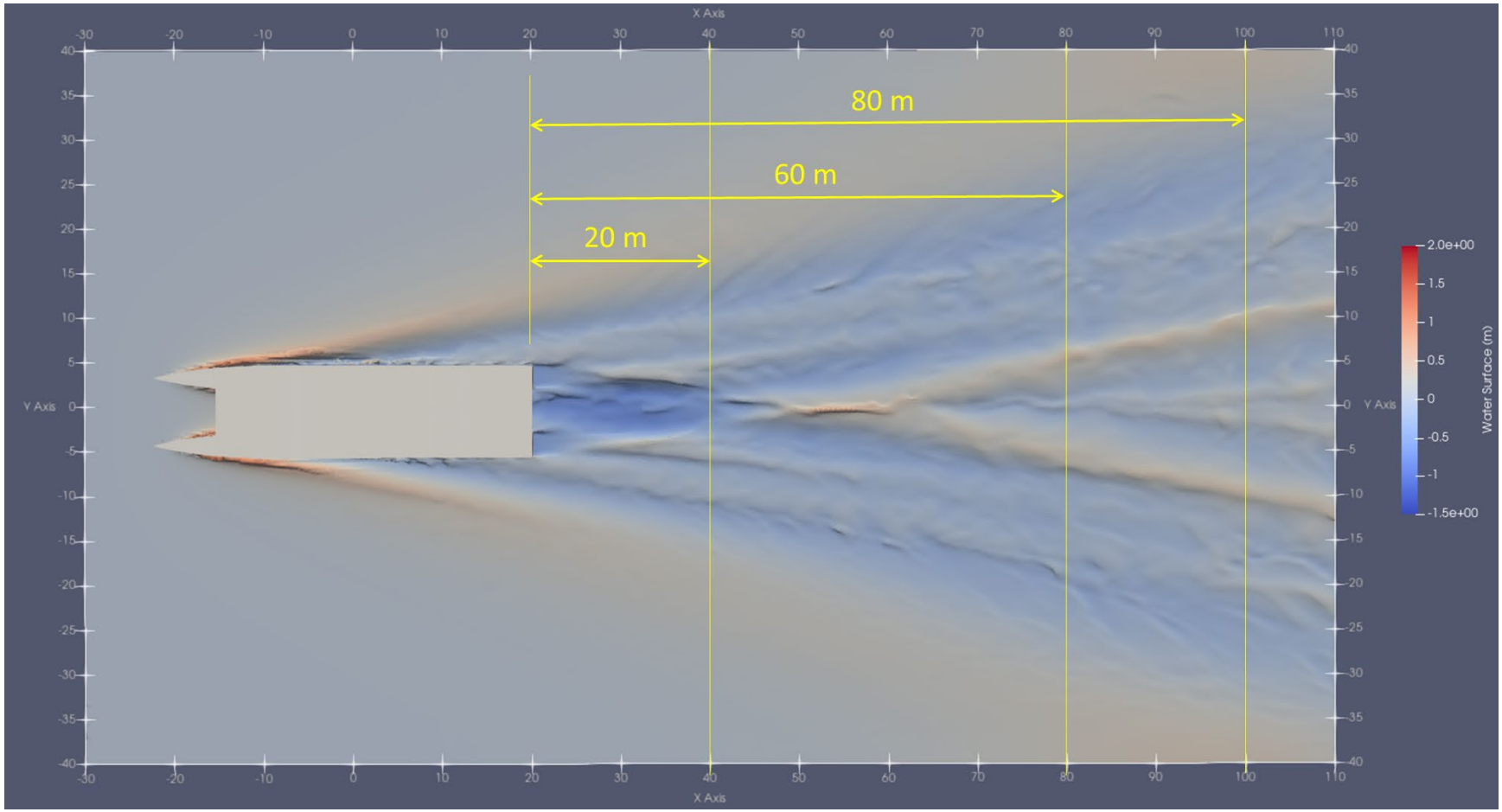


Figure 4. Plan view of MENDOCINO wake patterns at 36 knots.

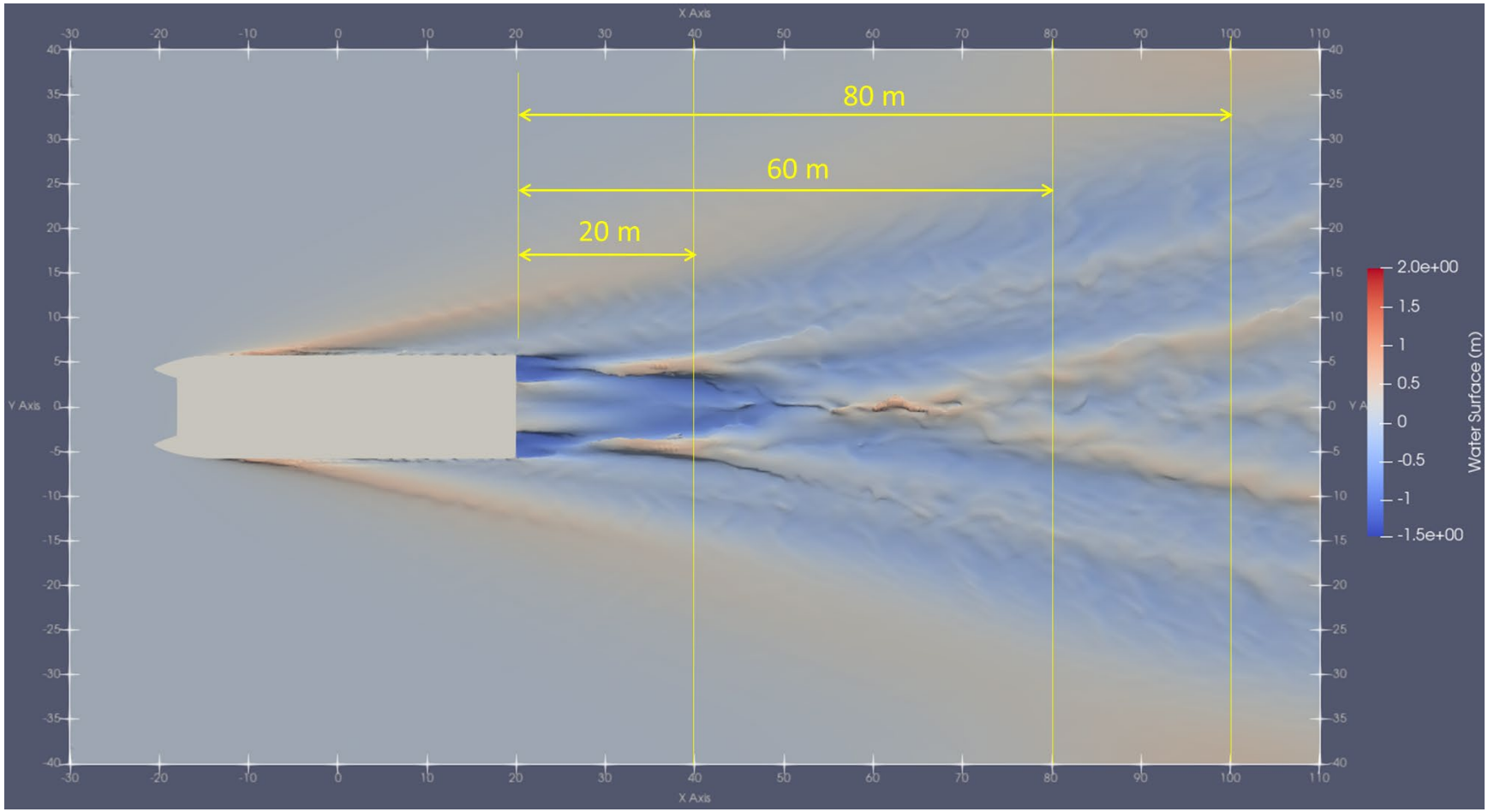


Figure 5. Plan view of NAPA/GOLDEN GATE wake patterns at 36 knots.

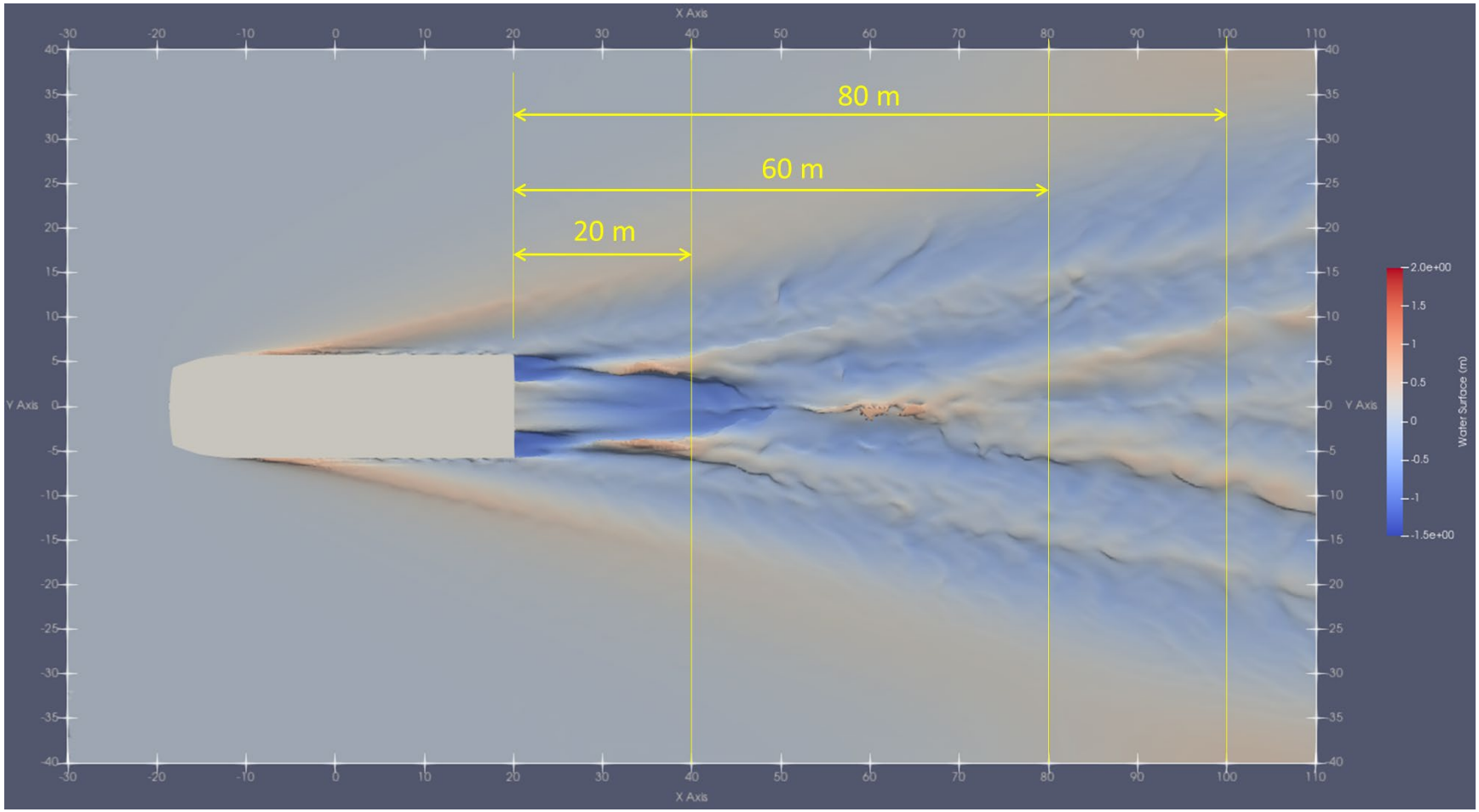


Figure 6. Plan view of DEL NORTE wake patterns at 36 knots.

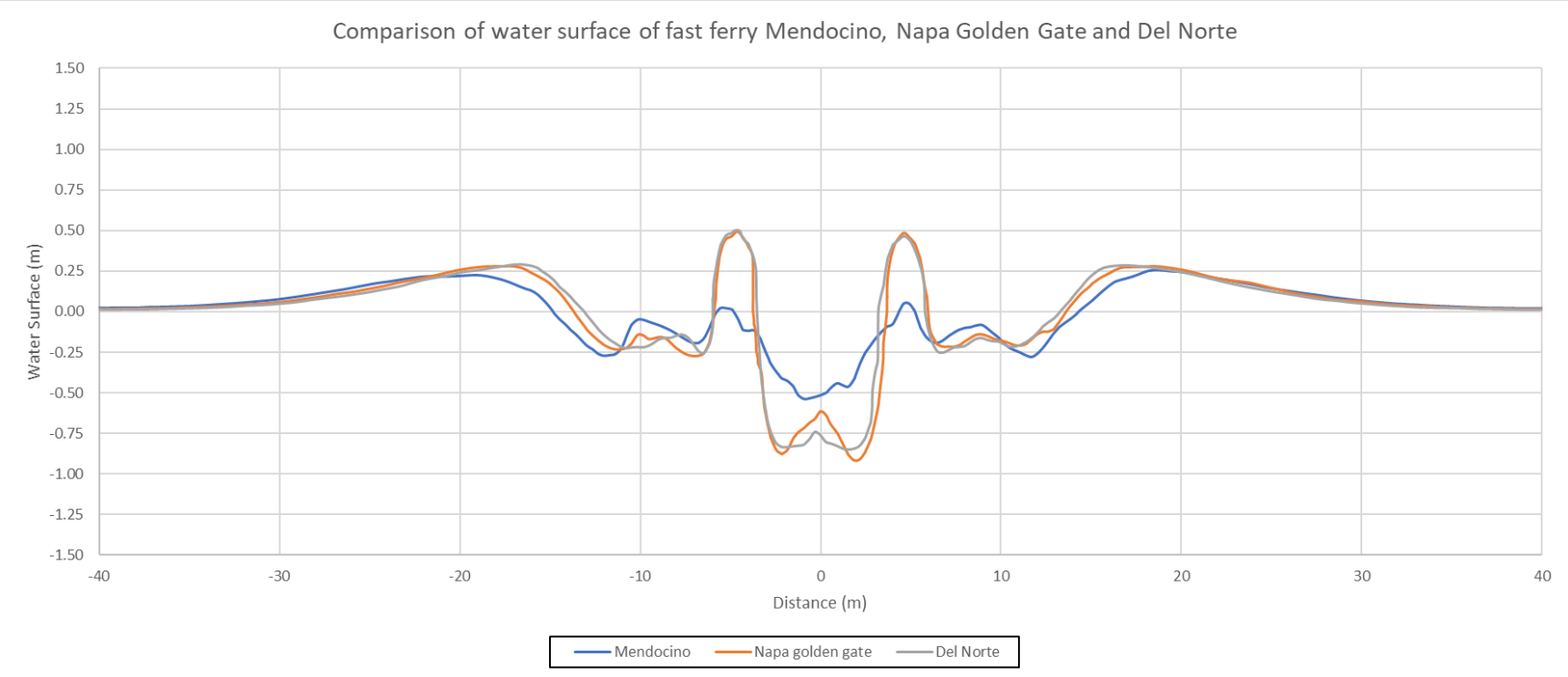


Figure 7. Cross sectional profiles of fast ferry wakes at 36 knots and 20 m behind the ferries' sterns.

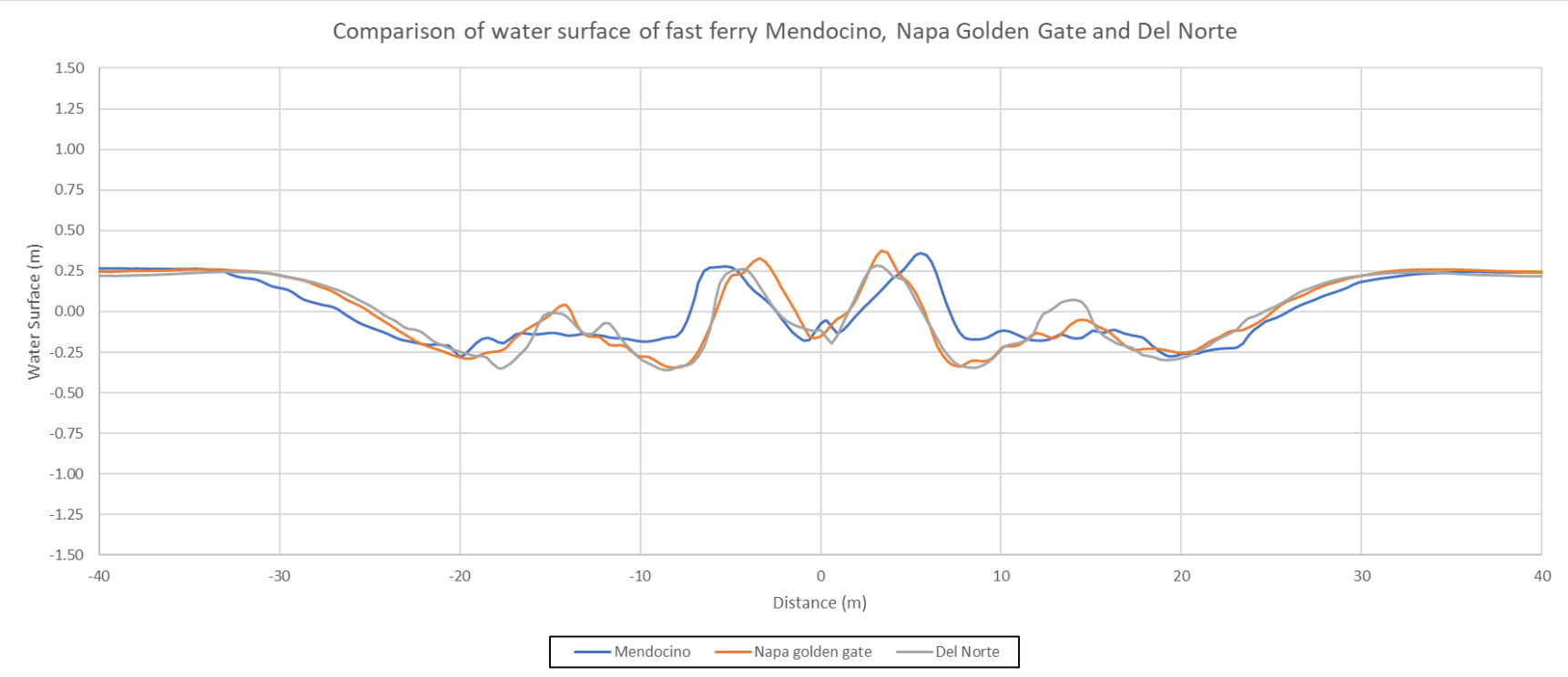


Figure 8. Cross sectional profiles of fast ferry wakes at 36 knots and 60 m behind the ferries' sterns.

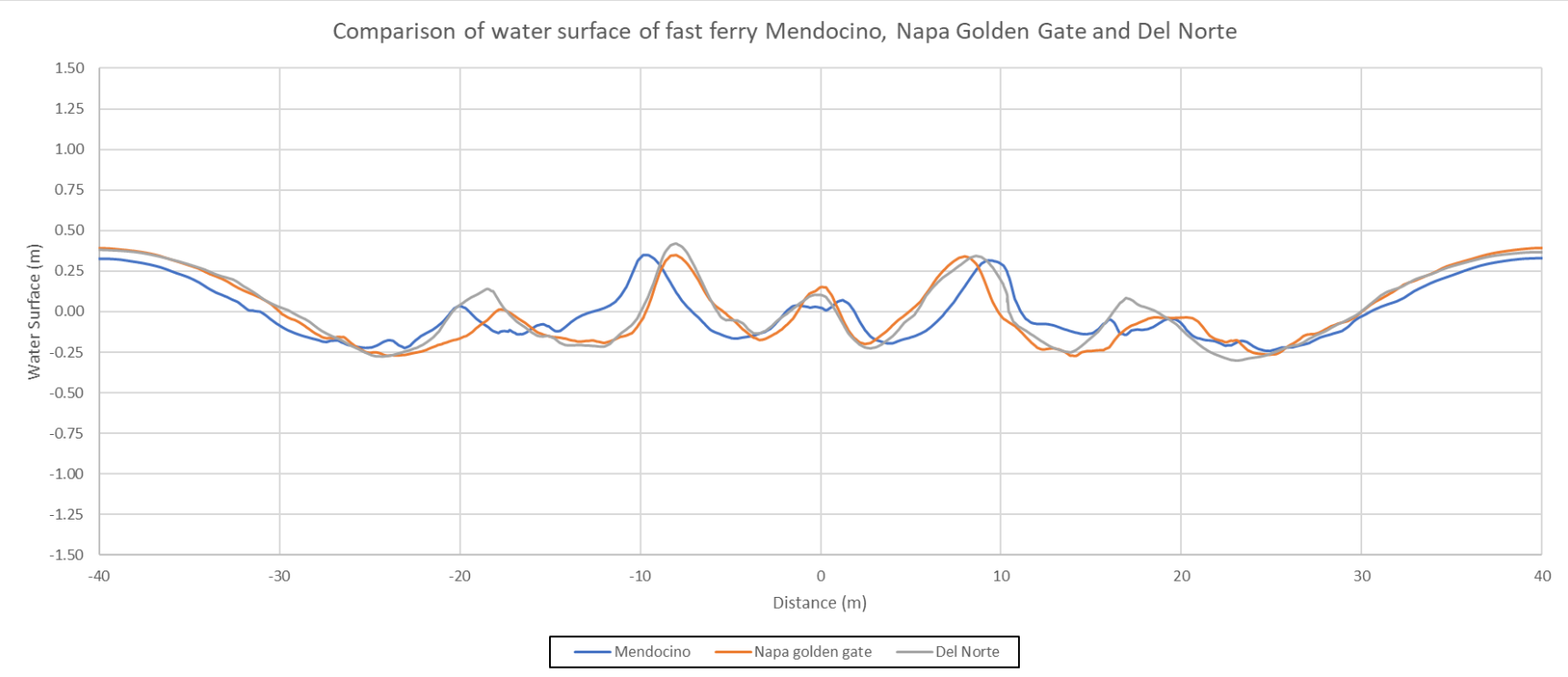


Figure 9. Cross sectional profiles of fast ferry wakes at 36 knots and 80 m behind the ferries' sterns.

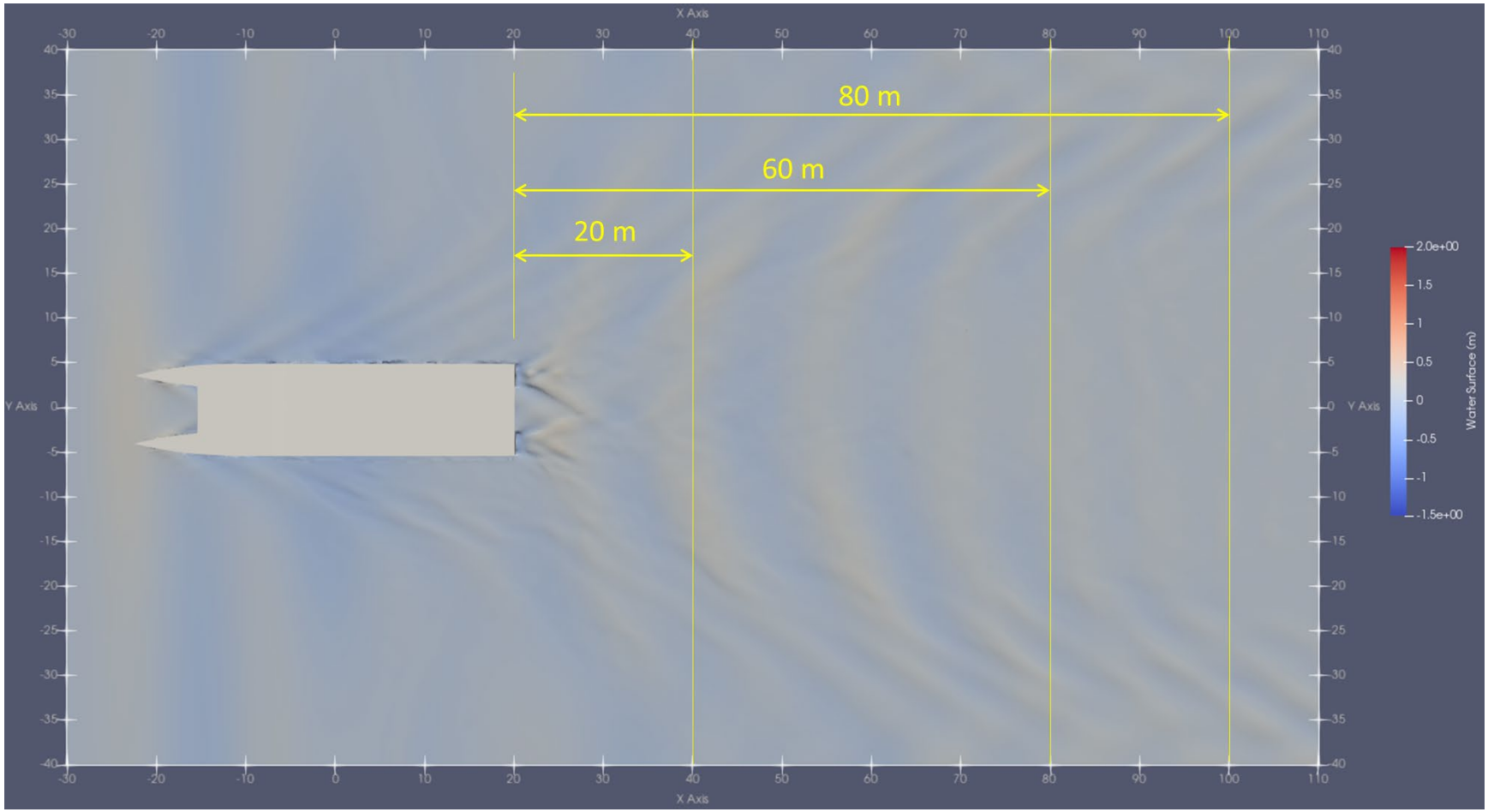


Figure 10. Plan view of MENDOCINO wakes at 9 knots.

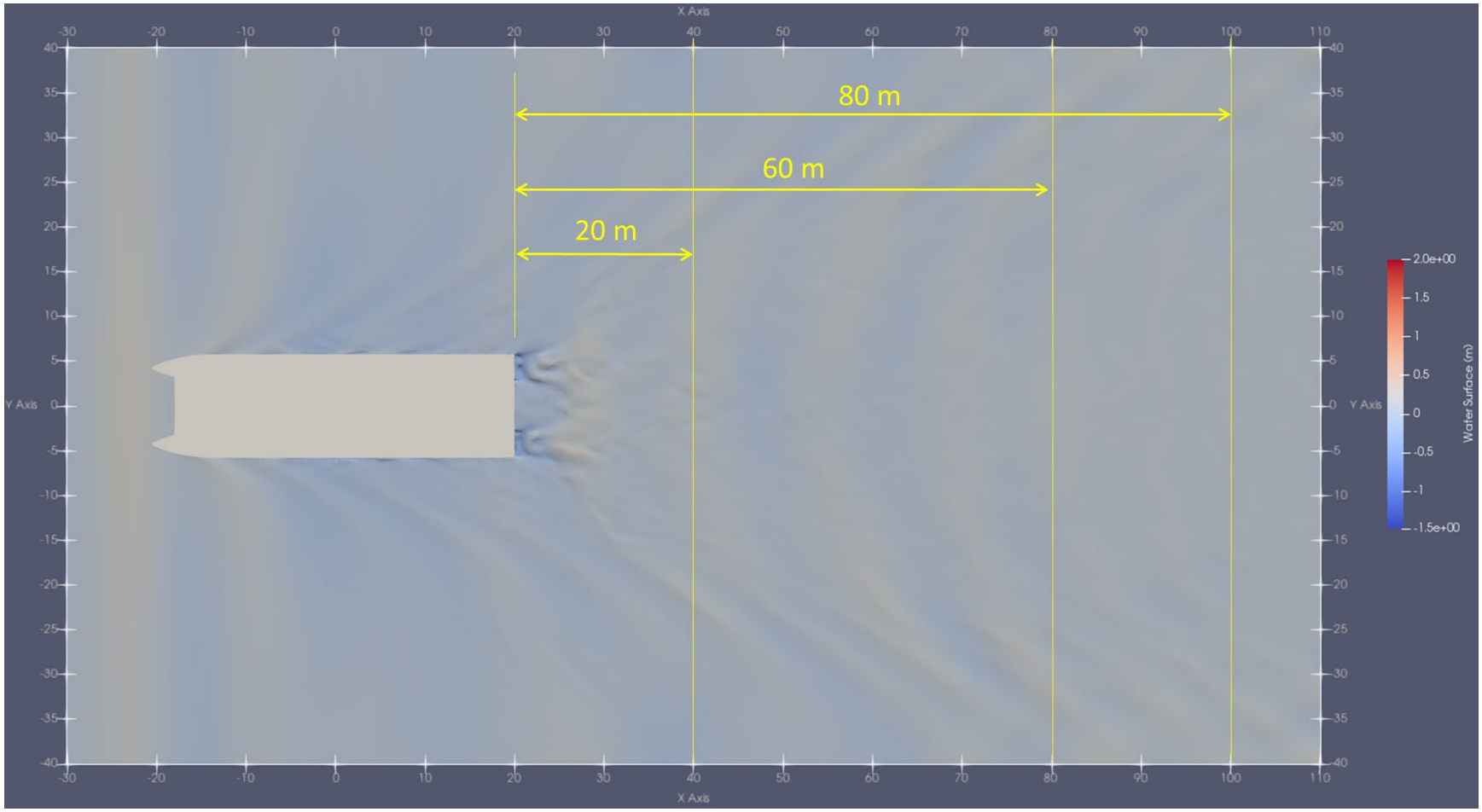


Figure 11. Plan view of NAPA/GOLDEN GATE wakes at 9 knots.

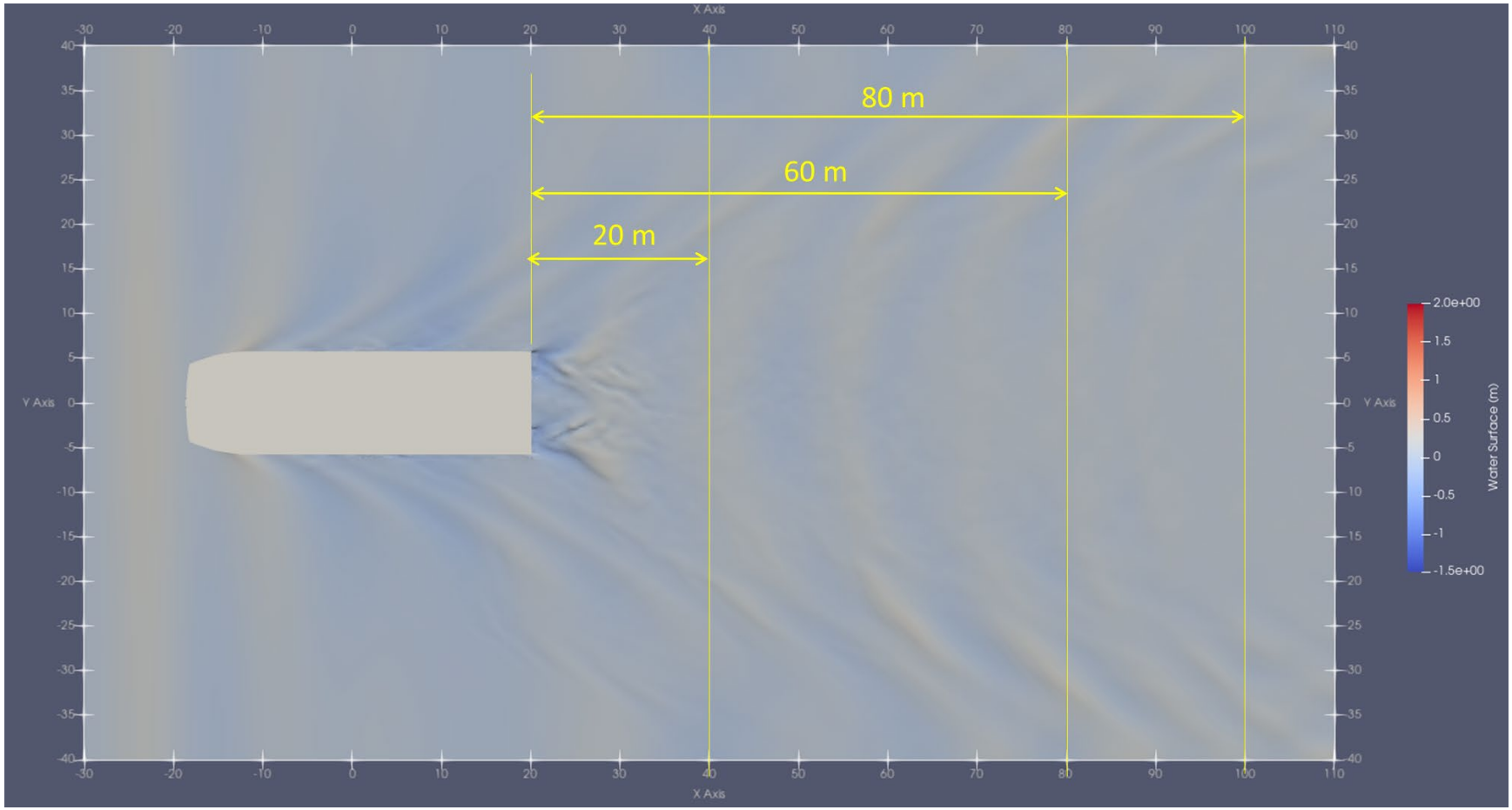


Figure 12. Plan view of DEL NORTE wakes at 9 knots.

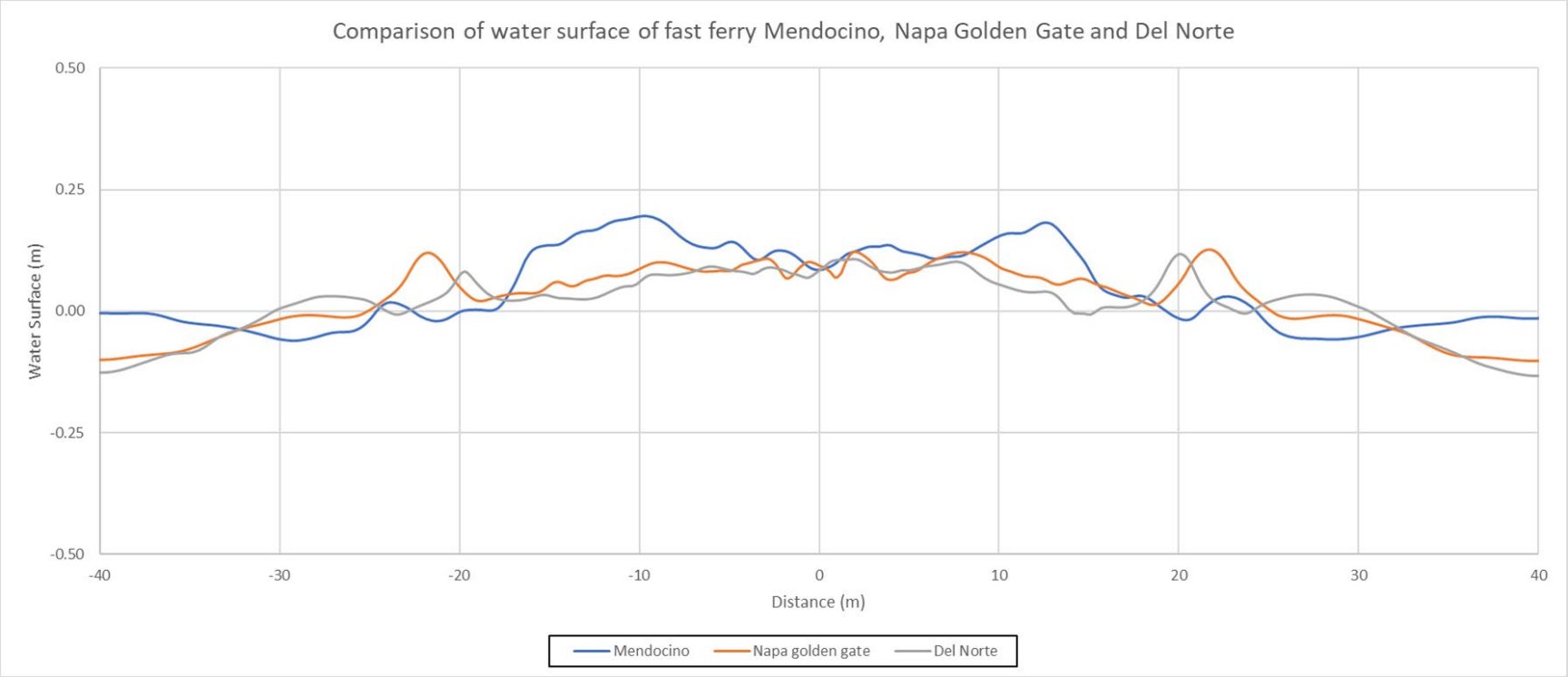


Figure 13. Cross sectional profiles of fast ferry wakes at 9 knots and 20 m behind the ferries' sterns.

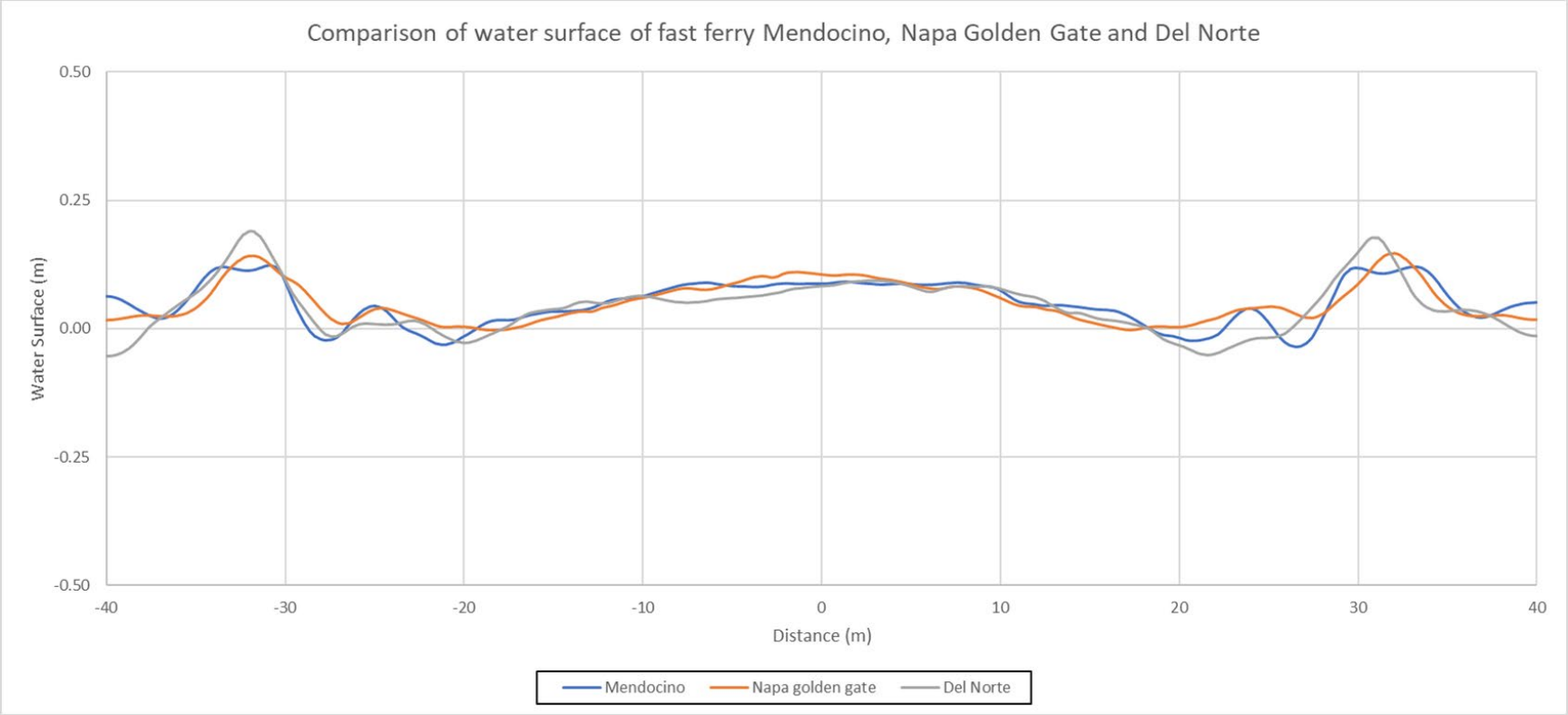


Figure 14. Cross sectional profiles of fast ferry wakes at 9 knots and 60 m behind the ferries' sterns.

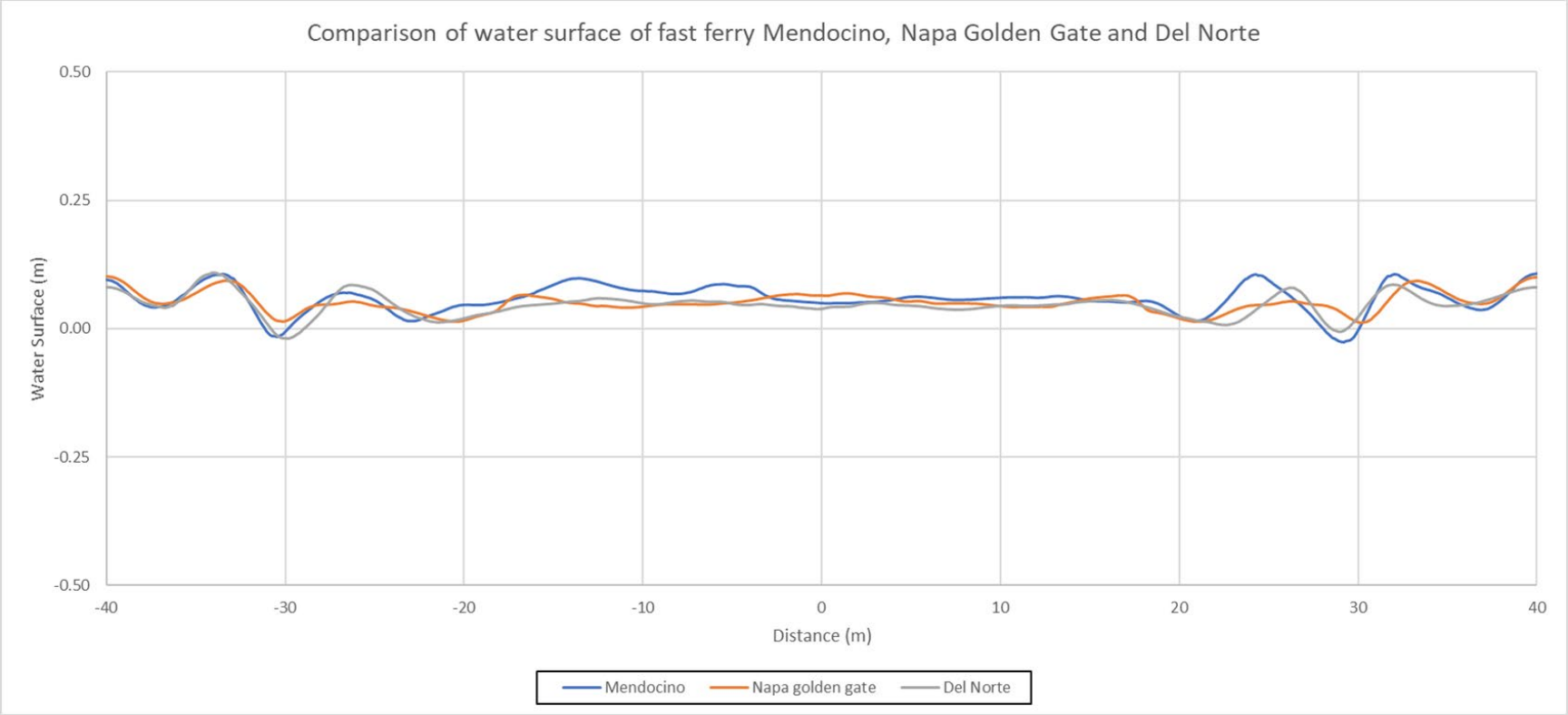


Figure 15. Cross sectional profiles of fast ferry wakes at 9 knots and 80 m behind the ferries' sterns.

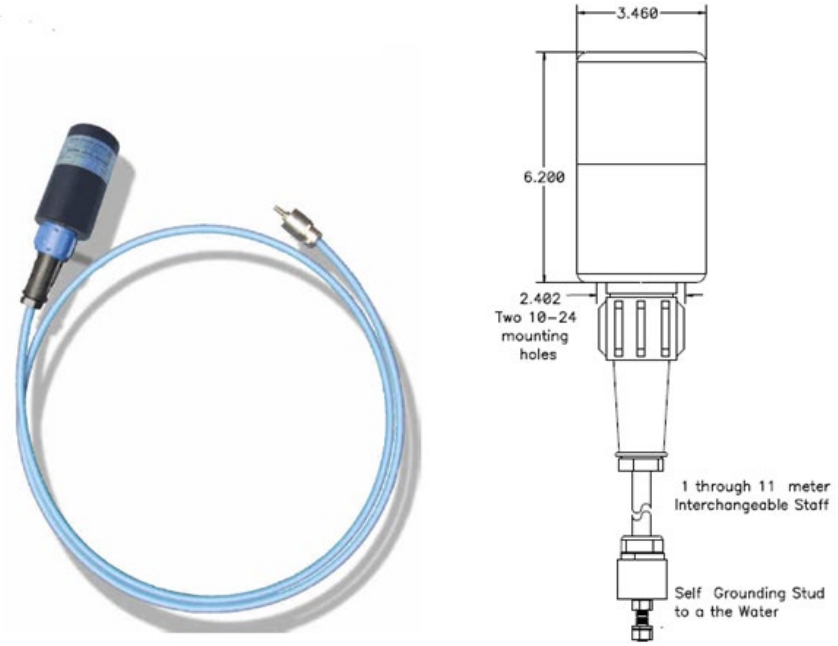


Figure 16. Wave Logger III.

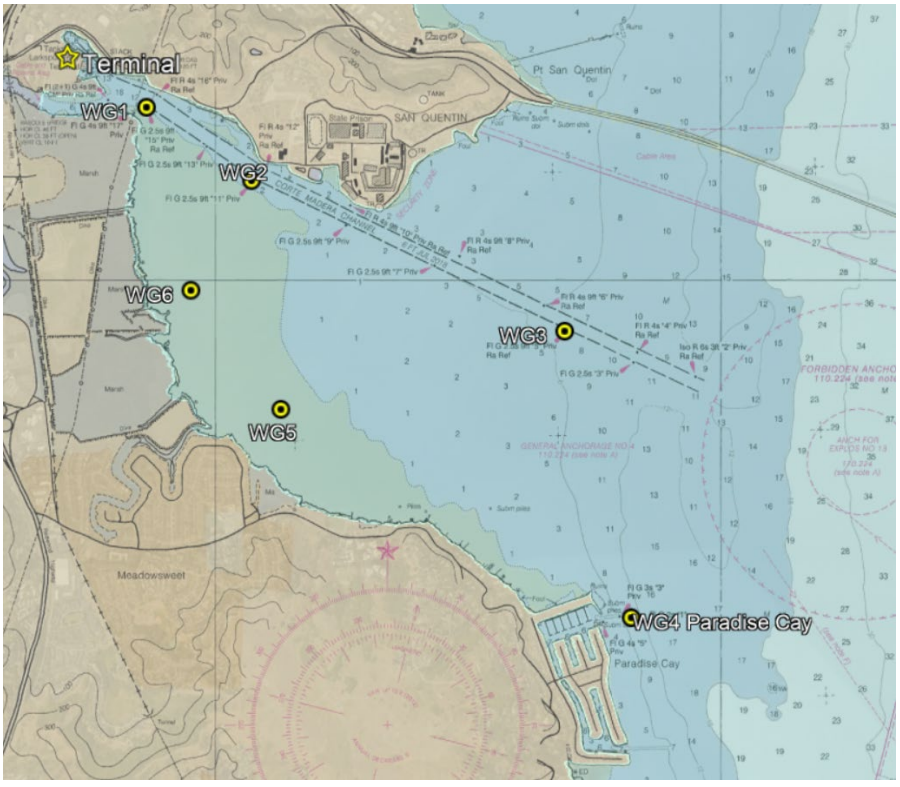


Figure 17. Gauge locations.



Figure 18. Gauge installation on channel marker pile and pole in mudflat.

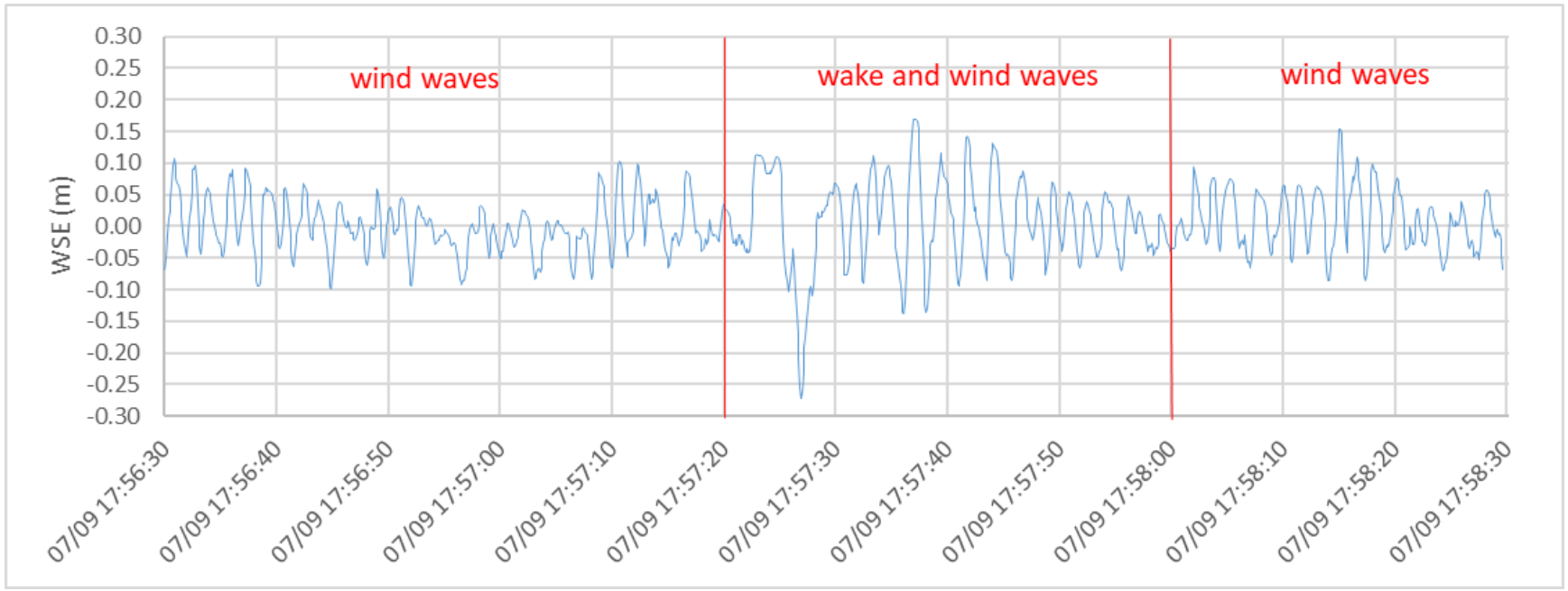


Figure 19. Wakes and waves due to the passage of the NAPA by WG3.

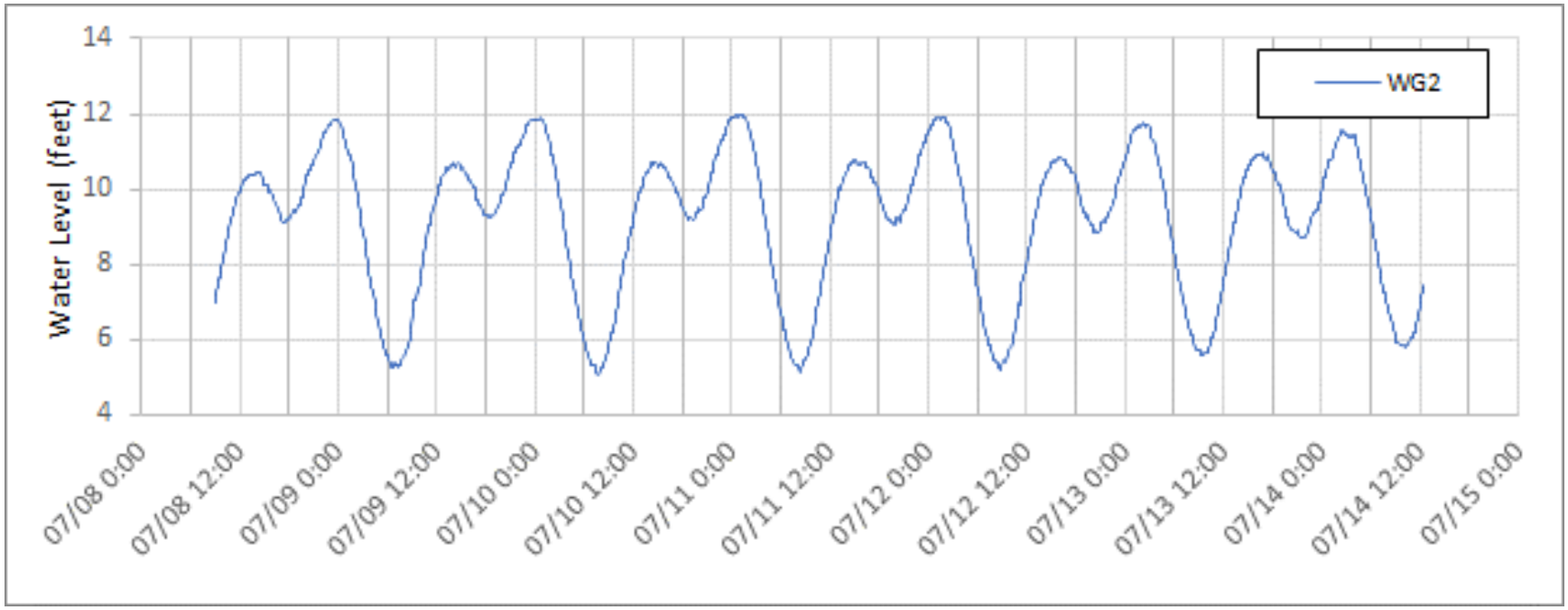


Figure 20. Raw water level measurements and tidal variations at WG2, relative to gauge staff bottom.

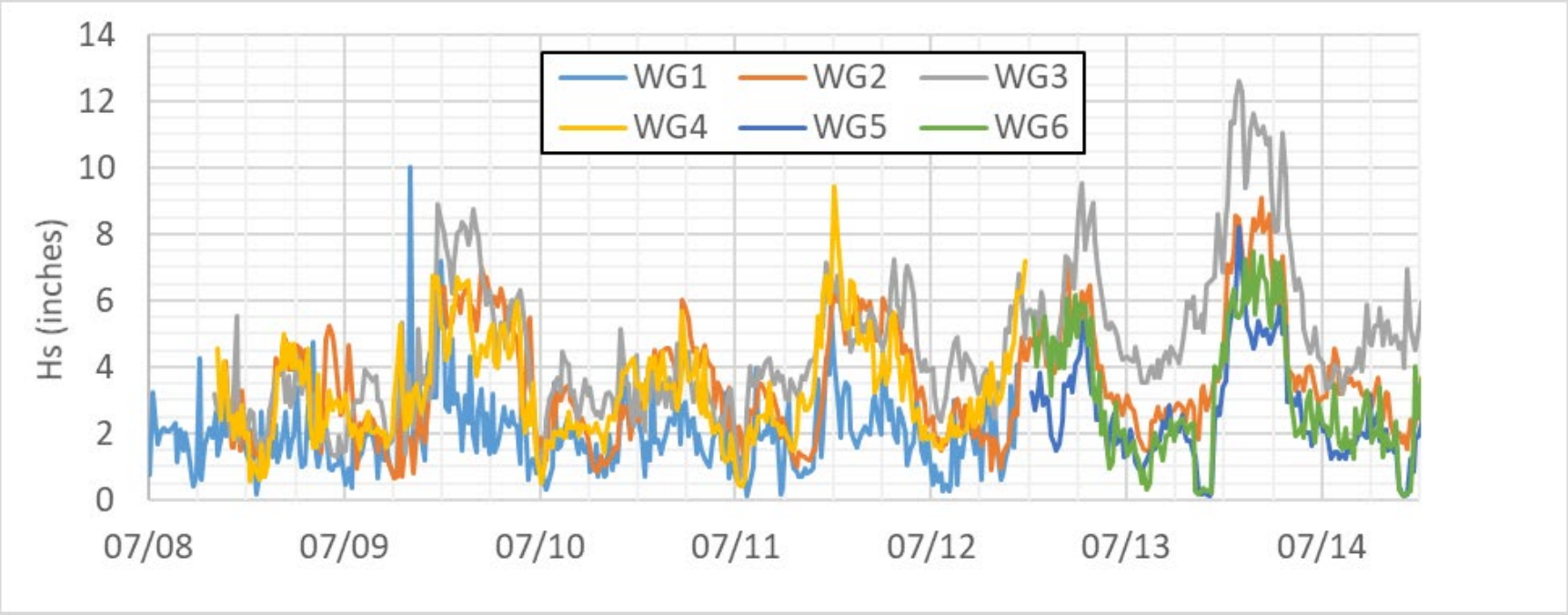


Figure 21. Significant wave height at the gauges' locations.

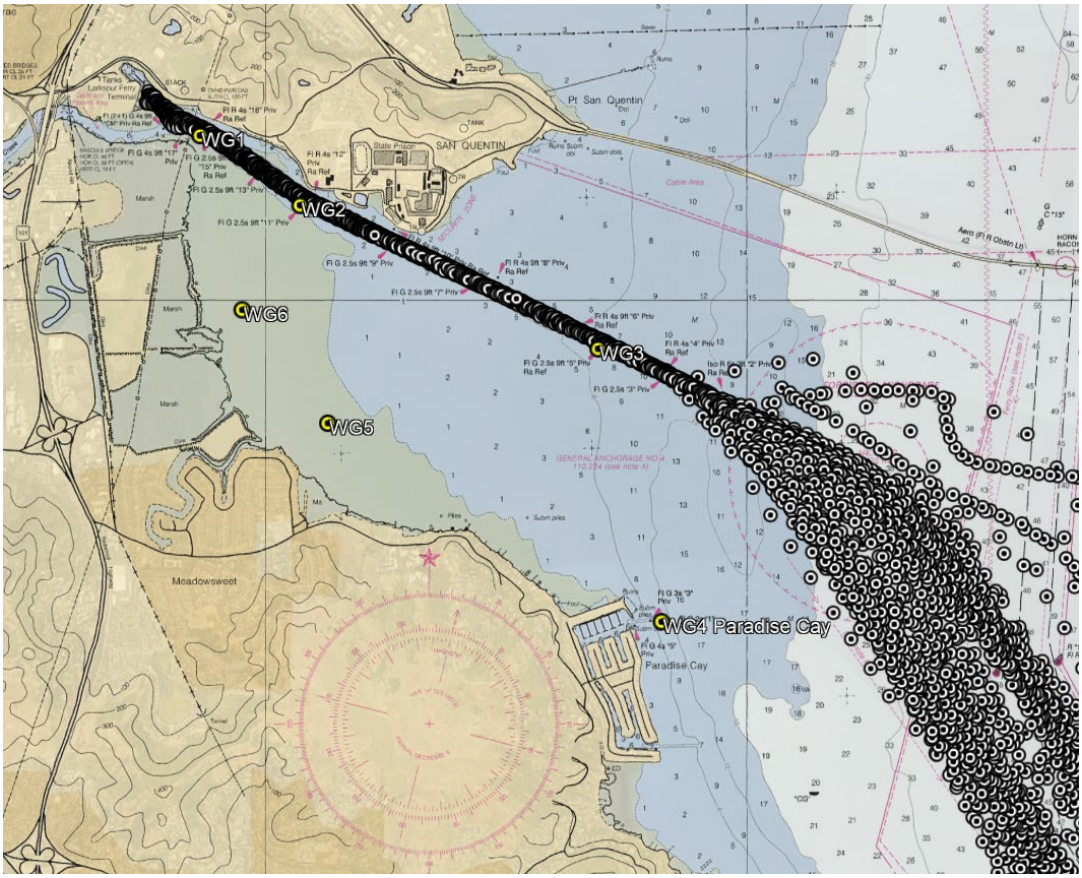


Figure 22. Tracks of the 59 ferry roundtrips between July 8 and 14, 2021 (nautical chart NOAA 18653, water depths in feet MLLW).

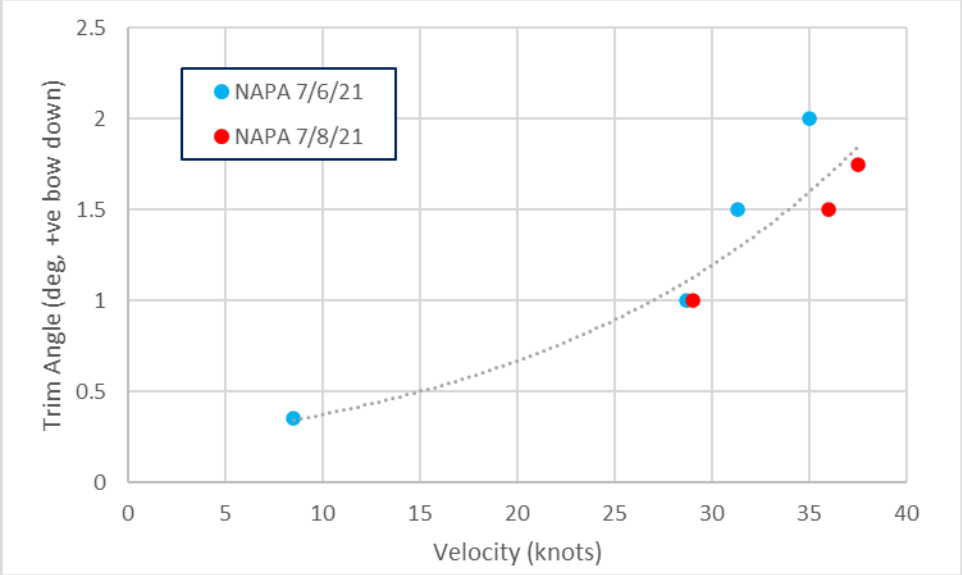


Figure 23. NAPA trim angles at speed.

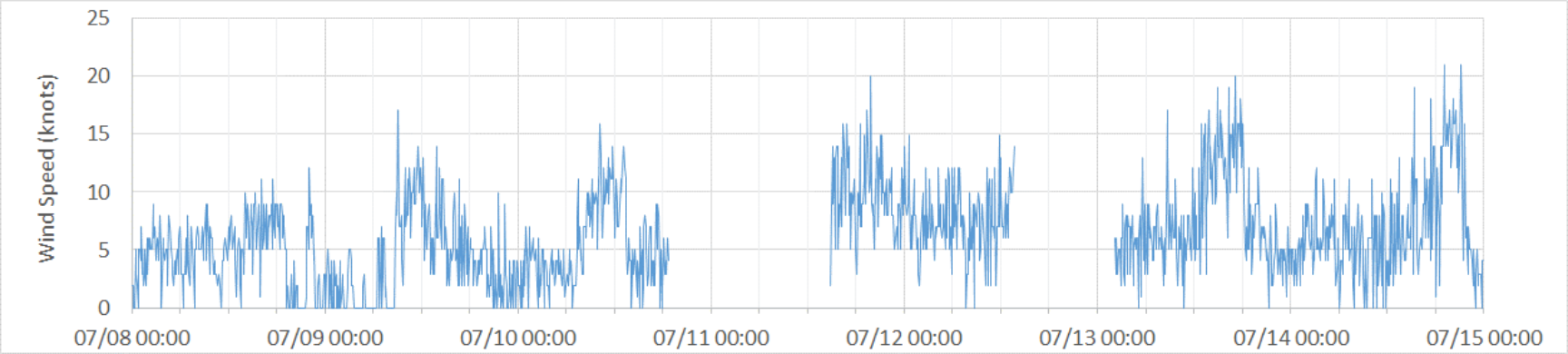


Figure 24. Wind speed measurements at Tiburon Pier station TIBC1 from July 8 to 14, 2021.

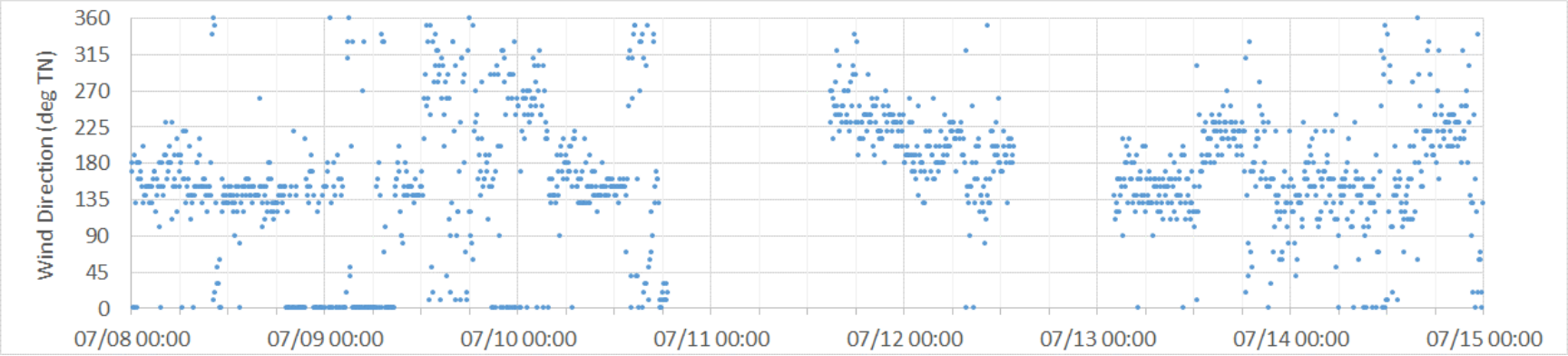


Figure 25. Wind direction measurements at Tiburon Pier station TIBC1 from July 8 to 14, 2021.

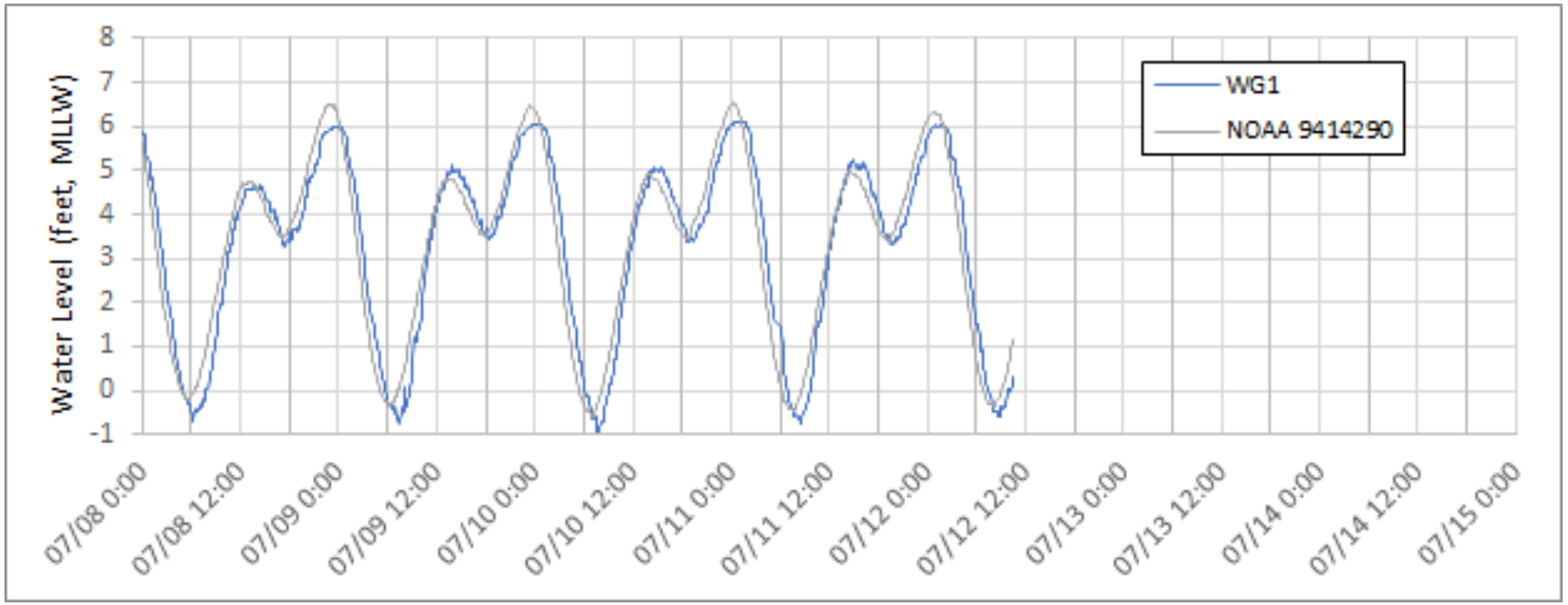


Figure 26. Water levels at NOAA station 9414290 San Francisco and WG1.

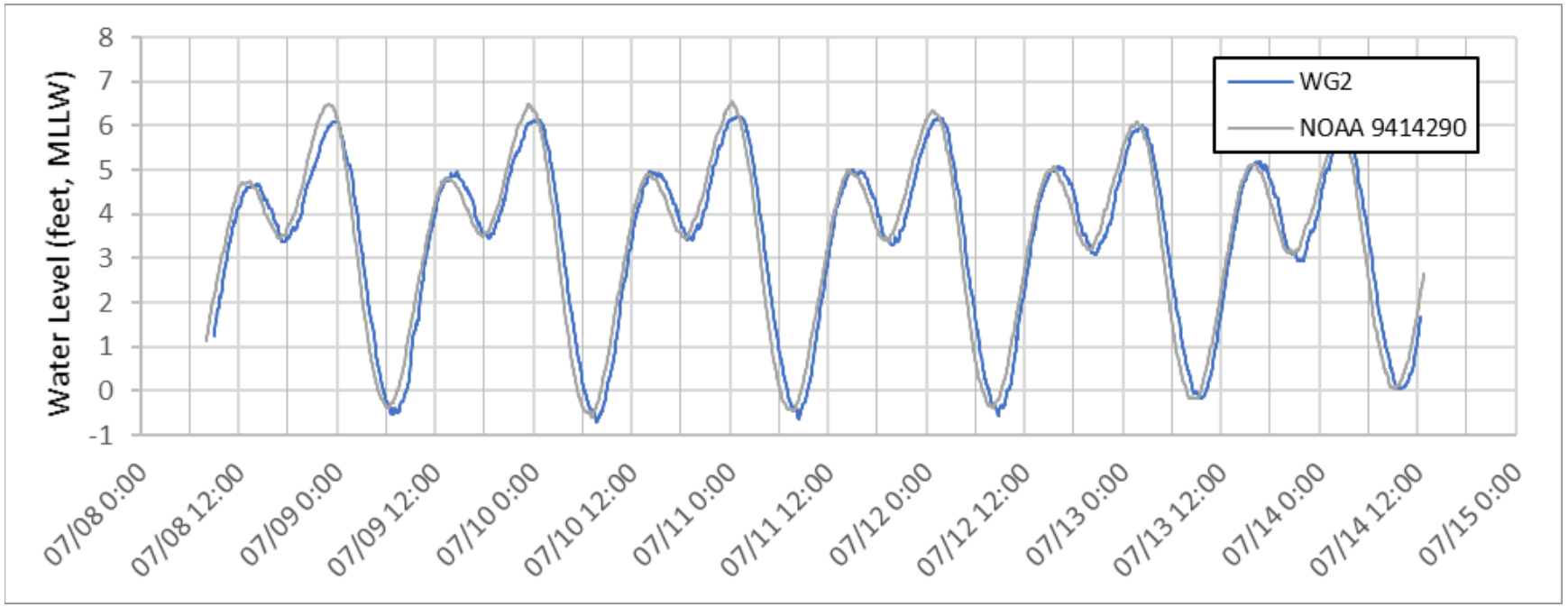


Figure 27. Water levels at NOAA station 9414290 San Francisco and WG2.

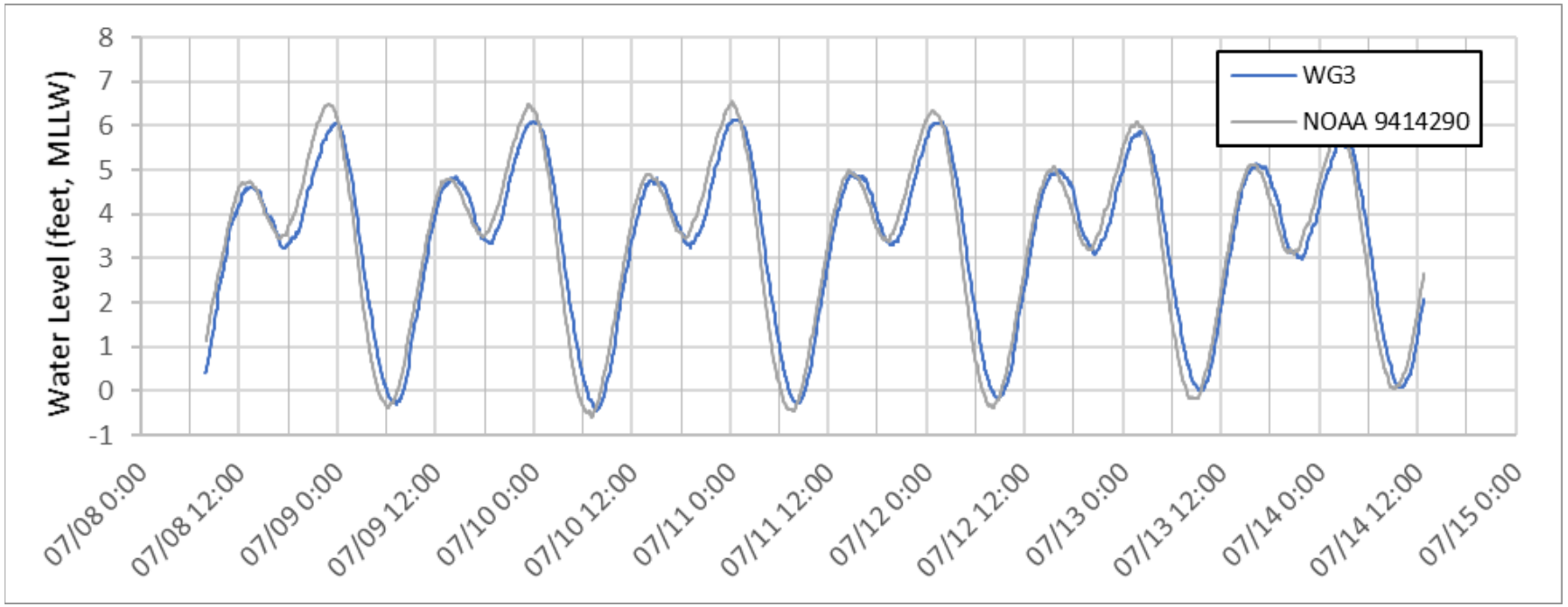


Figure 28. Water levels at NOAA station 9414290 San Francisco and WG3.

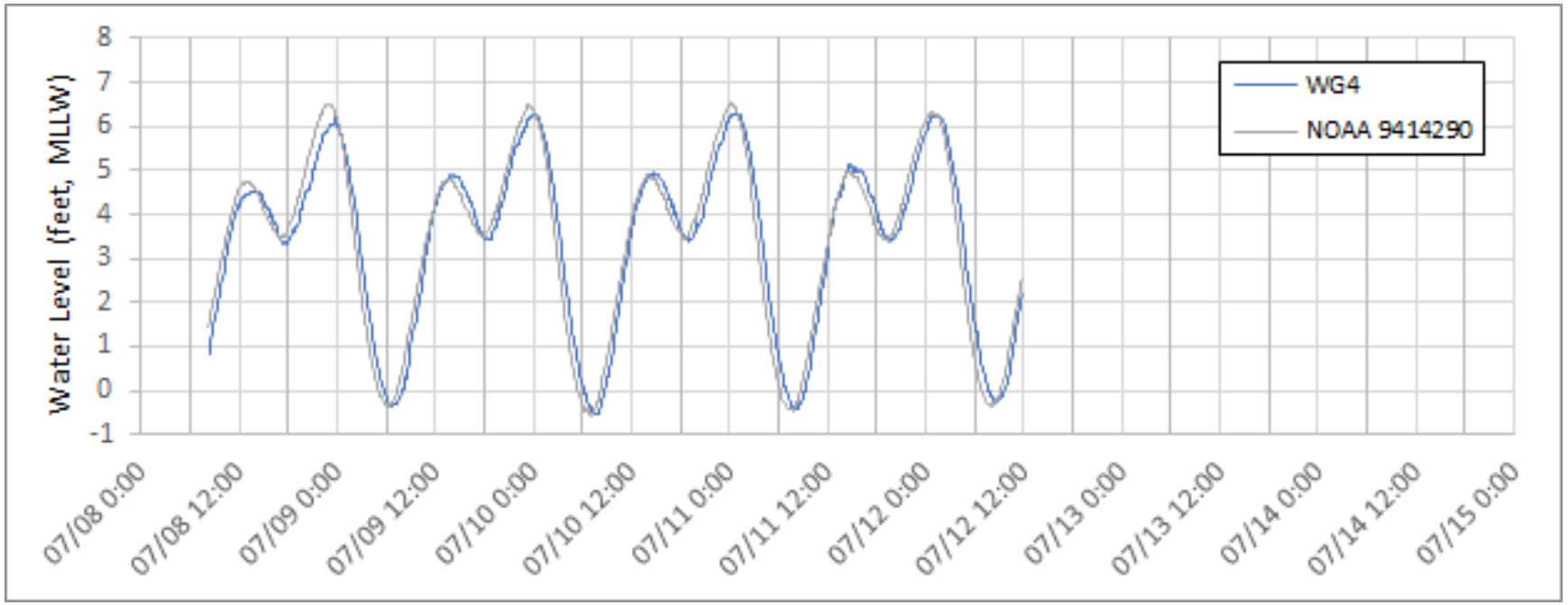


Figure 29. Water levels at NOAA station 9414290 San Francisco and WG4.

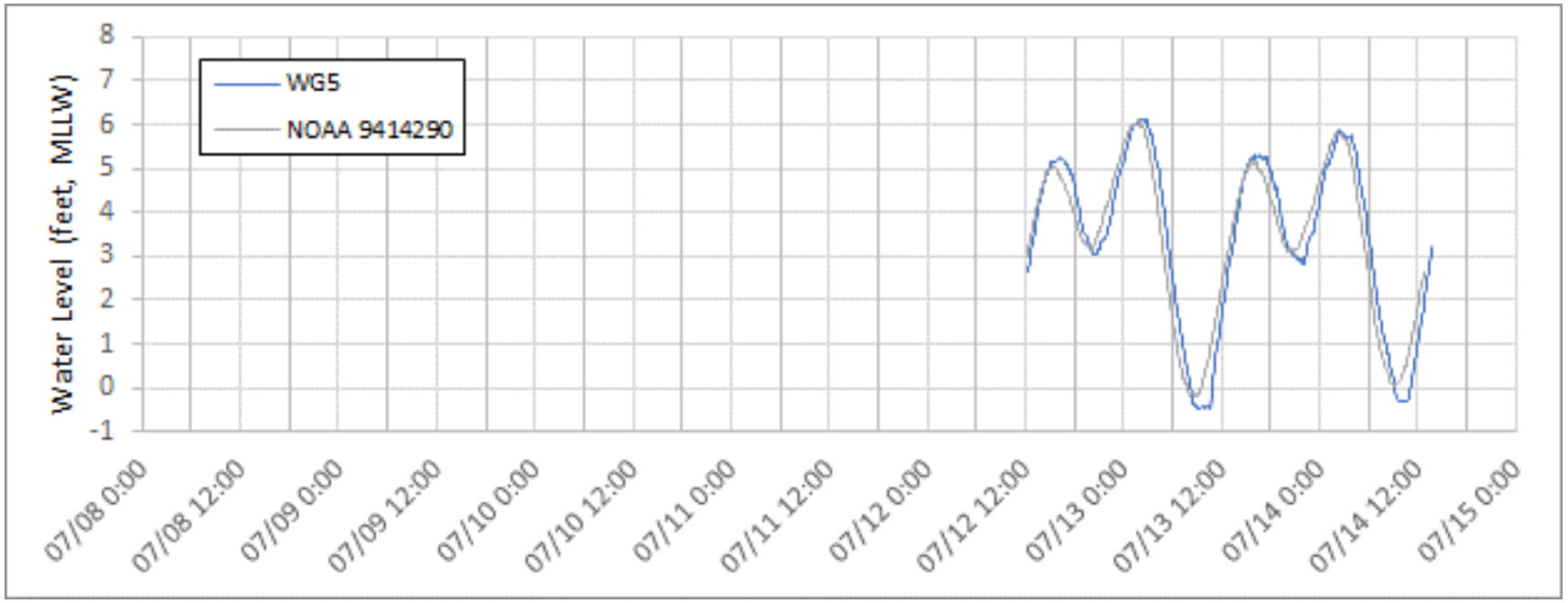


Figure 30. Water levels at NOAA station 9414290 San Francisco and WG5.

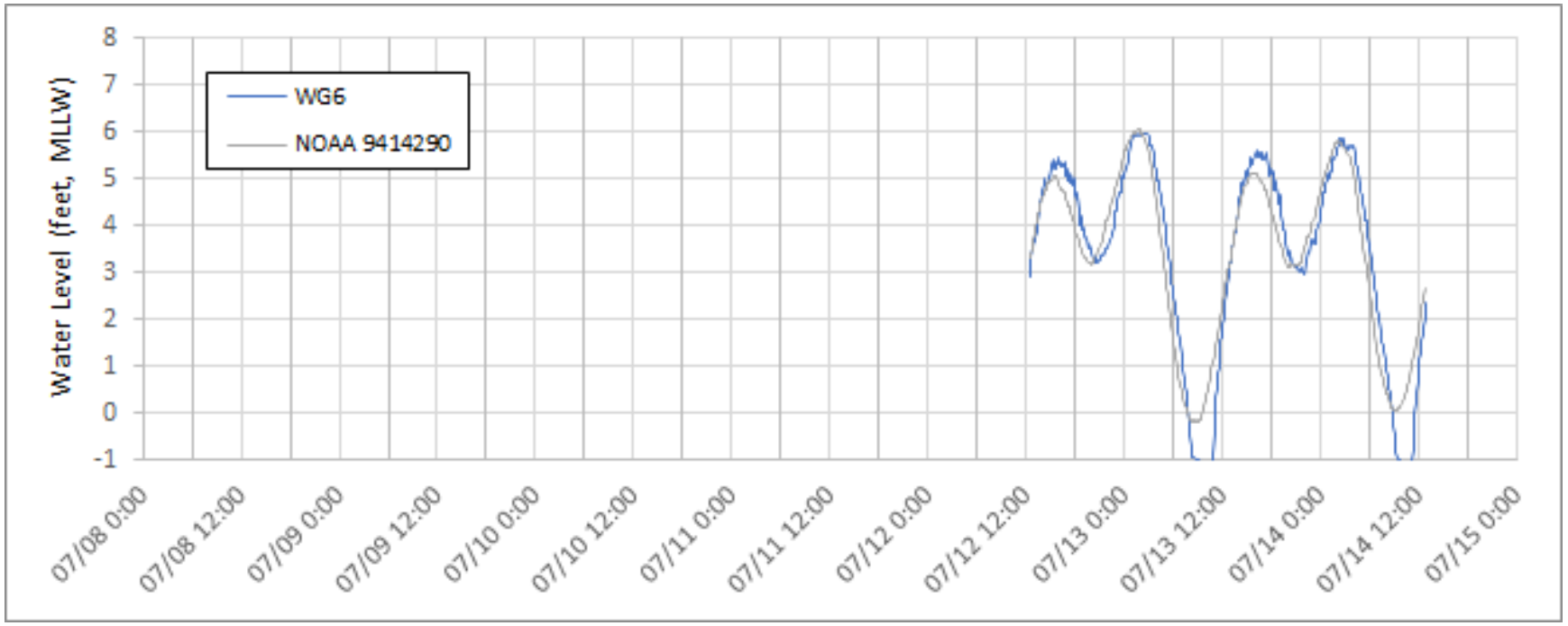


Figure 31. Water levels at NOAA station 9414290 San Francisco and WG6.

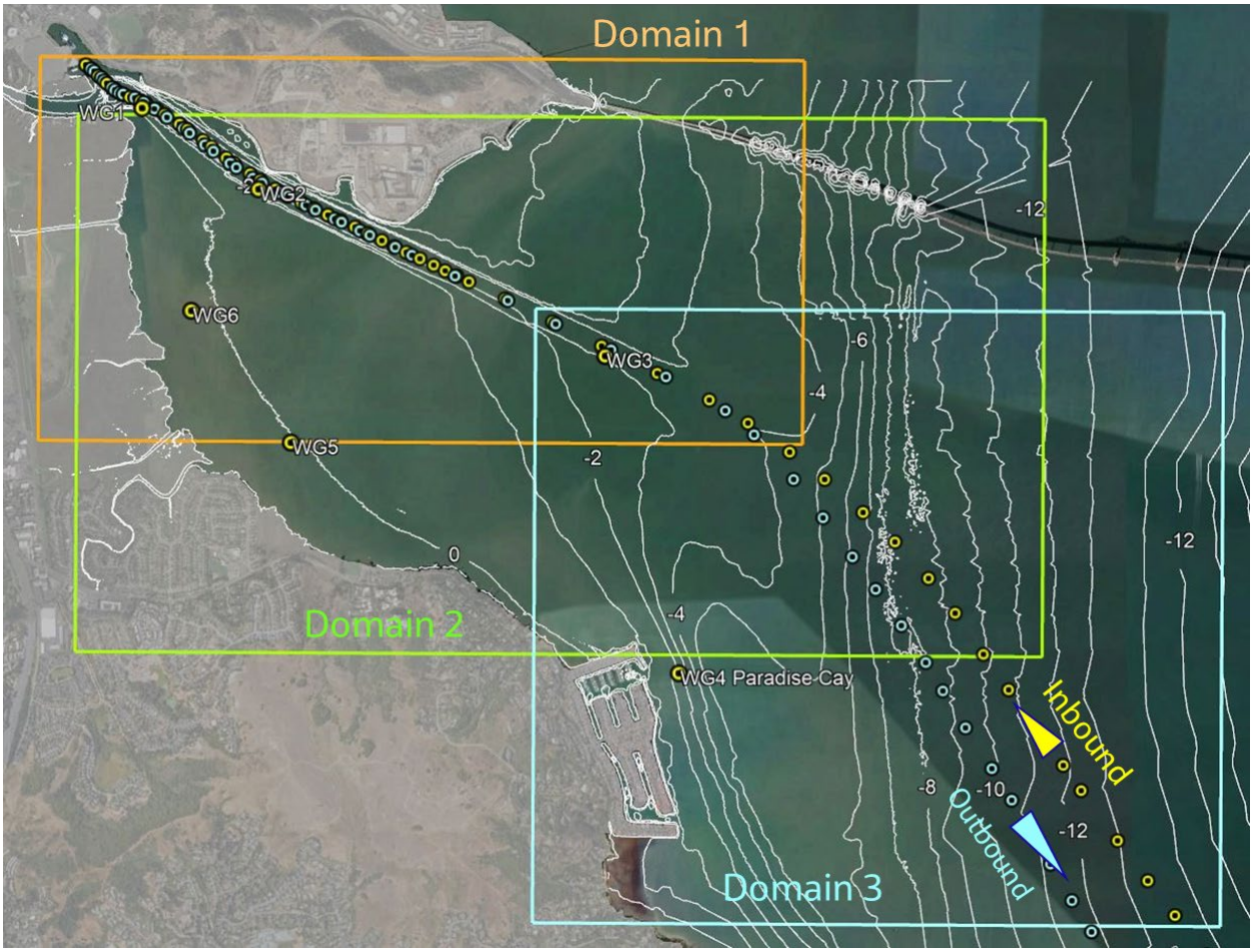


Figure 32. FUNWAVE computational domains, gauge locations, model bathymetry (m, NAVD88), and representative fast ferry outbound and inbound trip tracks.



Figure 33. NAPA 4th outbound trip track on July 8, 2021 (red) and NAPA 38 outbound trip tracks between July 8 and 14, 2021.

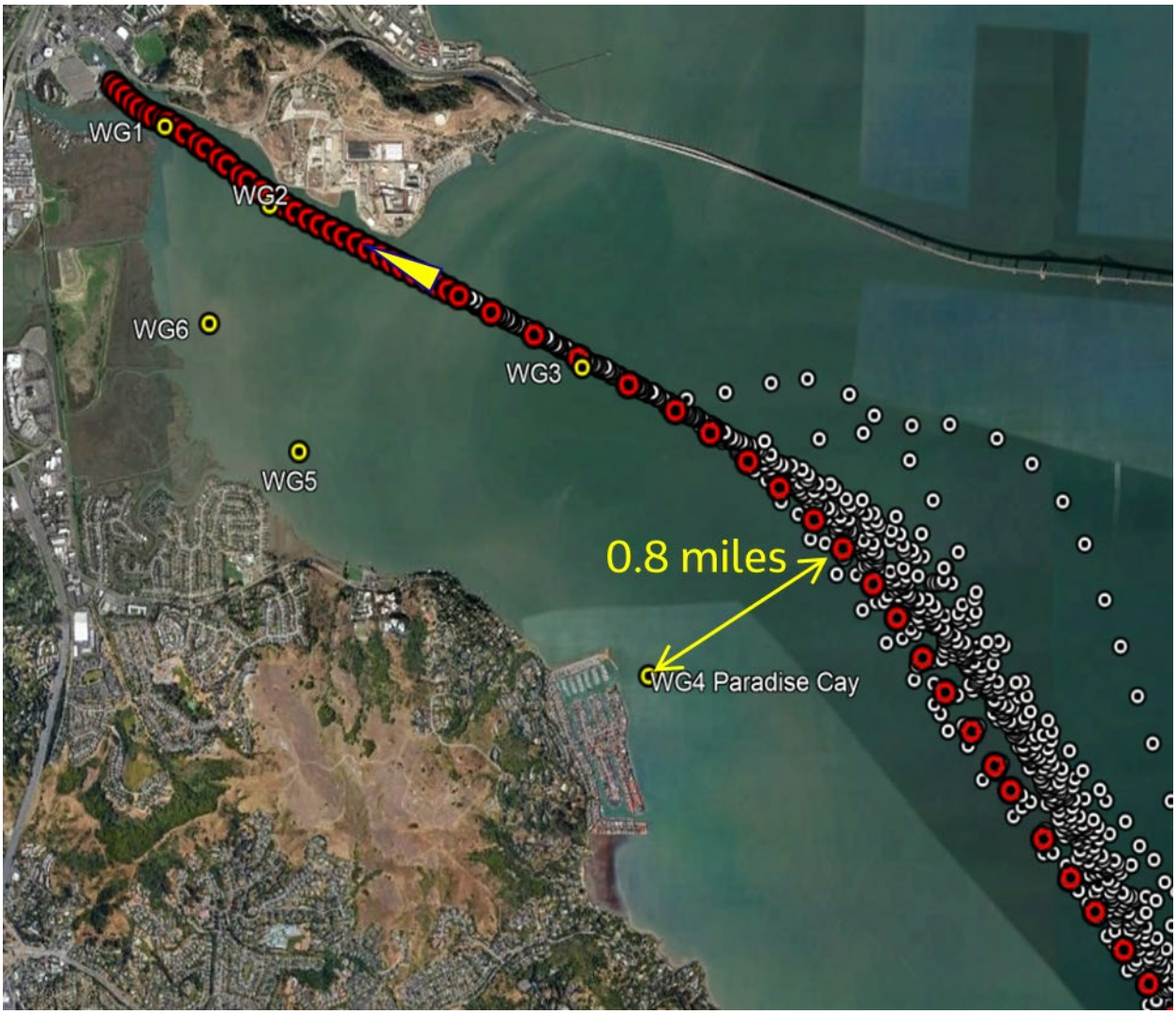


Figure 34. NAPA 4th inbound trip track on July 8, 2021 (red) and NAPA 38 outbound trip tracks between July 8 and 14, 2021.

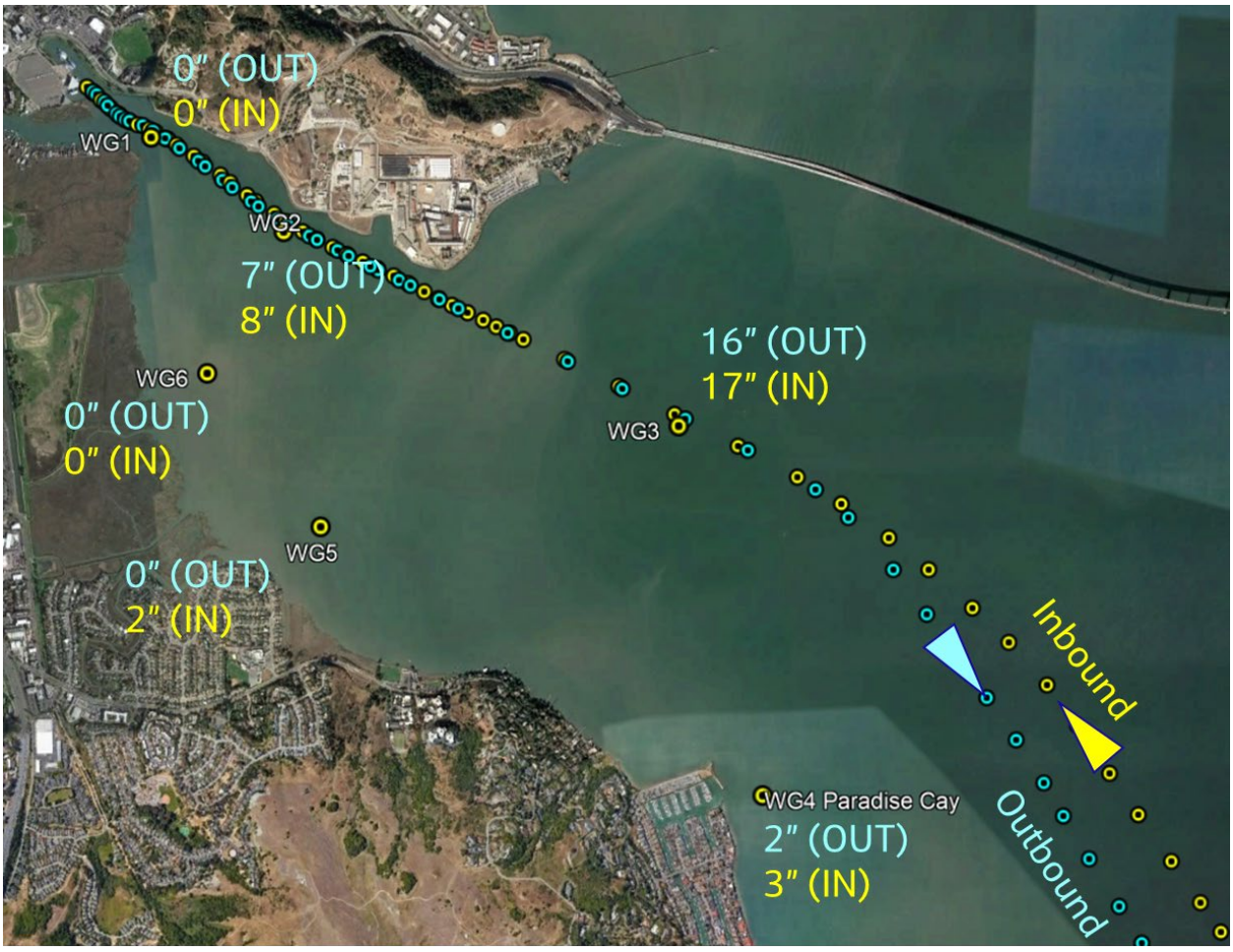


Figure 35. NAPA 4th outbound (blue) and inbound (yellow) trip tracks on July 8, 2021, and resulting peak wake heights at the gauge locations.

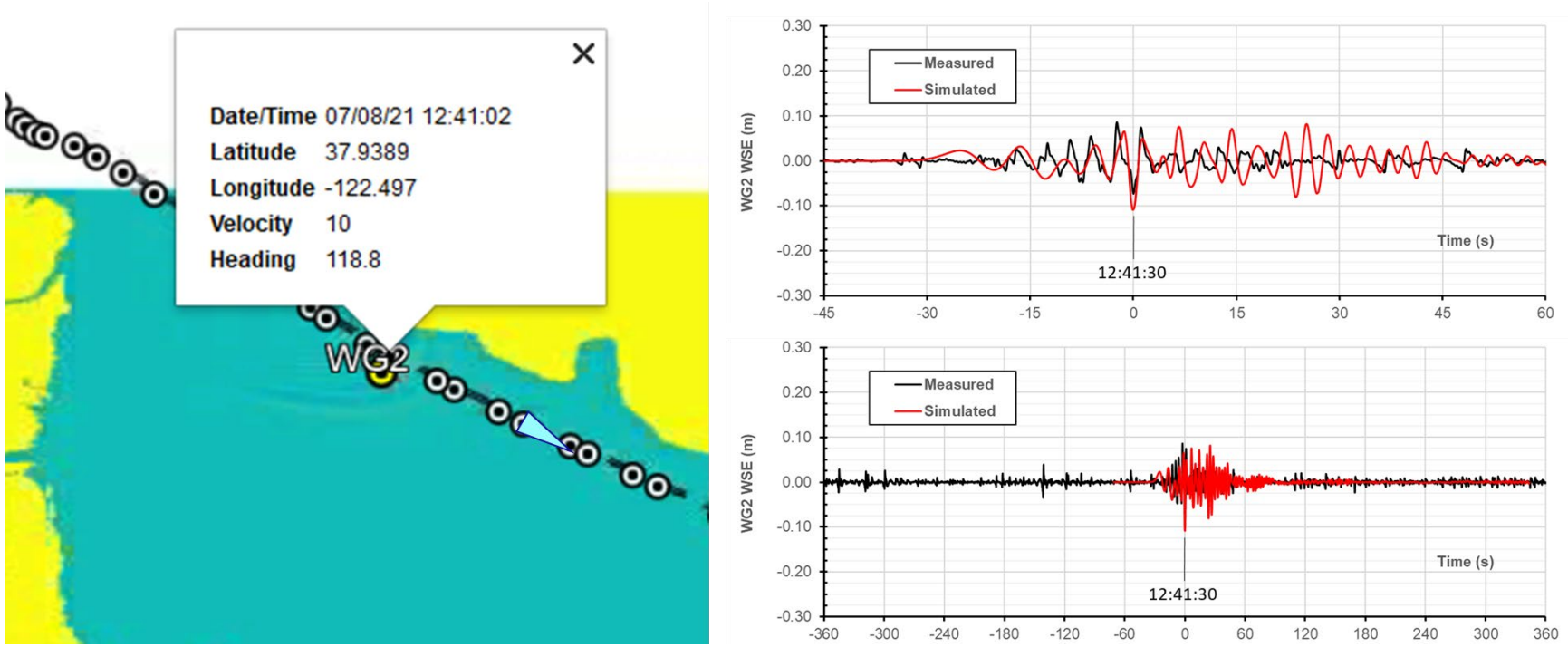


Figure 36. NAPA parameters and wake pattern during its passage by WG2 on its 4th outbound trip on July 8, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

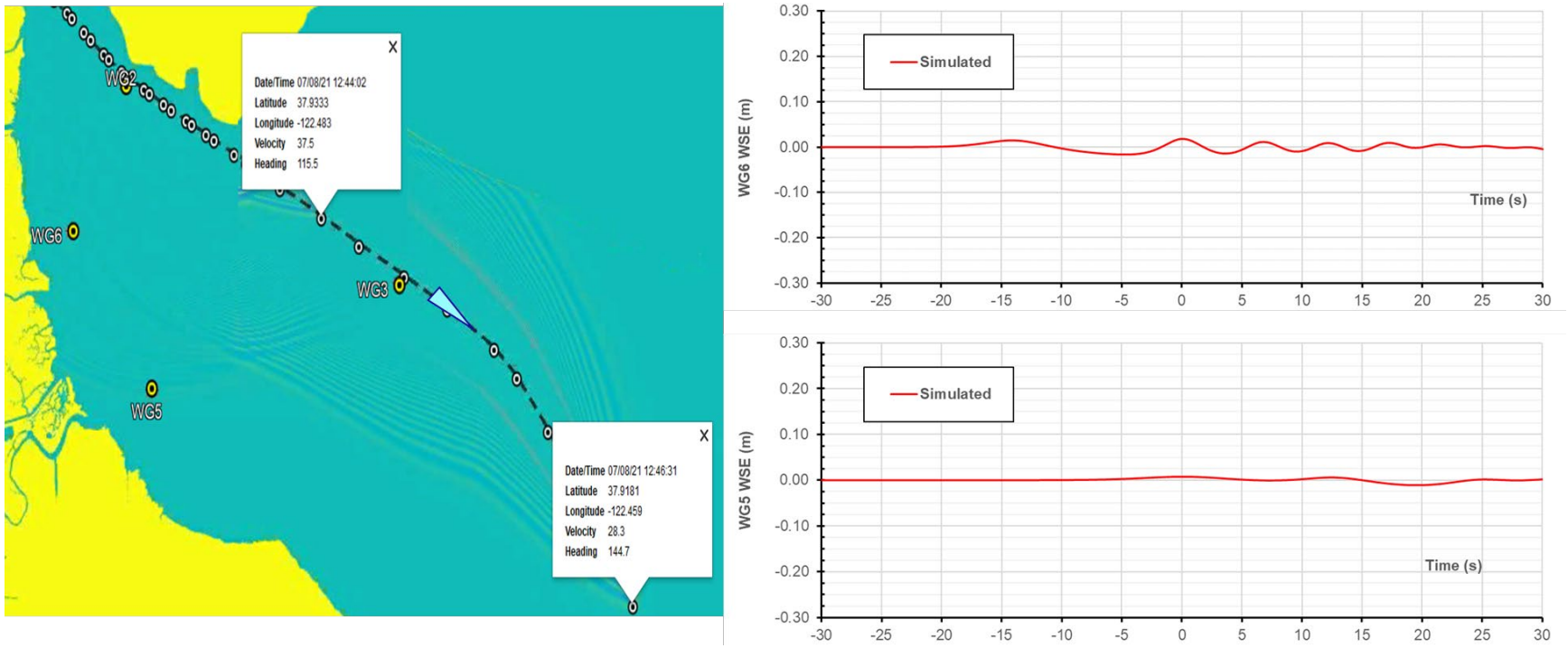


Figure 37. NAPA parameters and wake pattern during its passage offshore the mudflat on its 4th outbound trip on July 8, 2021 (left), and corresponding simulated water surface elevations (WSE) at WG6 and WG5.

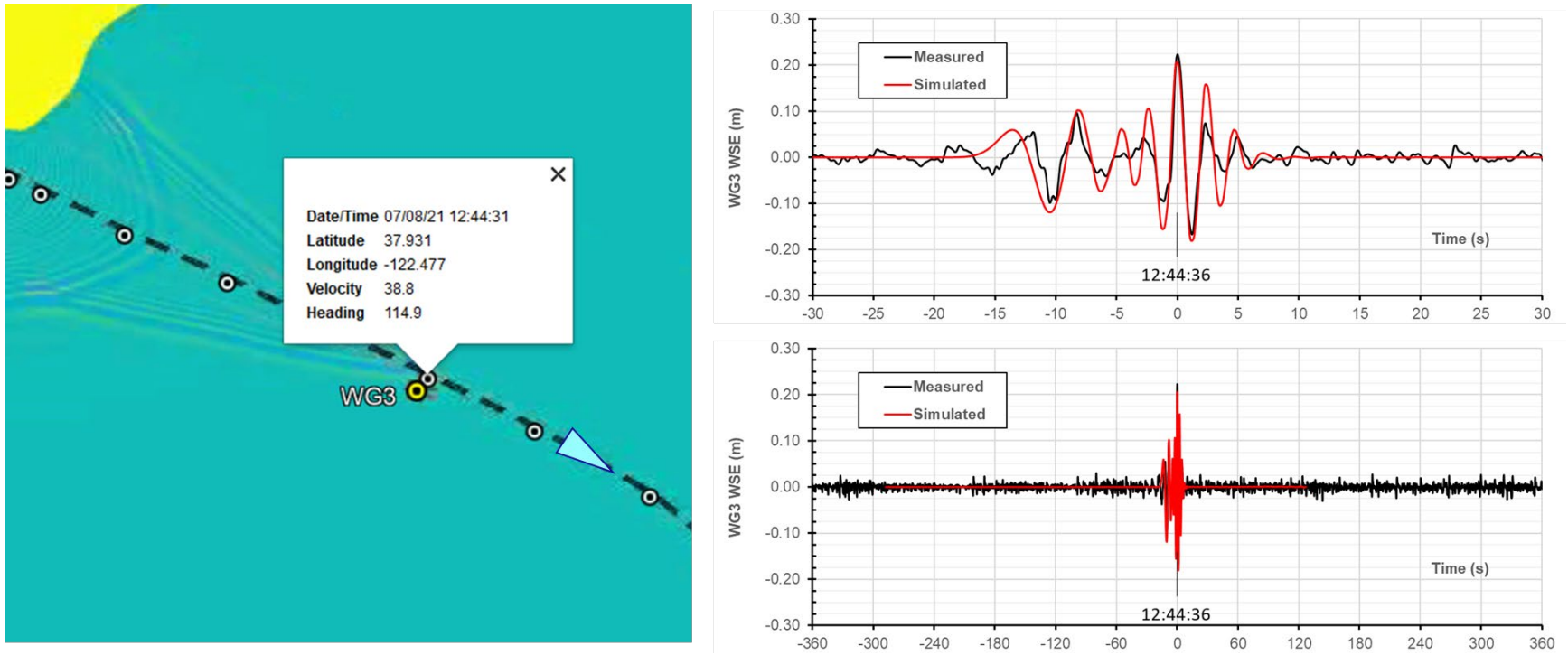


Figure 38. NAPA parameters and wake pattern during its passage by WG3 on its 4th outbound trip on July 8, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

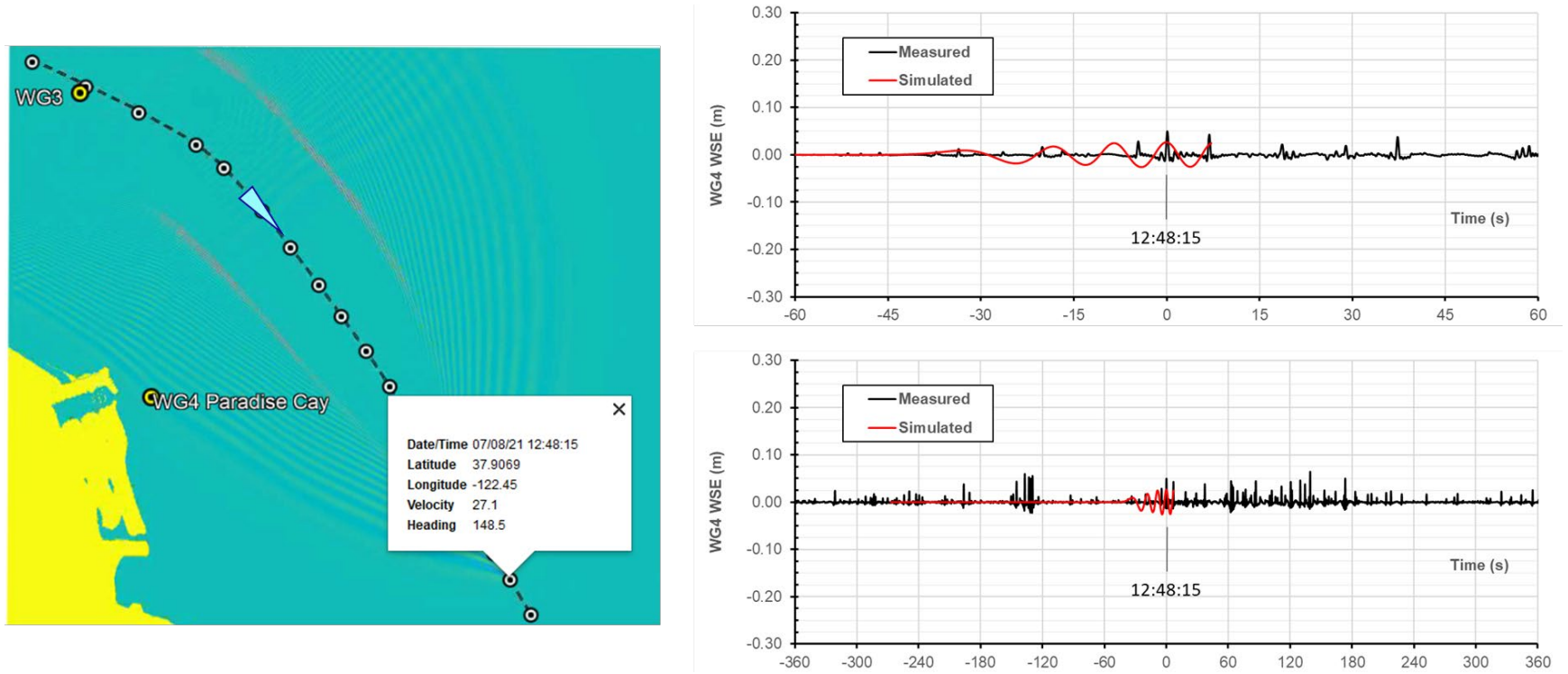


Figure 39. NAPA parameters and wake pattern during its passage offshore WG4 on its 4th outbound trip on July 8, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

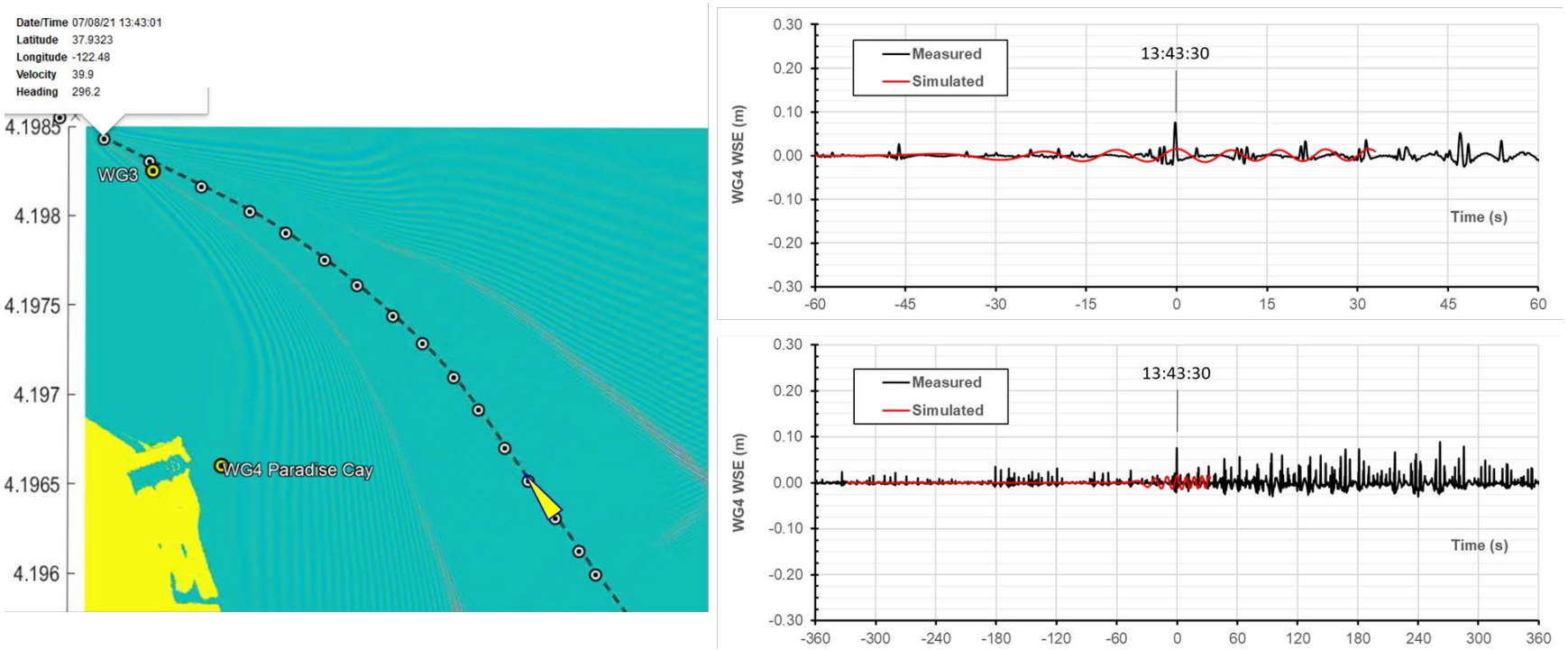


Figure 40. NAPA parameters and wake pattern during its passage offshore WG4 on its 4th inbound trip on July 8, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

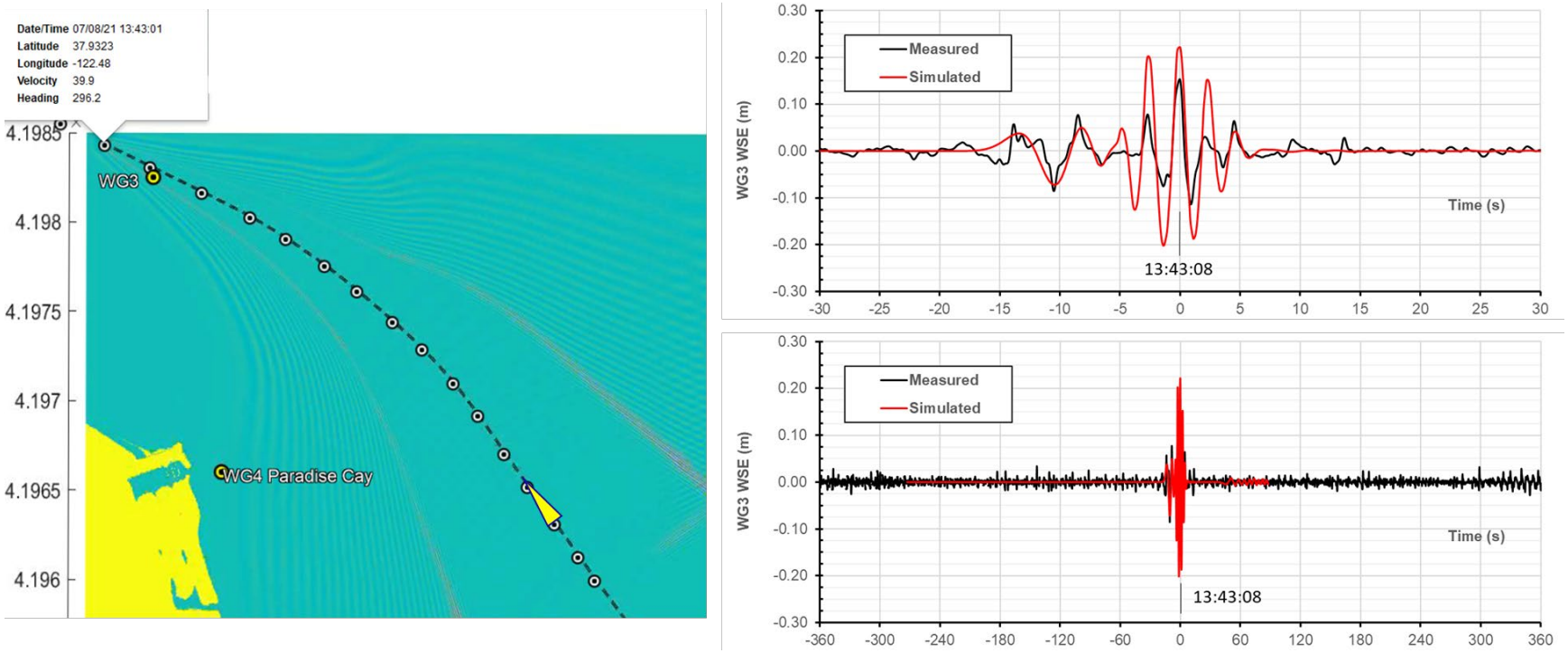


Figure 41. NAPA parameters and wake pattern during its passage by WG3 on its 4th inbound trip on July 8, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

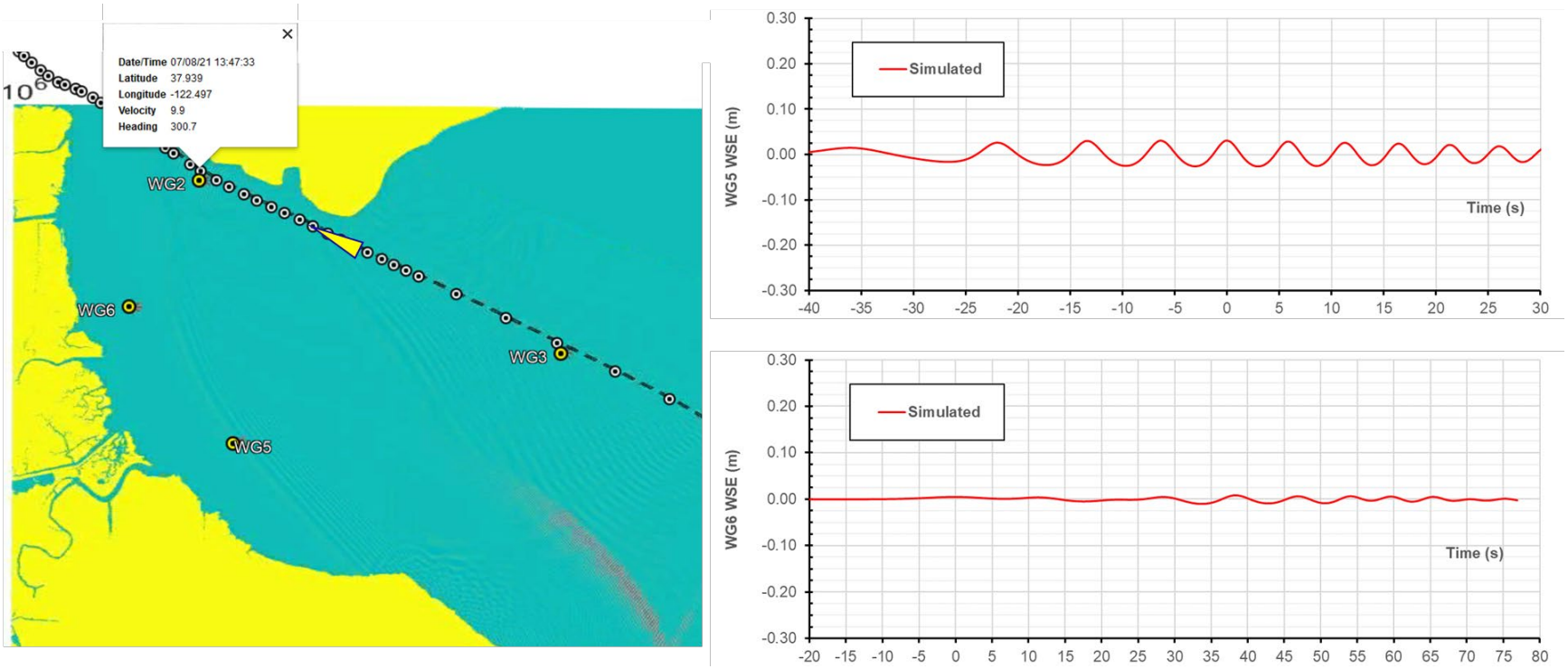


Figure 42. NAPA parameters and wake pattern during its passage offshore the mudflat on its 4th inbound trip on July 8, 2021 (left), and corresponding simulated water surface elevations (WSE) at WG5 and WG6.

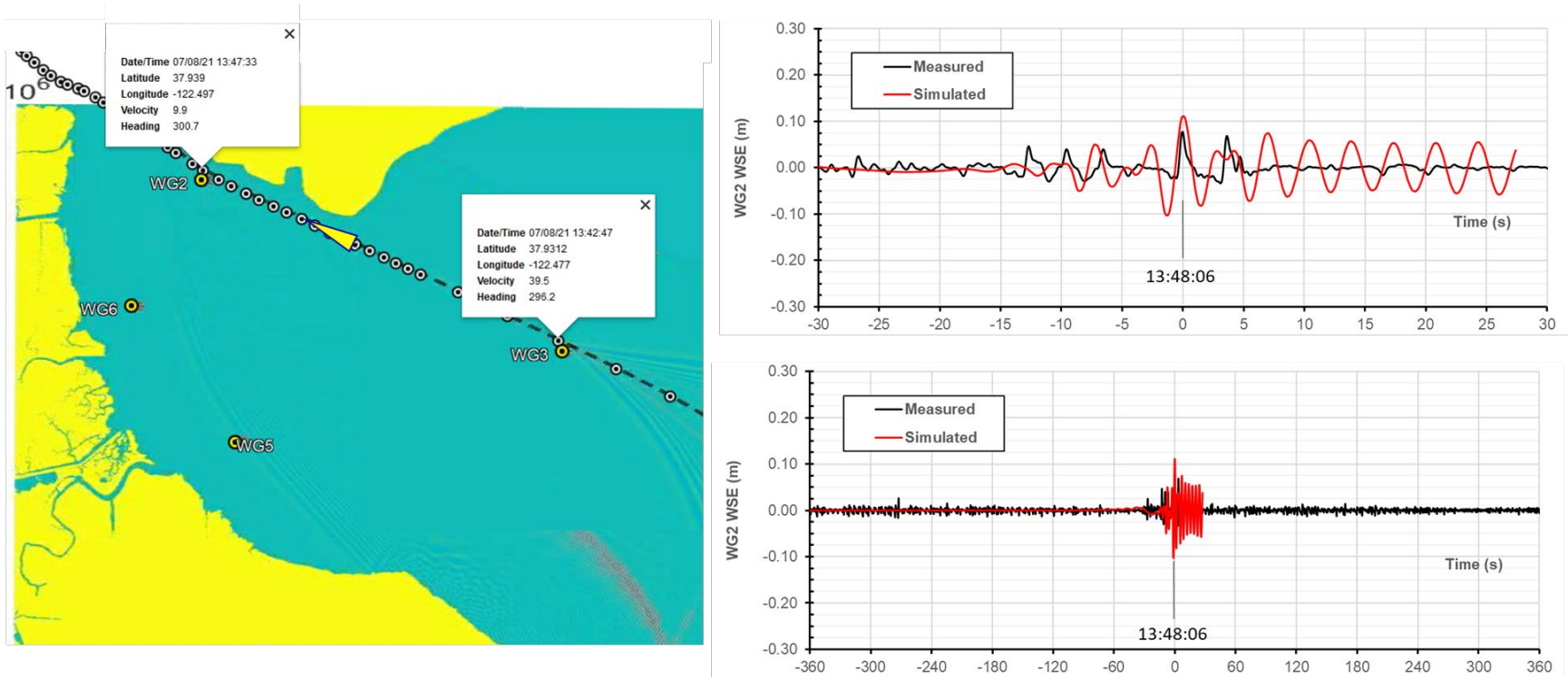


Figure 43. NAPA parameters and wake pattern during its passage by WG2 on its 4th inbound trip on July 8, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

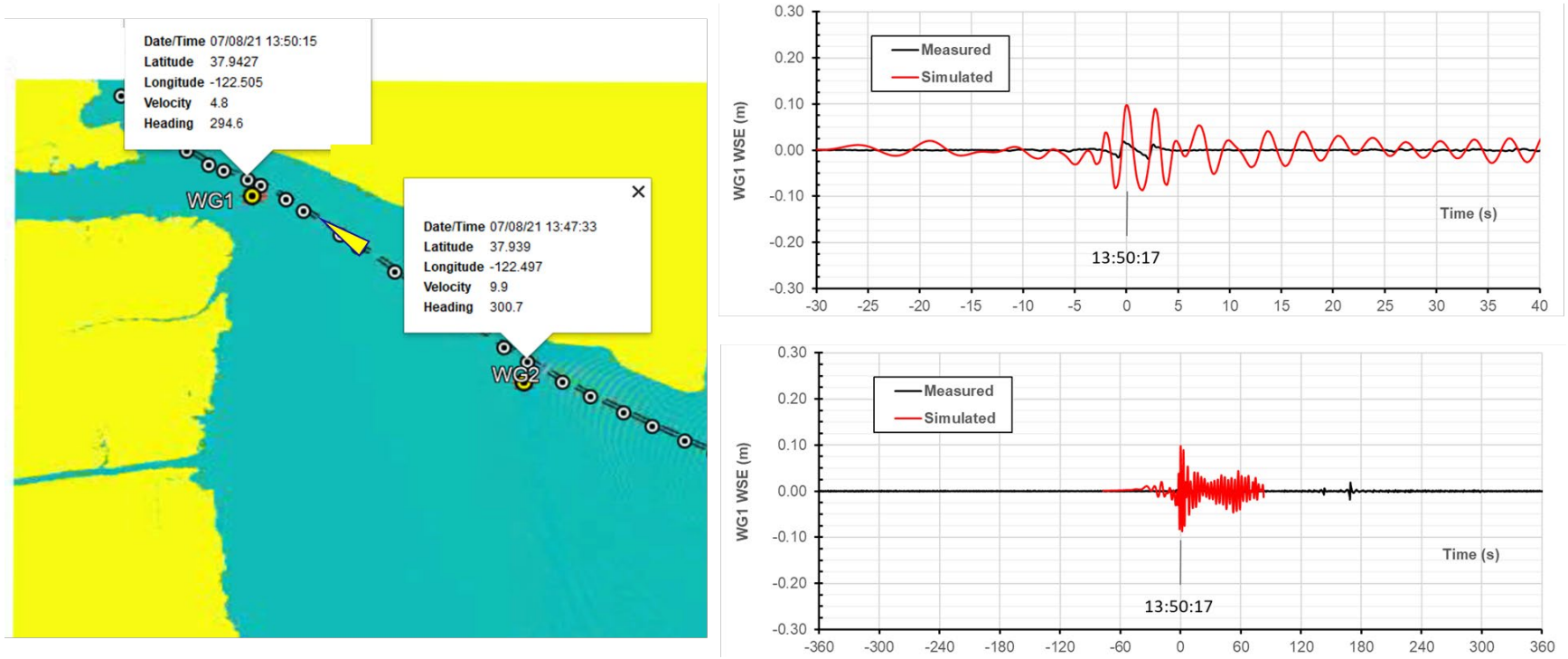


Figure 44. NAPA parameters and wake pattern during its passage by WG1 on its 4th inbound trip on July 8, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

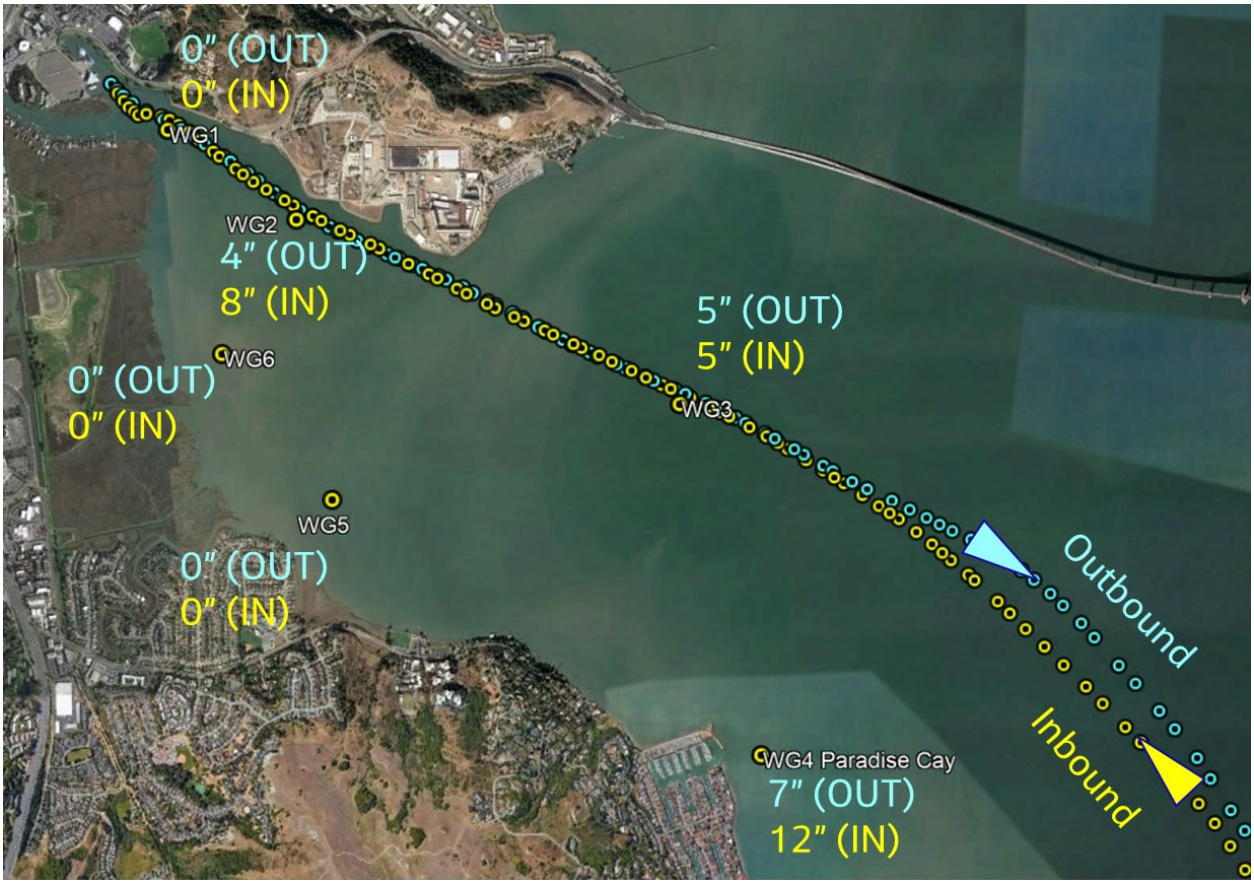


Figure 45. MARIN 1st outbound (blue) and SAN FRANCISCO 1st inbound (yellow) trip tracks on July 8, 2021, and resulting peak wake heights at the gauge locations.

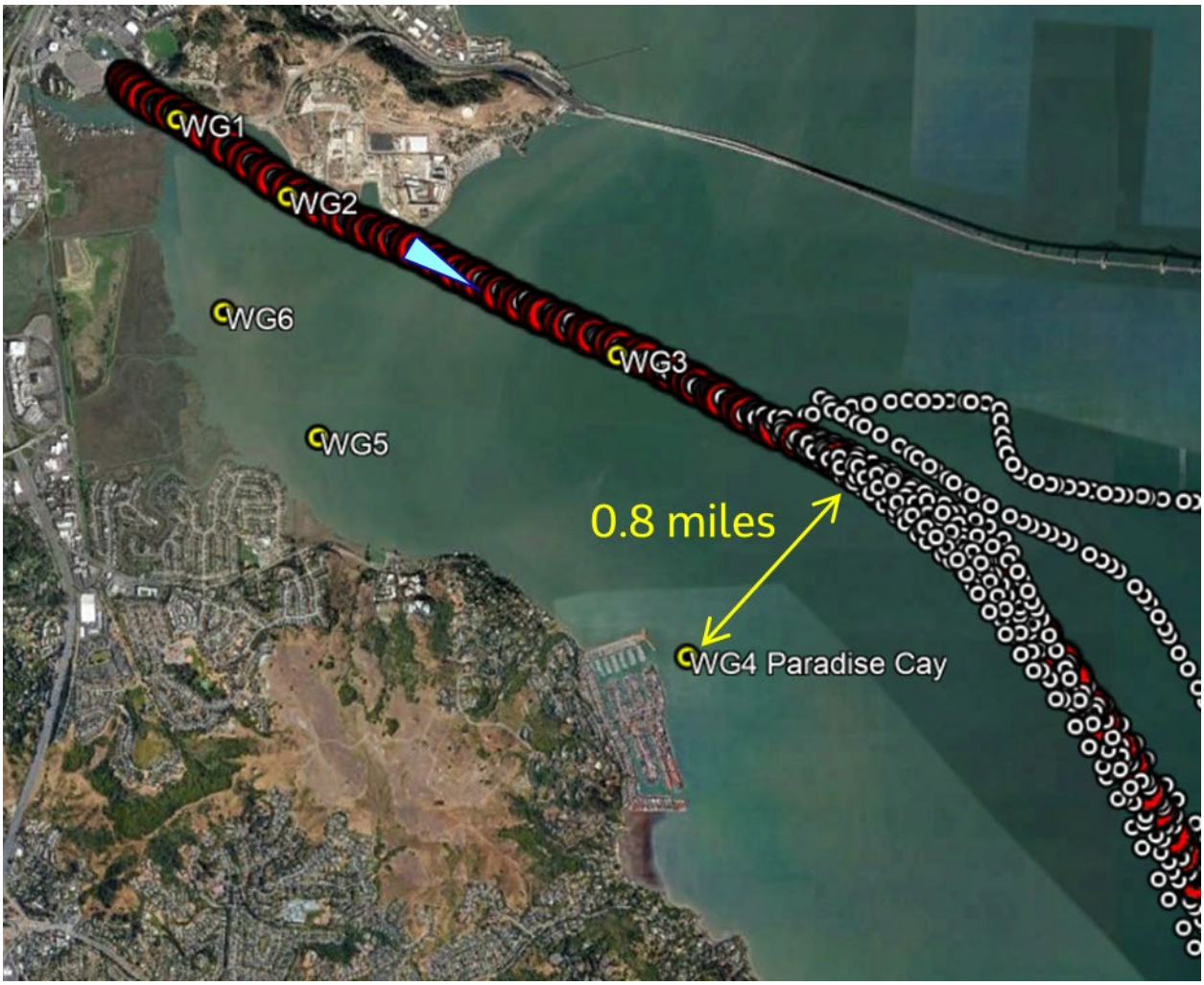


Figure 46. MARIN 1st outbound trip track on July 10, 2021 (red) and 12 SPAULDING CLASS ferries outbound trip tracks between July 9 and 11, 2021.

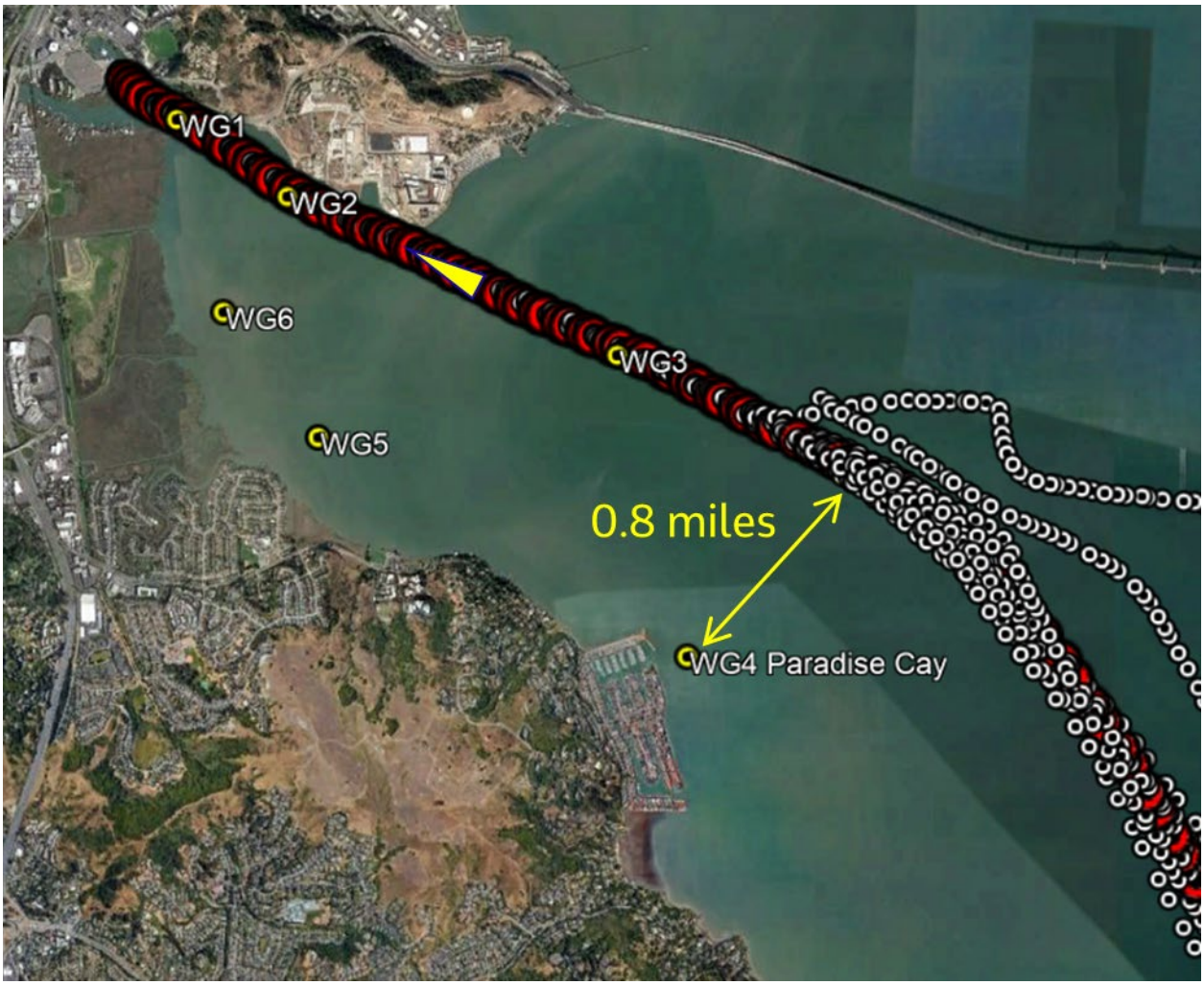


Figure 47. SAN FRANCISCO 1st inbound trip track on July 10, 2021 (red) and 12 SPAULDING CLASS ferries inbound trip tracks between July 9 and 11, 2021.

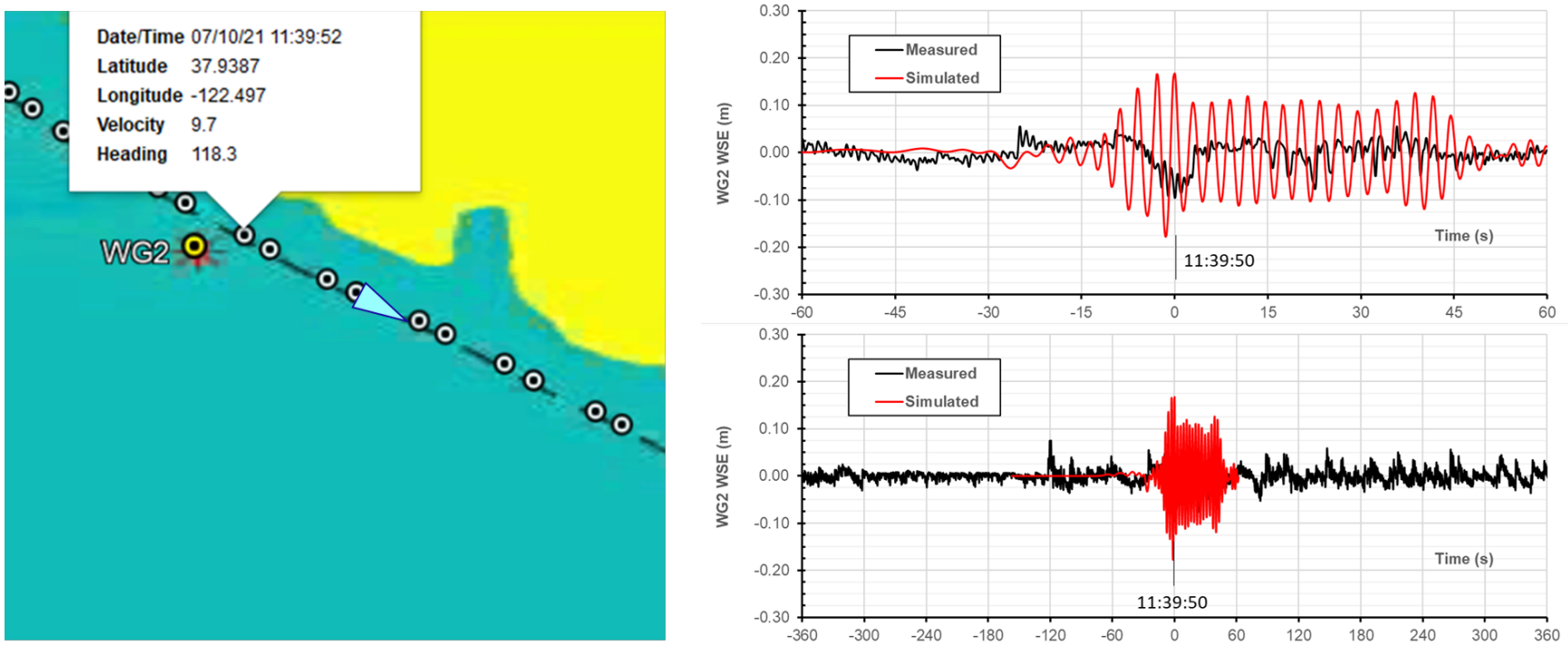


Figure 48. MARIN parameters and wake pattern during its passage by WG2 on its 1st outbound trip on July 10, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

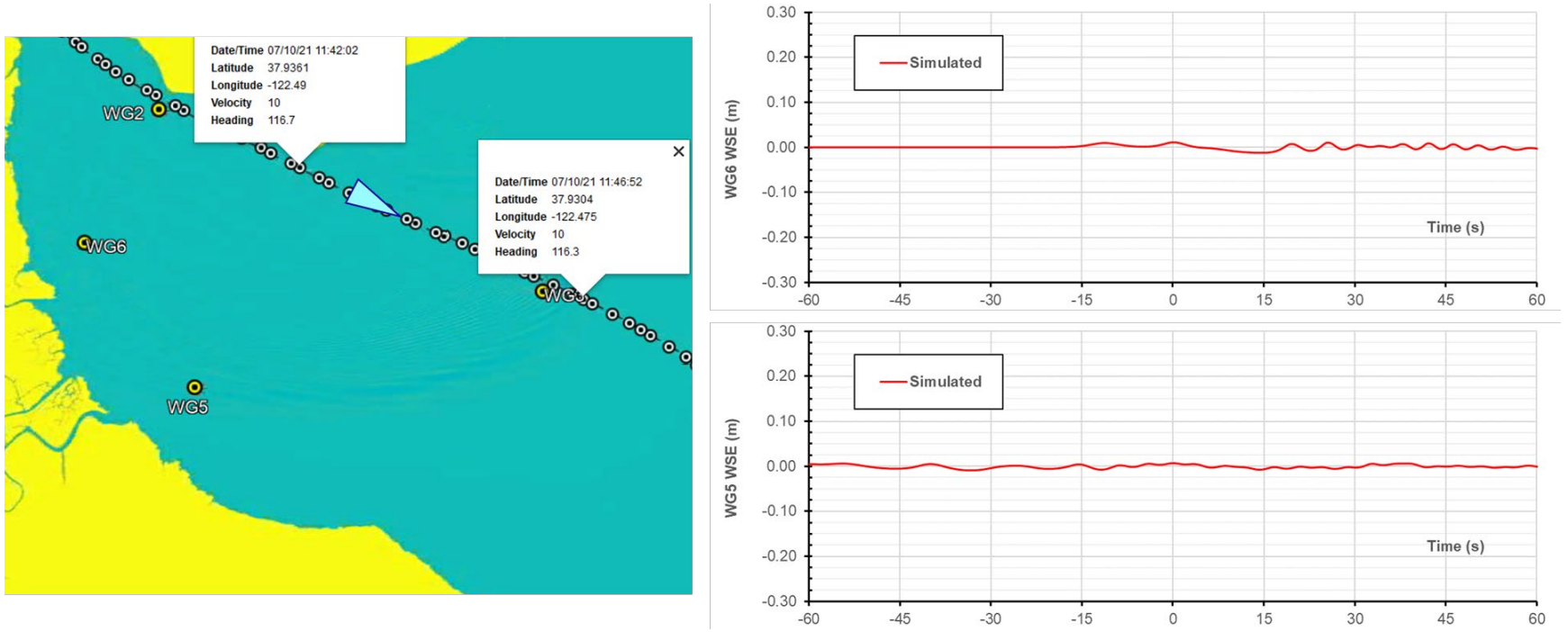


Figure 49. MARIN parameters and wake pattern during its passage offshore the mudflat on its 1st outbound trip on July 10, 2021 (left), and corresponding simulated water surface elevations (WSE) at WG6 and WG5.

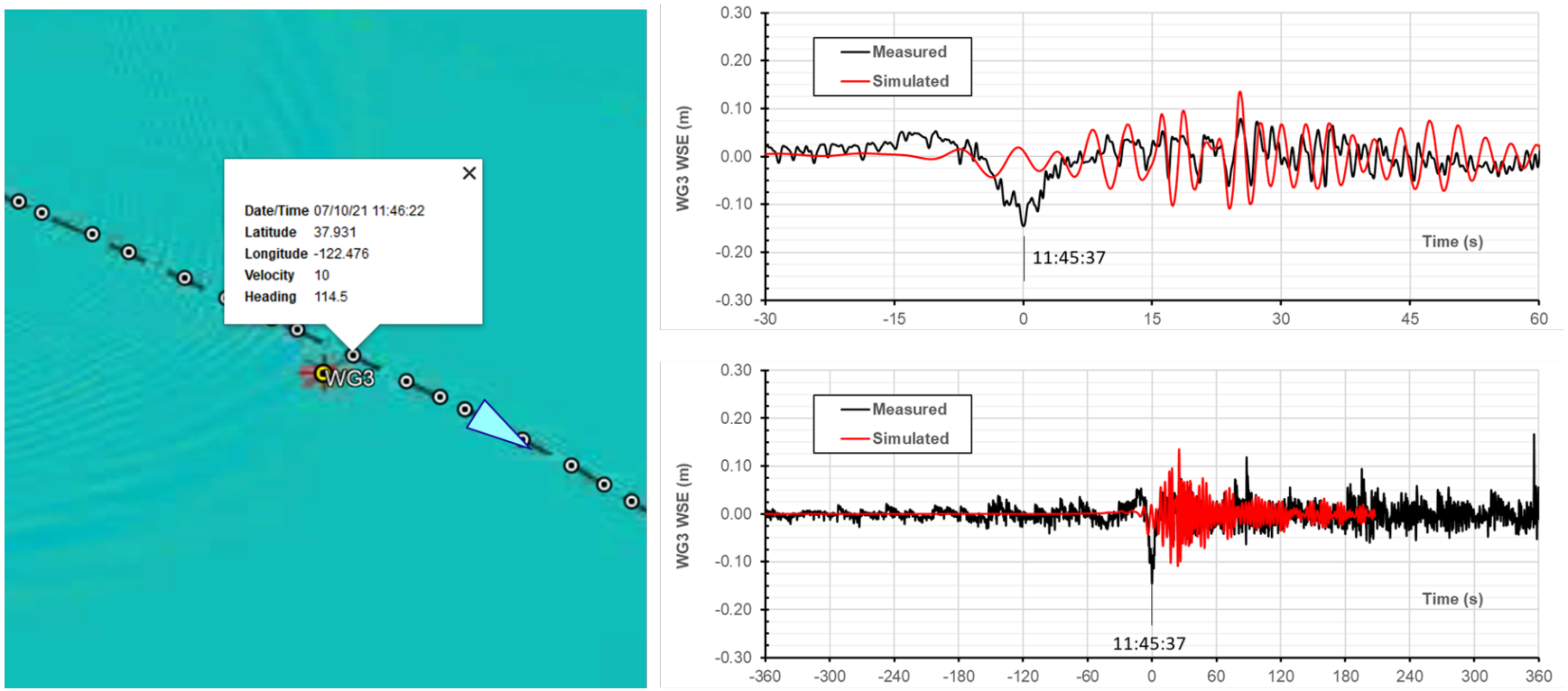


Figure 50. MARIN parameters and wake pattern during its passage by WG3 on its 1st outbound trip on July 10, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

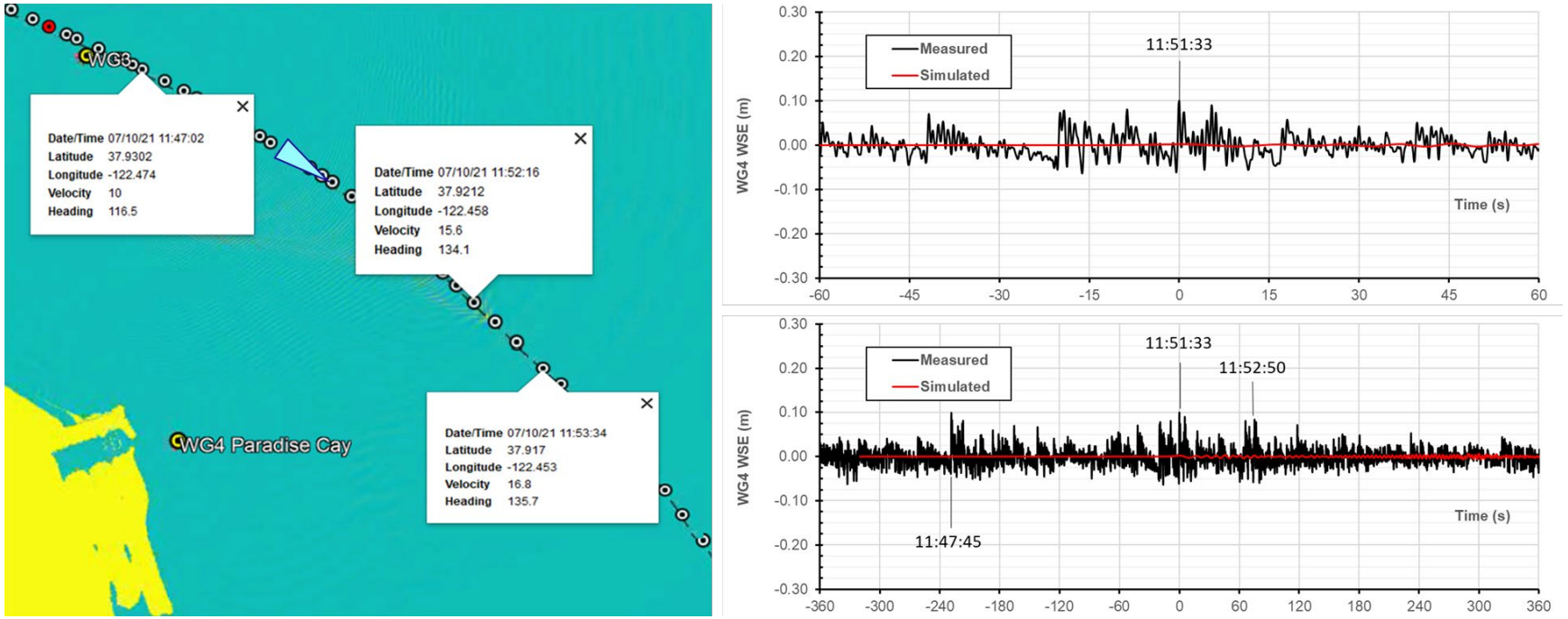


Figure 51. MARIN parameters and wake pattern during its passage by WG4 on its 1st outbound trip on July 10, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

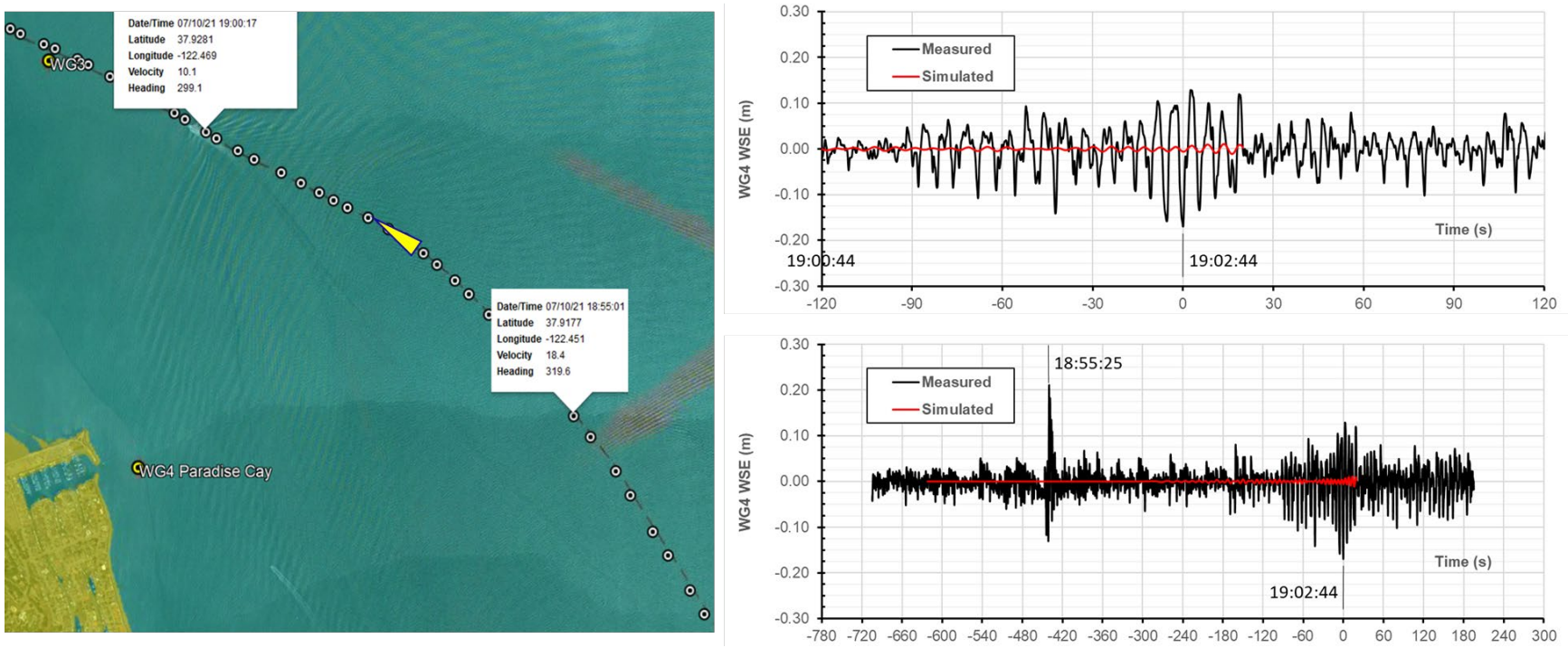


Figure 52. SAN FRANCISCO parameters and wake pattern during its passage by WG4 on its 1st inbound trip on July 10, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

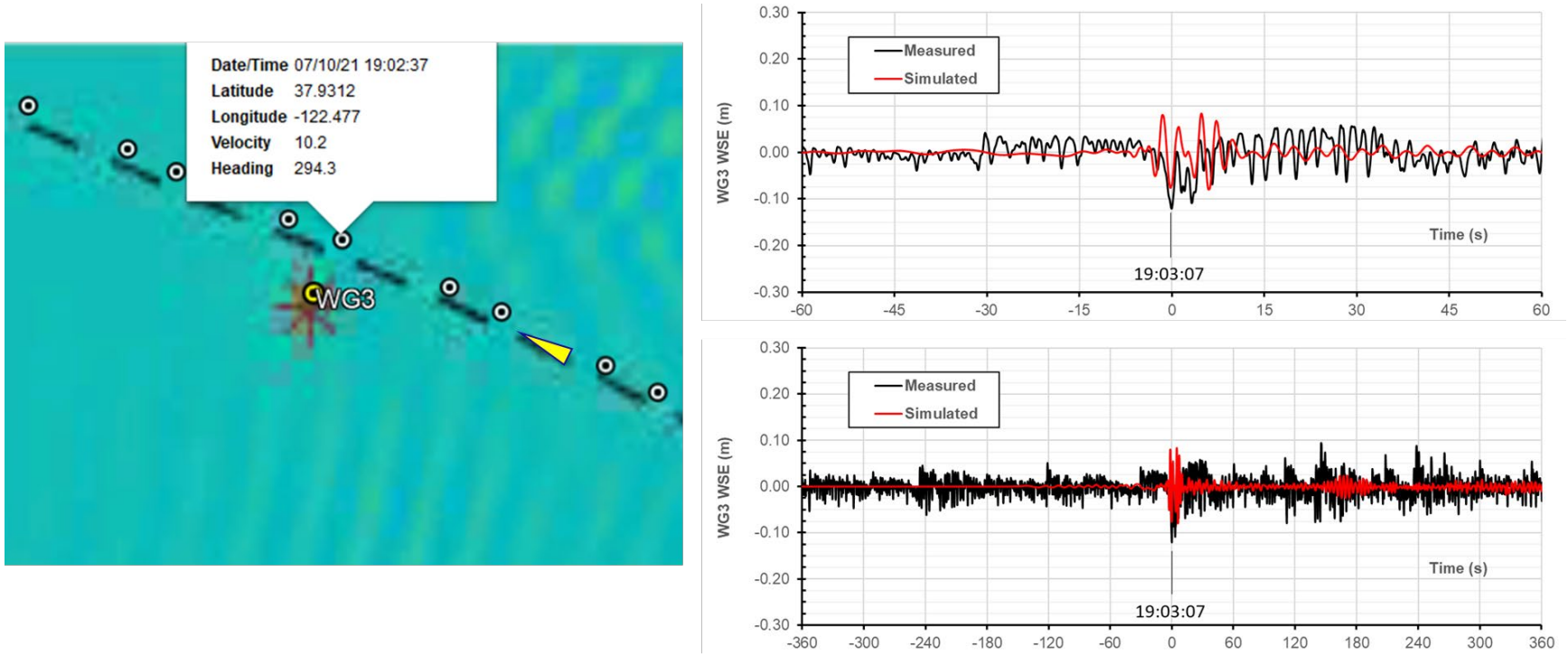


Figure 53. SAN FRANCISCO parameters and wake pattern during its passage by WG3 on its 1st inbound trip on July 10, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

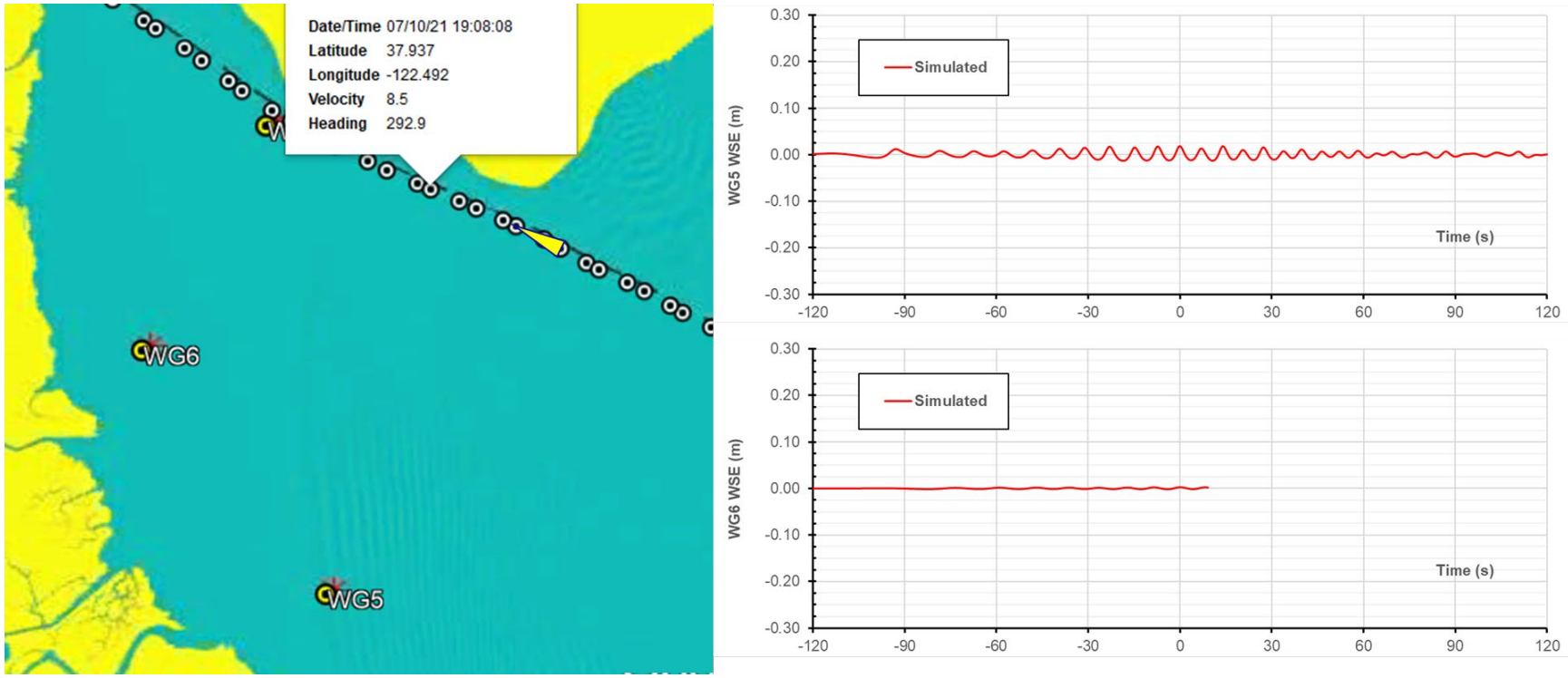


Figure 54. SAN FRANCISCO parameters and wake pattern during its passage offshore the mudflat on its 1st inbound trip on July 10, 2021 (left), and corresponding simulated water surface elevations (WSE) at WG5 and WG6.

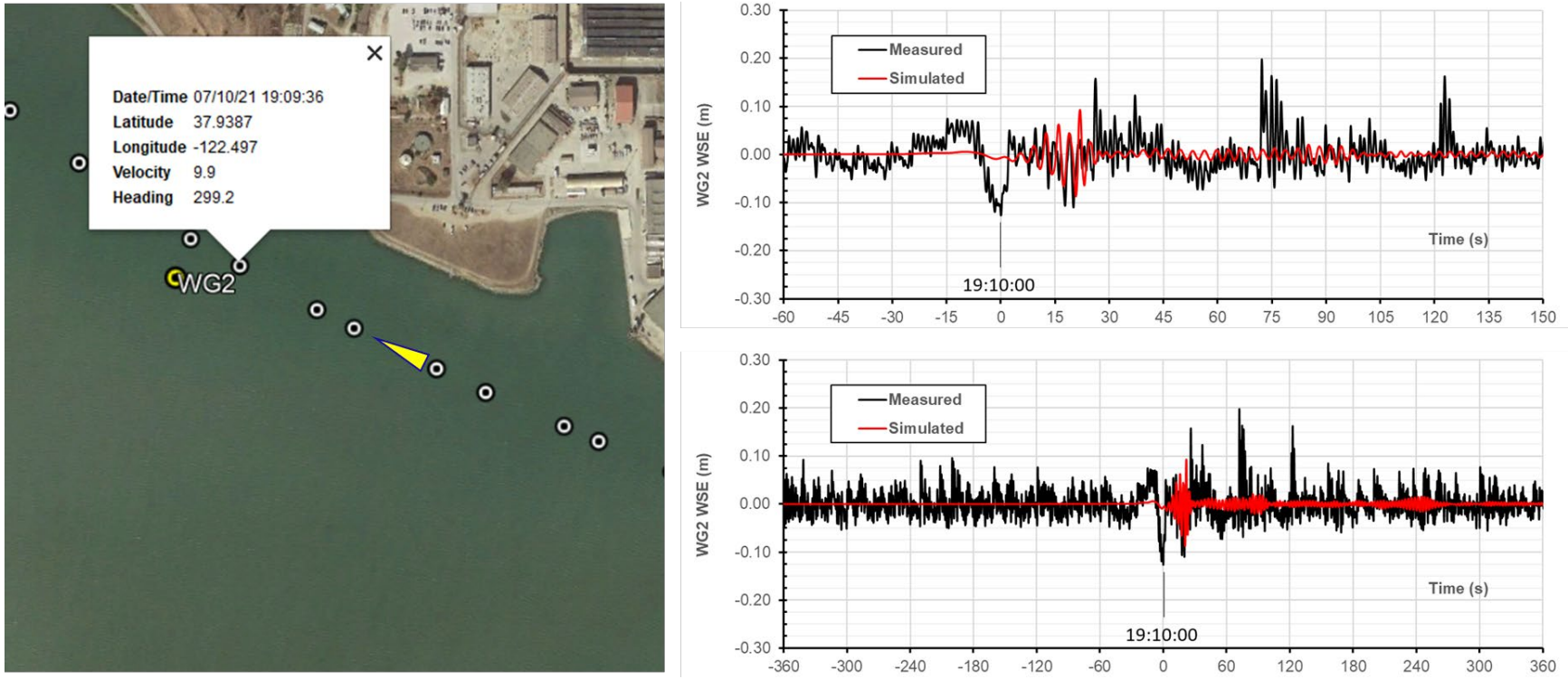


Figure 55. SAN FRANCISCO parameters during its passage by WG2 on its 1st inbound trip on July 10, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

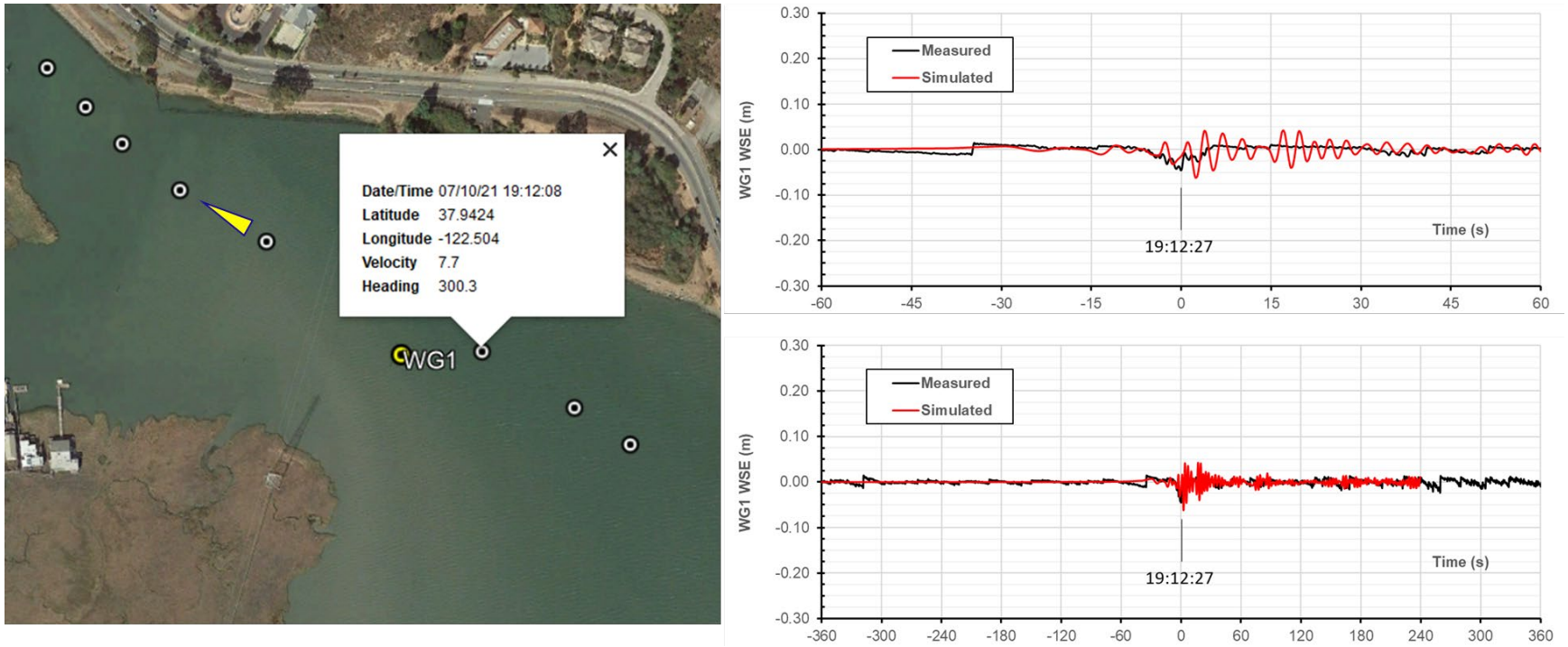


Figure 56. SAN FRANCISCO parameters during its passage by WG1 on its 1st inbound trip on July 10, 2021 (left), and corresponding simulated and measured water surface elevations (WSE).

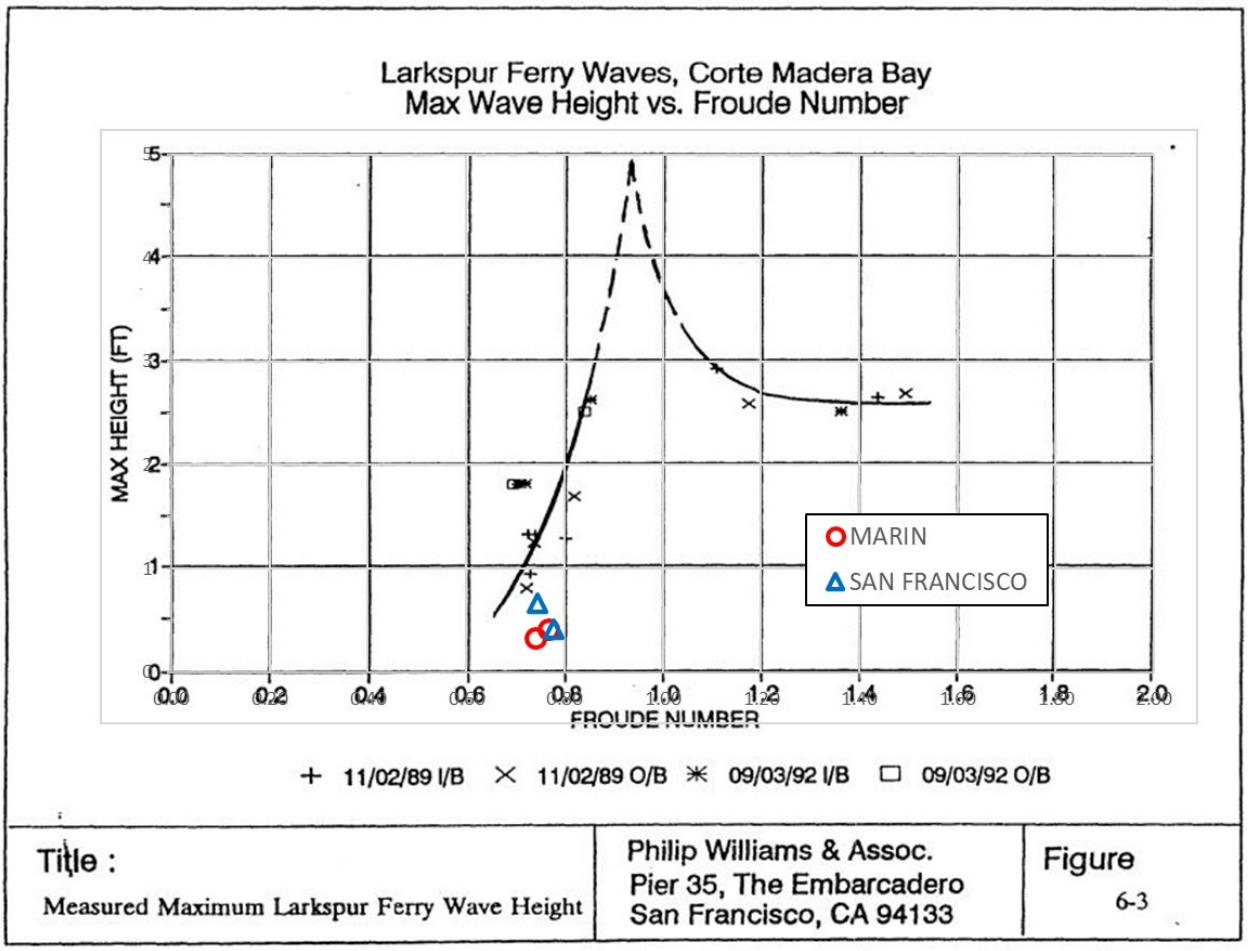


Figure 57. MARIN and SAN FRANCISCO peak wake heights measured at the Corte Madera Channel CM 11 (WG2) and CM 5 (WG3) on their 1st inbound and outbound trips, respectively, on July 10, 2021, and measured by PWA (1993) at CM 7 in November 1989 and September 1992.



Figure 58. Key coastal features and activities in the area of interest.

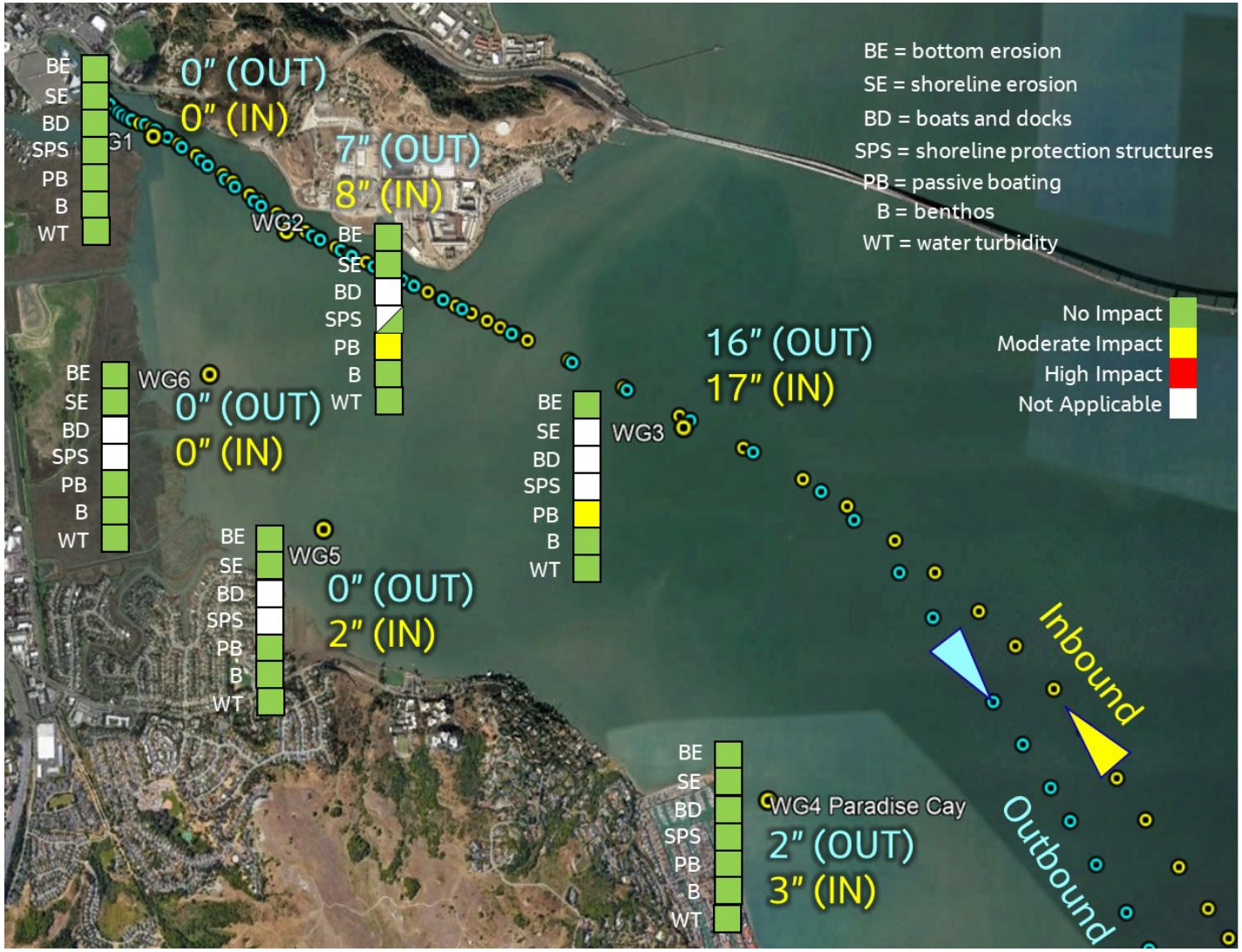


Figure 59. Summary of fast ferry wakes impact assessment.

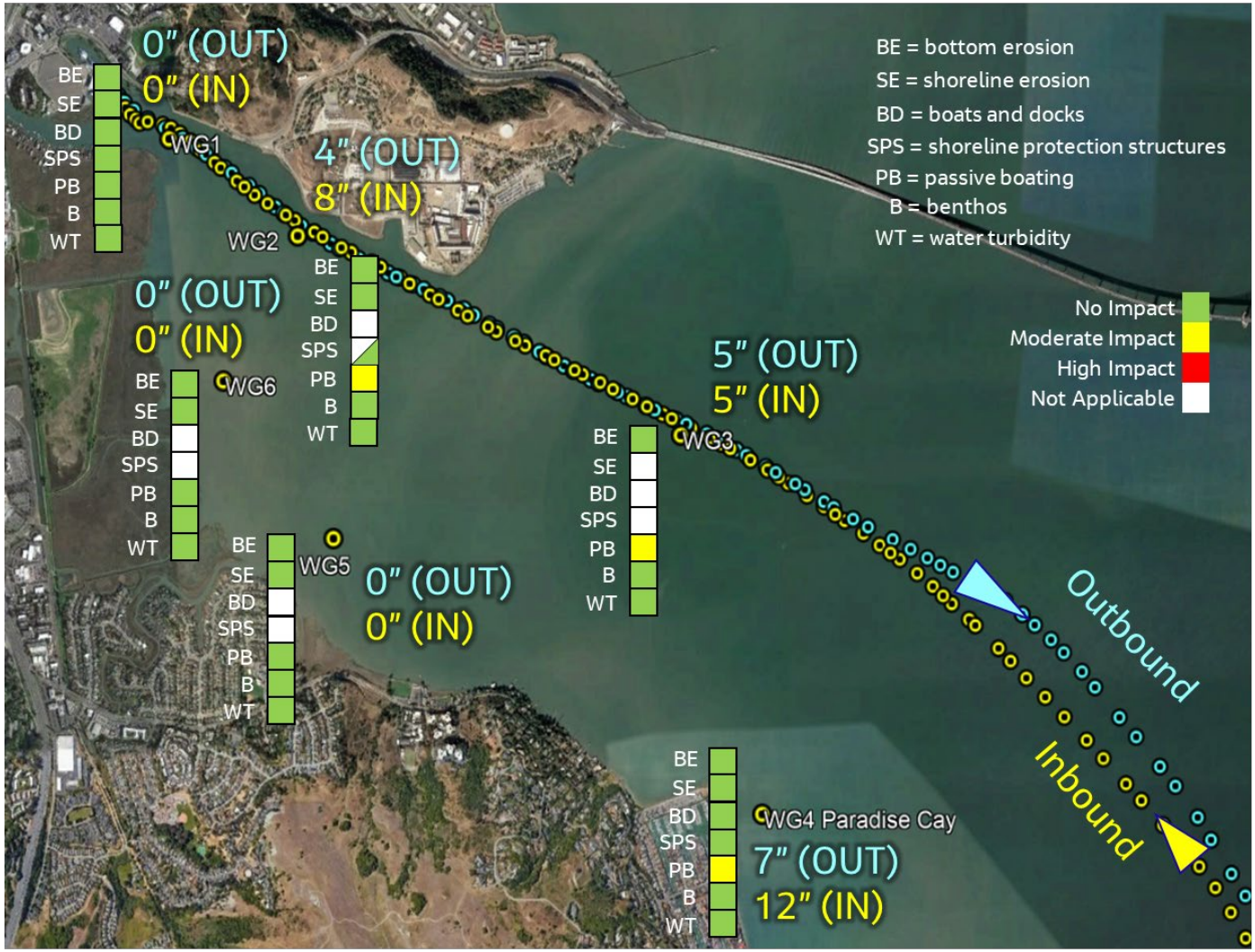


Figure 60. Summary of SPAULDING CLASS ferry wakes impact assessment.

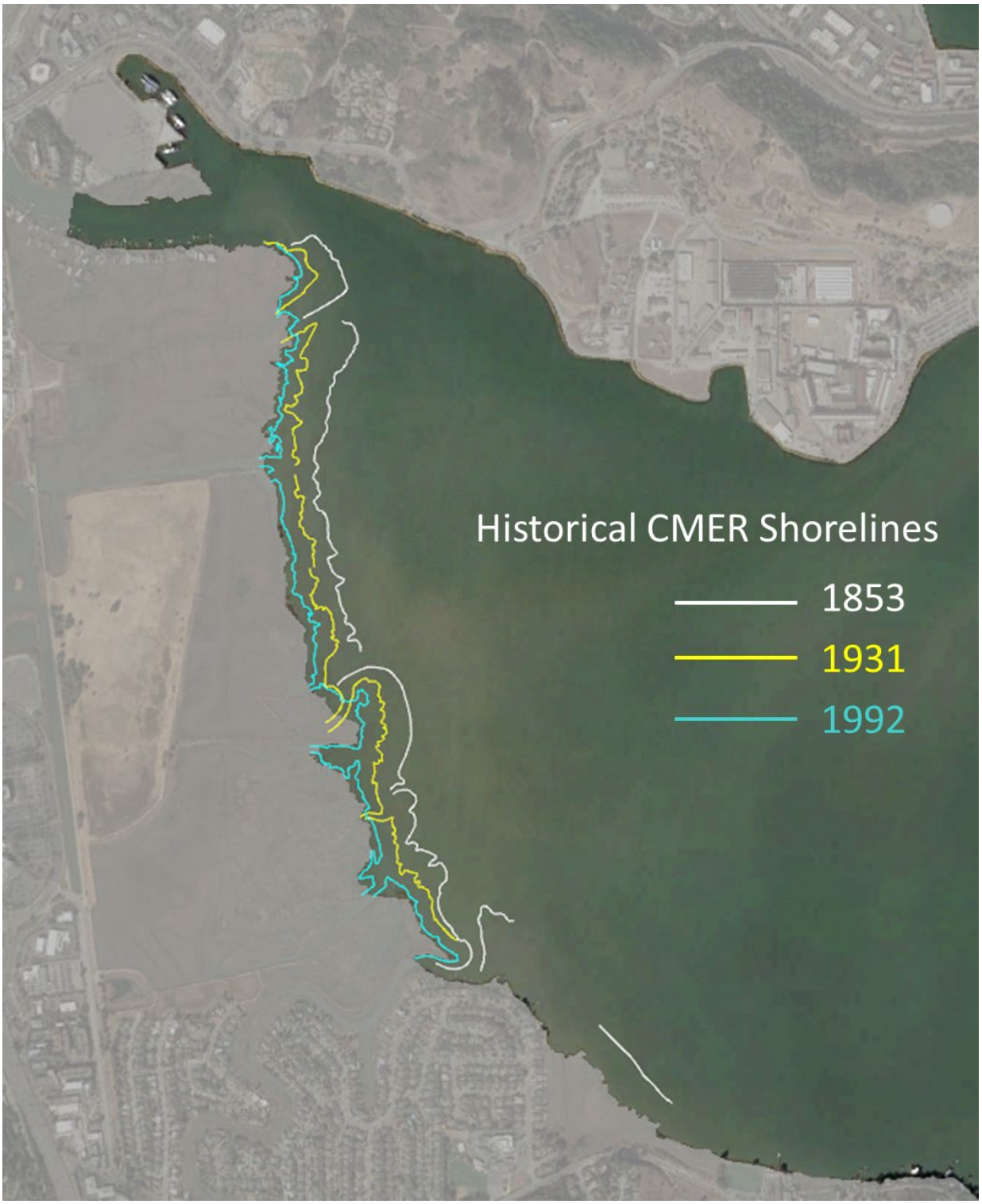


Figure 61. CMER historical shorelines, adapted from Carkin et al. (2020).

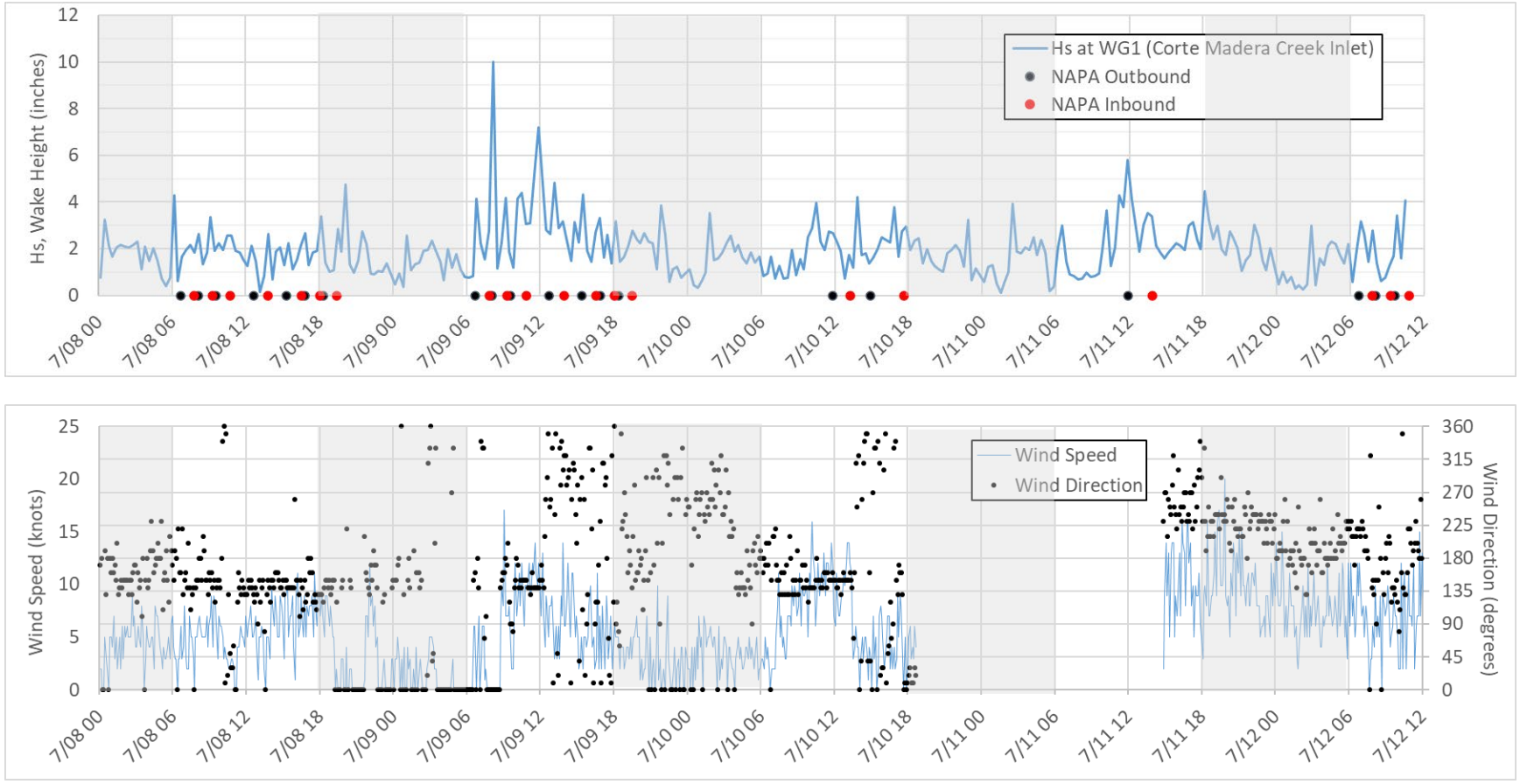


Figure 62. Significant wave heights and representative peak wake heights at WG1 for NAPA roundtrips between July 8 and 12, 2021 (top), and wind speed and direction (bottom) during the field measurements (greyed areas indicate times when the last ferry trips of the day are typically completed, and when wind and waves generally die down).

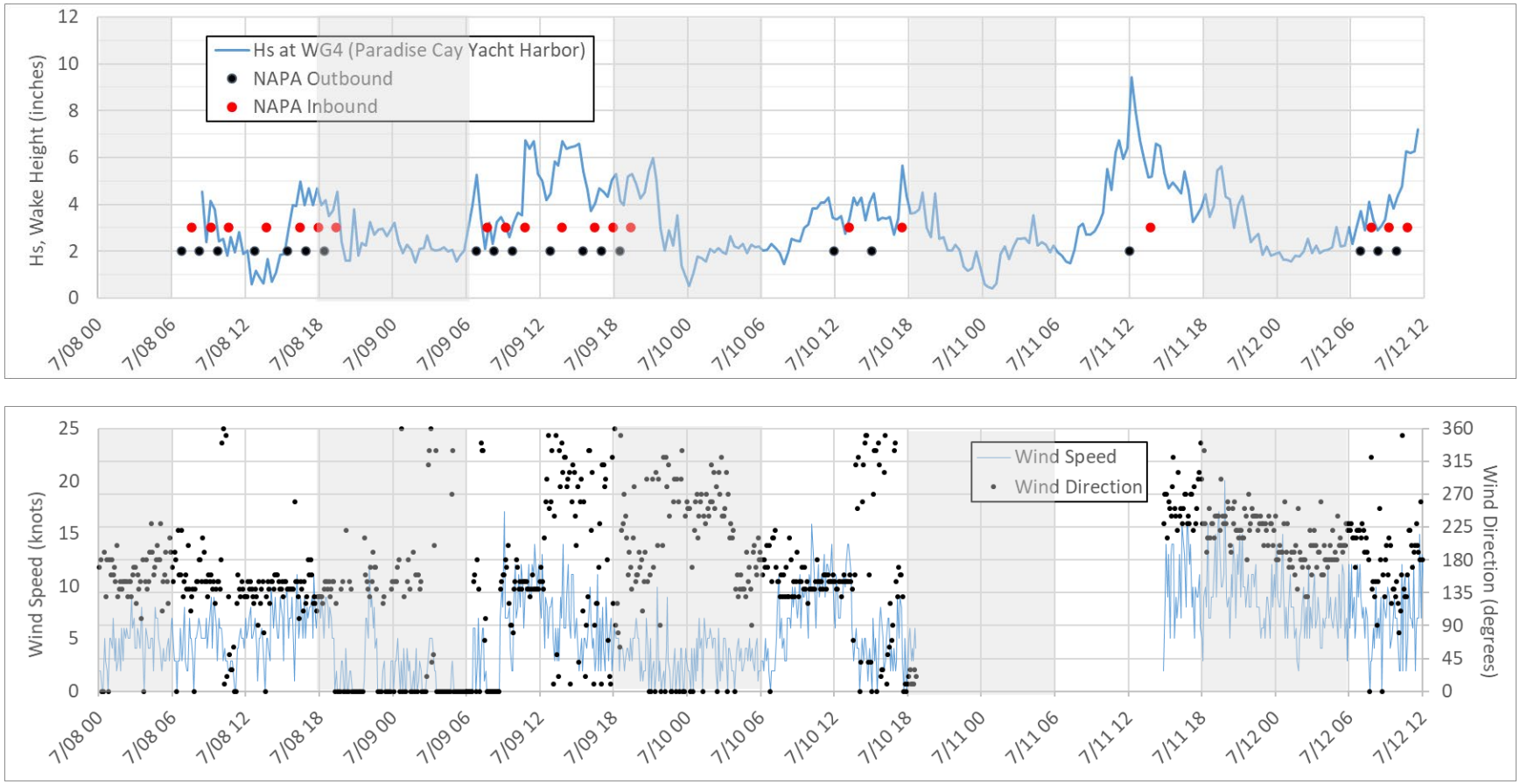


Figure 63. Significant wave heights and representative peak wake heights at WG4 for NAPA roundtrips between July 8 and 12, 2021 (top), and wind speed and direction (bottom) during the field measurements (greyed areas indicate times when the last ferry trips of the day are typically completed, and when wind and waves generally die down).

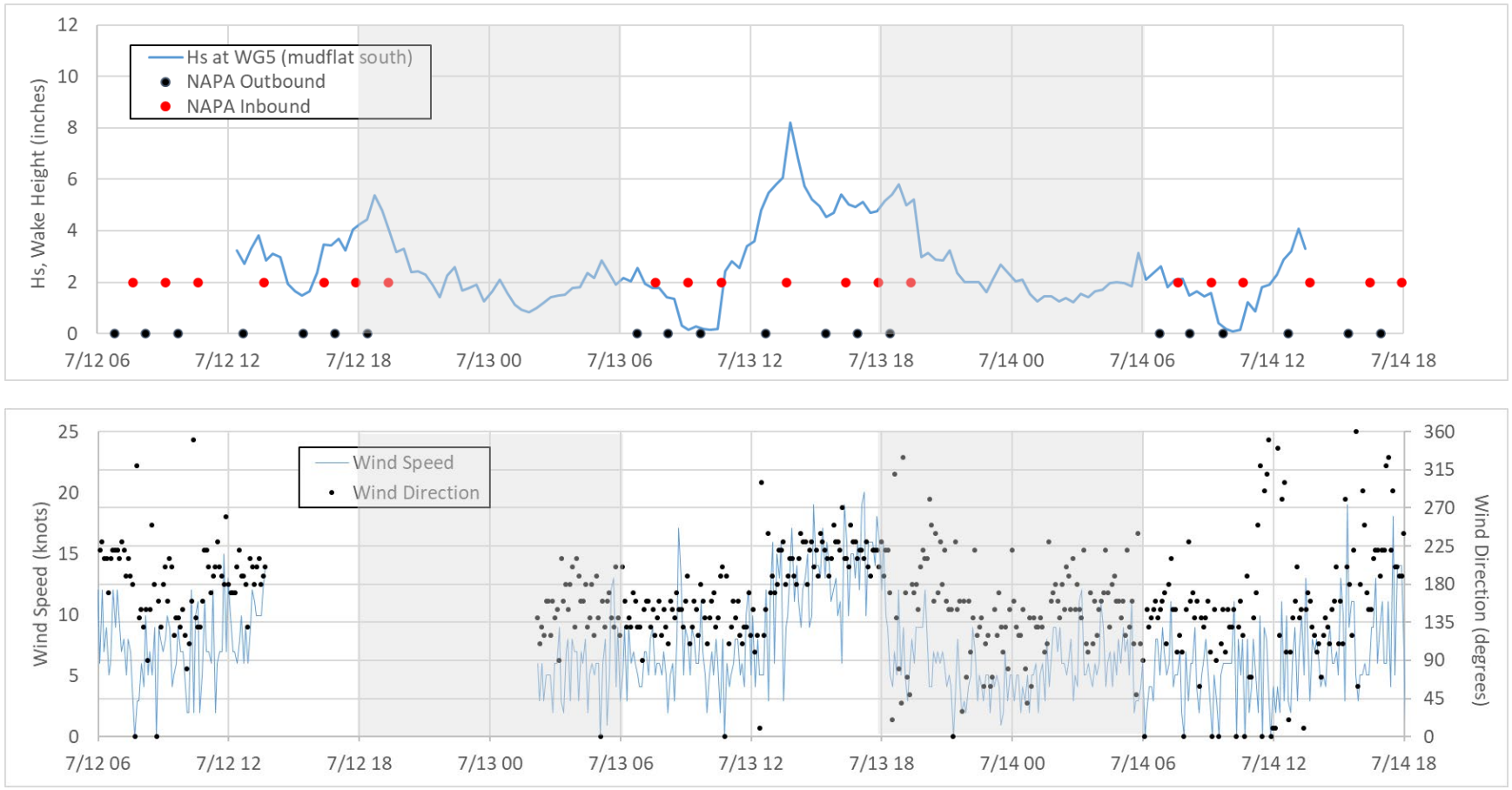


Figure 64. Significant wave heights and representative peak wake heights at WG5 for NAPA roundtrips between July 12 and 14, 2021 (top), and wind speed and direction (bottom) during the field measurements (greyed areas indicate times when the last ferry trips of the day are typically completed, and when wind and waves generally die down).

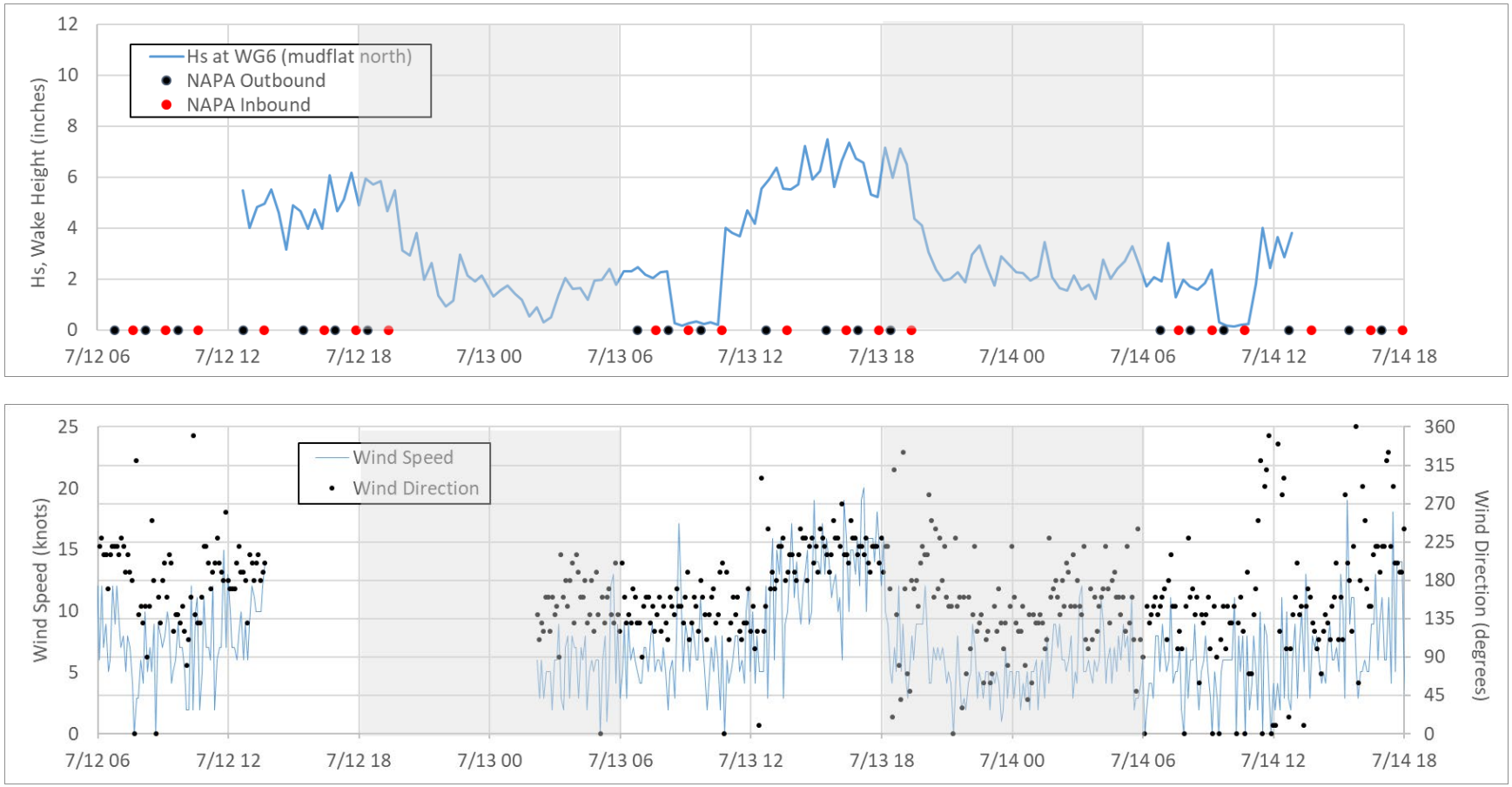


Figure 65. Significant wave heights and representative peak wake heights at WG6 for NAPA roundtrips between July 12 and 14, 2021 (top), and wind speed and direction (bottom) during the field measurements (greyed areas indicate times when the last ferry trips of the day are typically completed, and when wind and waves generally die down).

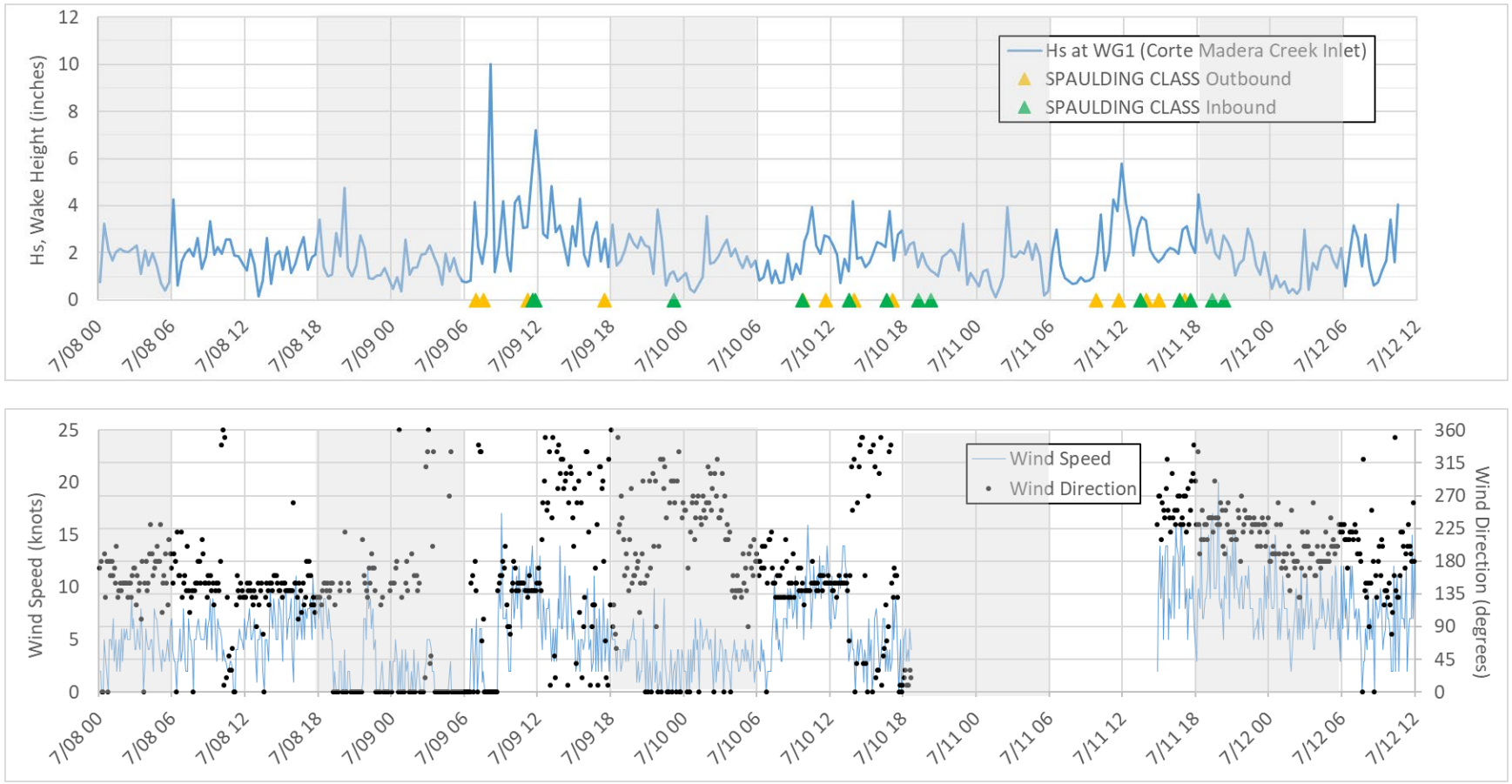


Figure 66. Significant wave heights and representative peak wake heights at WG1 for SPAULDING CLASS roundtrips between July 8 and 12, 2021 (top), and wind speed and direction (bottom) during the field measurements (greyed areas indicate times when the last ferry trips of the day are typically completed, and when wind and waves generally die down).

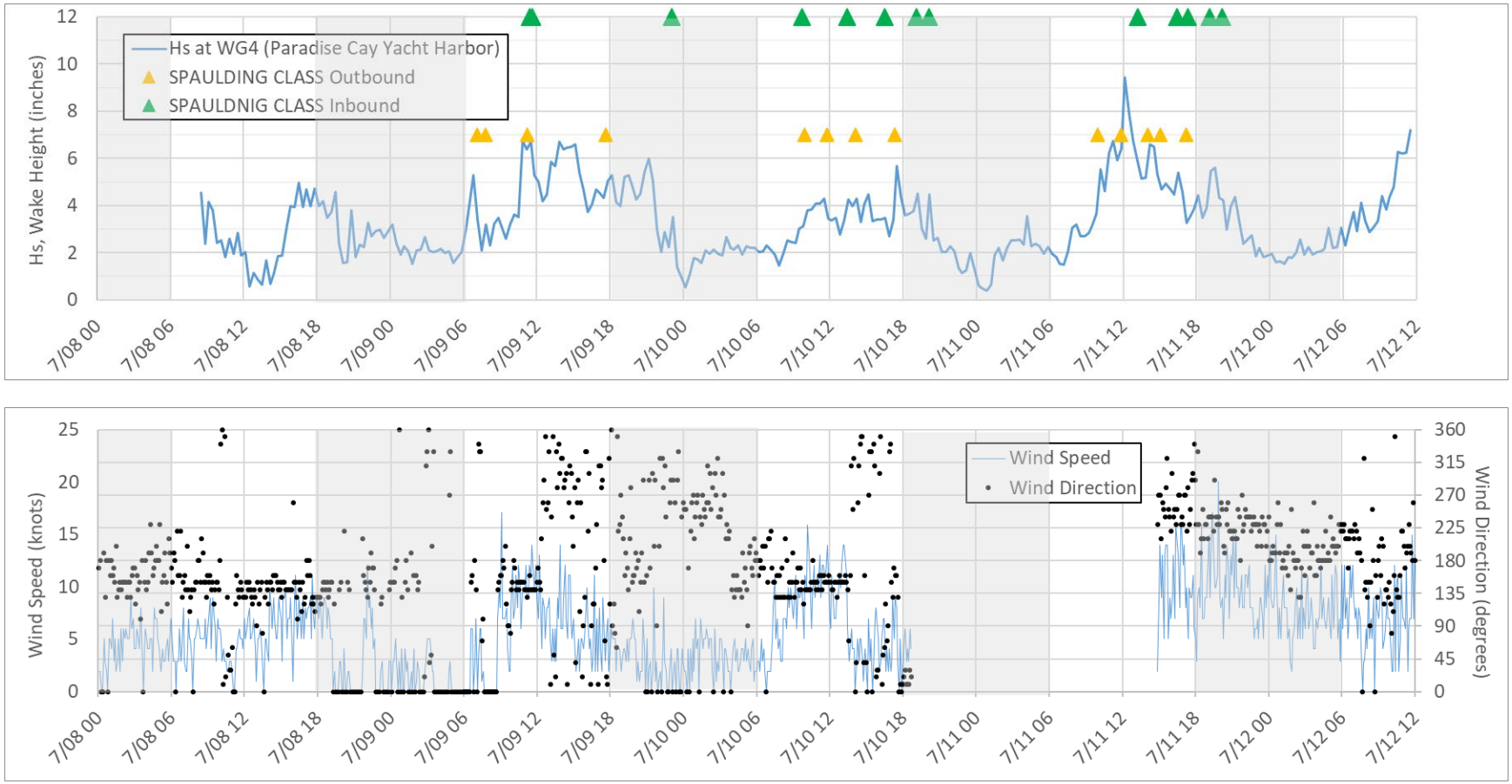


Figure 67. Significant wave heights and representative peak wake heights at WG4 for SPAULDING CLASS roundtrips between July 8 and 12, 2021 (top), and wind speed and direction (bottom) during the field measurements (greyed areas indicate times when the last ferry trips of the day are typically completed, and when wind and waves generally die down).



Figure 68. Corte Madera Bay bathymetry (m, NAVD88), gauge locations and location of sediment sample (S1) by Lacy and Hoover (2011)

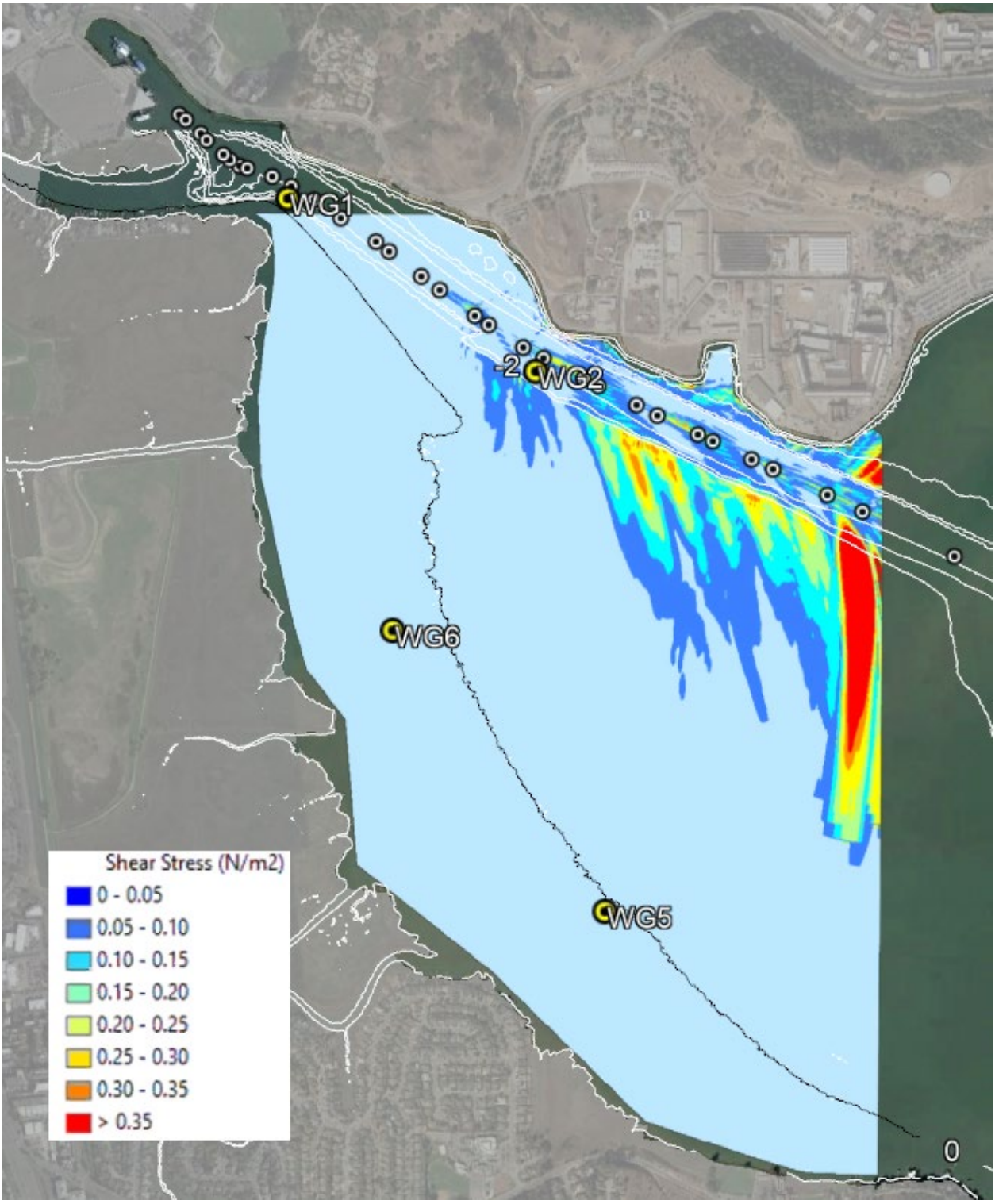


Figure 69. Corte Madera Bay bathymetry (m, NAVD88, 1 m contours), gauge locations and peak shear stresses generated by the NAPA on its 4th outbound trip on July 8, 2021. Areas in red indicate potential bottom erosion.

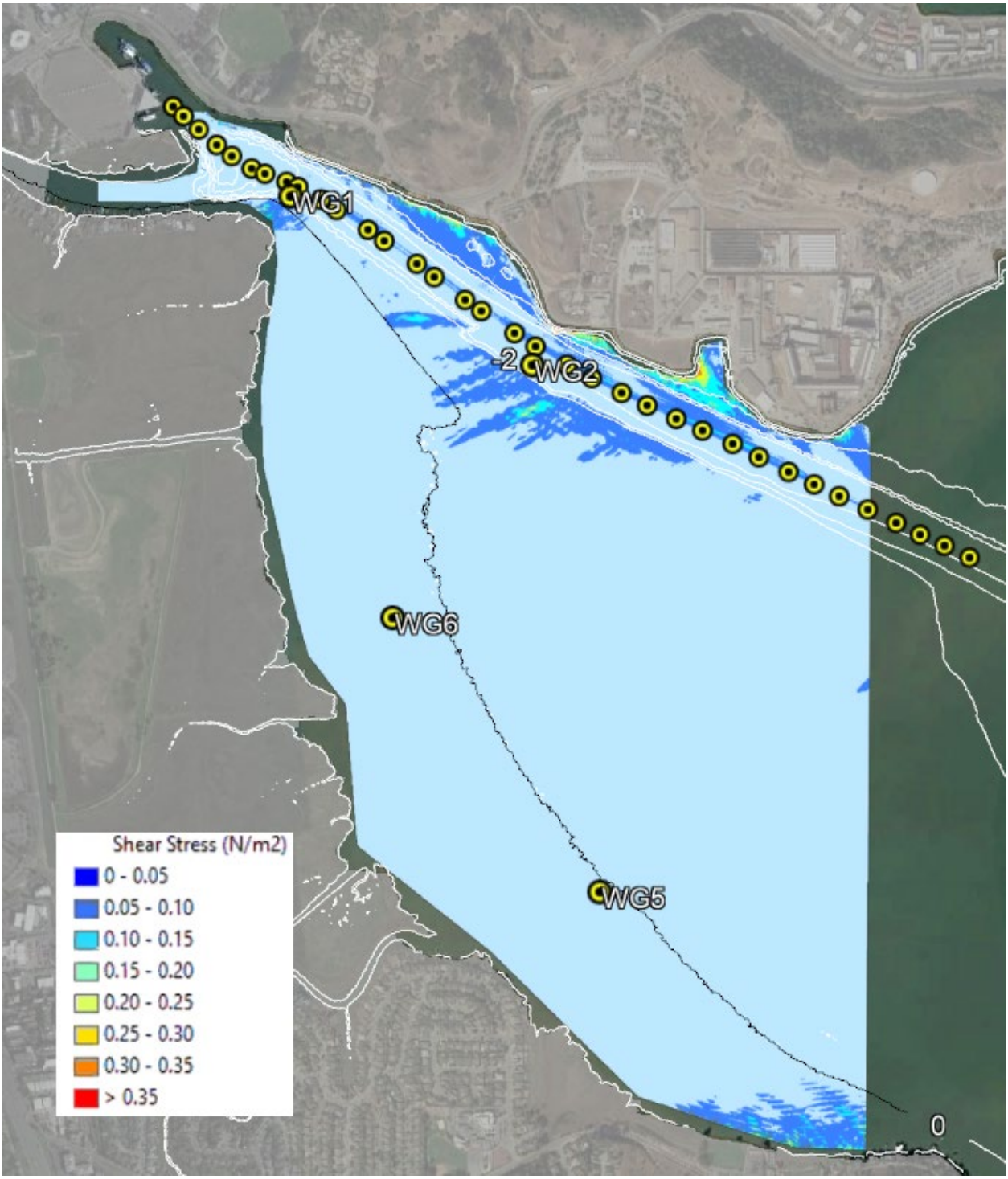


Figure 70. Corte Madera Bay bathymetry (m, NAVD88, 1 m contours), gauge locations and shear stresses generated by the NAPA on its 4th inbound trip on July 8, 2021.

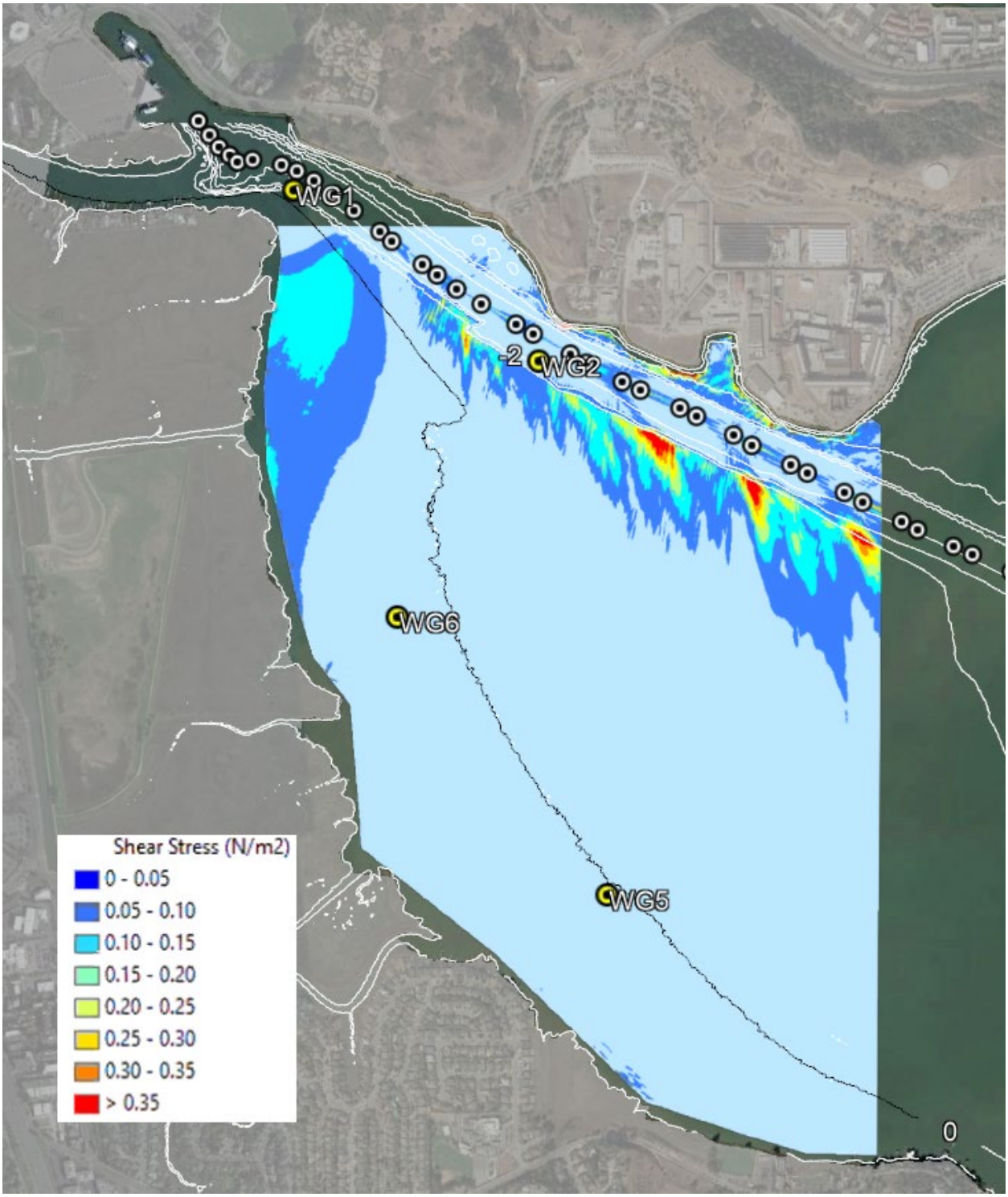


Figure 71. Corte Madera Bay bathymetry (m, NAVD88, 1 m contours), gauge locations and peak shear stresses generated by the MARIN on its 1st outbound trip on July 10, 2021. Areas in red indicate potential bottom erosion.

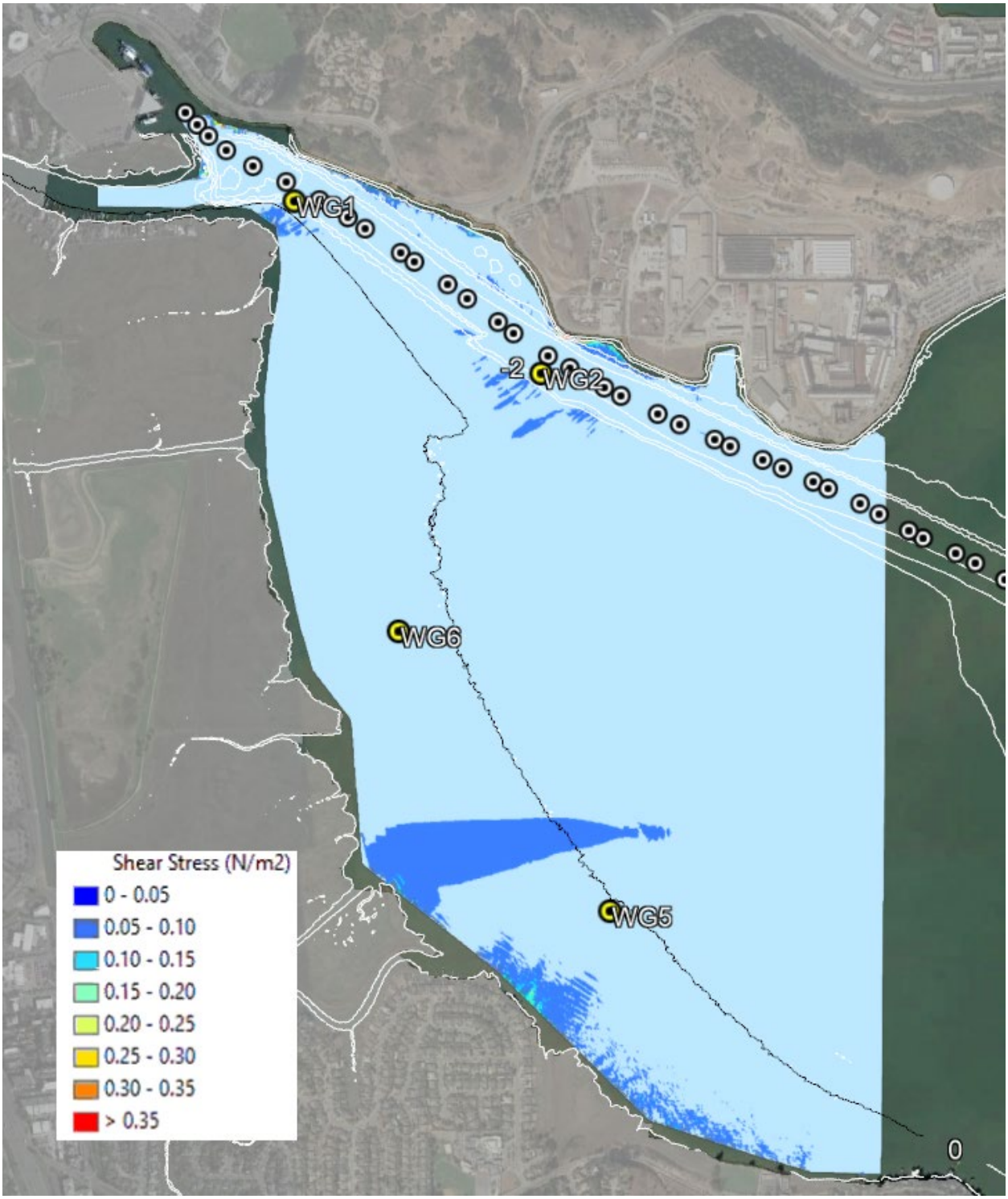


Figure 72. Corte Madera Bay bathymetry (m, NAVD88, 1 m contours), gauge locations and peak shear stresses generated by the SAN FRANCISCO on its 1st inbound trip on July 10, 2021.



Figure 73. Natural shoreline on the northern shore of Corte Madera Bay from Point San Quentin to just southeast of the Larkspur terminal, and shoreline erosion along non-engineered revetment (insert).

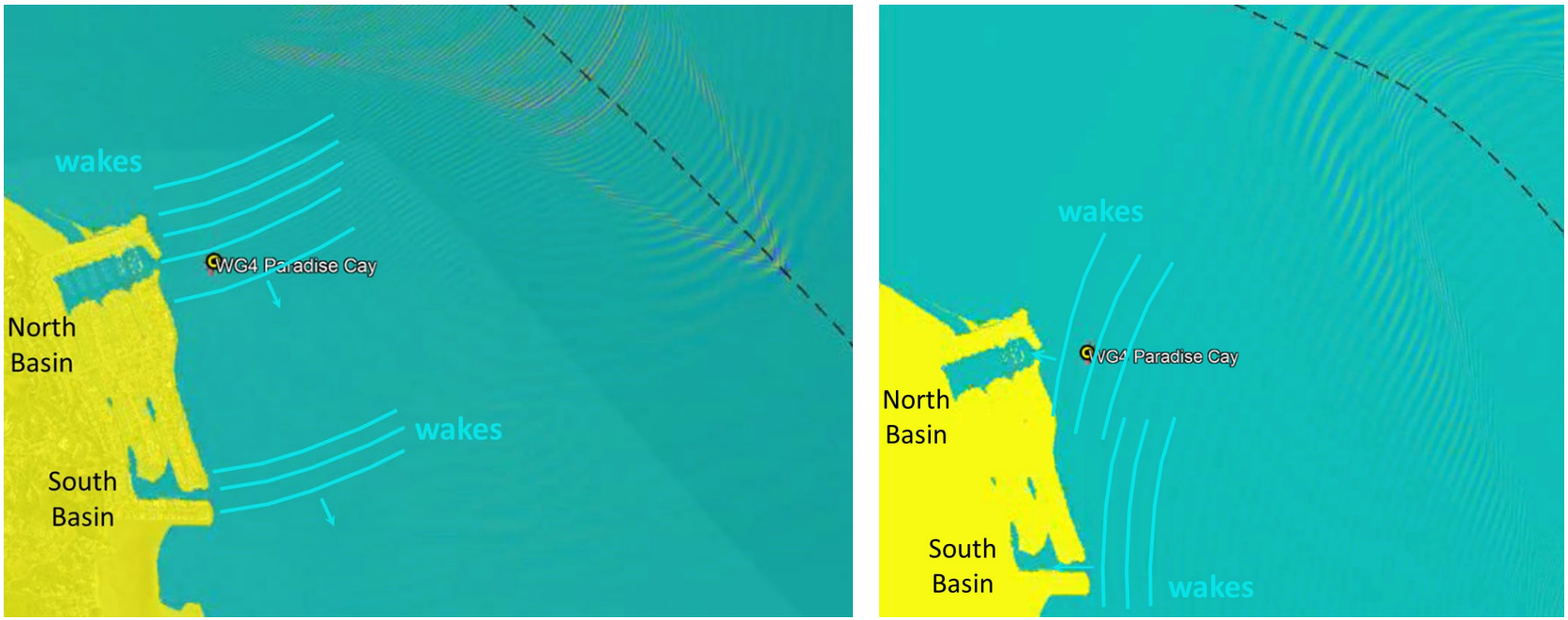


Figure 74. SPAULDING CLASS ferry wake patterns in the outbound (left) and inbound (right) directions at the Paradise Cay Yacht Harbor.

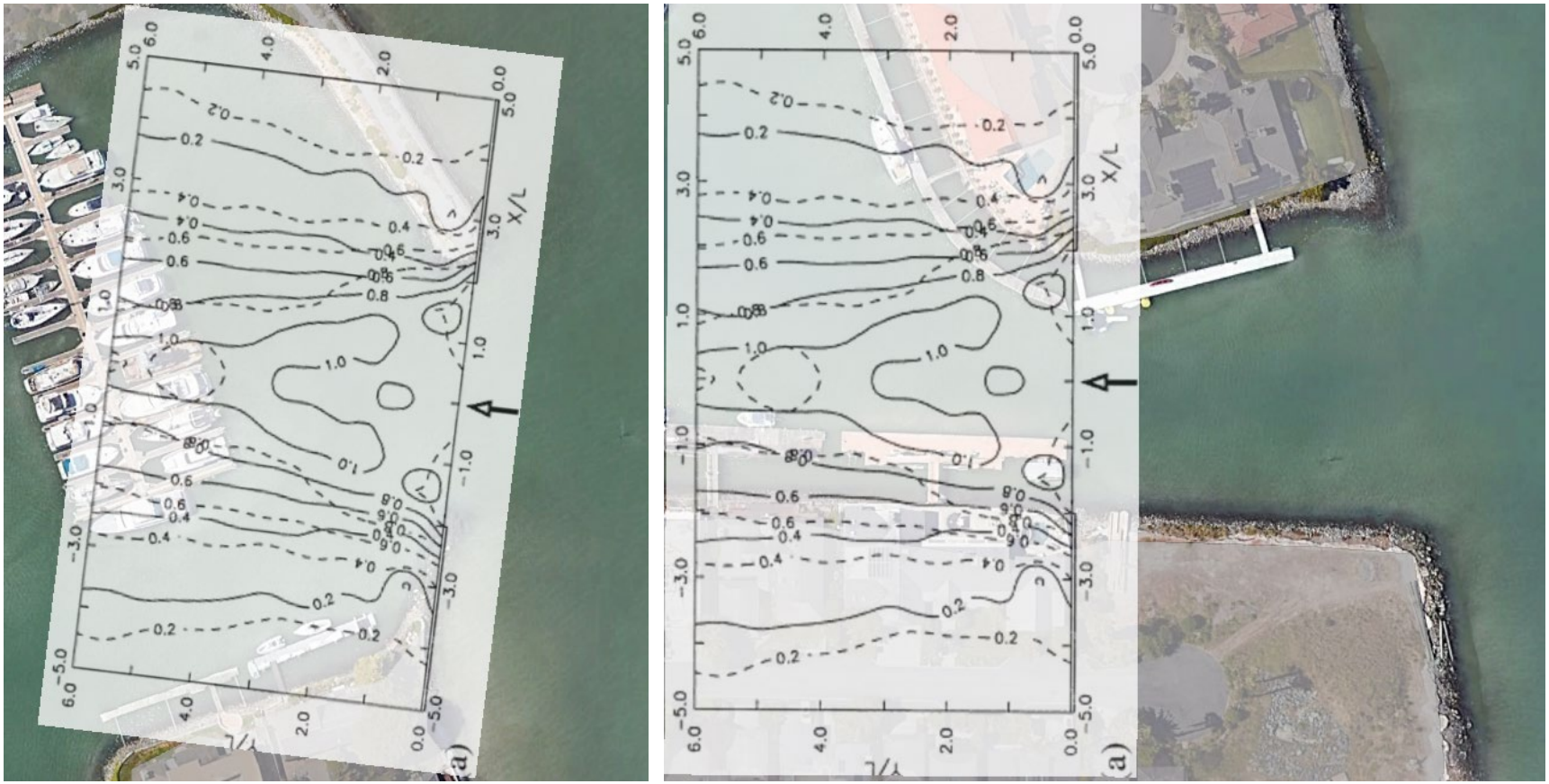


Figure 75. Experimental and numerical diffraction coefficients for unidirectional irregular waves through a breakwater, with gap (B) to wavelength (L) ratio B/L = 4 (Li et al.., 2000), Paradise Cay Yacht Harbor north basin (left) and south basin (right).

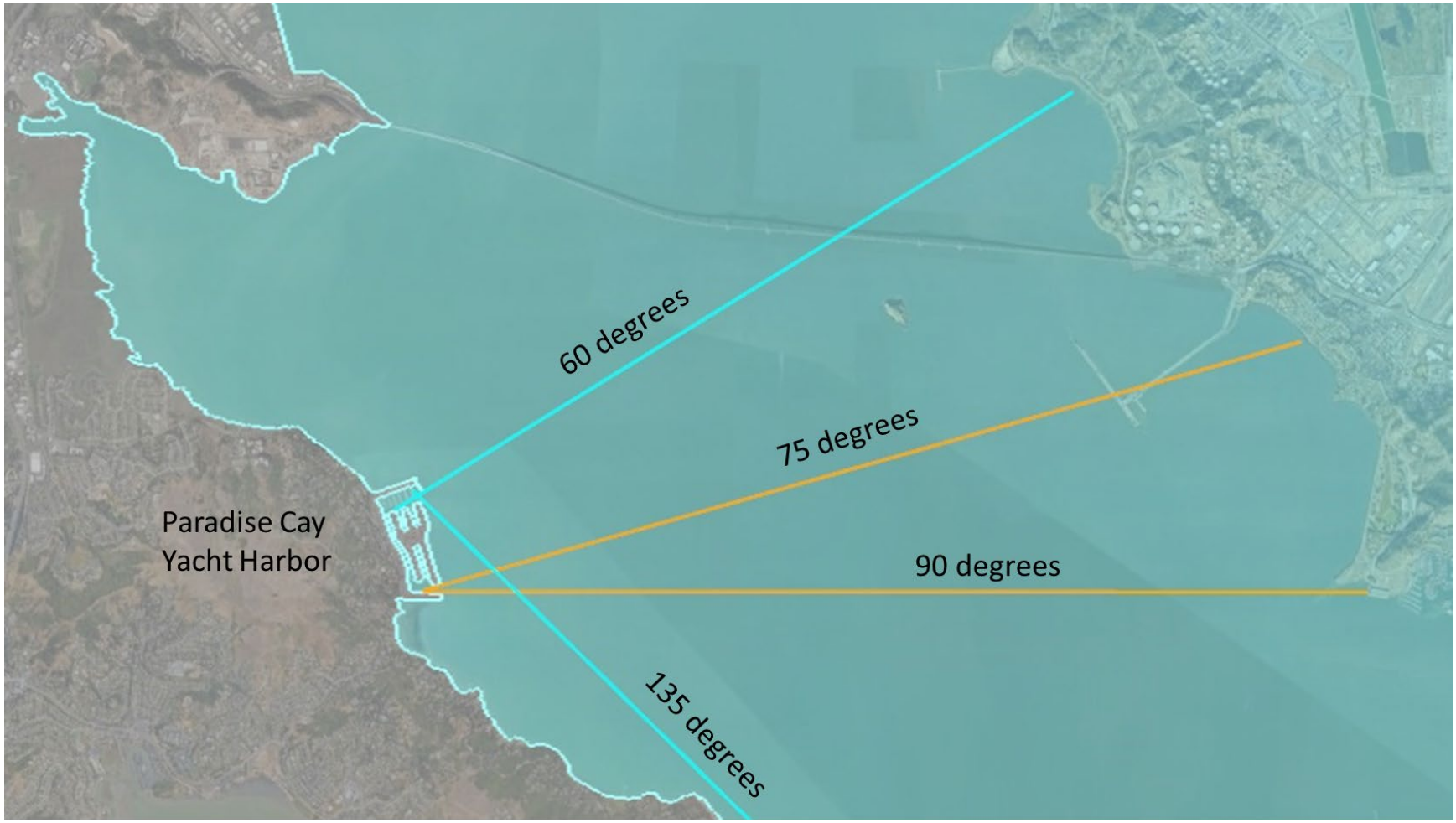


Figure 76. Wind and wave windows affecting Paradise Cay Yacht Harbor basins, north basin 60 to 135 degrees and south basin 75 to 90 degrees.

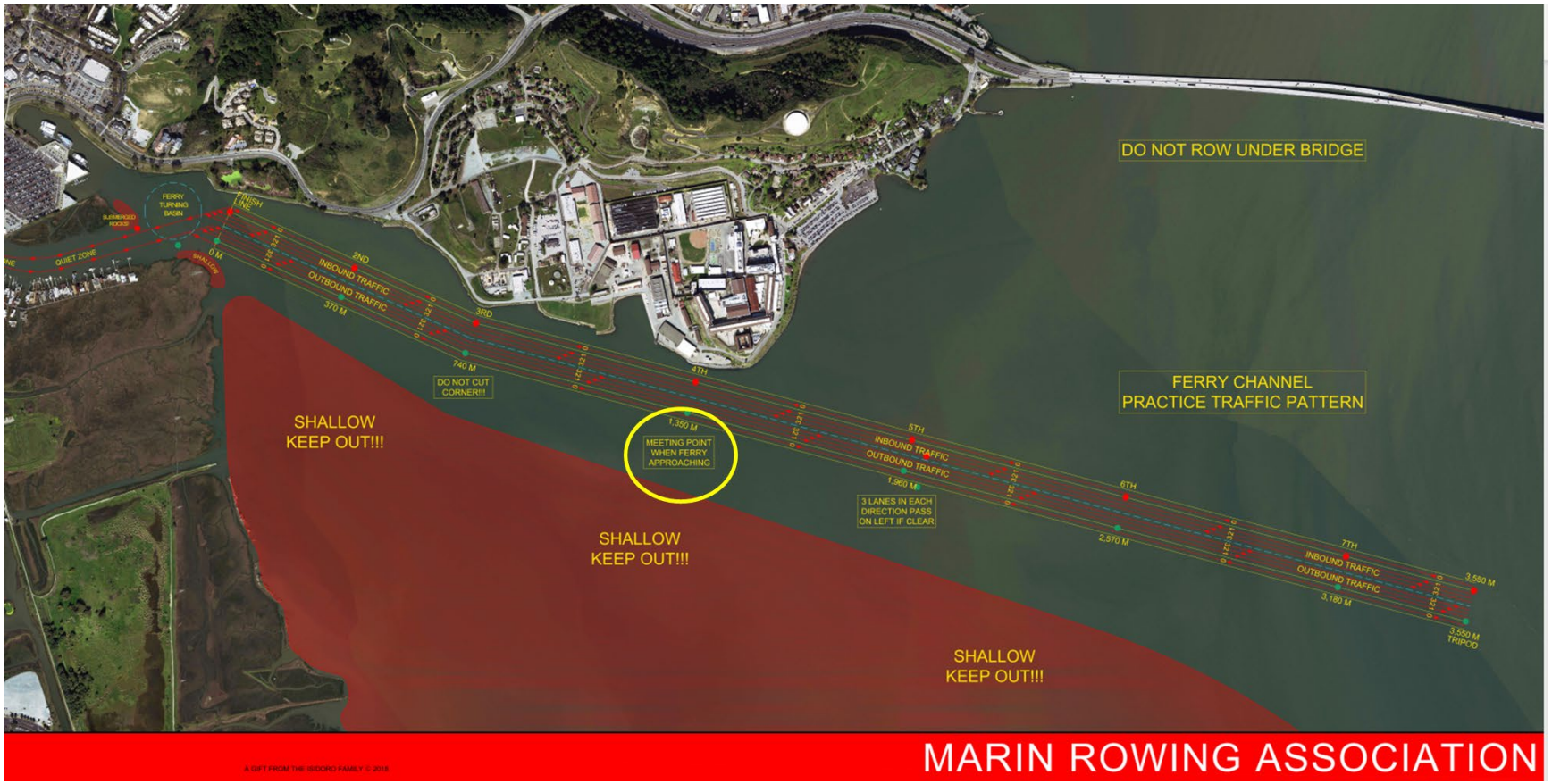


Figure 77. MRA rowing area and meeting point when ferry approaching (circled).

Appendix A. Collection of Information

Appendix A. Collection of Information

This appendix describes the collection information performed to characterize the area of interest for the Larkspur Ferry Wake Wash and Shoreline Erosion Analysis, and to provide the necessary information to define a baseline scenario, and perform the wake wash analysis and assessment of corresponding impacts. Generally, the area of interest consists of the Corte Madera Channel and vicinity and, specifically, the mudflat and tidal marsh [Corte Madera Ecological Reserve (CMER) marsh] to the southwest, the shoreline to the northeast of the Corte Madera Channel, docking facilities at the Greenbrae Boardwalk Community and the Paradise Cay Yacht Harbor.

1. Introduction

The characterization of the area of interest and the definition of the baseline scenario required the collection of a wide range of information which was achieved performing site visits, water level measurements and collecting existing information from stakeholders and the public domain. These consisted of data and information about:

- Topography and bathymetry
- Wind, waves, and water levels
- Coastal morphology, habitats and shoreline protection structures
- Greenbrae Boardwalk Community docking facilities
- Paradise Cay Yacht Harbor
- Ferry characteristics and operation

Geographical Information System (GIS) data was stored in the project GIS.

2. Topography and Bathymetry

The following were collected:

- 2015 post-dredge bathymetric survey (eTrac, 2015)
- 2018-2019 LIDAR survey, U.S. Geological Survey (USGS, 2019)
- 2010 bathymetry survey and Digital Elevation Model (DEM) of Corte Madera Bay (USGS, 2011)
- Coastal DEM of San Francisco Bay (NOAA, 2010)
- NOAA Nautical Chart 18653

3. Wind, Waves and Water Levels

Wind data was collected from NOAA's National Data Buoy Center Station TIBC1, which is an anemometer located on Tiburon Pier approximately 15 m (49 feet) above the mean sea level, and 5 miles to the southeast of the ferry terminal. Wind is not a relevant parameter for the wake wash and shoreline erosion analysis but is indicative (depending on wind speed, direction and duration) of the magnitude that wind-generated waves could reach in the area of interest. Wind data from July 8 to 14, 2021 were downloaded from TIBC1 and analyzed to help discriminate between wind-generated waves and ferry wakes measured during that period.

No third-party wave measurements are available for Corte Madera Bay. However, water surface elevations measured as part of the ferry wake measurements performed between July 8 to 14, 2021 were used to derive wave conditions.

No third-party water level measurements are available for Corte Madera Bay. However, water levels measured at NOAA San Francisco Station 9414290 (NOAA, 2021) were considered representative and were used to calibrate the water levels measured as part of the ferry wake measurements performed between July 8 to 14, 2021.

4. Coastal Morphology, Habitats and Shoreline Protection Structures

Descriptions and locations of coastal morphology, habitats and shoreline protection structures were developed from the inspection of aerial photos, a site visit, and databases. Stored in the project Geographical Information System (GIS) database, these included:

- Google Earth and ArcGIS Earth aerial photos
- Site visit of July 2021 (during the wake measurements from July 8 to 14, 2021)
- San Francisco Bay Shore Inventory GIS Data (SFEI, 2021a)
- Shoreline Vulnerability Index (BCDC, 2021a)
- San Francisco Bay Eelgrass 250m Buffer (BCDC, 2021b)
- San Francisco Bay Eelgrass 45m Buffer (BCDC, 2021c)
- California Aquatic Resource Inventory (CARI) Wetlands, Streams, and Riparian Areas (SFEI, 2021b)
- U.S. Geological Survey Data Series 182, usSEABED: Pacific Coast Offshore Surficial - Sediment Data Release, version 1.0 (USGS, 2021)
- FEMA Flood Zone (FEMA, 2021)
- Marin County Fine Scale Vegetation (2021)
- USDA Natural Resources Conservation Service Soil Types (2021)

5. Greenbrae Boardwalk Community Docking Facilities

Information about the Greenbrae Boardwalk Community docking facilities was collected from the inspection of aerial photos, a site visit, and the literature.

6. Paradise Cay Yacht Harbor

Information about the Paradise Cay Yacht Harbor was collected from the inspection of aerial photos, a site visit, and the literature.

7. Ferry Characteristics and Operations

Ferry characteristics (e.g., dimensions, displacement, power, propulsion and drawings) and operation (speeds, displacement, routes and schedule) were obtained from:

- GGBHTD Ferries particulars, routes and schedules (GGBHTD, 2021a, b)
- Del Norte hull lines (GGBHTD, 2021c)
- Mendocino hull lines (GGBHTD, 2021d)
- Spaulding Class hull lines (GGBHTD, 2021e)
- Napa and Golden Gate Ferries (Chinook Class) hull lines (Washington State Ferries, 2021)

8. References

eTrac. 2015. *Larkspur Ferry Terminal Berths and Channel Maintenance Dredging.* November.

Federal Emergency Management Administration (FEMA). 2021. *GIS Web Services for the FEMA National Flood Hazard Layer (NFHL)*. https://hazards.fema.gov/femaportal/wps/portal/NFHLWMS/. Accessed 2021.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2021a. *Ferry Vessels*. https://www.goldengate.org/ferry/history-research/fleet. Accessed 2021.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2021b. *Ferry Map and Schedule*. https://www.goldengate.org/ferry/route-schedule/larkspur-san-francisco/?backurl=%2Fferry%2Fschedules-maps%2F. Accessed 2021.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2021c. *AMD360-B Hull Lines.* AMD Drawing 9666.040.001, May 8, 1997. Delivered by email on April 23, 2021, by James Shea.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2021d. *43m Catamaran Ferry Hull Lines Plan*. Drawing No. R439 2398/1-11, July 2000, delivered on April 14, 2021, by James Shea. *43m Catamaran Passenger Ferry Hull Lines for Stern Extension*. Design IC14145, Sheet D-021, January 13, 2015. Delivered by email on May 18, 2021, by James Shea.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2021e. *170 ft AL Pass. Vessel: M/V San Francisco Lines Plan*. Drawing No. 7056-041-001, September 24, 2013..

Washington State Ferries. 2021. *Chinook Class AMD/D.C.I. 385 Hull Lines Plan. Drawing No. 4773.01-96, Filename 01-96S1. AMD Drawing 9676.040.001*. May 23, 1997. Delivered through Washington State Department of Transportation Public Disclosure Request Center on May 18, 2021, in response to Reference #P007802-051321.

Marin County. 2021. *Marin County Fine Scale Vegetation*. https://parksconservancy.maps.arcgis.com/apps/webappviewer/index.html?id=4ef2881436bc4365be881b17f69ab067. Accessed 2021.

National Oceanic and Atmospheric Administration (NOAA). 2010. *San Francisco Bay, California 1/3 arc-second NAVD88 Coastal Digital Elevation Model.* https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ngdc.mgg.dem:741. Accessed 2021.

National Oceanic and Atmospheric Administration (NOAA). 2021. *Tides and Currents.* https://tidesandcurrents.noaa.gov/datums.html?id=9414290. Accessed 2021.

San Francisco Bay Conservation & Development Commission (BCDC). 2021a. *Shoreline Vulnerability Index*. https://data-bcdc.opendata.arcgis.com/datasets/BCDC::shoreline-vulnerability-index-bcdc-2021/about. Accessed 2021.

San Francisco Bay Conservation & Development Commission (BCDC). 2021b. *San Francisco Bay Eelgrass 250m Buffer 2021*. https://data-bcdc.opendata.arcgis.com/datasets/sf-bay-eelgrass-250m-buffer-bcdc-2021/explore?location=37.813916%2C-122.301956%2C10.66. Accessed 2021.

San Francisco Bay Conservation & Development Commission (BCDC). 2021c. *San Francisco Bay Eelgrass 45m Buffer 2020*. https://data-bcdc.opendata.arcgis.com/datasets/sf-bay-eelgrass-45m-buffer-bcdc-2020/explore?location=37.813833%2C-122.301957%2C10.66. Accessed 2021.

San Francisco Estuary Institute & Aquatic Science Center (SFEI). 2021a. *San Francisco Bay Shore Inventory GIS Data*. https://www.sfei.org/data/sf-bay-shore-inventory-gis-data#sthash.DNQ8hXtU.psoUjubU.dpbs. Accessed 2021.

San Francisco Estuary Institute & Aquatic Science Center (SFEI). 2021b. *California Aquatic Resource Inventory (CARI) Wetlands, Streams, and Riparian Areas*. https://www.sfei.org/data/california-aquatic-resource-inventory-cari-version-11-gis-data#sthash.HDjnOrBM.dpbs. Accessed 2021.

U.S. Department of Agriculture. 2021. *Soil Data Explorer*. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Accessed 2021.

U.S. Geological Survey (USGS). 2019. *2018-2019 USGS Lidar: Northern California Wildfire - QL1*. https://www.fisheries.noaa.gov/inport/item/59131. Accessed 2021.

U.S. Geological Survey (USGS). 2011. *2010 Bathymetric Survey and Digital Elevation Model of Corte Madera Bay, California.* https://www.usgs.gov/publications/2010-bathymetric-survey-and-digital-elevation-model-corte-madera-bay-california. Accessed 2021.

U.S. Geological Survey (USGS). 2021. *U.S. Geological Survey Data Series 182, usSEABED: Pacific Coast Offshore Surficial - Sediment Data Release, version 1.0*. https://pubs.usgs.gov/ds/2006/182/data_cata.html. Accessed 2021.

Appendix B. Characterization of Baseline Scenario

Appendix B. Characterization of Baseline Scenario

This appendix presents a conceptual characterization of the area of interest for the Larkspur Ferry Wake Wash and Shoreline Erosion Analysis. Generally, the area of interest consists of the Corte Madera Channel and vicinity and, specifically, the mudflat and tidal marsh [Corte Madera Ecological Reserve (CMER) marsh] to the southwest, the shoreline to the northeast of the Corte Madera Channel, docking facilities at the Greenbrae Boardwalk Community and the Paradise Cay Yacht Harbor.

This characterization is based on observations during a site visit, and information provided by the GGBHTD and collected in the public domain. A summary of the sources of information collected is included in Appendix A. The focus of the characterization is on those aspects relevant to the potential environmental impacts of ferry operations like ferry transit frequency, velocity and routes.

1. General Setting

The following is a summary and adaptations of descriptions included mainly in PWA (1993).

The Larkspur Ferry Terminal is located at the northern end of Corte Madera Bay, just north of the mouth of the Corte Madera Creek which flows eastward into the bay. The bay is located on the northwestern area of Central San Francisco Bay, just south of the Richmond-San Rafael Bridge. It is a very shallow, mud bottom and broad embayment with average depths of less than 6 feet. It lies between Point San Quentin to the north and the Tiburon Peninsula to the south. The bay opens to the east-southeast and so, it is exposed to wind, waves and ship wakes from east-northeast to south-southeast. The terminal is serviced by an approximately 230-foot wide, 14-foot deep and 2.5-mile long navigation channel oriented parallel to the northern shoreline of the bay (eTrac, 2015).

Between the terminal and the San Quentin Prison, the northern shoreline of the bay (the southern shoreline of Point San Quentin) is armored with bulkheads, rubble, and riprap revetment. The shoreline along the southern margin of the Corte Madera Creek is not armored, rather it is composed of mudflats and tidal salt marsh of cordgrass and pickleweed. The Greenbrae Boardwalk Community, along the southern shore of the creek, is composed of a group of stilt homes built atop the marsh plain.

To the south of the navigation channel, along the southern shoreline of the bay is the 620-acre Corte Madera Ecological Reserve (CMER). It consists of three marshes, from north to south the Heerdt, North Muzzi, and Muzzi (inner and outer) Marshes, and an expansive mudflat that fronts the marshes and extends from the Corte Madera Creek to the north to the San Clement Creek to the south. Outside the CMER, the mudflat extends south along the Marina Village shoreline up to the Paradise Cay Yacht Harbor.

Figure 1 shows a map of Corte Madera Bay and the location of the various components of the area of interest.



Figure 1. Corte Madera Bay and locations of the Larkspur Ferry Terminal, navigation channel, Point Quentin, marshes, creeks, Greenbrae Boardwalk Community, Marine Village and Paradise Cay Harbor (source: ESRI ArcGIS Earth).

2. Bathymetry

Figure 2 shows the bathymetry of Corte Madera Bay in feet relative to the mean lower low water (MLLW). The bay bottom is relatively flat and dominated by the expansive mudflat fronting the CMER marshes. It slopes gently to the east into San Francisco Bay with depths ranging between 1 and 3 feet MLLW.

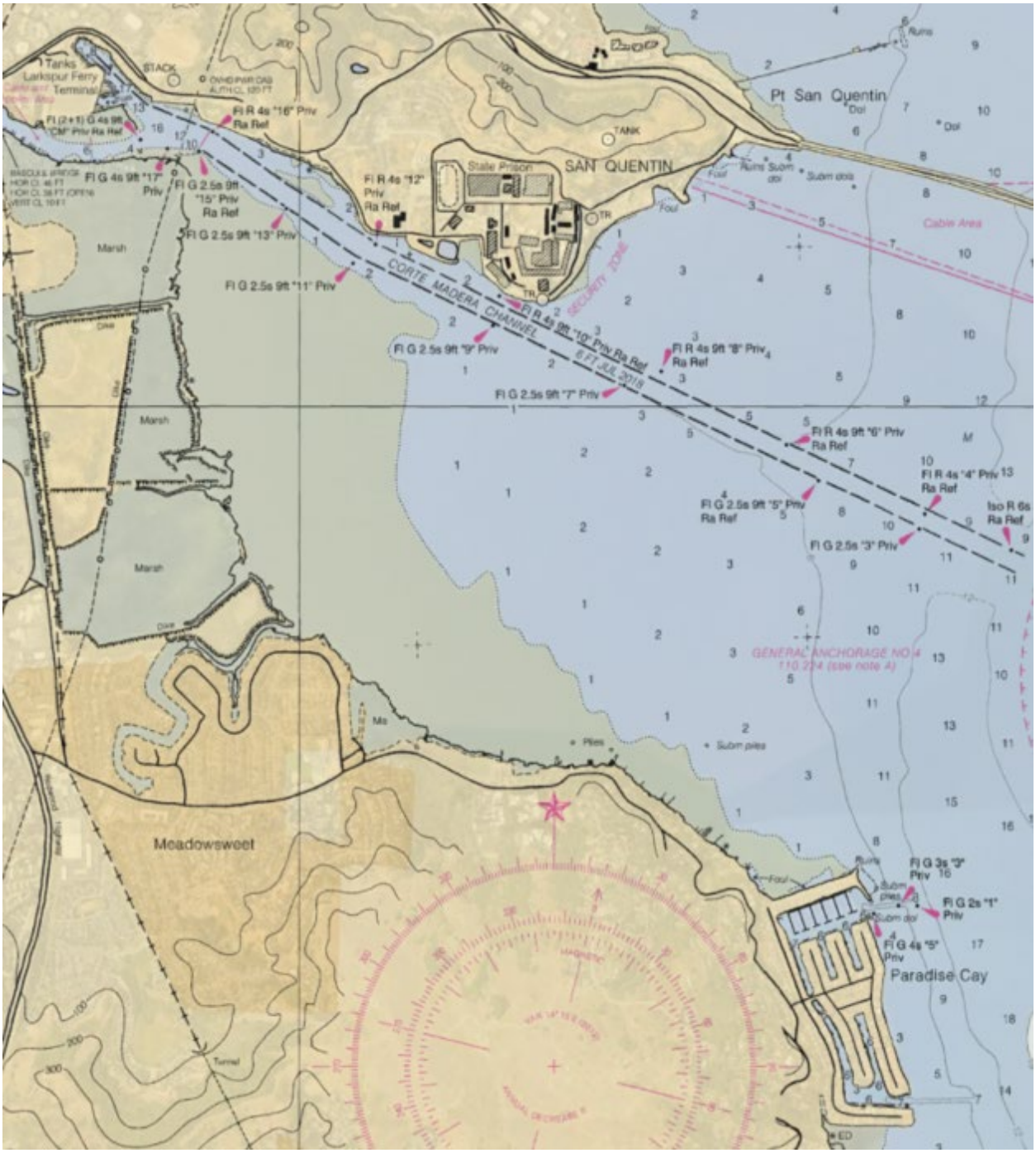


Figure 2. Corte Madera Bay bathymetry, depths in feet MLLW (source: NOAA chart 18653).

3. Bottom Sediment

A detailed characterization, by means of sampling and analyses, of the Corte Madera Bay bottom sediment does not exist. However, a sample taken by Lacy and Hoover (2011) at the eastern edge of the mudflat and to the east of the San Clemente Creek is considered the most recent and representative. The grain size

analysis showed that the sediment is predominantly silt (67 percent), with some clay (27 percent) and a small sand fraction (6 percent) characterizing it as silty clay. Their analysis also showed that the sediment has a bimodal distribution, with the largest peak at 0.04 mm and the smallest at 0.004 to 0.006 mm. PWA (1993 and 1995) also characterized the bottom sediment in Corte Madera Bay as silty clay (and clayey silt) commonly known as San Francisco Bay Mud.

4. Shoreline Inventory

The following is a summary and adaptations of descriptions mainly included in PWA (1995).

Using the Corte Madera Creek as a boundary, the shorelines of Corte Madera Bay can be divided into the northern and southern shorelines. The northern shoreline (the southern shoreline of Point San Quentin) from Point San Quentin to Corte Madera Creek is approximately 12,000 feet long. It includes some natural (unprotected) shoreline, but it is generally armored with bulkheads, rubble and riprap revetments. The shoreline inventory developed by SFEI (2021) refers to these structures as engineered levee, berm, and shoreline protection structure, respectively. The southern shoreline consists of undeveloped marsh and waterfront residences and is approximately 14,800 feet long between the Corte Madera Creek and the Paradise Cay Yacht Harbor northern jetty. The marsh plain is almost level and lies at an elevation of about 3.5 feet mean sea level (MSL). According to SFEI (2021), the southern shoreline consists of wetland and berms with some shoreline protection structures, mainly, along the southern end. The Paradise Cay Yacht Harbor features two entrance channels and is fully protected with riprap revetments. Figure 3 shows the shoreline types in Corte Madera Bay according to SFEI (2021).

The Greenbrae Boardwalk Community is an approximately 50-home community along the southern bank of the Corte Madera Creek. The homes are founded on piles and most feature docks for recreational boats, mainly powerboats in the 25 to 35-foot length range, and small craft like canoes and kayaks.



Figure 3. Shoreline types in Corte Madera Bay (source: SFEI, 2021).

5. Wind, Waves and Water Levels

The following is a summary and adaptations of descriptions mainly included in PWA (1995).

In general, the prevailing summer winds in San Francisco Bay are northwesterly and westerly winds that can reach average speeds greater than 9 mph. Although prevailing winter average wind speeds are generally lower, biweekly winter storms cause strong southeasterly and southerly winds that can sometimes exceed 40 mph. Diurnal wind variations are greatest during summer, with typical afternoon speeds (20 mph) three times faster than morning speeds.

The direction from which winds blow is crucial in wave generation. Corte Madera Bay opens to the east-southeast direction and so, it is exposed to wind and waves from east-northeast to south-southeast.

Besides these, Corte Madera Bay is also affected by vessel wakes which include ferries, commercial ships and recreational boats. Ferries have operated in northern San Francisco Bay since the 1860's. The Larkspur service began in 1976, and the Sausalito service began in 1970. Commercial ship traffic in northern San Francisco Bay has been relatively constant in the last 70 years, while large oil tankers have been regularly using the main shipping channel to San Pablo Bay in the last 40 years. Recreational boats have always been popular in San Francisco Bay. A number of boat berths were constructed in Corte Madera Creek (Greenbrae Boardwalk Community) between 1950 and 1970. However, the boat usage is not frequent.

San Francisco Bay is subjected to the mixed semi-diurnal tides of the Pacific Coast, meaning that there are two unequal high tides and two unequal low tides in each roughly 25-hour period. Tides reverse themselves four times each day at approximately six-hour intervals. The relatively narrow and long Corte Madera Bay and the shore-parallel alignment of the navigation channel suggests that ebbing and flooding tides induce shore-parallel currents.

No third-party water level measurements are available for Corte Madera Bay. However, water levels measured at NOAA San Francisco Station 9414290 are considered representative. Table 1 shows the water level datums per NOAA (2021). The tide range is approximately 6 feet and extreme total water levels can reach approximately 8.6 feet MLLW.

Table 1. Water level datums in San Francisco Bay station 9414290.

Datum		Level (feet)
100-year Total Water Level (TWL)		8.63
Maximum TWL observed		8.66
Highest Astronomical Tide	HAT	7.26
Mean Higher High Water	MHHW	5.84
Mean Sea Level	MSL	3.12
Mean Lower Low Water	MLLW	0
North American Vertical Datum 88	NAVD88	-0.06
Lowest Astronomical Tide	LAT	-1.93

6. Ferry Characteristics and Operations

At the Larkspur Ferry Terminal, the GGBHTD currently operates seven ferries:

- three monohull displacement type ferries of the SPAULDING CLASS: the SONOMA, SAN FRANCISCO and MARIN, and
- four catamaran type fast ferries: the NAPA, GOLDEN GATE, DEL NORTE and MENDOCINO.

The SPAULDING CLASS ferries are the same. However, among the fast ferries, the NAPA and GOLDEN GATE are sister ferries (i.e., same design, acquired from Washington State Ferries) and the DEL NORTE and MENDOCINO are different. General characteristics of the ferries are listed in Table 2 and photos are shown in Figure 4. Additional details can be found in GGBHTD (2021a, b).

Table 2. GGBHTD ferries characteristics.

	Spaulding Class	Del Norte	Mendocino	Napa[c]	Golden Gate[d]
Passengers	750[a], 630[b]	400	450	450	450
Speed (knots)	20.5	36	36	36	36
LOA	169′-1″	135′-4″	141′-1″	143′-3″	143′-3″
Beam	34′-3″	39′-4″	34′-0′	39′-4″	39′-4″
Mean Draft, Loaded	6′-0″	5′-0″	4′-9″	5′-0″	5′-0″

[a] Marin
[b] Sonoma and San Francisco
[c] formerly Snohomish
[d] Chinook



Figure 4. GGBHTD ferries (source: GGBHTD (2021c).

Ferry traffic within Corte Madera Bay is constrained to the 230-foot wide, 14-foot deep and 2.5-mile long navigation channel, which is wide enough for two-way ferry traffic. Away from the navigation channel the bay is too shallow and ferry traffic is not possible.

The GGBHTD services two routes from Larkspur: 1) to San Francisco (Ferry Building) and 2) to Oracle Park. The fast ferries operate the Larkspur-San Francisco route all days of the week, with a higher frequency of trips from Monday to Friday. The Spaulding Class ferries operate the Sausalito-San Francisco and Tiburon-San Francisco routes, but overnight at Larkspur departing to Sausalito and Tiburon early in the morning

and returning to Larkspur late in the evening. When baseball games are played at Oracle Park the Spauling Class ferries service the Larkspur-Oracle Park route.

To mitigate the impact of wakes on the shorelines the maximum number of ferry crossings is 42 per day, and the ferries transit the navigation channel at a limiting speed of 10 knots. Beyond the end of the channel the fast ferries transit at their design speeds. The Spaulding Class ferries make the crossing in approximately 45 minutes and the fast ferries in approximately 30 minutes.

7. Coastal Morphology and Habitats

Given the ecological significance of the CMER, the most studied coastal process in Corte Madera Bay is the interaction between waves, bottom, water levels and shorelines, in particular along the shoreline of the CMER and its fronting mudflat. The most recent and comprehensive of such studies was the one performed by the USGS (Carkin et al., 2020) which noted that the Corte Madera Bay shoreline has retreated significantly during the 163-year period from 1853 to 2016. Total shoreline retreat during that period ranged from about 70 to 150 m (230 to 492 feet), which corresponds to a long-term rate of 0.4 to 0.9 m/year (1.3 to 3 feet/year), depending on the location along the highly irregular shoreline. Carkin et al. (2020) also noted evidence of high retreat rates due to strong human-influenced effects, like the Muzzi dike borrow canal, and hypothesized that the relatively high retreat rates in the central part of the CMER are likely due to greater exposure and focusing of wave energy reflection or refraction within Corte Madera Bay. Finally, they noted that the ferry wakes have not resulted in a higher shoreline retreat rate in the unprotected Corte Madera Creek shoreline (Greenbrae Boardwalk Community) than in the bay-facing section of the marsh in that area.

A similar conclusion was reached by Brady and Associates (1995). Resulting from their Larkspur Ferry Acquisition Initial Study/Environmental Assessment they noted that the marshes in Corte Madera Bay have been continuously eroding over the last 140 years (to 1992) at a rate of about 1.6 to 2.3 feet/year (0.5 m/year to 0.7 m/year) and that wave energy is the primary factor of marsh erosion. Furthermore, they noted that, at the time of their study, the retreat rate at CMER was the same as it was before Larkspur Ferry service began in 1976. Their estimated retreat rates are very similar to those estimated by Carkin et al. (2020).

Recognizing the historical retreat of the CMER marsh, and to mitigate the erosion effects of waves and enhance the shoreline resilience in the face of sea level rise/climate change, the Marin Community Foundation funded in 2017 the development of a conceptual design to reduce the rate of salt marsh scarp retreat caused by wave erosion and long-term sediment deficits by using methods analog to regional salt marsh-fringing barrier beaches (Baye, 2020). As part of that project, the San Francisco Estuary Institute (SFEI) conducted two drone surveys over a roughly 80-acre area to investigate change along the marsh edge over a one-year timespan (SFEI and Baye, 2020). SFEI estimated marsh sediment loss from the scarp retreat from 2018-2019 to be about 30,000 metric tons, and estimated average marsh scarp retreat rates over time periods 1993-2010 and 2010-2018 similar to those of the USGS (Carkin et al., 2020) (1992-2016). The differences among corresponding long-term marsh scarp retreat rates by SFEI and USGS are less than 1 m/year (3.3 feet/year).

Water turbidity is associated with sediment in suspension that reduces the penetration of light below the water surface, photosynthesis and productivity. According to Baye (2020), the mudflat has naturally high background levels of suspended sediment during low to moderate wave activity, as well as during high wave activity. Benthos (bottom organisms) in Corte Madera Bay are already adapted to the natural,

historically high levels of turbidity. According to Brady and Associates (1995), there are no special status benthos in Corte Madera Bay and most are well adapted to the bay's variable hydrologic conditions.

8. References

eTrac. 2015. *Larkspur Ferry Terminal Berths and Channel Maintenance Dredging.* November.

Baye, P. 2020. *Conceptual Designs For Marsh-Fringing Beach Nourishment to Reduce Wave Erosion of Muzzi Marsh, Corte Madera Ecological Reserve, Marin County, California.* Task 3 Technical Memorandum for "New Life for Eroding Shorelines". San Francisco State University – Estuary & Ocean Science Center, Tiburon, California. September.

Brady and Associates. 1995. *Larkspur Ferry Acquisition, Initial Study/Environmental Assessment*. Golden Gate Bridge Highway and Transportation District. June.

Carkin, B.A., Kayen, R.E. and F.L. Wong. 2020. *Shoreline Retreat of the Corte Madera Marshes, 1853 to 2016, Marin County, California*. U.S. Geological Survey, Open-File Report 2020-1074.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2021a. *Ferry Vessels*. https://www.goldengate.org/ferry/history-research/fleet. Accessed 2021.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2021b. *Ferry Map and Schedule*. https://www.goldengate.org/ferry/route-schedule/larkspur-san-francisco/?backurl=%2Fferry%2Fschedules-maps%2F. Accessed 2021.

Golden Gate Bridge Highway and Transportation District (GGBHTD). 2021c. *Golden Gate Ferry Fleet.* https://www.goldengate.org/ferry/photo-gallery/golden-gate-ferry-fleet. Accessed 2021.

Lacy, J.R. and D.J. Hoover. 2011. *Wave Exposure of Corte Madera Marsh, Marin County, California - A Field Investigation*. Open-File Report 2011–1183. U.S. Geological Survey.

National Oceanic and Atmospheric Administration (NOAA). 2021. *Tides and Currents.* https://tidesandcurrents.noaa.gov/datums.html?id=9414290. Accessed 2021.

Phil Williams & Associates (PWA). 1993. *An Analysis of the Relative Effect of Ferry Wakes on Shoreline Erosion at the Corte Madera Ecologic Reserve*. August.

Phil Williams & Associates (PWA). 1995. *An Assessment of the Impact of the Operation of an Additional Ferry on Shoreline Erosion in Marin County*. April.

San Francisco Estuary Institute (SFEI) and P. Baye. 2020. *New Life for Eroding Shorelines: Beach and Marsh Edge Change in the San Francisco Estuary*. Publication #984, San Francisco Estuary Institute, Richmond, CA. Version 1.0. April.

San Francisco Estuary Institute & Aquatic Science Center (SFEI). 2021. *San Francisco Bay Shore Inventory GIS Data*. https://www.sfei.org/data/sf-bay-shore-inventory-gis-data#sthash.DNQ8hXtU.psoUjubU.dpbs. Accessed 2021.

D2. Corte Madera Creek Ferry Wake Study

Corte Madera Creek Ferry Wake Study

Revision: 0

Golden Gate Bridge, Highway and Transportation District

Larkspur Ferry Service and Parking Expansion Study
August 26, 2026

Corte Madera Creek Ferry Wake Study

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Executive Summary

Introduction

Golden Gate Bridge, Highway and Transportation District (District) ferries arriving at the Larkspur Ferry Terminal (Terminal) generate wakes. At the Terminal and in its immediate vicinity, these wakes are negligible due to the ferries' low relative velocities (Jacobs 2023). However, neighbors at the nearby Greenbrae Boardwalk Community (Community) in the Corte Madera Creek (Creek) inlet have expressed concerns about damage to boats and docks due to the wakes and shoreline erosion.

At the directive of the District and to supplement the assessment presented by Jacobs (2023), Jacobs performed the Corte Madera Creek Ferry Wake Study (Study). The Study consisted of measuring for approximately 3 months water surface elevations with capacitance-type gauges at four locations in the vicinity of the Terminal and in the Creek. The measured data were analyzed to determine the characteristics of wind-generated waves (wind-waves) and wakes generated by both the catamaran-type fast ferries and the monohull Spaulding Class ferries arriving at the Terminal.

The Study consisted of the following tasks:

- Task 1 – Planning
- Task 2 – Wake Gauges Deployment, Maintenance, and Retrieval
- Task 3 – Data Collection
- Task 4 – Data Processing
- Task 5 – Data Analysis

The following sections describe the work performed in these tasks and the results of the Study.

Planning

The water surface elevation measurements were performed with Wave Logger III OSSI-010-010 capacitance-type gauges manufactured by Ocean Sensor Systems. These gauges are battery powered, autonomous, and sample at 10 hertz (Hz); data are stored onboard on a Secure Digital (SD) card.

To determine the appropriate number and locations for installing the gauges, a site inspection was conducted on January 16, 2025, in coordination with representatives from the Community. The inspection was carried out by boat by a team consisting of District staff, Community members, and the District's consultants. The team navigated around the Creek on a small motorboat, discussed wake propagation, checked locations and water depths, and selected six preliminary wake gauge (WG) locations. The selected locations satisfied key criteria, including adequate water depth, minimal exposure to boat traffic and obstructions, suitable bottom conditions or structural features for securing the gauges (e.g., piles, docks, piers), convenient access for maintenance, and reasonable protection against theft.

Once the WG locations were selected, the team observed the propagation wakes generated by the District's fast ferries that arrived at the Terminal at around 12:19 and 13:13. As is typical with ship wakes, the observed wakes consisted of a series of small waves increasing in height up to a relatively high (peak) wave and then smaller waves that dissipated over time. To assess the wake conditions at the Community and document their effects on the berthed boats and docks, the team followed the wakes by boat and recorded video. An approximately 6-inch peak wave was observed at channel marker 17 at 12:19:31 due to the passing of the first fast ferry. The inspection of the video indicated that the wave period was approximately 1.4 seconds, which was consistent with a numerical calculation. By the time the wake arrived at 147 Greenbrae Boardwalk pier at approximately 12:20:30 it had already dissipated significantly

and was negligible and inconsequential for the dock and boat berthed there. This was also observed at all docks and boats upstream along the Creek.

An approximately 6-inch peak wave was observed at around 13:13:37 at channel marker 17 due to the passing of the second arriving fast ferry. The inspection of the video indicated that the wave period was approximately 1.3 seconds, which was consistent with a numerical calculation. By the time the wake reached the 147 Greenbrae Boardwalk pier at approximately 13:14:44 it had already dissipated significantly and was negligible and inconsequential for the dock and boat berthed there. This was also observed at all docks and boats upstream along the Creek.

Wake Gauges Deployment, Maintenance and Retrieval

Prior to deployment from March 16 to 18, 2025, the calibrations of the six WGs planned for deployment were checked on a dock at the Terminal. Out of the six WGs, five checked successfully, resulting in the exclusion of one of the originally planned locations. The WGs were deployed on March 18, 2025, from a small motorboat by two Jacobs and two District (driver and deck hand) staff. The deployment locations are shown on Figure ES-1. WG_133 and WG_MF (Mudflat) were not deployed at their planned locations. At the request of the 133 Greenbrae Boardwalk homeowner, WG_133 was deployed at approximately 40 feet downstream from the planned location to allow for more boat maneuvering space. At the request of the Marin Rowing Association, WG_MF was deployed approximately 100 feet upstream and closer to shore from the planned location to avoid obstructing rowers.



Figure ES-1. Locations of WGs Deployed on March 18, 2025
Source: Google Earth Vexcel Imaging US

To check on WG performance and collect data, the WGs were serviced two times by Jacobs and District staff, on April 21 and May 21, 2025. Servicing was conducted from a motorboat at high tide to minimize the risk of grounding the motorboat. The WGs were retrieved on June 12, 2025, 86 days (12.3 weeks) after installation.

Data Collection

Four primary datasets were collected: continuous 10-Hz water surface elevations from the WGs; reference tide data from National Oceanic and Atmospheric Administration station 9414863 Richmond to validate the gauge-derived tides; ferry track records from the San Francisco Marine Exchange detailing name, coordinate history, velocity, and course; and wind velocity/direction from National Data Buoy Center station TIBC1 at the Tiburon Pier to aid in separating wind-waves from ferry wakes.

Between March 19 and June 11, 2025, District ferries made a total of 1,280 arrival trips. The operating fleet consisted of four catamaran-type fast ferries (NAPA, GOLDEN GATE, DEL NORTE, MENDOCINO) and three monohull Spaulding Class ferries (MARIN, SAN FRANCISCO, SONOMA).

Data Processing

Because raw measurements contain the superposition of multiple processes, frequency-domain filtering was used to isolate individual components based on their frequencies: astronomical tides (~12.4 hours), seiching/infragravity waves (minutes to hours), ocean swell (10 to 20+ seconds), local wind-waves (2 to 5 seconds), and ferry wakes (estimated at 1.4 to 3 seconds). The daily 10-Hz raw count records (864,000 samples per day) were converted to physical units and filtered: tide was extracted using a low-pass filter, the water surface elevation was extracted with a band-pass filter, and the significant wave height was derived using the standard deviation of the water surface elevation calculated over a 12-minute window.

Ferry track records were processed to identify the ferry velocity, course, and passing times corresponding to each ferry's closest distance to WG_CM17. Trips were filtered based on three selection criteria: arrival between 6:00 and 21:00; distance to WG_CM17 of 360 feet or less; and ferry velocity of 4.7 knots or higher. Screening per these criteria resulted in a subset of 1,019 trips (935 fast ferry and 84 Spaulding Class trips) for analysis.

Data Analysis

To verify wake gauge performance, the continuous water levels (WLs) derived from the WGs were compared with National Oceanic and Atmospheric Administration station 9414863 Richmond measurements. While low-tide differences of 0.6 to 0.8 meter (2.0 to 2.6 feet) were initially observed, comparing the independent, co-located sensors at WG_CM17 and WG_CM revealed almost identical WLs, ruling out sensor malfunction. The discrepancies observed during low tides in the later stages of the second and third deployments were attributed to debris and marine growth accumulating on the lower sections of the coaxial staffs at WG_CM17, WG_CM, WG_147, and WG_MF. Additionally, WG_133 suffered high-tide data clipping at approximately 1 meter [3.28 feet] above mean sea level (MSL), leading to moisture intrusion inside its waterproof electronics enclosure, which rendered its data unusable; WG_133 data were therefore excluded from the Study.

The critical sector for wind-wave generation affecting the Terminal lies between 115 and 135 degrees. A relatively strong wind event occurred on March 30, 2025, during which wind from 130 degrees generated a significant wave height of about 6 inches at the highly exposed WG_CM17. In contrast, the sheltered WG_CM did not record a comparable wave height because it was located downwave and was partially sheltered by the southern shoreline of the Creek. Furthermore, WLs during this event were low (~0.7 foot mean lower low water), causing the wind-waves to break in the shallow nearshore mudflats before reaching WG_CM. No wind-waves reached the sheltered inner locations of WG_147 and WG_MF. Throughout the 3-month Study, wind-waves were generally negligible as winds from the critical sector rarely exceeded 10 knots.

Of the 1,019 trips considered for analysis, daily time histories of water surface elevation, significant wave height, and ferry passings were visually inspected (332 daily plots) to identify events that could be relevant to the Community's concerns (ferry wakes, wind-waves and shoreline erosion). A total of 42 trips (39 fast ferry and 3 Spaulding Class trips) were selected, analyzed, and assessed as inconsequential with respect to the Community's concerns.

Continuous measurements demonstrated that fast ferry wakes at the closest and most exposed locations (WG_CM17 and WG_CM) were typically negligible, remaining less than 4 inches peak to peak and never exceeding 6 inches peak-to-peak. Furthermore, relative to wind-waves, wakes are of a relatively short ephemeral duration, lasting only a few seconds compared to wind-waves, which persist for hours.

At WG_147, a rare wave measuring approximately 12 inches peak-to-peak was recorded on May 15, 2025, prior to the passage of the NAPA ferry. Because similar waves were recorded when no ferries were arriving, these waves were attributed to powerboats that are berthed in and regularly transit the Creek. Spaulding Class monohull ferries (such as the SAN FRANCISCO and MARIN) generated wakes that were consistently less than 4 inches peak to peak.

Conclusions

Based on the nearly 3-month Study period, which was of sufficient duration to capture representative wind-wave and ferry wake conditions, the following conclusions are considered representative of and applicable to typical ferry operations throughout the year:

1. Fast Ferry Wakes
    a) Wakes are typically negligible: Records show that fast ferry wakes at the most exposed and closest locations to the ferry tracks (WG_CM17 and WG_CM) were typically negligible (less than 4-inch peak-to-peak high) and never exceeded 6 inches peak to peak. Furthermore, relative to wind-waves, wakes were of a relatively short ephemeral duration, lasting only a few seconds compared to the wind-waves that last several minutes to hours.
    b) Indistinguishability from ambient conditions: In multiple instances, fast ferry wakes were indistinguishable from ambient wind-waves.
    c) Wind-wave enhancement: During strong wind events, ferry wakes can combine with the co-occurring wind-waves, as observed when the DEL NORTE wake reached an approximately 10-inch peak-to-peak height during the strong wind event of March 30, 2025. It must be noted that, in perspective, the impact of that few-seconds duration wave would be negligible compared to the impact of the wind-waves that lasted several hours that day.
2. Spaulding Class Ferry Wakes
    a) Consistently low: Wakes generated by the monohull Spaulding Class ferries were typically negligible and less than a 4-inch peak-to-peak high.
    b) Minimal ambient contrast: Similar to fast ferries, the wakes from Spaulding Class ferries were frequently indistinguishable from wind-waves under typical ambient conditions.
3. Wake Dissipation and Shoreline Impact
    a) Rapid wave energy dissipation: Observations during the site inspection showed that fast ferry wakes dissipate rapidly as they propagate away from the ferry track. For example, a 6-inch peak wave observed at CM17 dissipated to a negligible and inconsequential height by the time it reached the 147 Greenbrae Boardwalk pier, causing no disruption to the dock or berthed boat.

b) No Creek penetration and long-distance attenuation: Observations during the site inspection revealed no wake penetration reaching the inner creek inlet (located between 69 and 101 Greenbrae Boardwalk). Wakes traveling to distant locations in the Creek (such as WG_MF, located approximately 1,500 feet from the ferry track) take 2 to 3 minutes to arrive and are significantly dissipated by the time they reach that area of the mudflat.

4. Impact of Wind-Waves versus Ferry Wakes

   a) Wind-wave dominance during strong winds: Strong winds from the 115 to 135 degrees sector are capable of generating waves that equal or exceed typical ferry wakes. A strong wind event on March 30, 2025, produced significant wave height (H_s) of about 6 inches at WG_CM17 and 3 inches at WG_CM.

   b) Sheltering: While the WG_CM17 location is highly exposed, the inner locations such as WG_CM, WG_147, and WG_MF are physically sheltered from wind-waves by the southern shoreline of the Creek and shallow nearshore depths that cause waves to diffract and break before propagating upstream the Creek.

   c) Low ambient baseline: Wind-waves at the monitoring stations were typically negligible throughout the study, as winds from the 115 to 130 degrees sector rarely exceeded 10 knots.

5. Non-Ferry Vessel Wakes

   a) High wake events: A rare wake event with an about 12-inch peak-to-peak high wave was recorded at WG_147 on May 15, 2025, prior to a ferry passing.

   b) Attribution to local powerboats: Because similar large peak-to-peak waves were recorded when no fast ferries were arriving, these are attributed to the numerous private powerboats berthed in and regularly transiting the Creek.

6. WG Performance and Data Quality

   a) Validation of sensor accuracy: Dual independent, nearly co-located gauges (WG_CM17 and WG_CM) recorded almost identical WLs, validating the reliability of the instrumentation and ruling out gauge malfunction as a source of anomalies.

   b) Debris and marine growth impacts: Discrepancies observed at the lowest tide levels during the later stages of the second and third deployments could have been caused by debris and marine growth accumulating on the lower sections of the coaxial staffs.

   c) Moisture intrusion failure: The gauge at WG_133 suffered high-tide clipping at approximately 1 m (3.28 feet) MSL, which may have led to moisture intrusion inside its waterproof electronics enclosure, rendering its data unusable and requiring its exclusion from the Study.

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Acronyms and Abbreviations

η	water surface elevation
ρ	seawater density
σ	standard deviation
ASCII	American Standard Code for Information Interchange
CM	channel marker
Community	Greenbrae Boardwalk Community
Creek	Corte Madera Creek
CSV	comma-separated values
District	Golden Gate Bridge, Highway and Transportation District
H_s	significant wave height
Hz	hertz
MLLW	mean lower low water
MSL	mean sea level
NOAA	National Oceanic and Atmospheric Administration
PVC	polyvinyl chloride
SD	Secure Digital
Study	Corte Madera Creek Ferry Wake Study
T	wake period
Terminal	Larkspur Ferry Terminal
WG	wake gauge
wind-wave	wind-generated wave
WL	water level

1. Introduction

The Golden Gate Bridge, Highway and Transportation District (District) ferries arriving at the Larkspur Ferry Terminal (Terminal) generate wakes. At the Terminal and in its immediate vicinity these wakes are negligible due to the ferries' low relative velocities (Jacobs 2023). However, neighbors at the nearby Greenbrae Boardwalk Community (Community) in the Corte Madera Creek (Creek) inlet have expressed concerns about damage to boats and docks due to the wakes and shoreline erosion.

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The following sections describe the work performed in these tasks and the results of the Study.

2. Planning

The water surface elevation measurements were performed with Wave Logger III OSSI-010-010 capacitance-type gauges manufactured by Ocean Sensor Systems and leased from Coastal Leasing Inc. These gauges are battery-powered, autonomous, and sample at 10 hertz (Hz); data are stored onboard on a Secure Digital (SD) card. Jacobs coordinated the procurement and shipping of the gauges, acquired all necessary hardware to deploy the gauges (pipes, tie-wraps, screws, etc.), and coordinated the deployment with the District. Figure 1 shows the schematic of the gauge.

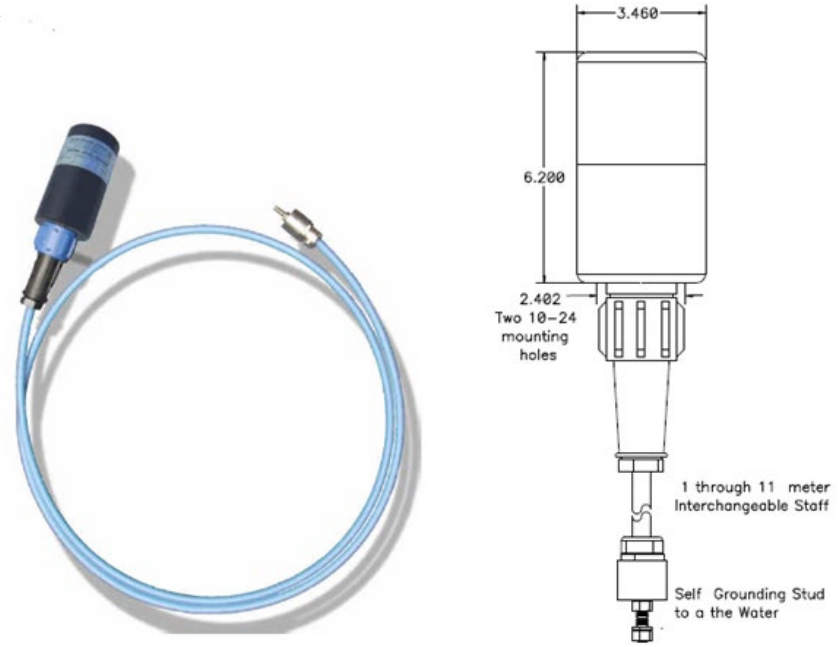


Figure 1. Ocean Sensor Systems Wave Logger III Capacitance-Type Gauge

To determine the appropriate number and locations for installing the gauges, a site inspection was conducted on January 16, 2025, in coordination with representatives from the Community. The inspection was carried out by boat by a team consisting of District staff, Community members, and the District's consultants.

Between 11:00 and 12:15, the team navigated around the Creek on a small motorboat, discussed wake propagation, checked locations and water depths, and selected six preliminary wake gauge (WG) locations. Weather conditions were ideal with negligible wind and no waves and rising tide at approximately 6 feet mean lower low water (MLLW) per the National Oceanic and Atmospheric Administration (NOAA) station 9414863 at Richmond (NOAA 2025). The station is located approximately 5 nautical miles to the east of the Terminal at the Chevron Long Wharf tanker terminal.

The selected locations satisfied key criteria, including adequate water depth, minimal exposure to boat traffic and obstructions, suitable bottom conditions or structural features for securing the gauges (e.g., piles, docks, piers), convenient access for maintenance, and reasonable protection against theft. Figure 2 shows the selected locations for the gauges, where CM17 is Channel Marker 17; CM is Channel Marker (not numbered); 147 and 133 are the locations close to the homes at 133 and 147 Greenbrae Boardwalk, respectively; Creek is located at the inlet of the creek between the homes at 69 and 101 Greenbrae Boardwalk; and Mudflat is at the mudflat just south of the Terminal.

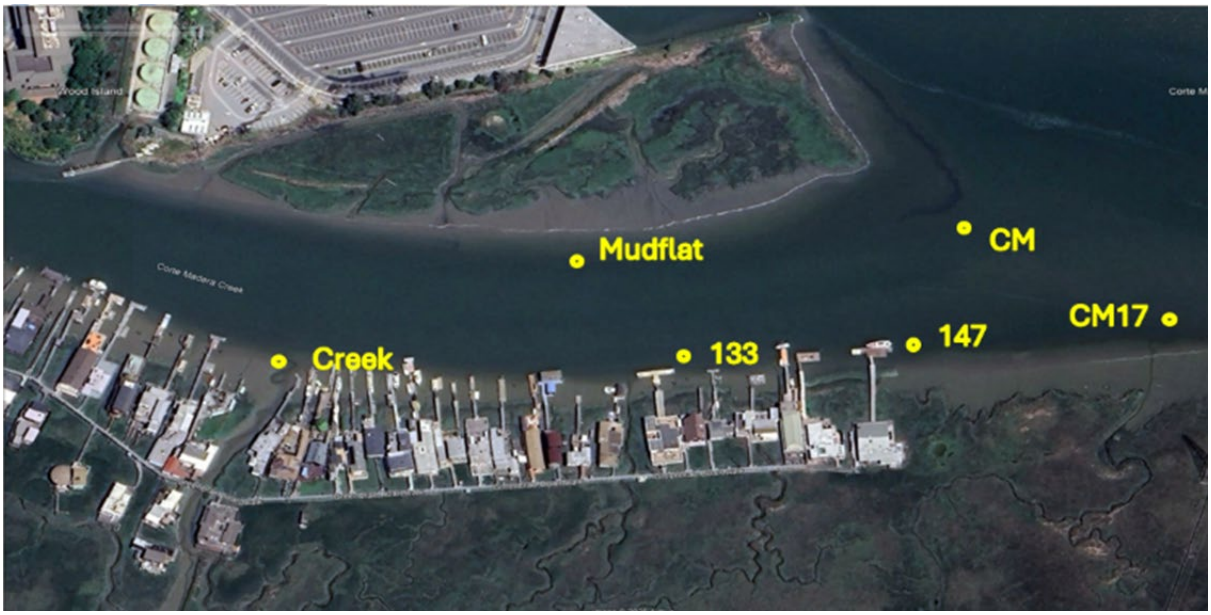


Figure 2. Locations of the Wake Gauges Selected on January 16, 2025

Once the WG locations were selected, the team observed the propagation wakes generated by District's fast ferries that arrived at the Terminal at around 12:19 and 13:13. As is typical with ship wakes, the observed wakes consisted of a series of small waves increasing in height up to a relatively high (peak) wave and then smaller waves that dissipated over time. To assess the wake conditions at the Community and document their effects on the berthed boats and docks, the team followed the wakes by boat and recorded video.

Figure 3 shows the approximately 6-inch peak wave observed at around 12:19:31 at CM17 due to the passing of an arriving fast ferry. The inspection of the video indicated that the wave period was approximately 1.4 seconds. Figure 4 shows that the wake reaching the 147 Greenbrae Boardwalk pier at approximately 12:20:30 had already dissipated significantly and was negligible and inconsequential for the dock and boat berthed there. This was also observed at all docks and boats upstream along the Creek.

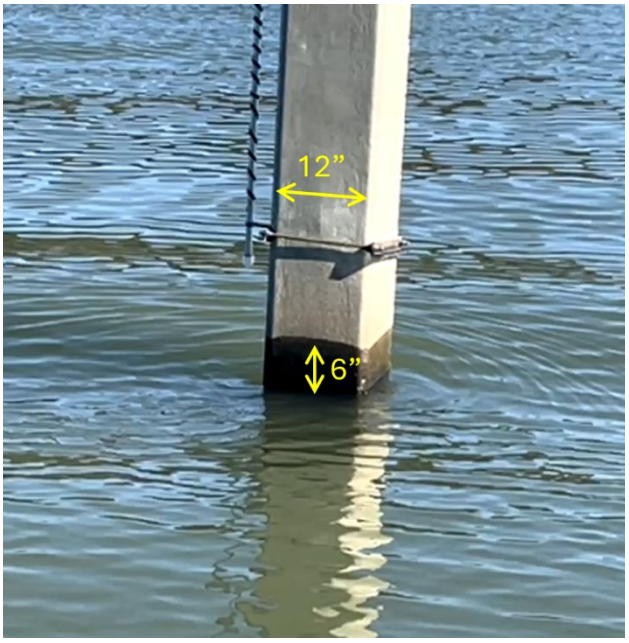


Figure 3. Fast Ferry Peak Wave Observed at CM17 During Site Visit on January 16, 2025, at Approximately 12:19:31



Figure 4. Fast Ferry Wake Arriving at the 147 Greenbrae Boardwalk Pier During Site Visit on January 16, 2025, at Approximately 12:20:30

To check the wake period (T), the analysis used the 430-foot distance between CM17 and the 147 Greenbrae Boardwalk pier, the observed 59-second wake travel time between these two locations, and the deep-water wave dispersion relationship. For the expected 1- to 2-second wake period and the relatively deep 14-foot MLLW water depth in the Creek on January 16, 2025, at 12:20, the use of the deep-water

wave dispersion relationship shown in Eq. (1) is justified. On this basis, the observed and calculated wake periods are consistent.

$$T = \frac{2\pi\, c}{g} \text{ where c} = \text{wake celerity and g} = \text{gravitational acceleration} \qquad \text{Eq. (1)}$$

$$c = \frac{430}{59} = 7.29 \text{ feet/s}$$

$$T = \frac{2\pi \text{ x } 7.29}{32.2} = 1.42 \text{ seconds}$$

On arrival, ferry velocities are relatively low, and only the transverse wakes that travel at the same velocity as the ferry are noticeable. The wake celerity c = 7.29 feet per seconds = 4.32 knots is consistent with the velocity of an arriving fast ferry passing by CM17.

Figure 5 shows the approximately 6-inch peak wave observed at around 13:13:37 at CM17 due to the passing of an arriving fast ferry. The inspection of the video indicated that the wave period was approximately 1.3 seconds. Figure 6 shows that the wake reaching the 147 Greenbrae Boardwalk pier at approximately 13:14:44 had already dissipated significantly and was negligible and inconsequential for the dock and boat berthed there. This was also observed at all docks and boats upstream along the Creek.



Figure 5. Fast Ferry Peak Wave Observed at CM17 During Site Visit on January 16, 2025, at Approximately 13:13:37



Figure 6. Fast Ferry Wake Arriving at the 147 Greenbrae Boardwalk Pier During Site Visit on January 16, 2025, at Approximately 13:40:44

To check T, the 430-foot distance between CM17 and the 147 Greenbrae Boardwalk pier, the observed 67-second wake travel time between these two locations, and Eq. (1) were used. The resulting wake period was 1.25 seconds, which is consistent with the observed period. The wake celerity of 430/67 = 6.42 feet per seconds = 3.8 knots is consistent with the velocity of an arriving fast ferry passing by CM17.

3. Wake Gauges Deployment, Maintenance and Retrieval

Each WG consists of a self-grounding coaxial staff, a microprocessor, a compact flash card data logger, four C size batteries, and an SD card for data storage, all contained in a rugged waterproof enclosure. The WG is deployed with the enclosure above the water and the coaxial staff vertically into the water. The gauge measures the water surface elevation on the staff relative to its bottom. The WGs were mounted on ruled 2-inch polyvinyl chloride (PVC) pipes with specialized mounting brackets as shown on Figure 7.



Figure 7. Wake Gauges Mounted on 2-Inch PVC Pipes Prior to Deployment

Prior to deployment from March 16 to 18, 2025, the calibrations of the six WGs planned for deployment were checked on a dock at the Terminal. For each WG, the calibration check consisted of vertically submerging the staff from the bottom to the top for approximately 1 minute, incrementally at 6-inch intervals, and recording data for 1 minute. The measurements were checked against the ruler on the PVC pipe. Out of the six WGs, five checked successfully, but one did not, resulting in the exclusion of one of the originally planned locations. Because during the site inspection no wake penetration was observed at the "creek" location (Figure 2), this location was excluded from the Study.

The WGs were deployed on March 18, 2025, from a small motorboat by two Jacobs and two District (driver and deck hand) staff. The deployment locations are shown on Figure 8 and coordinates and water depths are listed in Table 1 and Table 2, respectively.

WG_133 and WG_MF (Mudflat) were not deployed at their planned locations. At the request of the 133 Greenbrae Boardwalk homeowner, WG_133 was deployed at approximately 40 feet downstream from the planned location to allow for more boat maneuvering space. At the request of the Marin Rowing Association, WG_MF was deployed approximately 100 feet upstream and closer to shore from the planned location to avoid obstructing rowers.



Figure 8. Locations of Wake Gauges Deployed on March 18, 2025
Source: Google Earth Vexcel Imaging US

Table 1. Coordinates of Wake Gauge Locations

WG	Latitude	Longitude	UTM Zone 10 (meters)		CSP Zone 3 (feet)	
			Easting	Northing	Easting	Northing
WG_CM17	37.94232	-122.50586	543,418.0	4,199,531.0	5,983,279.5	2,171,783.2
WG_CM	37.94280	-122.50693	543,323.7	4,199,582.9	5,982,974.7	2,171,961.7
WG_147	37.94223	-122.50717	543,303.1	4,199,519.7	5,982,901.5	2,171,756.2
WG_133	37.94217	-122.50828	543,205.5	4,199,512.8	5,982,580.7	2,171,742.1
WG_MF	37.94271	-122.50942	543,104.9	4,199,571.9	5,982,255.9	2,171,944.8

CSP = California State Plane; UTM = Universal Transverse Mercator; WG = wake gauge

Table 2. Water Depths at the Wake Gauge Locations

WG	Water Depth (feet)	
	MSL	MLLW
WG_CM17	-13.9	-10.6
WG_CM	-13.1	-9.8
WG_147	-4.2	-1.0
WG_133	-4.3	-1.7
WG_MF	-2.9	0.3

MLLW = mean lower low water; MSL = mean sea level; WG = wake gauge

WG_CM17 and WG_CM were attached to channel markers by strapping the PVC pipes to the markers' concrete piles using tie-wraps and a cam strap. All other WGs were mounted on PVC pipes sleeved over metal pipes embedded in the creek bottom. The steel pipes were driven into the mud to a depth sufficient to provide a stable foundation for the PVC pipes supporting the WGs. A hole was drilled through the PVC pipes to secure the WGs from self-burying and settling under their own weight with a through pin. Figure 9 shows WG_CM17 and WG_CM, and Figure 10 shows WG_147, WG_133 and WG_MF installed.



Figure 9. WG_CM17 (left) and WG_CM (right) Attached to Channel Markers



Figure 10. WG_147 (left), WG_133 (center) and WG_MF (right)

To check on WG performance and collect data, the WGs were serviced two times by Jacobs and District staff, on April 21 and May 21, 2025. Servicing was conducted from a motorboat at high tide to minimize the risk of grounding the motorboat. Weather conditions during each servicing event were favorable, with clear skies, low wind, and no waves. These conditions supported the safe and efficient data retrieval at each location, in 1 day, without requiring removal of the WGs from their mounts.

The WGs were retrieved on June 12, 2025, 86 days (12.3 weeks) after installation. The retrieval of WG_CM17 and WG_CM was straightforward because these only required cutting the tie-wraps and undoing the cam straps. The retrieval of the other WGs was more involved because the removal of the steel pipes embedded on the creek bottom was required.

Table 3 shows the dates when the WGs calibration, deployment, maintenance, and retrieval were performed. Data collected during maintenance and retrieval were limited and not used. The total number of full, 24-hour day measurements was 83.

Table 3. Wake Gauge Calibration, Deployment, Maintenance, and Retrieval Dates

Activity	Dates
Calibration	3/16 to 3/18
Start 1st Deployment[a]	3/19
End 1st Deployment[a]	4/20
1st Maintenance	4/21
Start 2nd Deployment[a]	4/22
End 2nd Deployment[a]	5/20
2nd Maintenance	5/21
Start 3rd Deployment[a]	5/22
End 3rd Deployment[a]	6/11
Retrieval	6/12

[a] 24 hours of data collection

4. Data Collection

The following data were collected during the Study:

- Water surface elevation
- Water levels
- Ferry tracks
- Wind speed and direction

4.1 Water Surface Elevation

The water surface elevation measurements were performed with Wave Logger III OSSI-010-010 WGs at a 10-Hz sampling rate as described in Sections 2 and 3. At each WG location, raw data were collected and saved onboard SD cards in American Standard Code for Information Interchange (ASCII) format comma-separated values (CSV) files (Ocean Sensor Systems 2025).

The WGs measure the water surface elevation, which is composed of the tide, long-period bay-wide disturbances like seiching, and short-period disturbances such as those caused by wind waves and vessel wakes. Upon retrieval, the data were filtered to derive water levels (WLs) (tide plus other long-period disturbances), wave heights, and ferry wakes time histories.

4.2 Water Levels

To verify the WLs derived from the measured water surface elevation measurements, data from NOAA station 9414863 Richmond were collected during the Study. Measurements at this station are considered representative of conditions at the Terminal due to its proximity, approximately 12 miles southeast of the Terminal.

4.3 Ferry Track

Ferry track records were obtained from the San Francisco Marine Exchange. Figure 11 shows the approximate area, and example locations, where the San Francisco Marine Exchange extracted Automatic Identification System transponders data of the ferries that transited that area. For each day and each ferry and for the duration of the Study, the ferry track records were provided in ASCII CSV files containing date and time, ferry name, latitude and longitude, velocity, and course. Table 4 shows the number of arrival trips each ferry made between March 19 and June 11, 2026. The catamaran-type fast ferries are the NAPA, GOLDEN GATE, DEL NORTE, and MENDOCINO, and the monohull Spaulding Class are the MARIN, SAN FRANCISCO, and SONOMA.

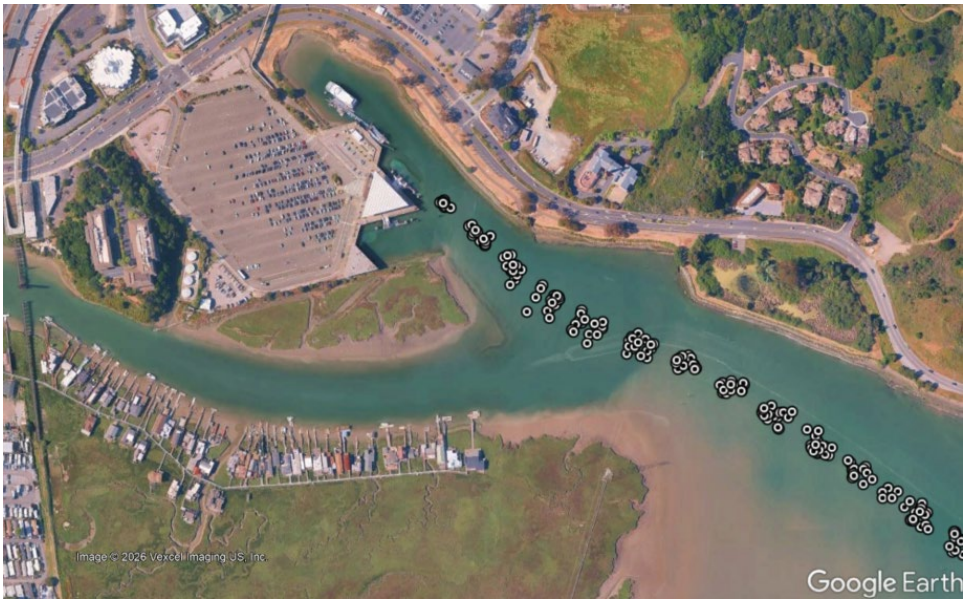


Figure 11. Approximate Area and Example Locations of Automatic Identification System Transponder Data Extraction

Source: Google Earth Vexcel Imaging US Inc.

Table 4. Number of Ferry Arrival Trips Between March 19 and June 11, 2025

Ferry Type	Name	Trips
Catamaran Fast	NAPA	438
	GOLDEN GATE	445
	DEL NORTE	177
	MENDOCINO	74
Monohull Spaulding Class	MARIN	68
	SAN FRANCISCO	40
	SONOMA	38
	TOTAL	**1,280**

4.4 Wind

To help discriminate between high wind-waves and ferry wakes in the WG measurements, and because no onsite wind measurements were available, wind speed and direction were acquired from National Data Buoy Center station TIBC1 at the Tiburon Pier (NDBC 2025). The Tiburon Pier is located approximately 5 miles to the southeast of the Terminal on the eastern shore of the Tiburon Peninsula.

5. Data Processing

The WGs measured the water surface elevation, which contains the superposition of processes occurring over a wide range of time scales (periods). The WGs sampled the water surface elevation at rate of 10 samples per second (10 Hz), capturing variations associated with astronomical tides, bay-wide oscillations like seiching, swell, locally generated wind-waves, and vessel wakes. These processes occur at distinctly different frequencies and can therefore be separated through frequency filtering. To isolate the components of interest, the WGs measurements were decomposed by filtering in the frequency domain.

The measured water surface elevations at each WG were transformed from the time domain to the frequency domain, where each process could be identified according to its characteristic frequency. Tidal fluctuations, with periods of 12.4 hours, occupy the lowest frequency portion of the spectrum. Long-period bay-wide oscillations, including seiching and infragravity waves, occur at intermediate frequencies, with periods ranging from minutes to hours. Surface gravity waves, including ocean swell propagating into San Francisco Bay, occur at 10 to 20+ seconds, and locally generated wind-waves in Corte Madera Bay occur at higher frequencies with periods generally between about 2 and 5 seconds. Ferry wakes occur at relatively high frequencies. Based on the water depths during the Study (approximately 11 to 16 feet) and ferry velocities (approximately 5 to 9 knots) near WG_CM17 (the closest WG to the ferry tracks), wake periods were estimated to range between 1.4 and 3 seconds.

Ferry wakes periods did not overlap with the longer-period processes. However, despite their narrow overlap with wind-waves in the 1.4- to 3-second period range, frequency-domain filtering was considered an effective means of separating the wakes in the measurements. In cases where the ferry wakes resembled wind-waves, the wind measurements were inspected.

The following describes the data processing steps for each WG measurement:

1. The WG raw measurements in digital counts were stored in ASCII CSV files, one for each day. The daily raw measurements were converted to physical units and daily records with 864,000 samples at 10 Hz were produced.

2. The tide was extracted from the physical unit records by first applying a fourth-order low-pass Butterworth filter with a cutoff of 1/3600 Hz (≈0.0002778 Hz; 1-hour period) and then resampling every 6 minutes, subtracting its mean and adding 0.99 minute to reference the tide to the MLLW (NOAA 2025).

3. The water surface elevation (h) record, sampled at 10 Hz, was extracted from the physical units record by applying a fourth-order band-pass Butterworth filter with minimum cutoff frequency f_{min} = 0.10 Hz and maximum cutoff frequency f_{max} = 1.0 Hz.

4. The wind-wave significant wave height (H_s) was derived from h by partitioning the record into 12-minute windows and calculating $H_s = 4\sigma_h$ for each window, where σ_h is the standard deviation of h within the window.

The following describes the data processing steps for the ferry track records:

1. For each day and for each ferry, the track record of each arriving trip within the approximate area shown on Figure 11 were extracted.

2. The track record for each day, ferry, and arrival trip was processed to extract and compile in a summary spreadsheet the date and time, ferry name, latitude and longitude, velocity, and course

corresponding to the ferry's closest distance to WG_CM17. The summary spreadsheet also included the WLs relative to MLLW and the water depth at the time of the ferry passage, the wake period, and the ferry travel time between its location and WG_CM17. WG_CM17 was chosen because it was the closest to the ferry tracks and a proxy for correlating the passing time of a ferry with h.

3. Not all track records were suitable for analysis, given that in some cases, the ferry was passing very slowly or too far from WG_CM17, etc. Therefore, a subset of the track records in the summary spreadsheet was extracted according to the criteria in Table 5. The number of arrival ferry trips matching the criteria and considered for the analysis is shown in Table 6.

Table 5. Criteria for Selection of Trips for Analysis

Criteria	Condition
Ferry Arrival Time to Terminal	Between 6:00 and 21:00
Ferry Distance to WG_CM17	Less than or equal to 360 feet
Ferry Velocity	Higher or equal to 4.7 knots

Table 6. Number of Ferry Arrival Trips Between March 19 and June 11, 2025, Considered for Analysis

Ferry	Trips
NAPA	347
GOLDEN GATE	387
DEL NORTE	148
MENDOCINO	53
MARIN	41
SAN FRANCISCO	26
SONOMA	17
TOTAL	**1,019**

6. Data Analysis

6.1 Water Levels

To verify the performance of the wake gauges, the study authors compared the WLs derived from the WG measurements with those measured at NOAA station 9414863 at Richmond, both sampled at 6-minute intervals.

Figure 12 shows the WL time histories at WG_CM17 and measured at NOAA station 9414863 Richmond relative to MSL, and Figure 13 shows the same for WG_CM. For both, anomalies are noted at the highest and lowest levels, but most notably at the lowest levels, at times in the order of 0.6 to 0.8 meter (2 to 2.6 feet). This could indicate a WG malfunction. However, Figure 14 shows almost identical WLs at WG_CM17 and WG_CM, which are two independent WGs located near each other (approximately 360 feet apart), as shown on Figure 8. This rules out WG malfunction. However, some discrepancies at the lowest levels during the third deployment are noted. This could be attributed to debris and/or marine growth in the lower section of the coaxial staff.

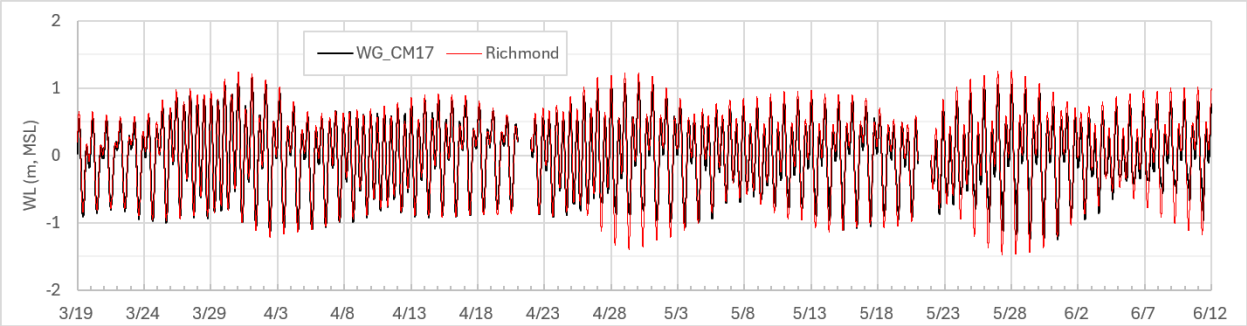


Figure 12. Water Level Time Histories at WG_CM17 and Measured at NOAA Station 9414863 Richmond

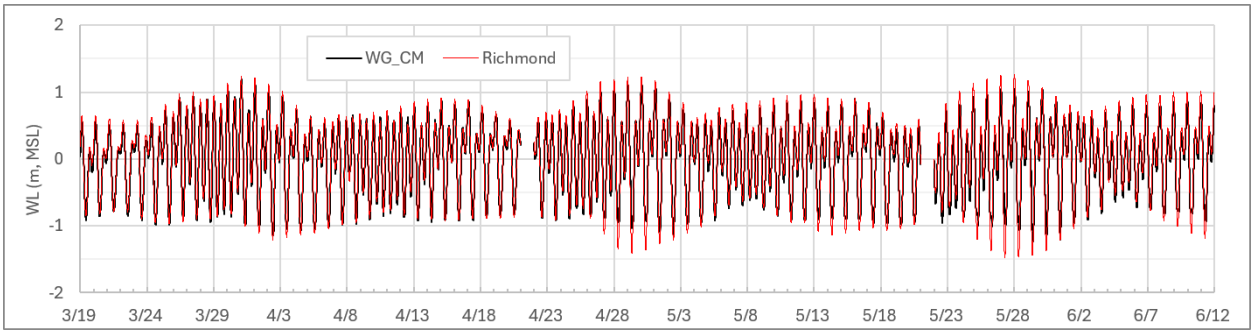


Figure 13. Water Level Time Histories at WG_CM and Measured at NOAA Station 9414863 Richmond

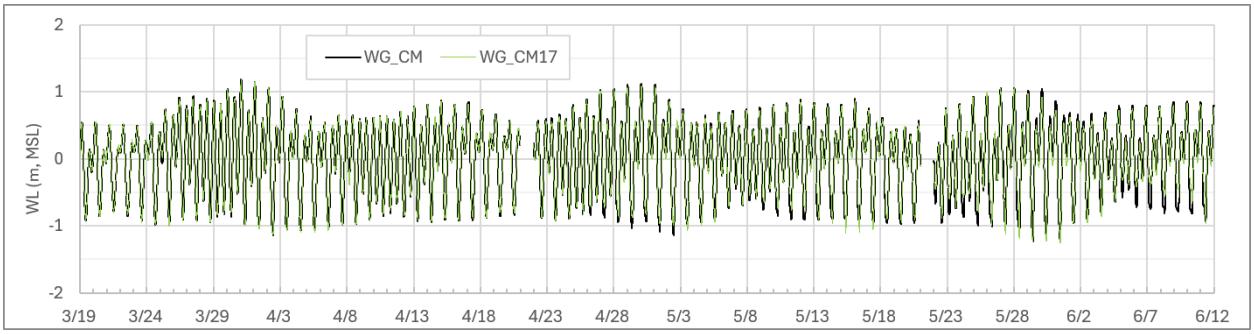


Figure 14. Water Level Time Histories at WG_CM and WG_CM17

Figure 15 shows the WL time histories at WG_147 and WG_CM17 relative to the MSL. These two WGs are close to each other (approximately 400 feet apart), and on the same side of the Creek as shown in Figure 8. The agreement is generally good; however, some discrepancies at the lowest levels during the second halves of the second and third deployments are noted. This could be attributed to debris and/or marine growth in the lower section of the coaxial staff. Also shown is the water depth at WG_147 below the lowest levels, indicating that the WL was always above the Creek bottom during very low tides.

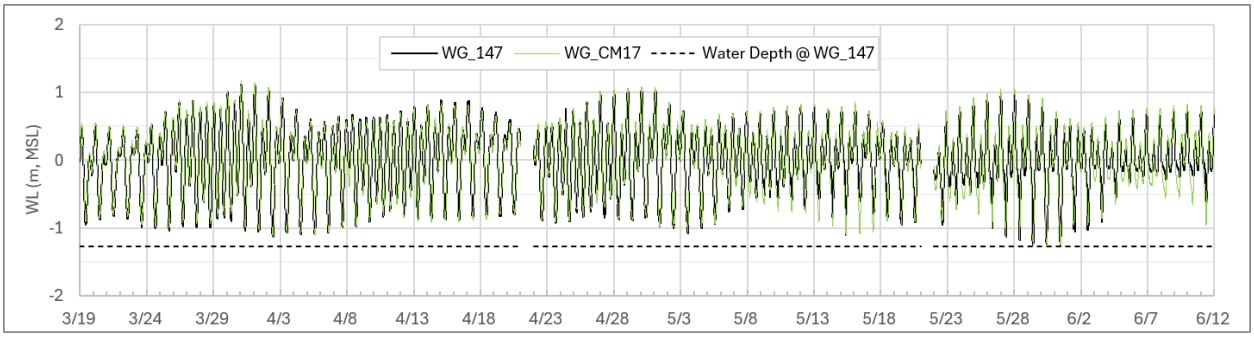


Figure 15. Water Level Time Histories at WG_147 and WG_CM17

Figure 16 shows the WL time histories at WG_MF and WG_CM relative to the MSL. These two WGs are approximately 715 feet from each other and on the same side of the Creek as shown on Figure 8. The agreement is generally good; however, some discrepancies at the lowest levels during the second halves of the second and third deployments are noted. This could be attributed to debris and/or marine growth in the lower section of the coaxial staff. Also shown is the water depth at WG_MF above the lowest levels, indicating that the WL was lower than the Creek bottom during very low tides.

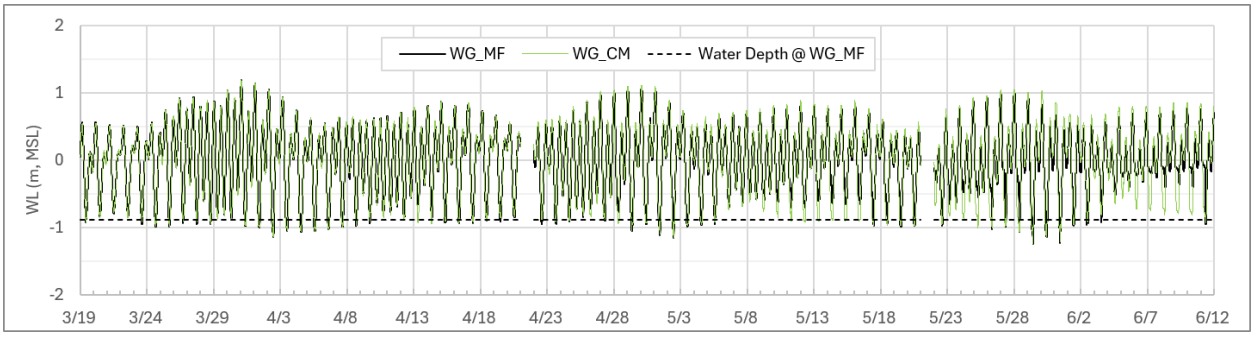


Figure 16. Water Level Time Histories at WG_MF and WG_CM

Figure 17 shows the WL time histories at WG_133 and WG_CM17 relative to the MSL. These two WGs are approximately 760 feet from each other and on the same side of the Creek as shown on Figure 8. While agreement is generally good during the first deployment, it is noted that during high tide the WL was clipped at about 1 meter (3.28 feet) MSL. This may have led to moisture intrusion in the electronics enclosure and WG malfunction during the second and third deployments. For this reason, measurements at WG_133 were not used.

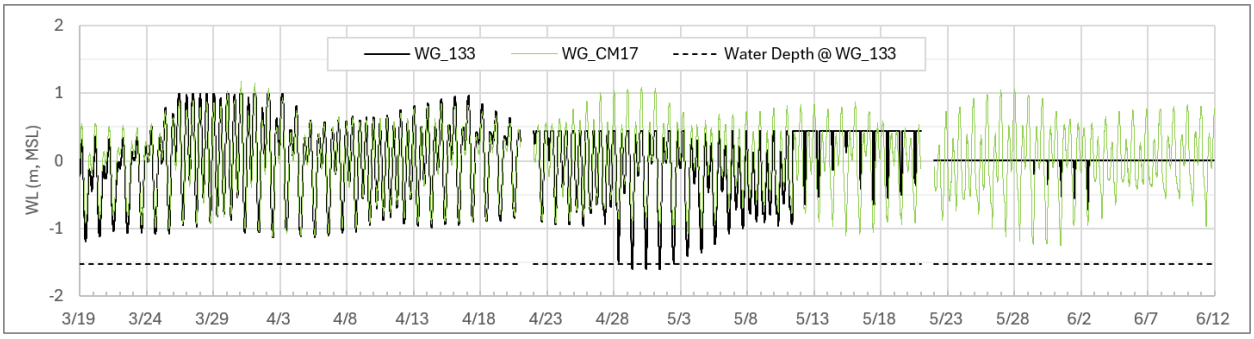


Figure 17. Water Level Time Histories at WG_133 and WG_CM17

6.2 Wind and Wind-Waves

Figure 18 shows the 115 to 135 degrees sector and approximate fetches of wind relevant to the generation of wind-waves that reach the Terminal.



Figure 18. Sector and Approximate Fetches of Wind Relevant to the Generation of Wind-Waves that Reach the Terminal

Figure 19 and Figure 20 show time histories of H_s at WG_CM17 and WG_CM, respectively, together with wind velocities measured at the Tiburon Pier from the 115- to 130-degree sector. A relatively strong wind event occurred on March 30, 2025, during which wind from approximately 130 degrees generated wave heights of about 6 inches at WG_CM17, the most exposed WG (Figure 8). In contrast, WG_CM did not record a comparable H_s (Figure 20) because it was located downwave of WG_CM17 and was partially sheltered by the southern shoreline of the Creek. In addition, the water level at WG_CM17 was relatively low (approximately 0.7 foot above MLLW), resulting in shallow nearshore conditions that likely caused the wind-generated waves to break before propagating toward WG_CM. Similarly, no wind-waves reached WG_147 and WG_MF.

The H_s time histories o Figure 19 and Figure 20 show that during the Study, wind-waves at these two most exposed locations were negligible and that wind from the 115- to 130-degree sector rarely exceeded 10 knots.

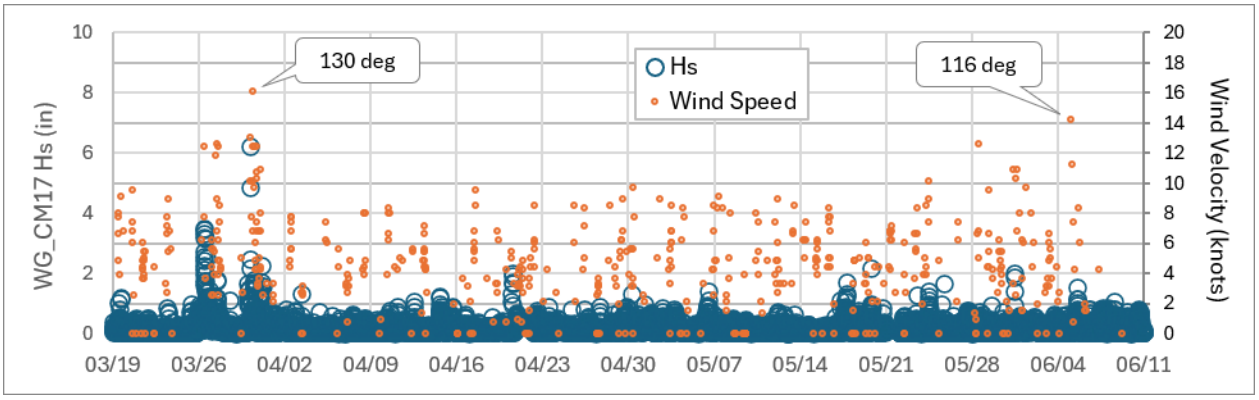


Figure 19. H_s and Wind Velocity Time Histories at WG_CM17

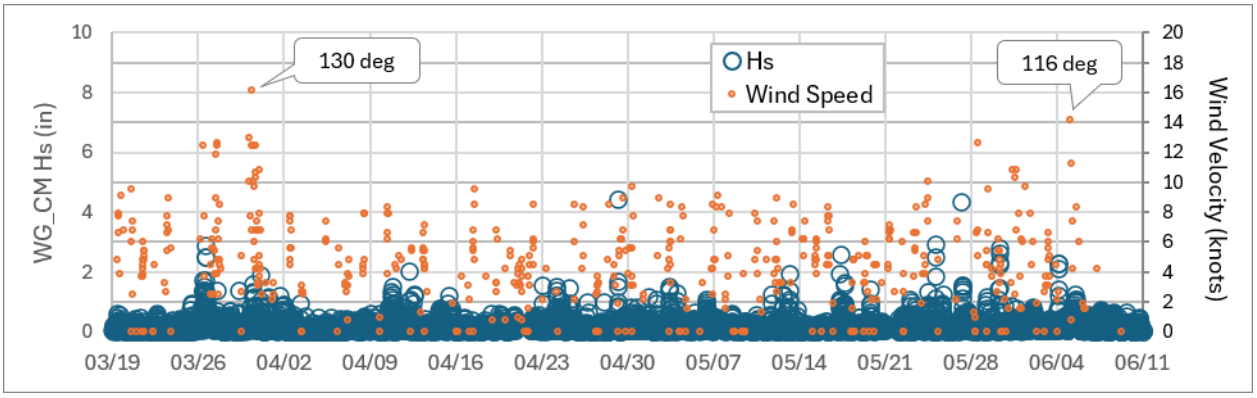


Figure 20. H_s and Wind Velocity Time Histories at WG_CM

6.3 Ferry Wakes

Of the 1,280 trips recorded during the Study (Table 4), 1,019 met the criteria outlined in Table 5 and were considered for analysis. For each day of measurements and for each gauge, time history plots of h , H_s, and ferry trips were visually inspected (83 days x 4 WGs = 332 plots) to identify events that could be relevant to the Community's concerns (ferry wakes, wind-waves, and shoreline erosion). Table 7 shows a breakdown by ferry of the 1,019 trips (935 fast ferry and 84 Spaulding Class ferry trips) that were

considered for analysis, as well as the 42 trips ultimately selected for detailed assessment (39 fast ferry and 3 Spaulding Class ferry trips) grouped by WG.

Table 7. Number of Ferry Arrival Trips Between March 19 and June 11, 2025, and Number of Trips Selected for Analysis

Ferry	Trips[a]	WG_CM17[b]	WG_CM[b]	WG_147[b]	WG_MF[b]
NAPA	347	2	2	3	2
GOLDEN GATE	387	4	2	3	6
DEL NORTE	148	3	3	---	---
MENDOCINO	53	5	4	---	---
MARIN	41	---	1	---	---
SAN FRANCISCO	26	2	---	---	---
SONOMA	17	---	---	---	---
TOTAL	**1,019**	**16**	**12**	**6**	**8**

[a] Number of trips matching the criteria in Table 5 and considered for analysis

[b] Number of trips selected for detailed assessment

The ferry wakes in the 42 trips selected were analyzed and assessed as inconsequential with respect to the Community's concerns. Selected time history plots of h , H_s, and velocities of the ferries passing by the WGs were developed and are presented Appendix A for the fast ferries and in Appendix B for the Spaulding Class ferries. These plots are a representative subset selected from the analysis of the 935 fast ferry trips and the 84 Spaulding Class ferry trips recorded during the Study. They were chosen to illustrate the wake and wind-wave events of interest, including periods where both occur simultaneously. All plots showed that at WG_CM17 and WG_CM, the most exposed and closest WGs to the ferry tracks, the ferry wakes are typically negligible (less than 4-inch peak-to-peak high) and never exceeded 6 inches peak to peak. Furthermore, relative to wind-waves, wakes are of a relatively short ephemeral duration, lasting only a few seconds compared to the wind-waves that last several minutes to hours. Selected plots from the appendices are included as follows.

Figure 21 shows fast ferry arrivals and periods of ferry wakes occurring simultaneously with wind-waves at WG_CM17. Wind-waves are less than H_s = 2 inches. Figure 22, for the same day, shows the leading, approximately 4-inch peak-to-peak, transverse wave of the GOLDEN GATE wake occurring simultaneously with wind-waves.

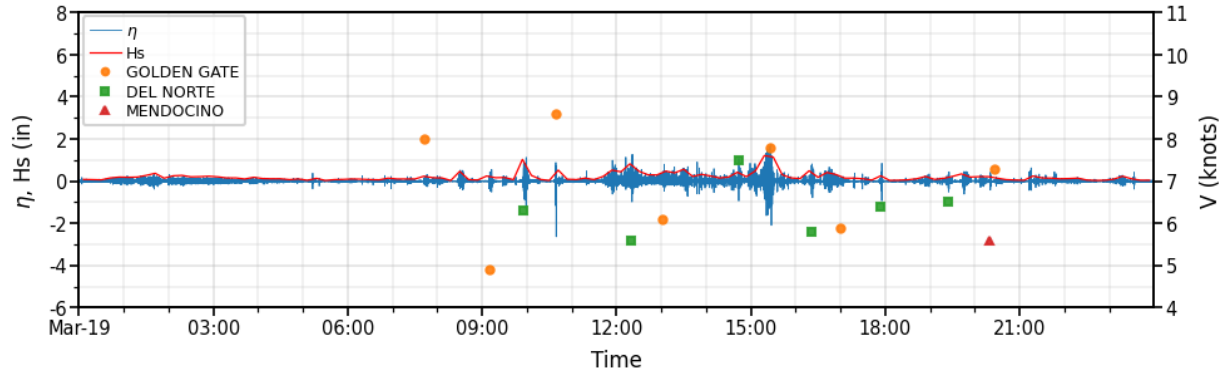


Figure 21. Time Histories of h , H_s, and Velocities of Fast Ferries Passing by WG_CM17 on March 19, 2025

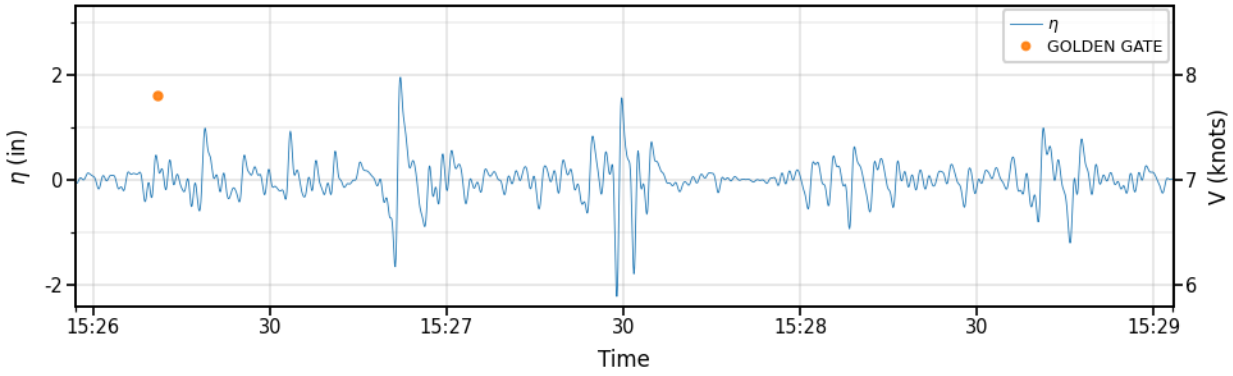


Figure 22. Time Histories of h and Velocity of the GOLDEN GATE Passing by WG_CM17 on March 19, 2025, at Approximately 15:26

Figure 23 shows ferry arrivals and periods of ferry wakes occurring simultaneously with wind-waves at WG_CM17. At their peak, wind-waves were about H_s = 3 inches and exceeded 2 inches for several hours. Figure 24 and Figure 25, for the same day, show GOLDEN GATE and MENDOCINO wakes, respectively, indistinguishable from the wind-waves.

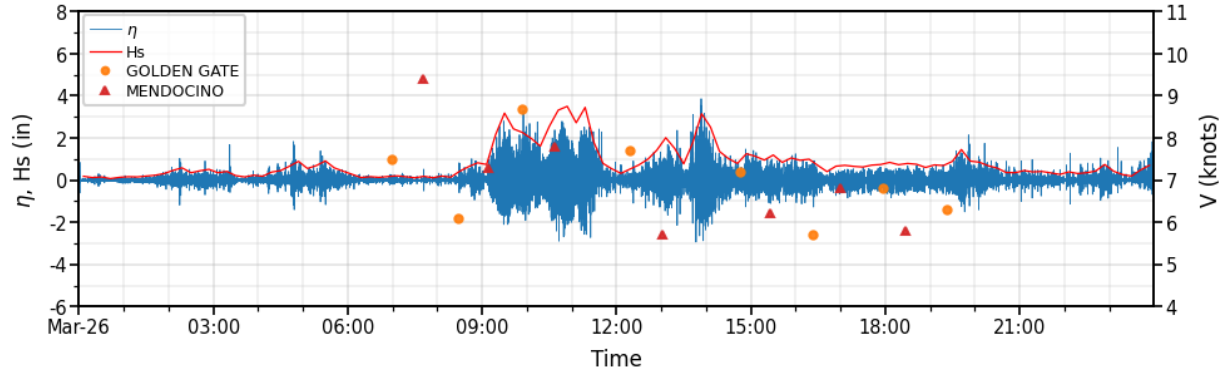


Figure 23. Time Histories of h , H_s, and Velocities of Fast Ferries Passing by WG_CM17 on March 26, 2025

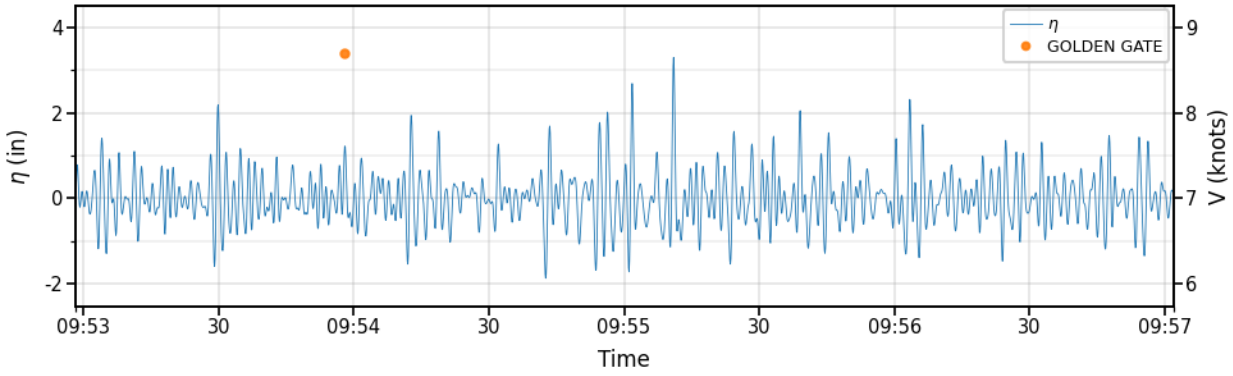


Figure 24. Time Histories of h and Velocity of the GOLDEN GATE Passing by WG_CM17 on March 26, 2025, at Approximately 09:54

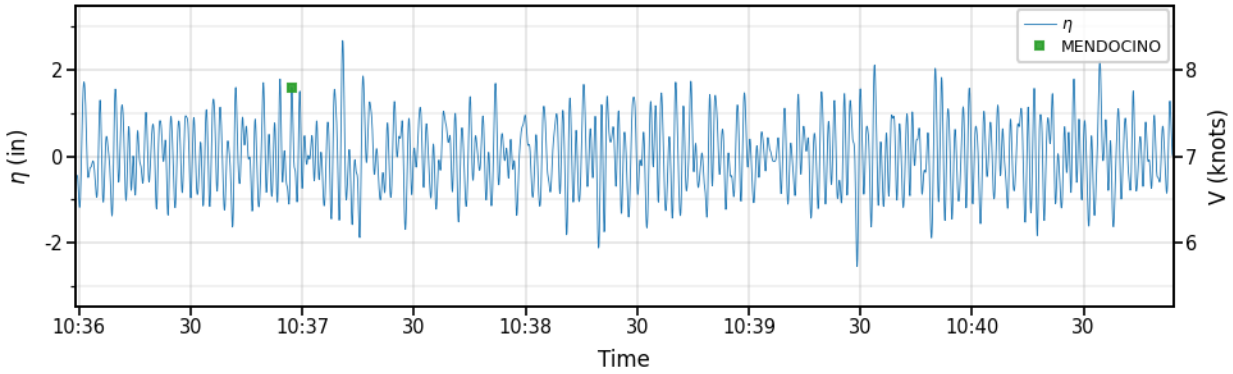


Figure 25. Time Histories of h and Velocity of the MENDOCINO Passing by WG_CM17 on March 26, 2025, at Approximately 10:37

Figure 26 shows the wind-waves between 05:00 and 06:00 at WG_CM17 due to the strong wind event of March 30, 2025, where H_s reached 6 inches. Figure 27 shows, for the same day, the leading, approximately 4-inch peak-to-peak, transverse wave of the MENDOCINO wake occurring simultaneously with wind-waves.

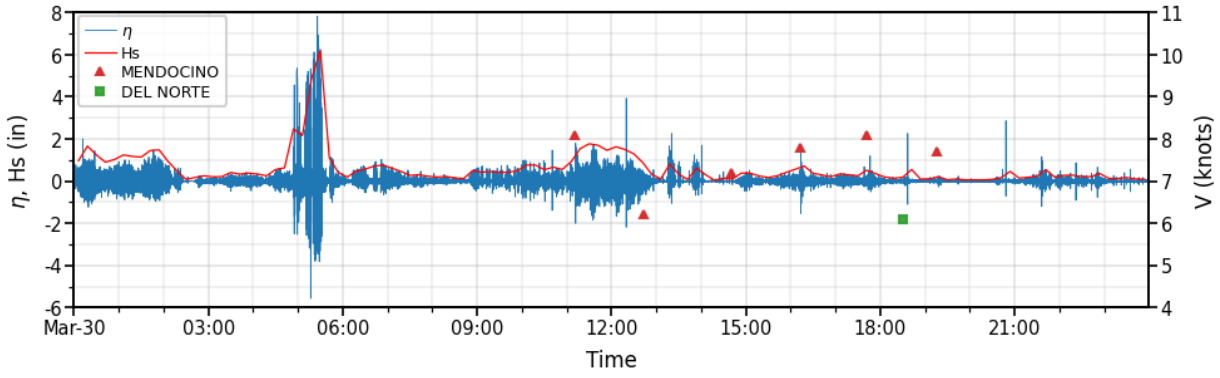


Figure 26. Time Histories of h , H_s, and Velocities of Fast Ferries Passing by WG_CM17 on March 30, 2025

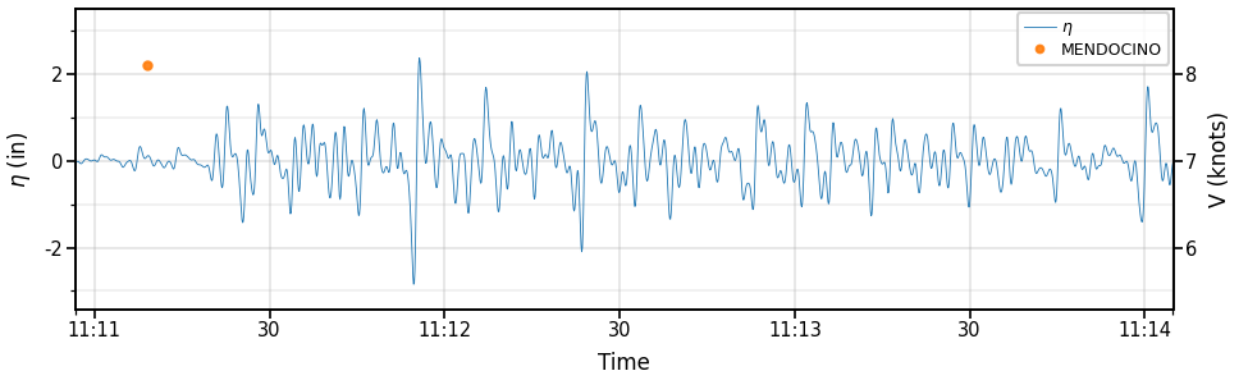


Figure 27. Time Histories of h and Velocity of the MENDOCINO Passing by WG_CM17 on March 30, 2025, at Approximately 11:11

Figure 28 shows the wind-waves between 06:00 and 08:00 at WG_CM due to the strong wind event of March 30, 2025, where H_s reached 3 inches. Figure 29 shows, for the same day, the DEL NORTE wake possibly combined with the wind-waves reaching an about 10-inch peak-to-peak height. It must be noted that, in perspective, the impact of that few-seconds-duration wave would be negligible compared to the impact of the wind-waves that lasted several hours that day.

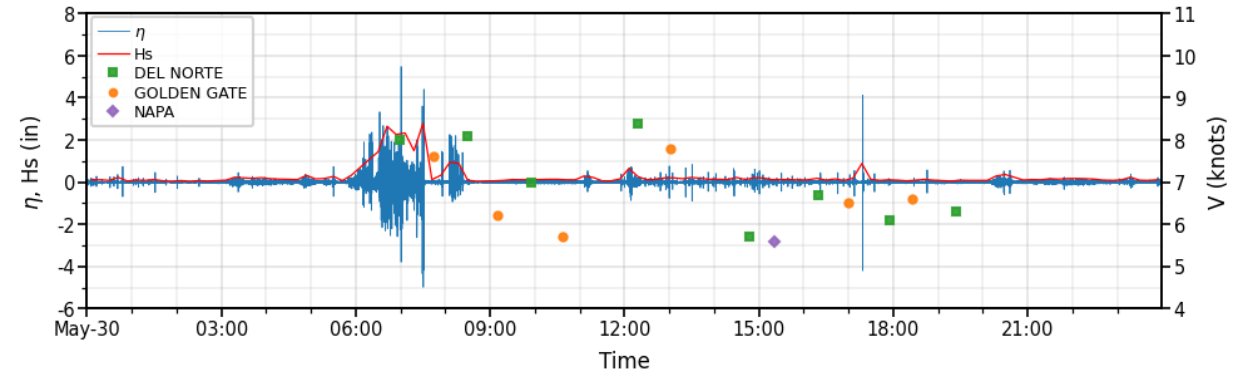


Figure 28. Time Histories of h , H_s, and Velocities of Fast Ferries Passing by WG_CM on May 30, 2025

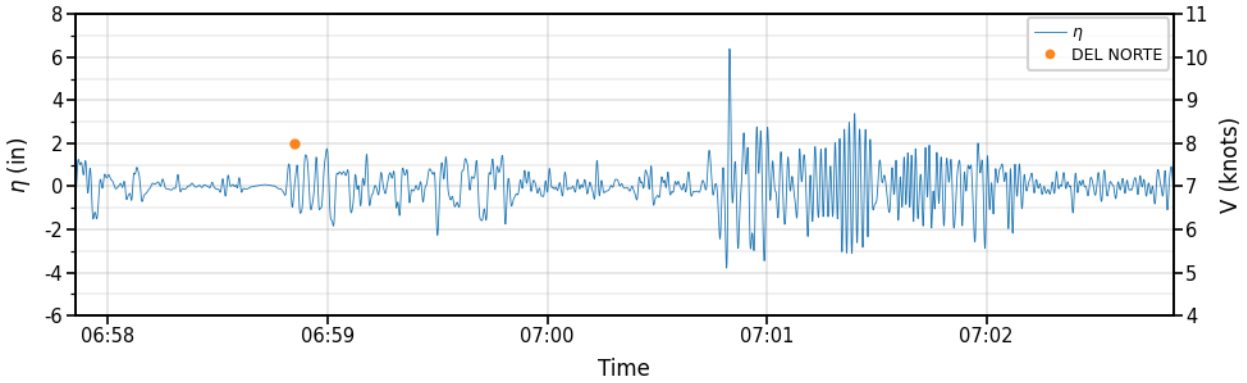


Figure 29. Time Histories of h and Velocity of the DEL NORTE Passing by WG_CM on May 30, 2025, at Approximately 06:58

Figure 30 and Figure 31 show a rare instance when, at WG_147, an about 12-inch peak-to-peak wave was recorded prior to the passage of the NAPA. While it is possible that the ferry slowed down and the wake train overtook and passed the ferry arriving earlier to WG_147, Figure 30 also shows another similar wave not corresponding to the passage of the NAPA, suggesting that those waves were not due to the passage of a ferry but to a different vessel. This is a realistic possibility, given the number of powerboats berthed in and regularly transiting the Creek.

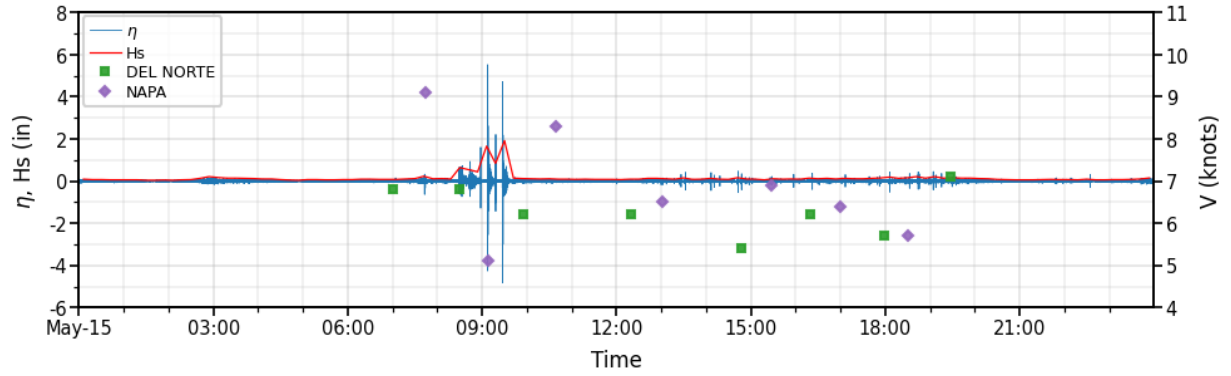


Figure 30. Time Histories of h , H_s, and Velocities of Fast Ferries Passing by WG_147 on May 15, 2025

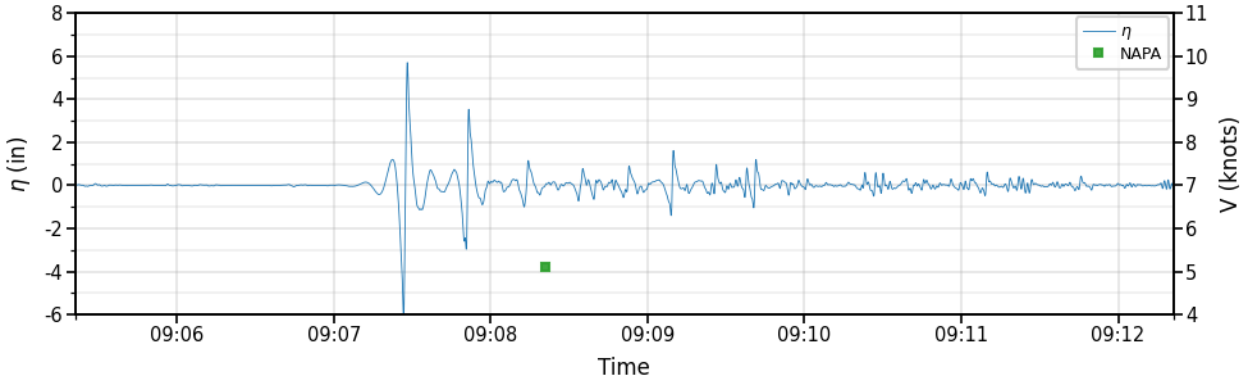


Figure 31. Time Histories of h and Velocity of the NAPA Passing by WG_147 on May 15, 2025, at Approximately 09:08

Figure 32 shows negligible wind-waves. Figure 33, for the same day, shows the leading, approximately 4-inch peak-to-peak, transverse wave of the ferry wake and negligible wind-waves at WG_CM17.

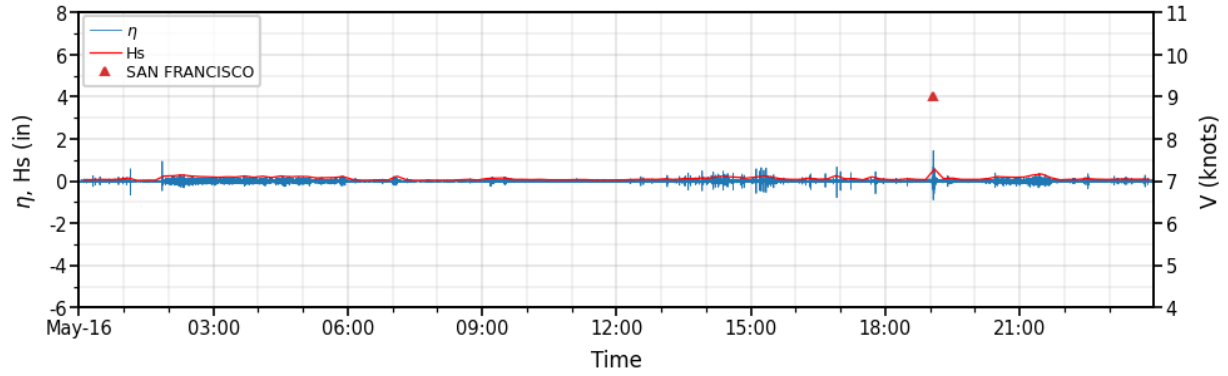


Figure 32. Time Histories of h , H_s, and Velocity of the SAN FRANCISCO Passing by WG_CM17 on May 16, 2025

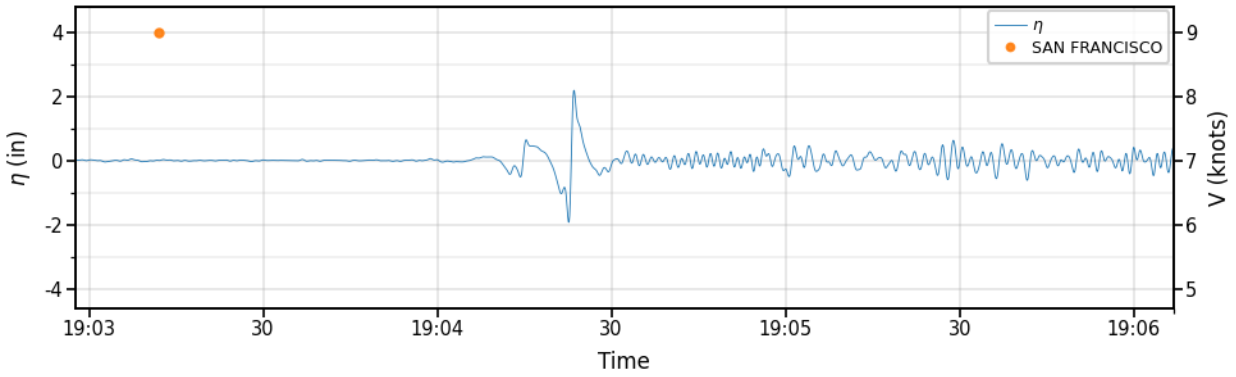


Figure 33. Time Histories of h and Velocity of the SAN FRANCISCO Passing by WG_CM17 on May 16, 2025, at Approximately 19:03

7. Conclusions

Based on the nearly 3-month Study period, which was of sufficient duration to capture representative wind-wave and ferry wake conditions, the conclusions are considered representative of and applicable to typical ferry operations throughout the year. The following are the conclusions of this Study:

1. Fast Ferry Wakes

    a) Wakes are typically negligible: Records show that fast ferry wakes at the most exposed and closest locations to the ferry tracks (WG_CM17 and WG_CM) were typically negligible (less than 4-inch peak-to-peak high) and never exceeded 6 inches peak to peak. Furthermore, relative to wind-waves, wakes were of a relatively short ephemeral duration lasting only a few seconds compared to the wind-waves that last several minutes to hours.

    b) Indistinguishability from ambient conditions: In multiple instances, fast ferry wakes were indistinguishable from ambient wind-waves.

    c) Wind-wave enhancement: During strong wind events, ferry wakes can combine with the co-occurring wind-waves, as observed when the DEL NORTE wake reached an about 10-inch peak-to-peak height during the strong wind event of March 30, 2025. It must be noted that, in perspective, the impact of that few-seconds-duration wave would be negligible compared to the impact of the wind-waves that lasted several hours that day.

2. Spaulding Class Ferry Wakes

    a) Consistently low: Wakes generated by the monohull Spaulding Class ferries were typically negligible and less than a 4-inch peak-to-peak high.

    b) Minimal ambient contrast: Similar to fast ferries, the wakes from Spaulding Class ferries were frequently indistinguishable from wind-waves under typical ambient conditions.

3. Wake Dissipation and Shoreline Impact

    a) Rapid wave energy dissipation: Observations during the site inspection showed that fast ferry wakes dissipate rapidly as they propagate away from the ferry track. For example, a 6-inch peak wave observed at CM17 dissipated to a negligible and inconsequential height by the time it reached the 147 Greenbrae Boardwalk pier, causing no disruption to the dock or berthed boat.

    b) No Creek penetration and long-distance attenuation: Observations during the site inspection revealed no wake penetration reaching the inner creek inlet (located between 69 and 101 Greenbrae Boardwalk). Wakes traveling to distant locations in the Creek (such as WG_MF, located approximately 1,500 feet from the ferry track) take 2 to 3 minutes to arrive and are significantly dissipated by the time they reach that area of the mudflat.

4. Impact of Wind-Waves versus Ferry Wakes

    a) Wind-wave dominance during strong winds: Strong winds from the 115 to 135 degrees sector are capable of generating waves that equal or exceed typical ferry wakes. A strong wind event on March 30, 2025, produced H_s of about 6 inches at WG_CM17 and 3 inches at WG_CM.

    b) Sheltering: While the WG_CM17 location is highly exposed, the inner locations like WG_CM, WG_147, and WG_MF are physically sheltered from wind-waves by the southern shoreline of the Creek and shallow nearshore depths that cause waves to diffract and break before propagating upstream the Creek.

c) Low ambient baseline: Wind-waves at the monitoring stations were typically negligible throughout the study, as winds from the 115 to 130 degrees sector rarely exceeded 10 knots.

5. Non-Ferry Vessel Wakes

   a) High wake events: A rare wake event with an about 12-inch peak-to-peak high wave was recorded at WG_147 on May 15, 2025, prior to a ferry passing.

   b) Attribution to local powerboats: Because similar large peak-to-peak waves were recorded when no fast ferries were arriving, these are attributed to the numerous private powerboats berthed in and regularly transiting the Creek.

6. WG Performance and Data Quality

   a) Validation of sensor accuracy: Dual independent, nearly co-located gauges (WG_CM17 and WG_CM) recorded almost identical water levels, validating the reliability of the instrumentation and ruling out gauge malfunction as a source of anomalies.

   b) Debris and marine growth impacts: Discrepancies observed at the lowest tide levels during the later stages of the second and third deployments could have been caused by debris and marine growth accumulating on the lower sections of the coaxial staffs.

   c) Moisture intrusion failure: The gauge at WG_133 suffered high-tide clipping at approximately 1 meter (3.28 feet) MSL, which may have led to moisture intrusion inside its waterproof electronics enclosure, rendering its data unusable and requiring its exclusion from the Study.

8. References

Jacobs. 2023. *Ferry Wake Wash and Shoreline Erosion Analysis, Baseline Scenario Analysis*. July 21, 2023.

National Data Buoy Center (NDBC). 2025. Station TIBC1 - Tiburon Pier, San Francisco Bay, CA. Accessed in December 2025.
https://www.ndbc.noaa.gov/station_history.php?station=tibc1.

National Oceanic and Atmospheric Administration (NOAA). 2025. Tides and Currents. NOAA station 9414863 Richmond, CA. Accessed in December 2025.
https://tidesandcurrents.noaa.gov/stationhome.html?id=9414863.

Ocean Sensor Systems. 2025.

Appendix A
Fast Ferries h, H_s, and Velocity Time Histories

Appendix A. Fast Ferry Wakes

A.1 Introduction

To analyze events that could be relevant to the Greenbrae Boardwalk Community's concerns (ferry wakes, wind-generated waves [wind-waves], and shoreline erosion), time history plots of h , H_s, and velocities of the fast ferries passing by the wake gauges (WGs) were developed and are presented in the following sections. These plots are a representative subset selected from the analysis of the 935 fast ferry trips recorded during the Corte Madera Creek Ferry Wake Study. They were chosen to illustrate the wake and wind-wave events of interest, including periods where both occur simultaneously. The plots are organized as follows:

- Plots are grouped by WG sections.
- The plots are presented in chronological order.
- For each WG, plots of daily time histories of h , H_s, and velocities of ferries passing by the WG are presented.
- The daily plots show events of interest like ferry wakes, wind-waves, and their simultaneous occurrence.
- Following each daily plot, corresponding detailed plots of time histories of h and velocity of a ferry for the events of interest selected in the daily plots are presented. These plots show detailed time histories of wakes, wind-waves, and periods when both occur simultaneously.
- 39 detailed plots are presented:
  - 14 for WG_CM17
  - 11 for WG_CM
  - 6 for WG_147
  - 8 for WG_MF
- The following are general observations representative of all trips recorded for the fast ferries.
  - Figure 1 shows ferry arrivals and periods of ferry wakes occurring simultaneously with wind-waves at WG_CM17. Wind-waves are less than H_s = 2 inches. Figure 2, for the same day, shows the leading, approximately 4-inch peak-to-peak, transverse wave of the GOLDEN GATE wake occurring simultaneously with wind-waves.
  - Figure 3 shows ferry arrivals and periods of ferry wakes occurring simultaneously with wind-waves at WG_CM17. At their peak, wind-waves were about H_s = 3 inches and exceeding 2 inches for several hours. Figure 4 and Figure 5, for the same day, show GOLDEN GATE and MENDOCINO wakes, respectively, indistinguishable from the wind-waves.
  - Figure 8 shows the wind-waves between 05:00 and 06:00 at WG_CM17 due to the strong wind event of March 30, 2025, where H_s reached 6 inches. Figure 9 shows, for the same day, the leading, approximately 4-inch peak-to-peak, transverse wave of the MENDOCINO wake occurring simultaneously with wind-waves.
  - Figure 44 shows the wind-waves between 06:00 and 08:00 at WG_CM due to the strong wind event of March 30, 2025, where H_s reached 3 inches. Figure 45 shows, for the same day, the

DEL NORTE wake possibly combined with the wind waves reaching an about 10-inch peak-to-peak height. It must be noted that, in perspective, the impact of that few-seconds duration wake would be negligible compared to the impact of the wind-waves that lasted several hours that day.

- All plots show that at WG_CM17 and WG_CM qwew the most exposed and closest WGs to the ferry tracks. The fast ferry wakes are typically negligible, less than 4 inches peak to peak high and never exceeding 6 inches peak to peak.
- Figure 53 and Figure 54 show a rare instance when, at WG_147, an about 12-inch peak-to-peak wave was recorded before the passage of the ferry. While it is possible that the ferry slowed down and the wake train overtook and passed the ferry arriving earlier to WG_147. Figure 53 also shows another similar wave not corresponding to the passage of a fast ferry, suggesting those waves were due to the passage of a different vessel. This is a realistic possibility given the number of powerboats berthed in and regularly transiting the Corte Madera Creek.
- Figure 68 shows ferry arrivals and periods of ferry wakes occurring simultaneously with wind-waves at WG_MF. Wind-waves are negligible. Figure 69 shows, for the same day, the passing time of the GOLDEN GATE by WG_CM17 and a wake at WG_MF approximately 7 minutes later. The GOLDEN GATE cannot have generated this wake because traveling at 6.7 knots in approximately 12.4 feet water depth; its wake would have covered the approximately 1,500 feet distance between the ferry and WG_MF in about 2 to 3 minutes and would have been significantly dissipated.

A.2 WG_CM17

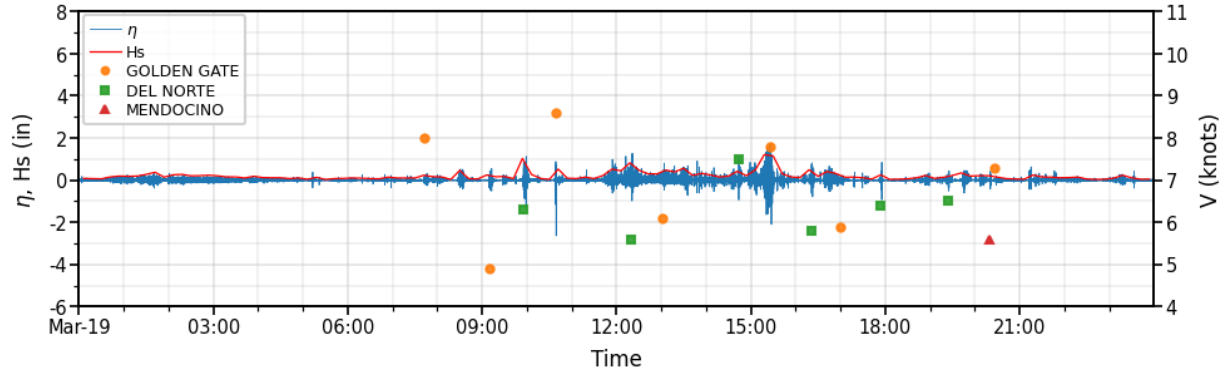


Figure 1. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on March 19, 2025

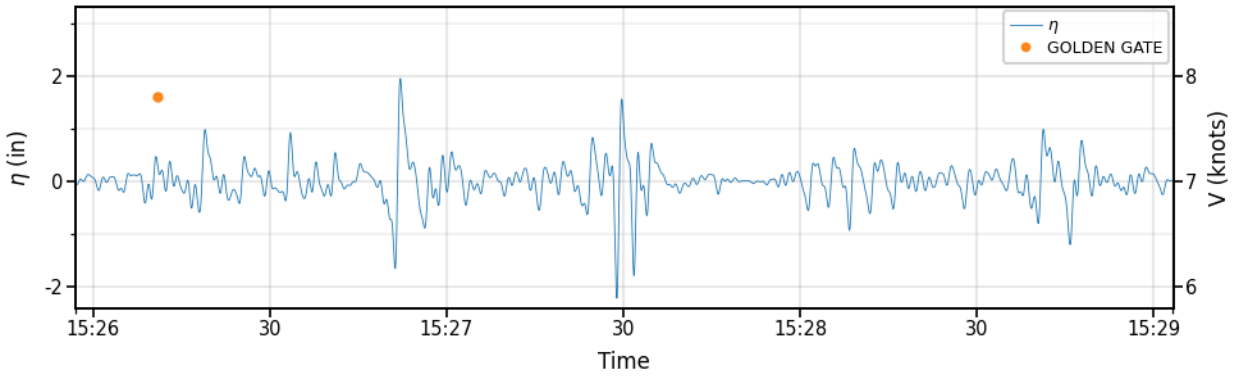


Figure 2. Time histories of h and velocity of the GOLDEN GATE passing by WG_CM17 on March 19, 2025, at approximately 15:26

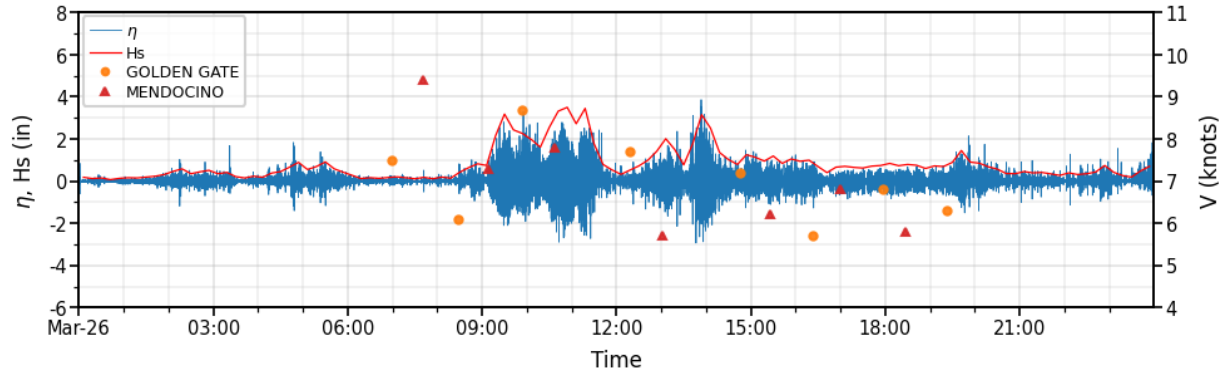


Figure 3. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on March 26, 2025

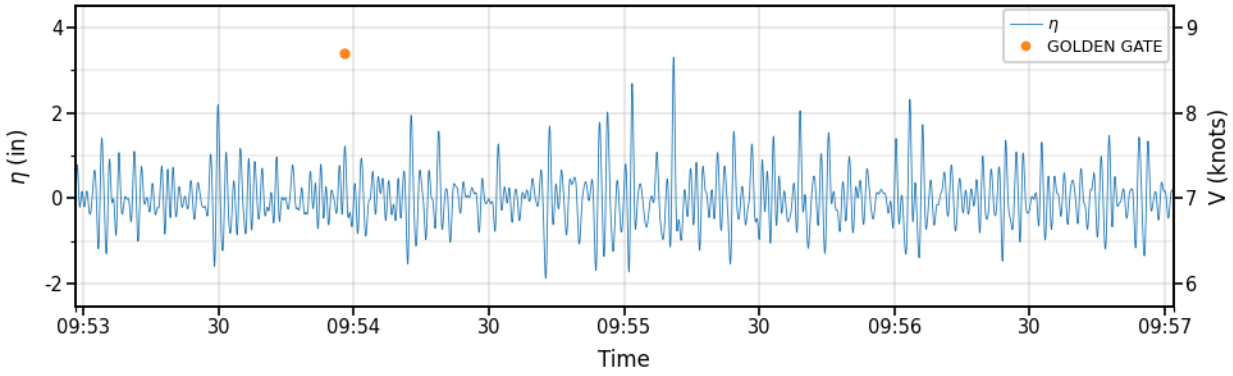


Figure 4. Time histories of h and velocity of the GOLDEN GATE passing by WG_CM17 on March 26, 2025, at approximately 09:54

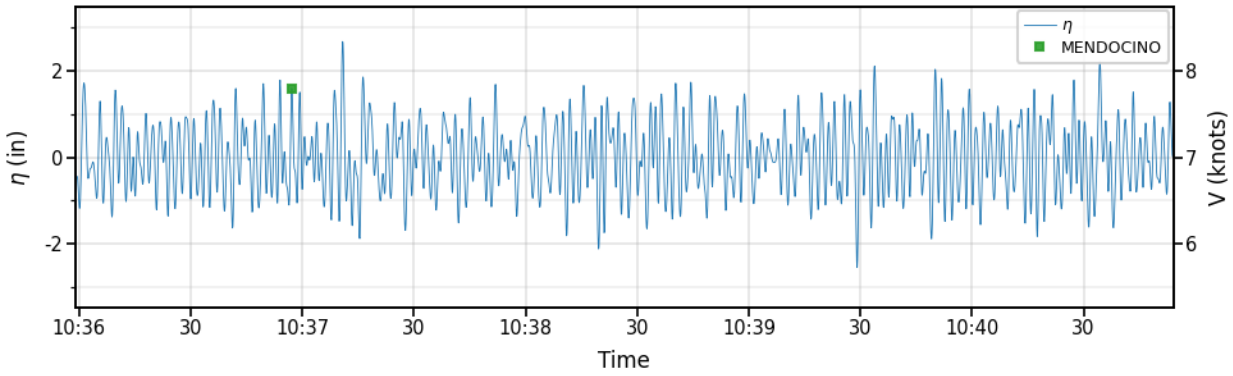


Figure 5. Time histories of h and velocity of the MENDOCINO passing by WG_CM17 on March 26, 2025, at approximately 10:37

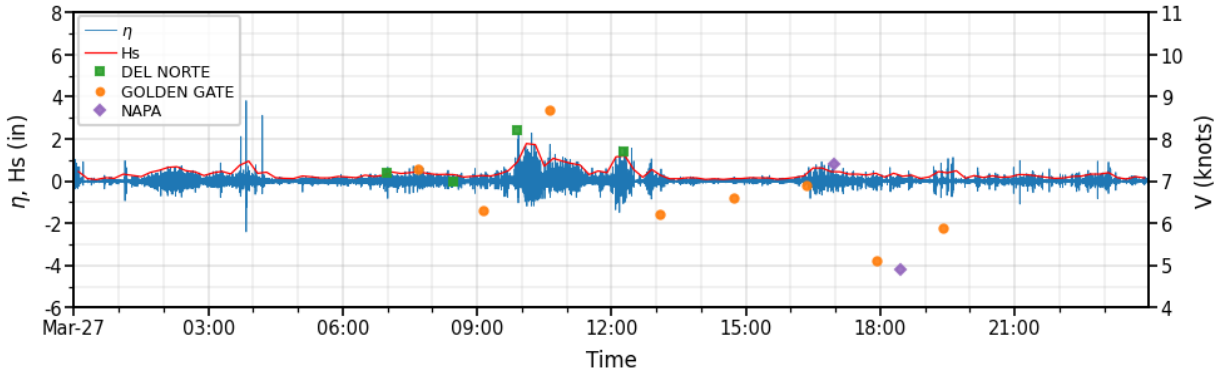


Figure 6. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on March 27, 2025

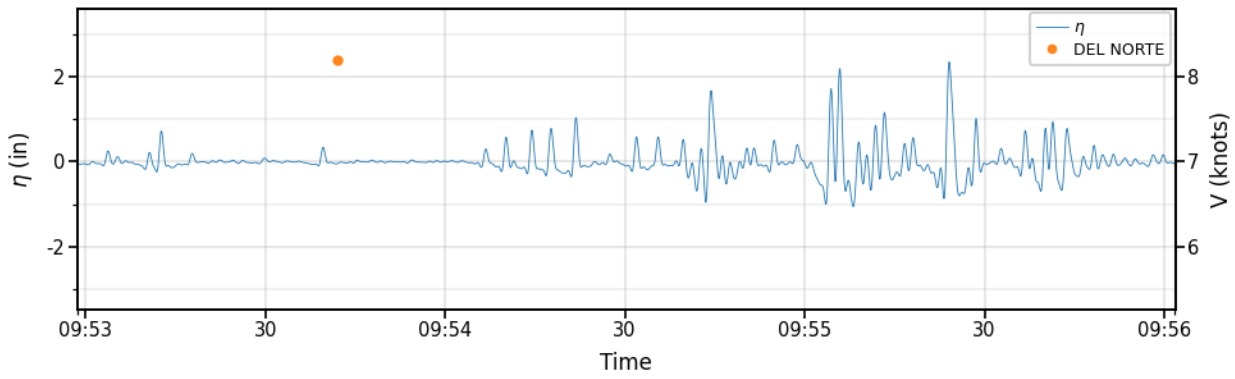


Figure 7. Time histories of h and velocity of the DEL NORTE passing by WG_CM17 on March 27, 2025, at approximately 09:54

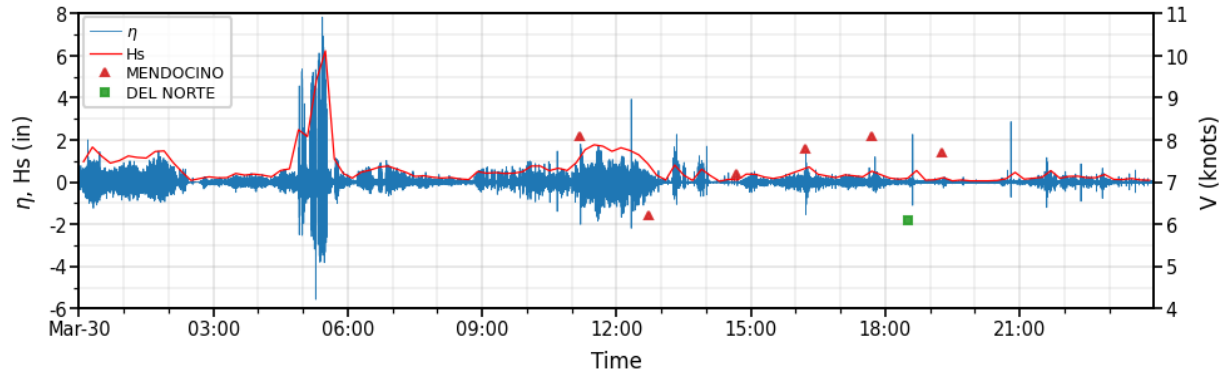


Figure 8. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on March 30, 2025

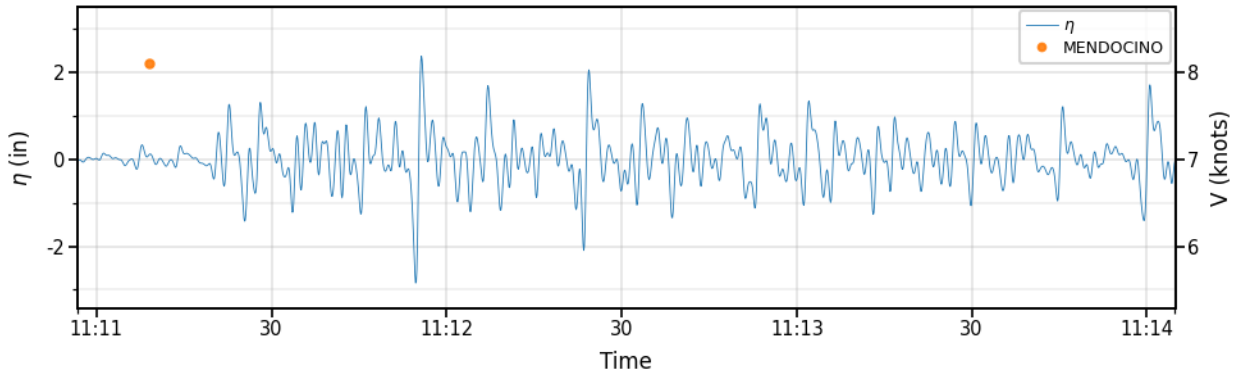


Figure 9. Time histories of h and velocity of the MENDOCINO passing by WG_CM17 on March 30, 2025, at approximately 11:11

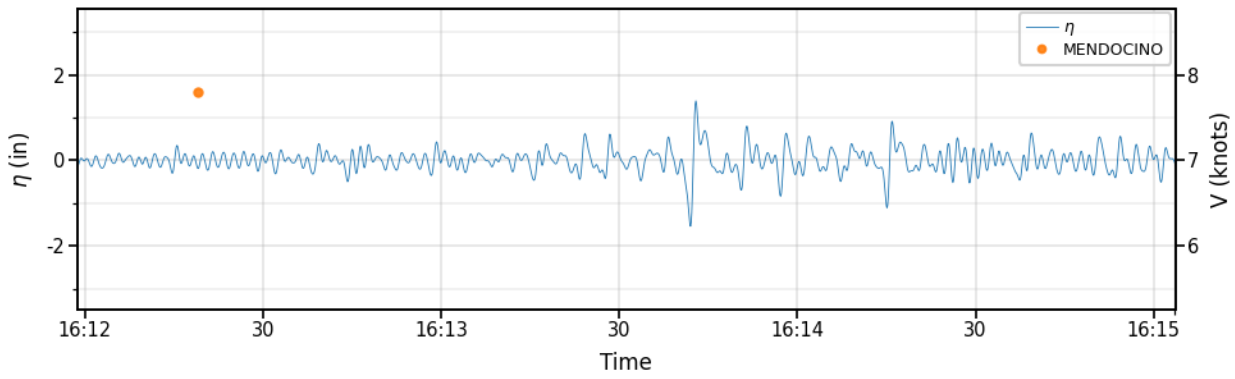


Figure 10. Time histories of h and velocity of the MENDOCINO passing by WG_CM17 on March 30, 2025, at approximately 16:12

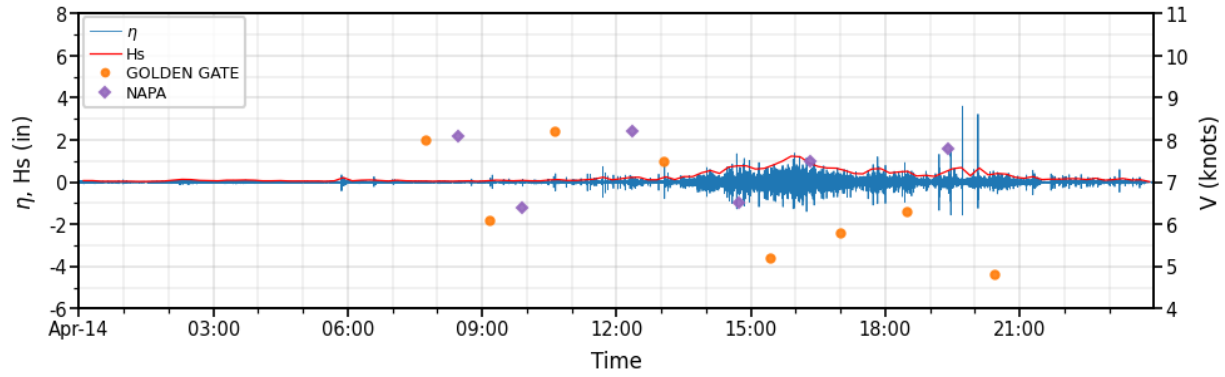


Figure 11. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on April 14, 2025

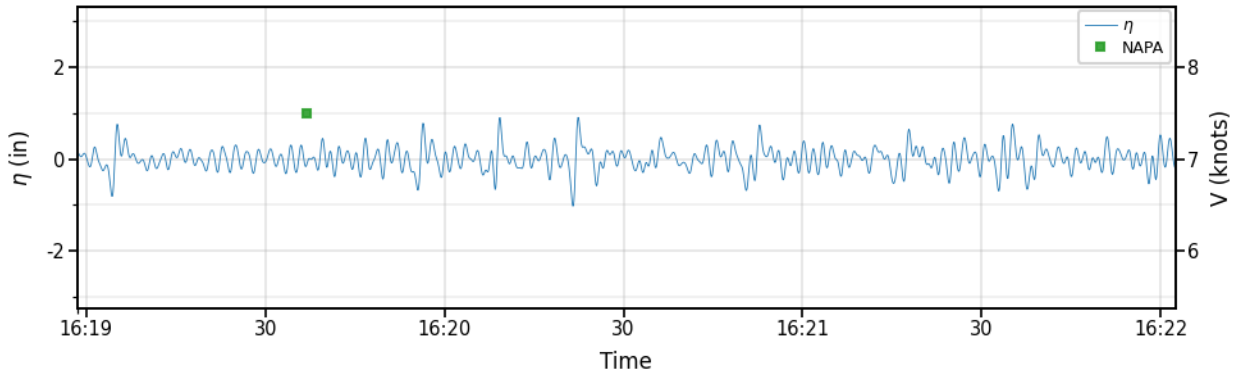


Figure 12. Time histories of h and velocity of the NAPA passing by WG_CM17 on April 14, 2025, at approximately 16:20

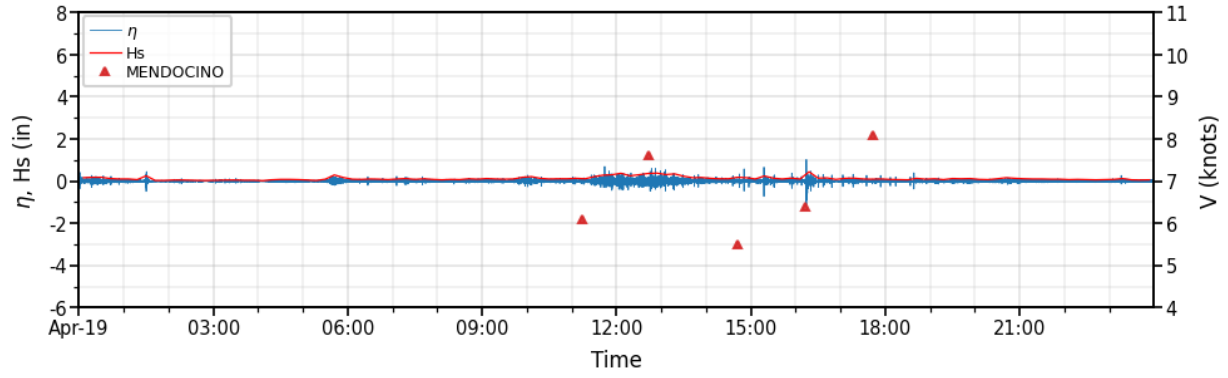


Figure 13. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on April 19, 2025

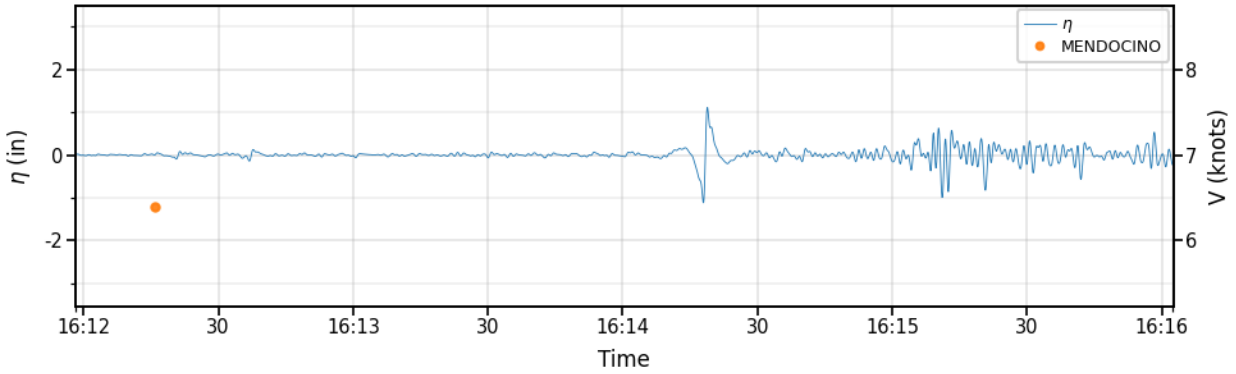


Figure 14. Time histories of h and velocity of the MENDOCINO passing by WG_CM17 on April 19, 2025, at approximately 16:12

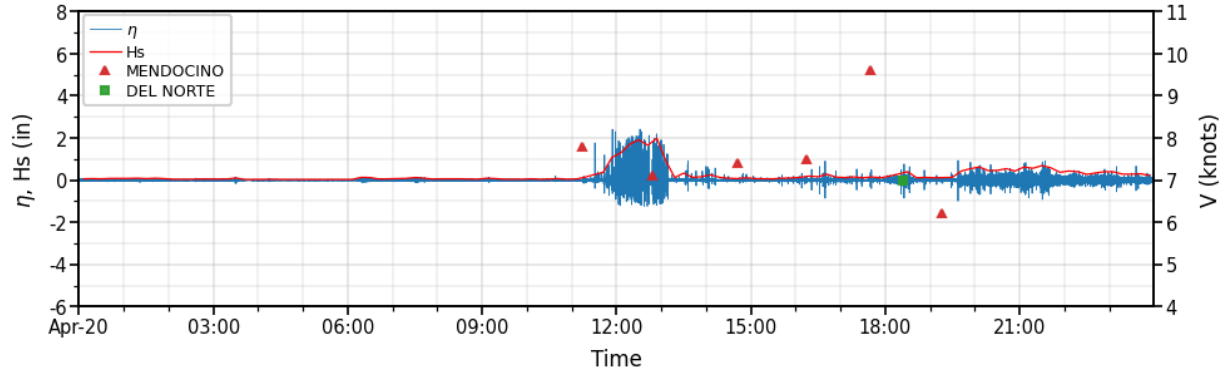


Figure 15. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on April 20, 2025

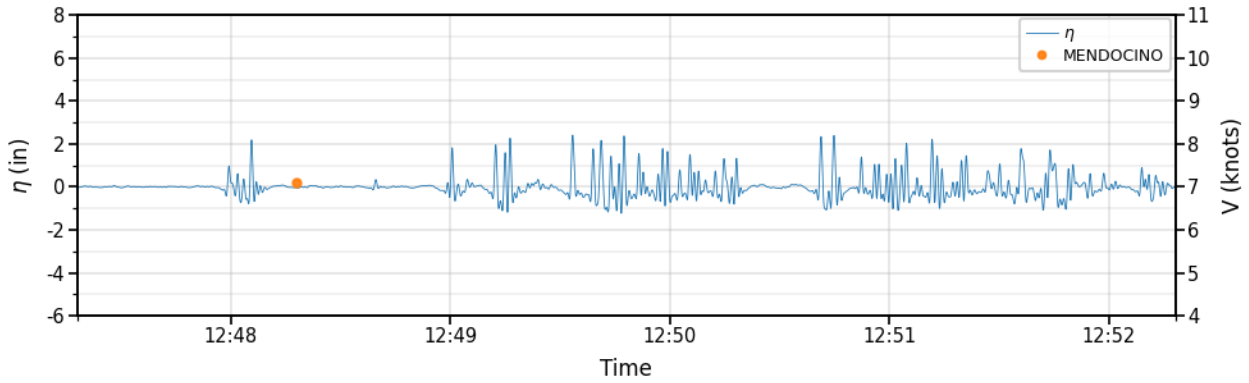


Figure 16. Time histories of h and velocity of the MENDOCINO passing by WG_CM17 on April 20, 2025, at approximately 12:48

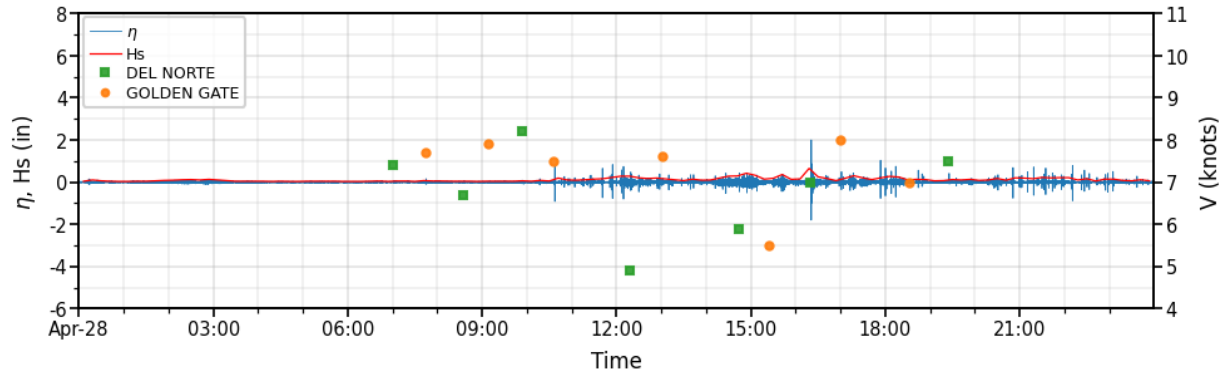


Figure 17. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on April 28, 2025

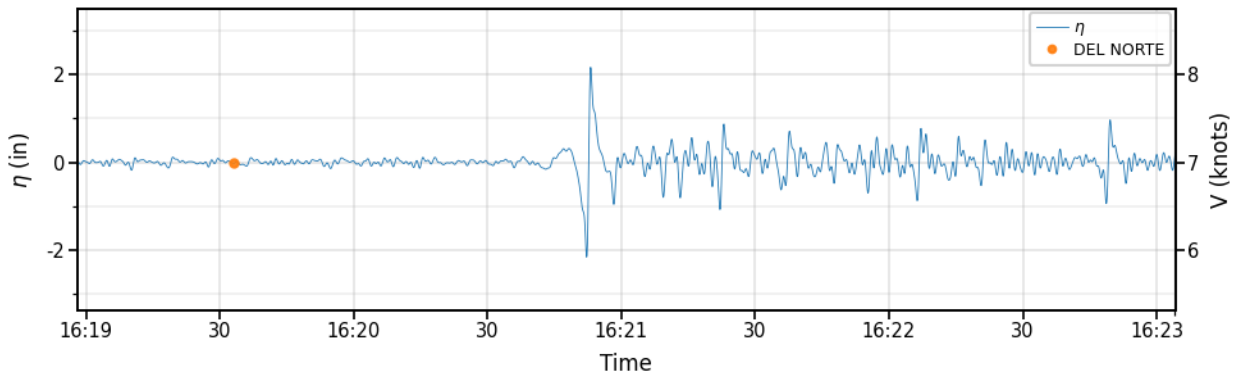


Figure 18. Time histories of h and velocity of the DEL NORTE passing by WG_CM17 on April 28, 2025, at approximately 16:20

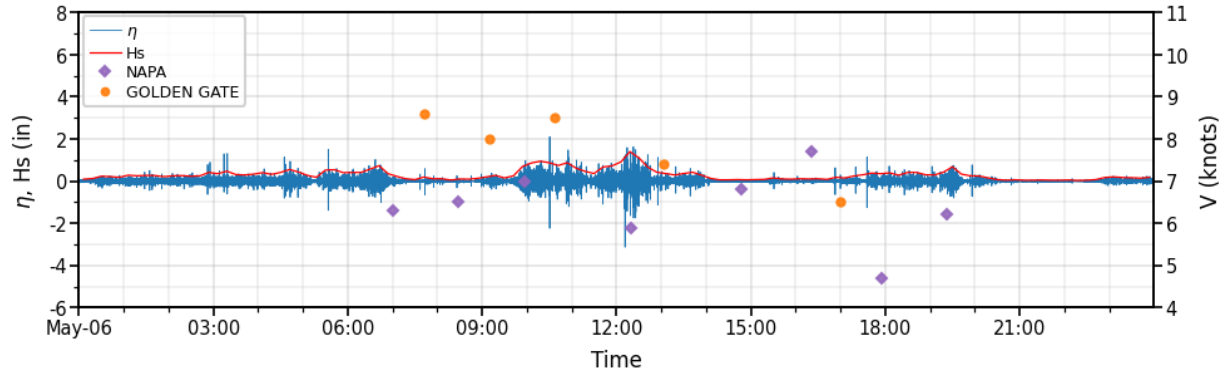


Figure 19. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on May 6, 2025

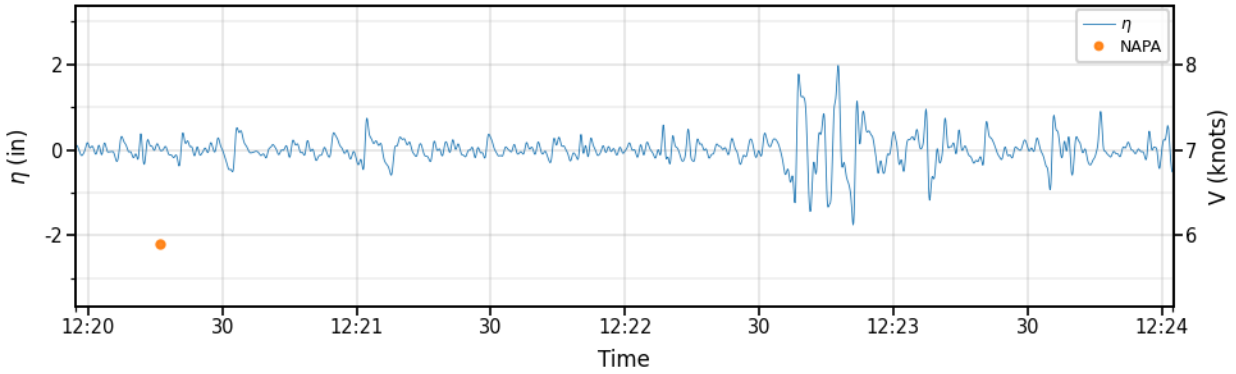


Figure 20. Time histories of h and velocity of the NAPA passing by WG_CM17 on May 6, 2025, at approximately 12:20

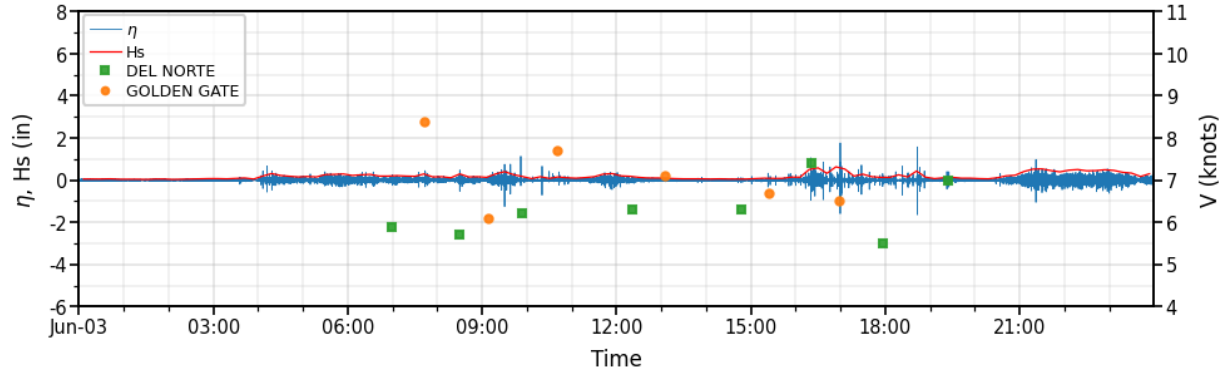


Figure 21. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on June 3, 2025

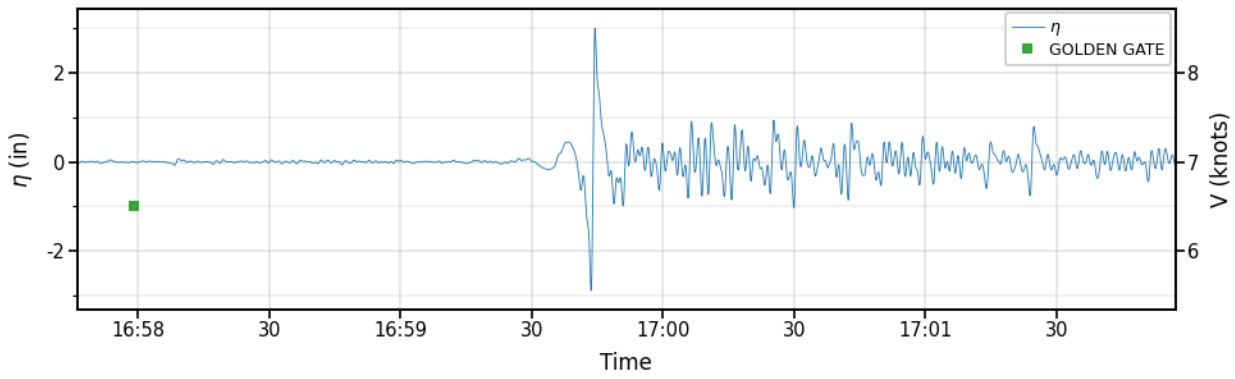


Figure 22. Time histories of h and velocity of the GOLDEN GATE passing by WG_CM17 on June 3, 2025, at approximately 16:58

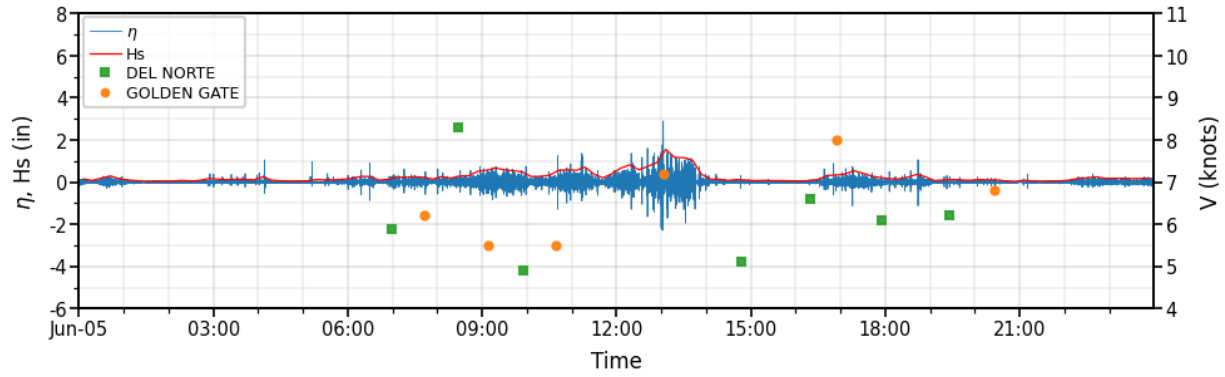


Figure 23. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on June 5, 2025

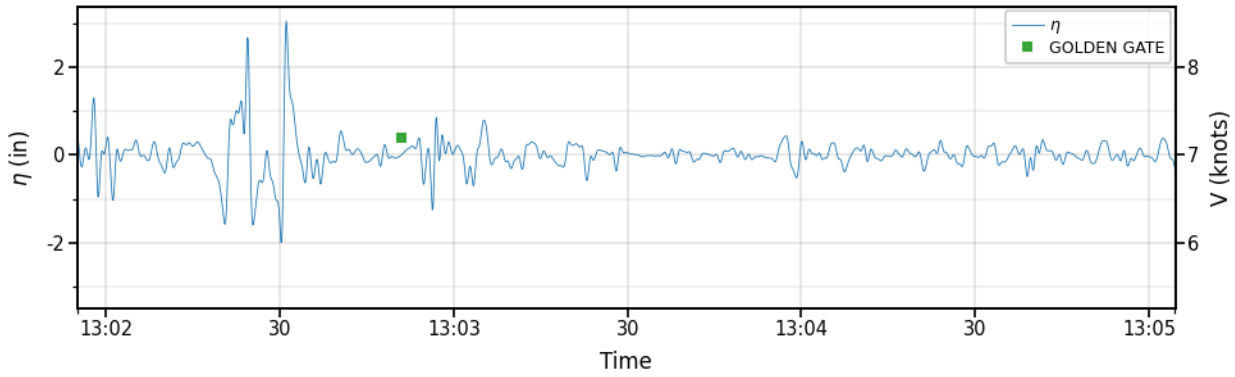


Figure 24. Time histories of h and velocity of the GOLDEN GATE passing by WG_CM17 on June 5, 2025, at approximately 13:03

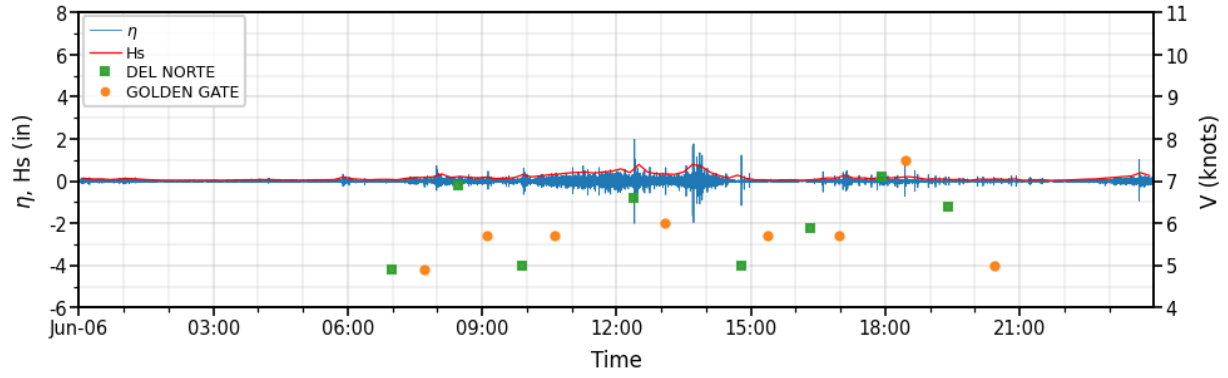


Figure 25. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM17 on June 6, 2025

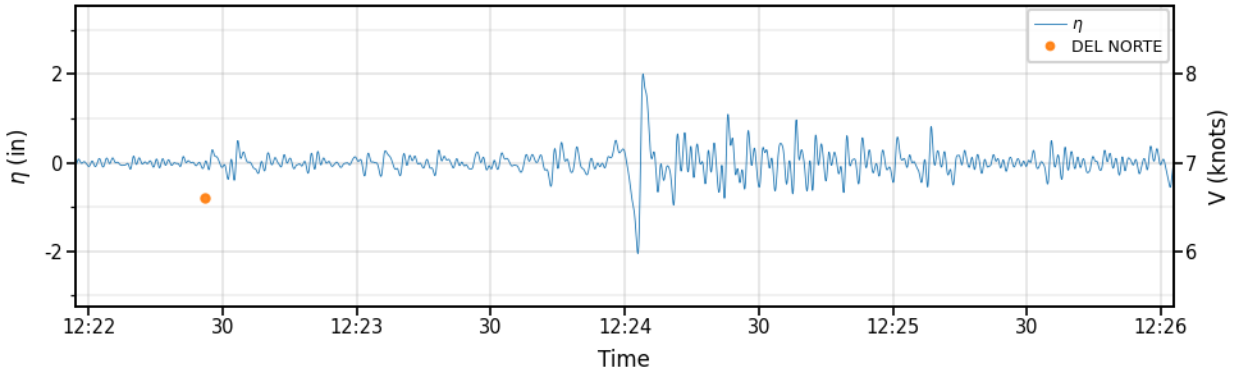


Figure 26. Time histories of h and velocity of the DEL NORTE passing by WG_CM17 on June 6, 2025, at approximately 12:22

A.3 WG_CM

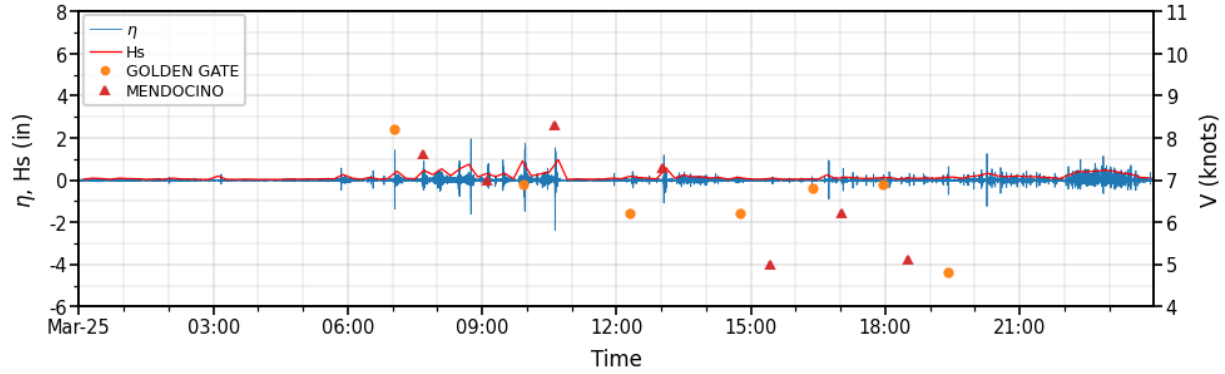


Figure 27. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM on March 25, 2025

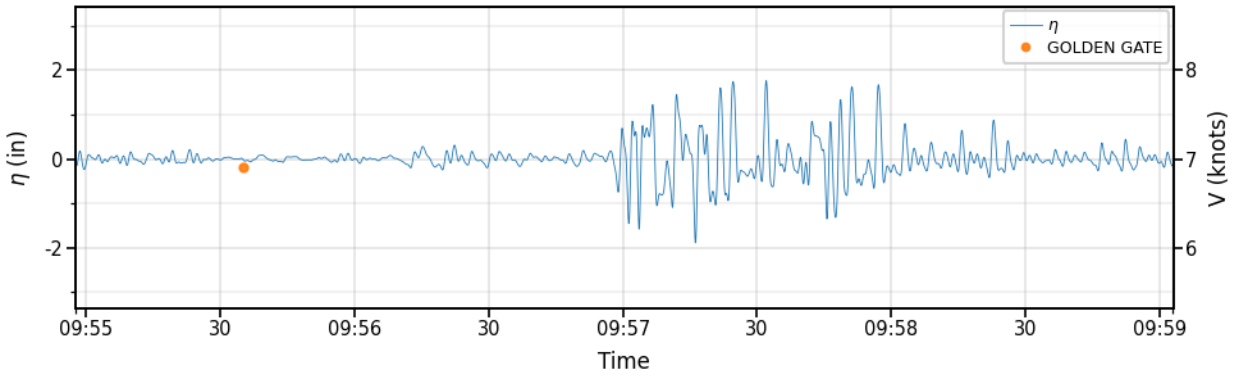


Figure 28. Time histories of h and velocity of the GOLDEN GATE passing by WG_CM on March 25, 2025, at approximately 09:56

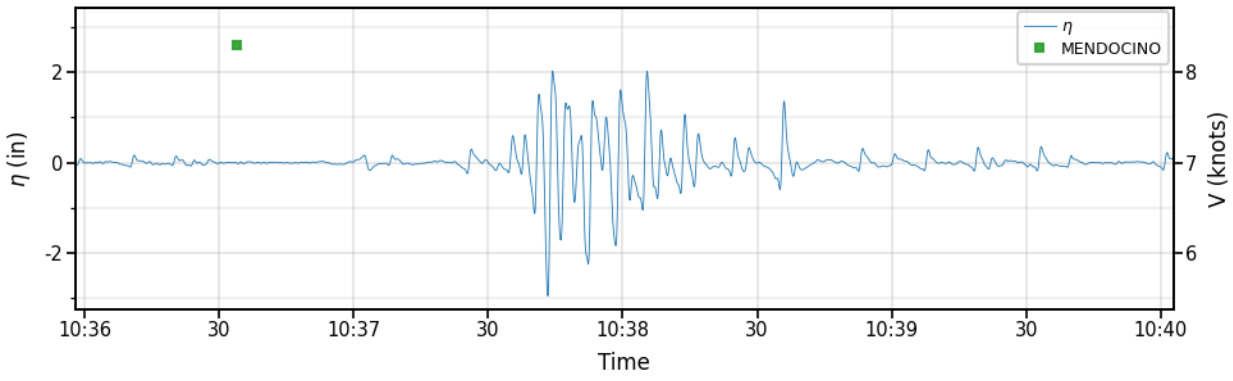


Figure 29. Time histories of h and velocity of the MENDOCINO passing by WG_CM on March 25, 2025, at approximately 10:37

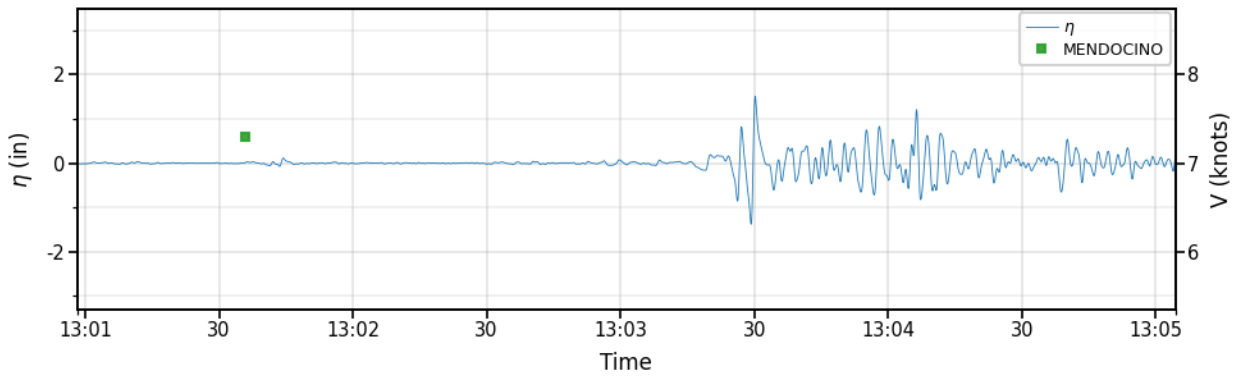


Figure 30. Time histories of h and velocity of the MENDOCINO passing by WG_CM on March 25, 2025, at approximately 13:02

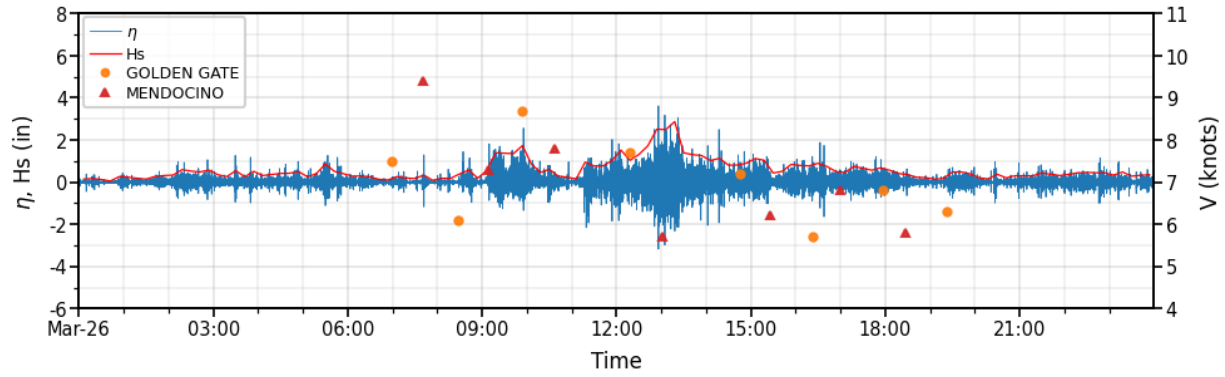


Figure 31. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM on March 26, 2025

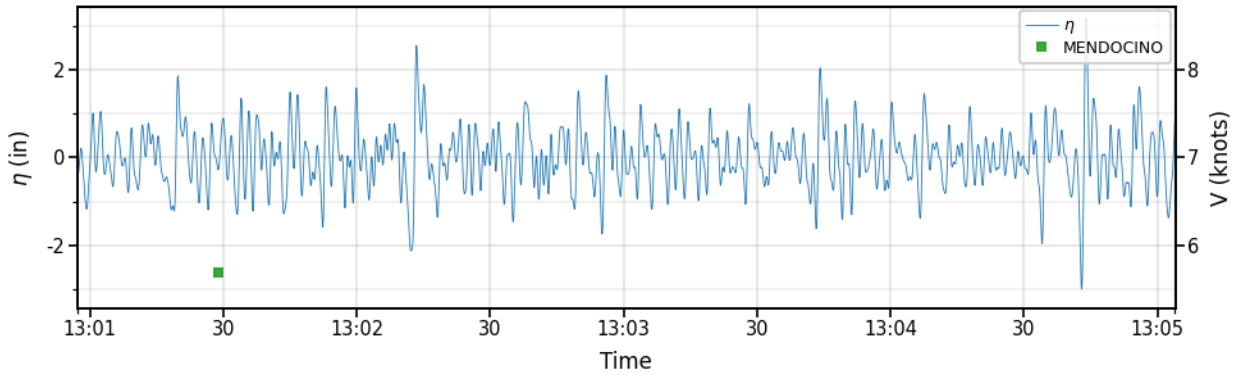


Figure 32. Time histories of h and velocity of the MENDOCINO passing by WG_CM on March 26, 2025, at approximately 13:01

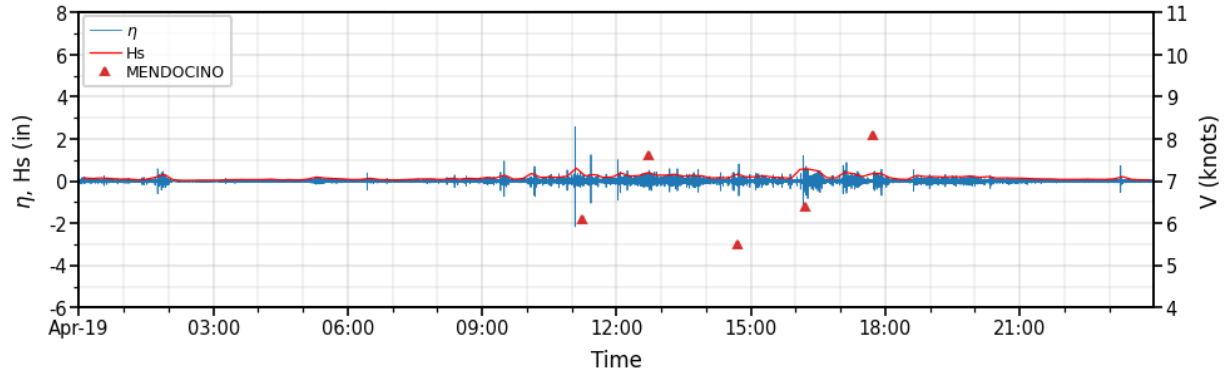


Figure 33. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM on April 19, 2025

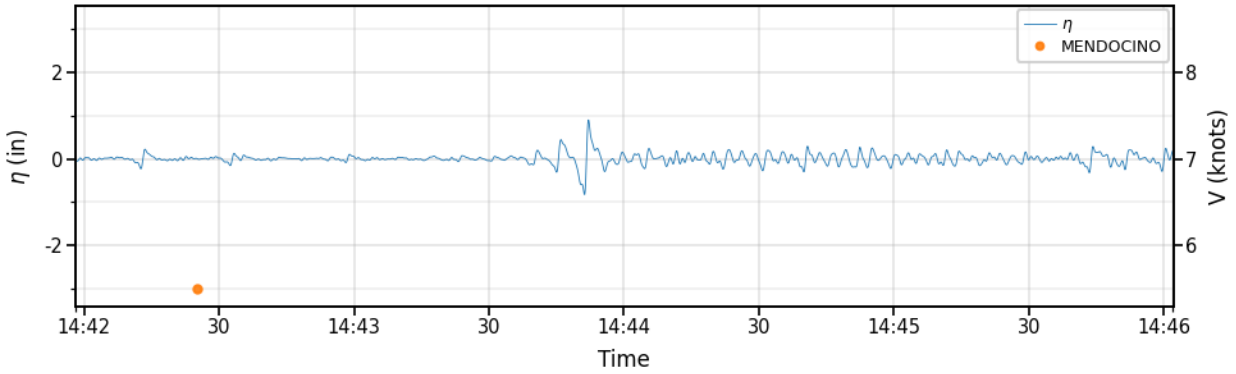


Figure 34. Time histories of h and velocity of the MENDOCINO passing by WG_CM on April 19, 2025, at approximately 14:42

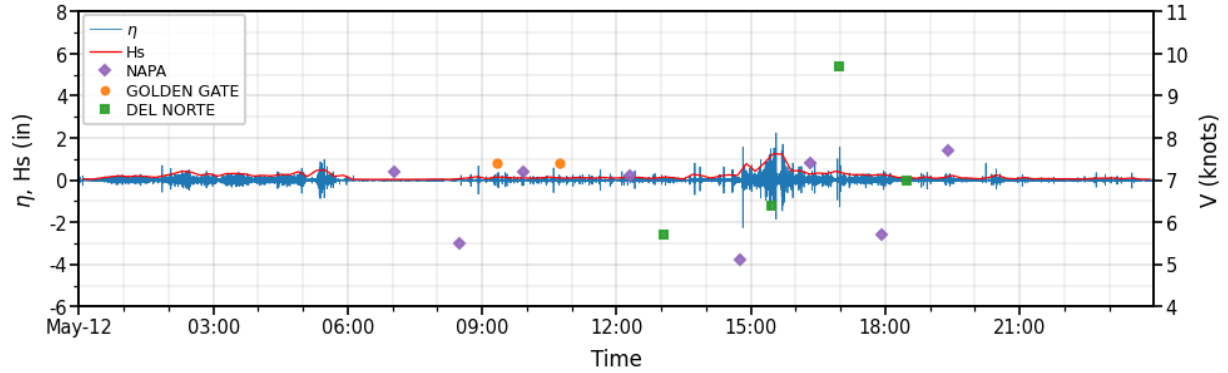


Figure 35. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM on May 12, 2025

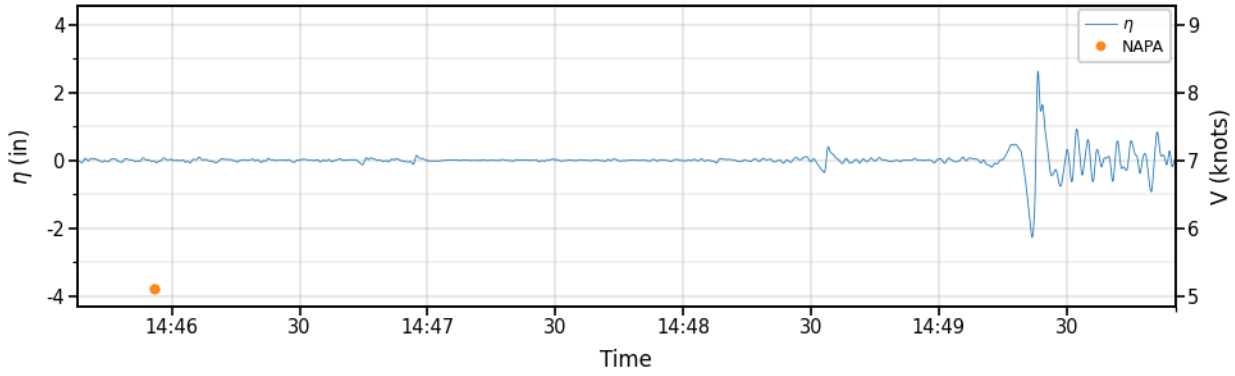


Figure 36. Time histories of h and velocity of the NAPA passing by WG_CM on May 12, 2025, at approximately 14:45

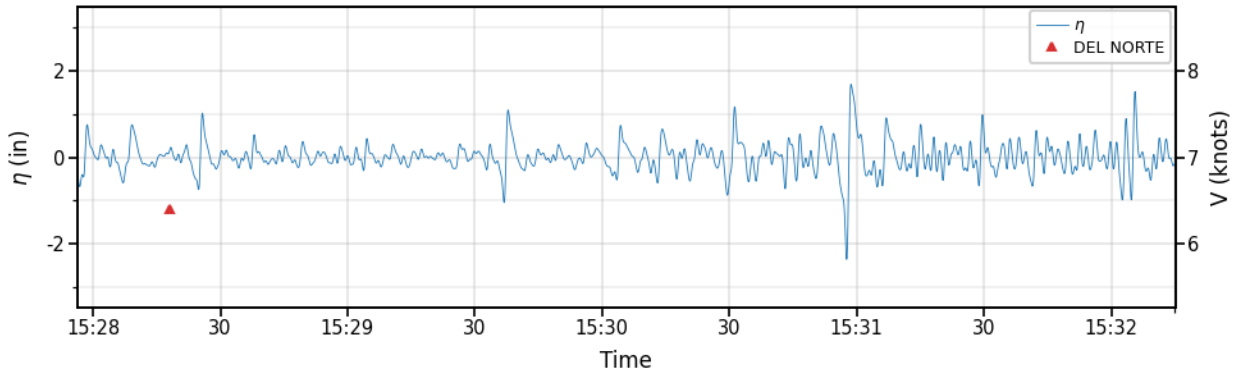


Figure 37. Time histories of h and velocity of the DEL NORTE passing by WG_CM on May 12, 2025, at approximately 15:28

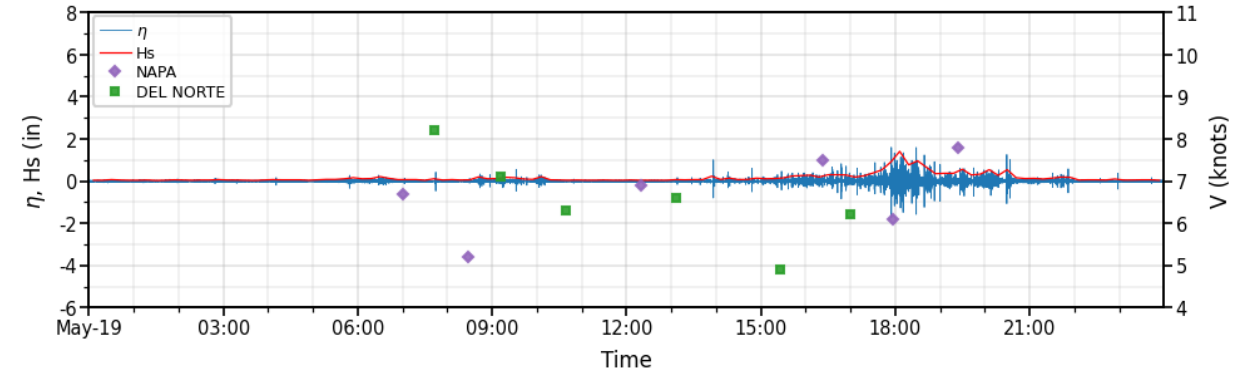


Figure 38. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM on May 19, 2025

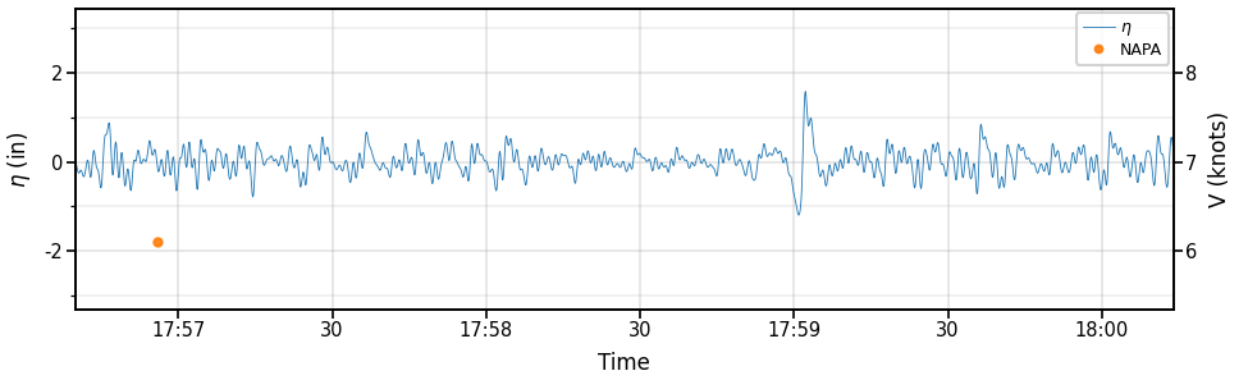


Figure 39. Time histories of h and velocity of the NAPA passing by WG_CM on May 19, 2025, at approximately 17:57

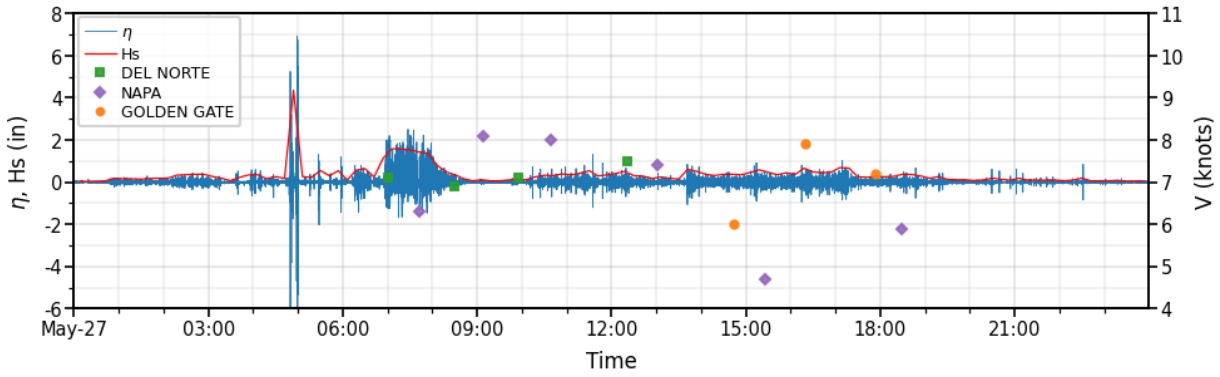


Figure 40. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM on May 27, 2025

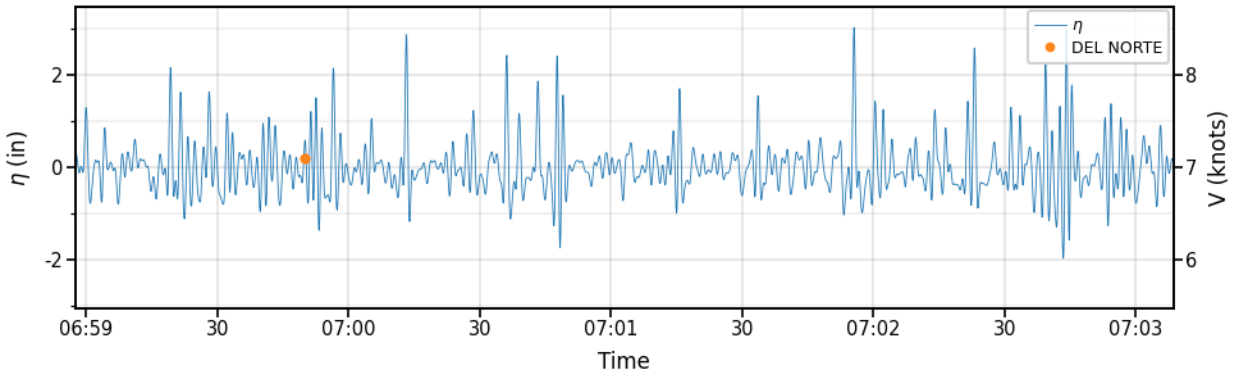


Figure 41. Time histories of h and velocity of the DEL NORTE passing by WG_CM on May 27, 2025, at approximately 06:59

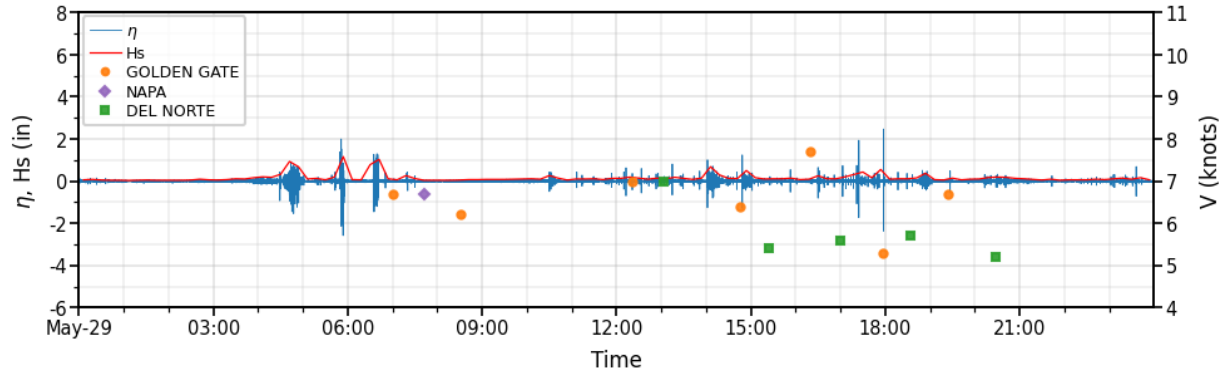


Figure 42. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM on May 29, 2025

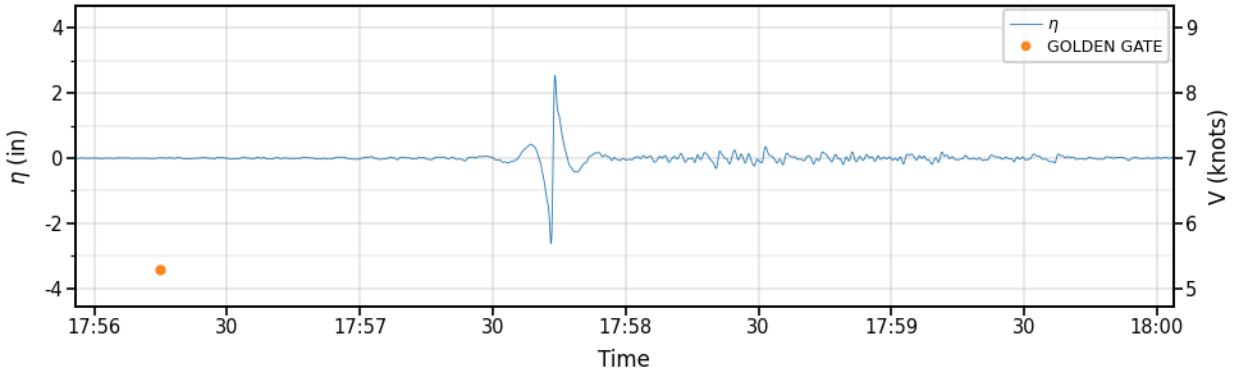


Figure 43. Time histories of h and velocity of the GOLDEN GATE passing by WG_CM on May 29, 2025, at approximately 17:56

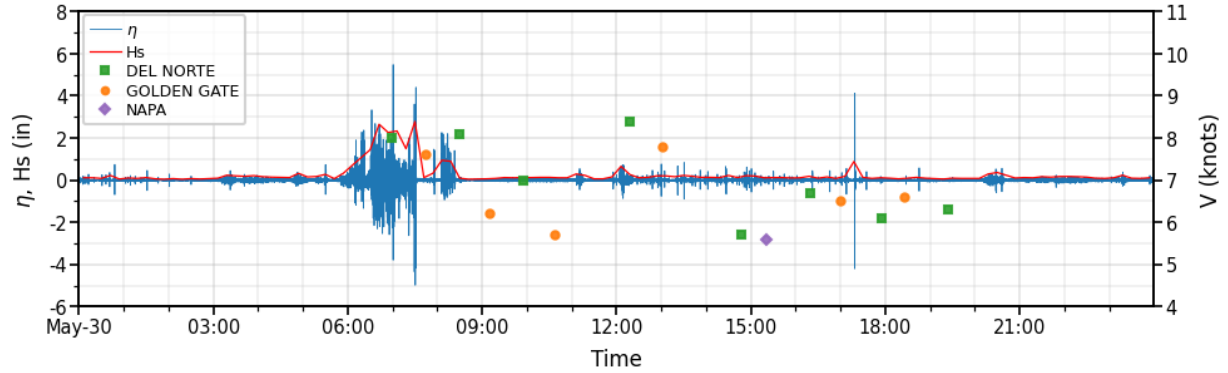


Figure 44. Time histories of h , H_s, and velocities of fast ferries passing by WG_CM on May 30, 2025

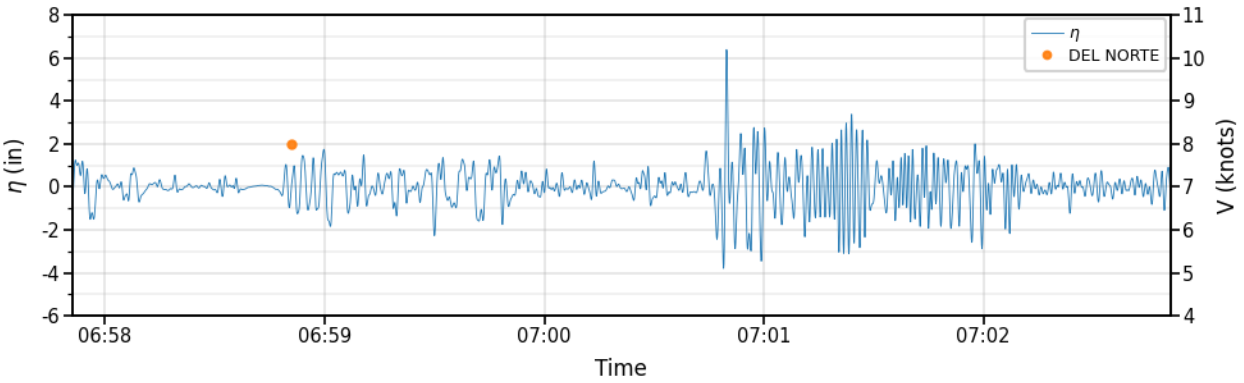


Figure 45. Time histories of h and velocity of the DEL NORTE passing by WG_CM on May 30, 2025, at approximately 06:58

A.4 WG_147

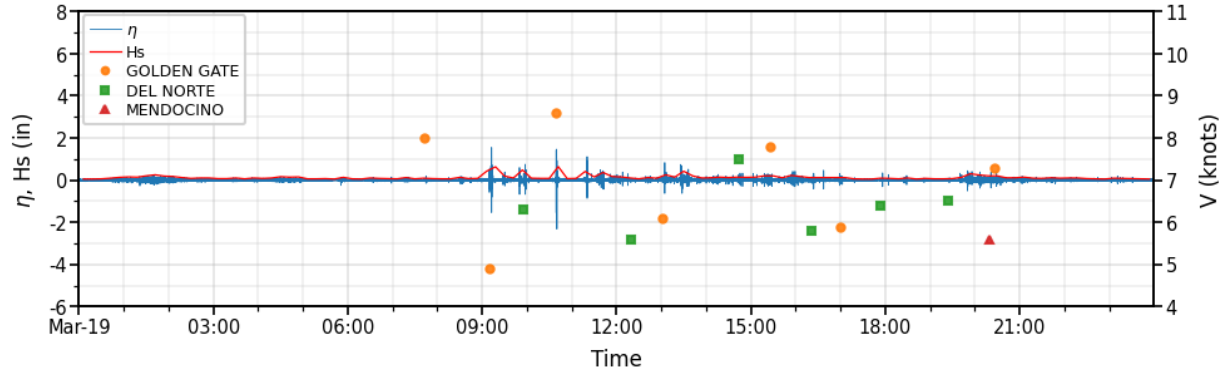


Figure 46. Time histories of h , H_s, and velocities of fast ferries passing by WG_147 on March 19, 2025

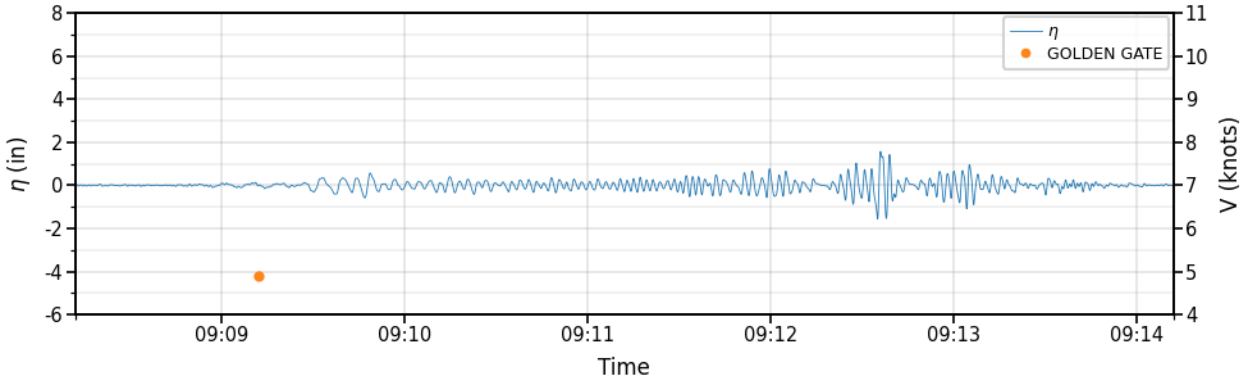


Figure 47. Time histories of h and velocity of the GOLDEN GATE passing by WG_147 on March 19, 2025, at approximately 09:09

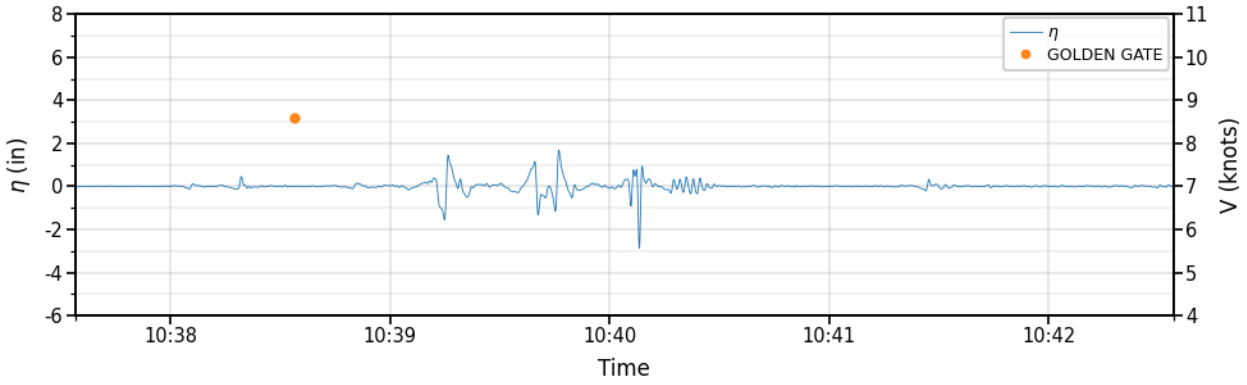


Figure 48. Time histories of h and velocity of the GOLDEN GATE passing by WG_147 on March 19, 2025, at approximately 10:38

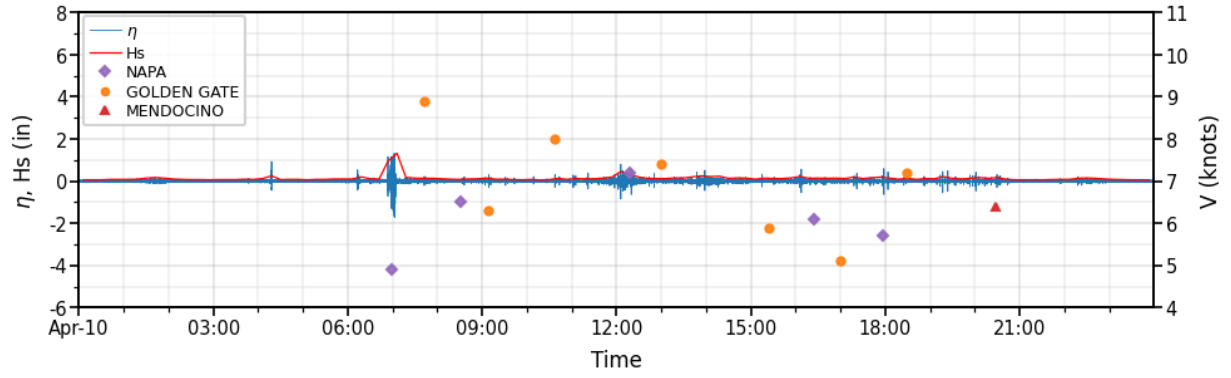


Figure 49. Time histories of h , H_s, and velocities of fast ferries passing by WG_147 on April 10, 2025

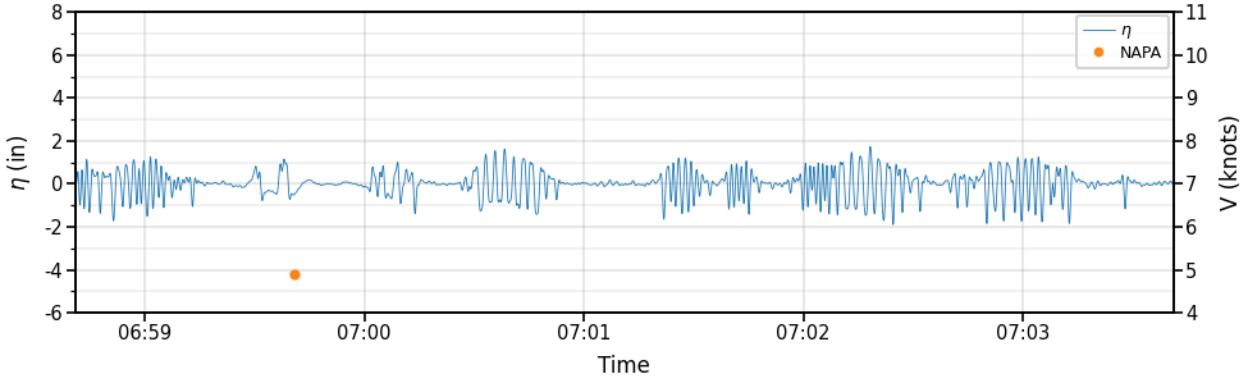


Figure 50. Time histories of h and velocity of the NAPA passing by WG_147 on April 10, 2025, at approximately 06:59

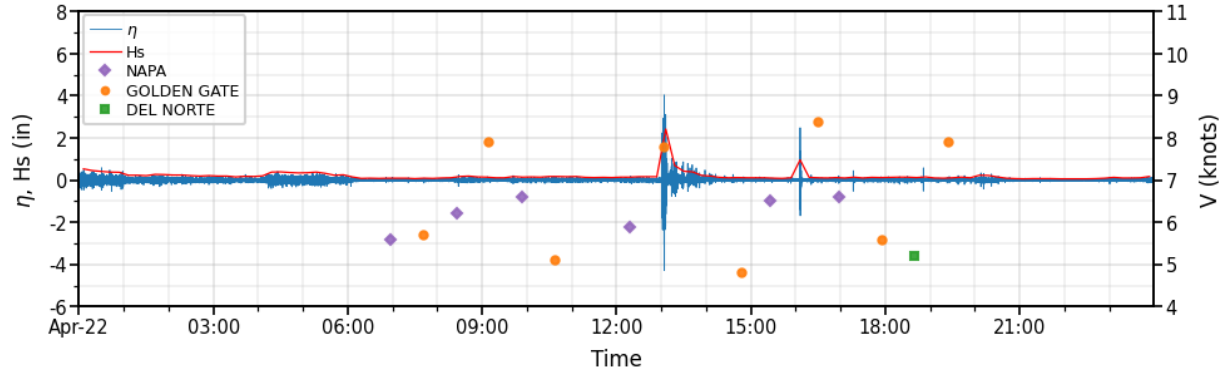


Figure 51. Time histories of h , H_s, and velocities of fast ferries passing by WG_147 on April 22, 2025

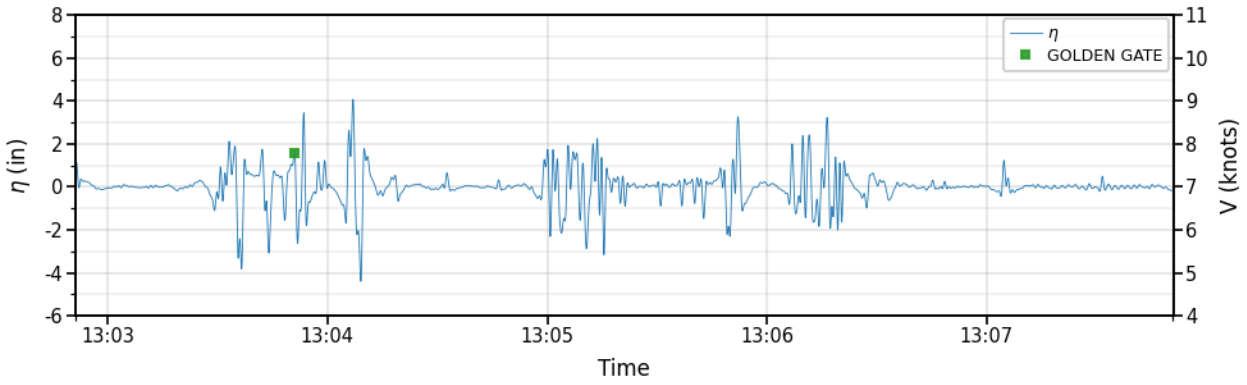


Figure 52. Time histories of h and velocity of the GOLDEN GATE passing by WG_147 on April 22, 2025, at approximately 13:03

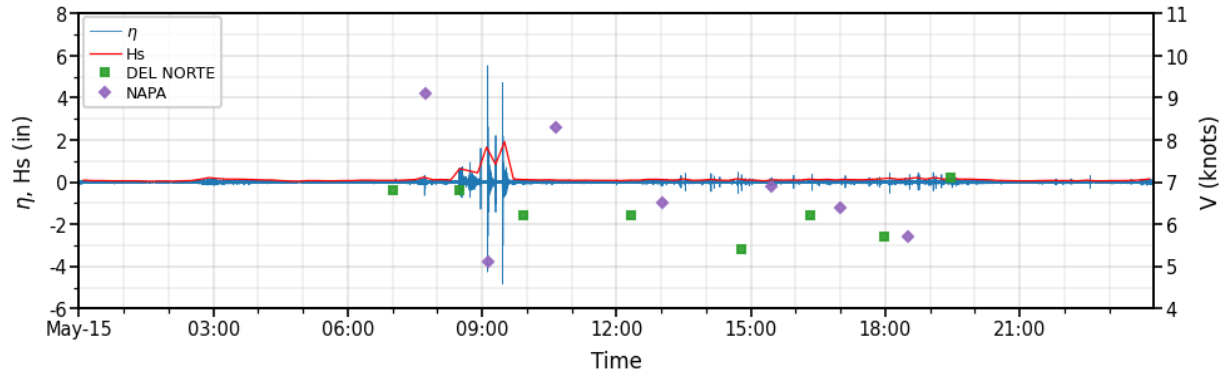


Figure 53. Time histories of h , H_s, and velocities of fast ferries passing by WG_147 on May 15, 2025

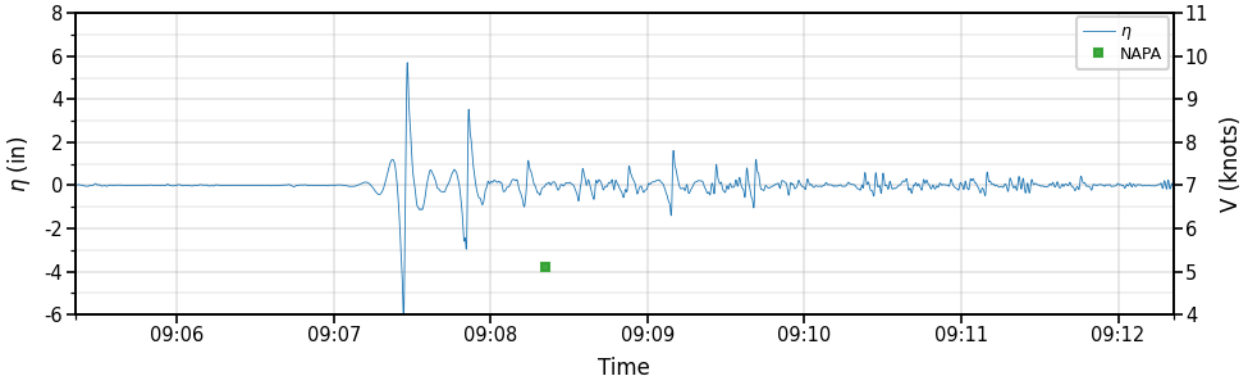


Figure 54. Time histories of h and velocity of the NAPA passing by WG_147 on May 15, 2025, at approximately 09:08

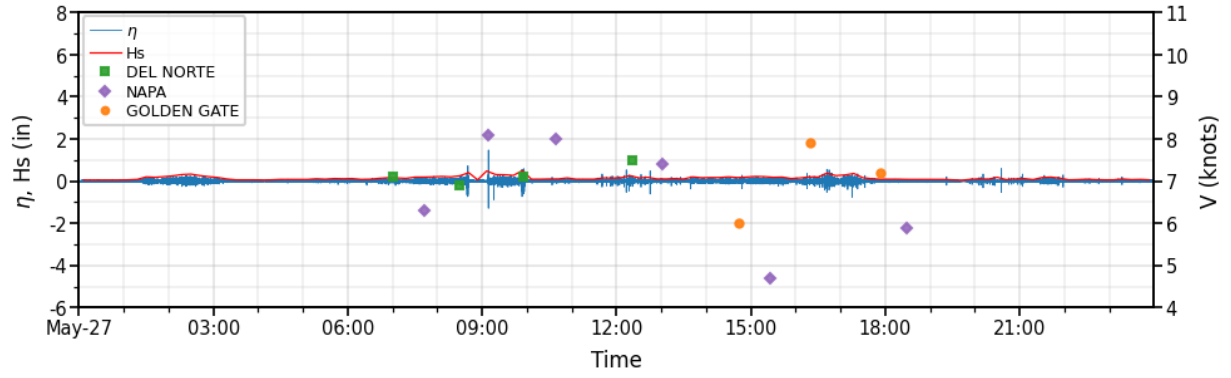


Figure 55. Time histories of h , H_s, and velocities of fast ferries passing by WG_147 on May 27, 2025

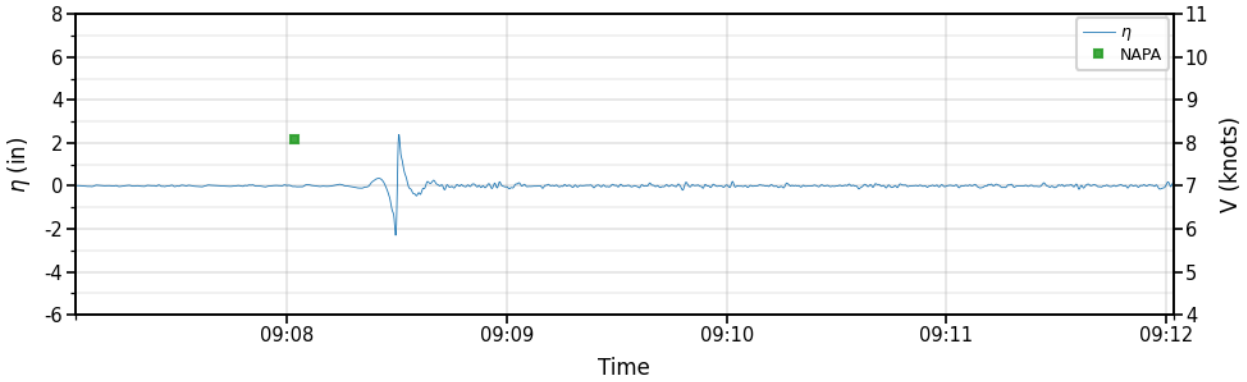


Figure 56. Time histories of h and velocity of the NAPA passing by WG_147 on May 27, 2025, at approximately 09:08

A.5 WG_MF

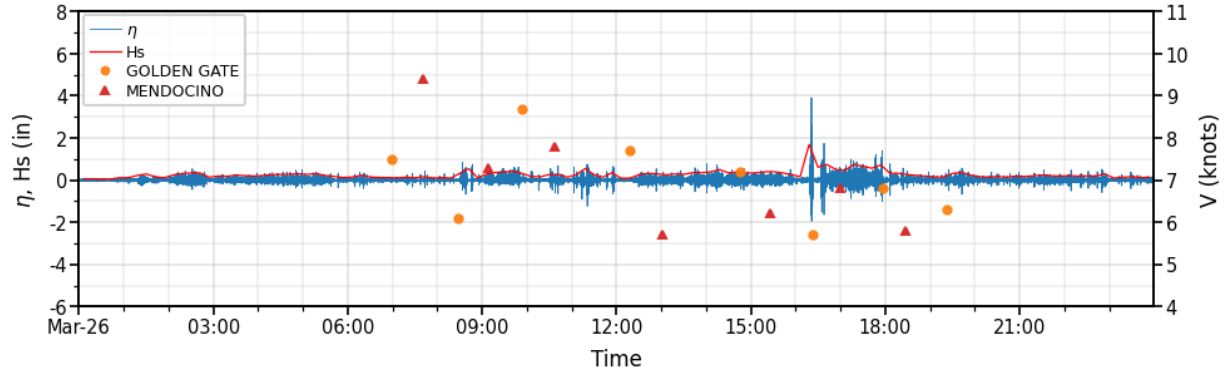


Figure 57. Time histories of h , H_s, and velocities of fast ferries passing by WG_MF on March 26, 2025

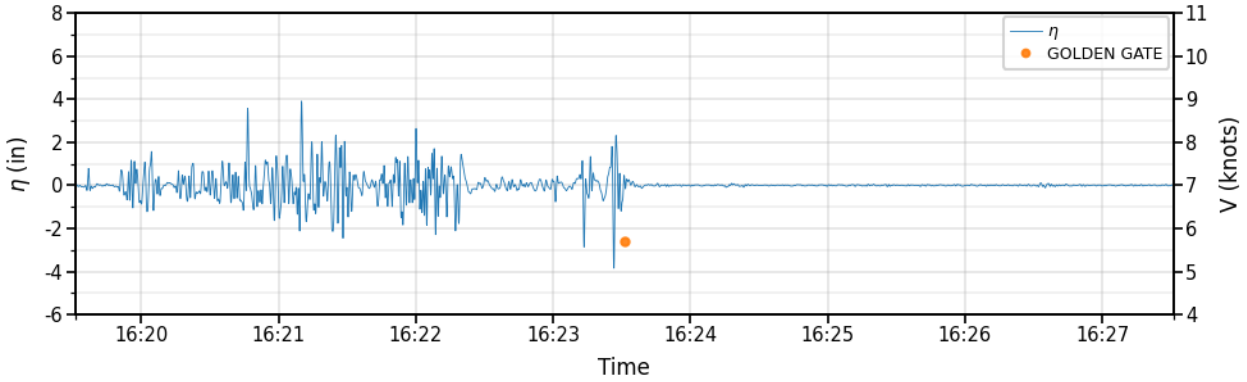


Figure 58. Time histories of h and velocity of the GOLDEN GATE passing by WG_MF on March 26, 2025, at approximately 16:23

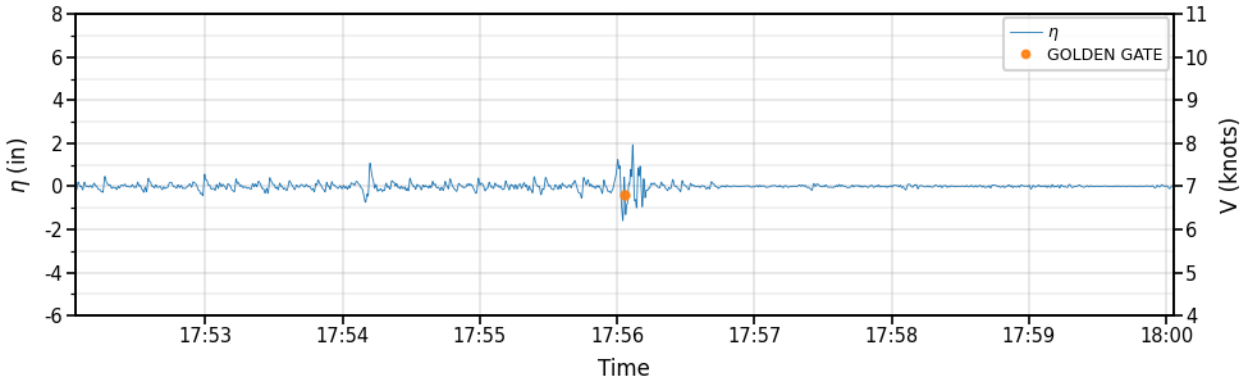


Figure 59. Time histories of h and velocity of the GOLDEN GATE passing by WG_MF on March 26, 2025, at approximately 17:56

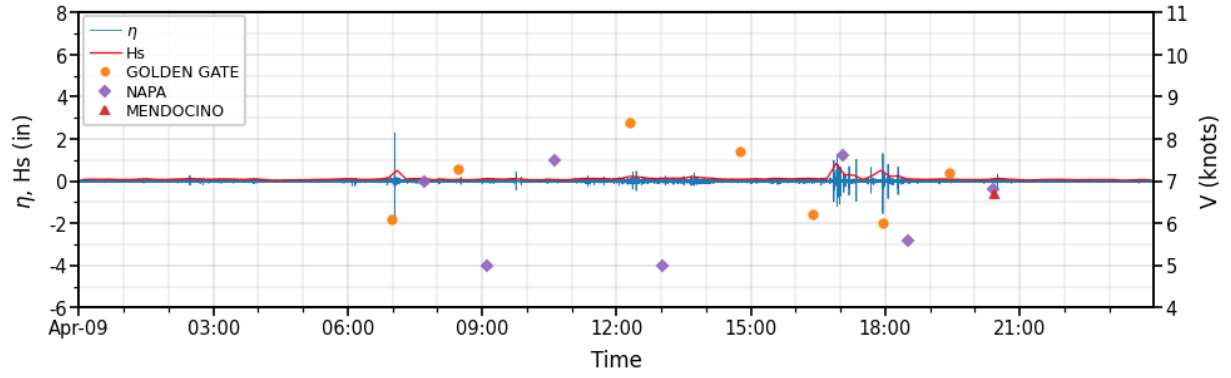


Figure 60. Time histories of h , H_s, and velocities of fast ferries passing by WG_MF on April 9, 2025

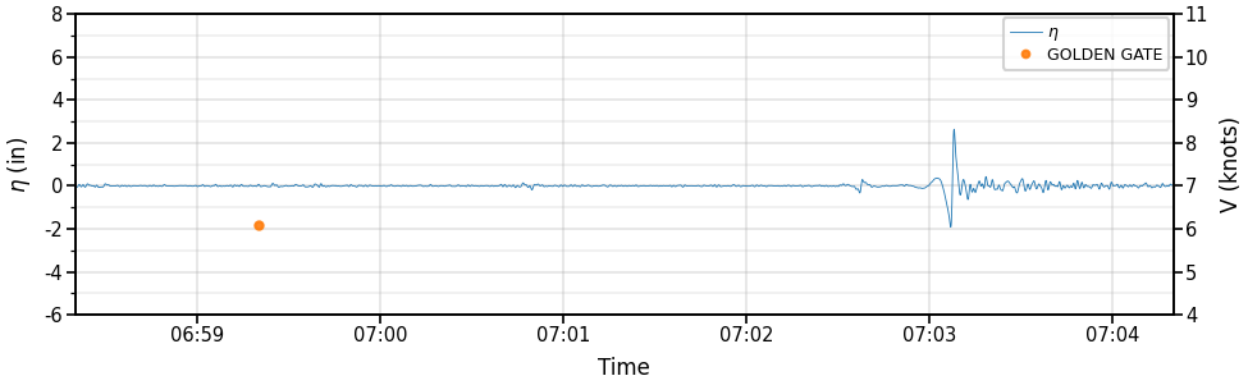


Figure 61. Time histories of h and velocity of the GOLDEN GATE passing by WG_MF on April 9, 2025, at approximately 06:59

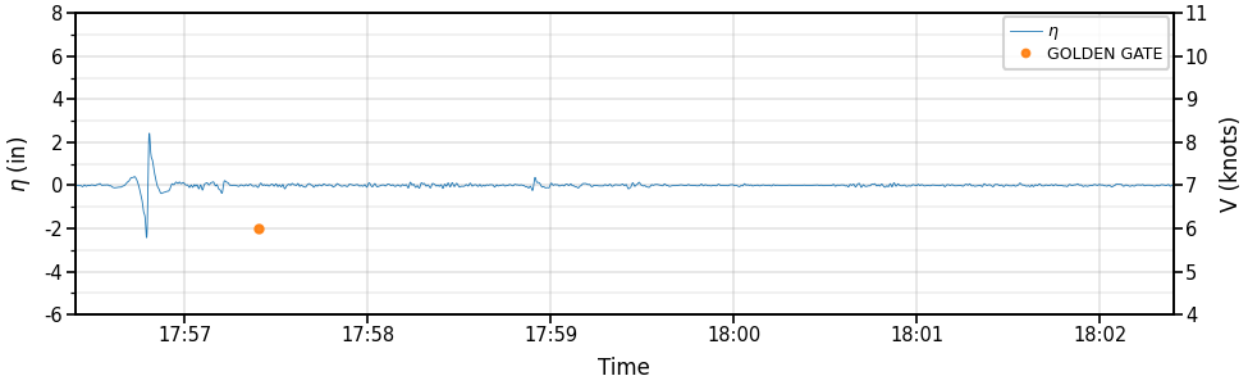


Figure 62. Time histories of h and velocity of the GOLDEN GATE passing by WG_MF on April 9, 2025, at approximately 17:57

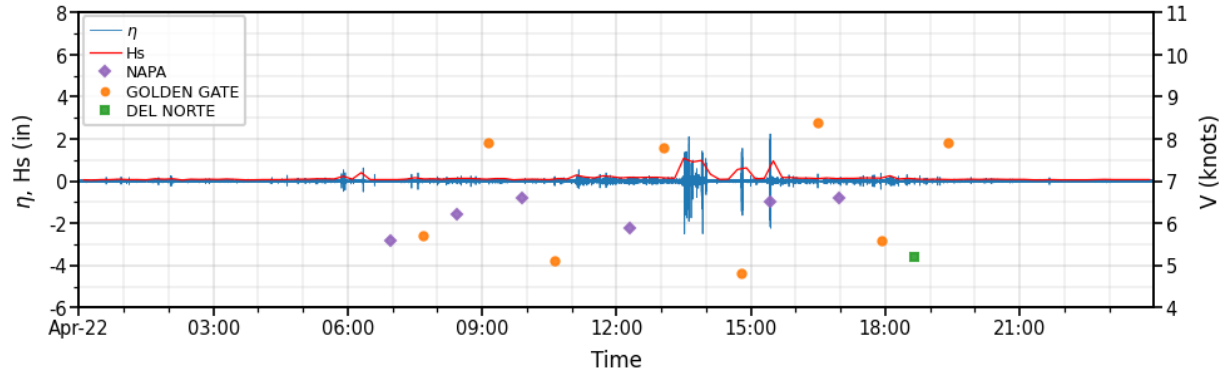


Figure 63. Time histories of h , H_s, and velocities of fast ferries passing by WG_MF on April 22, 2025

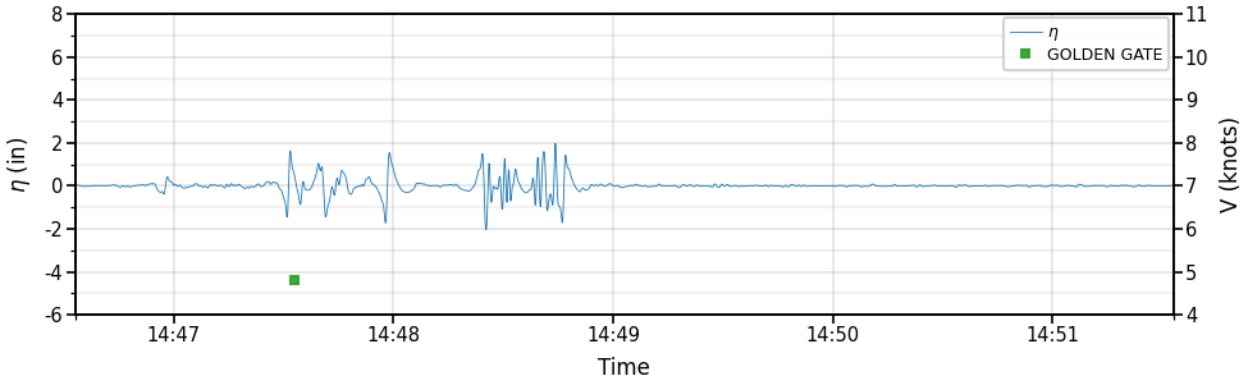


Figure 64. Time histories of h and velocity of the GOLDEN GATE passing by WG_MF on April 22, 2025, at approximately 14:47

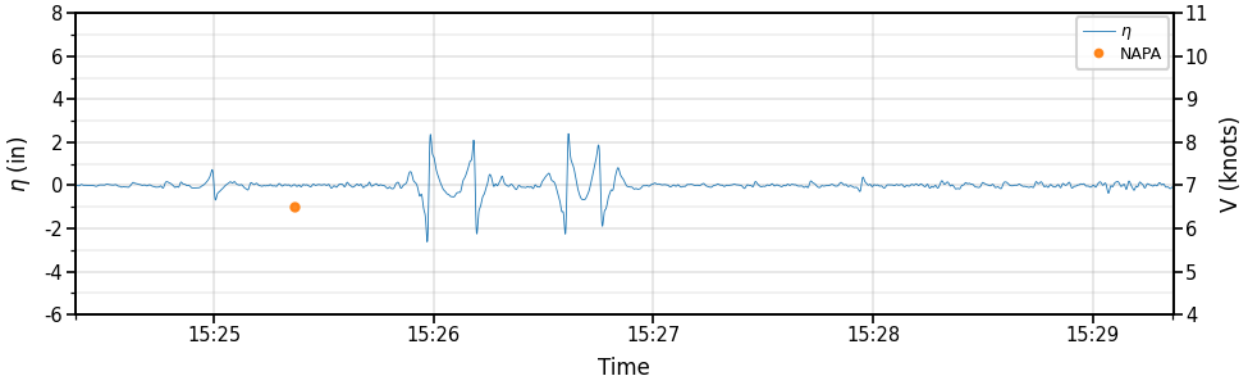


Figure 65. Time histories of h and velocity of the NAPA passing by WG_MF on April 22, 2025, at approximately 15:25

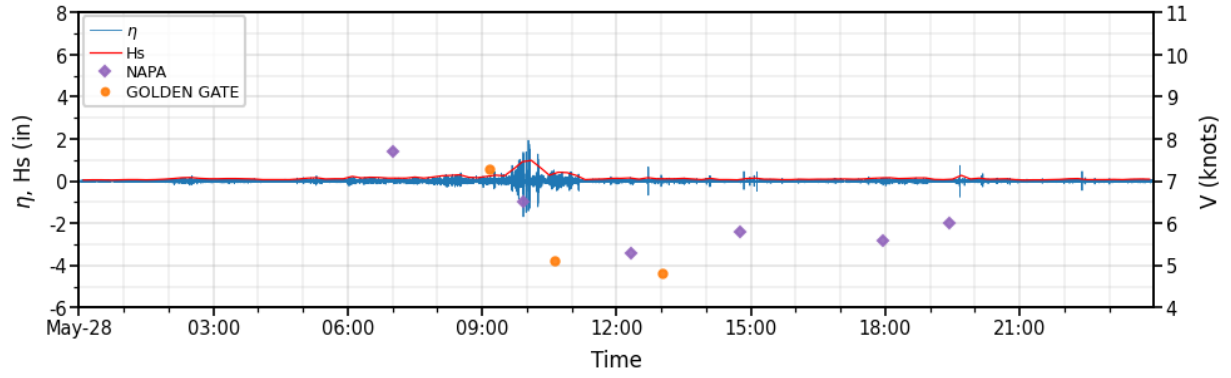


Figure 66. Time histories of h , H_s, and velocities of fast ferries passing by WG_MF on May 28, 2025

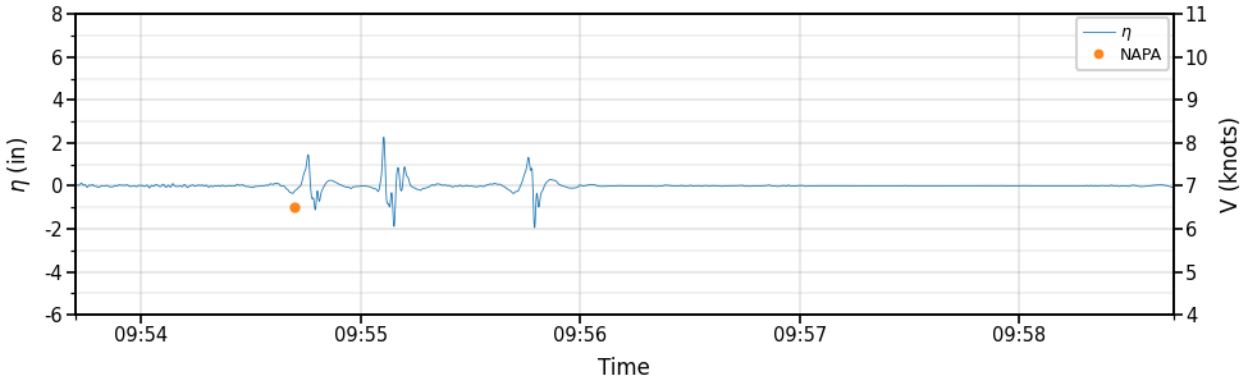


Figure 67. Time histories of h and velocity of the NAPA passing by WG_MF on May 28, 2025, at approximately 09:54

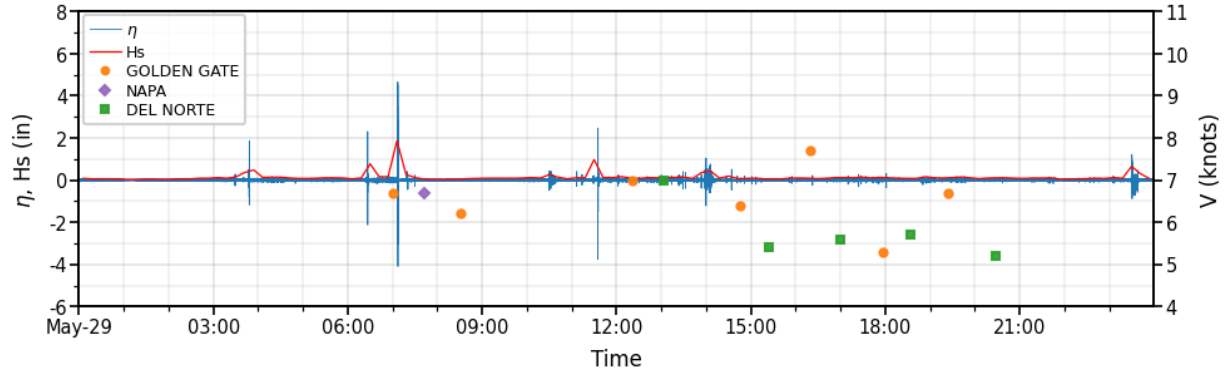


Figure 68. Time histories of h , H_s, and velocities of fast ferries passing by WG_MF on May 29, 2025

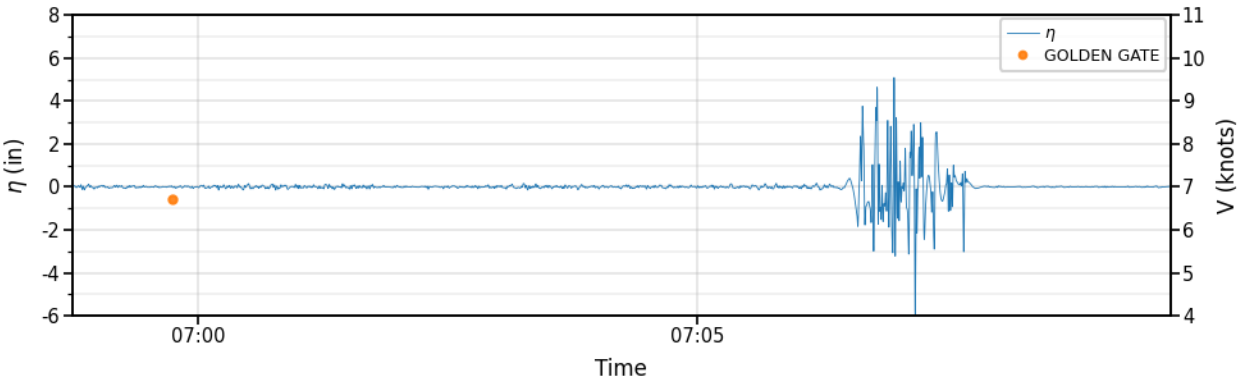


Figure 69. Time histories of h and velocity of the GOLDEN GATE passing by WG_MF on May 29, 2025, at approximately 07:00

Appendix B
Spaulding Class Ferries h, H_s, and Velocity Time Histories

Appendix B. Spaulding Ferry Wakes

B.1 Introduction

To analyze events that could be relevant to the Greenbrae Boardwalk Community's concerns (ferry wakes, wind-generated waves [wind-waves], and shoreline erosion), time history plots of h , H_s, and velocities of the Spaulding Class ferries passing by the wake gauges (WGs) were developed and are presented in the following sections. These plots are a representative subset selected from the analysis of the 84 Spauling Class ferry trips recorded during the Corte Madera Creek Ferry Wake Study. They were chosen to illustrate the wake and wind-wave events of interest, including periods where both occur simultaneously. The plots are organized as follows:

- Plots are grouped by WG sections.
- The plots are presented in chronological order.
- For each WG, plots of daily time histories of h , H_s, and velocities of ferries passing by the WG are presented.
- The daily plots show events of interest like ferry wakes, wind-waves, and their simultaneous occurrence.
- Following each daily plot, corresponding detailed plots of time histories of h and velocity of a ferry for the events of interest selected in the daily plots are presented. These plots show detailed time histories of wakes, wind-waves, and periods when both occur simultaneously.
- Three detailed plots are presented:
  - Two for WG_CM17
  - One for WG_CM
- The following are general observations representative of all trips recorded for the Spaulding Class ferries.
  - Figure 1 shows negligible wind-waves. Figure 2, for the same day, shows what appears to be the leading, approximately 4-inch peak-to-peak, transverse wave of the SAN FRANCISCO wake occurring simultaneously with wind-waves and before the passage of the ferry. Possibly, the ferry slowed down, and the wake train overtook and passed the ferry arriving earlier to the WG_CM17.
  - Figure 3 shows negligible wind-waves. Figure 4, for the same day, shows the leading, approximately 4-inch peak-to-peak, transverse wave of the SAN FRANCISCO wake and negligible wind-waves at WG_CM17.
  - Figure 5 shows negligible wind-waves. Figure 6, for the same day, shows an indistinguishable MARIN wake and an about H_s = 1-inch wind-wave at WG_CM.
  - All plots show that at WG_CM17 and WG_CM are the most exposed and closest WGs to the ferry tracks. The Spaulding Class ferry wakes are typically negligible, less than 4 inches peak to peak high and never exceeding 6 inches peak to peak.

B.2 WG_CM17

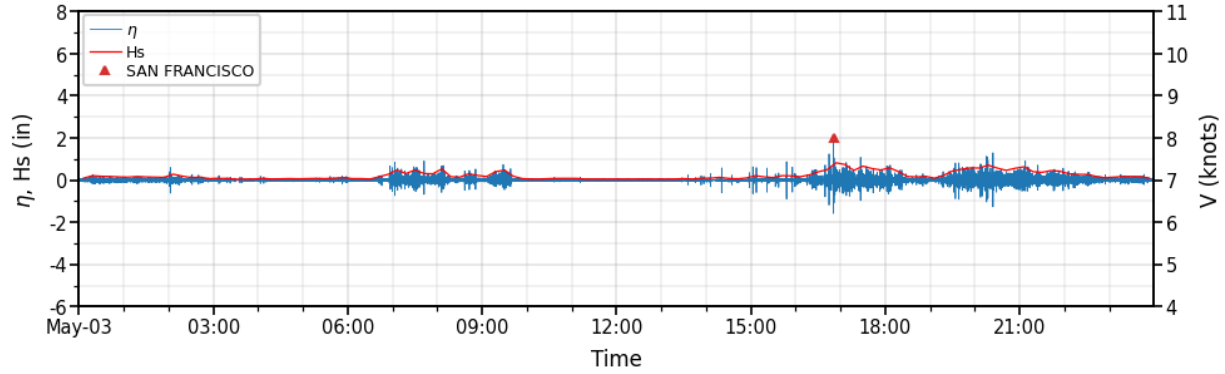


Figure 1. Time histories of h , H_s, and velocity of the SAN FRANCISCO passing by WG_CM17 on May 3, 2025

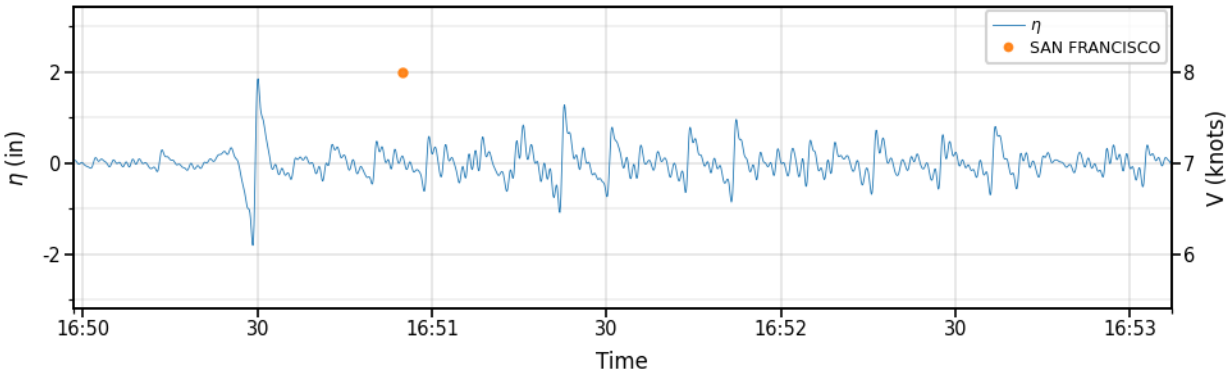


Figure 2. Time histories of h and velocity of the SAN FRANCISCO passing by WG_CM17 on May 3, 2025, at approximately 16:51

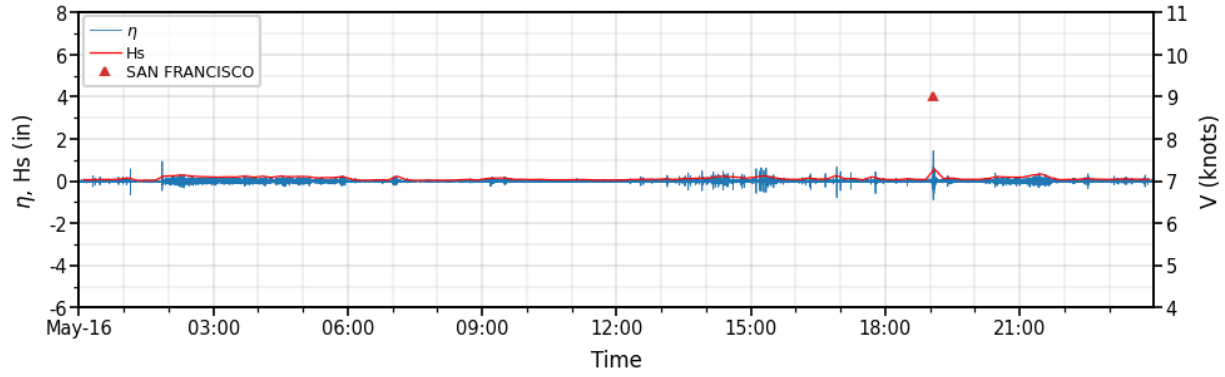


Figure 3. Time histories of h , H_s, and velocity of the SAN FRANCISCO passing by WG_CM17 on May 16, 2025

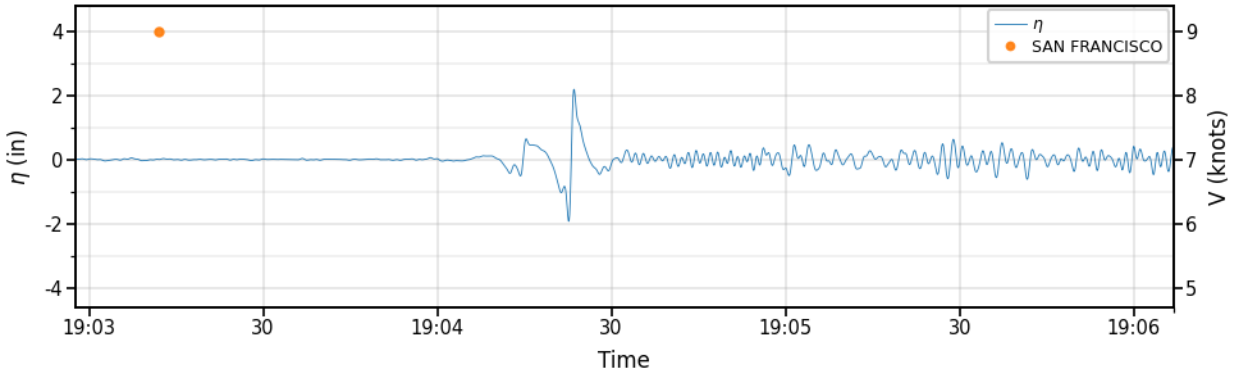


Figure 4. Time histories of h and velocity of the SAN FRANCISCO passing by WG_CM17 on May 16, 2025, at approximately 19:03

B.3 WG_CM

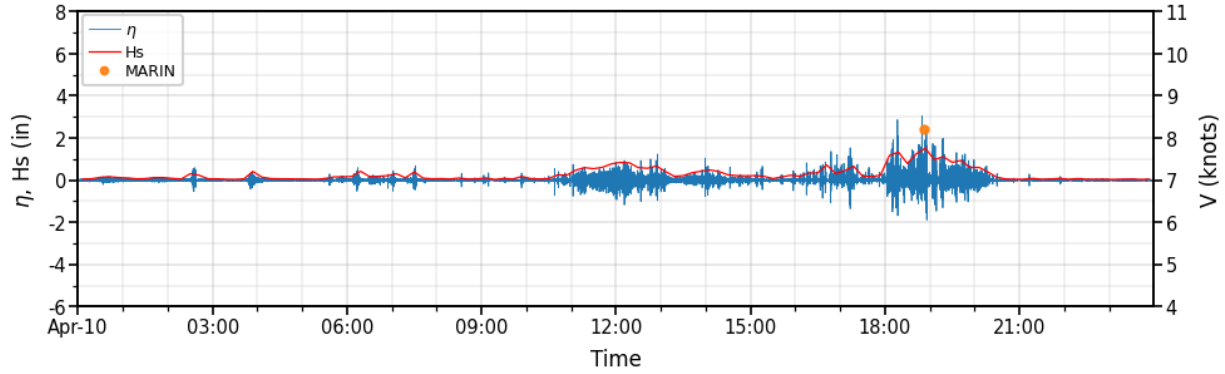


Figure 5. Time histories of h , H_s, and velocity of the MARIN passing by WG_CM on April 10, 2025

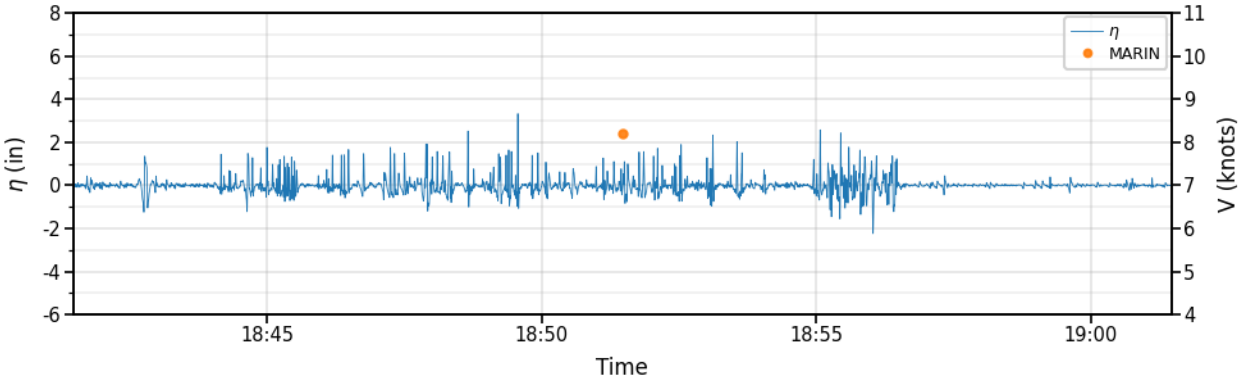


Figure 6. Time histories of h and velocity of the MARIN passing by WG_CM on April 10, 2025, at approximately 18:51

D3. NAPA and LIWA Class Fast Ferry Wake Study

NAPA and LIWA Class Fast Ferry Wake Study

Document No.: 260518151645_51760f64
Revision: Draft

Golden Gate Bridge, Highway and Transportation District

Larkspur Ferry Service and Parking Expansion

August 18, 2026

NAPA and LIWA Class Fast Ferry Wake Study

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Executive Summary

Introduction

The Golden Gate Bridge, Highway and Transportation District is in the process of acquiring new LIWA Class catamaran fast ferries to replace the catamaran fast ferries in their fleet. A critical aspect of fast ferry performance is it wake generation, as wakes may result in negative impacts such as shoreline erosion, damage to littoral zone habitats and shoreline structures, boating accidents, etc. Therefore, it is always desirable to design and operate fast ferries in ways that minimize the wakes they generate.

To assess the wake-making merits of the LIWA relative to the District's existing fast ferries, the District commissioned Jacobs to perform a wake study (Study) based on computational fluid dynamics (CFD) simulations. For selected representative conditions, simulations were performed and LIWA wakes were compared to those corresponding to the NAPA, one of the ferries in the District's fast ferry fleet and considered representative.

To achieve the objective of the Study, the following tasks were performed:

- Task 1 – CFD Model Setup
- Task 2 – CFD Model Validation
- Task 3 – Wake Simulations
- Task 4 – Wake Analysis

CFD Model Setup

The CFD model setup was performed in three steps:

1. Collection of Data and Information
2. CFD Model Domain Development
3. CFD Model Optimization

Jacobs collected 3-dimensional models and hydrostatic parameters of the ferries, tidal datums and Corte Madera Channel bathymetries the from the District, the LIWA designer and online sources.

For computational efficiency, a rectangular cross-section CFD model domain was developed. A half-model was simulated, consisting of one half of the catamaran ferry (one hull) and fluid domain, symmetrical about a symmetry plane. The domain was 750 m long, 260 m wide and 3.66 m (12 feet) deep. The domain was discretized using a structured mesh comprising three levels of nested local refinement regions. Finer mesh resolutions were applied around the ferry hull, free surface, and near-wake region, while coarser cells were used in areas farther from the ferry to improve computational efficiency. The k-omega shear stress transport (SST) turbulence model was used.

Sensitivity simulations were performed to evaluate mesh resolution, numerical stability, computational performance, and time-step control, turbulence model, displacement and trim. Additionally, the waterjets were also modelled to investigate their effects on the wake field. The sensitivity simulations showed that the wake field was insensitive to the turbulence model employed, as well as to the variations in displacement and trim investigated, and to the presence of waterjets.

CFD Model Validation

Simulations were performed to compare the simulated NAPA wakes to those measured on July 8, 2021 (Jacobs, 2023). In general, the simulated wakes were larger than the measured, although the waves peaks were reasonably well represented. Also, the general pattern and phasing of the waves were also well represented. The model validation was considered acceptable for the purpose of the Study which was to assess the wake-making merits of the LIWA relative to the District's existing fast ferries.

Wake Simulations

The simulations were performed for departure and arrival conditions, at 10 knots to generate wakes in the ferry low transit speed section of the Channel, and at 36 knots to generate wakes for the service speed. Except for heave and trim, the ferries were static in all the other degrees of freedom. Table ES 1 shows the simulations matrix.

Table ES 1. Simulations matrix

Run	Ferry	Velocity[a]	Condition	Displacement[b]	Trim[c]
1	NAPA	10	Departure	245.92	0.221
2			Arrival	228.34	0.447
3		36	Departure	245.92	-0.0134
4			Arrival	228.34	-0.002
5	LIWA	10	Departure	confidential	0.221
6			Arrival	confidential	0.447
7		36	Departure	confidential	-0.0134
8			Arrival	confidential	-0.002

[a] knots
[b] tonnes
[c] m, at-rest, (aft draft – fore draft), +(ve) stern down

Wake Analysis

The simulated water surface elevation time histories were extracted at a location y = 40 m (131 feet) from and perpendicular to the ferry centerline. The wakes were qualitatively analyzed by visually inspecting wake patterns in water surface elevation plots and quantitively by comparing the corresponding wake energies.

The wake pattern analysis showed that:

- At 10 knots and for the departure and arrival conditions, the NAPA and LIWA wake patterns were generally similar. However, for both ferries, the wakes generated in the arrival condition were slightly smaller than those in the departure condition likely due to the lighter displacement of the ferries in the arrival condition. The largest wave in the wake train for both ferries and both conditions was the divergent (bow) wave. The transverse waves exhibited similar number and phasing. Overall, the LIWA wake appeared less energetic than the NAPA.
- At 36 knots and for the departure and arrival conditions, the NAPA and LIWA wake patterns were generally similar. Like for the 10-knot ferry velocity and for both ferries, the wakes generated in the arrival condition were slightly smaller than those in the departure condition likely due to the lighter displacement of the ferries in the arrival condition. For both ferries and both conditions, the

divergent (bow) wave was comparable to the highest divergent waves. The transverse waves exhibit similar number and phasing. Overall, the LIWA and NAPA divergent waves were comparable, but the LIWA transverse waves appear much less energetic than the NAPA's.

The wake energy analysis is summarized below and in Table ES 2:

- At 10 knots, the LIWA wake is less energetic than the NAPA's under both departure and arrival conditions at 10 knots, with E reductions of 17% and 18%, respectively.
- At 36 knots, the LIWA wake is less energetic than the NAPA's for both departure and arrival scenarios, achieving reductions of 29% and 30%, respectively.

It is concluded that, within the operational conditions analyzed in this Study, the LIWA will generate smaller wakes than the existing District's fast ferries.

Table ES 2. Summary of total wake energy (E) relative differences

Condition	Velocity[a]	Ferry	ΔE[b]
Departure	10	NAPA	
		LIWA	-17
Arrival	10	NAPA	
		LIWA	-18
Departure	36	NAPA	
		LIWA	-29
Arrival	36	NAPA	
		LIWA	-30

[a] knots
[b] percent difference relative to NAPA

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Acronyms and Abbreviations

3D	3-dimensional
AIS	Automatic Identification System
CFD	computational fluid dynamics
Channel	Corte Madera Channel
CM	channel marker
District	Golden Gate Bridge, Highway and Transportation District
E	total wake energy per unit width
EBDG	Elliot Bay Design Group
f_{max}	maximum cutoff frequency
f_{min}	minimum cutoff frequency
g	acceleration due to gravity
J	Joule
LCB	longitudinal center of buoyancy
LCF	longitudinal center of flotation
LCG	longitudinal center of gravity
LIWA	LIWA Class fast ferry
NOAA	National Oceanic and Atmospheric Administration
Study	wake study
SST	shear stress transport turbulence
VCB	vertical center of buoyancy
VOF	Volume of Fluid
WG	wake gauge
WSE	water surface elevation
X	total length of the wake train
η	water surface elevation
ρ	seawater density

1. Introduction

The Golden Gate Bridge, Highway and Transportation District (District) is in the process of acquiring new LIWA Class catamaran fast ferries (LIWA) designed by One2Three Naval Architects to replace the catamaran fast ferries in their fleet. A critical aspect of fast ferry performance is it wake generation, as wakes may result in negative impacts such as shoreline erosion, damage to littoral zone habitats and shoreline structures, boating accidents, etc. Therefore, it is always desirable to design and operate fast ferries in ways that minimize the wakes they generate.

To assess the wake-making merits of the LIWA relative to the District's existing fast ferries, the District commissioned Jacobs to perform a wake study (Study) based on computational fluid dynamics (CFD) simulations. For selected representative conditions, simulations were performed and LIWA wakes were compared to those corresponding to the NAPA, one of the ferries in the District's fast ferry fleet. The wake wash assessment performed by Jacobs (2023) showed that the NAPA can be considered representative of the District's existing fast ferries as its wakes (and those of its sister ferry, the GOLDEN GATE) are comparable to those of the MENDOCINO and DEL NORTE, the other fast ferries in the fleet.

The following summarizes key aspects of the Study:

- The CFD simulations were performed with OpenFOAM, an open-source software widely used in engineering and science by both commercial and academic organizations. See OpenFOAM (2025) for additional information.
- The CFD model domain consisted of a rectangular cross-section, deep as needed to accommodate the selected representative water depth; wide enough to prevent blockage, and long enough to capture the generated wakes.
- The simulations were performed at 10 knots to generate wakes in the ferry low transit speed section of the Corte Madera Channel (Channel), and at 36 knots to generate wakes for the service speed.
- The simulations were performed at a representative water depth of 3.66 m (12 feet) corresponding to the sections of the Channel where the ferries run at 10 and 36 knots. This depth was selected based on the analysis of tidal datums and the Channel bathymetry. The CFD model domain bottom was smooth and constant depth, and no channel banks were included.
- Departure and arrival conditions were simulated for each ferry.
- The ferries were free to heave and trim.
- Except for heave and trim, the ferries were static in all the other degrees of freedom. The water flow entered and exited the domain aligned with the ferry longitudinal axis (no yaw) at the selected ferry speeds (i.e., a water-moving channel).
- The effects of trim controls (e.g., interceptors) were not modeled/studied.
- To validate the CFD model, NAPA wakes were simulated and compared to the wakes measured on July 8, 2021 (Jacobs, 2023).

To achieve the objective of the Study, the following tasks were performed:

- Task 1 – CFD Model Setup
- Task 2 – CFD Model Validation
- Task 3 – Wake Simulations

- Task 4 – Wake Analysis

The following sections describe the work performed and the results of the Study.

2. CFD Model Setup

The CFD model setup was performed in three steps:

1. Collection of Data and Information
2. CFD Model Domain Development
3. CFD Model Optimization

2.1 Collection of Data and Information

Jacobs collected the following data and information from the District, One2Three Naval Architects and online sources:

- NAPA 3-dimensional (3D) hull model (Elliot Bay Design Group, 2011), and hydrostatics and mass properties (John Gray, 2025a)
- LIWA 3D hull model, hydrostatics and mass properties (Campbell Baird, 2026a,b)
- Tidal datums at National Oceanic and Atmospheric Administration (NOAA) station 9414863 Richmond, California (NOAA, 2025)
- Corte Madera Channel bathymetry (Manson Construction, 2022, and Moffatt & Nichol, 2015)

Figure 1 shows the NAPA and LIWA ferries.



Figure 1. NAPA (left) and LIWA (right) ferries

2.2 CFD Model Domain Development

For computational efficiency, a rectangular cross-section CFD model domain was developed. The following describes some general characteristics of the domain.

- A half-model was simulated, consisting of one half of the catamaran ferry (one hull) and fluid domain, symmetrical about a symmetry plane. Figure 2 shows this setup for the NAPA.
- The inlet was placed approximately 160 m (4x ferry lengths) upstream of the ferry bow and a uniform velocity profile matching the selected ferry speeds was applied.

- The outlet was placed downstream approximately 550 m downstream of the ferry stern to capture the wake development and propagation. A zero gradient condition was applied to ensure undisturbed, constant flow exit.
- The water flow entered and exited the domain aligned with the ferry longitudinal axis (no yaw) at the selected ferry speeds (i.e., a water-moving channel).
- The lateral walls (boundaries) were placed sufficiently apart at 260 m such that blockage was prevented. Relaxation areas were included along the lateral walls to absorb the wakes exiting the domain and prevent reflections. Figure 3 shows a plan view of the model domain.
- At the free surface, the Volume of Fluid (VOF) method was implemented.
- At the hull surface, a no slip condition was implemented, and a smooth hull surface was assumed.
- The domain (water) depth was 3.66 m (12 feet) and the bottom was smooth and with zero normal flow. This representative water depth was selected based on the review of the tidal datums and the Channel bathymetry and because it is a realistic minimum conducive to the generation of the largest wakes. Appendix A includes a Technical Memorandum summarizing the analysis and selection of the representative water depth.
- The k-omega shear stress transport (SST) turbulence model was used, which is the standard in ship hydrodynamics.
- The domain was discretized using a structured mesh comprising three levels of nested local refinement regions. Finer mesh resolutions were applied around the ferry hull, free surface, and near-wake region, while coarser cells were used in areas farther from the ferry to improve computational efficiency.

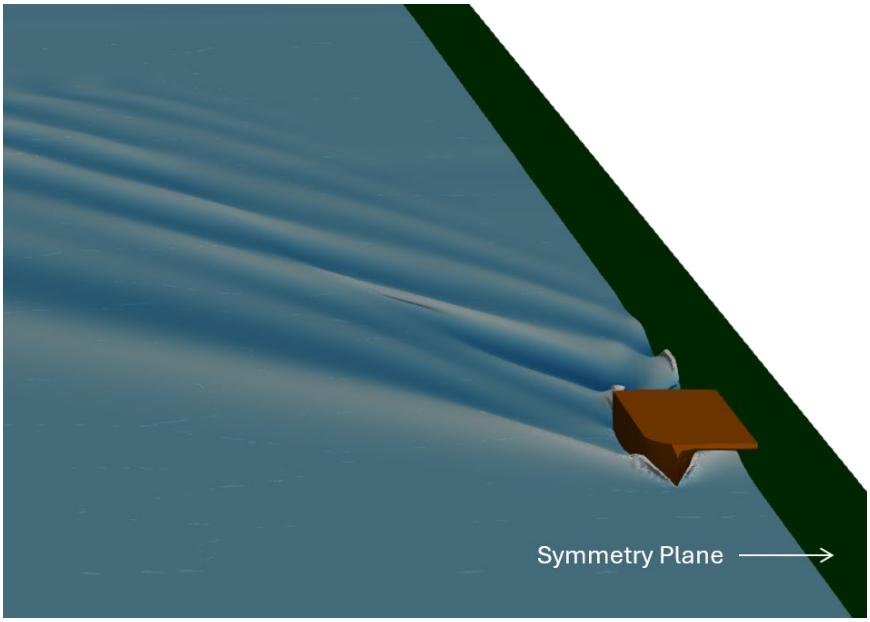


Figure 2. NAPA half-model about symmetry plane

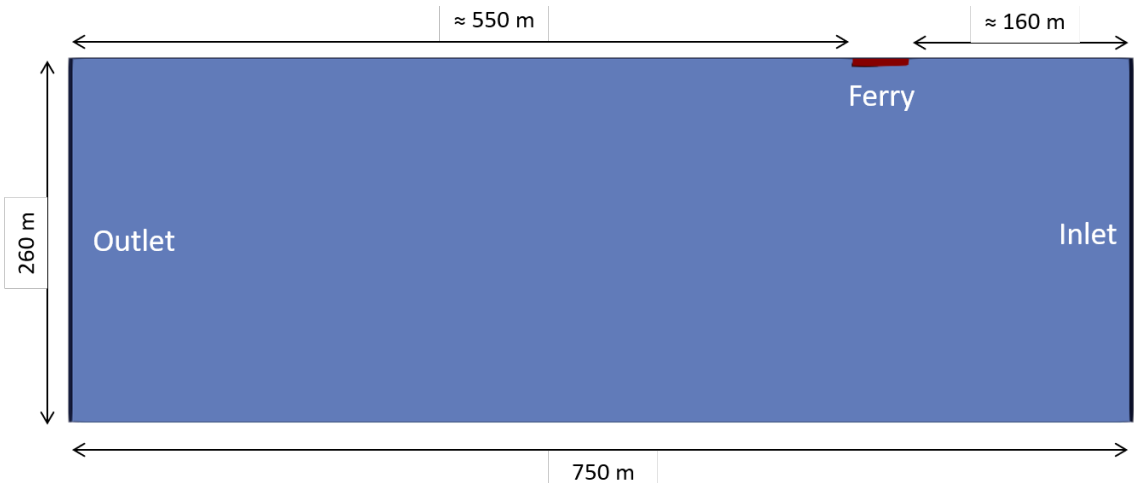


Figure 3. Plan view of model domain

2.3 CFD Model Optimization

Sensitivity simulations were performed to evaluate mesh resolution, numerical stability, computational performance, and time-step control, turbulence model, displacement and trim. Additionally, the waterjets were also modelled to investigate their effects on the wake field.

Mesh sensitivity simulations were undertaken using a progressively refined mesh sequence, beginning with a coarse mesh and subsequently increasing the mesh resolution, including around the ferry and the wake field. The resulting water surface elevations (WSE) and wake characteristics were compared between successive mesh refinement simulations. Mesh refinement continued until further increases in resolution produced negligible changes in the computed wake heights and overall wake field, indicating that the computation had reached a mesh-independent state. The final mesh was therefore selected as the optimal balance between accuracy and computational efficiency and where further refinement resulted in little or no change to the wake field.

Figure 4 shows the plan view of the domain mesh refinement regions, Figure 5 shows a partial cross-section, and Figure 6 a profile view of the refinement around the ferry and free surface.

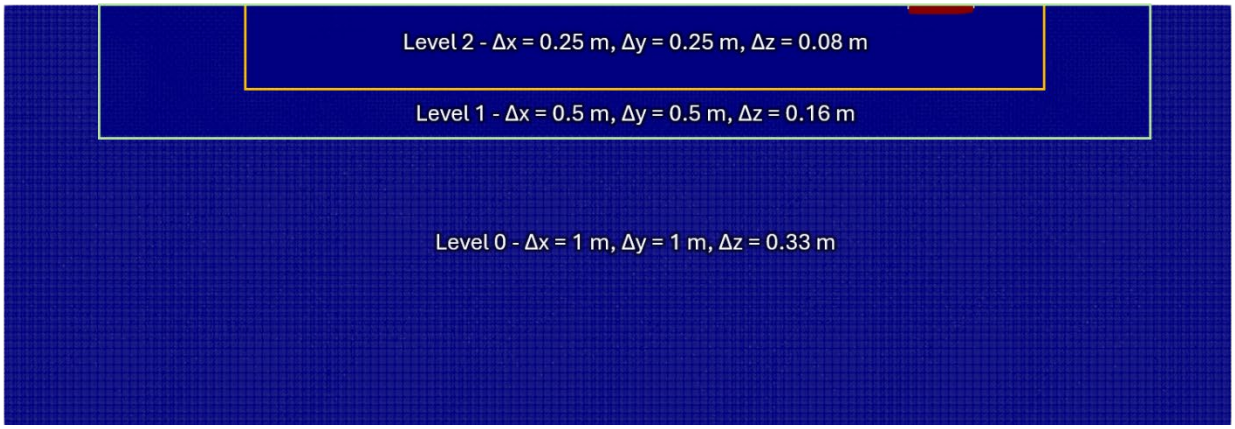


Figure 4. Plan view of the domain mesh refinement regions

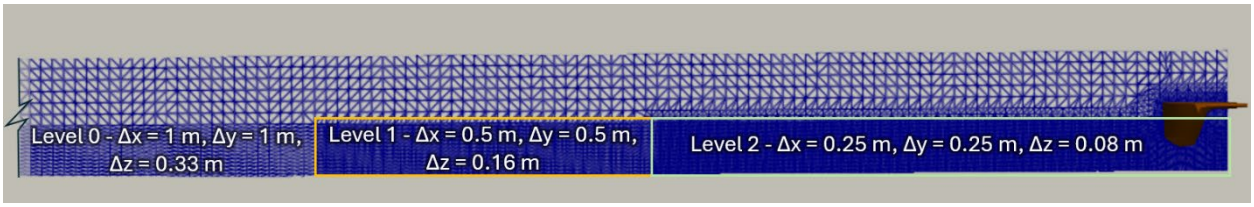


Figure 5. Partial cross-section view of the domain mesh refinement regions

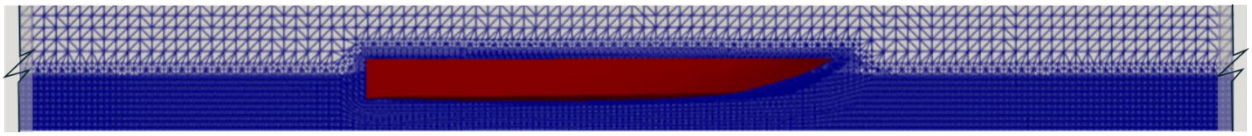


Figure 6. Profile view of the domain mesh refinement around the ferry and free surface

Numerical stability was assessed by monitoring solution convergence, residual behavior, conservation properties, and the presence of any non-physical oscillations within the flow field. Based on the results, numerical parameters and solver settings were adjusted as required to ensure robust and stable model performance.

Both fixed and variable time-step approaches were evaluated. A variable time-step formulation was ultimately adopted as it enabled the Courant number to be maintained within prescribed stability limits throughout the simulations. Maximum Courant numbers of 5.0 for the flow field and 2.5 for the free-surface interface were specified. The use of adaptive time-stepping allowed the solver to automatically reduce the time step during periods of increased free-surface deformation and strong velocity gradients, whilst permitting larger time steps during less dynamic phases of the simulation.

To verify the target displacements, trims and other ferry hydrostatic parameters, simulations were performed in still water with zero forward speed, and the models were allowed to respond freely in heave and trim. Table 1 lists the target and modelled displacements and at-rest trims of the NAPA and LIWA models for the departure and arrival conditions. Additional hydrostatic parameters like longitudinal and vertical centers of buoyancy (LCB, VCB), longitudinal center of flotation (LCF), and wetted areas were also verified and agreed well, however, are not disclosed due to confidentiality reasons. Target refers to the parameter listed in the corresponding ferry hydrostatics, 3D model refers to the parameter obtained from the 3D models receive, and CFD model refers to the parameter obtained after meshing the 3D model.

Table 1. Target versus modelled NAPA and LIWA displacements and at-rest trims

Ferry	Condition	Displacement[a]			Trim[b]		
		Target	3D Model	CFD Model	Target	3D Model	CFD Model
NAPA	Departure	240.49	245.91	245.92	0.216	0.216	0.221
	Arrival	222.98	228.38	228.34	0.443	0.443	0.447
LIWA	Departure	confidential	confidential	confidential	-0.014	-0.014	-0.0134
	Arrival	confidential	confidential	confidential	0.012	0.012	-0.002

[a] tonnes
[b] m, at-rest, (aft draft – fore draft), +(ve) stern down

After verifying the target hydrostatic parameters, additional simulations were conducted to evaluate the sensitivity of the following on the wake field:

- the turbulence model
- displacement and trim
- waterjets

The simulations were performed using the NAPA model in the departure condition with a velocity of 38.7 knots in a water depth of 16.5 feet corresponding to the 4th departure trip on July 8, 2021, when passing 118 feet from wake gauge (WG) 3 (Jacobs, 2023).

To evaluate the sensitivity of the turbulence model, simulations with the k-Omega SST model and the k-Epsilon turbulence model were performed. No significant differences in the wake field were observed so the k-Omega SST model, which is the industry standard for modelling wakes and wave breaking, was adopted.

Figure 7 shows a comparison of the wakes between the target and the following two displacement and trim conditions:

- 7% reduction in the displacement (i.e., equivalent to approximately 200 less passengers)
- 7% reduction in displacement + bow down trim of 1.4 degrees.

The effects of a lower displacement and trim on the wake are minimal, having little effect on the wake heights and phasing.

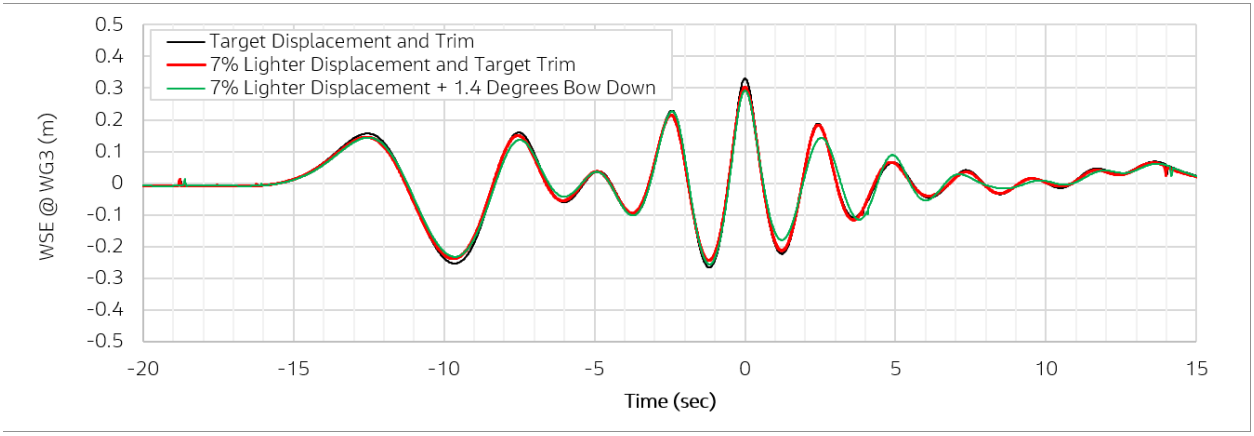


Figure 7. Assessment of wake sensitivity to displacement and trim

Figure 8 shows the wake pattern for the NAPA at 38.7 knots in a water depth of 16.5 feet with no and with two waterjets. Although it was noted that the turbulence is marginally higher in the vicinity of the "rooster tail" with the waterjets, there was no noticeable difference in the wake field.

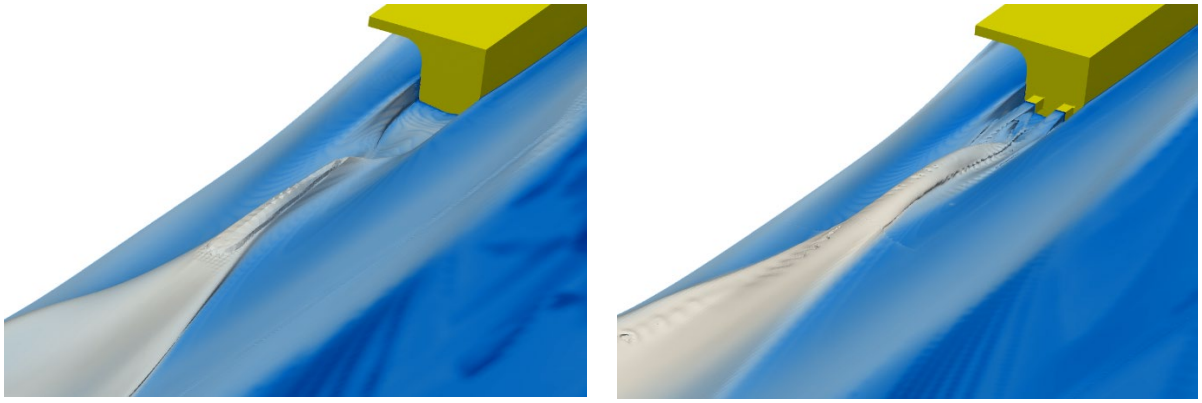


Figure 8. NAPA wake pattern at 38.7 knots in a water depth of 16.5 feet, no waterjets (left) with two waterjets (right)

The sensitivity simulations showed that the wake field is insensitive to the turbulence model employed, as well as to the variations in displacement and trim investigated, and to the presence of waterjets.

3. CFD Model Validation

Simulations were performed to compare the simulated NAPA wakes to those measured on July 8, 2021 (Jacobs, 2023). The following work was performed:

- The NAPA was set up with the at-rest fore and aft drafts provided by John Gray (2025b), corrected to the Elliot Bay Design Group (EBDG) baseline. This resulted in aft draft = 1.79 m (5.87 feet) and fore draft = 1.25 m (4.10 feet) and displacement of 201.43 tonnes (198.3 long-tons)
- The longitudinal center of gravity (LCG) (14.31 m = 46.94 feet from transom) was set to achieve the at-rest drafts.
- The simulations were performed with the model free to heave and trim.
- The simulations were performed at the ferry speeds and water depths corresponding to the wake measurements.
- NAPA's wakes measured at WG2, in the ferry low transit speed section of the Channel corresponding to channel marker (CM) 11, and at WG3, in the ferry service speed section corresponding to CM5, were used corresponding to the following trips:
  - 4th trip of the day departing Larkspur at around 12:35 July 8, 2021.
  - 4th trip of the day arriving at Larkspur at around 13:52 July 8, 2021.
- For the validation simulations, the CFD model domain included an approximate representation of the pre-dredging Channel banks surveyed in 2022 (Manson Construction, 2022).
- Agreement between simulated and measured wakes was assessed qualitatively by visual inspection. No quantitative assessment by comparing wake energies was performed.

Figure 9 and Figure 10 show the NAPA tracks, departing and arriving, respectively on July 8, 2021, and WG locations. Ferry locations, velocities, headings, etc. were obtained from the NAPA's Automatic Identification System (AIS) and provided by the San Francisco Marine Exchange (Jacobs, 2023). Table 2 summarizes the conditions and parameters used in the validation simulations.



Figure 9. NAPA 4th trip departing track on of July 8, 2021, and WG locations (Google Earth Vexcel Imaging US Inc. n.d.)



Figure 10. NAPA 4th trip arriving track on July 8, 2021, and WG locations (Google Earth Vexcel Imaging US Inc. n.d.)

Table 2. Summary of NAPA conditions and parameters used in the validation simulations

Condition	WG2 (CM11)				WG3 (CM5)			
	Time[a]	Velocity[b]	Distance[c]	Water Depth[d]	Time[a]	Velocity[b]	Distance[c]	Water Depth[d]
Departure	12:41:02	10	113	16.6	12:44:31	38.7	118	16.5
Arrival	13:47:33	9.9	136	16.7	13:42:47	39.7	118	16.5

[a] local time at the passage of the ferry by the wake gauge on Julu 8, 2021
[b] knots, ferry velocity at the wake gauge
[c] feet, perpendicular distance from ferry centerline to wake gauge
[d] feet, water depth at the ferry track

The wakes measured on both the 4th NAPA departing and arriving trips on July 8, 2021, were selected for analysis because tidal currents were negligible during slack tide and wind was light (approximately 5 knots), resulting in insignificant wind-waves. Consequently, environmental influences on the measured WSE were minimal, allowing the measurements to be attributed primarily to ferry wakes. Nevertheless, other sources of water surface fluctuations, including wakes from local and distant vessel traffic, ocean swell propagating into the Bay, and natural basin oscillations (seiches), may have been present in the measurements. To isolate the ferry wakes, these background disturbances were removed with an ideal frequency-domain band-pass filter with minimum cutoff (f_{min}) and maximum cutoff (f_{max}) frequencies, selected on a case by case basis.

Time histories of the measured, band-passed filtered WSE representing the ferry wakes, and the CFD-simulated wakes for the NAPA are presented below, where the wakes are aligned (time zero) at the time of the peak wave. Figure 11 and Figure 12 show the simulated and measured NAPA wakes at WG2 for the departing and arriving trips. Figure 13 and Figure 14 show the wakes at WG3.

In general, the simulated wakes are larger than the measured, although the waves peaks are reasonably well represented. Also, the general pattern and phasing of the waves are also well represented. The model validation was considered acceptable for the purpose of the Study which is to assess the wake-making merits of the LIWA relative to the District's existing fast ferries.

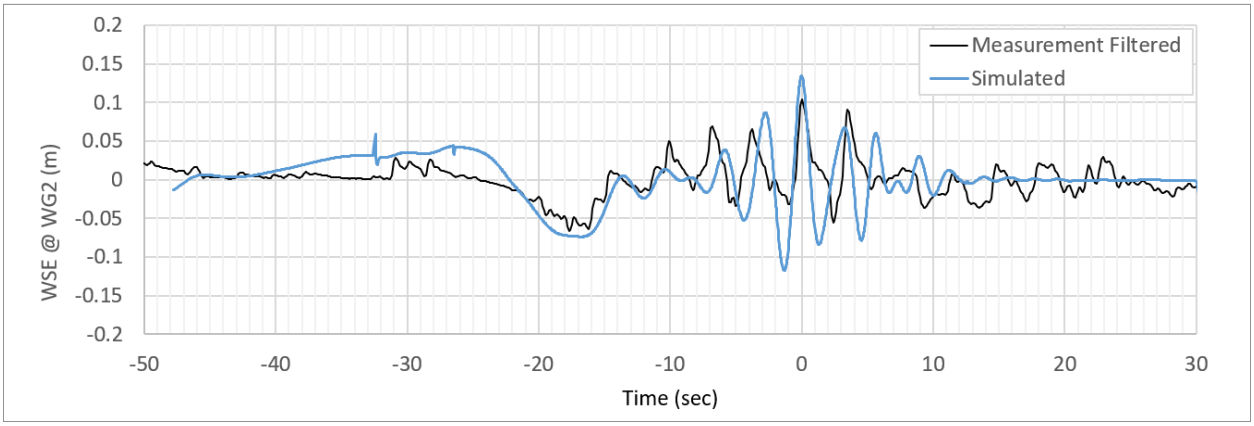


Figure 11. NAPA wakes at WG2 for the 4th departing trip on July 8, 2021 (measurement band-pass filtered at f_{min} = 0.022 and f_{max} = 2 Hz)

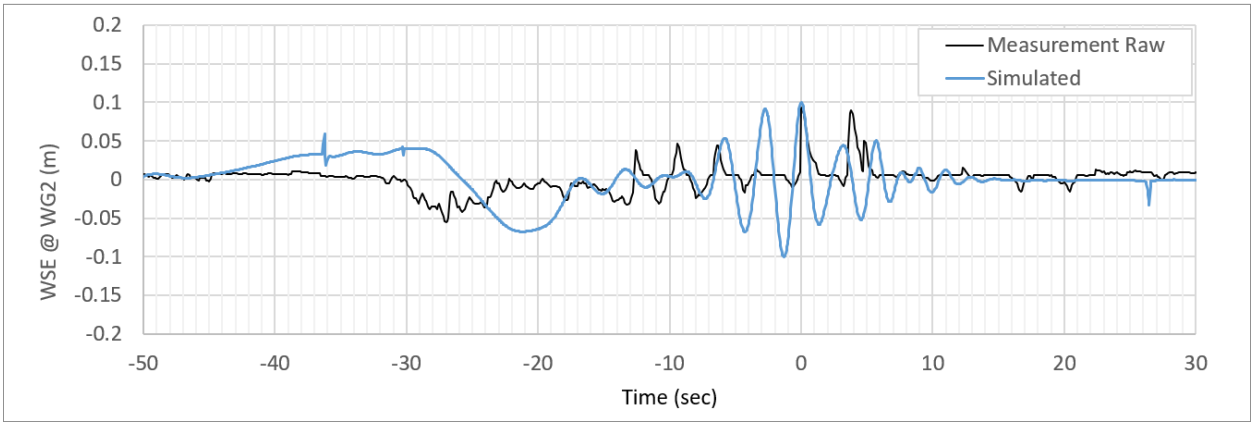


Figure 12. NAPA wakes at WG2 for the 4th arriving trip on July 8, 2021 (measurement unfiltered)

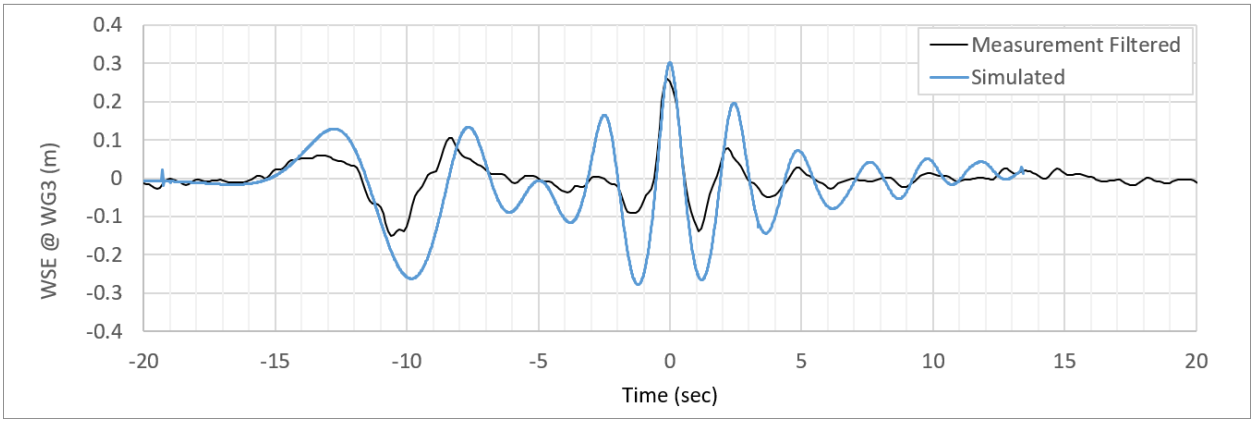


Figure 13. NAPA wakes at WG3 for the 4th departing trip on July 8, 2021 (measurement band-pass filtered at f_{min} = 0.067 and f_{max} = 1.95 Hz)

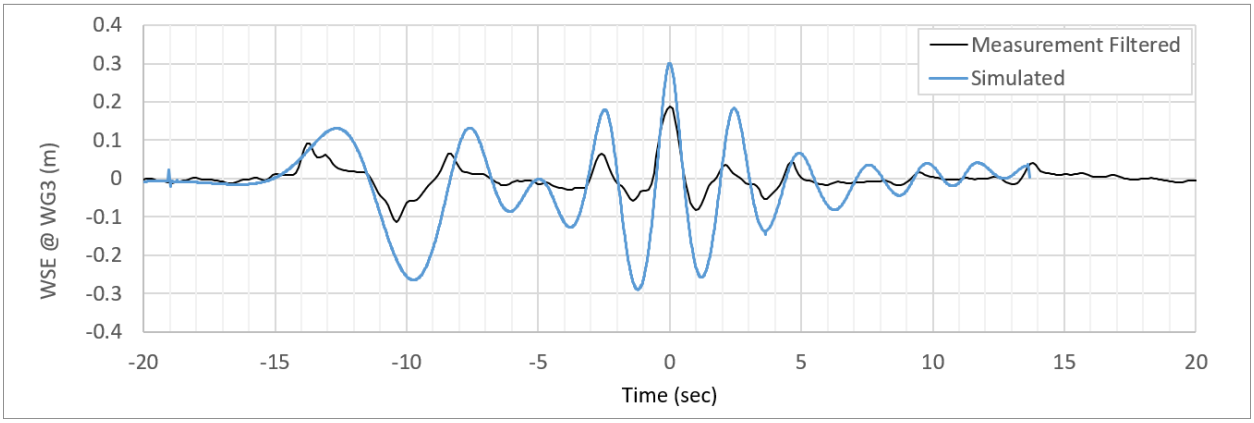


Figure 14. NAPA wakes at WG3 for the 4th arriving trip on July 8, 2021 (measurement band-pass filtered at f_{min} = 0.067 and f_{max} = 1.7 Hz)

4. Wake Simulations

The simulations were performed in the rectangular cross-section domain described in Section 2.2, at 10 knots to generate wakes in the ferry low transit speed section of the Channel, and at 36 knots to generate wakes for the service speed. Except for heave and trim, the ferries were static in all the other degrees of freedom. Table 3 shows the simulations matrix.

The LIWA features interceptors to adjust the trim at-speed, but these were not modeled. Per Christian Stark (2025) the interceptors are not expected to produce any effects at 10 knots and would not be deployed but would be deployed at 36 knots. To mimic the effect of the interceptors and achieve the target level trim at 36 knots (Campbel Baird, 2026a) the LIWA at-rest LCG was shifted forward for the departure and the arrival conditions.

Table 3. Simulations matrix

Run	Ferry	Velocity[a]	Condition	Displacement[b]	Trim[c]
1	NAPA	10	Departure	245.92	0.221
2			Arrival	228.34	0.447
3		36	Departure	245.92	-0.0134
4			Arrival	228.34	-0.002
5	LIWA	10	Departure	confidential	0.221
6			Arrival	confidential	0.447
7		36	Departure	confidential	-0.0134
8			Arrival	confidential	-0.002

[a] knots
[b] tonnes
[c] m, at-rest, (aft draft – fore draft), +(ve) stern down

5. Wake Analysis

The simulated WSEs time histories were extracted at a location y = 40 m (131 feet) from and perpendicular to the ferry centerline which is consistent with the location of the markers in the Channel relative to its centerline and ferry tracks (Jacobs, 2023). Additionally, the time reference, t = 0 seconds, aligned to the time when the ferry transom was aligned with the WSE extraction location. Figure 15 shows a schematic of the wake extraction location.

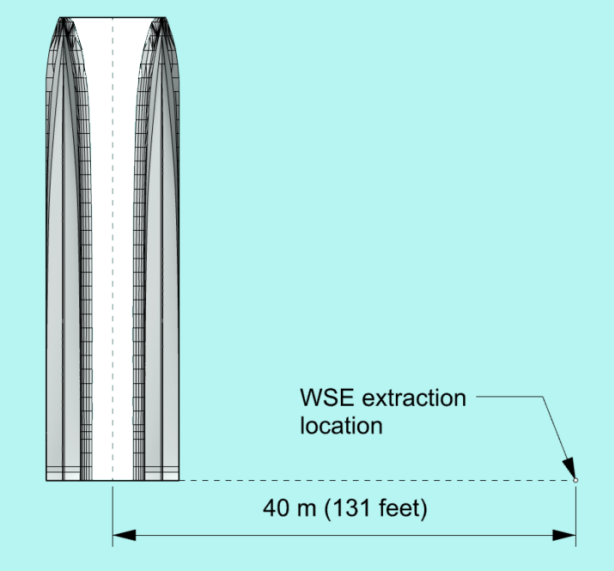


Figure 15. Schematic of WSE extraction location

The wakes were qualitatively analyzed by visually inspecting wake patterns in WSE plots and quantitively by comparing the corresponding wake energies.

5.1 Wake Pattern Analysis

Figure 16 and Figure 17 show the NAPA and LIWA WSEs at 10 knots for the departure and arrival conditions, respectively. The wake patterns are generally similar for both conditions. However, for both ferries, the wakes generated in the arrival condition are slightly smaller than those in the departure condition likely due to the lighter displacement of the ferries in the arrival condition. The largest wave in the wake train for both ferries and both conditions is the divergent (bow) wave. This wave is nearly perpendicular to the ferry centerline as it reaches the WSE extraction location before the ferry transom passes that point. The time offset (LIWA wake arriving earlier) is attributed to the LIWA being slightly longer than the NAPA. The transverse waves exhibit similar number and phasing. Overall, the LIWA wake appears less energetic than the NAPA's.

Figure 18 and Figure 19 show the NAPA and LIWA WSEs at 36 knots for the departure and arrival conditions, respectively. The wake patterns are generally similar for both conditions and, like for the 10-knot ferry velocity and for both ferries, the wakes generated in the arrival condition are slightly smaller than those in the departure condition likely due to the lighter displacement of the ferries in the arrival condition. For both ferries and both conditions, the divergent (bow) wave is comparable to the highest divergent waves. The divergent wave reaches the WSE extraction location after the ferry transom passes that point denoting a typically narrow divergent wave angle. The time offset (LIWA wake arriving earlier) is attributed to the LIWA being slightly longer than the NAPA. The transverse waves exhibit similar number and phasing. Overall, the LIWA and NAPA divergent waves are comparable, but the LIWA transverse waves appear much less energetic than the NAPA's.

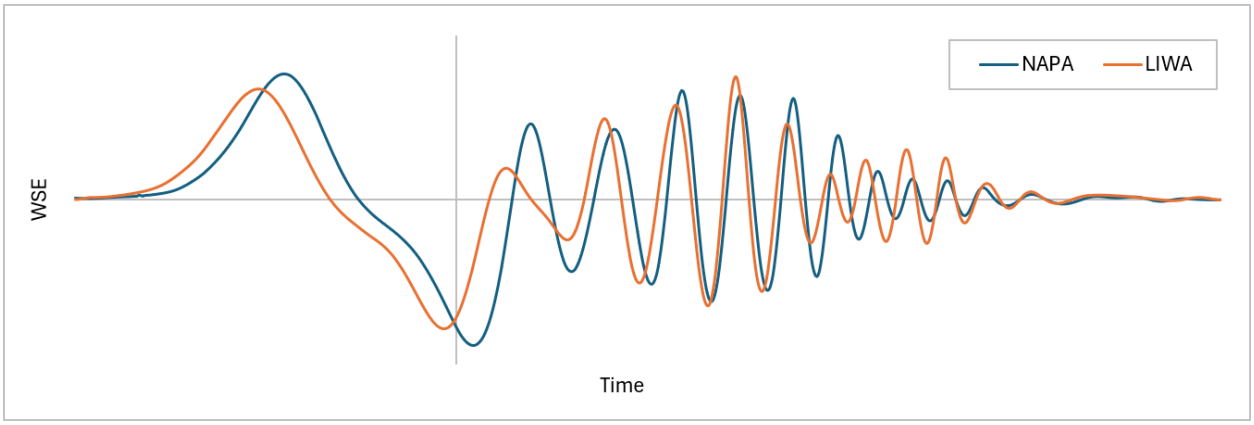


Figure 16. NAPA and LIWA WSEs for the departure condition at 10 knots

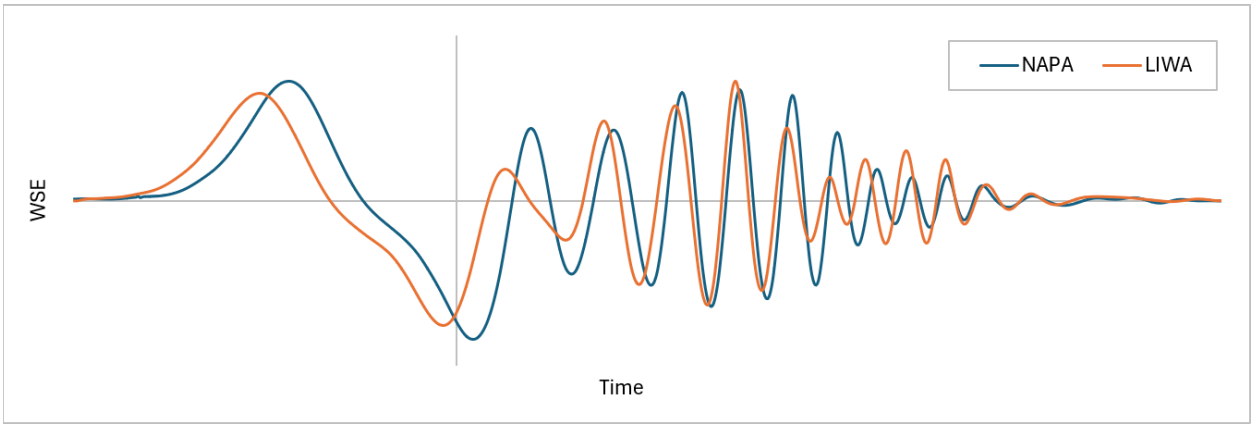


Figure 17. NAPA and LIWA WSEs for the arrival condition at 10 knots

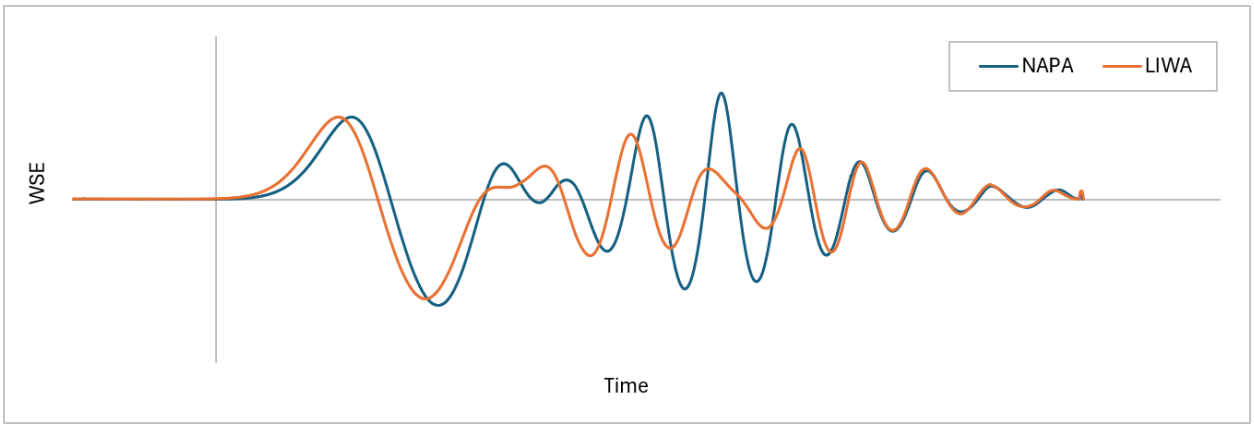


Figure 18. NAPA and LIWA WSEs for the departure condition at 36 knots

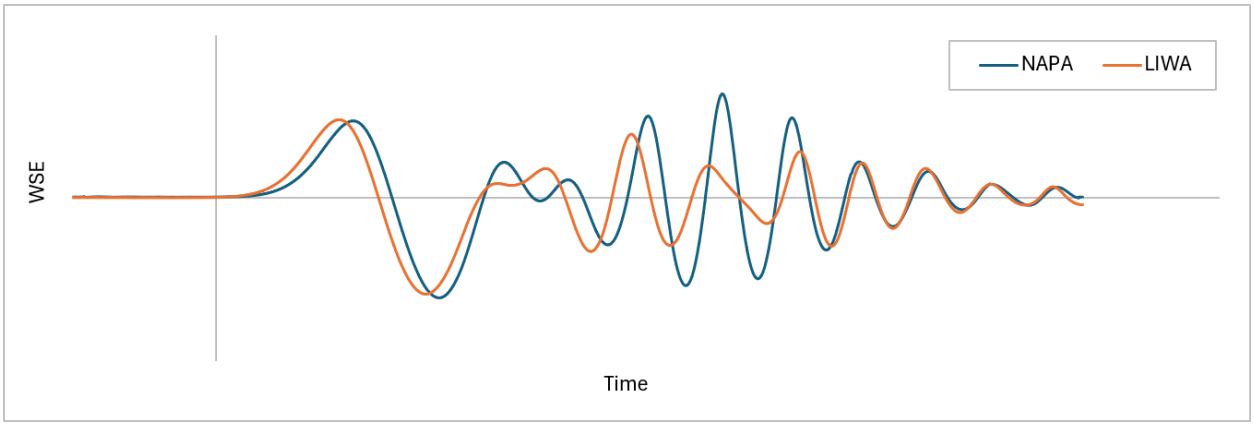


Figure 19. NAPA and LIWA WSEs for the arrival condition at 36 knots

5.2 Wake Energy Analysis

The total wake energy, the energy in all waves in the wake train, was calculated for both the NAPA and LIWA and for both departure and arrival conditions. The total energy was calculated by integrating the simulated water surface elevation squared in the space domain as follows:

$$E = \rho g \int_0^X \eta^2 \, dx \qquad \text{Eq. (1)}$$

where E is the total wake energy per unit width of wave crest in Joules/m (J/m), ρ is the seawater density, g is the acceleration due to gravity, η is the water surface elevation and X is the total length of the wake train. While there are assumptions regarding the direction of each wave (i.e., the waves are assumed to be perpendicular to the direction of the ferry and moving at the ferry velocity) Eq. (1) is a consistent approach for the comparison of wake energies.

Table 4 summarizes the Es for each condition and ferry and the relative differences. The analysis shows that the LIWA wake is less energetic than the NAPA's under both departure and arrival conditions at 10 knots, with E reductions of 17% and 18%, respectively. Similarly, at 36 knots, the LIWA wake is less energetic than the NAPA's for both departure and arrival scenarios, achieving reductions of 29% and 30%, respectively.

Table 4. Summary of E relative differences

Condition	Velocity[a]	Ferry	ΔE[b]
Departure	10	NAPA	
		LIWA	-17
Arrival	10	NAPA	
		LIWA	-18
Departure	36	NAPA	
		LIWA	-29
Arrival	36	NAPA	
		LIWA	-30

[a] knots
[b] percent difference relative to NAPA

6. Conclusions

The following are conclusions of this Study.

1) To assess the wake-making merits of the LIWA relative to the District's existing fast ferries, a wake study based on computational fluid dynamics (CFD) was performed using the widely used and open-source software OpenFOAM. The NAPA was selected as the representative ferry of the existing District's fast ferry fleet.

2) For computational efficiency, a rectangular cross-section CFD model domain was developed, and sensitivity simulations were performed. The sensitivity simulations showed that the wake field was insensitive to the turbulence model employed, as well as to the variations in displacement and trim investigated, and to the presence of waterjets.

3) Simulations were performed to compare the simulated NAPA wakes to those measured on July 8, 2021. In general, the simulated wakes were larger than the measured, although the wave peaks were reasonably well represented. Also, the general pattern and phasing of the waves were also well represented. The model validation was considered acceptable for the purpose of the Study which was to assess the wake-making merits of the LIWA relative to the District's existing fast ferries.

4) For the NAPA and LIWA and for departure and arrival conditions and 10 and 36 knots ferry velocities, a total of 8 simulations were performed. The wakes were qualitatively analyzed by visually inspecting wake patterns in WSE plots and quantitively by comparing the corresponding total wake energies. The total wake energy, the energy in all waves in the wake train, was calculated by integrating the simulated water surface elevation squared in the space domain.

5) The wake pattern analysis showed that:

    a. At 10 knots and for the departure and arrival conditions, the NAPA and LIWA wake patterns were generally similar. However, for both ferries, the wakes generated in the arrival condition were slightly smaller than those in the departure condition likely due to the lighter displacement of the ferries in the arrival condition. The largest wave in the wake train for both ferries and both conditions was the divergent (bow) wave. The transverse waves exhibited similar number and phasing. Overall, the LIWA wake appeared less energetic than the NAPA.

    b. At 36 knots and for the departure and arrival conditions, the NAPA and LIWA wake patterns were generally similar. Like for the 10-knot ferry velocity and for both ferries, the wakes generated in the arrival condition were slightly smaller than those in the departure condition likely due to the lighter displacement of the ferries in the arrival condition. For both ferries and both conditions, the divergent (bow) wave was comparable to the highest divergent waves. The transverse waves exhibit similar number and phasing. Overall, the LIWA and NAPA divergent waves were comparable, but the LIWA transverse waves appear much less energetic than the NAPA's.

6) The wake energy analysis showed that:

    a. At 10 knots, the LIWA wake is less energetic than the NAPA's under both departure and arrival conditions at 10 knots, with E reductions of 17% and 18%, respectively.

    b. At 36 knots, the LIWA wake is less energetic than the NAPA's for both departure and arrival scenarios, achieving reductions of 29% and 30%, respectively.

7) It is concluded that, within the operational conditions analyzed in this Study, the LIWA will generate smaller wakes than the existing District's fast ferries.

7. References

Campbell Baird, Senior Naval Architect, One2Three Naval Architects. 2026a. LIWA Rhino 3D model file: 22022 Hull Model G for WAKE STUDY v2.0.3dm. Personal communication (email) with Claudio Fassardi, Jacobs, May 12.

Campbell Baird, Senior Naval Architect, One2Three Naval Architects. 2026b. Excel file with Hydrostatics and other data: 22022 Hydrostatics for Wake Study v1.0.xlsx. Personal communication (email) with Claudio Fassardi, Jacobs, May 5.

Christian Stark, Vice President, Aurora Marine Design. 2025. Personal communication (email) with Claudio Fassardi, Jacobs. March 17.

Elliot Bay Design Group (EBDG). 2011. Damage Stability Assessment. Golden Gate O.N. 1063252 September 19.

John Gray, Director of Engineering & Maintenance, Ferry Division, Golden Gate Bridge, Highway and Transportation District. 2025a. NAPA 3D model file: 11064_A.GFT. Personal communication (email) with Claudio Fassardi, Jacobs, April 16.

John Gray, Director of Engineering & Maintenance, Ferry Division, Golden Gate Bridge, Highway and Transportation District. 2025b. Log sheet NAPA 4th trip on July 8, 2021. Personal communication (email) with Claudio Fassardi, Jacobs, February 5.

Jacobs. 2023. Ferry Wake Wash and Shoreline Erosion Analysis, Baseline Scenario Analysis. July 21.

Manson Construction. 2022. Larkspur Ferry Terminal Berths and Channel Maintenance Dredging Progress Survey. November 30.

Moffatt & Nichol. 2015. Larkspur Ferry Terminal Postdredge Multibeam Survey. December 4.

NOAA. 2025. Tides and Currents. NOAA station 9414863 Richmond https://tidesandcurrents.noaa.gov/stationhome.html?id=9414863 and NOAA station 9414290 San Francisco https://tidesandcurrents.noaa.gov/stationhome.html?id=9414290. Accessed in December 2025.

OpenFOAM. 2025. The OpenFOAM Foundation. https://openfoam.org. Accessed in March 2025.

Appendix E. Photolog

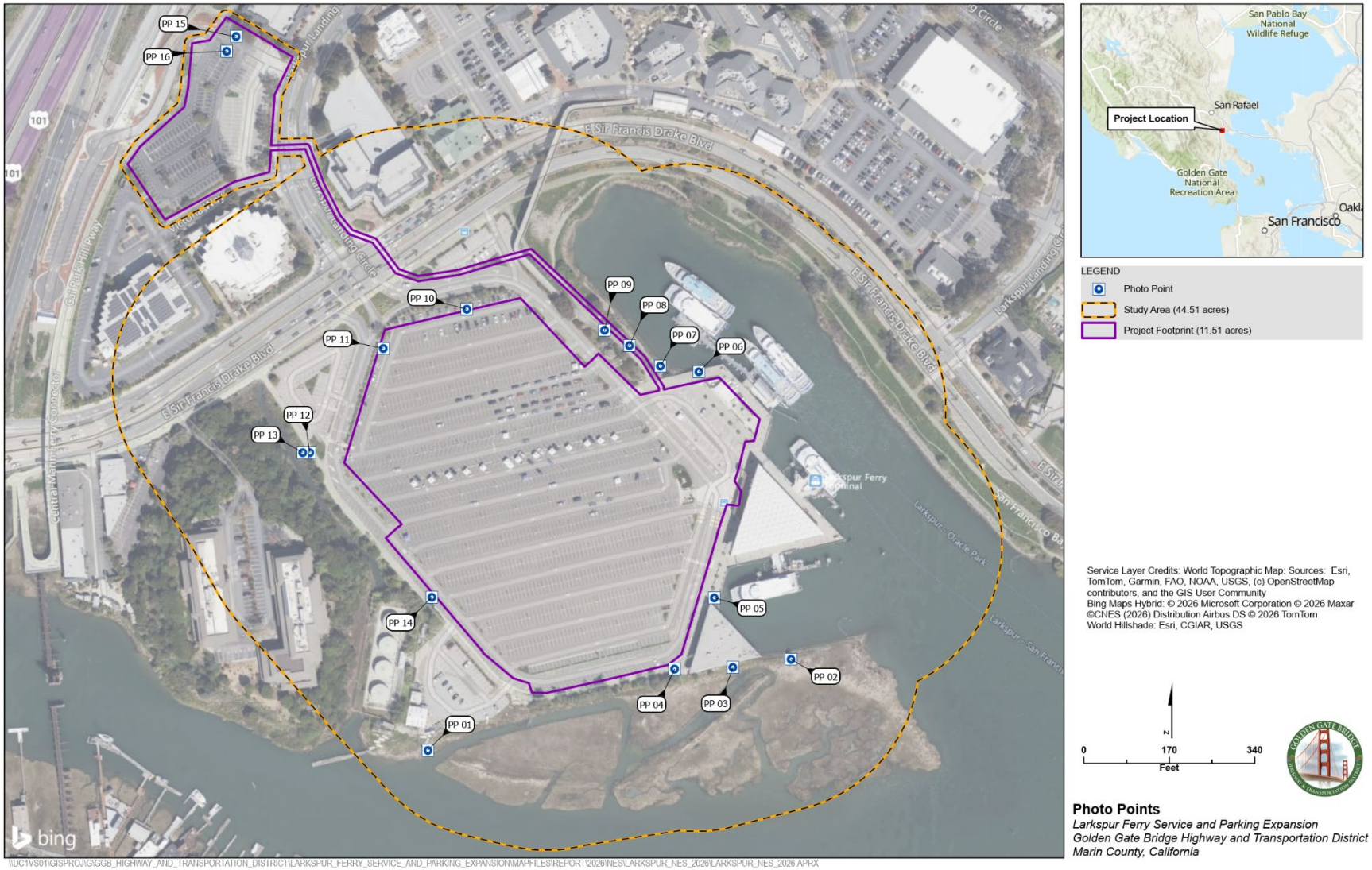


Photo Points
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

Figure F-1. Photo Points

Photo Point 1: Invasive Spartina Project protocol-level California Ridgway's rail survey station. Located in southwest portion of BSA, approximately 230 feet south of proposed Project footprint. Taken on March 18, 2026.

Photo 1-1: Facing southeast; view of Triangle Marsh and Corte Madera Creek.



Photo 1-2: Facing east, view of Triangle Marsh and parking lot outside of Project footprint.



Photo 1-3: Facing north, view of ice plant between Triangle Marsh and parking lot.



Photo Point 2: Invasive Spartina Project protocol-level California Ridgway's rail survey station. Located in southeast portion of BSA, approximately 210 feet east of Project footprint. Taken on March 18, 2026.

Photo 2-1: Facing northeast, view of ferry terminal.



Photo 2-2: Facing southeast, view of Triangle Marsh and ferry route.



Photo 2-3: Facing south, view of Triangle Marsh and residences on north side of Corte Madera Marsh.



Photo 2-4: Facing west, view of Triangle Marsh.



Photo Point 3: Located in southeast portion of BSA, approximately 100 feet east of Project footprint. Taken on March 18, 2026.

Photo 3-1: Facing east, view of Triangle Marsh and building outside of Project footprint.



Photo 3-2: Facing west, view of building outside of Project footprint and Triangle Marsh.



Photo Point 4: Located at the southeast corner of Project footprint. Taken on March 18, 2026.

Photo 4-1: Facing west, view of upland and developed area between Project footprint and Triangle Marsh, including bike path and landscaping.



Photo 4-2: Facing northeast, view of ferry buildings adjacent to eastern boundary of Project footprint.



Photo Point 5: Located adjacent to southeastern boundary of Project footprint. Taken on March 18, 2026.

Photo 5-1: Facing southeast, view of ferry route and eastern portion of Triangle Marsh.



Photo 5-2: Facing northeast, view of main ferry terminal.



Photo Point 6: Located outside northeastern boundary of Project footprint. Taken on March 18, 2026.

Photo 6-1: Facing northwest, view of wetlands and upland areas.



Photo Point 7: Located southeast of proposed Pedestrian Improvement corridor. Taken on March 18, 2026.

Photo 7-1: Facing southeast, view of wetland below proposed Bike Parking.



Photo 7-2: Facing northeast, view of wetland adjacent to proposed Pedestrian Improvement corridor.



Photo 7-3: Facing northwest, view of upland/landscaping between proposed Pedestrian Improvement corridor and wetlands.



Photo Point 8: Located in southeast portion of proposed Pedestrian Improvement corridor. Taken on March 18, 2026.

Photo 8-1: Facing southeast, view of wetlands and adjacent uplands.



Photo 8-2: Facing south, view of uplands, proposed Pedestrian Improvement corridor, and landscaping.



Photo 8-3: Facing north, view of wetlands and adjacent uplands/landscaping.



Photo Point 9: Located in southeast portion of proposed Pedestrian Improvement corridor. Taken on March 18, 2026.

Photo 9-1: Facing northwest, view of proposed Pedestrian Improvement corridor and adjacent landscaping.



Photo 9-2: Facing southeast, view of proposed Pedestrian Improvement corridor and adjacent uplands and landscaping.



Photo Point 10: Located at north side of Main? North? Lot. Taken on March 18, 2026.

Photo 10-1: Facing northwest, view of parking spaces, landscaping, and roadway north of Project footprint.



Photo Point 11: Located at northwest side of existing parking lot. Taken on March 18, 2026.

Photo 11-1: Facing southeast, view of existing parking lot.



Photo Point 12: Located west of existing parking lot, upland of riparian area. Taken on March 18, 2026.

Photo 12-1: Facing northwest, view of riparian area, uplands, and adjacent bike lanes.



Photo 12-2: Facing west, view of riparian area and uplands.



Photo Point 13: Located in riparian area west of existing parking lot. Taken on March 18, 2026.

Photo 13-1: Facing northwest, view of riparian area and waterway.



Photo 13-2: Facing south, view of riparian area and waterway.



Photo 13-3: Facing southeast, view of riparian area and waterway.



Photo Point 14: Located at southwest side of Project footprint. Taken on March 18, 2026.

Photo 14-1: Facing northwest, view of bike lane and adjacent vegetation.



Photo 14-2: Facing west, view of storage area west of Project footprint.



Photo 14-3: Facing southeast, view of bike lanes and storage area west of Project footprint.



Photo Point 15: Located at north side of proposed North Lot. Taken on March 18, 2026.

Photo 15-1: Facing southwest, view of existing parking area.



Photo 15-2: Facing southeast, view of existing parking area and landscaping.



Photo Point 16: Located in northeast portion of proposed North Lot. Taken on March 18, 2026.

Photo 16-1: Facing northwest, view of existing parking area and adjacent Larkspur Station.



Photo 16-2: Facing southwest, view of existing parking area and landscaping.



Photo 16-3: Facing south, view of existing parking area and landscaping.



Photo 16-4: Facing southeast, view of existing parking area and landscaping.



Cultural Resources Report

Larkspur Ferry Service Expansion and Parking Project

Golden Gate Bridge, Highway and Transportation District

September 2, 2026



Cultural Resources Report

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Executive Summary

The Larkspur Ferry Service Expansion and Parking Project (Project) is being implemented by the Golden Gate Bridge, Highway and Transportation District (District) to meet future ferry ridership demand and reduce traffic congestion on United States Highway 101 (US 101) in Marin and Sonoma Counties and in the Larkspur Landing area. To meet future ferry passenger travel demand, the Project would increase ferry service incrementally based on demand from 42 daily trips up to as many as 76 daily trips through 2050. The Project would also implement a range of landside access improvements at the ferry terminal. These improvements include expanded parking capacity, transportation demand management strategies, enhanced pedestrian and bicycle/scooter access (including accommodations for e-bikes), increased transit and shuttle services, and improved connections with Sonoma–Marin Area Rail Transit (SMART).

A cultural resources inventory and evaluation was conducted in accordance with the California Environmental Quality Act (CEQA) for the Project Area Limits (PAL). The 18.57-acre PAL encompasses all potential work locations, staging areas, and access routes for the Project.

As the CEQA Lead Agency, the District requested a search of the Sacred Lands File (SLF) and list of Native American tribes with cultural and traditional ties to Marin County maintained by the Native American Heritage Commission (NAHC) to initiate consultation in accordance with Assembly Bill 52. The SLF search was negative. The District initiated outreach with both of the NAHC listed tribes (the Federated Indians of Graton Rancheria [FIGR] and the Guidiville Indian Rancheria) and invited consultation on the Project with both tribes. The FIGR responded and is in ongoing consultation with the District. They have expressed their concern about the potential for buried Coast Miwok archaeological deposits that may be impacted by the Project.

Jacobs cultural resources staff conducted a records search and research of published literature and past field research in the PAL and 0.5-mile radius study area. The records search conducted by California Historical Resources Information System Northwest Information Center's staff in 2021, and updated in 2026, provided records of cultural resources and cultural resources investigations within the PAL and 0.5-mile radius study area. The records search did not identify any previously recorded archaeological resources in the PAL, and seven resources within 0.5 mile. Seven previous investigations that included fieldwork include all or part of the PAL, while another 31 are within 0.5 mile.

Jacobs cultural resources staff conducted a pedestrian survey of the PAL and immediate surroundings in 2021, and again in 2026, to visit known cultural resources and identify any previously unidentified cultural resources within the PAL. The survey identified the 1976 Larkspur Ferry Terminal as an architectural history resource. No archaeological resources were identified during the survey.

The PAL has heightened sensitivity for buried archaeological deposits based on its location at the edge of the San Francisco Bay, and the Federated Indians of Graton Ranchera have expressed concerns that there may be such deposits in the PAL. Jacobs conducted a geoarchaeological study to further evaluate the potential of the PAL for such deposits. The review of the history of development within the PAL, underlying soils and geology, and known precontact era Coast Miwok sites in the immediate area confirm the potential sensitivity of the PAL for buried archaeological deposits beneath the artificial fill and previous subsurface disturbance. Drilled core sampling investigations were conducted by Jacobs in 2023 (Jacobs 2024) and 2026 (Jacobs in preparation). In total, the 9 core samples spread across the Main Lot and the North Lot confirm this sensitivity but did not identify archaeological materials.

The 1976 Larkspur Ferry Terminal facility was found to meet the criteria for listing in the California Register of Historical Resources for its representation of High Tech Structuralism architectural design. The key character-defining features of the resource are primarily represented through the two primary

terminal structures (Shelter Structure and Service Building) with their mid-century aesthetic and prominence as vertical focal points of the facility from most viewpoints around the facility. The Larkspur Terminal Facility is considered a historical resource for the purposes of CEQA.

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Acronyms and Abbreviations

Acronym	Description
ADA	Americans with Disabilities Act
amsl	above mean sea level
BCE	Before Common Era
bgs	below ground surface
BP	Before Present
CCR	California Code of Regulations
CE	Common Era
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CRHR	California Register of Historical Resources
cal BP	calibrated date Before Present
District	Golden Gate Bridge Highway and Transportation Terminal District
FIGR	Federated Indians of Graton Rancheria
LFT	Larkspur Ferry Terminal
LHPB	Larkspur Heritage Preservation Board
NAHC	Native American Heritage Commission
NETR	Nationwide Environmental Title Research
NRHP	National Register of Historic Places
NWIC	Northwest Information Center
PAL	Project Area Limits
PRC	Public Resources Code
Project	Larkspur Ferry Service Expansion and Parking Project
SLF	Sacred Lands File

Acronym	Description
SMART	Sonoma–Marin Area Rail Transit
SOI	Secretary of the Interior
THPO	Tribal Historic Preservation Officer
U.S.C.	United States Code
US 101	United States Highway 101
USGS	United States Geological Survey

1. Introduction

Jacobs prepared this Cultural Resources Report for the Golden Gate Bridge, Highway and Transportation Terminal District (District) for the proposed Larkspur Ferry Service Expansion and Parking Project (Project) in Marin County, California to conform with the requirements of the California Environmental Quality Act (CEQA). The District is the lead agency responsible for CEQA compliance.

This proposed Project would be constructed at the existing Larkspur Ferry Terminal (LFT) facility on the San Francisco Bay near Sir Francis Drake Boulevard in Marin County, California (Figure 1).

The District is implementing the Project to accommodate growing ferry ridership demand, enhance regional transit connectivity, reduce greenhouse gas emissions, and provide a reliable alternative to automobile travel along the United States Highway 101 (US 101) corridor in Sonoma, Marin, and San Francisco counties, as well as within San Francisco.

Jacobs initiated the cultural resources inventory and evaluation March 2021 with a records search at the California Historical Resources Information System's Northwest Information Center (NWIC), a pedestrian survey, and background literature review, and has updated the inventory in response to Project design updates with a records search at the NWIC March 2026 for the revised Project Area Limits (PAL) and 0.5-mile study area. The 18.57-acre PAL encompasses all potential work locations, staging areas, and access routes for the Project. This report presents the Project location and description in Section 2, the regulatory context in Section 3, the environmental and cultural setting in Section 4, the cultural resources inventory methods and findings in Section 5, the cultural resources evaluation in Section 6.3.2 and the conclusion in Section 6.3.3.

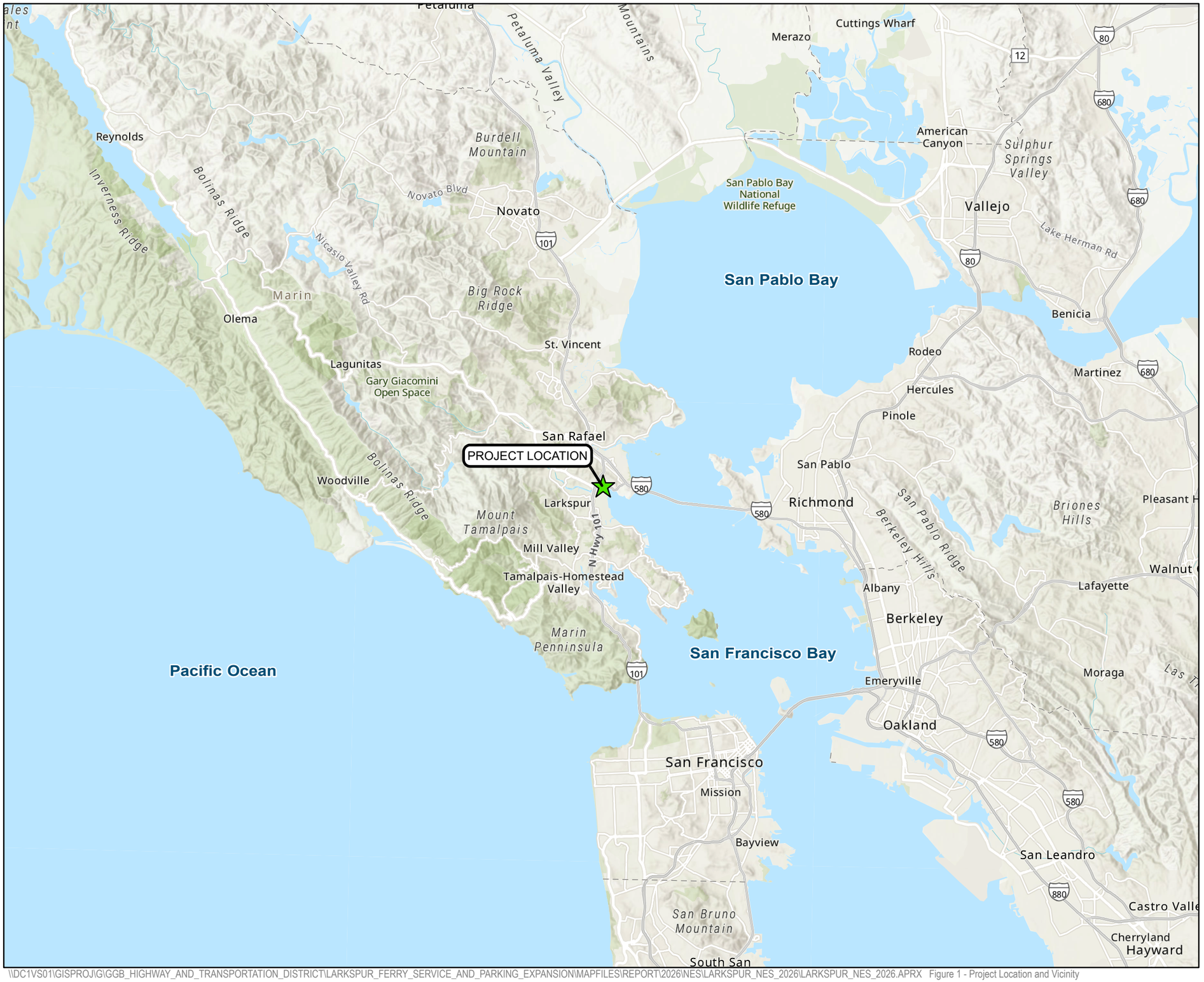


Figure 1
Project Location and Vicinity
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2026\NES\LARKSPUR_NES_2026\LARKSPUR_NES_2026.APRX Figure 1 - Project Location and Vicinity

2. Project Location and Description

The Project is being developed to meet future ferry passenger travel demand. The Project would increase ferry service incrementally based on demand from 42 daily trips up to as many as 76 daily trips through 2050. The Project would also implement a range of landside access improvements at the ferry terminal. These improvements include expanded parking capacity, transportation demand management (TDM) strategies, enhanced pedestrian and bicycle/scooter access (including accommodations for e-bikes), increased transit and shuttle services, and improved connections with Sonoma–Marin Area Rail Transit (SMART). Refer to Figure ES-1.

2.1 Existing Project Location

The LFT and associated facilities are along the central San Francisco Bay near Sir Francis Drake Boulevard in Marin County, California, at latitude 37°56'40.2"N and longitude 122°30'31.4"W (Figure 1). The study area is within the San Rafael US Geological Survey (USGS) 7.5-minute topographic quadrangle and within the City of Larkspur city limits. The terminal is adjacent to San Francisco Bay wetlands and tidal areas and is bordered by a mix of transportation, commercial, and open-space land uses.

The LFT is connected to the wider transportation network via Sir Francis Drake Boulevard, which connects to US 101, the recently opened adjacent stop on the Sonoma-Marin Area Rail Transit (SMART), SMART Connect Larkspur shuttle, and Golden Gate Transit Bus Service.

2.1.1 Existing Setting

The LFT provides regular and special-event ferry service and is supported by multimodal access and two surface parking lots, the Main Lot and North Lot. Proposed subsurface construction work is limited to the Main Lot and North Lot. The LFT buildings and structures are included in this analysis to consider the potential impact of proposed new above-ground parking garages.

2.1.1.1 Larkspur Ferry Terminal

The LFT was constructed between 1975 and 1976 on the site of the former Hutchinson's Rock Quarry and officially opened on December 11, 1976. The LFT was designed by architect Jacques de Brer and features an 18,000-square-foot open-air "space frame" canopy. The terminal is Americans with Disabilities Act (ADA)-compliant and includes amenities for passengers such as a covered waiting area, restrooms, and bicycle racks accommodating up to 72 bicycles The terminal is accessible and includes amenities for passengers, such as a covered waiting area, restrooms, and bicycle racks accommodating up to 80 bicycles inside the paid area and an additional 60 outside. Immediately outside the terminal building, there are pick-up and drop-off spaces for bus transit and private vehicles/rideshare vehicles in front of the terminal building, along with a surface parking lot to serve ferry passengers who choose to drive and park.

2.1.1.2 Landside Facilities

Landside facilities include the Main Lot and North Lot, which are surface lots and together have a total of 2,023 parking spaces. The Main Lot is accessed from Sir Francis Drake Boulevard and is an approximate hexagon shape, keeping with the original design of the terminal and surrounding areas. Four fuel storage tanks are used for daily ferry service; located just beyond the employee lot, each tank holds 75,000 gallons.

The North Lot is to the north of the Main Lot across Sir Francis Drake Boulevard near the SMART station and is accessed from Larkspur Landing Circle. It has 215 parking spaces.

2.2 Project Description

This project description includes only those elements of design that entail ground disturbance during construction, or that alter that physical setting of the LFT for the purposes of this report.

2.2.1 Build Alternatives

The Project proposes to increase ferry service; improve the pickup/drop-off area to provide designated areas for fixed-route transit loading and unloading, Transportation Network Companies, and drop off; upgrade bicycle storage facilities; improve pedestrian connections; and use a phased approach to construct new parking garages on the Main and North Lots. There are two Build Alternatives being considered. Alternatives 1 and 2 occupy the same footprint and are essentially the same with the exception of (1) Alternative 2 includes additional TDM measures that fully address projected ridership demand with one less parking level in the Main Lot, and (2) Main Lot parking garage height (Alternative 1 is a five-level garage, and Alternative 2 is a four-level garage). Construction of the Build Alternatives would occur in phases, with Phase I consisting of TDM and transit improvements, along with a parking garage on the North Lot, and Phase II including further TDM and transit improvements and a parking garage on the Main Lot.

2.2.1.1 Alternative 1: Increased Ferry Service and New Parking Garages

Alternative 1 would construct a five-level parking garage with secured bicycle parking on the Main Lot. The Main Lot garage's first level would be elevated to accommodate near-term forecast sea-level rise (Year 2100 Projection). First-level elevations would be increased approximately 1 to 5 feet above the existing grade. Generally, areas close to the marsh would be elevated 5 feet, while areas closer to Sir Francis Drake Boulevard would be elevated 1 foot based on difference between projected sea-level rise and existing grade. The concrete garage would include approximately 1,200,000 square feet of parking for 3,998 stalls (401 surface lot stalls and 3,597 garage stalls). The garage would include an elevator and connect to existing onsite utilities. All major construction would occur outside of the San Francisco Bay Conservation and Development Commission's shoreline band. Anticipated work within the shoreline band would be limited primarily to restriping the remaining surface lot to accommodate the new circulation and remaining surface parking within the lot, landscape improvements and drainage tie-ins as applicable.

2.2.1.2 Alternative 2: Increased Ferry Service, New Parking Garages, and Enhanced Transportation Demand Measures

Alternative 2 would construct a four-level parking garage with secure bicycle parking on the Main Lot after Phase I construction of the North Lot garage. The Main Lot garage's first level would be elevated to accommodate near-term forecast sea-level rise (Year 2100 Projection). First-level elevations would be increased approximately 1 to 5 feet above the existing grade. Generally, areas close to the marsh would be elevated 5 feet, while areas closer to Sir Francis Drake Boulevard would be elevated 1 foot based on difference between projected sea-level rise and existing grade. The concrete garage would include approximately 960,000 square feet of parking for 3,258 stalls (401 surface lot stalls and 2,857 garage stalls). The garage would include an elevator and connection into existing onsite utilities. All major construction would occur outside of the Bay Conservation and Development Commission's shoreline band. Anticipated work within the shoreline band would be limited primarily to restriping the remaining surface

lot to accommodate the new circulation pattern and configuration of surface parking within the lot, landscape improvements, and drainage tie-ins, as applicable.

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2.2.2 Common Design Features – Build Alternatives

The following describes common design features for the Build Alternatives. The Build Alternatives would require the same construction activities within the same footprint. The only difference would be for Alternative 2 Phase 2, which would be slightly shorter in duration because of one less parking level in the Main Lot parking garage.

2.2.2.1 Increased Ferry Service

The District's ferry ridership forecasts indicate ferry demand more than doubling from historic peak levels to 17,600 daily riders by 2050. To accommodate future demand, the Project would provide the District operational flexibility to incrementally expand ferry service beyond the current average limit of 42 daily ferry crossings, ultimately providing up to 76 daily ferry crossings as warranted by future ridership levels and funding availability.

2.2.2.2 North Lot Parking Garage

The concrete garage would include approximately 260,000 square feet of parking for 850 stalls (145 surface/level 1 stalls and 705 garage stalls). The garage would include two elevators to comply with the Americans with Disabilities Act (ADA).

2.2.2.3 Additional Common Design Features

Both Build Alternatives would also include the following components:

- Secure bicycle parking for up to 350 bicycles at the Main Lot
- Electric vehicle charging in accordance with the California Green Building Standards Code (Title 24, Part 11)
- New pedestrian crossing on Larkspur Landing Circle to enhance pedestrian movements from the North Lot to the ferry terminal
- Connection to existing drainage facilities and utilities
- Installation of solar canopies shades across approximately 75% of the upper levels of both garages, resulting in an estimated annual clean energy output of 5,700,000 kilowatt-hours per year for electric vehicle charging to help offset grid demand
- Uniform distribution of interior and exterior lights for the Main and North Lots that are provided through the following principles (actual spacing and total number of fixtures can vary based on many factors; typically, fewer are preferred, but it requires more advanced fixtures and will be developed in final design):
  - Minimum surface lighting level is 1 foot-candle, and there is a 5-foot-candle minimum at interaction areas. The maximum surface lighting level will be defined in the final design (as low as acceptable) to avoid glare.
  - All new exterior fixtures will be NightSky-compliant (each shining down only), preventing glare.

- Interior fixtures are placed such that the cutoffs do not let a significant amount of light protrude outside the building envelope, preventing glare. Because they are ceiling mount, they shine downward by nature.
- Fixtures will be light-emitting diode (LED) with minimum Color Rendering Index of 90 and automated (daylight and occupancy dimming).
- Vehicle headlights in the garage are permanently blocked by solid crash-walls and do not shine outwards form the upper levels, preventing glare.

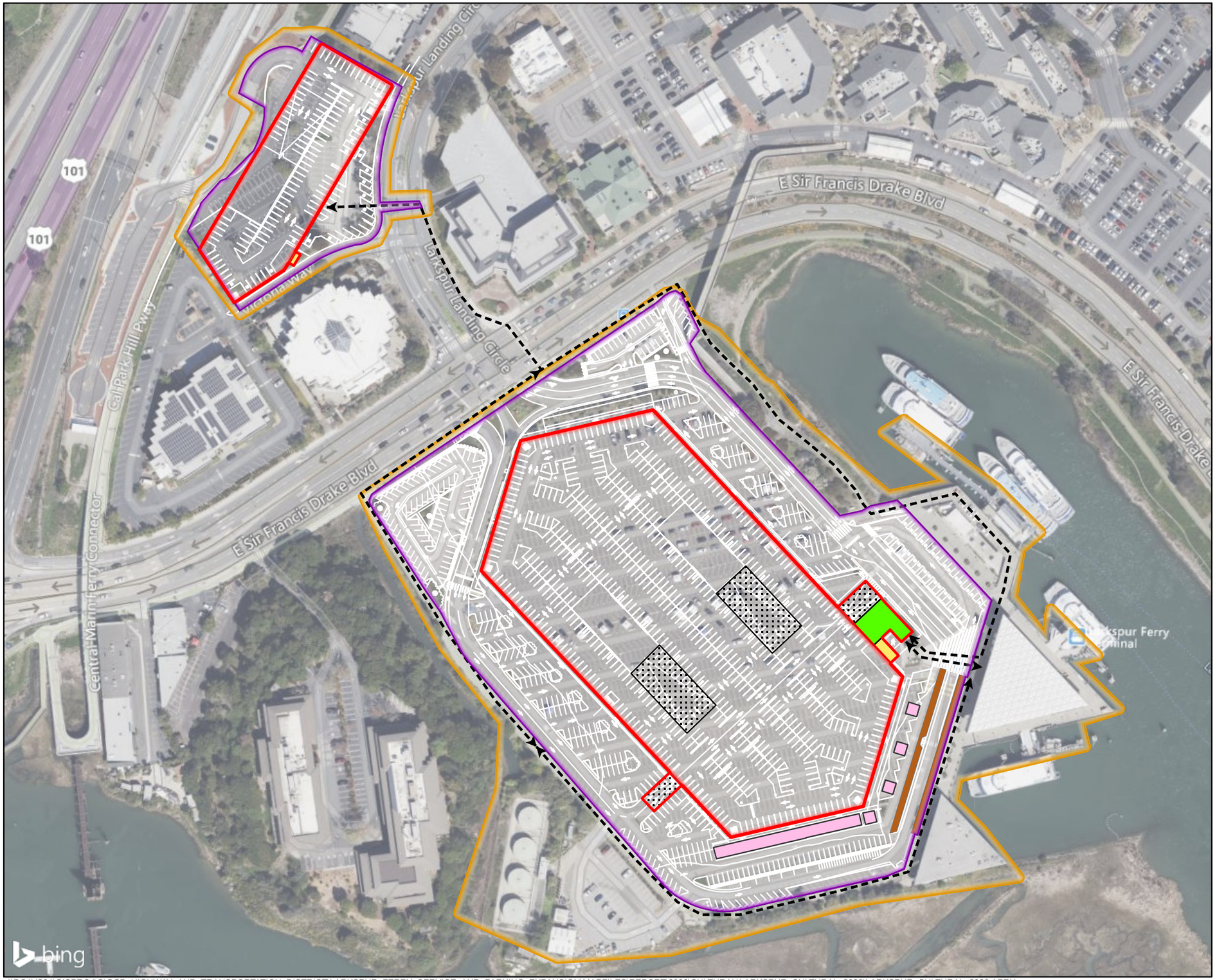
2.2.3 Common Construction Activities – Build Alternatives

Construction activities that involve ground disturbance are the same for both alternatives and are limited to the same footprints in both the Main Lot and the North Lot. The Main Lot consists of the 5.5-acre parking garage footprint and surrounding 5.6-acre surface parking lot. The parking garage footprint within the Main Lot will be excavated to remove from 5 to 10 feet of liquefiable soil and will be refilled with engineered fill. The foundation would require either approximately 950 36-inch-by-90-foot-long concrete auger cast piles or 2,151 90 foot-long 18x204 steel H-piles; constructing plie caps, grade beams, and perimeter foundation walls; and installation of under-slab utilities will be installed to support the Main Lot parking garage. Auger cast piles involve drilling a continuous hollow-stem auger into the ground and pumping fluid concrete through the stem as the auger is removed. A prefabricated steel reinforcement case is immediately inserted while the concrete is still wet. H-piles would be driven. Other excavation within the parking garage footprint will include a 15-square-foot excavation to a depth of 10 feet for the elevator shaft, and excavations to connect new utilities to existing onsite utilities. After construction of the garage, the 5.6-acre surface parking area will be improved by demolishing existing pavement, regrading, and compacting the area. The stormwater drainage will be improved, and curbs, gutters, sidewalks, and ramps will be completed. After the lot is paved, the installation of lighting, signage, and parking control devices may entail small, localized excavations of up to 5 feet depth.

The North Lot consists of the 1.02-acre parking garage and 0.62-acre surface parking area surrounding the garage. Within the 1.02-acre parking garage footprint, construction begins by demolishing the existing pavement and curbs, followed by mass excavation to remove approximately 3 feet of soil to achieve the required subgrade elevation for the mat foundation. New utilities will be installed prior to construction of the mat slab, and a 15-square-foot, 10-foot-deep elevator shaft will be excavated. Construction of the garage will be followed by demolition of existing pavement in the 0.62-acre surface parking area. The area will be regraded and compacted, and the stormwater drainage will be improved. In addition to reconstructing curbs, gutters and sidewalks, and repaving the lot, the installation of lighting, signage, and parking control devices may entail small, localized excavations of up to 5 feet depth.

2.3 Project Area Limits

The PAL consists of the geographic area where the Project construction and use may directly or indirectly cause change of character or use of historical resources (e.g., archaeological sites and/or built environment resources). The PAL is depicted in Figure 2. Potential impacts on archaeological sites are posed primarily by ground-disturbing activities such as clearing, grubbing, grading, staging, excavation, pile driving, and filling. Historic built environment resources may be directly affected by such construction activities, as well as indirectly by noise, vibration, and substantial changes to the visual environment associated with implemented use of Project improvements.





LEGEND

- Cultural Resources Project Area Limits (18.57 acres)
- Project Footprint (13.70 acres)
- 0.5-mile Study Area
- Parking Structure
- ADA Parking
- Bike Parking
- Pickup and Drop off Stalls
- Ramp
- Elevator
- Pedestrian Path

Service Layer Credits: World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
Bing Maps Hybrid: © 2026 Microsoft Corporation © Maxar ©CNES (2026) Distribution Airbus DS © Mapbox © 2026 TomTom
World Hillshade: Esri, CGIAR, USGS

N

0 100 200

Feet

Figure 2
Cultural Resources Project Area Limits
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

\\DC1VS01\GISPROJ\G\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2026\CULTURAL\LARKSPUR_CULTURAL_2026\LARKSPUR_CULTURAL_2026.APRX

The proposed PAL for this Project is defined as the extent of construction-related ground disturbance, inclusive of staging, laydown and parking areas, as well as the physical location of improvements proposed under the various alternatives. The PAL also includes the Ferry Terminal buildings and structures to address the possibility of visual impacts resulting from the proposed multi-story parking garage within the adjacent parking area.

2.3.1 Native American Consultation

The District initiated Native American outreach and consultation February 18, 2021, requesting a Sacred Lands File (SLF) search and contact list of California Native American tribes that are traditionally and culturally affiliated with Marin County from the Native American Heritage Commission (NAHC). As the CEQA lead agency, the District has responsibilities under Assembly Bill 52 to consult with California Native American tribes that are affiliated with the geographic area of the proposed Project.

The NAHC responded on March 2, 2021, stating that the SLF search was negative and providing contact information for the two Marin County tribes requesting consultation, the Federated Indians of Graton Rancheria (FIGR) and Guidiville Indian Rancheria. On April 16, 2021, the District sent a letter to the identified tribes describing the Project and informing the Tribes that the NAHC search of the SLF was negative, and that the record search conducted by the NWIC did not identify any previously recorded archaeological resources within the PAL. The record of Native American outreach communications is presented in Appendix A.

The Tribal Historic Preservation Officer (THPO) for the FIGR, Buffy McQuillen, replied to the District's Director of Planning via email on June 9, 2021. The email response from McQuillen indicated *"The Tribe has reviewed the project notification dated April 16,2021 and would like to let you know that there may be Tribal Cultural Resources in the project area. Please let us know if you have any questions."*

The District's Director of Planning met with FIGR representatives on August 23, 2021. The FIGR shared their concerns about the potential presence of Tribal Cultural Resources in the Project area.

In a letter dated July 18, 2023, sent by email and certified mail, the Director of Planning provided a project status update and invited the FIGR to monitor preliminary geotechnical investigations to be undertaken the week of August 14, 2023. The investigation used direct push coring and core penetration tests to determine the underlying geotechnical site conditions for building foundation design. The District received no response from FIGR.

The Director of Planning sent a letter by email and certified mail to THPO McQuillen of FIGR September 19, 2024, inviting FIGR to attend the upcoming Open House and Scoping Meeting to be held October 15, 2024, to formally initiate the environmental process for the Project and invite the public to provide feedback on the Environmental Impact Report.

The Director of Planning sent a letter by email and certified mail to FIGR THPO McQuillen June 10, 2026, notifying her of upcoming soil coring investigations to test archaeological sensitivity of subsurface deposits, and inviting FIGR to provide a monitor for the investigation. FIGR THPO McQuillen, and FIGR staff Hector Garcia Cabrales, Cultural Resources Specialist, and Kyle Rabellino, Archaeologist, visited the investigation on Friday, June 26. They observed the coring, and discussed observations with Jacobs geoarchaeologist Kyle Brudvik.

Appendix A contains copies of Native American correspondence.

2.4 Professional Qualifications

The cultural resources research and reporting was conducted by Jacobs cultural resources specialists Brian Ramos, PhD, RPA; Mark Bowen, MA; Irem Oz, MA; Kyle Brudvik, MA, RPA; and Heather Price, PhD, RPA. Ramos, Price and Brudvik meet the US Secretary of the Interior's Standards for Professional Qualifications (36 Code of Federal Regulations [CFR], Part 61) in archaeology and together have a combined 71 years of professional experience. Brudvik specializes in geoarchaeology and conducted the geoarchaeological coring investigation and reporting. Bowen and Oz have a combined 50 years of professional experience and meet the US Secretary of the Interior's Standards for Professional Qualifications for history and architectural history.

3. Regulatory Context

This section summarizes the state regulations and policies applicable to the proposed Project related to cultural resources.

3.1 California Environmental Quality Act Statue and Guidelines

CEQA provides a broad definition of what constitutes a cultural or historical resource. Cultural resources can include traces of precontact habitation and activities, historic sites and materials, and places used for traditional Native American observances or places with special cultural significance. Note that precontact is the preferred term in California to refer to the period of occupation by indigenous people prior to the arrival of Europeans. "Prehistoric" is preserved in this report when it occurs in direct quotes, or bibliographic references. In general, any trace of human activity over 50 years in age is required to be treated as a potential cultural resource.

According to the State CEQA Guidelines (Section 15064.5[a][3]), a resource is generally considered historically significant if it meets the criteria for listing in the California Register of Historical Resources (CRHR) (Public Resources Code [PRC] Section 5024.1; California Code of Regulations [CCR], Title 14, Section 4852). A historical resource is defined as any site that:

- is listed in or determined to be eligible by the State Historical Resources Commission for listing in the CRHR, or is determined to be significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, or cultural annals of California; and
- is eligible for listing in the CRHR; or
- is included in a local register of historical resources, as defined by PRC Section 5020.1(k), or is identified as significant in an historical resource survey meeting the requirements of PRC Section 5024.1(g).

The State CEQA Guidelines also require considering unique archaeological resources (Section 15604.5). PRC Section 21083.2(g) includes the following definition:

> As used in this section, "unique archaeological resource" means an archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely addicting to the current body of knowledge, there is a high probability that it meets any of the following criteria:
>
> (1) contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information,
>
> (2) has a special and particular quality such as being the oldest of its type or the best available example of its type, or
>
> (3) is directly associated with a scientifically recognized important prehistoric or historic event or person.

3.1.1 California Register of Historical Resources

The CRHR includes resources that are listed in or formally determined eligible for listing in the National Register of Historic Places (NRHP), as well as some California State Landmarks and California Points of Historical Interest. Properties of local significance that have been designed under a local preservation

ordinance (local landmarks or landmark districts) or that have been identified in a local historical resource inventory may be eligible of listing in the CRHR and are presumed to be significant resources for the purposes of CEQA unless a preponderance of evidence indicates otherwise (PRC 5024.1, 14 CCR 4850).

The eligibility criteria for listing in the CRHR are similar to those for the NRHP but focus on the importance of the resources to California history and heritage. A cultural resource may be eligible for listing on the CRHR if:

1. It is associated with events or patterns of events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the U.S.; or
2. It is associated with the lives of persons important to local, California, or national history; or
3. It embodies the distinctive characteristics of a type, period, or region, or method of construction, or represents the work of a master, or possesses high artistic values; or
4. It has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California, or the nation.

In addition to meeting one of the evaluation criteria, the resource must retain integrity. The CRHR definition of integrity is slightly different from those of the NRHP. Section 4852(c) of the CCR (Title 14, Chapter 11.5), defines integrity as "the authenticity of an historical resources' physical identity evidenced by the survival of characteristics that existed during the resource's period of significance." The regulation also states that eligible resources must "retain enough of their historic character or appearance to be recognizable as historical resources and to convey the reasons for their significance," and then lists the same seven aspects of integrity used for evaluating properties for the National Register of Historic Places (location, design, materials, workmanship, setting, feeling, and association.

3.1.2 City of Larkspur

The City of Larkspur Municipal Code includes regulations that address historic preservation within the City Limits. As per Code Section 18.19 (Heritage Preservation) excepting for work that meets the provisions of Larkspur Municipal Code Sections 18.19.025 and 18.19.060 (generally considered "ordinary maintenance and interior improvements"), projects requiring a discretionary land use permit, building permit, grading or demolition permit for properties listed on the official historic resources inventory, determined to be eligible for inclusion on the historic resources inventory, or located within the H (Historic) District shall be subject to the requirements of the Heritage Preservation chapter.

Under this section of the Larkspur Municipal Code, "Historic district" means one or more properties zoned H, containing a number of structures and sites that meet one of several listed definitions noted below, or a collection of structures that individually may not be of major architectural or historic importance but as a group contribute to the overall historic and architectural character of the community.

"Historic resource" means structures, sites, areas, and natural phenomena which have one or more of the following characteristics:

1. A reminder of past years, events, and persons important in local, state, or national history.
2. An example of a once common structure with a design that specifically relates to its now rare or nonexistent first use or business.

3. A unique or irreplaceable asset to the City or a neighborhood, which asset enriches human life and/or serves an educational benefit by providing future generations examples of the physical surroundings of the past.

4. An example essential to maintaining the overall historic character of a larger area.

5. A structure having architectural significance. A structure determined to have architectural significance shall be one which is valuable as an example of:
    a. Architectural design that is attributable to a historic period.
    b. A commonly identified architectural style or method of construction.
    c. Architectural design that is unusual, beautiful, or ingenious.
    d. A notable work of a major builder or designer.
    e. Unusual quality of workmanship.
    f. Unusual use of construction materials.

Additionally, "Historic resources inventory" means a list of officially designated historic resources, as adopted by resolution of the City Council (City of Larkspur 2026a).

3.1.3 Resource Types

Three broad classes of cultural resources are considered in this section: precontact, ethnographic, and historic. Those cultural resources determined eligible to the CRHR are called historical resources and are further defined under state law as buildings, sites, structures, objects, areas, places, records, manuscripts, and tribal cultural resources (CCR, Title 14, §§4852a, 5064.5(a)(3); PRC, §§5020.1(h,j), 5024.1[e][2, 4], 21074).

Precontact archaeological resources are those materials relating to precontact human occupation and use of a particular environment. These resources may include sites and deposits, structures, artifacts, rock art, trails, and other traces of activity by indigenous peoples. In California, the precontact period began about 12,000 years ago and extended through the 18th century until 1769, when the first Europeans settled in California.

Ethnographic resources are those materials important to the heritage of a particular ethnic or cultural group, such as Native Americans or African, European, or Asian immigrants. They may include traditional resource collecting areas, ceremonial sites, topographic features, value-imbued landscapes, cemeteries, shrines, or neighborhoods and structures. Ethnographic resources are variations of natural resources and standard cultural resource types. They are subsistence and ceremonial locales and sites; structures; objects; and rural and urban landscapes assigned cultural significance by traditional users. The decision to call resources ethnographic depends on whether associated peoples perceive them as traditionally meaningful to their identity as a group and the survival of their lifeways.

Historical period resources are those materials, archaeological and architectural, usually but not necessarily associated with Euro-American exploration and settlement of an area and the beginning of a written historical record. They may include archaeological deposits; sites; structures; trail and road corridors; artifacts; or other evidence of historical human activity. Under federal and state requirements, historical period cultural resources must be greater than 50 years old to be considered of potential historical importance. A resource less than 50 years of age may be historically significant if the resource is of exceptional importance. The Office of Historic Preservation endorses recording and evaluating resources over 45 years of age to accommodate a 5-year lag in the planning process.

4. Environmental and Cultural Setting

This section describes the environmental and cultural setting of the Project and immediate vicinity and was used to establish expectations regarding archaeological sensitivity and the potential for previously unrecorded archaeological resources in the PAL, as well as provide the contextual framework by which any identified cultural resources would be analyzed and evaluated. There have been numerous previous cultural resource studies in the PAL and 0.5-mile radius study area, with extensive descriptions of the natural and cultural setting relevant to the PAL. The following context (Sections 4.1 through 4.3) is taken from Dr. Brian F. Byrd and Michael Darcangelo's report *Archaeological Survey Report for the Central Marin Ferry Connection Project, Larkspur, Marin County, California* (2011) that was prepared for the District. The Byrd and Darcangelo report provides an overview of the natural and cultural settings relevant to the Project.

4.1 Paleoenvironmental Setting

The following section was developed by geo-archaeologists Jack Meyer and Jeffrey Rosenthal (Byrd and Darcangelo 2011) who have extensive experience developing predictive models for identification of buried archaeological sites based in part on examinations of past landforms.

> *During the last glacial maximum some 22,000 years ago, vast ice sheets covered the northern part of the continent, and the climate in central California was considerably cooler than at any time since then. At that time worldwide sea levels were at least 100 meters lower than today, and the California coastline was located some 25 to 50 kilometers west of its current position (Atwater et al. 1977; Bard et al. 1996; Helley et al. 1979). At that time, the combined runoff from the Sacramento and San Joaquin rivers merged to form the California River (Howard 1979), which passed through the Carquinez Strait and into the Franciscan Valley (Axelrod 1981), now occupied by San Francisco Bay. The smaller streams and rivers draining the South Bay also joined this massive drainage as it flowed west through the Golden Gate and across the continental shelf, where it eventually emptied into the Pacific Ocean near the modern-day Farallon Islands (Atwater et al. 1977; Axelrod 1981). Thus, instead of a "bay," there was a broad inland valley that supported grassland and riparian communities.*
>
> *As the continental ice sheets began to melt some 16,000 years ago, the world's oceans rose rapidly, causing the Pacific shoreline to migrate eastward. For instance, between 13,500 and 11,000 BP, sea levels rose about 40 meters, at an astounding average rate of about 16 meters every 1,000 years (Bard et al. 1996). This dating coincides with the earliest known evidence for human occupation in the region. The sea continued to rise at an average rate of about 6.7 meters per 1,000 years between 11,000 and 9000 BP, submerging much of the continental shelf west of the project area. Over the next 2,000 years (9000-7000 BP), sea level rose about ten meters at a more modest rate of roughly five meters per 1,000 years. Thus, there was a cumulative rise in sea level of approximately 70 meters during the latest Pleistocene and early Holocene. As the waters rose, freshwater marshes began to form, and sediments carried by the California River accumulated on the floor of the Franciscan Valley marking the transition from valley to bay.*
>
> *Between 7000 and 6000 BP, there was a dramatic decrease in the rate of sea level rise worldwide (Stanley and Warne 1994). During this time, the sea inundated the Franciscan Valley at a more gradual rate of about 1.3 meters every 1,000 years, for a total of 8.0 meters over the past 6,000 years. This allowed sedimentation to keep pace with inundation, which permitted the formation of extensive tidal marsh deposits during the middle Holocene (Atwater et al. 1979). As base levels rose, the lower reaches of the stream and river channels became choked with sediments that spilled onto the surface*

of existing fans and floodplains, forming large alluvial floodplains (Helley et al. 1979). As a result, bay and marsh deposits now cover many formerly stable Holocene-age land surfaces, such as those documented in core samples from beneath the Bay (Atwater et al. 1977:Plate 1; Lee and Praszker 1969:60-63; Louderback 1951:90; Story et al. 1966; Treasher 1963:Figure 5).

Several studies confirm that many of the Late Pleistocene and Early Holocene land surfaces located around the Bay were overlain by deposits of younger alluvium that are generally less than 6,000 years old (Borchardt 1992; Gmoser et al. 1999; Helley et al. 1979; McIlroy et al., 2001; Meyer 2000; Stewart et al. 2002). Stratigraphic and radiocarbon evidence indicates that the Holocene-age alluvial deposits average two to three meters in thickness, with deposits exceeding ten meters in a few areas. These older land surfaces usually exhibit well-developed buried soils (paleosols) that represent a significant stratigraphic boundary in the region. As a result, older archaeological sites located in and around the Bay were submerged by sea level rise and/or buried by sediment deposition.

During the Late Holocene, the Bay grew in size as marshlands expanded in response to higher sea levels and the decomposition, compaction, and subsidence of intertidal deposits. These processes resulted in the formation of large tidal mudflats and peat marshes, which further promoted the deposition of sediment around the margins of the Bay. Radiocarbon dates from Palo Alto Marsh indicate that these deposits were generally formed during the past 2,000 years (Atwater et al. 1979:349). Dates of 1665 and 1520 cal BP have been obtained from layers of organic clay from marsh deposits buried at depths of 6.1 to 6.5 meters along lower Colma Creek near San Bruno (Price 1981).

Isotopic analysis of shell suggests that salinity and discharge levels of the Bay have undergone substantial fluctuations over the past 6,000 years (Ingram and DePaolo 1993; Ingram et al., 1996; Wells 1995; Wells and Goman 1994). The mass extinction of large prehistoric oyster beds that flourished in southern San Francisco Bay between 1700 and 1850 cal BP indicates that significant changes did occur (Story et al. 1966). Given the potential influence of large-scale environmental changes on the distribution and abundance of certain plant and animal communities, it is likely that prehistoric human adaptive strategies also varied over time.

More recent changes on the San Francisco Peninsula include the appearance of introduced (non-native) plant species, which generally coincides with the arrival of the Spanish and other Euro-American settlers during the 1700s and 1800s (Reidy 2001; West 1989). An intense drought during the late 1800s reduced the vegetation cover and made the landscape susceptible to erosion (Burcham 1982:171), as did many of the activities associated with historic-period settlement. Hydraulic-mining activities in the Sierra Nevada increased the amount of sediment deposited within the Bay (Gilbert 1917). Lasting evidence of these changes is found in estuarine deposits and along many stream channels where the lowest terraces are often composed of historic-age sediments (Knudsen et al. 2000; Mudie and Byrne 1980). Finally, thick deposits of artificial fill were placed around the margins of the Bay to reclaim the marshes and wetlands for human development (Lee and Praszker 1969; Witter et al. 2006). While some archaeological resources may have been partially or completely destroyed by urban development, others were likely buried and protected by artificial fill deposited during the historical and modern eras.

Several key points from Meyer and Rosenthal's landscape evolution are important for assessing the potential for buried archaeological deposits in the PAL. Firstly, large-scale environmental changes played a major role in the evolution of the Bay Area landscape over the past 22,000 years. Many of these changes affected the distribution of human populations and buried and/or submerged large segments of the landscape that were once available for human use and occupation. Thus, the relatively incomplete nature of the Bay Area archaeological record, with a dearth of known sites from the earliest period of occupation,

from roughly 12,000 to 5,000 years ago, may be a result of sites from this time period having been buried by sediments as the bay was formed.

4.2 Natural Setting

The PAL is located on the Marin Peninsula on the northern portion of the San Francisco Bay area. The PAL is within former marshlands at the outlet of Corte Madera Creek into the bay. The PAL ranges in elevation from less than one meter above mean sea level (amsl) at the marsh margins of the Larkspur Ferry Terminal property, to around two meters amsl across the existing terminal parking lot.

The PAL is characterized by a Mediterranean climate, with cool, wet winters, and warm, dry summers. Rainfall in the area typically occurs in December through March, and without extreme fluctuation in temperature, although summer months are dry and warmer.

San Francisco Bay, formed by rising sea levels at the end of the Pleistocene, is part of a large estuary that includes San Pablo and Suisun bays Central and the Carquinez Strait. According to Byrd and Darcangelo (2011), the estuary and surrounding dry land provided important environs for precontact inhabitants typified by estuaries, coastal marshlands, and coastal prairies. The dominant vegetation along creek edges includes yellow willow (*Salix lasiandra*), arroyo willow (*Salix lasiolepis*), broadleaf cattail (*Typha latifolia*), common tule (*Scirpus acutus*), and California bulrush (*Scirpus californicus*). Pickleweed (*Salicornia virginica*), Pacific cordgrass (*Spartina foliosa*), and salt grass (*Distichlis spicata*) are common species in coastal salt marshes. Native grasses along the coastal prairie, such as Pacific reed grass (*Calamagrostis nutkaensis*), Pacific hairgrass (*Deschampsia holciformis*), and California bentgrass (*Agrostis californica*), are mixed with introduced species from Europe (Crampton 1974).

Byrd and Darcangelo (2011) note that prior to modern development the LFT and the Main Lot of the PAL would have been tidal marsh lands, and would have contained abundant edible resources, such as fish, shellfish, and large mammals, as well as a range of plant resources. Anadromous fish were available in the creeks that drained into the San Francisco Bay. Tule elk (*Cervus elaphus nannodes*), pronghorn (*Antilocapra americana*), and grizzly bear (*Ursus chelan*), native to the area, were hunted out by the 1900s, and most of the San Francisco Bay marshlands have since been destroyed by landfill projects and construction (Byrd and Darcangelo (2011).

The PAL is located within the Coast Ranges geomorphic province of California (CGS 2002). The Coast Ranges are characterized by northwest trending mountains and valleys that are generally parallel to fault zones (e.g., the San Andreas Fault Zone). The PAL is underlain by artificial fill (asphalt on top of mostly quarried rock, gravel, sand, and silt), Holocene Bay Mud (<11,700 years ago), Pleistocene Older alluvium (2.58 million years ago to 11,700 years ago;), and Cretaceous Franciscan Complex mélange (approx. 161 to 66 million years ago) (Blake et al. 2000). The Franciscan Complex is a mix of small-to-large resistant rock masses (mainly sandstone, greenstone, chert, and serpentine) in a matrix of highly sheared to pulverized rock material.

The Main Lot is on an artificial peninsula created on top of the former marshland. Below the artificial fill, the Holocene Bay Mud is typically soft and unconsolidated silty clay, which locally contains peat and shell. The depth to bedrock varies across the site; it is typically shallower in the north and west, and deepest to the east and southeast, where ferries dock.

The Holocene Bay Mud and alluvium, Pleistocene Older alluvium, and the top surface of the mélange, are known throughout the Bay Area to contain evidence of human habitation that include shellmound sites that may contain burials and ceremonial artifacts.

4.3 Cultural Setting

4.3.1 Precontact Setting

Initial intensive archaeological investigations of the Bay Area's prehistory began primarily by Nelson (1909) between 1906 and 1908. Nelson conducted an extensive survey of the Bay Area's shellmounds or middens (culturally formed earthworks comprised of shellfish refuse deposits). Nelson mapped more than 425 shellmounds including some of the most significant archaeological sites along California's central coast. The shellmounds, consisting of shells, ash, rocks, other cultural material, as well as burials, were once numerous around the margins of San Francisco Bay. Most "Nelson Mounds" have been destroyed by modern development and there are few visible remnant mounds visible above ground. However, due to the extensive nature of some mounds the possibility remains that intact mound sub-strata may lie several meters below current sea level, and below modern development. Any such intact deposits would have a high potential to contain human burials.

In 1909 and 1910, Nelson sampled middens in Sausalito (CA-MRN-3), Greenbrae (CA-MRN-76), and San Rafael (CA-MRN-315) in the hope of finding evidence of cultural evolution (Moratto 1984:233). Based on this work, Nelson identified two cultural complexes: the older phase (Ellis Landing Facies) is characterized by cobble mortars, large projectile points, *Olivella* saucer beads, mica ornaments, and elk bone whistles; while the younger phase (Emeryville Facies) is evidenced by incised *Haliotis* ornaments, *Olivella* rectangle beads, imperforate charmstones, and shaped flat-bottom mortars. These discoveries convinced Nelson that southeast Marin County was part of the San Francisco Bay cultural region and provided him with the basis for an archaeological sequence in the North Bay area (Moratto 1984:233-234).

Much of the archaeological investigation in Marin County has been devoted to the discovery of the 1579 landing site of Sir Francis Drake. Neither historians nor archaeologists agree on where Drake landed, although he is generally considered to have landed at what is known today as Drakes Beach on the Point Reyes peninsula (Marschner 2000:165). Heizer directed intermittent surveys of the Point Reyes peninsula and Drake's Bay vicinity during 1938 and 1939 and conducted the first scientific excavations there during 1940 (Moratto 1984:234). At the Estero site (CA-MRN-232), Heizer discovered corroded iron ship's spikes and sherds of Ming Dynasty porcelain – the first sixteenth-century artifacts recognized from a Marin County archaeological site (Moratto 1984:234). In 1940 and 1941, Beardsley resumed work at CA-MRN-232 and excavated three other Point Reyes sites: Mendoza (CA-MRN-275), Cauley (CA-MRN-242), and McClure (CA-MRN-266). Based on this work, Beardsley established a precontact cultural sequence for the area (Beardsley 1954). Beardsley defined three facies in western Marin County: McClure (Middle Horizon), Mendoza (Late Horizon, Phase I), and Estero (Late Horizon, Phase II) (Beardsley 1954).

More recently, Bennyhoff and Fredrickson (1969) developed a new taxonomic model for Central California and the North Coast Ranges to replace the earlier Central California Taxonomic System (CCTS). Based on this model, the earliest occupation of North Coast Ranges is represented by the Paleo-Indian Post pattern from ca. 10,000 to 6,000 before the common era (BCE) (Fredrickson 1973, 1974, 1984).

The Lower Archaic period (6,000 – 3,000 BCE) and Middle Archaic period (3,000 – 1,000 BCE) are represented by the Borax Lake pattern. The Borax Lake pattern indicates the importance of both hunting and seed collecting and the technologies associated with these activities including wide-stem projectile points and the millingstone and mano. Concave-base points and the bowl mortars appeared during the Mendocino aspect of the Middle Archaic period.

The Upper Archaic period (1,000 BCE – CE 500), recognized as the Ellis Landing aspect of the Berkeley pattern, is marked by the replacement of millingstones with mortars and pestles and the replacement of concave-base projectile points with shouldered lanceolate and contracting stem forms.

The most recent precontact/protohistoric period, the Emergent period (CE 500 – 1850), is characterized by a proliferation of settlements, intensification of trade, the use of clamshell disc beads as money, and new levels of social and political complexity mark the Augustine pattern.

4.3.2 Ethnographic Context

The PAL is located within the aboriginal territory of the Coast Miwok (Barrett 1908; Goerke 2007; Kelly 1978; Kroeber 1925:272-278). Kroeber (1925:273) described the Coast Miwok as comprising three tribes: the Olamentko of Bodega Bay, the Lekahtewut between Petaluma and Firestone, and the Hookooeko of Marin County. The Coast Miwok spoke one of the California Penutian languages and were closely related linguistically to the nearby Lake Miwok group which included Pomo, Wappo and Wintun peoples.

Native inhabitants of the northern Bay Area were hunters and gatherers with subsistence activities focused on seasonal availability of plant resources such as acorn, nuts, seeds, greens, bulbs; and game resources such as deer, antelope, elk, smaller animals. Subsistence activities also were directed towards the procurement of sea mammals and fishing; and collecting shellfish (oysters, mussels, and abalone). The heavy reliance on marine food resources by native inhabitants of the Bay Area is marked by abundant shellmounds and middens that represent precontact period villages, now archaeological sites, reflecting the accumulation of vast amounts of shell and bones from marine mammals, fish and birds around the perimeter of the Bay. The settlement system consisted of a primary village located along a principal stream, with satellite communities or special-use sites, usually seasonally occupied, in the surrounding countryside.

Kroeber (1925) identifies two ethnographic settlements near the Project area, including *Liwanelowa* in the vicinity of the town of Sausalito and *Awani-wi* near the city of San Rafael. According to Byrd and Darcangelo (2011) the PAL appears to include lands of a Coast Miwok tribelet known as the *Huimen* who were focused in the Richardson Bay area but also occupied the Corte Madera Creek area (Kelly 1978:415; Milliken 1988). The adjacent *Aguastos tribelet (*also referred to as the *Awani-wi* and the *Tamal-Aguasto)* occupied the San Rafael Creek area to the north. According to Milliken's (2006) study of North Bay Native groups of the Mission Period, the boundary between the *Huimen* and the *Aguastos* is located along San Quentin Peninsula. Both the *Huimen* and *Aguastos* had high population densities of 8.06 per square mile and 5.09 per square mile, respectively, based on Mission records. Beyond Mission record data, very little is known of these two tribelet/multi-family political groups (Byrd and Darcangelo 2011).

Coast Miwok houses were typically conical shaped structures built of perishable wood, grass, rushes and tule around a work frame constructed from forked poles (Kroeber 1925). Coast Miwok households consisted primarily of nuclear families with approximately six to ten inhabitants (Cook and Heizer 1968:91). Other structures including sweathouses and ceremonial buildings were often present. According to Kelly (1978) Coast Miwok sweathouse were circular structures whose floors were dug up to a meter into the ground. The sweathouse construction included a large central post and a series of smaller posts set around perimeter of the pit. Sweathouses were considered the domain of men. Ceremonial buildings, often referred to as dance houses, were larger (around 4.5 meters in diameter) than sweathouses but similar in construction style. Their use was restricted to members of secret societies; male and female gathering took place in the main building, while female-only meetings took place in an adjacent, smaller structure that lacked an earth covering (Kelly 1978).

The present-day Federated Indians of Graton Rancheria are a federally recognized amalgam of three tribes that include Coast Miwok descendants. The FIGR maintain a *rancheria* near Graton and the Graton Resort and Casino in Rohnert Park in Sonoma County. They are recognized by the NAHC as having cultural and traditional ties to Marin and Sonoma Counties.

4.4 Historic Setting

4.4.1 Overview of Marin County

Marin County is a southward-facing peninsula that is bordered by Sonoma County to the north, the San Francisco Bay and San Pablo Bay to the east, San Francisco to the south, and the Pacific Ocean to the west. This geography, which is defined by water barriers and limited land access, has historically shaped the county's development patterns and reliance on ferries and regional transportation infrastructure. The first European settlement in Marin County was Mission San Rafael Archangel, established in 1817 (Kyle 1990:174). After California's statehood in 1850, Marin became one of the original 27 counties, and San Rafael was designated as the county seat (Kyle 1990:174).

Early industries such as agriculture, logging, and viticulture were important to the county's development. New settlers established numerous dairy farmers and the towns of Tomales, Olema and Nicasio were the center of early trading for goods produced on the dairy farms. By 1862, Marin County provided one quarter of California's butter. Potatoes, grains, oysters, clams, and mussels were also shipped from Marin County's coastal towns to San Francisco (Bowen 2014:5), emphasizing the county's early economic ties to regional markets across the Bay.

Transportation improvements in the 1870s, which included introduction of trains, steamships, and ferries, significantly expanded those connections. Ferry slips built in Sausalito and Tiburon linked Marin County with San Francisco, improving access to markets and facilitating the movement of people and goods. These ferry services also brought visitors to Marin County's rural areas and thereby made tourism another thriving industry for Marin County (Bowen 2014:5). Waterborne transportation thus became a vital component of Marin County's regional identity and economic vitality.

Marin County would continue to grow and thrive into the 20th century. Like many northern California counties, the county was greatly impacted by World War II. Wartime industry came to Marin County in the form of airfields and shipyards, which brought thousands of workers. Many of those who relocated during the war remained after its conclusion, accelerating suburban growth and increasing daily travel between Marin County and San Francisco (Bowen 2014:5). In the postwar period, rising automobile use and commuter demand placed increasing pressure on regional transportation systems, shaping later investments in bridges, highways, and renewed ferry service. Today, Marin County continues to thrive and has a population of more than 250,000 (U.S. Census Bureau 2021b).

4.4.2 City of Larkspur

In 1887, the American Land and Trust Company laid out the townsite of Larkspur (LHPB 2008). Lot sizes ranged from 50 by 100 feet to 100 by 250 feet, with prices between $125 and $300 (*The Daily Examiner* 1888: 6). The town's location along Corte Madera Creek and near San Francisco Bay made it well suited to transportation-related development, and by the early 1900s its downtown area included two hotels, bakeries, a blacksmith, a livery stable, meat and grocery stores, and a lumberyard. These services supported local residents as well as travelers and commuters.

Larkspur incorporated as a city in 1908, and its city hall was dedicated on July 4 of that year (LHPB 2008: 9-10). During the early decades of the 20th century, residential subdivisions were platted and streets, roads, and infrastructure were expanded, as the city's started to transform into both residential community and a transportation node linked to rail and ferry service. Schools, libraries, houses of worship, fire stations, and parks were well established by the mid-20th century.

Following World War II, Larkspur experienced a housing boom, with new subdivisions and multi-family housing constructed to accommodate a growing population. The city's 1965 General Plan designated most land within city boundaries for residential and commercial development. In the 1970s, revisions to the General Plan were made for the preservation of open space and ridgelines, signaling shifting planning priorities. In 1978, the City Council adopted its Heritage Preservation Ordinance and established the Heritage Preservation Board to focus on preserving Larkspur's history, culture, and heritage (LHPB 2008:248, 250, 346). Today, Larkspur has a population of more than 12,000 (U.S. Census Bureau 2021a).

4.4.3 Transportation Context: Golden Gate Bridge, Highway and Transportation District

The Golden Gate Bridge, Highway and Transportation District is a special district of the State of California created to plan, build, operate, and maintain the Golden Gate Bridge and related transportation facilities. Today, the District operates and maintains the Golden Gate Bridge as well as two integrated public transit systems, Golden Gate Transit and Golden Gate Ferry, that connect Marin, Sonoma, San Francisco, and Contra Costa counties. Acting under authority granted by California state law, the District's mission is to provide safe and reliable bridge operations while delivering transportation services within the US 101 Golden Gate Corridor (District 2021a). The District's expanding role in regional transportation planning directly shaped the development of ferry terminals in Marin County, including the LFT.

4.4.3.1 Formation and Early History of the District

The Golden Gate Bridge, Highway and Transportation District was formed in response to long-standing regional transportation challenges associated with crossing the Golden Gate Strait, the narrow channel separating San Francisco County to the south from Marin County to the north. In the early 1920s, San Francisco City Engineer Michael O'Shaughnessy, mayoral secretary Edward Rainey, and engineer Joseph B. Strauss proposed the creation of a special district of the State of California to plan, finance, design, and construct a bridge across the strait. They argued that a regional governing institution was necessary to ensure that all affected counties were represented in the decision-making processes and share financial responsibility among the counties that would benefit from the Project (District 2021a).

In January 1923, a meeting convened by Sonoma County banker Franklin P. Doyle resulted in the formation of the Bridging the Golden Gate Association, which actively promoted the bridge concept and pursued to enable legislation for its construction. Working with Assemblyman Frank L. Coombs and Marin County attorney George H. Harlan, legislation authorizing the creation of a Bridge and Highway District was signed into law in May 1923. Under the legislation, counties could elect to join the district by petition and approval of their boards of supervisors (District 2021a).

Although the bridge itself would span only between San Francisco and Marin counties, the proposed district was envisioned as a broader regional entity. Between 1925 and 1928, San Francisco, Marin, Sonoma, Del Norte, and portions of Napa and Mendocino counties voted to join the proposed district. Its formation faced opposition, particularly from established ferry operators, who viewed the bridge as a direct threat to their businesses. Additional resistance came from groups concerned about financial risk, taxation, and the potential environmental impacts of increased growth and tourism. Legal challenges

delayed implementation. In December 1928, the Golden Gate Bridge and Highway District was formally and legally established as the sole entity responsible for the bridge's design, construction, and financing (District 2021a).

The District's Board of Directors convened for the first time in January 1929 and appointed key personnel, which included Joseph B. Strauss as Chief Engineer. Following receipt of a construction permit from the U.S. War Department in 1930, construction started, and the Golden Gate Bridge opened to traffic in May 1937. The Project was financed through bond sales secured by toll revenues and backed by property within the member counties. Final bond payments were made in 1971, leaving the District with substantial financial reserves that later allowed for the expanded transportation responsibilities (Kowleski 1979: 6; District 2021a).

Originally established to operate the bridge as a highway facility, the District's role expanded significantly as vehicle traffic increased in the following decades. By the late 1960s, rapid population growth in Marin and Sonoma counties and rising commute traffic brought the bridge to its theoretical capacity during peak periods, particularly along the US 101 corridor connecting Marin County to San Francisco. These conditions prompted the state lawmakers to expand the District's purpose and authority (Kowleski 1979: 10).

4.4.3.2 Revival of Ferry Service: Golden Gate Ferry System

Following the opening of the Golden Gate Bridge in 1937, ferry service between Marin County and San Francisco rapidly declined and was discontinued entirely by 1941. This left the bridge as the sole direct transportation link between the North Bay and San Francisco for nearly three decades (District 2021a; Kowleski 1979: 7). As congestion intensified along the Golden Gate Corridor in the postwar period, revived ferry service emerged as an alternative to the continued reliance on the private automobile (Kowleski 1979: 9).

During the time that traffic congestion on the Golden Gate Bridge was becoming a serious problem, the bridge's original construction debt was about to be paid off, which allowed the District to have the financial flexibility and the motivation to reconsider other options to handle the transportation across the strait. A series of studies explored options including increasing bridge capacity, constructing new bridges or tunnels, expanding bus service, and reviving ferry operations. Among these options, a modern commuter ferry system emerged as a comparatively low-cost, flexible, and environmentally constrained solution. In July 1969, the Feasibility Study of a San Francisco-Marin Ferry System, prepared by Arthur D. Little, Inc., concluded that a modern commuter ferry system could divert up to 5,800 commuters per weekday from automobile travel and remove as many as 2,900 vehicles per day from the Golden Gate Bridge during its first year of operation (Little 1969: 17; Kowleski 1979: 7).

Based on these findings, the California State Legislature formally authorized the Golden Gate Bridge and Highway District to plan and implement a mass transportation program within the US101 Golden Gate Corridor, including ferry operations. At that time, the word "Transportation" was added to the District's name to reflect its expanded mandate. Although the District lacked authority to levy taxes, surplus bridge toll revenue could be used to support intercounty transit services, supplemented by state and federal funding (District 2021a.; Kowleski 1979: 9).

The District formally entered the transit business in August,1970, with the inauguration of Golden Gate Ferry service between Sausalito and San Francisco. During the same period, limited bus service began operating to and from the Sausalito ferry terminal, establishing an integrated bus and ferry system. In December 1971, state legislation further required the District to undertake long range transportation planning for the corridor. Following extensive public outreach, including 21 public hearings across six

counties, the unified system of buses and ferries, known as Golden Gate Transit and Golden Gate Ferry, was confirmed as the preferred regional transit solution (District 2021a.; Kowleski 1979: 9).

As ferry ridership increased, the District expanded service beyond southern Marin County. After extensive study, Larkspur was selected as the principal northern Marin terminal due to its central location, proximity to US 101, and ability to serve commuters from both central and northern Marin County. In 1972, the District purchased a 25-acre waterfront site in Larkspur for approximately $1.25 million. The approximately 11 nautical mile crossing between Larkspur and San Francisco allowed ferry travel times to remain competitive with peak period automobile travel, making the route preferable for daily commuters (Little 1969; Kowleski 1979: 10). Williams & Burrows, Inc. was awarded the building contract.

Construction of the Larkspur Ferry Terminal was authorized in 1974. With the completion and dedication of the LFT in 1976, the ferry service expanded to include the Larkspur route in December 1976. The opening of the terminal marked a significant milestone in the development of a permanent ferry system for the North Bay (District 2021b). Since its establishment, Golden Gate Ferry service became an integral component of the District's transportation network, providing a reliable alternative to automobile commuting between Marin County and San Francisco. The Larkspur route, in particular, has continued to serve as a major hub within the system, carrying more than one million passengers annually (District 2021c).

The terminal was completed and dedicated in 1976, coinciding with the placement into service of the G.T. Marin, the first purpose-built vessel for the route. Ferry operations expanded quickly with the addition of the G.T. Sonoma in March 1977, followed later that year by the G.T. San Francisco (District 2021b). The opening of the Larkspur route represented a significant milestone in the development of a permanent, integrated ferry system serving the North Bay.

Since its establishment, the Larkspur Ferry has remained a central component of the District's ferry operations. The route continues to provide an important alternative to automobile commuting between Marin County and San Francisco, carrying more than one million passengers annually as recently as 2020 (District 2021c).

4.4.4 Larkspur Ferry Terminal

4.4.4.1 History of the Ferry Terminal Site

The approximately 11-acre property on the San Quentin Peninsula was marshland prior to 1924, when Hutchinson's Rock Quarry began operations immediately to the north. The marshland was filled with waste gravel from the quarry between 1924 and the early 1970s when the quarry was abandoned (Tait and Lawson 1973). The Ferry Terminal is the first development to occupy the property on the south side of Sir Francis Drake Boulevard, which includes the Main Lot. Approximately six feet of additional fill was placed atop the quarry waste during construction of the Ferry Terminal. The North Lot, on the north side of Sir Francis Drake Boulevard, occupies a small portion of the former quarry, while housing and a shopping center occupy the main quarry area. The approach channel to the Ferry Terminal, within waters of the Bay, was widened and deepened to accommodate ferry maneuvers during construction of the terminal. This involved dredging approximately 1,500,000 cubic yards of Bay sediments (Tait and Lawson 1973).

4.4.4.2 Planning of Larkspur Ferry Terminal

Early planning for the Larkspur Ferry Terminal began as the District evaluated locations to serve growing commuter demand in central and northern Marin County. In a preliminary report presented to the District's directors, consultant Philip F. Spaulding advised that three to four conventional ferryboats with

planing hulls would be required to provide peak-period service to Marin County, with departures at approximately 30-minute intervals. Spaulding identified potential terminal locations at both Corte Madera and Larkspur, noting that either site would require extensive dredging and significant site preparation in order to accommodate ferry operations (*Daily Independent Journal* 1970: 7).

In 1971, the District agreed to purchase a waterfront site in Larkspur for development of a ferry terminal, contingent on approval of federal funding. The site, located at the edge of San Francisco Bay, encompassed approximately 25.4 acres. During the same period, the District also approved the purchase of a separate 10-acre parcel near the intersection of US 101 and State Route 17 for a bus maintenance facility, planning for an integrated ferry and bus transit system in the future (*San Francisco Chronicle* 1971: 7).

The Larkspur ferry terminal site was formally acquired in April 1972 from T. I. Properties. That year, the District announced plans to invest in an expanded ferry program, including construction of three new ferry vessels, one intended to expand Sausalito service and two designated to serve to the proposed Larkspur terminal (*San Francisco Chronicle* 1972a: 4). In support of terminal development, the District selected the architectural firm of Braccia, Debrer, and Heglund to prepare a master plan for the Larkspur facility (*San Francisco Chronicle* 1972b: 5).

By early 1973, the District formally authorized the architects to proceed with final design. Initial plans envisioned completion of the terminal by June 1974, with estimated costs of approximately $4.7 million, inclusive of the site acquisition. The proposed design included a passenger terminal, repair and maintenance facilities, and limited commercial uses. Environmental considerations played a significant role in the planning process, and the design was changed to preserve adjacent pickleweed marshlands as wildlife habitat, addressing concerns raised by environmental advocacy groups (*San Francisco Chronicle* 1973a: 49).

Despite these measures, opposition and regulatory challenges continued. By May 1973 there were indications that permitting challenges could delay the Project (*Daily Independent Journal* 1973: 10). Additional concerns focused on the impacts of dredging at the mouth of Corte Madera Creek, including disposal of dredged materials and the presence of potentially toxic metals in bay mud (*San Francisco Chronicle* 1973b: 55). During this period, revised cost estimates climbed sharply, reaching approximately $10.4 million, more than double earlier projections. This revised number was exclusive of additional costs for dredging, redesign, and consulting services (*San Francisco Chronicle* 1973c: 5; *The Times Herald* 1973: 6).

In February 1974, the Bay Conservation and Development Commission approved the terminal project, subject to stringent environmental conditions. These included requirements for marshland restoration using dredged bay mud, construction of a public waterfront viewing area, and incorporation of a bikeway along the site (*San Francisco Chronicle* 1974: 5). State Lands Commission approval for dredging was issued in June 1974, followed by final authorization from the U.S. Army Corps of Engineers in October 1974, clearing the project for construction (*Daily Independent Journal* 1974a: 6, 1974b: 15; District 2021b). Williams & Burrows of Belmont began construction in mid-January 1975 after the District awarded the firm the contract for terminal construction and dredging operations (*Daily Independent Journal* 1975a: 1).

4.4.4.3 Design and Designers

The Larkspur Ferry Terminal was designed as a highly visible and architecturally expressive transportation facility intended to serve as the primary Marin County terminal for Golden Gate Ferry operations. Initial passenger amenities included an approximately 18,000-square-foot open-air terminal structure and a

parking facility accommodating approximately 1,000 vehicles. The terminal was designed by the San Francisco-based architectural firm Braccia, DeBrer and Heglund under the leadership of architect Jacques de Brer, with landscape architecture by Royston, Hanamoto, Beck & Abey (District 2026; Naim 1979: 122).

Jacques de Brer was born in Brussels and raised in Santiago, Chile; he relocated to Los Angeles as a teenager. He earned a bachelor's degree from the University of Southern California and a master's degree in architecture from the University of California, Berkeley, where he later served as a lecturer in the College of Environmental Design until the early 1990s. After winning first place in the Santa Rosa Civic Center design competition, de Brer established a private architectural practice in San Francisco. His work received numerous professional recognitions, including an American Institute of Architects award for his design of the LFT and an honorable mention for the Vietnam Veterans Memorial competition in Washington, DC. In addition to projects in the United States, de Brer completed community-oriented design work in Guatemala and Eritrea. He remained active in architectural practice and education until his death in 2006 (San Francisco Chronicle 2006; SFGATE.com 2006).

The LFT building is constructed in the Late Modernist style and is specifically associated with High Tech Structuralism, which is a design approach that emerged in the 1970s. This style emphasizes the clear expression of structural systems, modern materials, and construction technology as visible elements of the design. This style is influenced by architects such as Norman Foster and Richard Rogers in Great Britain, as well as Renzo Piano and Santiago Calatrava internationally. High Tech Structuralism treats structure and engineering elements such as space frames, tensile roofs, and cable structures as defining architectural features. Simmons notes that in the San Francisco Bay Area, examples of this style are not very common and therefore architects adapt elements of structural expression to create visually dynamic Late Modernist buildings that use exposed structural systems as a primary design feature (Simonson 2024: 84).

The dominant architectural feature of the Larkspur Ferry Terminal is its triangular steel space frame roof, which provides a covered but unenclosed passenger waiting and circulation area. The space frame forms an equilateral triangle measuring approximately 192 feet on each side at the roofline and is supported by three inverted pyramidal legs above an open terminal deck. The triangular geometry is repeated throughout the truss system, with horizontal members forming smaller equilateral triangles across multiple levels (Kowleski 1979: 13-14; Naim 1979: 122). Passenger circulation was a key design consideration. Ticketing and entry points are located adjacent to parking areas, bus stops, and passenger drop-off zones. Once inside the terminal, passengers are guided toward boarding areas through changes in elevation and the configuration of structural elements. Disembarking passengers use perimeter ramps that return them to parking area (Naim 1979: 122).

The terminal structure is supported by a pile-supported, cast-in-place concrete deck designed to address the site's geotechnical conditions, which include soft bay mud and marshland soils. This foundation system was intended to provide rigidity and seismic stability while extending the terminal structure over the water. The triangular configuration of the space frame allows for three ferry berths and associated maintenance space within the narrow navigation channel (Naim 1979: 122). Support facilities, which include service buildings, fuel storage, and parking, occupy the remainder of the approximately 25-acre site extending into Corte Madera Creek (Kowleski 1979: 13-14).

Landscape architecture for the terminal and surrounding site was designed by Royston, Hanamoto, Beck & Abey, a well-known San Francisco-based firm known for integrating large-scale infrastructure projects with environmental and community-oriented design. The firm was established in 1960, and it played a significant role in shaping postwar landscape architecture in California, completing parks, institutional campuses, transit facilities, and large-scale planning projects throughout the Bay Area. At Larkspur Ferry

Terminal, the landscape design addressed circulation, parking, and environmental restoration (The Cultural Landscape Foundation 2026).

The LFT has undergone several alterations since its construction. These include:

- Expansion of ferry berths from the original three berths to four berths in the 1990s (District 2021b).
- Removal of landscape planters between approximately 1987 and 1993 (NETR 2026).
- Reconfiguration of the existing parking lot to accommodate additional vehicles circa 1995 and 2008 (District 2021b).
- Improvement of bicycle access to the terminal and replacement of existing bicycle racks with new ones in 2008 (District 2021b).
- Addition of parking areas north and northwest of the original parking lot circa 2008, including installation of concrete walkways, curbs, and ADA-compliant ramps.
- Repavement of parking areas circa 2013.
- Addition of a covered passenger waiting area within the existing space-frame structure in March 2026 (District 2021b)
- Minor adjustments to passenger circulation and operational features to support evolving ferry service needs.
- Minor site and landscape modifications associated with environmental management and maintenance requirements.
- Accessibility improvements, with the facility designed to be wheelchair accessible (District 2021b).

4.4.4.4 Construction and Operation

Construction of the LFT began in mid-January 1975. Early in the construction phase, future commuter access to the site was identified as a significant problem. Local roads serving the terminal area had been designed for much lighter traffic volumes, originally accommodating horse-and-buggy circulation. The District implemented short-term traffic control measures, including roadway improvements and installation of four-way stops, while addressing longer-term access solutions (*Daily Independent Journal* 1975b: 6).

By January 1976, construction was reported to be approximately 80 percent complete. At that time, the project was approximately 35 months behind schedule and approximately $9 million over the original cost estimate. Cost increases were due to higher-than-anticipated expenses related to the construction of the marine infrastructure (*San Francisco Examiner* 1976a: 3). Construction of Berth 1 was identified as a significant cost factor, as it proved more expensive than originally projected (*Daily Independent Journal* 1976a: 1).

Delays continued into early 1976. In February, the Marin County Grand Jury ruled that the terminal should not open until adequate ingress and egress improvements were completed. Although an opening had been projected for June 1976, the ruling effectively halted commencement of service until roadway issues were resolved (*Daily Independent Journal* 1976b: 16). During this period, reporting highlighted the widening gap between original system-wide estimates and actual expenditures. Plans released in 1970 had projected that seven ferries and four terminals could be constructed for approximately $16.4 million. By 1976, costs exceeded $38 million, while the system had been reduced to three terminals and three ferries (*Daily Independent Journal* 1976c: 1).

The terminal building itself was substantially complete by July 1976, however, the start of service was further delayed by the unavailability of ferry vessels (*San Francisco Examiner* 1976b: 1). The Larkspur Ferry Terminal was ultimately dedicated on Saturday, December 11, 1976. Opening ceremonies included representatives from the District, Marin County, and the City of Larkspur, as well as an inaugural sailing. To encourage ridership, free transportation was offered to passengers using feeder bus services during the initial commute period (*The Press Democrat* 1976: 3; District 2021b).

Regular commute service on the Larkspur route began on December 13, 1976. The first Spaulding-class vessel, the G.T. Marin, entered service at opening, followed by the G.T. Sonoma in March 1977 and the G.T. San Francisco in September 1977. With the delivery of the third vessel, ferry operations typically utilized two vessels in daily service, with one maintained as a backup (District 2021b).

Over time, the LFT became an important component of regional transportation, particularly during periods of disruption. In January 1982, severe storms and resulting mudslides closed US 101 for multiple days. During this time ferry use surged to record levels, exceeding 12,000 passengers in a single day. Additional vessels were temporarily chartered to meet the demand. The following years saw operational growth, increased service frequency, infrastructure additions such as the pedestrian overpass connecting the terminal to LFT in 1982 and expanded passenger amenities (District 2021b).

By the late 20th and early 21st centuries, ferry operations at Larkspur had evolved to incorporate high-speed vessels, service reconfigurations, and ongoing improvements to parking, access, and passenger facilities. These changes reflected the terminal's continued role as a major Marin County transportation hub and its adaptability to changing commuter needs (District 2021b).

5. Cultural Resources Inventory

Background research, including a records search, Native American consultation, geoarchaeological testing, and a pedestrian survey were conducted to identify cultural resources that may be affected by the Project.

5.1 Cultural Resources Identification Methods and Results

5.1.1 Background Research

On February 16, 2021, Jacobs architectural historian Mark Bowen requested a records search at the California Historical Resources Information System Northwest Information Center (NWIC). The record search was completed on February 26, 2021, and included the PAL and a 1/8-mile radius study area. The records search was updated on April 4th, 2026, and the records search area was extended to a 0.5-mile radius.

In addition to a search of the NWIC's database of cultural resources and cultural resources investigations, the following sources of information were consulted as part of the records search:

- National Register of Historic Places–Listed Properties
- California Register of Historical Resources–Listed Properties
- California Inventory of Historical Resources, 1976 and updates
- California State Historical Landmarks, 1996 and updates
- California Points of Historical Interest, 1992 and updates
- The State Office of Historic Preservation's Directory of Properties–Historical Resources Inventory, 4-02-2026
- Archaeological Determinations of Eligibility, 4-02-2026
- California Historical Landmarks, State of California, 1996 and updates
- Directory of Properties in the Historic Resources Inventory, State of California, 4-02-2026
- Historic Spots in California, Hoover and Kyle 1990
- Built Environment Resource Directory (BERD) 2-2-2026

The City of Larkspur Historic Resources Inventory was consulted as part of this background research. No resources were identified within the PAL (City of Larkspur 2026b).

5.1.2 Record Search Results

The records search results from 2026 subsume those from 2021, and the following discussion presents the most recent information available. The relative intensity of coverage of the PAL and 0.5-mile records search study area by previous studies that have included pedestrian survey, as well as their relative age, provides a context for assessing the nature and number of recorded cultural resources.

5.1.2.1 Previous Investigations of the PAL and 0.5-Mile-Radius Records Search Study Area

The records search identified 7 previous cultural resources investigations that have covered all or some portion of the PAL. Another 31 investigations have been conducted within the larger 0.5-mile records search study area radius. Table 1 presents the previous investigations.

Table 1. Previous Investigations in the PAL and 0.5-Mile Study Area

Report Number	Report Year	Report Title	Report Author(s)
Within the PAL			
S-013070	1975	Archaeological Report for Green Brae Brickyard, 125 East Sir Francis Drake Boulevard, Larkspur, California	Madrone Associates
S-016949	1991	A Cultural Resources Evaluation of a Proposed Reclaimed Water Pipeline in the San Quentin Point, Corte Madera, Larkspur, Kentfield and San Rafael Areas	Roop, William
S-040318(a)	2010	Archaeological Survey Report for the Central Marin Ferry Connection Project, Larkspur, Marin County, California, Federal Program #CML 6406 (010), 04-Mrn-101, PM 8.5-8.9	Byrd, Brian F, Michael Darcangelo et al.
S-040318(b)	2011	Historic Property Survey Report, 04 MRN Regional Measure 2 CML 6406 (010) Larkspur 00-000201-09 1	Webb, Toni
S-040319	2011	Archaeological Survey Report for the Central Marin Ferry Connection Project, Larkspur, Marin County, CA, Federal Program #CML 6406 (010), 04- Mrn-101, Pm 8.5-8.9	Byrd, Brian F. and Michael Darcangelo
S-044351	2014	Archaeological Survey Report for the Proposed Freeway Performance Initiative Project, Marin County, California, 04-MRN-101, PM 0.0/27.6, 04-MRN-580, PM 2.4/4.5, EA 151600	Darko, Emily
S-048525	2014	Historic Architectural Survey Report for the SMART Rail Corridor, San Rafael to Larkspur Project, Marin County, California	Bowen, Madeline
Within 0.5 Mile of the PAL			
S-001165	1978	Pipeline and Water Treatment Plant Facilities, Marin County	Desgrandchamp, Cindy and Mathew Clark
S-002076	1980	Final Report – Archaeological Evaluation of the Former Remillard Brick Kiln (CA-Mrn_255), Larkspur	Roop, William and Steven O'Brien
S-002301	1980	Archaeological Resources of point San Quentin	Archeo-Tec, Inc.
S-006424	1984	Archaeological Resources Evaluation for the Central Marin Sanitation Wastewater Transportation Facilities Improvement Project – Phase II, Marin County, California (EP Project No. C-06-2467-21)	Desgrandchamp, Cindy and David Chavez

Report Number	Report Year	Report Title	Report Author(s)
S-009907	1988	Archaeological Survey of Landmark Plaza (former Victoria Station Restaurant), 17 E. Sir Francis Drake Blvd., Larkspur, California	Saltzman, Teresa Miller
S-010760	1989	Historic Properties Survey Report for Construction of High Occupancy Vehicle Lanes on Route 101 from Lucky Drive to San Pedro Road and Modifications of Routes 101/580 Interchange, in Cities of San Rafael and Larkspur, Marin County, 4-MRN-101, P.M. 8.4/12.7 04232-115750	Jones, Terry, Robert Gross, and Denise O'Connor
S-012242	1976	A Reconnaissance of the Wood Island Archaeological Site	Jackson, Thomas L.
S-012801	1991	Cultural Resources Technical Report, Municipal Water District Water Supply Project	Medin, Anmarie
S-012945	1957	The Examination of Indian Shell Mounds Within San Francisco Bay with Reference to the Possible 1579 Landfall of Sir Francis Drake	Treganza, Adan E.
S-013217	1990	An Archaeological Survey for the AT&T Fiber Optics Cable, San Francisco to Point Arena, California	Origer, Thomas M.
S-014868	1993	A Cultural Resources Evaluation of the Sir Francis Drake Boulevard Repaving and Drainage Improvement Project, Marin County, California	Roop, William
S-015337	1993	Archaeological Monitoring of Soil Boring at Remillard Brick Kiln/Restaurant	Bryne, Stephen
S-017570	1976	An archaeological reconnaissance of the proposed additions for the Ross Valley Sewage Treatment Plant on Sir Francis Drake Boulevard	Dietz, Stephen A.
S-023626	2000	Archaeological Investigations at CA-MRN-225/H, Larkspur, Marin County, California	Bieling, David G., Randall L. Dean, et. al.
S-023745	2001	Archaeological Survey for Lucky Drive Levee Project, Marin County, California	Holson, John
S-025255	2000	Archaeological Field Inspection of the Proposed Development of Lot 41, San Quentin Point, Larkspur, Marin County, California	Holman, Miley Paul
S-026317	1985	An Evaluation of Archaeological Resources Within the Ross Valley Sanitary District Parcel, 2000 Larkspur Landing Circle, Larkspur, California	Roop, William
S-026330	2002	A Cultural Resources Evaluation of 135 East Sir Francis Drake Boulevard, Larkspur, Marin County, California (APN 018-171-05)	Pesnichak, Lisa

Report Number	Report Year	Report Title	Report Author(s)
S-026993	1989	Final Report: Monitoring of Construction Activities For the Reuse of the Former Remillard Brick Kiln, Larkspur Landing, City of Larkspur, California	Roop, William
S-031737	2004	Archaeological Resources Technical Report for the Sonoma-Marin Area Rail Transit (SMART) Project, Sonoma and Marin Counties, California	Denardo, Carole and Daniel Hart
S-033646	2007	Transportation Authority of Marin, Highway 101 Greenbrae Corridor, Cultural Resources Feasibility Study	Byrd, Brian F.
S-037429	2010	A Cultural Resources Evaluation of the Marin Sanitary Service Parcel, Jacoby Street, San Rafael, Marin County, California	Roop, William
S-037740	2010	San Quentin Area Bike and Pedestrian Access Cultural and Paleontological Resources Constraints Study, near San Quentin State Prison, Marin County, California (LSA #ALT0903)	Fuerstenberg, Theadora
S-038998	2011	Extended Phase 1, Geoarchaeological Explorations for the US 101/Route 580 Twin Cities Greenbrae Corridor Improvement Project, Larkspur and Corte Madera, Cal trans District 04, Marin County, California	Kaijankoski, Phillip and Jack Meyer
S-038999	2011	Archaeological Survey Report for the U.S. 101/Route 580 Twin Cities Greenbrae Corridor Improvement Project, Larkspur and Corte Madera, Marin County, California, 04-Mrn-101-PM 7.2/8.9, EA 1A660-0	Byrd, Brian
S-039344	2008	Limited Cultural Resources Evaluation for the Ross Valley Sanitation District Kentfield Forcemain Rehabilitation Project, Located in the City of Kentfield, Marin County, California	Pastron, Allen G.
S-043710	2013	Cultural Resources Study, Phase II Greenbrae Pipeline Replacement Project	Peabody, Joshua
S-044053	2013	Cultural Resources Constraints Report: HPR 2000 Redwood Hwy, Larkspur	Cox, Beatrice and Esme Hammerle
S-050060	2016	Phase I Cultural Resources Evaluation for the Pump Stations 12 and 13 Rehabilitation Project, located in Larkspur, Marin County, California	Archeo-Tec, Inc.
S-052655	2017	Final Initial Study/Mitigated Negative Declaration, Larkspur Landing Remediation Project, 2000 Larkspur Landing Circle, Larkspur, CA	Norby, Greg
S-054359	1973	Historical and Archaeological Survey of the Proposed Larkspur Ferry Terminal, Larkspur, California	Goerke, Elizabeth B.

5.1.2.2 Previously Recorded Cultural Resources within the PAL and 0.5-Mile Records Search Study Area

Resources within the PAL

The records search identified no previously recorded archaeological or built environment resources in the PAL.

Previously Recorded Resources within 0.5 Mile of the PAL

Eight previously recorded cultural resources are within the 0.5-mile records search study area surrounding the PAL and five of these are archaeological resources (Table 2). Of the four precontact era archaeological resources, two are within 80 and 600 feet of the PAL, respectively. Site records for these two sites are presented in Appendix B. One of these, informally called Wood Island, was noted as a heavily disturbed midden across a natural drainage from the PAL (Jackson 1976). Although an accurate map was not provided for the deposit at the time of discovery, based on the report description, the approximate location is roughly 80 feet from the western edge of the PAL. The disturbed midden (habitation debris) with flaked stone, estimated to be no more than 2 inches deep, sits on a knob of bedrock at an elevation of 52 feet above mean sea level overlooking the Bay and the former marshland of the PAL.

The second nearby precontact era site lies across the channel from the Ferry Terminal approximately 600 feet to the east of the PAL. The site, P-21-000541/CA-MAR-255, was once a substantial shellmound that had been leveled to accommodate the Green Brae Brickyard and Remillard Brick Kiln in the late 1800s (Treganza 1955; Lee 1978; Roop and O'Brien 1980). Archaeological testing identified evidence of a Coast Miwok habitation site including disturbed midden with fire-affected rock; flaked stone tools and debris; animal bone from fish, birds and deer too fragmentary to identify further; worked bone tools; fragmentary groundstone implements; Olivella shell beads; and fragmentary shaped mica (Roop and O'Brien 1980). Shellfish included mussel, clam and oyster. The lower part of the shellmidden was discovered extending below the level of the water table, suggesting the initial occupation of the site occurred earlier in the development of the Bay. Due to the disturbance that resulted in massive removal of materials, and mixing of those that remained together with very few diagnostic artifacts, the chronology of the site is not well established.

Based on the testimony and sketch map of the Green Brae Brick Yard created by John Tacchi, who was born at the brickyard, the Ferry Terminal of the PAL was marshland in the late 1800s and at a lower elevation than the habitation site CA-MAR-255 across the channel. The 1975 drawing by John Tacchi is provided in the 1978 National Register Nomination for the Green Brae Brick Yard Remillard Brick Kiln (Lee 1978) (refer to Appendix B).

There are two remaining built environment resources within 0.5 mile of the PAL: P-21-001157 (Superintendent's House for the Remillard Brick Kiln) and P-21-002831 (Greenbrae Boardwalk). These resources are not within the PAL and will not be discussed further. The Northwestern Railroad has largely been replaced by the SMART transit system.

Table 2. Previously Recorded Cultural Resources in the 0.5-Mile Study Area

Primary #	Name/Description	Resource Type	Comments
Informal Resource	Wood Island Coast Miwok habitation debris and lithic scatter	Precontact Archaeological Site	Not in PAL, approximately 80 feet west
P-21-000108	Nelson No. 78, CA-MRN-78, Coast Miwok habitation first mapped by Nelson (Nelson 1909)	Precontact Archaeological Site	Not in PAL, approximately 1,800 feet northwest
P-21-000458	CA-MRN-525, Coast Miwok habitation site with lithic scatter on top of the San Quentin Peninsula	Precontact Archaeological Site	Not in PAL, approximately 2,270 feet to the east
P-21-000541	Coast Miwok habitation site CA-MRN-255 beneath Green Brae brick yard and kiln	Precontact Archaeological Site	Not in PAL, approximately 600 feet east
P-21-001157	Superintendent's House (for Remillard Brick Kiln)	Historic Building	Not in PAL
P-21-001158	Green Brae Brick Yard; Green Brae Brick Kiln	Historic Archaeological Site and Structure	Not in PAL
P-21-002618	Northwestern Pacific Railroad	Historic Linear Resource	Not in PAL
P-21-002831	Greenbrae Boardwalk	Historic Structure	Not in PAL

5.2 Field Survey

5.2.1 Archaeological Field Survey

Jacobs archaeological staff conducted a pedestrian survey of the PAL and nearby areas on June 4, 2021. The PAL is located within and surrounded on three sides by areas that have been developed for use by the Ferry Terminal or other commercial/transportation use. The majority of the PAL consists of the 10.41 acres of surface-level parking in the Main Lot and the approximately 1.64-acre surface-level parking in the North Lot. These areas are paved, with the exception of some planter areas along the perimeter of the Main Lot and some landscaped trees arranged at the Sir Frances Drake Boulevard entry/exit. Jacobs staff established that the PAL contains no exposed native soil, making the survey unproductive. However, adjacent margins of the bay and the reported location of Wood Island on the nob west of the PAL were inspected. Visibility was poor due to thick vegetation dominated by poison oak, and the hillside has suffered erosion, possibly removing a portion of the site. No evidence of the reported flaked stone or midden were observed.

5.2.2 Built Environment Field Survey

A Jacobs architectural historian conducted a pedestrian survey of the built environment within the PAL on June 4, 2021. The architectural historian took digital photographs and prepared a formal description and evaluation of the LFT. Included within the LFT survey are the prominent Shelter Building, the Service Building, loading platforms, maintenance facilities buildings, and the parking areas. The Department of

Parks and Recreation 523 form for the LFT is presented in Appendix B. Appendix C contains representative photographs of the Project area from the built-environment survey.

5.3 Buried Archaeological Site Sensitivity

While archival research and the archaeological pedestrian survey did not identify archaeological resources within the PAL, San Francisco Bay margins and natural drainages are generally sensitive for buried archaeological resources. Although the area is heavily developed with roads, parking lots, and office and commercial space, subsurface archaeological deposits continue to be discovered in highly developed locations throughout the area surrounding the bay. The precontact archaeological sites on either side of the PAL, including Wood Island to the west and P-21-000541/CA-MRN-255 to the east, confirm that Coast Miwok people inhabited the immediate vicinity, leaving open the possibility that there may be more ancient occupations buried beneath the PAL by sediments deposited as the bay level rose during the early to mid-Holocene.

5.3.1 Geoarchaeological Testing

Jacobs conducted geoarchaeological testing between June 26 and 30, 2026 at six locations (four in the Main Lot and two in the North Lot) to further characterize the buried archaeological context and test for archaeological deposits (Figure 3). Testing locations were sampled using direct push coring technology, in which an approximately 2-inch hollow tube was pushed directly into the subsurface and retrieved for inspection. With this method, continuous stratigraphic cores of the sediments between ground surface and underlying bedrock. In the Main Lot they reached bedrock at depths of 60 to 65 feet and in the North Lot they extended to approximately 25 feet. The report of the investigation methods and findings is in preparation (Jacobs 2026 in preparation) and are summarized for the purposes of this inventory and evaluation report.

Previous geotechnical investigations, including those Jacobs conducted in June 2026, have sampled 20 locations across the PAL and have characterized the sequence of sediments lying beneath the Project between the ground surface (i.e., asphalt top) and Franciscan Complex bedrock. Figure 3 shows the locations of Jacobs' 2026 soil cores as well as previous geotechnical cores conducted since 1973. None of the logs of test bores reported evidence indicating buried archaeological deposits (Tait and Lawson 1973; Winzler and Kelly 1998; Stimac Associates, Inc. 2008; Jacobs 2024; Jacobs 2026 in preparation). A Jacobs archaeologist was present for the testing conducted in 2023 (Jacobs 2024) and a Jacobs geoarchaeologist conducted the testing in 2026. In general, the Main Lot sequence, from ground surface to bedrock, includes 6 feet of artificial fill, Bay Mud to approximately 45 feet below ground surface (bgs), and Alluvial soils, predominantly sandy clays, overlying the Franciscan Complex mélange bedrock encountered at around 60 feet bgs. Bay Mud includes occasional pockets of sandy and silty clay with a sparse scatter of fragmented shell and fibrous organics (marsh grasses). The North Lot sits on approximately 6 feet of fill, and 12 to 18 feet of Bay Mud above the Franciscan Complex mélange bedrock.

Subsurface testing provides a representative sample of the sediments underlying the PAL and confirms the potential for encountering buried archaeological deposits beneath the artificial fill and previously installed utilities and drainage system of the Main Lot and North Lot. Although no evidence for archaeological deposits was observed in any of the 20 cores, the cores represent a limited sample of the total volume of sediments that may be impacted by Project construction. They are sufficient to establish the near-surface and more deeply buried sediments and geology of the PAL, and the presence of Bay Mud, a cumulative deposit with the potential for buried archaeological deposits.





LEGEND

- Project Footprint (13.70 acres)
- Cultural Resources Project Area Limits (18.57 acres)
- Resources
- Soil Boring
- Pedestrian Improvements

Geology

- afbm - Artificial fill over Bay mud (Historic)
- fsr - Franciscan complex, melange

Service Layer Credits: World Topographic Map: Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, (c) OpenStreetMap contributors, and the GIS User Community
Bing Maps Hybrid: © 2026 Microsoft Corporation © Maxar ©CNES (2026) Distribution Airbus DS © Mapbox © 2026 TomTom
World Hillshade: Esri, CGIAR, USGS

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Figure 3
Buried Site Sensitivity Analysis
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

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6. Summary and Recommendations

6.1 Archaeology

No archaeological resources have been observed or recorded within the PAL. The age and depositional nature of sediments and bedrock underlying the PAL are such that the PAL has the potential for unknown buried cultural resources with the Bay Mud, which occurs between the artificial fill, and the Franciscan Complex bedrock, which is reached at variable depths across the PAL; it is generally within 15 to 20 feet of the ground surface in the North Lot and within approximately 45 to 60 feet of the ground surface in the Main Lot.

6.2 Unanticipated Discoveries

In the unlikely event that any cultural resources are encountered during construction, ground-disturbing activities in the vicinity of the discovery must be immediately halted. A professional archaeologist must evaluate the find in consultation with the California State Historic Preservation Officer, lead federal agency, and affected tribes as appropriate.

If construction activities encounter any human remains or anything that appears to possibly be human remains including cremations and burials, teeth, bone, or mortuary items, ground-disturbing activities in the vicinity of the discovery must be immediately halted and the find protected from further disturbance, unauthorized access, or other impacts to maintain integrity and respect for the remains. Federal law and regulations (Archaeological Resources Protection Act, 16 United States Code [U.S.C.] 470 and 43 CFR 7; Native American Graves Protection and Repatriation Act, 25 U.S.C. 3001 and 43 CFR 10; and Public Lands, Interior, 43 CFR § 8365.1-7) and California State law (California Health and Safety Code 7050.5) require all parties that discover human remains in California to follow a well-defined process, regardless of whether the remains are modern or archaeological.

6.3 Built Environment

The built-environment resources within the Larkspur Ferry Terminal were formally evaluated for their ability to meet the criteria for listing in both the CRHR and NRHP. This consists of the formal Ferry Terminal constructed in 1976 and all associated features and structures such as the Shelter Building, the Service Building, loading platforms, maintenance facilities buildings, and the parking areas.

6.3.1 Description

The LFT property is a public transportation terminal located in the City of Larkspur, Marin County. The terminal is set along the water side of Sir Francis Drake Boulevard near the mouth of Corde Medera Creek where it empties into the San Rafael Bay, which is part of the larger San Francisco Bay (Photograph 1; all photographs are presented in Appendix C). The land portion of the ferry terminal property is approximately 14.5 acres total and features a series of buildings, structures, parking areas, and surrounding lands for ferry operations and passenger use. Dock and boarding structures are set within the bay waters and an 83-acre basin that aligns north to south on the eastern side of the property for the landing of large passenger-only ferry boats. The surrounding area is urbanized with Larkspur Landing shopping center and numerous other commercial buildings to the north and west along with US 101. A series of residences are located to the southwest along the right bank of Corte Madera Creek.

While the great majority of the almost 15-acre property is occupied by the paved parking areas, several buildings and structures related to operations of the ferry terminal are in spaces at the southeast and southwest of the property to better access the waterfront and allow for adequate passenger vehicle parking.

Buildings located in two distinct areas of the property. The first area, at the southeast corner of the property, includes the main shelter structure and the adjacent service building. The second area is at the southwest corner of the property and features a fueling/maintenance area with fuel tanks and maintenance structures.

The **Shelter Structure** is the primary focus of the ferry terminal property visually with its large and distinct construction features and materials (Photograph 2). The general design theme of the Shelter Structure has been identified as a notable example of "High-Tech Structuralism" or "Structural Expressionism" with its "space frame," tensile roof, cable structure, and futuristic-looking technology (geometric shape thematic, exposed frame, etc.) construction for which the style became popular. The overall design of the geometric-focused shade structure consists of repeating equilateral triangles and features a triangular shaped open canopy topped with a tensile roof that is supported by a steel "space frame" that uses interconnected pipe and gussets to create triangular nodes that form the frame. The structure is set upon three reinforced concrete pyramidal base supports that peak upward to connect at a point with inverted pyramidal space frame "legs" that connect at a point atop the concrete supports (Photograph 3). The triangle-themed space-frame structure (whose roof measures 108 feet along each side) is topped with triangular tensile roof panels that are semi-opaque to allow sunlight through. While the open structure sits over two stories high, the covered floor plan includes reinforced concrete steps and benches and features numerous "kiosks" for various visitor uses including bathrooms and vending (Photograph 4). A steel security fence encircles the structure, and frosted glass panels are located along the western elevation. Concrete walkways lead the visitors to the geometrically shaped loading ramps that are part of the ferry piers on the east side of the shelter structure. A smaller "spaceframe" flat-roof awning is located on the west elevation supported by concrete columns (visible in Photograph 2). Lights are simple monopole types that feature simple flared light fixture toppers.

The Service Building is located directly to the south and follows a similar triangular geometric shape theme as the Shelter Structure (Photograph 5). The Service Building is slightly smaller-scale and does not use the same construction materials and design as the Shelter Building. The smaller and more utilitarian design gives the Service Building a secondary appearance when compared to the Shelter Structure. Like the Shelter Structure, the building is a triangular-plan footprint and two stories in height. The building walls are reinforced concrete and internal steel I-beams and external columns. The interior footprint is smaller in area than the 4-foot boxed eaves clad with sheet-metal fascia that extend 10 feet beyond the building walls with recessed lighting (Photograph 6). The building walls are reinforced concrete panels on the bottom and heavily tinted fixed-pane anodized frame glass in a "band" along the upper story. Pipe-style columns extend vertically along the building walls reinforced at the points with seismic cross-braces. Access doors include personnel doors and larger roll-up equipment doors.

Loading platforms for the ferries are located around the Shelter Building and the Service Building on the concrete platform (Photograph 7). The Shelter Building features two loading platforms on either side of the Shelter Building. An additional "run-up" platform is located to the north of the Shelter Building and is adjacent to the ADA parking area and a small rectangular shed building (Photographs 8 and 9). Lights are simple monopole types that feature simple flared light fixture toppers.

In the southwestern corner of the property is the **Maintenance Yard,** a set of four fuel-oil storage tanks and a prefabricated steel side-gable roof Utility Building (Photograph 10). The utilitarian steel tanks are

approximately 20 feet in height and 36 feet in diameter. Set in a row behind the Utility Building, the tanks are largely hidden from view, as is the underground pump station (Photograph 11).

The large **Main Lot parking area** is a simple open paved area (shaped in a hexagon when viewed from above) that is encircled by the main circulation road within the property. Some landscape planting features are present around the perimeter including a tri-flag flagpole, while no distinct landscape features are located within the main parking area itself (Photograph 12). Two smaller parking areas are located on either side of the ferry terminal entryway at Sir Francis Drake Boulevard. A simple reinforced concrete pedestrian overcrossing crosses the boulevard at the northeastern corner of the property landing near a small, tree and shrub landscaped area at the northwest end of the ferry basin. Lights are simple monopole types that feature simple flared light fixture toppers.

6.3.2 Eligibility Assessment

The Larkspur Ferry Terminal has not been previously evaluated for eligibility for listing in the NRHP and/or the CRHR. While the terminal has been recognized in professional architectural contexts, including identification by Docomomo (DOcumentation and COnservation of buildings, sites, landscapes and neighborhoods of the MOdern MOvement) as an important example of 1970s modern architecture (Docomomo 2021), no formal NRHP or CRHR eligibility determination has been identified. The following sections evaluate the Larkspur Ferry Terminal as an individual property, focusing on its architectural significance, historical associations, and integrity.

6.3.2.1 CRHR Criterion 1

The Larkspur Ferry Terminal is associated with broad patterns of regional transportation history, specifically the introduction of ferry service in the Golden Gate Corridor during the late 20th century as part of efforts to address increasing congestion on the Golden Gate Bridge and US 101. Construction of the terminal occurred within the context of statewide and regional initiatives that expanded the role of the Golden Gate Bridge, Highway and Transportation District into multimodal transit operations, including coordinated bus and ferry service serving Marin County.

While the terminal reflects these important transportation trends, it does not appear to meet Criterion 1 of the NRHP/CRHR both individually and as a larger district. The revival of ferry service was initiated prior to construction of the LFT and implemented across multiple locations. The LFT was not the first ferry terminal developed as part of this effort and did not serve as the primary catalyst for the District's transition into public transit operations. Rather, it functioned as one component within a broader transportation program.

Although the Larkspur Ferry Terminal is associated with these late-20th-century transportation planning efforts, the property does not demonstrate a direct or singular association with a significant historical event. Its development reflects broader regional trends rather than a uniquely influential role in shaping those events. As a result, the LFT does not meet the requirements for individual eligibility under CRHR Criterion 1.

6.3.2.2 CRHR Criterion 2

The LFT does not appear to be individually significant for its association with the lives of historically important persons at the local, state, or national level. Available information does not show that the property is directly associated with any individual whose contributions meet the level of significance required under CRHR Criterion 2.

6.3.2.3 CRHR Criterion 3

The Larkspur Ferry Terminal was constructed in the High-Tech Structuralism style, a late-20th-century expression of Late Modernism. This style is most commonly associated with large institutional and infrastructure buildings and projects. As defined in *San Francisco Modern and Postmodern Architectural Styles (1960-2000)*, this style emphasizes the visual expression of structure, engineering systems, and modern materials as primary architectural features rather than concealing them behind finished surfaces (Simonson 2024: 84).

High-Tech Structuralism emerged in the 1970s as an expression of Late Modernism and is characterized by bold geometry, exposed structural systems, and innovative construction methods. The style commonly features space frames, long-span structures, and clearly articulated load-bearing elements. Fully realized examples of High-Tech Structuralism are rare in San Francisco and the greater Bay Area, particularly in association with transportation or infrastructure facilities. Within this limited group, the LFT is specifically identified as a notable example (Simonson 2024: 84).

Under CRHR Criterion 3, the LFT appears eligible for listing as a significant and rare example of the Late Modernist/High-Tech Structuralist-style. Constructed within the established period of significance for Late Modernism (1960s-1980s), the terminal demonstrates defining characteristics of the style through its monumental geometric form, extensive use of exposed steel structure, and emphasis on engineering as a visible architectural element (Simonson 2024: 86). The design goes beyond basic functional needs to create a visually legible and sculptural public facility, consistent with principles of Institutional Late Modernism.

The terminal's architectural significance is further supported by professional recognition of its design. The Project received an American Institute of Architects award, and the terminal was featured in *Architectural Record* shortly after its completion (Naim 1979). While the terminal's architect, Jacques de Brer, is not listed in the City's collection of biographies for Architects of Merit, the award and professional publication indicate the recognition of Larkspur Ferry Terminal's design quality. The terminal is also identified by Docomomo (2021) as an important example of 1970s modern architecture, which further confirms its significance within the Late Modern architectural style.

Simonson's Late Modernism evaluation framework also lists eligibility standards for CRHR Criterion 3 (2024: 87-88). The Larkspur Ferry Terminal meets all of these eligibility standards outlined by Simonson as follows:

- Completed in 1976, within the Late Modernism period of significance.
- Design quality demonstrated through professional publication and awards (Naim 1979; American Institute of Architects recognition).
- Retains character-defining features and high integrity of design, materials, and workmanship.
- Represents a rare extant example of High-Tech Structuralism applied to transportation infrastructure in the Bay Area.

Based on the applicable historic context, period of significance, and evaluation criteria, the LFT meets the requirements for individual eligibility under CRHR Criterion 3 as a rare and well-expressed example of High-Tech Structuralism within Late Modernist infrastructure architecture.

6.3.2.4 CRHR Criterion 4

Under CRHR Criterion 4, the resource is not significant for its research potential. What is known about the road, the owners, and activities regarding the LFT construction, modification, and use has been thoroughly

researched and documented. Given the high level of documentation for the building, the physical components appear unlikely to yield important primary information under CRHR Criterion 4.

6.3.2.5 Period of Significance and Character Defining Features

The period of significance for the Larkspur Ferry Terminal is 1976, the year the facility was completed and placed into service. This date falls within the period of significance for Late Modernism, which is defined in *San Francisco Modern & Postmodern Architectural Styles* as between 1960 and 1980 (Simonson 2024: 86).

Based on the Late Modernism evaluation framework outlined in Simonson (2024: 88), the following character-defining features of Late Modernist architecture are present at the LFT:

- Visually heavy massing and materials: The terminal's large-scale steel space-frame structure gives it a strong visual presence.
- Strong geometric and sculptural forms: The equilateral triangular space-frame roof and inverted pyramidal supports create a bold geometric and sculptural forms.
- Common use of flat roofs: The terminal features a flat roof form.
- Use of modern materials such as metal and concrete: The terminal features steel framing and concrete substructures.
- Pronounced structural components: Terminal's structural elements are intentionally exposed and visually emphasized.
- Expressionist and sculptural qualities: The terminal treats the roof structure as a sculptural element.

6.3.2.6 Integrity Discussion

Larkspur Ferry Terminal has undergone several alterations since its construction. These include:

- Reconfiguration of the (Main) parking lot to accommodate additional vehicles circa 1995 and 2008 (District 2021b).
- Removal of landscape planters between approximately 1987 and 1993 (NETR 2026).
- Expansion of ferry berths, from the original three berths to four berths in the1990s (District 2021b).
- Minor adjustments to passenger circulation and operational features to support evolving ferry service needs.
- Minor site and landscape modifications (including replacement of original globe light standards) associated with environmental management and maintenance requirements (circa 2009).

To be eligible under CRHR Criterion 3, a Late Modernist property must retain integrity from the period when its design was completed, with emphasis on integrity of design, materials, and workmanship (Simonson 2024: 89). The Larkspur Ferry Terminal was completed in 1976, within the period of significance for Late Modernism, and continues to retain the physical characteristics that convey its architectural significance.

Location: The LFT retains integrity of location. The terminal remains in its original waterfront setting at the mouth of Corte Madera Creek, where it was constructed in 1976 to serve ferry operations between Marin County and San Francisco.

Design: The terminal retains a high degree of integrity of design. The defining elements of the facility, the triangular steel space-frame roof structure, open terminal deck, and overall geometric configuration remain intact. Alterations have been limited to functional and operational changes that do not alter the original architectural design.

Setting: The terminal facility retains a moderate degree of integrity of setting. Although surrounding infrastructure, parking areas, and adjacent development have changed over time, the terminal continues to serve as a waterfront ferry facility with a strong visual relationship to San Francisco Bay.

Materials: The ferry terminal retains integrity of materials. Primary materials associated with the period of significance, steel structural elements and concrete foundations and deck, remain extant. Later additions and site improvements have not replaced the materials that convey the building's Late Modernist and High-Tech Structuralist character.

Workmanship: The ferry terminal retains integrity of workmanship. The quality and expression of the original structural system remain visible and continue to convey the design and construction techniques of the period.

Feeling: The terminal retains integrity of feeling as a Late Modernist transportation facility. Its monumental form, exposed structure, and open terminal space continue to convey the architectural character of 1970s infrastructure design.

Association: The building retains integrity of association. The terminal continues to function as a ferry facility and remains directly associated with the transportation network.

Conclusion: Based on the integrity analysis above, the Larkspur Ferry Terminal retains a high degree of integrity across all aspects relevant to evaluation under CRHR Criterion 3.

6.3.3 Conclusion

A cultural resources investigation was conducted for the PAL and identified no archaeological resources, artifacts, features, or other cultural materials. As a result, implementation of the Project is not expected to adversely affect archaeological resources. Nevertheless, steps to address unanticipated discoveries is included above to provide procedures for the treatment of any previously unknown archaeological resources, tribal cultural resources, or human remains that may be encountered during construction activities.

In addition, the evaluation determined that the LFT appears eligible for listing in the CRHR under Criterion 3, reflecting its significance in design, construction, or architectural characteristics. Accordingly, the LFT is considered a historical resource for the purposes of the CEQA.

7. References

Atwater, Brian, Charles Hedel, and Edward Helley. 1977. *Late Quaternary Depositional History, Holocene Sea Level Changes, and Vertical Crustal Movement, Southern San Francisco Bay, California*. US Geological Survey Professional Paper, No. 1014. US Government Printing Office, Washington, DC.

Atwater, Brian F., Susan G. Conard, James N. Dowden, Charles W. Hedel, Roderick L. MacDonald, and Wayne Savage. 1979. "History, Landforms, and Vegetation of the Estuary's Tidal Marshes." In *San Francisco Bay: The Urbanized Estuary. Investigations into the Natural History of San Francisco Bay and Delta With Reference to the Influence of Man*, edited by T. J. Conomos, A. E. Leviton, and M. Berson, pp. 347-386. Pacific Division of the American Association for the Advancement of Science, San Francisco, California.

Axelrod, Daniel I. 1981. Holocene Climatic Changes in Relation to Vegetation Disjunction and Speciation. *The American Naturalist* 117(6):847-870.

Bard, E., B. Hamelin, M. Arnold, L. Montaggioni, G. Cabioch, G. Faure, and F. Rougerie. 1996. Deglacial Sea-Level Record from Tahiti Corals and the Timing of Global Meltwater Discharge. *Nature* 382(241-244).

Barrett, Samual A. 1908. *The Geography and Dialects of the Miwok Indians*. University of California Publication in American Archaeology and Ethnology 6(2): 3333-368.

Beasely, Richard K. 1954. *Temporal and Areal Relationships in Central California Archaeology*. University of California Archaeological Survey Reports 24 and 25. University of California, Berkeley, Department of Anthropology, Berkeley.

Bennyhoff, James A. and David A. Fredrickson. 1969. A proposed integrative taxonomic system for Central California Archaeology. *Contributions of the University of California Archaeological Research Facility* 52, Berkeley.

Blake, M. C., R. W. Graymer, D. L. Jones, and A. Soule. 2000. Geologic map and map database of parts of Marin, San Francisco, Alameda, Contra Costa, and Sonoma Counties, California. US Geological Survey, Miscellaneous Field Studies Map MF-2337, amp scale 1:75,000.

Borchardt, Glenn. 1992. *Holocene Slip Rate of the Hayward Fault, Union City, California*. Final Technical Report to the United States Geological Survey. Soil Tectonics, Berkeley, California.

Bowen, Madeline. 2014. *Historic Architectural Survey Report for the Sonoma-Marin Area Rail Transit (SMART) Rail corridor San Rafael to Larkspur Project, Marin County, California*. Copy of file with the Northwest Information Center.

Byrd, Dr. Brian F., and Michael Darcangelo. 2011. *Archaeological Survey Report for the Central Marin Ferry Connection Project, Larkspur, Marin County, California Federal Program #CML 6406 (010)*. Copy of file with the Northwest Information Center.

Burcham, Levi T. 1982. *California Range Land: An Historico-Ecological Study of the Range Resource of California*. Center for Archaeological Research Publication Number 7, University of California, Davis.

California Geological Survey (CGS). 2002. California Geomorphic Provinces, Note 36.

City of Larkspur. 2026a. City of Larkspur City Municipal Code Chapter 18.19: Heritage Preservation. Website: https://larkspur.municipal.codes/Code/18.19. Accessed May 8, 2026.

City of Larkspur. 2026b. City of Larkspur Historic Resources Inventory (Approved by City Council Resolution 33/08. Website: https://www.ci.larkspur.ca.us/DocumentCenter/View/411/Historic-Resources-Inventory?bidId=. Accessed May 8, 2026.

Cook, Sherburne F., and Robert F. Heizer. 1968. Relationships among Houses, Settlement Areas, and Population in Aboriginal California. In *Settlement Archaeology*, edited by K. C. Chang, pp. 79-116. National Press Books, Palo Alto.

Crampton, Beecher. 1974. Grasses in California (Volume 33). California Natural History Guides. University of California Press, Los Angeles.

Daily Independent Journal. 1970. (April 17). "Rosy Future Painted for Ferry Runs." Available at newspapers.com, accessed April 20, 2026.

Daily Independent Journal. 1973. (May 11). "Green Light Urged on Larkspur Ferry Terminal." Available at newspapers.com, accessed April 20, 2026.

Daily Independent Journal. 1974a. (October 12). "Larkspur Ferry Permit Issued." Available at newspapers.com, accessed April 20, 2026.

Daily Independent Journal. 1974b. (June 7). "Panel Approved Ferry Terminal Dredging Permit." Available at newspapers.com, accessed April 20, 2026.

Daily Independent Journal. 1975a. (January 23). "Larkspur Terminal Pile Driving." Available at newspapers.com, accessed April 20, 2026.

Daily Independent Journal. 1975b. (June 21). "Narrow Streets Plague Terminal." Available at newspapers.com, accessed April 20, 2026.

Daily Independent Journal. 1976a. (January 23). "Ferry Berth Cost Zooms." Available at newspapers.com, accessed April 20, 2026.

Daily Independent Journal. 1976b. (February 17). "Jury Urges Delay on Larkspur Terminal." Available at newspapers.com, accessed April 20, 2026.

Daily Independent Journal. 1976c. (March 2). "Ferry Pullout Proposed." Available at newspapers.com, accessed April 20, 2026.

Docomomo. 2021. *The '70S Turn 50!* Website: https://www.docomomo-noca.org/70s-turn-50-noca-map. Accessed June 30.

Fredrickson, D. A. 1973 Early Cultures of the North Coast Ranges, California. Ph.D. dissertation, University of California, Davis.

Fredrickson, D. A. 1974. Cultural Diversity in Early Central California: A view from the North Coast Ranges. The Journal of California Anthropology 1(1):41-54.

Fredrickson, D. A. 1984. The North Coastal Region. In *California Archaeology*, pp. 471-527, edited by Michael J. Moratto. Academic Press, Inc., San Diego.

Gilbert, Karl Grove. 1917. *Hydraulic-Mining Debris in the Sierra Nevada*. US Geological Survey Professional Paper 105. Government Printing Office, Washington, DC.

Gmoser, Glenn, Jeff Rosenthal, William Hildebrandt, and Pat Mikkelsen. 1999. *Archaeological Survey of the I-680 Corridor between Dublin and Milpitas in Alameda and Santa Clara Counties for the "Sunol" Grade Southbound Improvement Project with Results of Extended Phase I/Phase II Archaeological Investigations at ALA-574, 575, 576.* Far Western Anthropological Research Group, Inc., Davis, California. California Department of Transportation, District 4, Oakland.

Goerke, Betty. 2007. *Chief Marin: Leader, Rebel, and Legend*. Heyday Books, Berkeley.

Golden Gate Bridge, Highway & Transportation District (District). 2021a. "About the District." Available at https://www.goldengate.org/district/about-the-district/, accessed April 20, 2021.

Golden Gate Bridge, Highway & Transportation District (District). 2021b. "Golden Gate Ferry Timeline." Available at https://www.goldengate.org/ferry/history-research/timeline/, accessed April 20, 2021.

Golden Gate Bridge, Highway & Transportation District (District). 2021c. "Statistics & Ridership." Available at https://www.goldengate.org/ferry/history-research/statistics-ridership/, accessed April 20, 2021.

Golden Gate Bridge, Highway & Transportation District (District). 2026. "Ferry Routes." Available at https://www.goldengate.org/ferry/history-research/sausalito-larkspur-tiburon-routes/, accessed April 20, 2026.

Helley, Edward J., K. R. LaJoie, W. E. Spangle, and M. L. Bair. 1979. *Flatland Deposits of the San Francisco Bay Region, California - Their Geology and Engineering Properties, Their Importance to Comprehensive Planning*. Professional Paper 943. Department of the Interior, United States Geological Survey, Washington, DC.

Hoover, Mildred Brooke and Douglas E. Kyle. 1990. *Historic Spots in California*. Stanford University Press, Stanford, CA.

Howard, A. D. 1979. *Geologic History of Middle California*. University of California Press, Berkeley and Los Angeles.

Ingram, B. Lynn, and Donald J. DePaolo. 1993. A 4,300-Year Strontium Isotope Record of Estuarine Paleosalinity in San Francisco Bay, California. *Earth and Planetary Science Letters* 119:103-119.

Ingram, B. Lynn, James C. Ingle, and Mark E. Conrad. 1996. Stable Isotope Record of Late Holocene Salinity and River Discharge in San Francisco Bay, California. *Earth and Planetary Science Letters* 141:237-248.

Jacobs. 2024. Draft Preliminary Geotechnical Report, Larkspur Ferry Service and Parking Expansion.

Jacobs. 2026 (in preparation). *Geoarchaeological Testing and Buried Site Sensitivity Analysis for the Larkspur Ferry Service and Expansion Project*. Prepared for the Golden Gate Highway, Bridge & Transportation District.

Jackson, Thomas L. *A Reconnaissance of the Wood Island Archaeological Site*.

Kawaguchi & Engineers. 2026. "The Expo'70 Space Frame for the Festival Plaza." Webpage. https://kawa-struc.com/expo70-1/?ref=langen. Accessed April 9, 2026.

Kelly, Isabel. 1978. Coastal Miwok. In *California*, edited by Robert F. Heizer, pp. 414-425. Handbook of North American Indians Vol. 8, William C. Sturtevant, general editor. Smithsonian Institution, Washington, DC.

Knudsen, Keith L., Janet M. Sowers, Robert C. Witter, Carl M. Wentworth, and Edward J. Helley. 2000. *Preliminary Maps of Quaternary Deposits and Liquefaction Susceptibility, Nine-County San Francisco Bay Region, California: A Digital Database*. US Geological Survey Open-File Report 00-444, Online Version 1.0, Menlo Park, California, http://pubs.usgs.gov/of/2000/of 00-444/. Updated September 22, 2005. Accessed December 2006.

Kowleski, S. M. 1979. *Golden Gate Ferry*. Golden Gate Bridge, Highway and Transportation District, San Francisco, California.

Kroeber, Alfred L. 1925. *Handbook of the Indians of California*. Bureau of American Ethnology Bulletin 78. Smithsonian Institution, Washington, DC. (Reprinted by Dover Publications, New York, 1976.)

Kyle, Douglas E. 1990. *Historic Spots in California*. Stanford University Press. Stanford, California.

Larkspur Heritage Preservation Board (LHPB). 2008. *Larkspur Past and Present: A History and Walking Guide*. Available at https://www.ci.larkspur.ca.us/DocumentCenter/View/10831/Book-Cover-through-Table-of-Contents, accessed April 20, 2021.

Lee, Charles H., and Michael Praszker. 1969. Bay Mud Developments and Related Structural Foundations. In *Geologic and Engineering Aspects of San Francisco Bay Fill*, edited by Harold B. Goldman, pp. 41-85. Special Report 197, California Division of Mines and Geology, San Francisco.

Lee, Robert H. 1978. National Register of Historic Places Inventory – Nomination Form. Green Brae Brick Yard Remillard Brick Kiln, Larkspur, California.

Little, Arthur D. 1969. *Feasibility Study of San Francisco-Marin Ferry System*. Prepared for San Francisco-Marin Water Transportation Study Committee. California.

Louderback, George D. 1951. Geologic History of San Francisco Bay. In *Geologic Guidebook of the San Francisco Bay Counties: History, Landscape, Geology, Fossils, Minerals, Industry, and Routes to Travel*. State of California Department of Natural Resources Bulletin 154:75-94. Division of Mines, San Francisco.

Marschner, Janice. 2000. *California: A Snapshot in Time 1850*. Coleman Ranch Press, Sacramento, California.

McIlroy, Jack, Jack Meyer, and Adrian Praetzellis. 2001. *Geoarchaeological and Archaeological Investigations for the Central Freeway Seismic Retrofit Project* Prepared by the Anthropological Studies Center, Sonoma State University, Rohnert Park, California. Prepared for California Department of Transportation, District 4, Oakland.

Meyer, Jack. 2000. *A Geoarchaeological Study of the Guadalupe Parkway Corridor, State Route 87, San Jose, Santa Clara County, California*. Anthropological Studies Center, Sonoma State Academic Foundation, Inc., Rohnert Park, California. On file, California Department of Transportation, District 4, Oakland, California.

Milliken, Randall. 1988. The Aguastos and Their Neighbors. In *Archaeological Investigations at CA-MRN-254, the Dominican College Site, San Rafael, Marin County, California, Vol 15-40*, edited by David G. Bieling. Submitted to Dominican College, San Rafael, California.

Milliken, Randall. 2006. *The Central California Ethnographic Community Distribution Model, Version 2.0, with Special Attention to the San Francisco Bay Area – Cultural Resources Inventory of Caltrans District 4 Rural Conventional Highways*. Consulting in the Past and Far Western Anthropological Research Group,

Inc., Davis, California. Submitted to Office of Cultural Resource Studies, California Department of Transportation District 4, Environmental Division.

Moratto, Michael J. 1984. *California Archaeology*. Academic Press, New York.

Mudie, P. J., and R. Byrne. 1980. Pollen Evidence for Historic Sedimentation Rates in California Coastal Marshes. *Estuarine and Coastal Marine Science* 10:305-316.

Naim, Janet. 1979. *The Artful of a Non-Building*. Architectural Record 1:122-124.

Nationwide Environmental Title Research (NETR). 2026. "Historic Aerials Database." 1987 and 1993 aerial imagery of the Larkspur Ferry Terminal. https://www.historicaerials.com/viewer.

Nelson, Nels C. 1909. *Shellmounds of the San Francisco Bay Region*. University of California Publications in American Archaeology and Ethnology 7(4):310-356.

Price, Carol A. 1981. *Maps and Descriptions of Radiocarbon-dated Samples from Central and Northern California*. Miscellaneous Field Studies Map MF-1321. US Geological Survey.

Reidy, Liam Michael. 2001. Evidence of Environmental Change over the Last 2,000 Years at Mountain Lake, in the Northern San Francisco Peninsula, California. Master's thesis, University of California, Berkeley.

Roop, William and Steven O'Brien. 1980. *Final Report – Archaeological Evaluation of the Former Remillard Brick Kiln (CA-Mrn_255), Larkspur*.

San Francisco Chronicle. 1971. (July 24). "Bridge Ferry Decision, Larkspur Terminal Site." Available at newspapers.com, accessed April 20, 2026.

San Francisco Chronicle. 1972a. (February 16). "Larkspur Ferry Site." Available at newspapers.com, accessed April 20, 2026.

San Francisco Chronicle. 1972b. (September 4). "The Airy Ferry Terminals." Available at newspapers.com, accessed April 20, 2026.

San Francisco Chronicle. 1973a. (December 13). "Larkspur Terminal, Ferry Costs Climb." Available at newspapers.com, accessed April 20, 2026.

San Francisco Chronicle. 1973b. (December 7). "Calm Hearing on Marin Terminal." Available at newspapers.com, accessed April 20, 2026.

San Francisco Chronicle. 1973c. (February 24). "New Ferry Terminal Plans Get an OK." Available at newspapers.com, accessed April 20, 2026.

San Francisco Chronicle. 1974. (February 8). "Larkspur Ferry Terminal OKs." Available at newspapers.com, accessed April 20, 2026.

San Francisco Chronicle. 2006. (September 3). "Jacques De Brer Obituary." Available at newspapers.com, accessed April 20, 2026.

San Francisco Examiner. 1976a. (July 7). "Terminal Problem: No Ferries." Available at newspapers.com, accessed April 20, 2026.

San Francisco Examiner. 1976b. (January 19). "A Ferry Terminal Done Right." Available at newspapers.com, accessed April 20, 2026.

SFGATE.com. 2006. (September 14). "Jacques de Brer - Larkspur terminal architect." Available at sfgate.com, accessed April 20, 2026.

Simonson, Hannah Lise. 2024. *San Francisco Modern and Postmodern Architectural Styles (1960-2000), Context: Architectural Methods & Styles, Sub-Context: Architectural Styles.* Prepared by Page & Turnbull, San Francisco, California. Submitted San Francisco Planning, San Francisco, California.

Stanley, Daniel Jean, and Andrew G. Warne. 1994. Worldwide Initiation of Holocene Marine Deltas by Deceleration of Sea-Level Rise. *Science* 265 (July):228-229.

Stewart, Suzanne, Jack Meyer, and Mike Newland. 2002. *Phase One Investigations for the Fort Baker Archaeological Survey, Golden Gate National Recreation Area, Marin County, California*. Prepared by the Anthropological Studies Center, Sonoma State University, Rohnert Park. Submitted to Golden Gate National Recreation Area, National Park Service, San Francisco. On file, Golden Gate National Recreation Area, National Park Service, San Francisco, California.

Stimac Associates, Inc. 2008. *Geotechnical Investigation. Proposed Larkspur Ferry Terminal Bike Bridge, Larkspur, California*.

Story, James A., Vincent E. Wessels, and John A. Wolfe. 1966. Radiocarbon Dating of Recent Sediments in San Francisco Bay. *Mineral Information Service* (now California Geology) 19:47-50.

Tait, Richard G. and Robert T. Lawson. 1973. Soil Investigation, Larkspur Ferry Terminal, Larkspur, California. Prepared for the Golden Gate Bridge, Highway, and Transportation District, San Francisco, California. On file at the NWIC, Sonoma State University, Rohnert Park, California.

The Cultural Landscape Foundation. 2026. "Royston, Hanamoto, Mayes & Beck." Available at https://www.tclf.org/pioneer/royston-hanamoto-mayes-beck, accessed April 23.

The Daily Examiner. 1888. (February 25). "Real Estate." Available at newspapers.com, accessed May 4, 2021.

The Press Democrat. 1976. (December 7). "Ferry Terminal To Be Dedicated Saturday." Available at newspapers.com, accessed April 20, 2026.

The Times Herald. 1971. (December 23). "Larkspur Fery Plan Approved." Available at newspapers.com, accessed April 20, 2026.

Treasher, Ray C. 1963. Geology of the Sedimentary Deposits in San Francisco Bay, California. In *Short Contributions of California Geology*, pp. 11-24. Special Report 82, California Division of Mines and Geology, San Francisco.

Treganza, Adan E. 1957. The Examination of Indian Shell Mounds Within San Francisco Bay with Reference to the Possible 1579 Landfall of Sir Francis Drake.

U.S. Census Bureau. 2021a. "Quick Facts: Larkspur city, California; Sierra Madre city, California; Los Alamitos city, California; Ridgecrest city, California; Monterey city, California." Available at https://www.census.gov/quickfacts/fact/table/larkspurcitycalifornia,sierramadrecitycalifornia,losalamitoscitycalifornia,ridgecrestcitycalifornia,montereycitycalifornia/PST045219, accessed May 4.

U.S. Census Bureau. 2021b. "Quick Facts: Marin County, California." Available at https://www.census.gov/quickfacts/marincountycalifornia, accessed May 4.

Wells, Lisa Esquivel. 1995. Environmental Setting and Quaternary History of the San Francisco Estuary. In *Recent Geologic Studies in the Santa Clara Valley*, edited by E.M. Sangines, D.W. Andersen, and A.B. Buising, pp. 237 250. Pacific Section of the Society of Economic Paleontologists and Mineralogists, vol. 76. Santa Fe Springs, California.

Wells, Lisa E., and Michelle Goman. 1994. Late Holocene Environmental Variability in the Upper San Francisco Estuary as Reconstructed from Tidal Marsh Sediments. In *Proceedings of the Eleventh Annual Pacific Climate (PACLIM) Workshop—April 19-22, 1994*, pp. 185-198. Interagency Ecological Program, Technical Report 40. California Department of Water Resources, Sacramento.

West, G. James. 1989. Early Historic Vegetation Change in Alta California: The Fossil Evidence. In *Columbian Consequences, Volume 1: Archaeological and Historical Perspectives on the Spanish Borderlands West*, edited by David Hurst Thomas, pp. 333-348. Smithsonian Institution, Washington, DC.

Winzler and Kelly Consulting Engineers. 1998. Larkspur Ferry Terminal Fuel System Improvements Log of Test Borings.

Witter, Robert C., Keith L. Knudsen, Janet M. Sowers, Carl M. Wentworth, Richard D. Koehler, and Carolyn E. Randolph. 2006. *Maps of Quaternary Deposits and Liquefaction Susceptibility in the Central San Francisco Bay Region, California*. US Geological Survey Open-File Report 2006-1037, Online Version 1.1, Menlo Park, California. http://pubs.usgs.gov/of/2006/1037/. Updated May 5, 2006. Accessed December 2006.

Appendix A. Native American Consultation Correspondence

NATIVE AMERICAN HERITAGE COMMISSION

CHAIRPERSON
Laura Miranda
Luiseño

VICE CHAIRPERSON
Reginald Pagaling
Chumash

SECRETARY
Merri Lopez-Keifer
Luiseño

PARLIAMENTARIAN
Russell Attebery
Karuk

COMMISSIONER
William Mungary
Paiute/White Mountain Apache

COMMISSIONER
Julie Tumamait-Stenslie
Chumash

COMMISSIONER
[**Vacant**]

COMMISSIONER
[**Vacant**]

COMMISSIONER
[**Vacant**]

EXECUTIVE SECRETARY
Christina Snider
Pomo

NAHC HEADQUARTERS
1550 Harbor Boulevard
Suite 100
West Sacramento,
California 95691
(916) 373-3710
nahc@nahc.ca.gov
NAHC.ca.gov

March 2, 2021

Brian Ramos, PhD, Senior Archaeologist
Jacobs

Via Email to: brian.ramos@jacobs.com

Re: Native American Tribal Consultation, Pursuant to the Assembly Bill 52 (AB 52), Amendments to the California Environmental Quality Act (CEQA) (Chapter 532, Statutes of 2014), Public Resources Code Sections 5097.94 (m), 21073, 21074, 21080.3.1, 21080.3.2, 21082.3, 21083.09, 21084.2 and 21084.3, Larkspur Ferry Terminal Expansion Project, Marin County

Dear Dr. Ramos:

Pursuant to Public Resources Code section 21080.3.1 (c), attached is a consultation list of tribes that are traditionally and culturally affiliated with the geographic area of the above-listed project. Please note that the intent of the AB 52 amendments to CEQA is to avoid and/or mitigate impacts to tribal cultural resources, (Pub. Resources Code §21084.3 (a)) ("Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource.")

Public Resources Code sections 21080.3.1 and 21084.3(c) require CEQA lead agencies to consult with California Native American tribes that have requested notice from such agencies of proposed projects in the geographic area that are traditionally and culturally affiliated with the tribes on projects for which a Notice of Preparation or Notice of Negative Declaration or Mitigated Negative Declaration has been filed on or after July 1, 2015. Specifically, Public Resources Code section 21080.3.1 (d) provides:

Within 14 days of determining that an application for a project is complete or a decision by a public agency to undertake a project, the lead agency shall provide formal notification to the designated contact of, or a tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, which shall be accomplished by means of at least one written notification that includes a brief description of the proposed project and its location, the lead agency contact information, and a notification that the California Native American tribe has 30 days to request consultation pursuant to this section.

The AB 52 amendments to CEQA law does not preclude initiating consultation with the tribes that are culturally and traditionally affiliated within your jurisdiction prior to receiving requests for notification of projects in the tribe's areas of traditional and cultural affiliation. The Native American Heritage Commission (NAHC) recommends, but does not require, early consultation as a best practice to ensure that lead agencies receive sufficient information about cultural resources in a project area to avoid damaging effects to tribal cultural resources.

The NAHC also recommends, but does not require that agencies should also include with their notification letters, information regarding any cultural resources assessment that has been completed on the area of potential effect (APE), such as:

1. The results of any record search that may have been conducted at an Information Center of the California Historical Resources Information System (CHRIS), including, but not limited to:

- A listing of any and all known cultural resources that have already been recorded on or adjacent to the APE, such as known archaeological sites;
- Copies of any and all cultural resource records and study reports that may have been provided by the Information Center as part of the records search response;
- Whether the records search indicates a low, moderate, or high probability that unrecorded cultural resources are located in the APE; and
- If a survey is recommended by the Information Center to determine whether previously unrecorded cultural resources are present.

2. The results of any archaeological inventory survey that was conducted, including:

   - Any report that may contain site forms, site significance, and suggested mitigation measures.

     All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum, and not be made available for public disclosure in accordance with Government Code section 6254.10.

3. The result of any Sacred Lands File (SLF) check conducted through the Native American Heritage Commission was negative.

4. Any ethnographic studies conducted for any area including all or part of the APE; and

5. Any geotechnical reports regarding all or part of the APE.

Lead agencies should be aware that records maintained by the NAHC and CHRIS are not exhaustive and a negative response to these searches does not preclude the existence of a tribal cultural resource. A tribe may be the only source of information regarding the existence of a tribal cultural resource.

This information will aid tribes in determining whether to request formal consultation. In the event that they do, having the information beforehand will help to facilitate the consultation process.

If you receive notification of change of addresses and phone numbers from tribes, please notify the NAHC. With your assistance, we can assure that our consultation list remains current.

If you have any questions, please contact me at my email address: Sarah.Fonseca@nahc.ac.gov.

Sincerely,



Sarah Fonseca
Cultural Resources Analyst

Attachment

Native American Heritage Commission
Tribal Consultation List
Marin County
3/2/2021

Federated Indians of Graton Rancheria
Greg Sarris, Chairperson
6400 Redwood Drive, Ste 300 — Coast Miwok
Rohnert Park, CA, 94928 — Pomo
Phone: (707) 566 - 2288
Fax: (707) 566-2291
gbuvelot@gratonrancheria.com

Guidiville Indian Rancheria
Donald Duncan, Chairperson
P.O. Box 339 — Pomo
Talmage, CA, 95481
Phone: (707) 462 - 3682
Fax: (707) 462-9183
admin@guidiville.net

This list is current only as of the date of this document. Distribution of this list does not relieve any person of statutory responsibility as defined in Section 7050.5 of the Health and Safety Code, Section 5097.94 of the Public Resources Code and section 5097.98 of the Public Resources Code.

This list is only applicable for consultation with Native American tribes under Public Resources Code Sections 21080.3.1 for the proposed Larkspur Ferry Terminal Expansion Project, Marin County.

April 16, 2021

Federated Indians of Graton Rancheria
Greg Sarris, Chairperson
6400 Redwood Drive, Ste 300
Rohnert Park, CA 94928

GOLDEN GATE BRIDGE
HIGHWAY & TRANSPORTATION DISTRICT

Dear Mr. Sarris,

The Golden Gate Bridge, Highway and Transportation District (District) is conducting the Larkspur Ferry Service and Parking Expansion Study (Study) to review ways to increase ferry ridership and reduce traffic congestion on Highway 101 in Marin and Sonoma Counties and in the Larkspur Landing area. The Study will consider how the ferry terminal can accommodate increases in ridership with adequate parking, transit connectivity (bus and rail), and active transportation, for overall reduction in traffic backup and congestion in the area.

Specifically, the Study will focus on:

- Examining how the Larkspur Ferry Terminal can accommodate further increases in demand as the Bay Area ferry network expands and travel on the US 101 corridor continues to grow.
- Expanding the Larkspur Ferry Terminal parking and landside access.
- Forecasting traffic circulation in Larkspur Landing vicinity and along Sir Francisco Drake Boulevard with future increases in ferry demand.

Informed by feedback from residents, transit riders, public agencies and other stakeholders, the Study will consider a variety of alternatives and develop a comprehensive evaluation of the environmental impacts that the proposed project would likely cause, and conceptual mitigation. The Draft Environmental Impact Report (DEIR) will be available for public comment and review in 2022. The Final Environmental Impact Report (FEIR) will be prepared and a final project will be approved by the District in 2023.

Increased ferry crossings to meet new passenger demand will be accommodated by increased parking, with the likelihood of new parking structure(s). The size of the structure and number of parking stalls will be dependent on passenger forecasts. Two sites are under consideration for these parking structures: one site is the main parking lot adjacent to the ferry terminal; another site is the overflow parking lot, also owned by the District, which is located in the Larkspur Landing shopping center, across Sir Francis Drake Boulevard (see attached Figures 1 and 2).

The new parking structure will require some modification to existing landside access and circulation configuration. Depending on the location, the parking structure will require construction activities including staging areas for equipment storage and some excavation for new utilities, pile driving and the elevator shaft. Most excavation will be 1-2 feet in depth. Although a small area (15 sq. ft.), the elevator shaft may require up to 10 feet in depth.

Jacobs Engineering (Jacobs) is assisting The Golden Gate Bridge, Highway and Transportation District (District) by conducting environmental review of their Larkspur Ferry Service and Parking Expansion study. As part of this effort Jacobs cultural resources staff conducted a record search, review and research of published literature and past field research in the project area at the California Historical Resources Information System at Sonoma State University to determine if there are known (recorded) cultural resources records within or adjacent to the Area of Potential Effect (APE). The record search did not identify any previously recorded archaeological resources in the project APE.

Jacobs contacted the Native American Heritage Commission (NAHC) on February 18, 2021 to request a search of their Sacred Lands File for the project location. The 3/2/2021 results of the NAHC Sacred Lands File check was negative.

You are being contacted about this Project because you are identified by the Native American Heritage Commission as a Native American Contact for Marin County.

We recognize that you, or others you know, may possess knowledge regarding cultural resources in this area that would be important to consider as the project is developed. We would very much appreciate if you would provide any comments, thoughts, concerns, or information you may have about cultural resources or sacred sites in the project area. Please contact me via email at RDowning@goldengate.org or by phone at 415-257-4583, or you may contact Jacobs senior archaeologist Brian Ramos Ph.D., at brian.ramos@jacobs.com, or 415-734-0039.

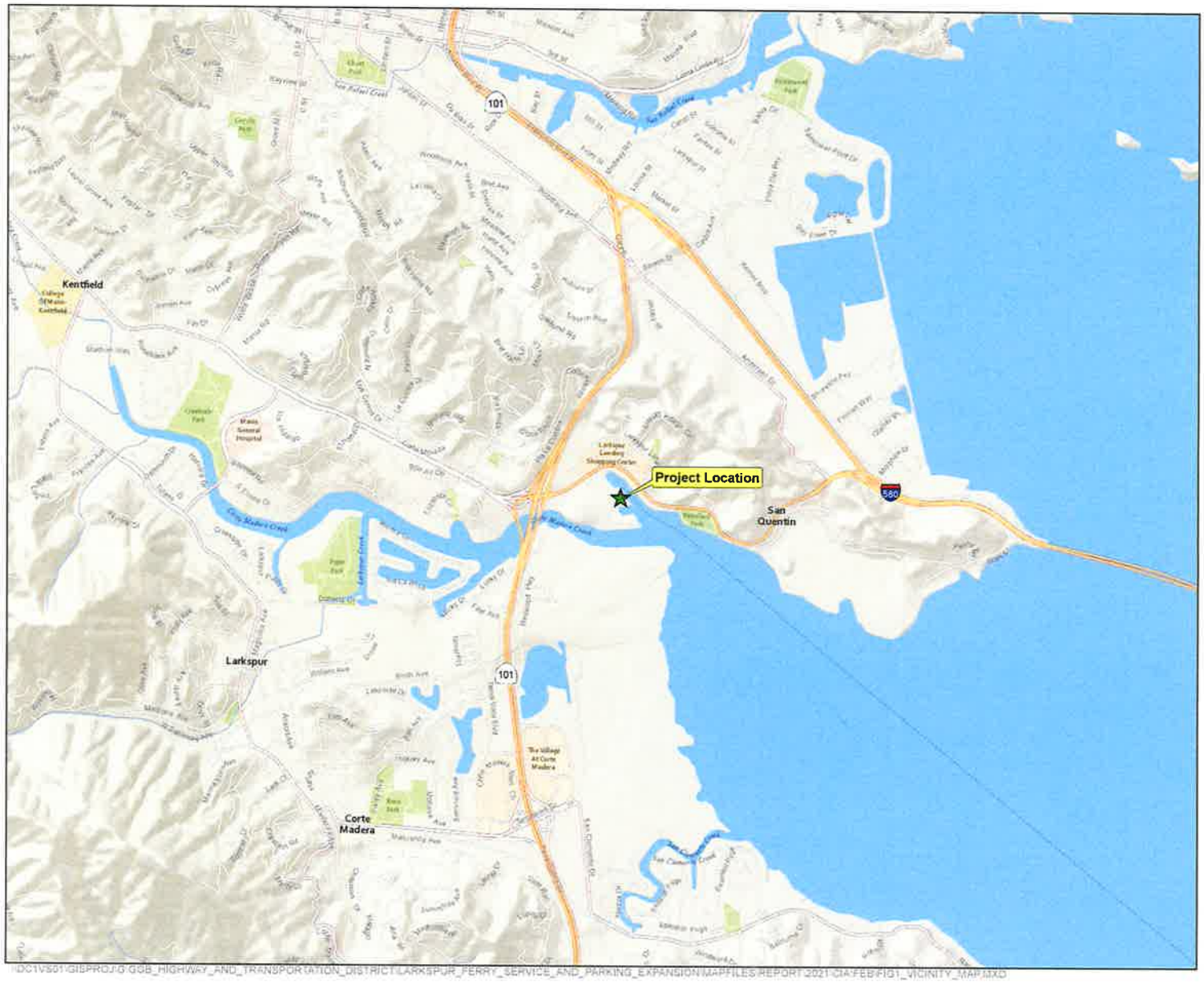
Sincerely,

Ron Downing

Ron Downing
Golden Gate Highway Bridge and Transportation District
Director of Planning/Project Manager
1101 Anderson Drive
San Rafael, CA 94901-5318

Enclosures: Figure 1-Vicinity Map
Figure 2-Project Location

c: Denis J. Mulligan, General Manager, GGBHTD
James P. Swindler, Deputy General Manager, GGBHTD
Michael N. Conneran, Partner, Hanson Bridgett LLP





LEGEND

★ Project Location

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FIGURE 1
Vicinity Map
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

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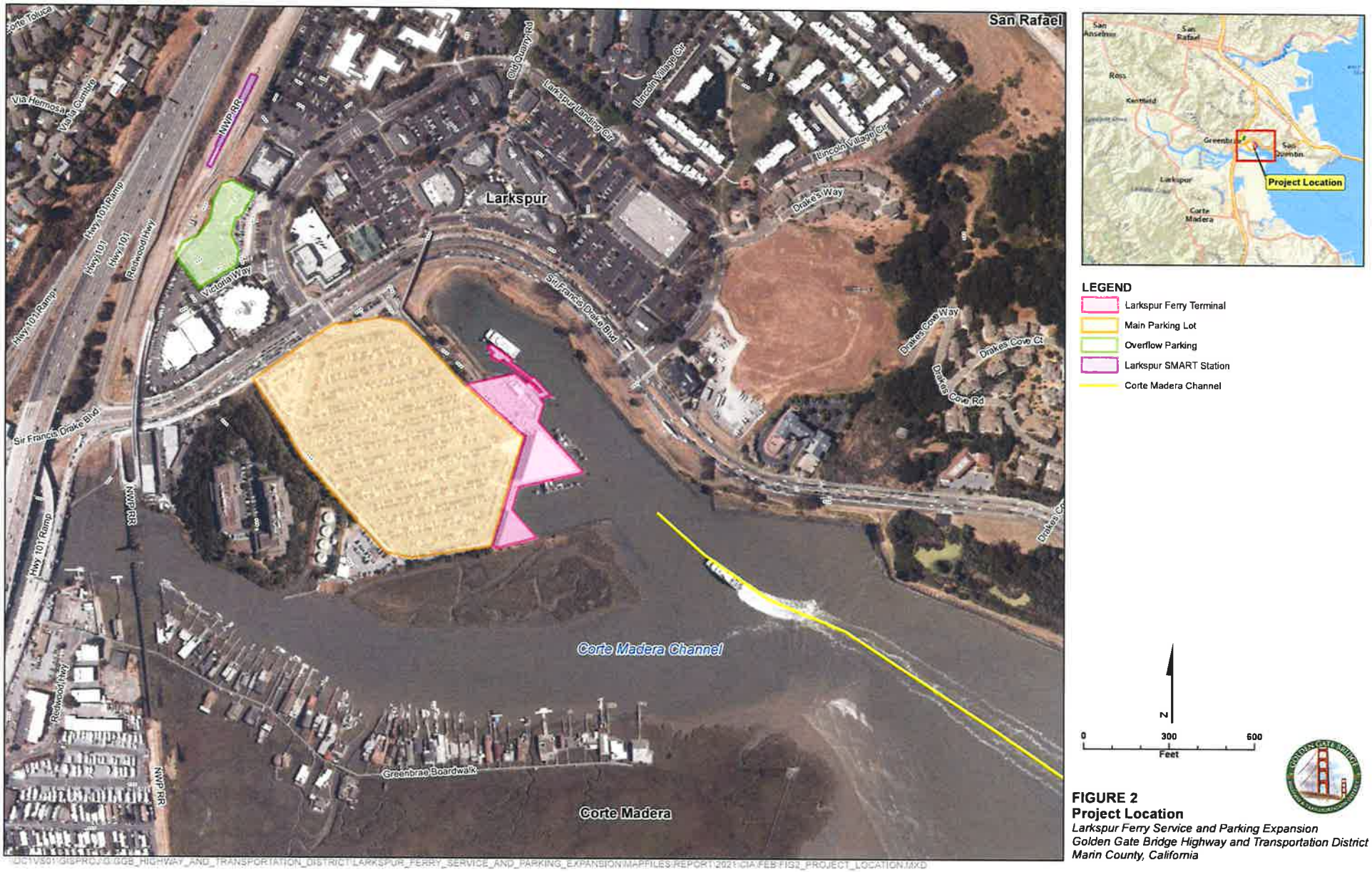


FIGURE 2
Project Location
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

April 16, 2021

GOLDEN GATE BRIDGE
HIGHWAY & TRANSPORTATION DISTRICT

Guidiville Indian Rancheria
Donald Duncan, Chairperson
P.O. Box 339
Talmage, CA 95481

Dear Mr. Duncan,

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Specifically, the Study will focus on:

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- Expanding the Larkspur Ferry Terminal parking and landside access.
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Informed by feedback from residents, transit riders, public agencies and other stakeholders, the Study will consider a variety of alternatives and develop a comprehensive evaluation of the environmental impacts that the proposed project would likely cause, and conceptual mitigation. The Draft Environmental Impact Report (DEIR) will be available for public comment and review in 2022. The Final Environmental Impact Report (FEIR) will be prepared and a final project will be approved by the District in 2023.

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The new parking structure will require some modification to existing landside access and circulation configuration. Depending on the location, the parking structure will require construction activities including staging areas for equipment storage and some excavation for new utilities, pile driving and the elevator shaft. Most excavation will be 1-2 feet in depth. Although a small area (15 sq. ft.), the elevator shaft may require up to 10 feet in depth.

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Jacobs contacted the Native American Heritage Commission (NAHC) on February 18, 2021 to request a search of their Sacred Lands File for the project location. The 3/2/2021 results of the NAHC Sacred Lands File check was negative.

You are being contacted about this Project because you are identified by the Native American Heritage Commission as a Native American Contact for Marin County.

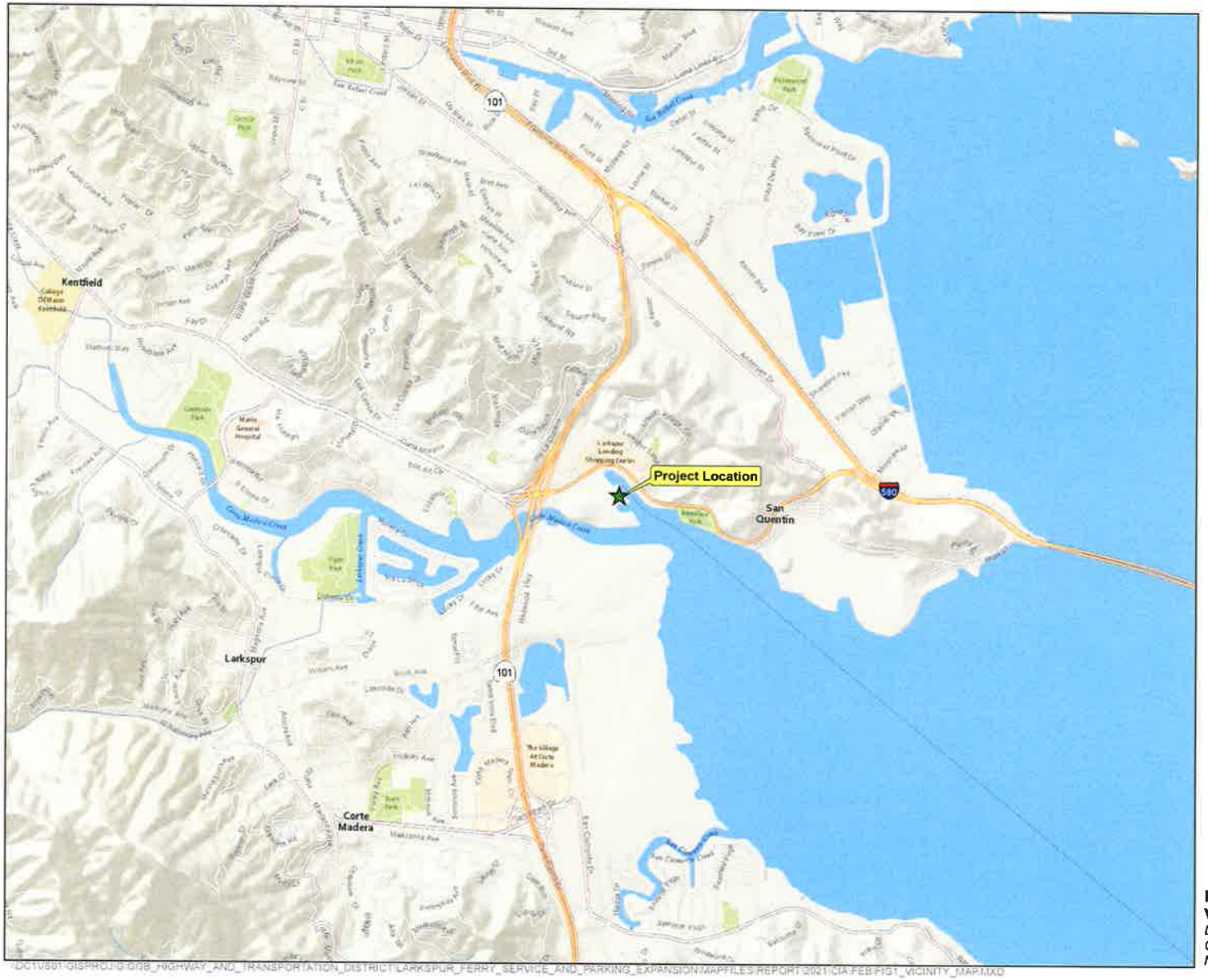
We recognize that you, or others you know, may possess knowledge regarding cultural resources in this area that would be important to consider as the project is developed. We would very much appreciate if you would provide any comments, thoughts, concerns, or information you may have about cultural resources or sacred sites in the project area. Please contact me via email at RDowning@goldengate.org or by phone at 415-257-4583, or you may contact Jacobs senior archaeologist Brian Ramos Ph.D., at brian.ramos@jacobs.com, or 415-734-0039.

Sincerely,

Ron Downing
Golden Gate Highway Bridge and Transportation District
Manager of Planning, Project Manager
1101 Anderson Drive
San Rafael, CA 94901-5318

Enclosures: Figure 1-Vicinity Map
Figure 2-Project Location

c: Denis J. Mulligan, General Manager, GGBHTD
James P. Swindler, Deputy General Manager, GGBHTD
Michael N. Conneran, Partner, Hanson Bridgett LLP





LEGEND

★ Project Location

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FIGURE 1
Vicinity Map
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

DC1V501 GISPROJ\GGB_HIGHWAY_AND_TRANSPORTATION_DISTRICT\LARKSPUR_FERRY_SERVICE_AND_PARKING_EXPANSION\MAPFILES\REPORT\2021\CIA\FEB\FIG1_VICINITY_MAP.MXD





LEGEND

- Larkspur Ferry Terminal
- Main Parking Lot
- Overflow Parking
- Larkspur SMART Station
- Corte Madera Channel

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Feet

FIGURE 2
Project Location
Larkspur Ferry Service and Parking Expansion
Golden Gate Bridge Highway and Transportation District
Marin County, California

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July 25, 2023

SENT BY CERTIFIED MAIL

GOLDEN GATE BRIDGE
HIGHWAY & TRANSPORTATION DISTRICT

Ms. Buffy McQuillen
Tribal Heritage Preservation Officer (THPO)
Federated Indians of Graton Rancheria
6400 Redwood Drive, Suite 300
Rohnert Park, CA 94928

RE: Preliminary Geotechnical Investigations for the GGBHTD Larkspur Ferry Service and Parking Expansion Study

Dear Ms. McQuillen,

I wanted to reach out and give you a status update on the Larkspur Ferry Service and Parking Expansion Study. As you may recall, we had a meeting with you and other representatives of the Federated Indians of Graton Rancheria (FIGR) on August 23, 2021. At this meeting, FIGR provided us with FIGR concerns regarding the potential presence of Tribal Cultural Resources in the project area for the Larkspur Ferry Terminal. As we discussed, our team was in the phase of exploring and evaluating conceptual parking expansion concepts for the two viable sites under consideration: the main parking lot (adjacent to the ferry terminal on Sir Francis Drake Boulevard) and the overflow ferry lot (located across the street in the adjacent Country Mart shopping complex). The evaluation of these conceptual alternatives will ultimately lead us to select a preferred site, footprint, height, and scale of a proposed parking structure to best meet future Larkspur ferry ridership demand.

Since this time, the COVID-19 pandemic and resulting decreases in ferry passenger volumes at the Larkspur Ferry Terminal required us to more fully address passenger parking needs for the future; we anticipate concluding our traffic demand forecasts by the end of summer. As such, we have not made much progress on evaluating proposed conceptual parking alternatives or selecting a preferred alternative since these would depend on approved ferry passenger demand.

In addition to the above status update, the GGBHTD has decided to move forward with preliminary geotechnical investigations at the two parking locations identified above. This investigation is planned to be conducted the week of August 14 through 18, 2023. The purpose of these investigations is to determine the underlying geotechnical site conditions for building foundation design (that is, pile driving parameters, seismicity issues and site placement of foundations, etc.). Two core samples and one cone penetration test (CPT) will be drilled at the main parking lot and one core sample and one CPT will be drilled at

the upper parking lot across from Sir Francis Drake Blvd. As part of this investigation, the Jacobs team will have a professional archaeologist at the site to monitor the three core samples after they are removed from their drilling location. They will inspect the samples for the presence or absence of cultural remains and prepare a summary of the findings which we can provide to FIGR on request.

As we mentioned to you previously, the District is committed to fully understanding any potential for our project to impact cultural resources. Although our archaeology team performed a record search that returned negative results for known archaeological and tribal resources within the project area, and we believe the chances of detection of potential sub-surface cultural resources would be low, we would like to invite a representative of FIGR to be present to monitor during the geotechnical investigation. Please let us know if you would be interested to participate in this monitoring effort or willing to share any information you may have on the potential for subsurface remains or past tribal activities at the project location.

As we continue to better understand the site conditions of the two parking lots for our environmental work (which has not yet started), we will continue to have further communications with FIGR because we recognize you may have knowledge of the area that would be important for the project's cultural resources assessment.

We hope this status update is useful for you for continued consultation on this project. We would like to hear back from you by August 4, 2023. If you would like to discuss this further or respond to this request, I can be reached by this email or by phone at 415-257-4583.

Sincerely,

Ron Downing

Ron Downing
Director of Planning/Project Manager
Golden Gate Bridge, Highway and Transportation District
1011 Andersen Drive
San Rafael, CA 94901-5318

c: Michael N. Conneran, Hanson-Bridgett LLP
Loretta Meyer, Jacobs Engineering Group

Attachment: Project Location Map

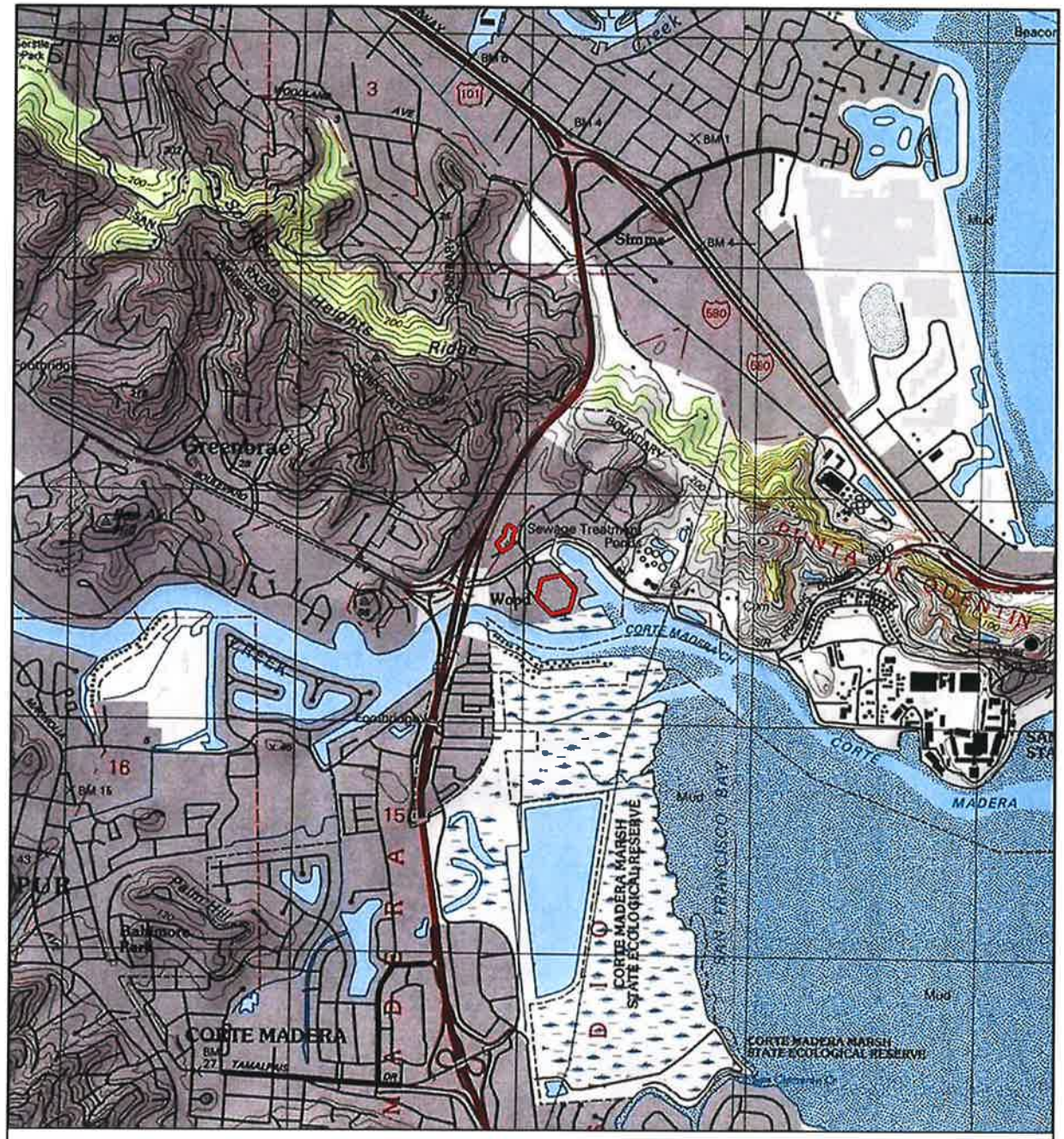


Figure 1. Location Map

June 10, 2026

GOLDEN GATE BRIDGE
HIGHWAY & TRANSPORTATION DISTRICT

Ms. Buffy McQuillen
Tribal Heritage Preservation Officer (THPO)
Federated Indians of Graton Rancheria
6400 Redwood Drive, Suite 300
Rohnert Park, CA 94928

RE: Soil Coring Investigations for the GGBHTD Larkspur Ferry Service and Parking Expansion Study

Dear Ms. McQuillen,

I wanted to reach out and notify you of a soil coring investigation planned for June 26-July 1 at the Larkspur Ferry parking lot (work dates do not include Saturday and Sunday, June 27-28). I would like to invite you to provide a FIGR monitor for the investigation. Jacobs is providing an SOI-qualified geoarchaeologist and archaeologist to monitor the coring.

As we mentioned to you previously, the GGBHTD is committed to fully understanding any potential for our project to impact cultural resources. The records search conducted by the Northwest Information Center March 3, 2026, did not identify any cultural resources within the Area of Potential Effects, but we understand that the project's bayside setting has the potential for buried archaeological deposits. Please let us know if you would be interested in providing a monitor June 26-July 1 or if you would be willing to share any information you may have on the potential for subsurface remains or past tribal activities at the project location.

The goal of the investigation is to test for the presence of archaeological deposits to the maximum depth of anticipated project-related disturbance. Four cores are planned for the main parking lot (adjacent to the ferry terminal on Sir Francis Drake Boulevard) and will be drilled to a maximum depth of 63 feet. Two cores are planned for the overflow ferry lot (located across the street in the adjacent Country Mart shopping complex) and will be drilled to a maximum depth of 20 feet.

We are still in the design phase and evaluating proposed conceptual parking alternatives. The two viable sites under consideration include the main parking lot and the overflow ferry lot. As part of the site evaluations GGBHTD conducted a preliminary geotechnical investigation August 14 and 15, 2023. The purpose of the investigation was to determine the underlying geotechnical site conditions for building foundation design (that is, pile driving parameters, seismicity issues and site placement of foundations, etc.). Two core samples and one cone penetration test (CPT) were drilled at the main parking lot and one

core sample and one CPT were drilled at the North parking lot across from Sir Francis Drake Blvd. Because the project is in a bayside location that may have the potential for buried archaeological deposits, GGBHTD invited FIGR and a qualified archaeologist to monitor the coring. GGBHTD did not receive a response from FIGR. Jacobs archaeologist Jenna Tanner inspected the samples for the presence of cultural remains. She looked for concentrations of shell, burned or unburned animal bone, charcoal, ash, fire-affected rock, flaked stone, groundstone, shell beads, mica, quartz crystals or ocher. None of the cores yielded such evidence.

As we continue to better understand the site conditions of the two parking lots for our environmental permitting studies, we will continue to have further communications with FIGR because we recognize you may have knowledge of the area that would be important for the project's cultural resources assessment.

We hope this status update is useful for you for continued consultation on this project. We would like to hear back from you at your earliest convenience. If you would like to discuss this further or respond to this request, I can be reached by this email or by phone at 415-257-4583.

Sincerely,

Ron Downing
Director of Planning/Project Manager
Golden Gate Bridge, Highway and Transportation District
1011 Andersen Drive
San Rafael, CA 94901-5318

c: Michael N. Conneran, Hanson-Bridgett LLP
Loretta Meyer, Jacobs Engineering Group

Sent via e-mail and USPS Certified Mail

Attachments: Project Location Map

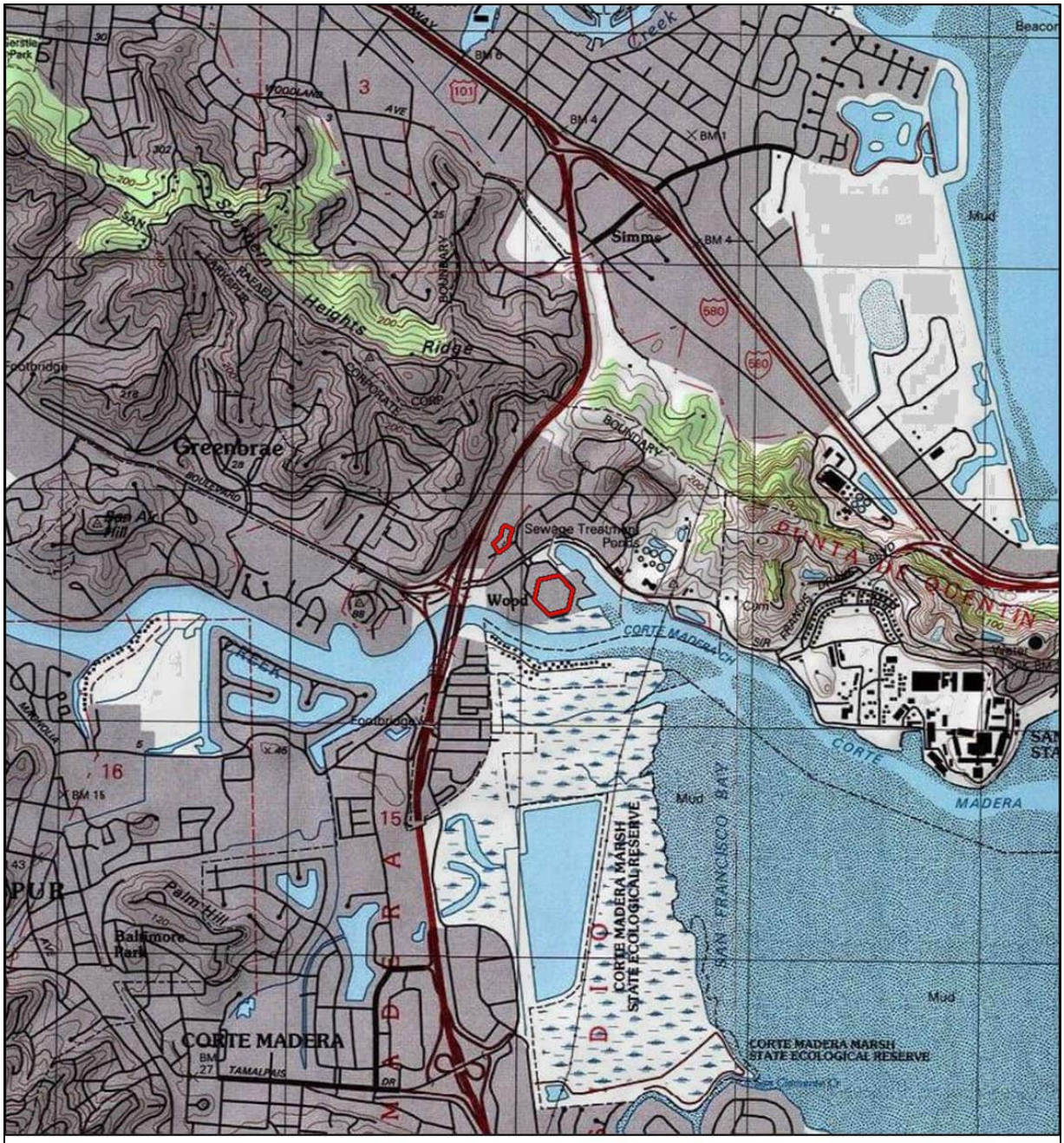


Figure 1. Location Map

Appendix B. Site Records

METADATA SHEET

P-21-000541
CA-MRN-255/H

Recording event 'b' was removed from this record because it is actually a supplement to the Historic resource that is also at that location. It was authored by David Bieling and dated 3/17/2000. The '/H' was also removed from the trinomial because the actual site is Prehistoric only.

The supplement is now recording event 'd' in the following Primary Record:

P-21-001158

Date: 6 December 2016
NWIC Staff: *Annette Neal*

P-21-000541 Occ.

University of California

Archaeological Survey

ARCHAEOLOGICAL SITE SURVEY RECORD

S-2301
S-12945

SAN RAFAEL 7.5'

1. Site Mrn-255 2. Map Tamalpais (1897 ed.) 3. County Marin

4. Twp. ____ Range ____; ____ ¼ of ____ ¼ of Sec. ____

5. Location Under old brick kilns at Point San Quentin

6. On contour elevation

7. Previous designations for site None

8. Owner 9. Address

10. Previous owners, dates

11. Present tenant

12. Attitude toward excavation Good (See Robert H. Power, Nut Tree, Vacaville; knows owner)

13. Description of site Village

14. Area 300' X 300' 15. Depth 6 ft.? 16. Height None

17. Vegetation None 18. Nearest water 0 ft.

19. Soil of site Shellmound 20. Surrounding soil type Yellow clay

21. Previous excavation

22. Cultivation 23. Erosion

24. Buildings, roads, etc. Old brick kilns on top of site

25. Possibility of destruction Already leveled, but could still be excavated

26. House pits

27. Other features

28. Burials

29. Artifacts Charmstones appear to be of Middle Horizon period.

30. Remarks

31. Published references S-1165 | S-2076

32. UCMA Accession No. 33. Sketch map Over

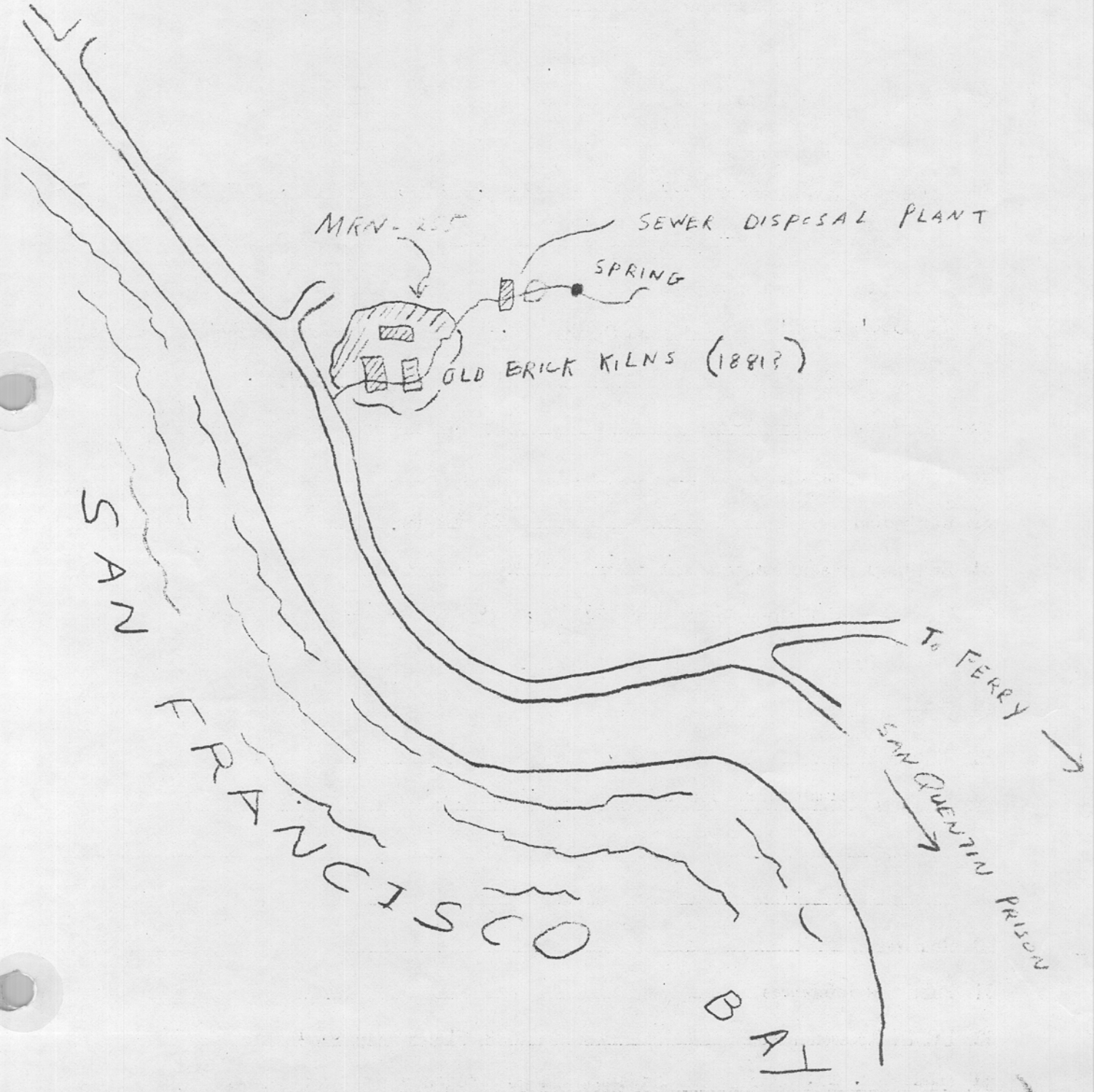
34. Date Mar. 13, 1955 35. Recorded by Treganza 36. Photos

S-13070

S-15337 C.A.A. 2/94

On Map

a


MRN-255
SEWER DISPOSAL PLANT
SPRING
OLD BRICK KILNS (1881?)
SAN FRANCISCO BAY
To FERRY
SAN QUENTIN PRISON

MRN-255

a

Form No. 10-300 (Rev. 10-74) PH0505633

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

DATA SHEET

FOR NPS USE ONLY
RECEIVED OCT 4 1977
DATE ENTERED MAR 24 1978

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

1 NAME

HISTORIC
Green Brae Brick Yard of the Remillard Brick Company

AND/OR COMMON
Remillard Brick Kiln

2 LOCATION

STREET & NUMBER
125 East Sir Francis Drake Blvd. — NOT FOR PUBLICATION

CITY, TOWN
Larkspur — VICINITY OF

CONGRESSIONAL DISTRICT
5th

STATE	CODE	COUNTY	CODE
California	06	Marin	041

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
—DISTRICT	—PUBLIC	—OCCUPIED	—AGRICULTURE	—MUSEUM
—BUILDING(S)	X PRIVATE	X UNOCCUPIED	—COMMERCIAL	—PARK
X STRUCTURE	—BOTH	—WORK IN PROGRESS	—EDUCATIONAL	—PRIVATE RESIDENCE
—SITE	**PUBLIC ACQUISITION**	**ACCESSIBLE**	—ENTERTAINMENT	—RELIGIOUS
—OBJECT	—IN PROCESS	X YES: RESTRICTED	—GOVERNMENT	—SCIENTIFIC
	—BEING CONSIDERED	—YES: UNRESTRICTED	—INDUSTRIAL	—TRANSPORTATION
		—NO	—MILITARY	X OTHER: unused (occasional historic tours are conducted)

4 OWNER OF PROPERTY

NAME
Robert H. Lee

STREET & NUMBER
41 Madrone Avenue

CITY, TOWN
Larkspur — VICINITY OF

STATE
California

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC.
Marin County Recorder's Office

STREET & NUMBER
Marin Civic Center Building

CITY, TOWN
San Rafael

STATE
California

6 REPRESENTATION IN EXISTING SURVEYS

TITLE
Larkspur General Plan

DATE
Adopted 1973 — FEDERAL — STATE — COUNTY X LOCAL

DEPOSITORY FOR SURVEY RECORDS
Larkspur City Hall

CITY, TOWN
Larkspur

STATE
California

7 DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
_EXCELLENT	XDETERIORATED	_UNALTERED	XORIGINAL SITE
_GOOD	_RUINS	XALTERED	_MOVED DATE_____
_FAIR	_UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

PRESENT PHYSICAL APPEARANCE

The present brick kiln and chimney stack are the only surviving structures of the Green Brae brickyard operation that, at one time, consisted of over 25 buildings and structures.

The exterior configuration of the brick kiln is that of a long, low brick structure having battered walls with regularly spaced arched openings in the walls. The end wall sections of the structure are rounded. The overall width is 64 feet, the length 195 feet and the height 12 feet. The kiln is made of unreinforced brick and has double walls with earth between for heat retention.

The exterior brick walls are battered to stabilize the arched roof, and have 16 wickets or openings through which the bricks were carried in and out of the kiln.

The roof of the kiln is flat, and has hundreds of small ports through which the coal was fed to fire the kiln.

The brick kiln is essentially stable structurally, but in need of considerable repair. The exterior walls and roof are covered with numerous areas of vegetation and brush, and some of the bricks forming the arched chamber openings have been removed by trespassers.

The inside of the present kiln is in the form of a toroid, or an elongated, endless tunnel, with a brick floor, walls and arched roof. It has a central section fitted with small flues and dampers which discharge into a main flue, which, in turn, is connected to the chimney stack by a large underground flue. The width inside the tunnel is 14 feet, its height is 11 feet and its length 370 feet in circumference.

The chimney stack constructed entirely of unreinforced brick, has tapered, octagonal sides and measures 125 feet in height. The stack bears the letters "R.B. Co." and the numbers "1891", representing the year the kiln was completed.

The unusual feature about the stack is its location relative to the kiln. Virtually all Hoffman kilns (see #8, Engineering Significance) have the stack located within the kiln, directly over the central flue.

The purpose of the stack was to provide adequate draft. The design was of great importance, and if improperly designed, resulted in higher fuel costs and incomplete firing of the brick.

See Continuation Sheet, Item #7, Page 1

8 SIGNIFICANCE

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW				
X PREHISTORIC	X ARCHEOLOGY-PREHISTORIC	__COMMUNITY PLANNING	__LANDSCAPE ARCHITECTURE	__RELIGION
__1400-1499	__ARCHEOLOGY-HISTORIC	__CONSERVATION	__LAW	__SCIENCE
__1500-1599	__AGRICULTURE	__ECONOMICS	__LITERATURE	__SCULPTURE
__1600-1699	__ARCHITECTURE	__EDUCATION	__MILITARY	__SOCIAL/HUMANITARIAN
__1700-1799	__ART	X ENGINEERING	__MUSIC	__THEATER
X 1800-1899	__COMMERCE	X EXPLORATION/SETTLEMENT	__PHILOSOPHY	__TRANSPORTATION
X 1900- 1915	__COMMUNICATIONS	X INDUSTRY	__POLITICS/GOVERNMENT	__OTHER (SPECIFY)
X1900-1968		X INVENTION		

SPECIFIC DATES 1891 - 1915 BUILDER/ARCHITECT Unknown

STATEMENT OF SIGNIFICANCE

PERIOD: PREHISTORIC - AREA OF SIGNIFICANCE: ARCHEOLOGY

The brick kiln is located on a site occupied in prehistoric times by the ethnographic group, the Coast Miwok Indians of the Penutian language family. These were a hunting and gathering people who resided in permanent villages along the San Francisco Bay and creeks that drained into the Bay. The kiln was constructed on top of one such site at the mouth of the Corte Madera Creek and recorded as 4-Mrn-225 where Middle Horizon charmstones[1] and an obsidian projectile point[2] were found. Although this site has been leveled, there is always the possibility of subsurface finds.[2]

PERIOD: 1865-1945 - AREA OF SIGNIFICANCE: ENGINEERING

The Remillard brick kiln in Larkspur is one of the few remaining examples of the Hoffman Type kiln in the United States.

It represents a brick making process which was considered to be the most efficient for its time, during the years 1865-1945.

This particular type of kiln was invented by Friedrich Hoffmann of Berlin, Prussia, in 1865. It revolutionized the manufacture of bricks because it was the first of the continuous type kilns. Previous kilns were the batch type which required the cooling of the bricks before new green bricks could be introduced. The Hoffman kiln could be fired continuously and new green brick could be added as the already fired bricks were removed.

See Continuation Sheet, Item #8, Page 1

9 MAJOR BIBLIOGRAPHICAL REFERENCES

Independent Journal, July 14, 1973.

Illustrated Edition, Oakland Tribune. 1898

Mason & Park. The Making of Marin, 1850-1975. North Shore Books, 1975. p. 92

San Quentin Peninsula Development Environmental Impact Report. Madrone Associates, 1975. p. 74

Sausalito News. November 14, 1890. p. 3

Walking Tours of Historic Larkspur. Larkspur Heritage Committee. 1976. p. 70

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY 1.74 acres

UTM REFERENCES

	ZONE	EASTING	NORTHING
A	10	543650	4199650
B			
C			
D			

VERBAL BOUNDARY DESCRIPTION

Beginning at the intersection of the calls set forth as North 86°15' East 264.69 feet and North 32°30' Rady 435.72 feet in the deed from Remillard Brick Company, a corporation to Sanitary District No. 1 of Marin County dated November 6, 1957 and recorded December 6, 1957 in Book 1158 of official records at page 228, Marin County Records; running thence along the southerly line of said parcel South 86°15' West 264.69' See Continuation Sheet, Item #10, Page 1

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE	CODE	COUNTY	CODE
STATE	CODE	COUNTY	CODE

11 FORM PREPARED BY (See Continuation Sheet, Item #11, Page 1

NAME / TITLE

Robert H. Lee, property owner

ORGANIZATION

DATE: April 18, 1977

STREET & NUMBER: 41 Madrone Avenue

TELEPHONE: (415) 924-3103

CITY OR TOWN: Larkspur

STATE: California

12 STATE HISTORIC PRESERVATION OFFICER CERTIFICATION

THE EVALUATED SIGNIFICANCE OF THIS PROPERTY WITHIN THE STATE IS:

NATIONAL ___ STATE X LOCAL ___

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

STATE HISTORIC PRESERVATION OFFICER SIGNATURE Herbert Mecks

TITLE SHPO DATE 8-22-77

FOR NPS USE ONLY

I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION DATE 3/29/78

ATTEST: Kathryn Cole KEEPER OF THE NATIONAL REGISTER

KEEPER OF THE NATIONAL REGISTER DATE 3.13.78

GPO 892-453

Form No. 10-300a
(Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

FOR NPS USE ONLY
RECEIVED OCT 4 1977
DATE ENTERED MAR 24 1978

OWNER OF PROPERTY

Andre F. Bosc
1155 Jones Street
San Francisco, California

Form No. 10-300a
(Rev. 10-74)

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REPRESENTATION IN EXISTING SURVEYS

Title: Walking Tours of Historic Larkspur
Date: 1975 and 1976
Depository: Larkspur Library x Local
City: Larkspur State: California

Title: "Historical and Archaeological Survey of the Proposed Larkspur Ferry Terminal"
Date: 1973 x Local
Depository: Department of Planning and Community Development
City: Larkspur State: California

Title: "Marin County Historic Resources Inventory"
Date: Ongoing - Spring, 1977, to be submitted to State 7/1/77
Depository: Civic Center Library x County
City: San Rafael State: California
Depository: Department of Parks and Recreation
Office of Historic Preservation x State
City: Sacramento State: California

Form No. 10-300a
(Rev. 10-74)

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No changes or alterations have been made to the original brick structure other than those attributed to deterioration. Only the wooden shed which once covered the kiln has been removed. (See description of original physical appearance.)

ORIGINAL PHYSICAL APPEARANCE

The Green Brae brickyard, encompassing some 150 acres, operated from 1891 to 1915, and functioned as a small community, with its workmen living in the 16 cabins on the property. Nearby were a cookhouse, stable, blacksmith shop, vegetable gardens and an orchard. Livestock grazed on the hillsides and hay was grown for the fifteen or more work horses. Tubb Lake was created to provide a water supply for domestic uses and for steam to run the brick machines. There was a small railroad to haul the clay from nearby pits. In addition, it had its own landing on San Francisco Bay from which the five company scow schooners carried millions of brick to San Francisco and Oakland.

The kiln structure was enclosed by a large wooden shed until the early 1940's when it was demolished. The shed provided protection against the weather for the firing operation and the workmen, thereby extending the months of operation. (See attached drawings.)

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(Rev. 10-74)

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AREA OF SIGNIFICANCE: ENGINEERING (continued)

The kiln is divided into 16 chambers each havings its own wicket, or opening, through which the bricks enter and leave the kiln. Green bricks are hand stacked to the ceiling in each chamber, leaving vertical hollow chases below the coal ports in the roof. The wickets are closed up with brick as soon as the chamber has been filled and tightly sealed with clay paste or "daub". Coal is then fed into the ports from the top of the kiln, into the hollow formed by the stacked brick and ignited.

Once the fire is started, it burns continuously and moves steadily around the kiln from chamber to chamber. The progress of the fire is about one foot per hour and its rate is controlled by flues and dampers within each chamber. After the fire moves far enough past the fired bricks and they have cooled, they are then removed and the chamber is filled with a new batch of green bricks. In this way the operation proceeds continuously. (See attached schematic drawings.)

The structure is unusual and complex in that there are double walls filled with earth, an underground flue system, arched ceilings and openings made with wedge bricks and a roof pierced with hundreds of ports.

The chimney stack is of exceptional design having a square base and tapered octagonal sides with a corbelled top, freestanding from the kiln itself, an unusual arrangement. It withstood the famous San Francisco earthquake of 1906.

The Remillard brick kiln is significant as an historical engineering landmark, representing a manufacturing process that was considered the best of its time in the important industry of brickmaking.

PERIOD: 1874-1885 - AREA OF SIGNIFICANCE: INVENTION

Edward Remillard improved the brick manufacturing techniques by inventing and patenting the brickyard truck in 1874[3] and the excavating and grading machine in 1885.[4]

See Continuation Sheet, Item #8, Page 2

Form No. 10-300a
(Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

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PERIOD: 1861-1968 - AREA OF SIGNIFICANCE: INDUSTRY

In 1891 the Remillard brothers built the Green Brae kiln to add to their Oakland based brick manufacturing company. The site chosen was one where bricks had been made since 1871.[5] The Remillard Brick Company thus increased its production capabilities by 10,000,000 annually.

Standing today on the San Quentin Peninsula, this brick kiln is the only surviving structure of the Remillard Brick Company, once the largest brick manufacturer on the Pacific Coast.[6] During its 107 years of operation from 1861-1968 , the Remillard Brick Company made the following significant contributions to industry in the Bay Area:

1. Constructed and operated at varying periods brickyards at 7 locations: Oakland, Santa Venetia, Pleasanton, Green Brae, San Pablo and 2 at San Jose.
2. In 1875 supplied the 26,000,000 bricks needed to construct the original Palace Hotel in San Francisco.[7]
3. As a brick manufacturer and construction firm, built the original St. Mary's College in Oakland, California in 1889.[8]
4. In 1898 the Company sold 30,000,000 bricks, the production of which employed 400 men with an annual payroll of $150,000.[9]
5. In 1906 and the years immediately following, supplied much of the brick required to rebuild San Francisco after its devastation by earthquake that year.
6. Manufactured and shipped from Marin County brickyards (Green Brae and Santa Venetia) the bricks to build the chocolate factory at Ghiradelli Square, the Cannery, the second Palace Hotel, the St. Francis and Clift Hotels and the Phelan and Flood Buildings.[10]
7. Maintained high manufacturing standards and produced bricks consistently reported as "superior" and "noted for their excellence".[11]

Although the Green Brae brickyard ceased maunfacture in 1915, the Remillard Brick Company continued operation until 1968 when the San Jose brickyard was closed.

Countess Lillian Remillard Dandini, daughter of the company's founder, owned the Green Brae kiln until her death at age 93 in 1973.

See Continuation Sheet, Item #8, Page 3

Form No. 10-300a
(Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

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RECEIVED OCT 4 1977
DATE ENTERED MAR 24 1978

Footnotes

1. Treganza, "The Examination of Indian Shellmounds within San Francisco Bay with Reference to the Possible 1579 Land Fill of Sir Francis Drake." 1957.

2. Goerke, "Historical and Archeological Survey of the Proposed Larkspur Ferry Terminal." 1973 P. C-4.

3. "Official Gazette", U.S. Patent Office, 1887, Vol. 2.

4. "Official Gazette". U.S. Patent Office, 1887, Vol. 39.

5. Salt Marsh and Tidelands Map #7, County of Marin,1871.

6. Alameda County Illustrated Oakland Tribune. 1898, P.211.

7. Woon, San Francisco and the Golden Empire., 1935, P.79.

8. Illustrated Edition, Oakland Tribune. 1890 P. 36.

9. Alameda County Illustrated Oakland Tribune. 1898, P. 162.

10. Independent Journal, "The Countess and the Brickyard." July 14, 1973.

11. Op. Cit., Oakland Tribune, P. 36.

Form No. 10-300a
(Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

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DATE ENTERED MAR 24 1978

CONTINUATION SHEET ITEM NUMBER 10 PAGE 1

GEOGRAPHICAL DATA - Verbal Boundary Description, continued

to the Southwest corner thereof; thence leaving said parcel and running along the Southeasterly line of that certain parcel of land described in the deed from Remillard Brick Company, a corporation to Sanitary District No. 1, recorded August 26, 1947 in Book 562 of official records at page 78, Marin County Records; North 43°39'48" East 307.68 Feet to the Northerly right of way line of Sir Francis Drake Highway, as described in the deed from Remillard Brick Company to the County of Marin recorded October 14, 1930 in Book 204 of official records at page 207, Marin County Records; thence along said line Southeasterly to a point which bears South 33°55'48" West from the point of beginning, thence leaving said line of Sir Francis Drake Highway and running North 33°55'48" East 343.97 feet to the point of beginning.

Form No. 10-300a
(Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

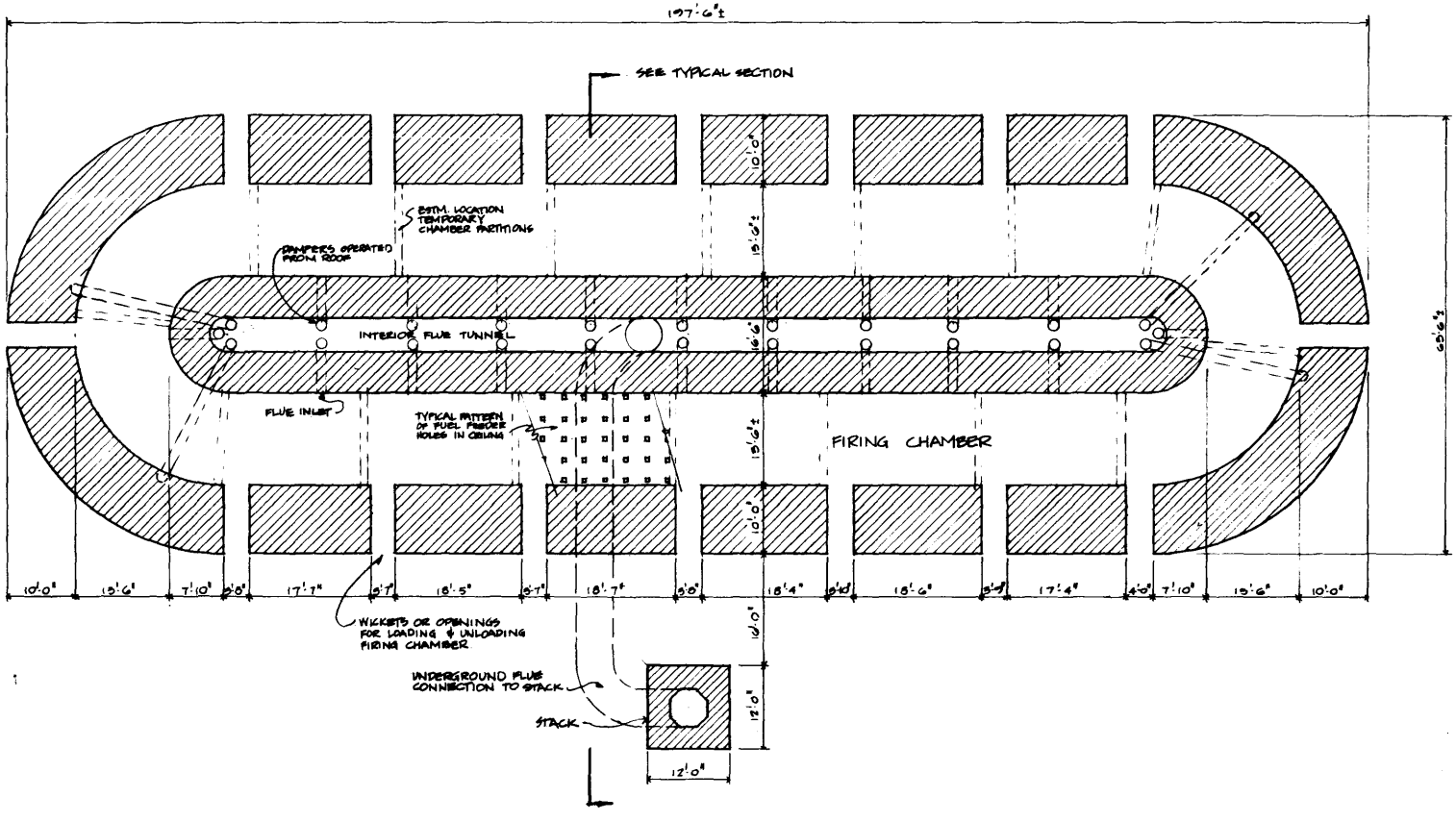
NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

FOR NPS USE ONLY
RECEIVED OCT 4 [illegible]
DATE ENTERED MAR 24 1978

CONTINUATION SHEET ITEM NUMBER 11 PAGE 1

FORM PREPARED BY

Name/Title: Nancy W. Curley, member
Organization: Larkspur Heritage Committee
Street & Number: 130 Elm Avenue
City: Larkspur State: California
Telephone: (415) 924-3133
Date: April 18, 1977



FLOOR PLAN ~ EXISTING KILN

1/8" = 1'-0"

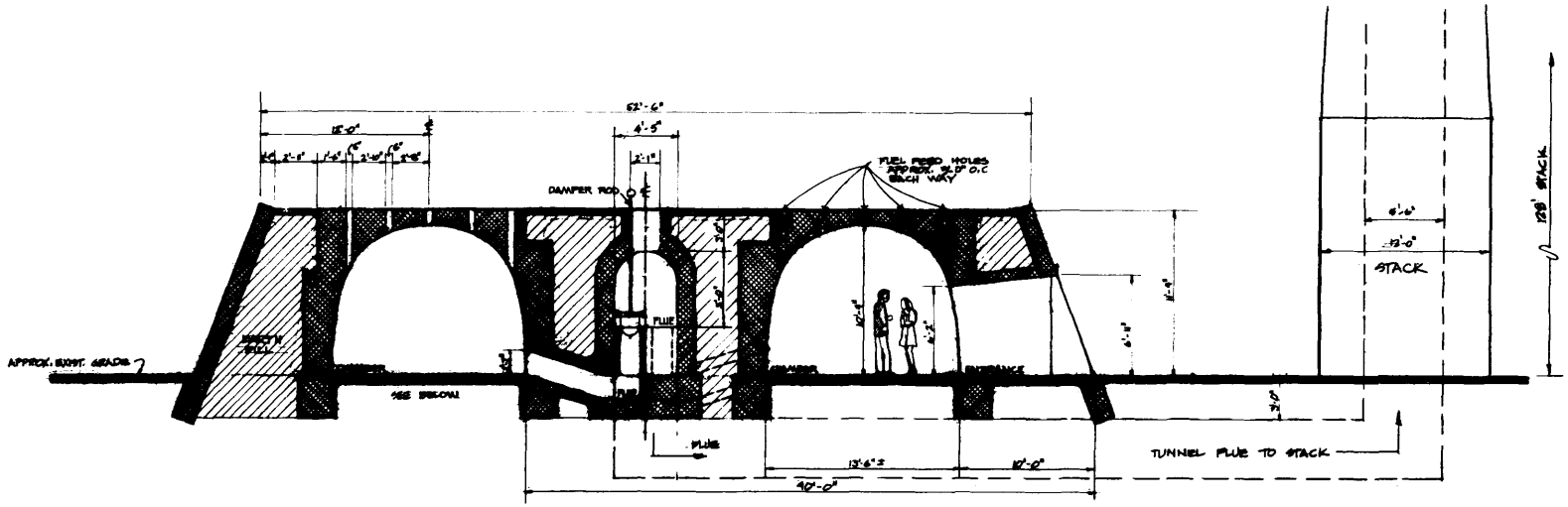
REMILLARD BRICK COMPANY KILN

EXISTING FLOOR PLAN 8/26/82

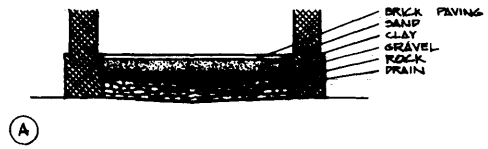
ROBERT H. LEE & ASSOCIATES
PIER 90 · SAN FRANCISCO, CALIFORNIA

5

Item #8 - Engineering Significance



SECTION
1/8"=1'-0"



(A)



(B)

POSSIBLE FLOOR SECTIONS
NO SCALE

REMILLARD BRICK CO. KILN

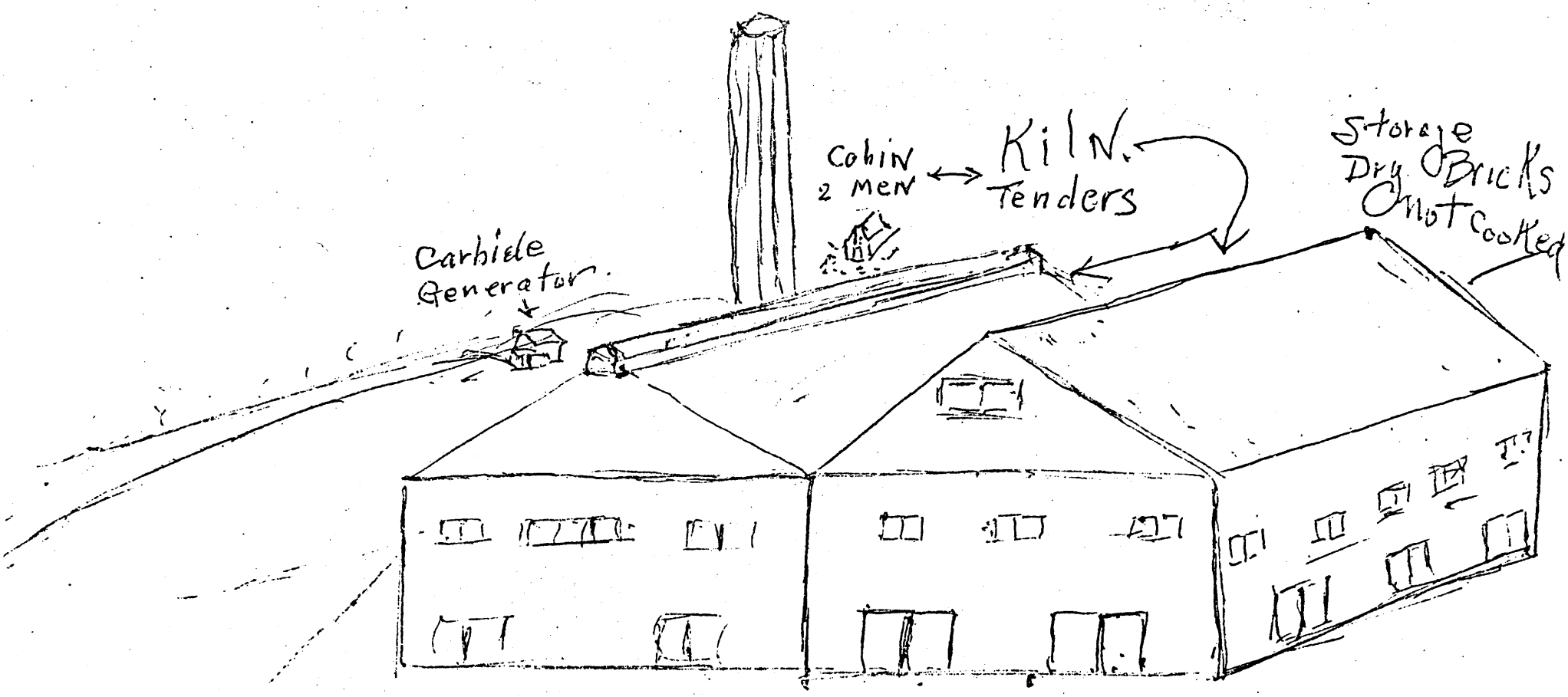
EXISTING SECTIONS.

5/26/72

ROBERT H. LEE & ASSOCIATES
PIER 40 · SAN FRANCISCO, CALIFORNIA

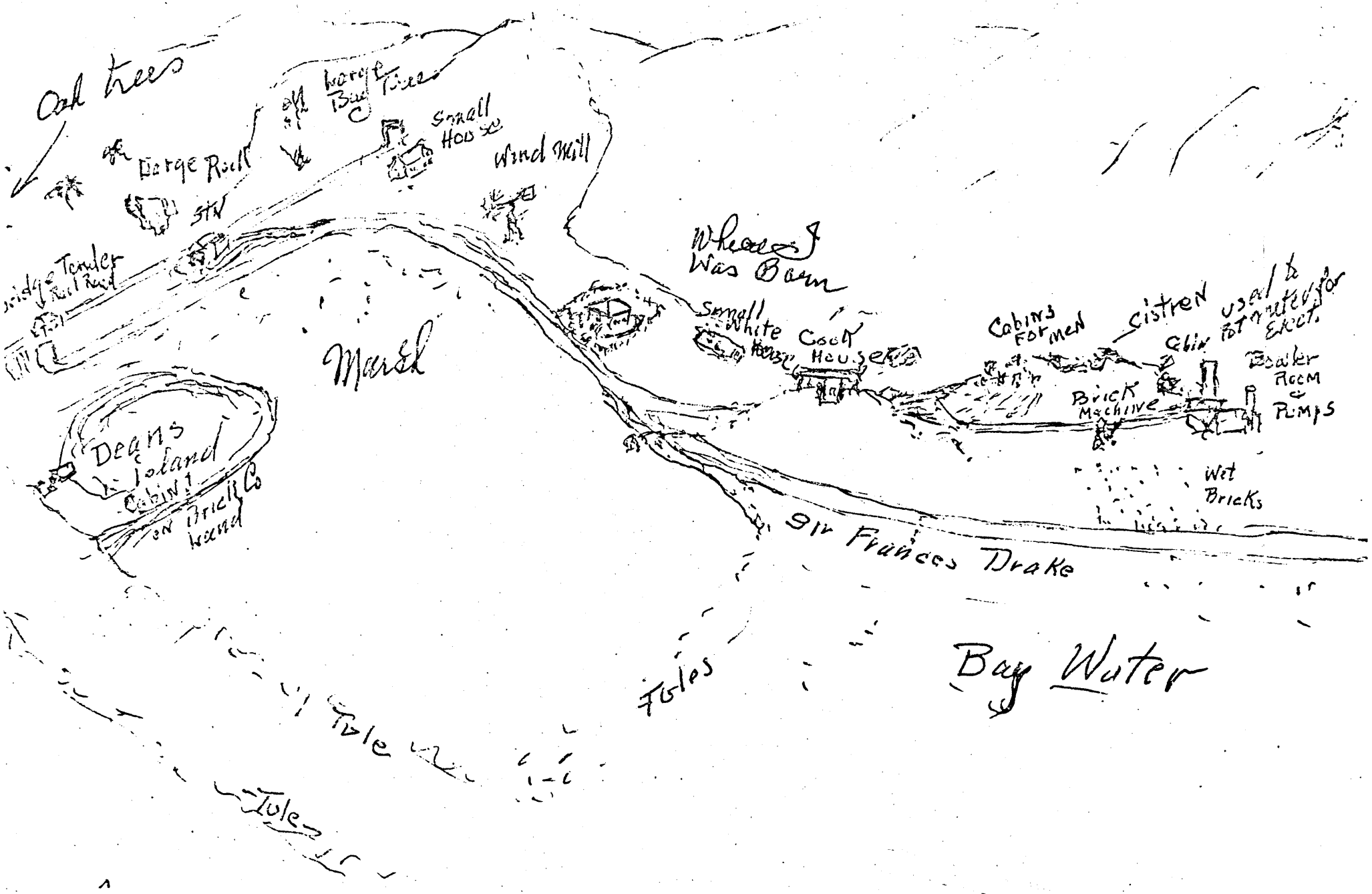
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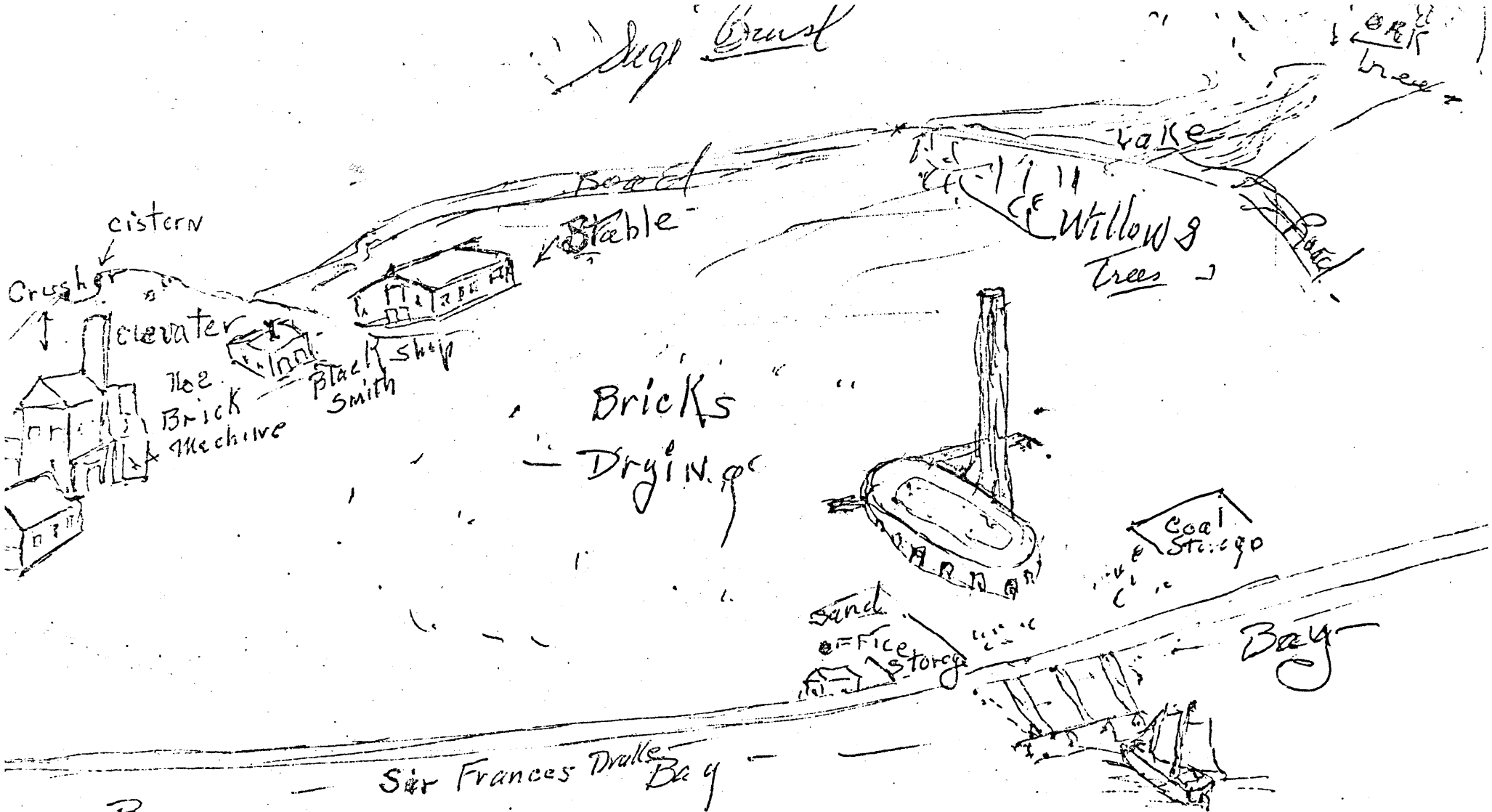
Item #8 - Engineering Significance



RECEIVED
NATIONAL
REGISTER

Drawn by Mr. John Tacchi, 1975
Born at Remillard Brick Yard, 1900
Resident 1900-1915
ITEM #7 - DESCRIPTION: ORIGINAL APPEARANCE


Oak trees
Large Tree
Small Hoo
Barge Road
Wind Mill
Bridge Tender Road
Marsh
Wheel Was Barn
Small White Cook House
Cabins For men
Cistren
Brick Machine
Boiler Room & Pumps
Wet Bricks
Deans Island Cabin on Brick Co land
Sir Frances Drake
Tules
Bay Water



RECEIVED
OCT 4 1977
NATIONAL REGISTER

Drawn by Mr. John Tacchi, 1975
Born at Remillard Brick Yard, 1900
Resident 1900-1915

ITEM #7 - DESCRIPTION: ORIGINAL APPEARANCE

METADATA SHEET

Informal resource

“467A-002”

‘Wood Island’

This informal resource relates to a mark that was found on the San Rafael 7.5’ USGS quad map during the transfer of all info to the NWIC GIS. The note on the map collar states, “Unrecorded Site”. The note in the GIS features states: “this is a midden site described in S-12242”. No other information is provided.

Date: 2018-Aug-08
NWIC Staff: George Riner

State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary # _____
HRI # _____
Trinomial _____
NRHP Status Code _____
Other Listings _____
Review Code _____ Reviewer _____ Date _____

 ***Resource Name or #** *(Assigned by recorder):* Larkspur Ferry Terminal

P1. Other Identifier: Larkspur Landing

***P2. Location:** ☐ **Not for Publication** ☒ **Unrestricted**

***a. County:** Marin **and** *(P2b and P2c or P2d. Attach a Location Map as necessary.)*

***b. USGS 7.5' Quad** San Rafael **Date** 1995 **T** 1N; **R** 6W; **of Sec** Unsectioned; **B.M.** Mount Diablo

c. Address 101 East Sir Francis Drake Boulevard **City** Larkspur **Zip** 94939

d. UTM: Zone 10S; 543170.50 mE/ 4199775.48 mN

e. Other Locational Data: This property is located on Assessor's Parcel Numbers (APNs) 018-172-18, 018-172-19, and 018-172-20, and includes a main shelter structure, an adjacent service building, a fueling/maintenance area with fuel tanks and maintenance structures, and a parking lot. It is situated in City of Larkspur, Assessor's Map Book 18, Page 17, Block 172, Parcel 18, 19, and 20. The property is approximately 50 feet east of the intersection of Larkspur Landing Circle and Sir Francis Drake Boulevard in the City of Larkspur, County of Marin, California.

***P3a. Description:**

The Larkspur Ferry Terminal property is a public transportation terminal located in the City of Larkspur, Marin County (Photograph 1). The terminal is set along the water side of Sir Francis Drake Boulevard near the mouth of Corde Medera Creek that empties into the San Rafael Bay which is part of the larger San Francisco Bay (Photograph 2). The land portion of the ferry terminal property is approximately 14.5 acres total and features a series of buildings, structures, parking areas, and surrounding lands for ferry operations and passenger use. Dock and boarding structures are set within the bay waters and an 83-acre basin that aligns north to south on the eastern side of the property for the landing of large passenger-only ferry boats. The surrounding area is urbanized with Larkspur Landing shopping center and numerous other commercial buildings to the north and west along with US 101. A series of residences are located to the southwest along the right bank of Corte Madera Creek (*see Continuation Sheet*).

***P3b. Resource Attributes**: HP11. Engineering Structure; HP30. Other



***P4. Resources Present**:
☒ Building ☒ Structure ☐ Object ☐ Site ☐ District ☐ Element of District ☐ Other *(Isolates, etc.)*

P5b. Description of Photo:
Photograph 1. Larkspur Ferry Terminal. View south. June 04, 2021.

***P6. Date Constructed/Age and Sources**:
☒ Historic ☐ Prehistoric ☐ Both
1976 (*The Press Democrat 1976*)

***P7. Owner and Address:**
Golden Gate Bridge, Highway and Transportation District

***P8. Recorded by:**
Mark Bowen and Irem Oz,
Jacobs Engineering
2485 Natomas Park Drive #600
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***P9. Date Recorded:** 05/12/2026

***P10. Survey Type:** Intensive

***P11. Report Citation:** *2026. Jacobs Engineering Inc. Cultural Resources Report for Larkspur Ferry Expansion Project, Marin County, California.*

***Attachments**: ☐ NONE ☒Location Map ☐Sketch Map ☒Continuation Sheet ☒Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐Other _____

***NRHP Status Code:** 3S; 3CS
***Resource Name or #**: Larkspur Ferry Terminal

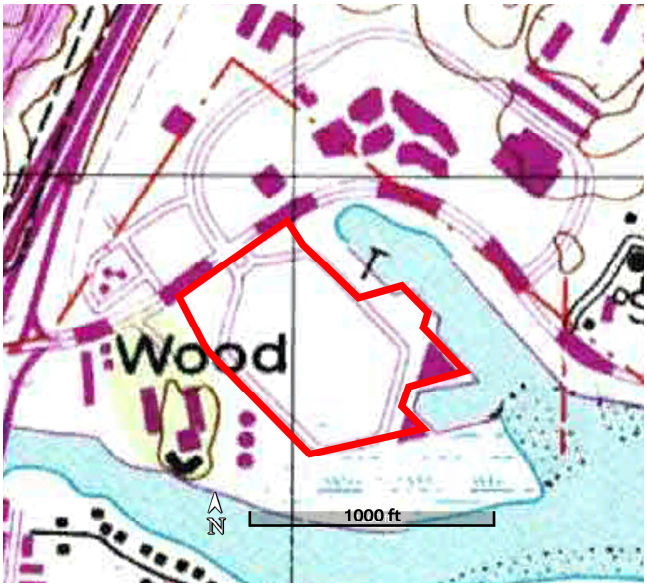
B1. Historic Name: Larkspur Ferry Terminal
B2. Common Name: Larkspur Ferry Terminal
B3. Original Use: Ferry Terminal B4. Present Use: Ferry Terminal
***B5. Architectural Style:** Late Modernism with High-Tech Structuralist design characteristics
***B6. Construction History:** *(Construction date, alteration, and date of alterations):* Ferry terminal constructed in **1976**; ferry berths expanded from three to four in the **1990s**; landscape planters removed **between 1987 and 1993**; pedestrian overpass constructed in **1982**; parking lot reconfigured **circa 1995** and **circa 2008**; bicycle access improvements and new bicycle racks installed in **2008**; additional parking areas constructed north and northwest of the original lot **circa 2008**; parking areas repaved **circa 2013**; and minor modifications to passenger circulation, operational features, and site elements **between the 1990s and 2010s**.
***B7. Moved:** ☒ **No** ☐ **Yes** ☐ **Unknown** **Date:** _____ **Original Location:** _____
***B8. Related Features:** Ferry berths and docking facilities; pedestrian overpass; parking areas and circulation infrastructure; ancillary service and maintenance structures

B9a. Architect: Braccia, DeBrer and Heglund (Jacques de Brer, lead architect) **b. Builder:** Williams & Burrows, Inc
***B10. Significance:** **Theme:** Transportation; Architecture **Area:** Marin County
Period of Significance: 1976 **Property Type:** Transportation Facility **Applicable Criteria** NRHP C, CRHR 3

(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

The Golden Gate Bridge, Highway and Transportation District constructed the Larkspur Ferry Terminal in 1976 as a ferry facility serving Marin County within the Agency's regional transportation system. The terminal developed in response to increasing demand for alternative commuter transportation between Marin County and San Francisco. San Francisco-based architect Jacques de Brer designed the facility and it features a distinctive Late Modernist design employing a High-Tech Structuralist approach. Its defining feature is a monumental triangular steel space-frame roof supported by exposed structural elements, creating an open-air terminal. Since its construction, the terminal underwent several alterations, including expansion of ferry berths in the 1990s, reconfiguration of parking areas, and minor modifications to circulation and site features between the 1980s and 2000s. Today, the property continues to function as an active ferry terminal and transportation hub serving Marin County.

The property has not been previously evaluated for listing in the National Register of Historic Places (NRHP) or the California Register of Historical Resources (CRHR), although it has been recognized as an important example of 1970s modern design. Research did not identify a direct association between the terminal and events or individuals significant in local, state, or national history. While the resource is associated with broader regional transportation trends, it does not rise to the level of significance under NRHP Crition A or CRHR Criterion 1. Similarly, it is not associated with significant individuals under NRHP Criterion B or CRHR Criterion 2 and does not appear likely to yield important information under NRHP Criterion D or CRHR Criterion 4. However, the terminal embodies distinctive characteristics of Late Modernist architecture and represents a significant example of High-Tech Structuralism in the San Francisco Bay Area. Its design was recognized through professional publication and an American Institute of Architects award, and the building retains a high level of integrity. The Larkspur Ferry Terminal is recommended eligible for listing in the NRHP Criterion C and CRHR under Criterion 3 *(see Continuation Sheet).*



B11. Additional Resource Attributes: *(List attributes and codes)*
***B12. References:** See Continuation Sheet
B13. Remarks: None
***B14. Evaluator:** Irem Oz, Jacobs Engineering
***Date of Evaluation:** 05/12/2026

(This space reserved for official comments.)

***P3a. Description (continued):**

While the great majority of the almost 15-acre property is occupied by the paved parking areas, several buildings and structures related to operations of the ferry terminal are in spaces at the southeast and southwest of the property to better access the waterfront and allow for adequate customer vehicle parking.

Buildings located in two distinct areas of the property, one at the southeast corner of property that includes the main shelter structure and the adjacent service building. The second area is at the southwest corner of the property that features a fueling/maintenance area with fuel tanks and maintenance structures (Photograph 3).

The Shelter Structure is the primary focus of the ferry terminal property visually with its large and distinct construction features and materials (Photograph 4). The general design theme of the Shelter Structure has been identified as a notable example of "High-Tech Structuralism" or "Structural Expressionism" with its "space frame," tensile roof, cable structure, and futuristic-looking technology (geometric shape thematic, exposed frame, etc.) construction for which the style became popular. The overall design is a geometric-focused shade structure that features a triangular shaped open canopy topped with a tensile roof that is supported by a steel "space frame" that uses interconnected pipe and gussets to create triangular nodes that form the frame. The structure is set upon three reinforced concrete pyramidal base supports that peak upward to connect at a point with inverted pyramidal space frame "legs" that connect at a point atop the concrete supports (Photograph 5). The triangle- themed space-frame structure (the roof measuring 108 feet each side) is topped with triangular tensile roof panels that are semi-opaque to allow sunlight through. While the open structure sits over two-stories high, the covered floor plan includes reinforced concrete steps and benches and features numerous "kiosks" for various visitor uses including bathrooms and vending (Photograph 6). A steel security fence encircles the structure and frosted glass panels are located along the western elevation. Concrete walkways lead the visitors to the geometrically shaped loading ramps that are part of the ferry piers on the east side of the shelter structure. A smaller "spaceframe" flat-roof awning is located on the west elevation supported by concrete columns (Visible in Photograph 7). Lights are simple monopole types that feature simple flared light fixture toppers.

The Service Building is located directly to the south and follows a similar triangular geometric shape theme as the Shelter Structure (Photograph 8). The Service Building is slightly smaller scale and does not use the same construction materials and design as the Shelter Building. The smaller and more utilitarian design gives the Office Building a secondary appearance when compared to the Shelter Structure. Like the Shelter Structure, the building is a triangular-plan footprint and two stories in height. The building walls are reinforced concrete and internal steel I-beams and external columns. The interior footprint is smaller in area than the 4-foot boxed eaves clad with sheet-metal facia that extend ten feet beyond the building walls with recessed lighting (Photograph 9). The building walls are reinforced concrete panels on the bottom and heavily tinted fixed-pane anodized frame glass in a "band" along the upper story. Pipe-style columns extend vertically along the building walls reinforced at the points with seismic cross-braces. Access doors include personnel doors and larger roll-up equipment doors.

Loading platforms for the ferries are located around the Shelter Building and the Service Building on the concrete platform (Photograph 10). The Shelter Building features two loading platforms on either side of the Shelter Building. An additional "run-up" platform is located to the north of the Shelter Building and is adjacent to the ADA parking area and a small rectangular shed building (Photograph 11 and 12). Lights are simple monopole types that feature simple flared light fixture toppers.

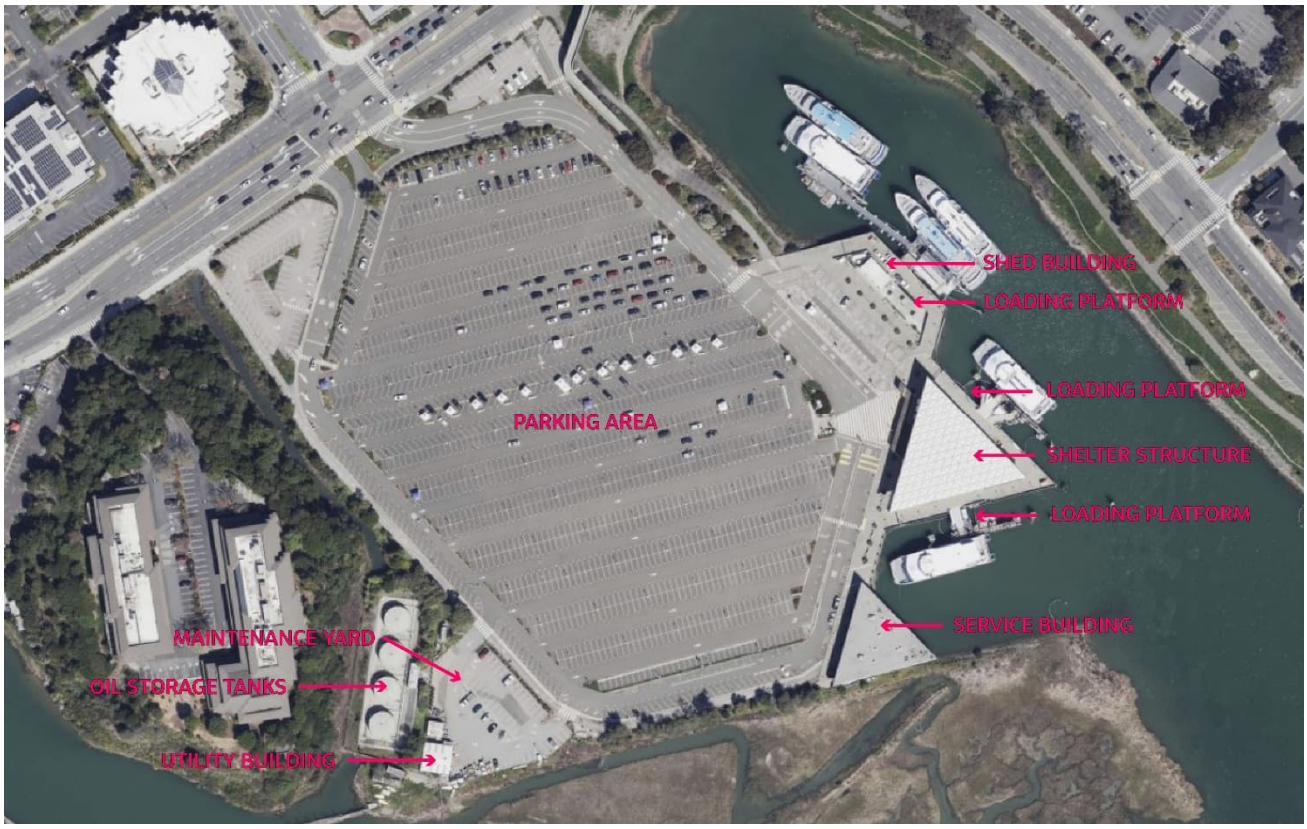
In the southwestern corner of the property is the Maintenance Yard, a set of four fuel-oil storage tanks and a prefabricated steel side-gable roof Utility Building (Photograph 13). The utilitarian steel tanks are approximately 20 feet in height and 36 feet in diameter. Set in a row behind the Utility Building, the tanks are largely hidden from view, as is the underground pump station (Photograph 14).

The large parking area is a simple open paved area (shaped in a hexagon when viewed from above) that is encircled by the main circulation road within the property. Some landscape planting features are present around the perimeter including a tri-flag flagpole while no distinct landscape features are located within the main parking area itself (Photograph 15). Two smaller parking areas are located on either side of the ferry terminal entryway at Sir Francis Drake Boulevard. A simple reinforced concrete pedestrian overcrossing crosses the boulevard at the northeastern corner of the property landing near a small, tree and shrub landscaped area at the northwest end of the ferry basin. Lights are simple monopole types that feature simple flared light fixture toppers.

P5a. Photographs (Continued):



Photograph 2: View of the Larkspur Ferry Terminal, facing south (Jacobs 06/04/2021).



Photograph 3: Aerial view of Larkspur Ferry Terminal



Photograph 4: View of the northeast and west sides of Shelter Structure, facing south (Jacobs 06/04/2021).



Photograph 5: Concrete pyramidal base supports of the Shelter Structure, facing east (Jacobs 06/04/2021).



Photograph 6: View of the kiosks, facing northeast (Jacobs 06/04/2021).



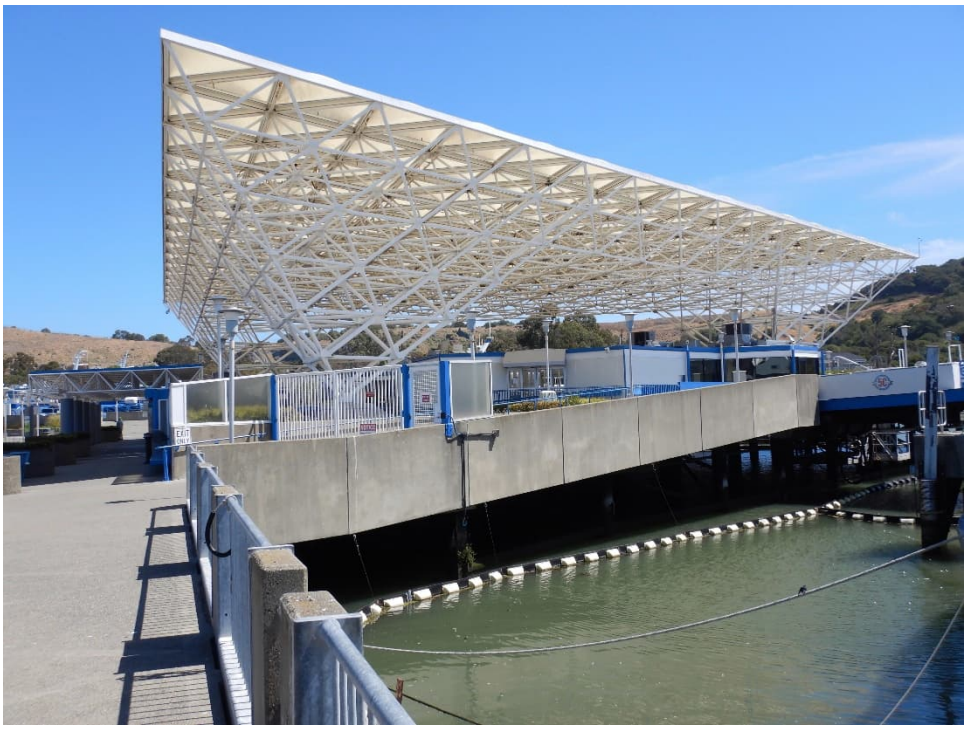
Photograph 7: View of Larkspur Ferry Terminal, with smaller spaceframe awning on the west elevation visible, facing east (Jacobs 06/04/2021).



Photograph 8: View of the Service Building, facing south (Jacobs 06/04/2021).



Photograph 9: View of the sheet metal fascia of the Service Building, facing south (Jacobs 06/04/2021).



Photograph 10: View of the loading platforms located around the Shelter Building, facing north (Jacobs 06/04/2021).



Photograph 11: View of the west façade of the Shed Building (Jacobs 06/04/2021).



Photograph 12: View of the Shed Building and the run-up platform, view east (Jacobs 06/04/2021).



Photograph 13: View of the Utility Building in the Maintenance Yard, view west (Jacobs 06/04/2021).



Photograph 14: View of the underground pump station and utilitarian steel tanks that are hidden from view, facing west (Jacobs 06/04/2021)**.**



Photograph 15: View of the large paved parking area, facing northeast (Jacobs 06/04/2021).

***B10. Significance (continued):**

Historic Context

Overview of Marin County

Marin County is a southward-facing peninsula that is bordered by Sonoma County to the north, the San Francisco Bay and San Pablo Bay to the east, San Francisco to the south, and the Pacific Ocean to the west. This geography, which is defined by water barriers and limited land access, has historically shaped the county's development patterns and reliance on ferries and regional transportation infrastructure. The first European settlement in Marin County was Mission San Rafael Archangel, established in 1817 (Kyle 1990:174). After California's statehood in 1850, Marin became one of the original 27 counties, and San Rafael was designated as the county seat (Kyle 1990:174).

Early industries such as agriculture, logging, and viticulture were important to the county's development. New settlers established numerous dairy farms and the towns of Tomales, Olema and Nicasio were the center of early trading for goods produced on the dairy farms. By 1862, Marin County provided one quarter of California's butter. Potatoes, grains, oysters, clams, and mussels were also shipped from Marin County's coastal towns to San Francisco (Bowen 2014:5), emphasizing the county's early economic ties to regional markets across the Bay.

Transportation improvements in the 1870s, which included introduction of trains, steamships, and ferries, significantly expanded those connections. Ferry slips built in Sausalito and Tiburon linked Marin County with San Francisco, improving access to markets and facilitating the movement of people and goods. These ferry services also brought visitors to Marin County's rural areas and thereby made tourism another thriving industry for Marin County (Bowen 2014:5). Waterborne transportation thus became a vital component of Marin County's regional identity and economic vitality.

Marin County would continue to grow and thrive into the 20th century. Like many northern California counties, the county was greatly impacted by World War II. Wartime industry came to Marin County in the form of airfields and shipyards, which brought thousands of workers. Many of those who relocated during the war remained after its conclusion, accelerating suburban growth and increasing daily travel between Marin County and San Francisco (Bowen 2014:5). In the postwar period, rising automobile use and commuter demand placed increasing pressure on regional transportation systems, shaping later investments in bridges, highways, and renewed ferry service. Today, Marin County continues to thrive and has a population of more than 250,000 (U.S. Census 2021b).

City of Larkspur

In 1887, the American Land and Trust Company laid out the townsite of Larkspur (LHPB 2008). Lot sizes ranged from 50 by 100 feet to 100 by 250 feet, with prices between $125 and $300 (The Daily Examiner 1888: 6). The town's location along Corte Madera Creek and near San Francisco Bay made it well suited to transportation-related development, and by the early 1900s its downtown area included two hotels, bakeries, a blacksmith, a livery stable, meat and grocery stores, and a lumberyard. These services supported local residents as well as travelers and commuters.

Larkspur incorporated as a city in 1908, and its city hall was dedicated on July 4 of that year (LHPB 2008: 9-10). During the early decades of the 20th century, residential subdivisions were platted and streets, roads, and infrastructure were expanded, as the city's started to transform into both residential community and a transportation node linked to rail and ferry service. Schools, libraries, houses of worship, fire stations, and parks were well established by the mid-20th century.

Following World War II, Larkspur experienced a housing boom, with new subdivisions and multi-family housing constructed to accommodate a growing population. The city's 1965 General Plan designated most land within city boundaries for residential and commercial development. In the 1970s, revisions to the General Plan were made for the preservation of open space and ridgelines, signaling shifting planning priorities. In 1978, the City Council adopted its Heritage Preservation Ordinance and established the Heritage Preservation Board to focus on preserving Larkspur's history, culture, and heritage (LHPB 2008:248, 250, 346). Today, Larkspur has a population of more than 12,000 (U.S. Census 2021a).

Transportation Context: Golden Gate Bridge Highway and Transportation District

The Golden Gate Bridge, Highway and Transportation District (District) is a special district of the State of California created to plan, build, operate, and maintain the Golden Gate Bridge and related transportation facilities. Today, the District operates and maintains the Golden Gate Bridge as well as two integrated public transit systems, Golden Gate Transit and Golden Gate Ferry, that connect Marin, Sonoma, San Francisco, and Contra Costa counties. Acting under authority granted by California state law, the District's mission is to provide safe and reliable bridge operations while delivering transportation services within the U.S. Highway 101 Golden Gate Corridor (District 2021a). The District's expanding role in regional transportation planning directly shaped the development of ferry terminals in Marin County, including the Larkspur Ferry Terminal.

Formation and Early History of the District

The Golden Gate Bridge, Highway and Transportation District was formed in response to long-standing regional transportation challenges associated with crossing the Golden Gate Strait, the narrow channel separating San Francisco County to the south from Marin County to the north. In the early 1920s, San Francisco City Engineer Michael O'Shaughnessy, mayoral secretary Edward Rainey, and engineer Joseph B. Strauss proposed the creation of a special district of the State of California to plan, finance, design, and construct a bridge across the strait. They argued that a regional governing institution was necessary to ensure that all affected counties were represented in the decision-making processes and share financial responsibility among the counties that would benefit from the project (District 2021a).

In January 1923, a meeting convened by Sonoma County banker Franklin P. Doyle resulted in the formation of the Bridging the Golden Gate Association, which actively promoted the bridge concept and pursued to enable legislation for its construction. Working with Assemblyman Frank L. Coombs and Marin County attorney George H. Harlan, legislation authorizing the creation of a Bridge and Highway District was signed into law in May 1923. Under the legislation, counties could elect to join the district by petition and approval of their boards of supervisors (District 2021a).

Although the bridge itself would span only between San Francisco and Marin counties, the proposed district was envisioned as a broader regional entity. Between 1925 and 1928, San Francisco, Marin, Sonoma, Del Norte, and portions of Napa and Mendocino counties voted to join the proposed district. Its formation faced opposition, particularly from established ferry operators, who viewed the bridge as a direct threat to their businesses. Additional resistance came from groups concerned about financial risk, taxation, and the potential environmental impacts of increased growth and tourism. Legal challenges delayed implementation. In December 1928, the Golden Gate Bridge and Highway District was formally and legally established as the sole entity responsible for the bridge's design, construction, and financing (District 2021a).

The District's Board of Directors convened for the first time in January 1929 and appointed key personnel, which included Joseph B. Strauss as Chief Engineer. Following receipt of a construction permit from the U.S. War Department in 1930, construction started, and the Golden Gate Bridge opened to traffic in May 1937. The project was financed through bond sales secured by toll revenues and backed by property within the member counties. Final bond payments were made in 1971, leaving the District with substantial financial reserves that later allowed for the expanded transportation responsibilities (Kowleski 1979: 6; District 2021a).

Originally established to operate the bridge as a highway facility, the District's role expanded significantly as vehicle traffic increased in the following decades. By the late 1960s, rapid population growth in Marin and Sonoma counties and rising commute traffic brought the bridge to its theoretical capacity during peak periods, particularly along the U.S. Highway 101 corridor connecting Marin County to San Francisco. These conditions prompted the state lawmakers to expand the District's purpose and authority (Kowleski 1979: 10).

Revival of Ferry Service: Golden Gate Ferry System

Following the opening of the Golden Gate Bridge in 1937, ferry service between Marin County and San Francisco rapidly declined and was discontinued entirely by 1941. This left the bridge as the sole direct transportation link between the North Bay and San Francisco for nearly three decades (District 2021a; Kowleski 1979: 7). As congestion intensified along the Golden Gate Corridor in the postwar period, revived ferry service emerged as an alternative to the continued reliance on the private automobile (Kowleski 1979: 9).

During the time that traffic congestion on the Golden Gate Bridge was becoming a serious problem, the bridge's original construction debt was about to be paid off, which allowed the District to have the financial flexibility and the motivation to reconsider other options to handle the transportation across the strait. A series of studies explored options including increasing bridge capacity, constructing new bridges or tunnels, expanding bus service, and reviving ferry operations. Among these options, a modern commuter ferry system emerged as a comparatively low-cost, flexible, and environmentally constrained solution. In July 1969, the Feasibility Study of a San Francisco-Marin Ferry System, prepared by Arthur D. Little, Inc., concluded that a modern commuter ferry system could divert up to 5,800 commuters per weekday from automobile travel and remove as many as 2,900 vehicles per day from the Golden Gate Bridge during its first year of operation (Little 1969: 17; Kowleski 1979: 7).

Based on these findings, the California State Legislature formally authorized the Golden Gate Bridge and Highway District to plan and implement a mass transportation program within the U.S. Highway 101 Golden Gate Corridor, including ferry operations. At that time, the word "Transportation" was added to the District's name to reflect its expanded mandate. Although the District lacked authority to levy taxes, surplus bridge toll revenue could be used to support intercounty transit services, supplemented by state and federal funding (District 2021a.; Kowleski 1979: 9).

The District formally entered the transit business in August,1970, with the inauguration of Golden Gate Ferry service between Sausalito and San Francisco. During the same period, limited bus service began operating to and from the Sausalito ferry terminal, establishing an integrated bus and ferry system. In December 1971, state legislation further required the District to undertake long range transportation planning for the corridor. Following extensive public outreach, including 21 public hearings across six counties, the unified system of buses and ferries, known as Golden Gate Transit and Golden Gate Ferry, was confirmed as the preferred regional transit solution (District 2021a.; Kowleski 1979: 9).

As ferry ridership increased, the District expanded service beyond southern Marin County. After extensive study, Larkspur was selected as the principal northern Marin terminal due to its central location, proximity to U.S. Highway 101, and ability to serve commuters from both central and northern Marin County. In 1972, the District purchased a 25-acre waterfront site in Larkspur for approximately $1.25 million. The approximately 11 nautical mile crossing between Larkspur and San Francisco allowed ferry travel times to remain competitive with peak period automobile travel, making the route preferable for daily commuters (Little 1969; Kowleski 1979: 10). Williams & Burrows, Inc. was awarded the building contract.

Construction of the Larkspur Ferry Terminal was authorized in 1974. With the completion and dedication of the Larkspur Ferry Terminal in 1976, the ferry service expanded to include the Larkspur route in December 1976. The opening of the terminal marked a significant milestone in the development of a permanent ferry system for North Bay (District 2021b). Since its establishment, Golden Gate Ferry service became an integral component of the District's transportation network, providing a reliable alternative to automobile commuting between Marin County and San Francisco. The Larkspur route, in particular, has continued to serve as a major hub within the system, carrying more than one million passengers annually (District 2021c).

The terminal was completed and dedicated in 1976, coinciding with the placement into service of the G.T. Marin, the first purpose-built vessel for the route. Ferry operations expanded quickly with the addition of the G.T. Sonoma in March 1977, followed later that year by the G.T. San Francisco (District 2021b). The opening of the Larkspur route represented a significant milestone in the development of a permanent, integrated ferry system serving the North Bay.

Since its establishment, the Larkspur Ferry has remained a central component of the District's ferry operations. The route continues to provide an important alternative to automobile commuting between Marin County and San Francisco, carrying more than one million passengers annually as recently as 2020 (District 2021c).

Larkspur Ferry Terminal

Planning of Larkspur Ferry Terminal

Early planning for the Larkspur Ferry Terminal began as the Golden Gate Bridge Highway and Transportation District evaluated locations to serve growing commuter demand in central and northern Marin County. In a preliminary report presented to the District's directors, consultant Philip F. Spaulding advised that three to four conventional ferryboats with planing hulls would be required to provide peak-period service to Marin County, with departures at approximately 30-minute intervals. Spaulding identified potential terminal locations at both Corte Madera and Larkspur, noting that either site would require extensive dredging and significant site preparation in order to accommodate ferry operations (*Daily Independent Journal* 1970: 7).

In 1971, the District agreed to purchase a waterfront site in Larkspur for development of a ferry terminal, contingent on approval of federal funding. The site, located at the edge of San Francisco Bay, encompassed approximately 25.4 acres. During the same period, the District also approved the purchase of a separate 10-acre parcel near the intersection of Highway 101 and State Route 17 for a bus maintenance facility, planning for an integrated ferry and bus transit system in the future (*San Francisco Chronicle* 1971: 7).

The Larkspur ferry terminal site was formally acquired in April 1972 from T. I. Properties. That year, the District announced plans to invest in an expanded ferry program, including construction of three new ferry vessels, one intended to expand Sausalito service and two designated to serve to the proposed Larkspur terminal (*San Francisco Chronicle* 1972a: 4). In support of terminal development, the District selected the architectural firm of Braccia, Debrer, and Heglund to prepare a master plan for the Larkspur facility (San Francisco Chronicle 1972b: 5).

By early 1973, the Golden Gate Bridge, Highway and Transportation District formally authorized the architects to proceed with final design. Initial plans envisioned completion of the terminal by June 1974, with estimated costs of approximately $4.7 million, inclusive of the site acquisition. The proposed design included a passenger terminal, repair and maintenance facilities, and limited commercial uses. Environmental considerations played a significant role in the planning process, and the design was changed to preserve adjacent pickleweed marshlands as wildlife habitat, addressing concerns raised by environmental advocacy groups (*San Francisco Chronicle* 1973a: 49).

Despite these measures, opposition and regulatory challenges continued. By May 1973 there were indications that permitting challenges could delay the project (*Daily Independent Journal* 1973: 10). Additional concerns focused on the impacts of dredging at the mouth of Corte Madera Creek, including disposal of dredged materials and the presence of potentially toxic metals in bay mud (*San Francisco Chronicle* 1973b: 55). During this period, revised cost estimates climbed sharply, reaching approximately $10.4 million, more than double earlier projections. This revised number was exclusive of additional costs for dredging, redesign, and consulting services (*San Francisco Chronicle* 1973c: 5; *The Times Herald* 1973: 6).

In February 1974, the Bay Conservation and Development Commission approved the terminal project, subject to stringent environmental conditions. These included requirements for marshland restoration using dredged bay mud, construction of a public waterfront viewing area, and incorporation of a bikeway along the site (*San Francisco Chronicle* 1974: 5). State Lands Commission approval for dredging was issued in June 1974, followed by final authorization from the U.S. Army Corps of Engineers in October 1974, clearing the project for

construction (*Daily Independent Journal* 1974a: 6, 1974b: 15; District 2021b). Williams & Burrows of Belmont began construction in mid-January 1975 after the District awarded the firm the contract for terminal construction and dredging operations (*Daily Independent Journal* 1975a: 1).

Design and Designers

The Larkspur Ferry Terminal was designed as a highly visible and architecturally expressive transportation facility intended to serve as the primary Marin County terminal for Golden Gate Ferry operations. Initial passenger amenities included an approximately 18,000-square-foot open-air terminal structure and a parking facility accommodating approximately 1,000 vehicles. The terminal was designed by the San Francisco-based architectural firm Braccia, DeBrer and Heglund under the leadership of architect Jacques de Brer, with landscape architecture by Royston, Hanamoto, Beck & Abey (District 2026; Naim 1979: 122).

Jacques de Brer was born in Brussels and raised in Santiago, Chile, de Brer relocated to Los Angeles as a teenager. He earned a bachelor's degree from the University of Southern California and a master's degree in architecture from the University of California, Berkeley, where he later served as a lecturer in the College of Environmental Design until the early 1990s. After winning first place in the Santa Rosa Civic Center design competition, de Brer established a private architectural practice in San Francisco. His work received numerous professional recognitions, including an American Institute of Architects award for his design of the Larkspur Ferry Terminal and an honorable mention for the Vietnam Veterans Memorial competition in Washington, D.C. In addition to projects in the United States, de Brer completed community-oriented design work in Guatemala and Eritrea. He remained active in architectural practice and education until his death in 2006 (*San Francisco Chronicle* 2006; *San Francisco Gate* 2006).

The Larkspur Ferry Terminal building is constructed in the Late Modernist style and is specifically associated with High Tech Structuralism, which is a design approach emerged in the 1970s. This style emphasizes the clear expression of structural systems, modern materials, and construction technology as visible elements of the design. This style is influenced by architects such as Norman Foster and Richard Rogers in Great Britain, as well as Renzo Piano and Santiago Calatrava internationally, High Tech Structuralism treats structure and engineering elements such as space frames, tensile roofs, and cable structures, as defining architectural features. Simmons notes that in the San Francisco Bay Area, examples of this style are not very common and therefore architects adapt elements of structural expression to create visually dynamic Late Modernist buildings that use exposed structural systems as a primary design feature (Simonson 2014: 84).

The dominant architectural feature of the Larkspur Ferry Terminal is its triangular steel space frame roof, which provides a covered but unenclosed passenger waiting and circulation area. The space frame forms an equilateral triangle measuring approximately 192 feet on each side at the roofline and is supported by three inverted pyramidal legs above an open terminal deck. The triangular geometry is repeated throughout the truss system, with horizontal members forming smaller equilateral triangles across multiple levels (Kowleski 1979: 13-14; Naim 1979: 122). Passenger circulation was a key design consideration. Ticketing and entry points are located adjacent to parking areas, bus stops, and passenger drop-off zones. Once inside the terminal, passengers are guided toward boarding areas through changes in elevation and the configuration of structural elements. Disembarking passengers use perimeter ramps that return them to parking area (Naim 1979: 122).

The terminal structure is supported by a pile-supported, cast-in-place concrete deck designed to address the site's geotechnical conditions, which include soft bay mud and marshland soils. This foundation system was intended to provide rigidity and seismic stability while extending the terminal structure over the water. The triangular configuration of the space frame allows for three ferry berths and associated maintenance space within the narrow navigation channel (Naim 1979: 122). Support facilities, which include service buildings, fuel storage, and parking, occupy the remainder of the approximately 25-acre site extending into Corte Madera Creek (Kowleski 1979: 13-14).

Landscape architecture for the terminal and surrounding site was designed by Royston, Hanamoto, Beck & Abey, a well-known San Francisco-based firm known for integrating large-scale infrastructure projects with environmental and community-oriented design. The firm is established in 1960, and it played a significant role in shaping postwar landscape architecture in California, completing parks, institutional campuses, transit facilities, and large-scale planning projects throughout the Bay Area. At Larkspur Ferry Terminal, the landscape design addressed circulation, parking, and environmental restoration (The Cultural Landscape Foundation 2026).

Larkspur Ferry Terminal has undergone several alterations since its construction. These include:

- Expansion of ferry berths, from the original three berths to four berths in the 1990s (District 2021b).
- A covered passenger waiting area was added within the existing space-frame structure (District 2021b)
- Removal of landscape planters between approximately 1987 and 1993 (NETR 1987 and 1993).
- Reconfiguration of the existing parking lot to accommodate additional vehicles circa 1995 and 2008 (District 2021b).
- Bicycle access to the terminal is improved and existing bicycle racks were replaced with new ones in 2008 (District 2021b).
- Addition of parking areas north and northwest of the original parking lot circa 2008, including installation of concrete walkways, curbs, and ADA-compliant ramps.

- Repavement of parking areas circa 2013.
- Minor adjustments to passenger circulation and operational features to support evolving ferry service needs.
- Minor site and landscape modifications associated with environmental management and maintenance requirements.
- Accessibility improvements, with the facility designed to be wheelchair accessible (District 2021b).

Construction and Operation

Construction of the Larkspur Ferry Terminal began in mid-January 1975. Early in the construction phase, future commuter access to the site was identified as a significant problem. Local roads serving the terminal area had been designed for much lighter traffic volumes, originally accommodating horse-and-buggy circulation. The Golden Gate Bridge, Highway and Transportation District implemented short-term traffic control measures, including roadway improvements and installation of a four-way stops, while addressing longer-term access solutions (*Daily Independent Journal* 1975b: 6).

By January 1976, construction was reported to be approximately 80 percent complete. At that time, the project was approximately 35 months behind schedule and approximately $9 million over the original cost estimate. Cost increases were due to higher-than-anticipated expenses related to the construction of the marine infrastructure (San Francisco Examiner 1976a: 3). Construction of Berth 1 was identified as a significant cost factor, as it proved more expensive than originally projected (*Daily Independent Journal* 1976a: 1).

Delays continued into early 1976. In February, the Marin County Grand Jury ruled that the terminal should not open until adequate ingress and egress improvements were completed. Although an opening had been projected for June 1976, the ruling effectively halted commencement of service until roadway issues were resolved (*Daily Independent Journal* 1976b: 16). During this period, reporting highlighted the widening gap between original system-wide estimates and actual expenditures. Plans released in 1970 had projected that seven ferries and four terminals could be constructed for approximately $16.4 million. By 1976, costs exceeded $38 million, while the system had been reduced to three terminals and three ferries (*Daily Independent Journal* 1976c: 1).

The terminal building itself was substantially complete by July 1976, however, the start of service was further delayed by the unavailability of ferry vessels (San Francisco Examiner 1976b: 1). The Larkspur Ferry Terminal was ultimately dedicated on Saturday, December 11, 1976. Opening ceremonies included representatives from the District, Marin County, and the City of Larkspur, as well as an inaugural sailing. To encourage ridership, free transportation was offered to passengers using feeder bus services during the initial commute period (*The Press Democrat* 1976: 3; District 2021b).

Regular commute service on the Larkspur route began on December 13, 1976. The first Spaulding-class vessel, the G.T. Marin, entered service at opening, followed by the G.T. Sonoma in March 1977 and the G.T. San Francisco in September 1977. With the delivery of the third vessel, ferry operations typically utilized two vessels in daily service, with one maintained as a backup (District 2021b).

Over time, the Larkspur Ferry Terminal became an important component of regional transportation, particularly during periods of disruption. In January 1982, severe storms and resulting mudslides closed Highway 101 for multiple days. During this time ferry use surged to record levels, exceeding 12,000 passengers in a single day. Additional vessels were temporarily chartered to meet the demand. The following years saw operational growth, increased service frequency, infrastructure additions such as the pedestrian overpass connecting the terminal to Larkspur Ferry Terminal in 1982, and expanded passenger amenities (District 2021b).

By the late 20th and early 21st centuries, ferry operations at Larkspur had evolved to incorporate high-speed vessels, service reconfigurations, and ongoing improvements to parking, access, and passenger facilities. These changes reflected the terminal's continued role as a major Marin County transportation hub and its adaptability to changing commuter needs (District 2021b).

NRHP and CRHR Evaluation:

The Larkspur Ferry Terminal has not been previously evaluated for eligibility in the NRHP or the CRHR. While the terminal has been recognized in professional architectural contexts, including identification by Documentation and Conservation of buildings, sites, landscapes and neighborhoods of the Modern Movement (DOCOMOMO) as an important example of 1970s modern architecture, no formal NRHP or CRHR eligibility determination has been identified. The following sections evaluate the Larkspur Ferry Terminal as an individual property, focusing on its architectural significance, historical associations, and integrity.

NRHP Criterion A, CRHR Criterion 1

The Larkspur Ferry Terminal is associated with broad patterns of regional transportation history, specifically the introduction of ferry service in the Golden Gate Corridor during the late 20th century as part of efforts to address increasing congestion on the Golden Gate Bridge and U.S. Highway 101. Construction of the terminal occurred within the context of statewide and regional initiatives that expanded the role of the Golden Gate Bridge, Highway and Transportation District into multimodal transit operations, including coordinated bus and ferry service serving Marin County.

While the terminal reflects these important transportation trends, it does not appear to meet Criterion A/1 of the NRHP/CRHR both individually and as a larger district. The revival of ferry service was initiated prior to construction of the Larkspur terminal and implemented across multiple locations. The Larkspur Ferry Terminal was not the first ferry terminal developed as part of this effort and did not serve as the primary catalyst for the District's transition into public transit operations. Rather, it functioned as one component within a broader transportation program.

Although the Larkspur Ferry Terminal is associated with these late-20th-century transportation planning efforts, the property does not demonstrate a direct or singular association with a significant historical event. Its development reflects broader regional trends rather than a uniquely influential role in shaping those events. As a result, the Larkspur Ferry Terminal does not meet the requirements for individual eligibility under NRHP Criterion A or CRHR Criterion 1.

NRHP Criterion B, CRHR Criterion 2

The Larkspur Ferry Terminal does not appear to be individually significant for its association with the lives of historically important persons at the local, state, or national level. Available information does not show that the property is directly associated with any individual whose contributions meet the level of significance required under NRHP Criterion B or CRHR Criterion 2.

NRHP Criterion C, CRHR Criterion 3

The Larkspur Ferry Terminal was constructed in the High-Tech Structuralism style, a late-20th-century expression of Late Modernism. This style is most commonly associated with large institutional and infrastructure buildings and projects. As defined in San Francisco Modern and Postmodern Architectural Styles (1960-2000), this style emphasizes the visual expression of structure, engineering systems, and modern materials as primary architectural features rather than concealing them behind finished surfaces (Simonsen 2024: 84).

High-Tech Structuralism emerged in the 1970s as an expression of Late Modernism and is characterized by bold geometry, exposed structural systems, and innovative construction methods. The style is commonly features space frames, long-span structures, and clearly articulated load-bearing elements. The fully realized examples of High-Tech Structuralism are rare in San Francisco and the greater Bay Area, particularly in association with transportation or infrastructure facilities. Within this limited group, the Larkspur Ferry Terminal is specifically identified as a notable example (Simonsen 2024: 84).

Under NRHP Criterion C and CRHR Criterion 3, the Larkspur Ferry Terminal appears eligible for listing as a significant and rare example of the Late Modernist/High-Tech Structuralist-style. Constructed within the established period of significance for Late Modernism (1960s-1980s), the terminal demonstrates defining characteristics of the style through its monumental geometric form, extensive use of exposed steel structure, and emphasis on engineering as a visible architectural element (Simonsen 2024: 86). The design goes beyond basic functional needs to create a visually legible and sculptural public facility, consistent with principles of Institutional Late Modernism.

The terminal's architectural significance is further supported by professional recognition of its design. The project received an American Institute of Architects award, and the terminal was published in Architectural Record shortly after its completion (Naim 1979). While building's architect, Jacques de Brer, is not listed in the City's collection of biographies for Architects of Merit, the award and professional publication indicate the recognition of Larkspur Ferry Terminal's design quality. The terminal is also identified by DOCOMOMO as an important example of 1970s modern architecture, which further confirms its significance within the Late Modern architectural style.

Simonsen's Late Modernism evaluation framework also lists eligibility standards for NRHP Criterion C/CRHR Criterion 3 (2024: 87-88). The Larkspur Ferry Terminal meets all of these eligibility standards outlined by Simonsen as follows:

- Completed in 1976, within the Late Modernism period of significance.
- Design quality demonstrated through professional publication and awards (Naim 1979; AIA recognition).
- Retains character-defining features and high integrity of design, materials, and workmanship.
- Represents a rare extant example of High-Tech Structuralism applied to transportation infrastructure in the Bay Area.

Based on the applicable historic context, period of significance, and evaluation criteria, the Larkspur Ferry Terminal meets the requirements for individual eligibility under NRHP Criterion C and CRHR Criterion 3 as a rare and well-expressed example of High-Tech Structuralism within Late Modernist infrastructure architecture.

NRHP Criterion D, CRHR Criterion 4

Under NRHP Criterion D and CRHR Criterion 4, the resource is not significant for its research potential. What is known about the road, the owners, and activities regarding the Larkspur Ferry Terminal construction, modification, and use has been thoroughly researched and documented. Given the high level of documentation for the building, the physical components appear unlikely to yield important primary information under NRHP Criterion D or CRHR Criterion 4.

Period of Significance and Character Defining Features

The period of significance for the Larkspur Ferry Terminal is 1976, the year the facility was completed and placed into service. This date falls within the period of significance for Late Modernism, which is defined in San Francisco Modern & Postmodern Architectural Styles as between 1960 and 1980 (Simonsen 2024: 86).

Based on the Late Modernism evaluation framework outlined in Simonsen (2024: 88), the following character-defining features of Late Modernist architecture are present at the Larkspur Ferry Terminal:

- Visually heavy massing and materials: The terminal's large-scale steel space-frame structure gives it a strong visual presence,
- Strong geometric and sculptural forms: The equilateral triangular space-frame roof and inverted pyramidal supports create a bold geometric and sculptural forms,
- Common use of flat roofs: The terminal features a flat roof form,
- Use of modern materials such as metal and concrete: The terminal features steel framing and concrete substructures,
- Pronounced structural components: Terminal's structural elements are intentionally exposed and visually emphasized,
- Expressionist and sculptural qualities: The terminal treats the roof structure as a sculptural element.

Integrity Discussion

Larkspur Ferry Terminal has undergone several alterations since its construction. These include:

- Reconfiguration of the parking lot to accommodate additional vehicles circa 1995 and 2008 (Goldengate.org n.d.).
- Removal of landscape planters between approximately 1987 and 1993 (NETR 1987 and 1993).
- Expansion of ferry berths, from the original three berths to four berths in the 1990s (Goldengate.org n.d.).
- Minor adjustments to passenger circulation and operational features to support evolving ferry service needs.
- Minor site and landscape modifications associated with environmental management and maintenance requirements.

To be eligible under NRHP Criterion C or CRHR Criterion 3, a Late Modernist property must retain integrity from the period when its design was completed, with emphasis on integrity of design, materials, and workmanship (Simonsen 2024: 89). The Larkspur Ferry Terminal was completed in 1976, within the period of significance for Late Modernism, and continues to retain the physical characteristics that convey its architectural significance.

Location: The Larkspur Ferry Terminal retains integrity of location. The terminal remains in its original waterfront setting at the mouth of Corte Madera Creek, where it was constructed in 1976 to serve ferry operations between Marin County and San Francisco.

Design: The terminal retains a high degree of integrity of design. The defining elements of the facility, the triangular steel space-frame roof structure, open terminal deck, and overall geometric configuration, remain intact. Alterations have been limited to functional and operational changes that do not alter the original architectural design.

Setting: The terminal facility retains a moderate degree of integrity of setting. Although surrounding infrastructure, parking areas, and adjacent development have changed over time, the terminal continues to serve as a waterfront ferry facility with a strong visual relationship to San Francisco Bay.

Materials: The ferry terminal retains integrity of materials. Primary materials associated with the period of significance, steel structural elements and concrete foundations and deck, remain extant. Later additions and site improvements have not replaced the materials that convey the building's Late Modernist and High-Tech Structuralist character.

Workmanship: The ferry terminal retains integrity of workmanship. The quality and expression of the original structural system remain visible and continue to convey the design and construction techniques of the period.

Feeling: The terminal retains integrity of feeling as a Late Modernist transportation facility. Its monumental form, exposed structure, and open terminal space continue to convey the architectural character of 1970s infrastructure design.

Association: The building retains integrity of association. The terminal continues to function as a ferry facility and remains directly associated with the transportation network.

Conclusion: Based on the integrity analysis above, the Larkspur Ferry Terminal retains a high degree of integrity across all aspects relevant to evaluation under NRHP Criterion C and CRHR Criterion 3.

Summary:
In conclusion, the Larkspur Ferry Terminal property meets the criteria for listing under NRHP Criterion C and CRHR Criterion 3 and is recommended eligible for listing on either register.

References

Bowen, Madeline.
2014. *Historic Architectural Survey Report for the Sonoma-Marin Area Rail Transit (SMART) Rail corridor San Rafael to Larkspur Project, Marin County, California*. Copy of file with the Northwest Information Center.

City of Larkspur
2026a City of Larkspur City Municipal Code Chapter 18.19: Heritage Preservation. Website: https://larkspur.municipal.codes/Code/18.19. Accessed May 8, 2026.
2026b City of Larkspur Historic Resources Inventory (Approved by City Council Resolution 33/08. Website: https://www.ci.larkspur.ca.us/DocumentCenter/View/411/Historic-Resources-Inventory?bidId=. Accessed May 8, 2026.

Daily Independent Journal
1970 (April 17). "Rosy Future Painted for Ferry Runs." Available at newspapers.com, accessed April 20, 2026.
1973 (May 11). "Green Light Urged on Larkspur Ferry Terminal." Available at newspapers.com, accessed April 20, 2026.
1974a (October 12). "Larkspur Ferry Permit Issued." Available at newspapers.com, accessed April 20, 2026.
1974b (June 7). "Panel Approved Ferry Terminal Dredging Permit." Available at newspapers.com, accessed April 20, 2026.
1975a (January 23). "Larkspur Terminal Pile Driving." Available at newspapers.com, accessed April 20, 2026.
1975b (June 21). "Narrow Streets Plague Terminal." Available at newspapers.com, accessed April 20, 2026.
1976a (January 23). "Ferry Berth Cost Zooms." Available at newspapers.com, accessed April 20, 2026.
1976b (February 17). "Jury Urges Delay on Larkspur Terminal." Available at newspapers.com, accessed April 20, 2026.
1976c (March 2). "Ferry Pullout Proposed." Available at newspapers.com, accessed April 20, 2026.

Documentation and Conservation Modern Movement Northern California (DOCOMOMO-NOCA)
2021 *The '70S Turn 50!* Website: https://www.docomomo-noca.org/70s-turn-50-noca-map. Accessed June 30.

Golden Gate Bridge Highway & Transportation District (GGBHTD).
2021a. "About the District." Available at https://www.goldengate.org/district/about-the-district/, accessed April 20, 2021.
2021b. "Golden Gate Ferry Timeline." Available at https://www.goldengate.org/ferry/history-research/timeline/, accessed April 20, 2021.
2021c. "Statistics & Ridership." Available at https://www.goldengate.org/ferry/history-research/statistics-ridership/, accessed April 20, 2021.
2026. "Ferry Routes." Available at https://www.goldengate.org/ferry/history-research/sausalito-larkspur-tiburon-routes/, accessed April 20, 2026.

Hoover, Mildred Brooke and Douglas E. Kyle.
1990. *Historic Spots in California*. Stanford University Press, Stanford, CA.

Kowleski, S. M.
1979 *Golden Gate Ferry*. Golden Gate Bridge, Highway and Transportation District, San Francisco, California.

Kyle, Douglas E.
1990 *Historic Spots in California*. Stanford University Press. Stanford, California.

Larkspur Heritage Preservation Board (LHPB).
2008. *Larkspur Past and Present: A History and Walking Guide*. Available at https://www.ci.larkspur.ca.us/DocumentCenter/View/10831/Book-Cover-through-Table-of-Contents, accessed April 20, 2021.

Naim, Janet
1979 *The Artful of a Non-Building*. Architectural Record 1:122-124.

Nationwide Environmental Title Research (NETR)
2026 "Historic Aerials Database." 1987 and 1993 aerial imagery of the Larkspur Ferry Terminal. https://www.historicaerials.com/viewer.

San Francisco Chronicle
1971 (July 24). "Bridge Ferry Decision, Larkspur Terminal Site." Available at newspapers.com, accessed April 20, 2026.
1972a (February 16). "Larkspur Ferry Site." Available at newspapers.com, accessed April 20, 2026.
1972b (September 4). "The Airy Ferry Terminals." Available at newspapers.com, accessed April 20, 2026.
1973a (December 13). "Larkspur Terminal, Ferry Costs Climb." Available at newspapers.com, accessed April 20, 2026.
1973b (December 7). "Calm Hearing on Marin Terminal." Available at newspapers.com, accessed April 20, 2026.
1973c (February 24). "New Ferry Terminal Plans Get an OK." Available at newspapers.com, accessed April 20, 2026.
1974 (February 8). "Larkspur Ferry Terminal OKs." Available at newspapers.com, accessed April 20, 2026.
1976a (July 7). "Terminal Problem: No Ferries." Available at newspapers.com, accessed April 20, 2026.
1976b (January 19). "A Ferry Terminal Done Right." Available at newspapers.com, accessed April 20, 2026.

2006 (September 3). "Jacques De Brer Obituary." Available at newspapers.com, accessed April 20, 2026.

San Francisco Gate
2006 (September 14). "Jacques de Brer - Larkspur terminal architect." Available at sfgate.com, accessed April 20, 2026.

Simonson*, Hannah Lise*
2024 *San Francisco Modern and Postmodern Architectural Styles (1960-2000), Context: Architectural Methods & Styles, Sub-Context: Architectural Styles.* Prepared by Page & Turnbull, San Francisco, California. Submitted San Francisco Planning, San Francisco, California.

The Cultural Landscape Foundation
2026. "Royston, Hanamoto, Mayes & Beck." Available at https://www.tclf.org/pioneer/royston-hanamoto-mayes-beck, accessed April 23.

The Daily Examiner.
1888 (February 25). "Real Estate." Available at newspapers.com, accessed May 4, 2021.

The Press Democrat
1976 (December 7). "Ferry Terminal To Be Dedicated Saturday." Available at newspapers.com, accessed April 20, 2026.

The Times Herald
1971 (December 23). "Larkspur Fery Plan Approved." Available at newspapers.com, accessed April 20, 2026.

U.S. *Census*.
2021a. "Quick Facts: Larkspur city, California; Sierra Madre city, California; Los Alamitos city, California; Ridgecrest city, California; Monterey city, California." Available at https://www.census.gov/quickfacts/fact/table/larkspurcitycalifornia,sierramadrecitycalifornia,losalamitoscitycalifornia,ridgecrestcitycalifornia,montereycitycalifornia/PST045219, accessed May 4.
2021b. "Quick Facts: Marin County, California." Available at https://www.census.gov/quickfacts/marincountycalifornia, accessed May 4.

Appendix C. Representative Photographs (Taken June 4, 2021)



Photograph 1: Overview of Larkspur Ferry Terminal, facing southwest.



Photograph 2: Shelter Structure, facing southeast.



Photograph 3: Detail of southwest base support, facing south.



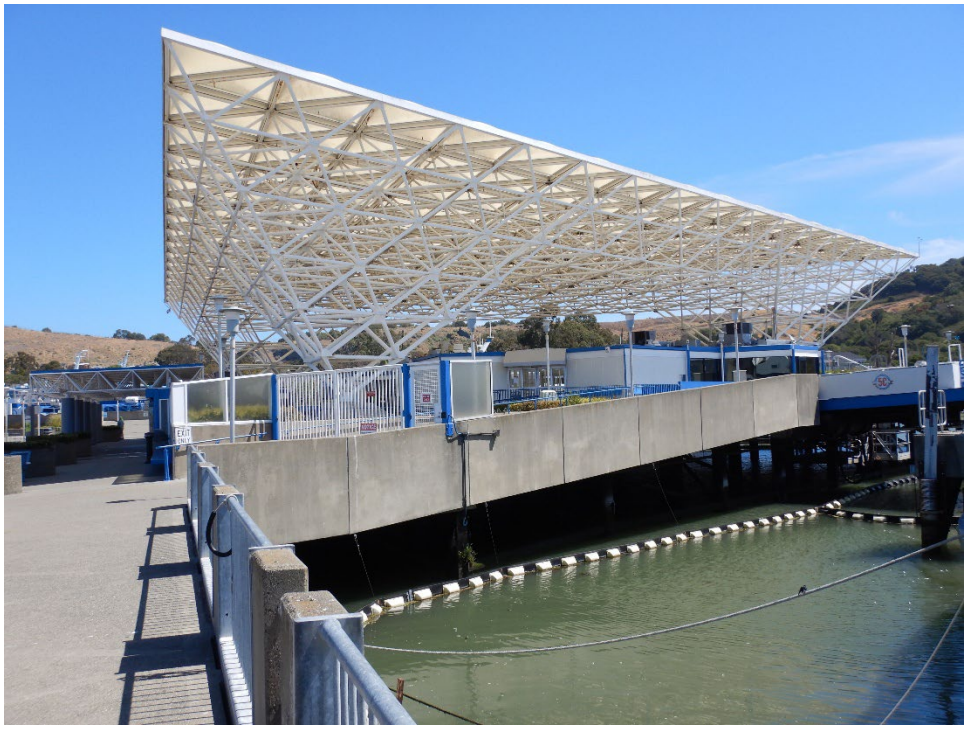
Photograph 4: "Kiosk A" and "Kiosk D" (which were physically combined) facing northeast.



Photograph 5: Service Building, facing south.



Photograph 6: Service Building eave detail view, facing south.



Photograph 7: View of piling supports for Shelter Structure and loading platforms, facing north.



Photograph 8: Utility shed, facing east.



Photograph 9: North Landing Structure, facing south.



Photograph 10: Maintenance Yard, facing southwest.



Photograph 11: Fuel tank and pump area, facing southwest.



Photograph 12: Representative view of Main Lot parking area, facing southwest.

Jacobs

Larkspur Ferry Terminal
Sea Level Rise Impact Assessment

Larkspur Ferry Service Expansion and Parking Project

Golden Gate Bridge, Highway and Transportation District



October 6, 2026

Executive Summary

Introduction

The Larkspur Ferry Terminal (LFT) is a coastal facility vulnerable to sea level rise (SLR). Consistent with the typical requirements of environmental reviews, state funding programs, infrastructure planning processes, and permitting, the Golden Gate Bridge, Highway and Transportation District (District) commissioned Jacobs to perform this assessment to evaluate the impacts of SLR on the LFT as a part of the Larkspur Ferry Service Expansion and Parking Project (Project).

The SLR impact assessment included the following tasks:

- Task 1 – Collection and Analysis of Information
- Task 2 – Site Visit
- Task 3 – Hazard Identification
- Task 4 – Vulnerability Assessment
- Task 5 – Risk Assessment and Adaptation Plan

Information reviewed, collected, and analyzed included:

- State of California Sea Level Rise Planning Guidance 2024 from the Ocean Protection Council (OPC 2024)
- A 1-meter resolution Digital Elevation Model (DEM) of the LFT and surrounding areas provided by the National Oceanic and Atmospheric Administration (NOAA) (NOAA 2025a)
- Tidal datums from NOAA station 9414863 Richmond (NOAA 2025b)
- 100-year total water level (TWL) data from NOAA station 9414290 San Francisco (NOAA 2025b)
- The Bay Area Conservation and Development Commission Shoreline Vulnerability Index (BCDC 2021)

Voids of information were filled with assumptions based on standard engineering practice and experience on similar projects.

Site Visit

A site visit was conducted on January 14, 2026, to assess the overall condition of the LFT, inspect shoreline structures and assets, and identify potential floodwater breaching points and pathways and potential flooding areas. The visit included a walk-through, visual inspection of the LFT perimeter and waterfront structures, photo and video recording, and rudimentary measurements. Interviews with District staff were conducted to learn about the history, condition, expected service life, maintenance, and improvement plans of the facilities and waterfront structures, as well as accounts of high-water level and flooding events and their consequences. Figure ES-1 shows an aerial view of the LFT, key locations, and perimeter inspected.



Figure ES-1. Aerial view of the Larkspur Ferry Terminal, key locations and perimeter inspected (image source: Google Earth Landsat/Copernicus)

The perimeter inspection started at Berths 2 and 3 and proceeded counterclockwise along a paved pathway that forks toward a pedestrian bridge over East Sir Francis Drake Boulevard (SFD Boulevard) and an undeveloped, low elevation area vulnerable to flooding. Moving west along the SFD Boulevard and onto a bike path, the inspection noted an unnamed Creek, equipped with gates at the SFD Boulevard to prevent upstream high-water propagation. In the relatively low and vulnerable southwest corner, a 4-foot engineered concrete levee surrounds four Fuel Tanks, while the Butler Building, Hazardous Materials (HazMat) Locker, and Backup Generator are elevated on concrete pads above grade. Continuing east along the southern boundary, a low vegetated berm separates the LFT from the marsh and Corte Madera Creek, where an underground stormwater outfall provides a floodwater pathway to the main parking lot. The inspection ended at the Administration Building.

To identify potential floodwater breaching points and pathways, an accurate representation of the LFT's topography was required. To verify the accuracy of the existing National Oceanic and Atmospheric Administration's (NOAA's) Digital Elevation Model (DEM), elevation measurements were taken and referenced to North American Vertical Datum 1988 (NAVD88) using NOAA station 9414863 Richmond tidal data (NOAA 2025b). Additionally, photos taken by District staff during the extreme high tide event of January 2 to 4, 2026, were analyzed for further verification. Because both the physical measurements and the extent of flooding visible in the photos correlated well with the NOAA DEM, the NOAA DEM was adopted for the assessment.

Hazard Identification

Hazards can affect the LFT in diverse ways. For example, there may be physical, operational, business, and environmental impacts. In this assessment, only physical and operational impacts were considered, such as flooding of terminal facilities, damage to structures and mechanical or electrical equipment, and service interruptions.

Hazard identification involves describing the coastal processes and conditions that may adversely affect the LFT's assets and operations. SLR is understood as a long-term driver that increases baseline water

levels and amplifies the effects of coastal hazards. The primary hazard affecting the LFT is coastal flooding. Episodic flooding may occur during extreme high-water levels caused by the combined effects of tides, storm surge, waves, tsunamis, and El Niño. Over the long term, SLR may result in permanent inundation of low-lying areas.

Wave runup and overtopping are negligible and not a hazard to the LFT. Wind records at NOAA station TIBC1 Tiburon Pier (NOAA 2025c) from May 2006 to October 2024 (595,323 15-minute observations) show that winds blow from the LFT's most exposed direction (120 to 130 degrees, which has an approximately 12-mile fetch to the southeast), about 5% of the time. For winds blowing from this exposed direction, these winds are less than 12 knots 92% of the time, generating waves at the LFT smaller than 1 foot high and negligible wind setup. Vessels transit at low speeds and produce minimal or no wakes. Tsunamis are also not considered a potential hazard. The measured water levels at NOAA station 9414863 Richmond (NOAA 2025b) due to the Tohoku Oki tsunami produced an elevation of the water level of about 1 foot above the predicted astronomical tide, and the simultaneous occurrence of tsunamis with extreme high-water levels is unlikely.

A relevant hazard to the LFT is the future extreme TWL resulting from SLR (an unusually high or low coastal water height caused by rare or severe events like king tides, storms, and heavy winds). These were estimated by combining the current 100-year TWL of 8.60 feet NAVD88 (derived from NOAA station 9414290 San Francisco [NOAA 2025b]) with SLR projections for five different risk aversion scenarios (OPC 2024). Figure ES-2 shows the TWLs for the five risk aversion scenarios for years 2020 through 2100.

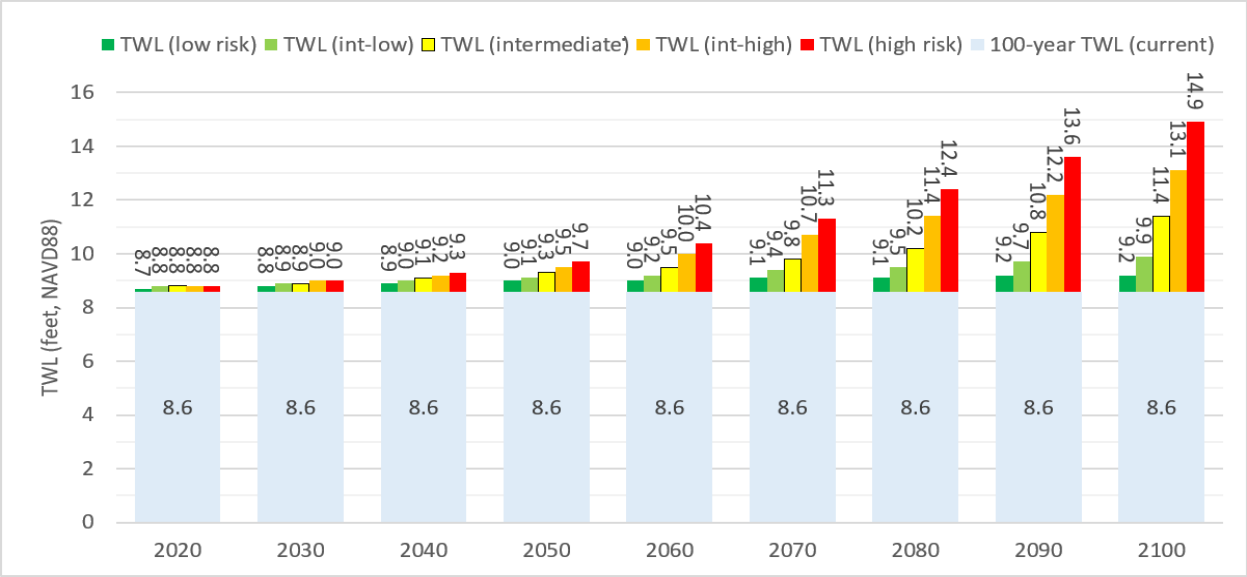


Figure ES-2. TWLs for the five risk aversion scenarios for years 2020 through 2100

Since the LFT is bordered by the Corte Madera Creek along its waterfront and lacks cut-off walls or other subsurface barriers, long-term groundwater emergence is expected to be primarily controlled by the mean sea level (MSL), rising progressively in response to SLR. In the short term, however, transient events such as extreme high tides and intense rainfall may temporarily elevate groundwater levels (GLs) above the MSL. But these elevated GLs are expected to dissipate relatively quickly, returning to pre-event conditions as these transient events recede.

Therefore, flooding due to long-term GL induced by SLR constitutes a hazard. This was estimated by combining the current MSL of 3.3 feet NAVD88 with the SLR projections. Figure ES-3 shows the GLs for the low, intermediate, and high risk aversion scenarios for years 2020 through 2100.

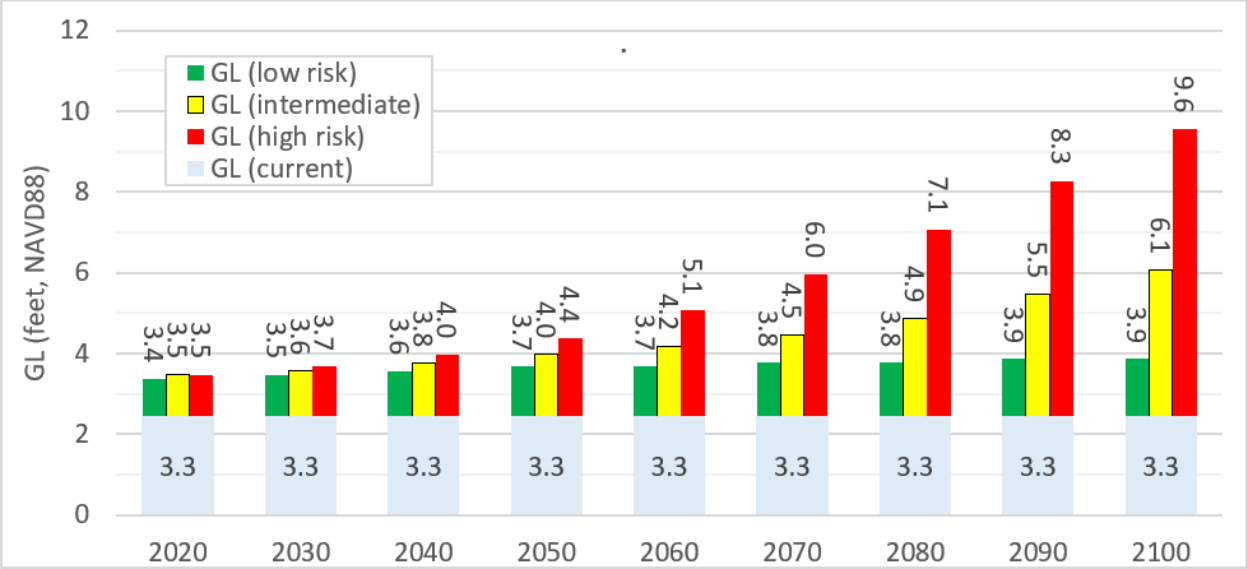


Figure ES-3. Groundwater Levels for the low, intermediate and high-risk aversion scenarios for years 2020 through 2100

Vulnerability Assessment

The LFT was divided into eight areas, where each area shares similar physical and operational conditions, asset types, levels of criticality, and adaptive capacities. Figure ES-4 shows the areas selected for the assessment.



Figure ES-4. Areas selected for the assessment (image source: Google Earth Vexcel Imaging US Inc.)

Despite not being on the waterfront, the SFD Boulevard is vulnerable to high TWL flooding and is a pathway to LFT flooding. The paved (i.e., asphalt- and concrete-surfaced) area, including the main parking lot, roadways, pathways, bike paths, walkways, and the planned Main Lot Parking Garage Structure (Main Lot Garage), could be vulnerable to flooding due to groundwater emergence.

For the identified high TWL flooding and groundwater emergence flooding hazards, the vulnerability of each area was assessed using the following methodology:

- High TWL flooding:
  - Identify floodwater breaching point elevation in the NOAA DEM, i.e., the lowest elevation in the area.
  - Select risk aversion scenario to define SLR projection based on site conditions, consequences of flooding, adaptive capacity, exposure to high TWL, LFT lifespan, and other criteria.
  - Delineate floodwater pathways and flood map derived from the NOAA DEM.
  - Cross-reference breaching point elevation with the sum of the current 100-year TWL and the projected SLR for the selected risk aversion scenario. This determined the ultimate horizon year by which adaptation measures must be fully operational, establishing a reverse-engineered timeline for project planning, design, permitting, funding, and construction.
- Groundwater emergence flooding:
  - Select risk aversion scenario to define SLR projection based on site conditions, consequences of flooding, adaptive capacity, exposure to groundwater emergence, LFT lifespan, and other criteria.
  - Define projected long-term GL due to SLR combining the current MSL at NOAA station 9414863 Richmond (NOAA 2025b) with the risk aversion scenario SLR projection.

- Define groundwater emergence by subtracting the projected long-term GL from the ground elevations in the NOAA DEM.

Table ES-1 lists the LFT areas and selected risk aversion scenarios.

Table ES-1. Larkspur Ferry Terminal areas and selected risk aversion scenarios

Area	Risk Aversion Scenario
LFT Buildings	High
Undeveloped	Low
East SFD Boulevard	Intermediate
Creek	Intermediate
Fuel Tanks	Intermediate
Butler Building	Intermediate
Marsh	Intermediate
Paved	High

Table ES-2 lists the areas ordered from the earliest to the latest, when the breaching points in each area are expected to be exceeded by the projected TWLs for the selected risk aversion scenarios.

Table ES-2. Years when the projected TWLs for the selected risk aversion scenarios would exceed the breaching points in each area

Years	Area	Breaching Point Elevation (feet NAVD88)	Risk Aversion Scenario	Projected TWL (feet NAVD88)
2020-2030	Butler Building	7.7	Intermediate	8.8 – 8.9
2020-2030	Creek	8.4	Intermediate	8.8 – 8.9
2020-2030	Undeveloped	8.5	Low	8.7 – 8.8
2040-2050	Marsh	9.2	Intermediate	9.1 – 9.3
2060-2070	Fuel Tanks	9.7	Intermediate	9.5 – 9.8
2060-2070	LFT Buildings	11.2	High	10.4 – 11.3
2070-2080	East SFD Boulevard	9.8	Intermediate	9.8 – 10.2

The Paved area is vulnerable to groundwater emergence flooding. It includes the existing main parking lot, roadways, pathways, bike paths, and walkways, which are critical to LFT operations. No practical or cost-effective solutions are available to prevent flooding caused by groundwater emergence, as groundwater can surface through pavement cracks, edges, drainage structures, and utility vaults, rendering conventional flood prevention largely ineffective. Therefore, the high-risk aversion scenario was selected for the Paved area.

The assessment showed that, in the Paved area and for the high-risk scenario, no groundwater would emerge before the year 2080. However, groundwater is expected to emerge within the fuel tank containment area between 2070 and 2080. Additionally, the assessment showed that if the first floor of the Main Lot Garage is built at the current ground elevation, long-term GLs within the perimeter of the Main Lot Garage in the southern area would be 1 to 2 feet below ground level (BGL) by 2080 and within 1 foot or at the ground level by 2090, and groundwater would emerge by 2100.

Table ES-3 lists the current MSL, high risk aversion scenario SLR projections and GLs for years 2080 through 2100.

Table ES-3. Current MSL, high risk aversion scenario SLR projections and GLs for years 2080 through 2100

Year	MSL (feet NAVD88)	SLR (feet NAVD88)	Groundwater Level (feet NAVD88)
2080	3.3	3.8	7.1
2090	3.3	5.0	8.3
2100	3.3	6.3	9.6

Risk Assessment and Adaptation Plan

The risk assessment complemented the vulnerability assessment by evaluating the significance of the vulnerabilities based on the likelihood of the flood hazards and their potential consequences, providing a basis for prioritizing areas and allocating resources.

The risk assessment was performed using the PIANC (2020) risk assessment matrix and based on qualitative ratings of likelihood and consequences. Likelihood ratings were assigned from Rare (1) for the high-risk aversion scenario to Almost Certain (5) for the low risk aversion scenario. Consequence ratings ranged from Insignificant (1) to Severe (5), based on the presence of critical assets and potential operational disruptions. According to the risk assessment, the following actions are recommended

- High Risk Level: East SFD Boulevard, Fuel Tanks and Butler Building areas: adaptation required as a high priority.
- Moderate Risk Level: LFT Buildings, Undeveloped, Creek, Marsh and Paved areas: adaptation required within existing asset management (maintenance, repair, rehabilitation, and replacement) cycles.

A phased approach to SLR adaptation planning at the LFT is recommended, including considerations for the Main Lot parking garage. A phased approach aligns adaptation investments with projected vulnerability timeframes, avoiding over-investment too early. It allows costs to be distributed over time, incorporates adaptive management principles as SLR projections are subject to uncertainty, and provides opportunities to integrate adaptation measures with existing asset management cycles. General adaptation measures considered feasible include floodwalls (I or T-type walls), gates, ramps, and elevating existing levees, provided they do not encroach into the Corte Madera Creek. Conclusions and recommendations include considerations for the Main Lot parking garage (12.c in the following list).

Conclusions

The following conclusions were made:

1. The site visit was very beneficial. It allowed for gaining first-hand knowledge about the characteristics and condition of the LFT waterfront and the impact of the high TWLs of January 2 to 4, 2026, and allowed the team to perform spot elevation measurements to verify the NOAA DEM.
2. The NOAA DEM showed good agreement with the spot elevation measurements and was adopted for the identification of potential floodwater breaching points and pathways and flooding areas for the different SLR projections selected.
3. High TWLs flooding and groundwater emergence flooding were identified as the principal hazards.

4. The LFT was divided into eight areas, where each area shares similar physical and operational conditions, asset types, levels of criticality, and adaptive capacities. These were the LFT Buildings, Undeveloped, East SFD Boulevard, Creek, Fuel Tanks, Butler Building, Marsh, and Paved areas.

5. For the waterfront areas, floodwater breaching point (lowest) elevations were identified, risk aversion scenarios and SLR projections were selected, floodwater pathways and flood maps delineated and ultimate horizon years by which adaptation measures must be fully operational were determined.

6. For the Paved area within the LFT, a risk aversion scenario and SLR projections were selected, projected long-term GLs and groundwater emergence locations and years were defined.

7. The vulnerability assessment showed that:

    a. The Butler Building, the Undeveloped and Marsh areas are currently vulnerable to high TWL flooding.

    b. Adaptation measures for high TWL flooding will be needed in the:

        i. Marsh area by 2040 – 2050 (southern area of the LFT : main parking lot, road and utility vaults)

        ii. Fuel Tanks area by 2060 – 2070 (fuel tanks and pipelines)

        iii. LFT Buildings area by 2060 – 2070 (buildings, passenger and ferry boarding areas, and utility vaults)

        iv. East SFD Boulevard area by 2070 – 2080 (roads, main parking lot and utility vaults)

    c. Adaptation measures for groundwater emergence flooding will be needed in the:

        i. Fuel Tanks area by 2080 (containment area)

        ii. Butler Building, Marsh, Paved areas by 2090 (employee and main [south] parking lots, bike path, and utility vaults)

        iii. Paved area by 2100 (main parking lot [north], and Main Lot Garage)

8. The risk assessment complemented the vulnerability assessment by evaluating the significance of the vulnerabilities based on the likelihood of the flood hazards and their potential consequences, providing a basis for prioritizing areas and adaptation measures and allocating resources.

9. Based on qualitative ratings of likelihood and consequences, the risk assessment showed that:

    a. The East SFD Boulevard, Fuel Tanks and Butler Building are areas at high risk, and adaptation is recommended as a high priority.
    b. The LFT Buildings, Undeveloped, Creek, Marsh and Paved are areas at moderate risk, and adaptation within existing asset management cycles is recommended.

10. While a vulnerability assessment may indicate that an asset will not be exposed until a time far into the future, the risk assessment may identify that asset as a high priority because of its critical physical and operational characteristics, the severe consequences if impacted by the hazard, and/or the long lead time required to develop the adaptation measure. This does not necessarily imply that a particular adaptation measure should be implemented immediately. Rather, it indicates that

immediate actions (planning, design, etc.) are warranted to ensure that the measure can be delivered before the identified vulnerability threshold is reached.

11. A phased approach to adaptation is recommended. A phased approach recognizes both the long implementation timelines associated with waterfront adaptation measures and the varying vulnerability timeframes across the LFT. It enables proactive, cost-effective, and adaptive decision-making, ensuring that adaptation measures are delivered when needed while maintaining flexibility in the face of future uncertainty.

Recommendations

In alignment with a phased approach, the following is recommended.

a. Perform hydrodynamic flood modeling to determine the duration of high TWLs exceeding the breaching point elevations, and to determine flooding pathways and quantify spatial extent and depth of flooding. This would assist in the definition of adaptation measures.

b. Decommission (plug, remove) the underground outfall that conveys the stormwater collected by the approximately 120-foot-long drain in the southern area of the main parking lot to the Corte Madera Creek. The outfall constitutes a path for the Corte Madera Creek seawater to flood the main parking lot in high TWLs.

c. Given that it does not have adaptation capacity, design and build the Main Lot Garage (planned to be in operation by 2040) so that its first floor is at the 11.4 feet NAVD88 elevation to prevent groundwater emergence flooding by 2100.

d. Butler Building is a high risk area; commence planning toward the immediate implementation of an adaptation measure for high TWL flooding by 2030 and for groundwater emergence flooding by 2090.

e. Creek and Undeveloped are moderate risk areas; within an existing asset management cycle, commence planning toward implementing adaptation measures for high TWL flooding by 2030.

f. Marsh is a moderate risk area; within an existing asset management cycle, commence planning toward implementing an adaptation measure for high TWL flooding by 2040 - 2050 and for groundwater emergence flooding by 2090.

g. Fuel Tanks is a high-risk area; commence planning toward the implementation of an adaptation measure for high TWL flooding by 2060 – 2070 and for groundwater emergence flooding by 2080.

h. LFT Buildings is a moderate risk area; within an existing asset management cycle, commence planning toward implementing an adaptation measure for high TWL flooding by 2060 - 2070.

i. East SFD Boulevard is a high-risk area; commence planning toward the implementation of an adaptation measure for high TWL flooding by 2070 – 2080.

j. Paved area at LFT is a moderate risk area; within an existing asset management cycle, commence planning toward implementing an adaptation measure for groundwater emergence flooding by 2090.

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Acronyms and Abbreviations

BGL	below ground level
DEM	Digital Elevation Model
District	Golden Gate Bridge, Highway and Transportation District
GL	groundwater level
HazMat	hazardous materials
IT	information technology
LFT	Larkspur Ferry Terminal
Main Lot Garage	Main Lot Parking Garage
MSL	mean sea level
NAVD88	North American Vertical Datum 1988
NOAA	National Oceanic and Atmospheric Administration
SFD Boulevard	Sir Francis Drake Boulevard
SLR	sea level rise
SVI	Shoreline Vulnerability Index
TWL	total water level

1. Introduction

The Larkspur Ferry Terminal (LFT) is a coastal facility vulnerable to sea level rise (SLR). Consistent with the typical requirements of state funding programs, infrastructure planning processes, and environmental reviews and permitting, the Golden Gate Bridge, Highway and Transportation District (District) commissioned Jacobs to perform this assessment to evaluate the impacts of SLR on its future infrastructure developments.

The SLR impact assessment included the following tasks:

- Task 1 – Collection and Analysis of Information
- Task 2 – Site Visit
- Task 3 – Hazard Identification
- Task 4 – Vulnerability Assessment
- Task 5 – Risk Assessment and Adaptation Plan

The following sections describe the work performed and the results of the assessment.

2. Collection and Analysis of Information

Jacobs reviewed, collected, and analyzed the following information:

- State of California Sea Level Rise Planning Guidance 2024 (OPC 2024)
- LFT and surrounding areas Digital Elevation Model (DEM) at 1-meter resolution (NOAA 2025a)
- National Oceanic and Atmospheric Administration (NOAA) station 9414863 Richmond tidal datums, tidal datums (NOAA 2025b)
- NOAA station 9414290 San Francisco, 100-year total water level (TWL) (NOAA 2025b)
- NOAA station TIBC1 Tiburon Pier (NOAA 2025c)
- LFT AutoCAD drawings (District 2026)
- Bay Area Conservation and Development Commission Shoreline Vulnerability Index (SVI) (BCDC 2021)
- Aerial imagery (ESRI ArcGIS, Google Earth)

Voids of information were filled with assumptions based on standard engineering practice and Jacobs's experience on similar projects.

3. Site Visit

A site visit was conducted on January 14, 2026, to:

- Assess the overall condition of the LFT
- Inspect shoreline structures and assets
- Identify potential floodwater breaching points and pathways and potential flooding areas

The visit included a walk-through, visual inspection of the LFT perimeter and waterfront structures, photo and video recording, and rudimentary measurements (tape measure, visual estimates, etc.).

Interviews with District's staff were conducted to learn about the history, condition, expected service life, maintenance and improvement plans of the facilities and waterfront structures, accounts of high-water level and flooding events and their consequences (historical vulnerabilities), and any other relevant anecdotal information. Figure 1 shows an aerial view of the LFT, key locations and the perimeter inspected.



Figure 1. Aerial view of the Larkspur Ferry Terminal, key locations and perimeter inspected (image source: Google Earth Landsat/Copernicus)

3.1 Perimeter Inspection

The inspection started at Berths 2 and 3, then continued in a counterclockwise direction along the perimeter of the LFT. Figure 2 and Figure 3 show east and south views of Berth 3, respectively.



Figure 2. East view of Berth 3



Figure 3. South view of Berth 3, Berth 2 and the Larkspur Ferry Terminal Building in the background

After Berths 2 and 3, the inspection proceeded along the mostly natural waterfront to the north of Berth 3. A pedestrian paved pathway extends to the north as shown in Figure 4. The pathway forks to the west into a pedestrian bridge over East Sir Francis Drake Boulevard (SFD Boulevard) and to the east to an undeveloped, low elevation area vulnerable to flooding. To the west of the pathway, an approximately 5-foot-high above-grade vegetated berm separates the pathway from the main parking lot.



Figure 4. Pedestrian pathway to the north of Berth 3, bridge over the Sir Francis Drake Boulevard and undeveloped, low elevation area (background and right)

From the pedestrian bridge and SFD Boulevard, the inspection proceeded west along SFD Boulevard, which bounds the LFT to the north. This section is approximately 560 feet long and consists of a sidewalk and planters that separate the LFT from SFD Boulevard. Immediately west of the pedestrian bridge, there is a one-lane main parking lot exit road. Near the midpoint, at the intersection with Larkspur Landing Court, a three-lane exit and a two-lane entrance connect to the LFT access road that runs counterclockwise around its perimeter. Figure 5 shows a west view from the pedestrian bridge of SFD Boulevard and the northern area of the main parking lot.



Figure 5. West view of the Sir Francis Drake Boulevard (right), main parking lot (left)

Upon reaching the west end of the sidewalk along SFD Boulevard, the inspection proceeded onto a bike path, which begins at SFD Boulevard and extends into the LFT. An unnamed Creek runs parallel to the on the east side of the bike path, originating at SFD Boulevard and flowing downstream to the Corte Madera Creek, forming the western boundary of both the LFT and the adjacent main parking lot. At SFD Boulevard, two gates are in place to prevent high water levels in the Creek from propagating upstream. The bike path trends southeast, with the Creek to the west and the main parking lot to the east. The path is generally level and has an elevation consistent with the adjacent main parking lot. Figure 6 shows the creek at SFD Boulevard, and Figure 7 shows a south view of the bike path.

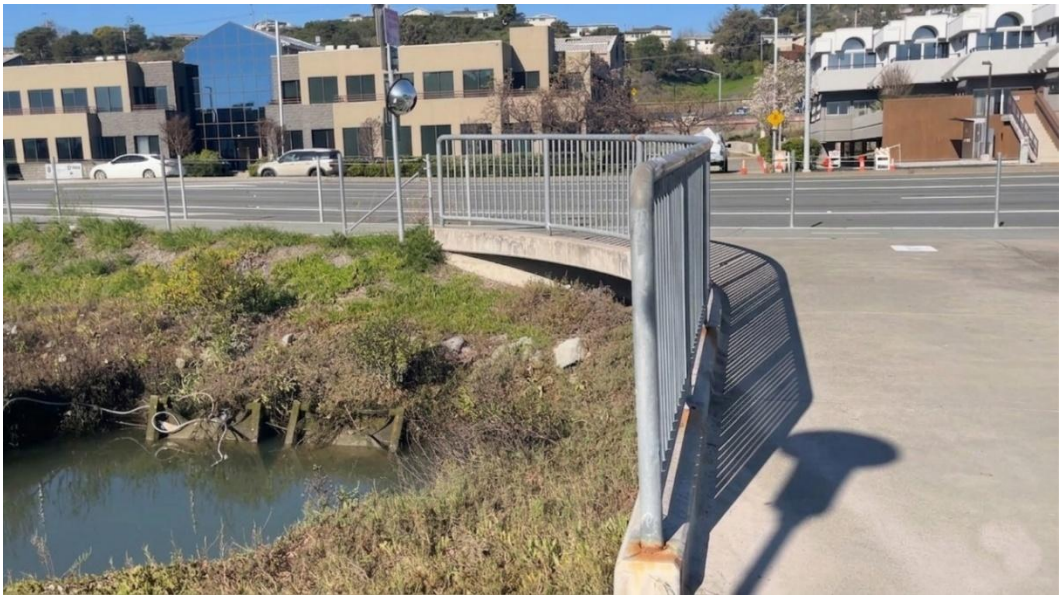


Figure 6. Creek at the Sir Francis Drake Boulevard, gates semi-submerged



Figure 7. South view of the bike path by the Creek

Approximately 400 feet from SFD Boulevard the Creek turns to the south. From that location, the bike path extends until it reaches the marsh at the Corte Madera Creek to then turn east. On the west side, the bike path borders four Fuel Tanks, an employee parking lot and ancillary facilities and, on the east side, the main parking lot. Figure 8 shows an aerial view to the south of the Creek, LFT perimeter, Fuel Tanks and ancillary facilities.

This area, in the southwest corner of the LFT, is relatively low and, as relayed by District's staff, vulnerable to flooding. An about 4-foot-high engineered concrete levee surrounds the Fuel Tanks in a containment area which protects the LFT and Creek from accidental spills and the tanks from flooding. Rainwater collected within the containment area is conveyed with ditches to a sump in the southwest corner where is pumped out into the Corte Madera Creek.

Additional assets in this area include the employee parking lot, the Butler Building where the information technology (IT) server room is housed and mooring equipment and hardware are stored, the Hazardous Materials (HazMat) (oil, paint, etc.) Locker, and the Backup Generator. These are built on concrete pads and elevated above grade; the Butler Building floor is about 13 inches above grade, the HazMat Locker doorway about 17 inches above grade, and the Backup Generator bottom 12 inches. Figure 9 shows the Fuel Tanks and Pump Station, Figure 10 the Butler Building, Figure 11 the HazMat Locker, and Figure 12 the Backup Generator.



Figure 8. Aerial view to the south of the southwest corner of the Larkspur Ferry Terminal, perimeter (yellow), Fuel Tanks and ancillary facilities (Google Earth Landsat/Copernicus n.d.)



Figure 9. North views of Fuel Tanks, west side (left) and east side and Pump Station (right)



Figure 10. Butler Building



Figure 11. HazMat Locker



Figure 12. Backup Generator

From the Butler Building, the inspection continued east along the bike path that borders the marsh and which fronts the LFT along its approximately 550-foot southern boundary. The bike path is generally level and has an elevation consistent with the adjacent main parking lot. A low, vegetated berm about 3-foot-high above-grade separates the bike path from the marsh and Corte Madera Creek. This waterfront area is relatively low and, as relayed by District's staff, vulnerable to flooding. Stormwater collected in an approximately 120-foot-long drain in the LFT access road adjacent to the bike path is conveyed through an underground outfall to the Corte Madera Creek. The outfall constitutes a path for the Corte Madera Creek seawater to flood the main parking lot in high water events. Figure 13 shows a general view of the marsh to the east from the Butler Building. Figure 14 shows a west view of the bike path along the LFT southern boundary.



Figure 13. East view of the marsh from the Butler Building



Figure 14. West view of the bike path and vegetated berm along the southern boundary of the Larkspur Ferry Terminal

The inspection ended at the Administration Building located at the southeast corner of the LFT (Figure 15). Like the passenger boarding pier where Berths 1 and 2 are located, the Administration Building is built on a pile-supported concrete deck. The perimeter of both is protected by approximately 44-inch-high concrete parapets and steel railings.



Figure 15. Southwest view the Administration Building (left) and northeast view of Larkspur Ferry Terminal Building Berth 1

3.2 Digital Elevation Model Verification

To identify potential floodwater breaching points and pathways and flooding areas, an accurate representation of the LFT topography was needed. For this purpose, the NOAA DEM (NOAA 2025a), which is referenced to North American Vertical Datum 1988 (NAVD88), was acquired. To verify the NOAA DEM elevations, 16 measurements were taken during the site visit. Figure 16 shows the locations and times of the measurements.



Figure 16. Locations and times of the 16 measurements taken to verify NOAA DEM

Twelve measurements were taken from fixed and uniform level surfaces to the water surface. To refer these measurements to NAVD88, corresponding elevations of the water surface relative to NAVD88 at NOAA station 9414863 Richmond (NOAA 2025b) were added.

For example, at 10:16 AM, the vertical distance measured from the deck at the north corner of Berth 2 to the water surface was 74 inches (6.17 feet). At that time, the water surface at NOAA station 9414863 the water level was 5.32 feet NAVD88 (NOAA 2025b), which results in an elevation of the deck of approximately 11.5 feet NAVD88, which is consistent with the11.2 feet NAVD88 elevation in the NOAA DEM. Later at 1:06 PM, the vertical distance measured from the deck at the east corner of Berth 1 to the water surface was 168 inches (14 feet). At that time, the water surface at NOAA station 9414863 was 1.86 feet NAVD88 (NOAA 2025b), which results in an elevation of the deck of approximately 15.9 feet NAVD88, which is the same as the 15.9 feet NAVD88 in the NOAA DEM. Table 1 lists the measurements, measured and NOAA DEM elevations relative to NAVD88. Where available and representative, elevations extracted from Bay Area Conservation and Development Commission's SVI dataset (BCDC 2021) are included; however, discrepancies with the measurements and NOAA DEM are noted, likely due to the relative distance between the verification locations and the relief of the shoreline, especially in areas of steep slopes.

Table 1. Measurements taken on January 14, 2026, and NOAA DEM elevations

Time (Local)	Location	Distance to Water Surface	Water Level (feet NAVD88)[a]	Elevations (feet NAVD88)		
				Measured	NOAA DEM	SVI
10:16 AM	Deck at north corner of Berth 2	74" (6.2')	5.32	11.5	11.2	12.4
10:22 AM	Deck at south corner of Berth 3	128" (10.7')	5.24	15.9	15.7	15.2
10:24 AM	Deck at Berth 3	128" (10.7')	5.21	15.9	15.7	16.0
10:36 AM	Deck at Berth 3 north access	75" (6.3')	5.04	11.3	11.1	12.1
10:48 AM	Top of culvert	43" (3.6')	4.83	8.4	9.9	10.0
10:50 AM	Deck at Berth 3 south access	80" (6.7')	4.79	11.5	11.5	12.4
11:15 AM	SFD Boulevard and bike path at Creek	54" (4.5')	4.27	8.8	8.3	N/A
12:00 PM	Deck at north corner of Administration Bldg.	94" (7.8')	3.26	11.1	11.4	11.5
12:02 PM	Deck at west corner of Berth 1	96" (8.0')	3.22	11.2	11.4	13.2
01:02 PM	Deck at Berth 1	165" (13.8')	1.95	15.8	16.0	16.0
01:06 PM	Deck at east corner of Berth 1	168" (14')	1.86	15.9	15.9	N/A
01:46 PM	Deck at east corner of Administration Bldg.	119" (9.9')	1.15	11.1	11.3	N/A

[a] Feet NAVD88, measured at NOAA station 9414863 Richmond (NOAA 2025b)
N/A = not available

Four spot measurements were taken within the LFT for additional verifications. At 10:26 AM, the height of the wall at the south corner of the picnic area was measured at 89.5 inches (7.46 feet). The wall extends above the elevation of the deck at Berth 3 (i.e., a parapet) by 42.5 inches (3.54 feet). Considering that the elevation of the deck at the south corner of Berth 3 is 15.7 feet NAVD88, the elevation of the ground at the south corner of the picnic area is 15.7 – 7.46 + 3.54 = 11.8 feet NAVD88, which is consistent with NOAA DEM 12 feet NAVD88.

Between 1:17 PM and 1:20 PM, a 56-inch (4.67-foot) elevation difference was measured between the top and bottom of the eight-step stairway in the Fuel Tanks area, shown in Figure 17. The NOAA DEM shows an elevation of 14.3 feet NAVD88 at the top and 9.8 feet NAVD88 at the bottom of the steps (top of the levee) which translates to a difference in elevation of 4.5 feet (54 inches) which is consistent with the measurement.

At 1:27 PM, a 42-inch (3.5 feet) elevation difference was measured between the top and bottom of the five-step stairway from the top of the levee to the Fuel Tanks ground, shown in Figure 17. The NOAA DEM shows an elevation of 9.6 feet NAVD88 at the top and 6.7 feet NAVD88 at the floor of the containment area, which translates into a difference in elevation of 2.9 feet (37 inches). The discrepancy can be justified based on the rudimentary nature of the measurement and the potential inaccuracy of the NOAA DEM within the containment area.

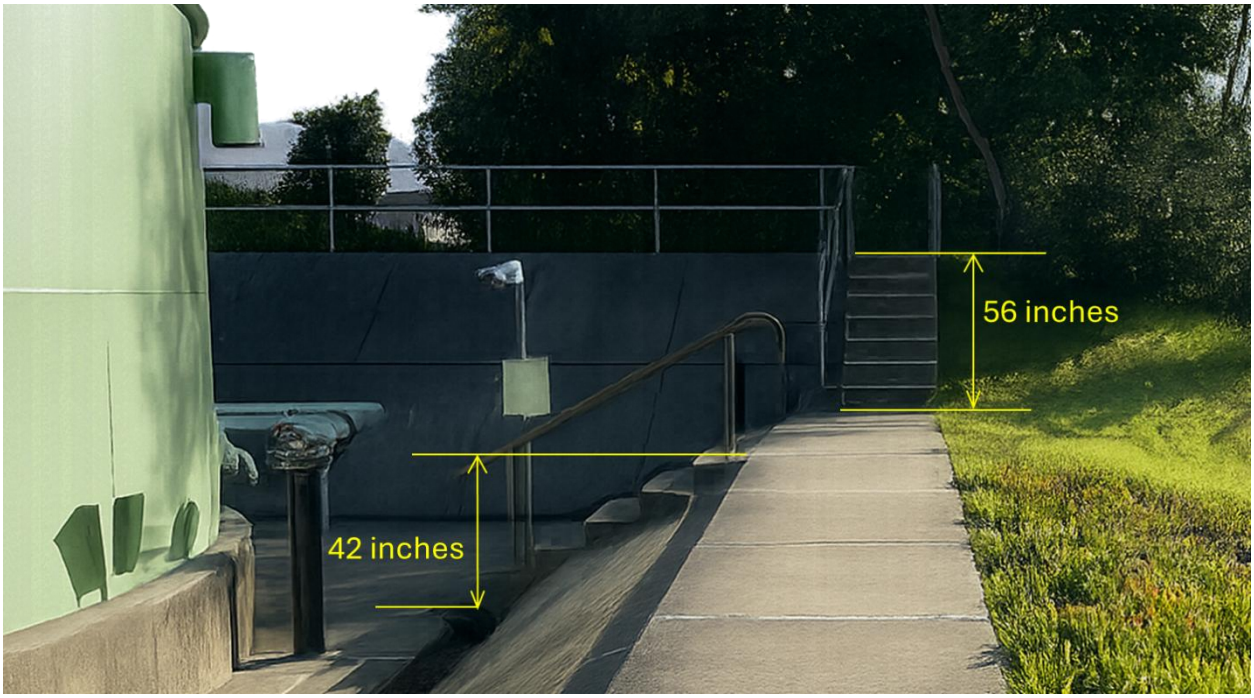


Figure 17. Differences in elevations in the Fuel Tanks area

The site visit was conducted about 10 days after an extreme high tide event which peaked between January 2 to 4, 2026. Photos taken by District staff during that event were used for additional verification of the NOAA DEM.

Figure 18 and Figure 19 show District's photos taken on January 2, 2026, at 9:39 AM when the TWL was 8.31 feet NAVD88 (NOAA 2025b). Figure 18 shows the flooded area in front of the Butler Building and Figure 19 shows the flooded area in the southern section of the LFT access road. Figure 20 shows a very good correlation between the flooded area according to the NOAA DEM and the extent of flooding from

the interpretation of the District's photos; the edge of the floodwater is close to the entrance of the Butler Building and the HazMat Locker is above water. Furthermore, the southern section of the LFT access road is partially flooded due to the intrusion of seawater through the outfall under the bike path and vegetated berm and drain along the road.

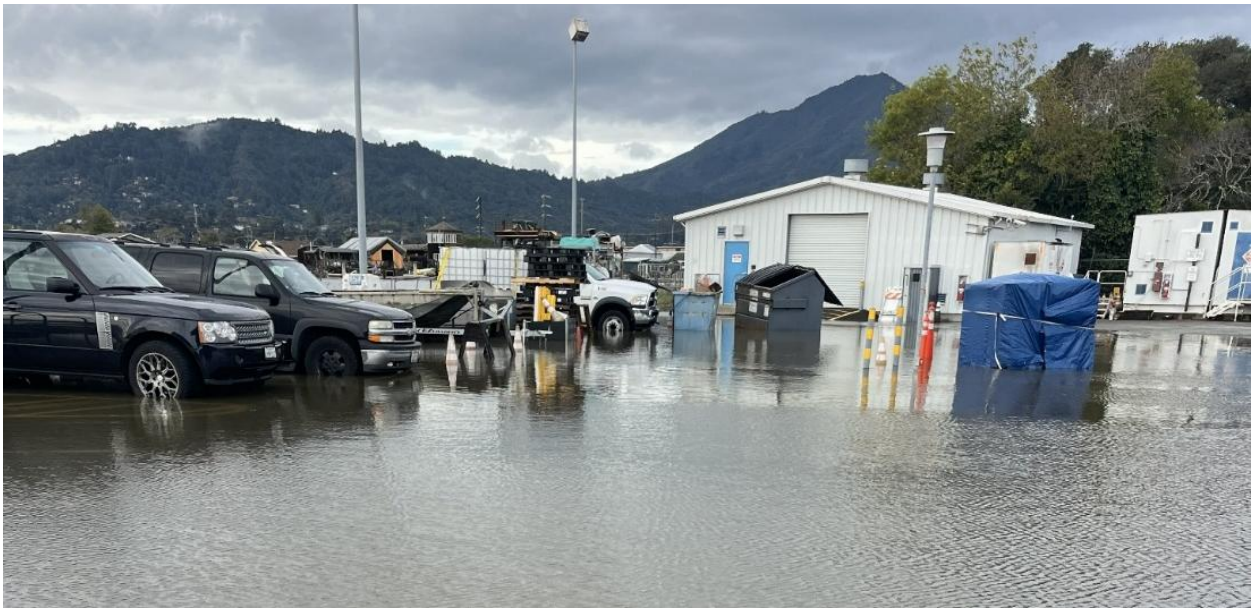


Figure 18. Flooded area in front of the Butler Building on January 2, 2026, at 9:39 AM, TWL = 8.31 feet NAVD88 (NOAA 2025b)



Figure 19. Flooded area in the southern section of the Larkspur Ferry Terminal access road on January 2, 2026, at 9:39 AM, TWL = 8.31 feet NAVD88 (NOAA 2025b)



Figure 20. Flooded area in the Butler Building area and southern section of the Larkspur Ferry Terminal access road according to the NOAA DEM on January 2, 2026, at 9:39 AM, TWL = 8.31 feet NAVD88 (NOAA 2025b)

Figure 21 shows a District's photo of the debris in the employee parking lot in the Butler Building area marking the edge of the highest floodwater elevation on January 3, 2026, at 10:36 AM when the TWL was 8.73 feet NAVD88 (NOAA 2025b). Figure 22 shows a very good correlation between the flooded area according to the NOAA DEM and the extent of flooding from the interpretation of the District's photo; the edge of the floodwater is close to the entrance of the Butler Building and covers a significant area of the employee parking lot.



Figure 21. Debris in the employee parking lot in the Butler Building area marking the edge of the highest floodwater elevation on January 3, 2026, at 10:36 AM, TWL = 8.73 feet NAVD88 (NOAA 2025b)



Figure 22. Flooded area in the Butler Building area and southern section of the Larkspur Ferry Terminal access road according to the NOAA DEM on January 3, 2026, at 10:36 AM, TWL = 8.73 feet NAVD88 (NOAA 2025b)

Figure 23 (same as Figure 21) shows the edge of the floodwater and flooded area in the employee parking lot in the Butler Building area on January 4, 2026, at 12:09 PM when the TWL was 8.23 feet NAVD88 (NOAA 2025b). Figure 24 shows the flooded area in the southern section of the LFT access road. Figure 25 shows a very good correlation between the flooded area according to the NOAA DEM and the extent of flooding from the interpretation of the District's photos; the edge of the floodwater is close to the entrance of the Butler Building, and the HazMat Locker is above water. Furthermore, the southern section of the LFT access road is partially flooded due to the intrusion of seawater through the outfall under the bike path and vegetated berm and drain along the road.



Figure 23. Edge of the floodwater and flooded area in the employee parking lot in the Butler Building area on January 4, 2026, at 12:09 PM, TWL was 8.23 feet NAVD88 (NOAA 2025b)



Figure 24. Flooded area in the southern section of the Larkspur Ferry Terminal access road on January 4, 2026, at 12:12 PM, TWL = 8.23 feet NAVD88 (NOAA 2025b)



Figure 25. Flooded area in the Butler Building area and southern section of the Larkspur Ferry Terminal access road according to the NOAA DEM on January 4, 2026, at 12:12 PM, TWL = 8.23 feet NAVD88 (NOAA 2025b)

The NOAA DEM showed good agreement with the measurements performed during the site visit and the flooded areas derived from the District's photos of the extreme high tide event of January 2 to 4, 2026. Therefore, the NOAA DEM was adopted for the identification of potential floodwater breaching points and pathways and flooding areas for the different SLR projections selected.

4. Hazard Identification

Hazards can affect the LFT in diverse ways. For example, there may be physical, operational, business, and environmental impacts. In this assessment, only physical and operational impacts were considered such as flooding of terminal facilities, damage to structures and mechanical or electrical equipment, and service interruptions.

Hazard identification involves describing the coastal processes and conditions that may adversely affect the LFT's assets and operations. SLR is understood as a long-term driver that increases baseline water levels and amplifies the effects of coastal hazards.

The primary hazard affecting the LFT is coastal flooding, which can occur in two forms. In the short term, episodic flooding may occur during extreme water levels caused by the combined effects of tides, storm surge, waves, tsunamis, and large-scale climate and oceanographic phenomena such as El Niño. The TWL is the water level resulting from the combination of these effects. Over the long term, SLR may result in permanent inundation of low-lying areas. Elevated water levels reduce the freeboard of coastal features and waterfront structures, thereby increasing the likelihood, frequency, depth and extent of flooding across the LFT.

Wave runup and overtopping represent additional coastal hazards. These processes occur when wave action reaches or exceeds the elevation of the shoreline, coastal defenses, or waterfront structures. Wave runup and overtopping can result in localized, short-duration flooding and impose hydraulic loads on infrastructure, particularly during storm conditions when still water levels may be elevated.

Although less frequent, tsunamis represent a potential high-impact hazard. Tsunamis can cause rapid increases in water level and flow velocity, leading to overtopping of coastal defenses and waterfront structures and resulting in significant, though typically short-duration, flooding.

In addition to these primary hazards, SLR can influence several secondary and interacting processes. As sea levels rise, coastal groundwater levels may also increase, potentially leading to groundwater emergence in low-lying areas and reduced stormwater drainage capacity. This can cause surface flooding independent of direct waterside overtopping or shoreline inundation and may affect buried utilities, pavements, foundations, and other subsurface infrastructure. Furthermore, higher groundwater levels can increase soil saturation, thereby increasing the susceptibility of certain soils to liquefaction during seismic events.

4.1 Wave Runup and Overtopping

Wave and current conditions in the vicinity of the LFT are mild. Vessels, consisting mostly of pleasure boats in the Corte Madera Creek and the District ferries arriving and departing the LFT, transit at relatively low speeds and produce minimal or no wakes.

Wind records at NOAA station TIBC1 Tiburon Pier (NOAA 2025c) for May 1, 2006, to October 3, 2024, include 595,323 15-minute observations. Of these, 29,552 observations (about 5%) are winds from the LFT's most exposed direction (120 to 130 degrees), which has an approximately 12-mile fetch to the southeast. Within this sector, winds are less than 12 knots in 27,277 observations (92%) and greater than 12 knots in 2,275 observations (8%). Winds of less than 12 knots generate waves at the LFT smaller than 1 foot high and negligible wind setup. Wave and vessel wake conditions will not change with rising sea levels, and considering that these are negligible, resulting wave runup and overtopping can also be considered negligible and not a hazard to the LFT.

4.2 Water Levels

High water levels would result in a higher likelihood of flooding due to overtopping of waterfront structures, higher groundwater levels, and higher likelihood of soil liquefaction in seismic events. Consequently, water levels are considered a hazard to the LFT.

Table 2 lists the water level datums and extreme measured (high and low) TWLs relevant to the LFT. Because future extreme TWLs due to SLR are typically estimated by combining the current 100-year TWL (1% annual chance of exceedance) with SLR projections, accurate knowledge of the current 100-year TWL is required.

Water level measurements at NOAA station 9414863 Richmond span just over 20 years (NOAA 2025b), which is insufficient to reliably estimate the 100-year TWL. Therefore, the 8.60 feet NAVD88 100-year TWL derived from the longer NOAA station 9414290 San Francisco record was adopted (NOAA 2025b).

Table 2. Water level datums at NOAA station 9414863 Richmond

Datums and TWLs	Elevation (feet NAVD88)
Maximum TWL (measured on January 3, 2026)	8.73
100-year TWL[a]	8.60
Mean Higher High Water	6.06
MSL	3.27
NAVD88	0.00
Mean Lower Low Water	0.02
Minimum TWL (measured on November 1, 2009)	-2.51

[a] NOAA station 9414290 San Francisco (NOAA 2025b)

MSL = mean sea level

4.3 Tsunamis

In addition to astronomic tides and weather effects such as storm surges and the El Niño mean sea level anomaly (both of which are less than 1 foot in California), water levels can rise due to tsunamis. Because the historical record for tsunamis in California is relatively short, and no anecdotal evidence or measurements are available at the LFT, the impact of tsunamis is unknown.

The most recent record is the measured water levels at NOAA station 9414863 Richmond (NOAA 2025b) due to the Tohoku Oki tsunami in Japan on March 11, 2011. Figure 26 shows the time history of the measured TWL at NOAA station 9414863 Richmond (NOAA 2025b) a couple of days after the tsunami occurred. Also shown is the residual, which is the difference between the measured TWL and the predicted astronomical tide. At its peak, the tsunami wave produced an elevation of the water level of about 1 foot above the predicted astronomical tide, however, during low tide. Considering that this is of the same order of magnitude as what storm surges and El Niño mean sea level anomalies could produce in California, and that the simultaneous occurrence of tsunamis with extreme high water levels (i.e., 100-year TWL) is unlikely, remote tsunamis are not considered a potential hazard for the LFT.

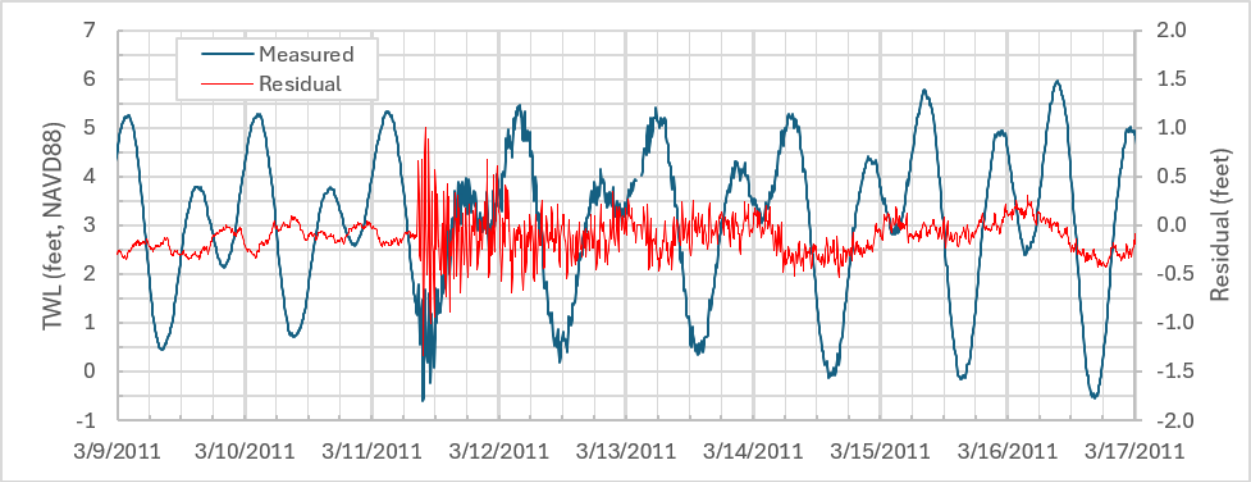


Figure 26. Time history of measured TWL at NOAA station 9414863 Richmond during the arrival of the Tohoku Oki tsunami and residual (measured TWL - predicted astronomical tide) (NOAA 2025b)

4.4 Sea Level Rise

A relevant hazard to the LFT is the future extreme TWLs resulting from SLR. These are typically estimated by combining the current 100-year TWL with SLR projections for time frames and risk aversion scenarios.

Table 3 lists the SLR projections (OPC 2024) for San Francisco, assumed representative for the LFT due to its proximity, for five different risk aversion scenarios for years 2020 through 2100. Figure 27 shows the TWLs, which combine the 100-year TWL (8.60 feet NAVD88) with the SLR projections, for years 2020 through 2100 for the five risk aversion scenarios.

Table 3. SLR projections for San Francisco (feet) (OPC 2024)

Year	Low	Intermediate Low	Intermediate	Intermediate High	High
2020	0.1	0.2	0.2	0.2	0.2
2030	0.2	0.3	0.3	0.4	0.4
2040	0.3	0.4	0.5	0.6	0.7
2050	0.4	0.5	0.7	0.9	1.1
2060	0.4	0.6	0.9	1.4	1.8
2070	0.5	0.8	1.2	2.1	2.7
2080	0.5	0.9	1.6	2.8	3.8
2090	0.6	1.1	2.2	3.6	5.0
2100	0.6	1.3	2.8	4.5	6.3

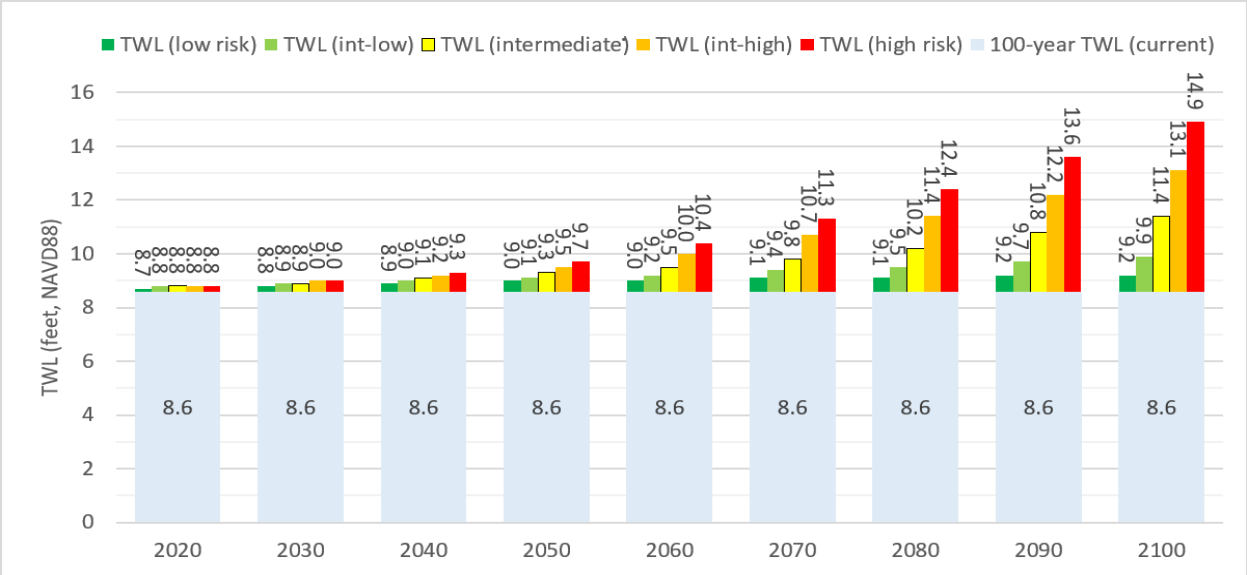


Figure 27. TWLs for the five risk aversion scenarios for years 2020 through 2100

4.5 Groundwater Emergence

Since the LFT is bordered by the Corte Madera Creek along its waterfront, long-term groundwater emergence is expected to be primarily controlled by the MSL, rising progressively in response to SLR.

Due to the direct hydraulic connection and the LFT's proximity to the Corte Madera Creek, coupled with the absence of cut-off walls or other subsurface barriers, the LFT soils are not expected to significantly impede landward groundwater flows. As a result, and in the long term, groundwater levels (GLs) are anticipated to track changes in MSL closely, with negligible lag attributable to soil hydraulic conductivity. In the short term, however, transient events such as extreme high tides and intense rainfall may temporarily elevate GLs above the MSL. But these elevated GLs are expected to dissipate relatively quickly, returning to pre-event conditions as these transient events recede.

Therefore, flooding due to long-term GL induced by SLR constitutes a hazard. It can be estimated combining the current MSL at NOAA station 9414863 Richmond (3.3 feet NAVD88, see Table 2) (NOAA 2025b) with the SLR projections for San Francisco (see Table 3). This approach is supported by Befus et al. (2020). Figure 28 shows the GLs for the low, intermediate, and high-risk aversion scenarios for years 2020 through 2100.

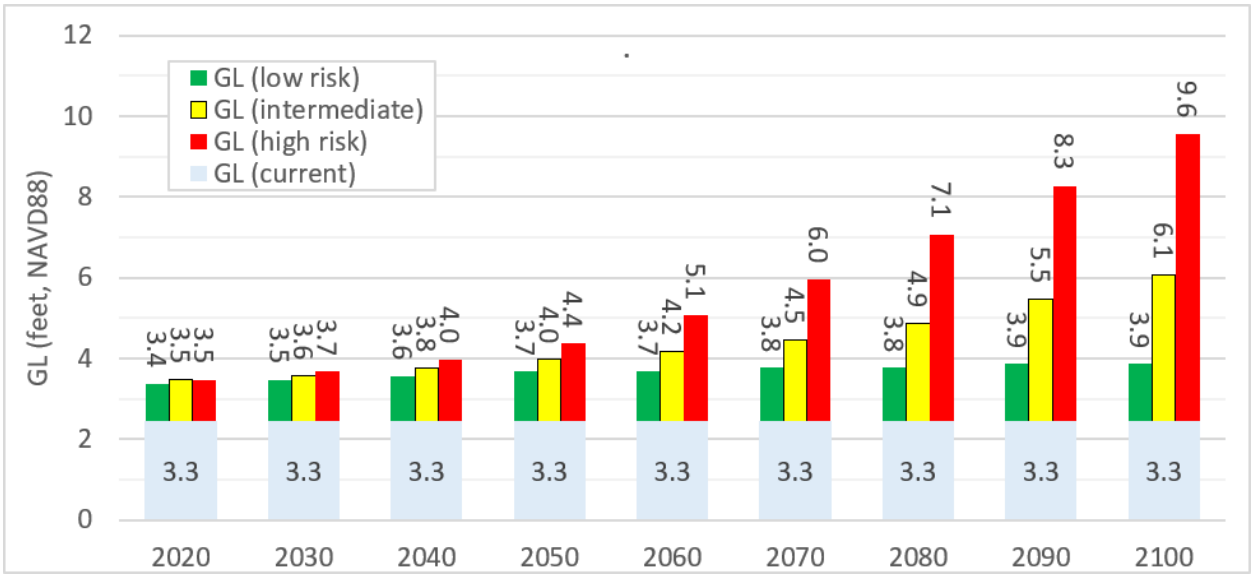


Figure 28. GLs for the low, intermediate, and high risk aversion scenarios for years 2020 through 2100

5. Vulnerability Assessment

Waterfronts like the LFT's typically comprise areas with different physical and operational conditions, asset types, levels of criticality, and varying adaptive capacities. For example, differences in elevation mean that areas of the waterfront will be overtopped by high TWLs at different times as the SLRs. As a result, analyzing the LFT's waterfront as a single uniform system can hide important spatial and temporal variations in vulnerability, while assessing it at an overly fine scale is often impractical. A balanced, areas-based approach is therefore more appropriate for a realistic and practical assessment.

The LFT was divided into eight areas, where each area shares similar physical and operational conditions, asset types, levels of criticality, and adaptive capacities. Figure 29 shows the eight areas selected for the assessment.

Despite not being on the waterfront, SFD Boulevard is vulnerable to high TWL flooding and is a pathway to LFT flooding. The Paved (i.e., asphalt- and concrete-surfaced) area, including the main parking lot, roadways, pathways, bike paths, and walkways and the planned Main Lot Parking Garage (Main Lot Garage), would be vulnerable to flooding due to groundwater emergence. Groundwater may emerge through pavement cracks, edges, drainage structures, utility vaults, and other subsurface pathways, making conventional prevention or control measures largely ineffective.



Figure 29. Areas selected for the assessment (Google Earth Vexcel Imaging US Inc. n.d.)

For the identified high TWL flooding and groundwater-emergence flooding hazards, the vulnerability of each area was assessed using the following methodology:

- High TWL flooding:
  - Identify floodwater breaching point elevation in the NOAA DEM, i.e., the lowest elevation in the area.
  - Select risk aversion scenario to define SLR projection based on site conditions, consequences of flooding, adaptive capacity, exposure to high TWL, LFT lifespan, and other criteria.
  - Delineate floodwater pathways and flood map derived from the NOAA DEM.
  - Cross-reference breaching point elevation with the sum of the current 100-year TWL and the projected SLR for the selected risk aversion scenario. This determined the ultimate horizon year by which adaptation measures must be fully operational, establishing a reverse-engineered timeline for project planning, design, permitting, funding and construction.
- Groundwater emergence flooding:
  - Select risk aversion scenario to define SLR projection based on site conditions, consequences of flooding, adaptive capacity, exposure to groundwater emergence, LFT lifespan, and other criteria.
  - Define projected long-term GL due to SLR combining the current MSL at NOAA station 9414863 Richmond (NOAA 2025b) with the risk aversion scenario SLR projection (Befus et al. 2020)

- Define groundwater emergence by subtracting the projected long-term GL from the ground elevations in the NOAA DEM.

5.1 Floodwater Breaching Points

5.1.1 Larkspur Ferry Terminal Buildings Area

The lowest elevation, and potential floodwater breaching point, in the LFT Buildings area is **11.2 feet NAVD88** at the northern end Berth 3. Figure 30 shows the location of the floodwater breaching point and the elevations in the vicinity.



Figure 30. Location and elevation of the floodwater breaching point (⊡) in the Larkspur Ferry Terminal Buildings area at the northern end of Berth 3 and elevations in the vicinity

5.1.2 Undeveloped Area

The lowest elevation, and potential floodwater breaching point, in the Undeveloped area is **8.5 feet NAVD88** at the northwest corner of the LFT basin. Figure 31 shows the location of the floodwater breaching point and the elevations in the vicinity.



Figure 31. Location and elevation of the floodwater breaching point (⊡) in the Undeveloped area at the northwest corner of the Larkspur Ferry Terminal basin and elevations in the vicinity

5.1.3 East Sir Francis Drake Boulevard Area

The lowest elevation, and potential floodwater breaching point, in the SFD Boulevard area is **9.8 feet NAVD88** at the eastern end of SFD Boulevard by the pedestrian bridge. Figure 32 shows the location of the floodwater breaching point and the elevations in the vicinity.



Figure 32. Location and elevation of the floodwater breaching point (⊡) in Sir Francis Drake Boulevard area at the eastern end of Sir Francis Drake Boulevard by the pedestrian bridge and elevations in the vicinity

5.1.4 Creek Area

The lowest elevation, and potential floodwater breaching point, in the Creek area is **8.4 feet NAVD88** near the northern end of the Creek. Figure 33 shows the location of the floodwater breaching point and the elevations in the vicinity.



Figure 33. Location and elevation of the floodwater breaching point (⊡) in the Creek area near the northern end of the Creek and elevations in the vicinity

5.1.5 Fuel Tanks Area

The lowest elevation, and potential floodwater breaching section, in the Fuel Tanks area is **9.7 feet NAVD88** on the top of the western side of the levee. The levee is generally level so floodwaters will breach that side of the levee at the same time. Figure 34 shows the location of the floodwater breaching section and the elevations in the vicinity.



Figure 34. Location and elevation of the floodwater breaching section (-----) in the Fuel Tanks area on the top of the west side of the levee and elevations in the vicinity

5.1.6 Butler Building Area

The lowest elevation, and potential floodwater breaching point, in the Butler Building area is **7.7 feet NAVD88** at the western landward edge of the marsh close to the Butler Building. The location corresponds well with floodwater breaching area observed during the high tides of January 2 to 4, 2026. Figure 35 shows the location of the floodwater breaching point and the elevations in the vicinity.



Figure 35. Location and elevation of the floodwater breaching point (▣) in the Butler Building area at the western landward edge of the marsh close to the Butler Building and elevations in the vicinity.

5.1.7 Marsh Area

The lowest elevation, and potential floodwater breaching point, in the Marsh area is **9.3 feet NAVD88** at the eastern landward edge of the marsh close to the Administration Building. Figure 36 shows the location of the floodwater breaching point and the elevations in the vicinity.

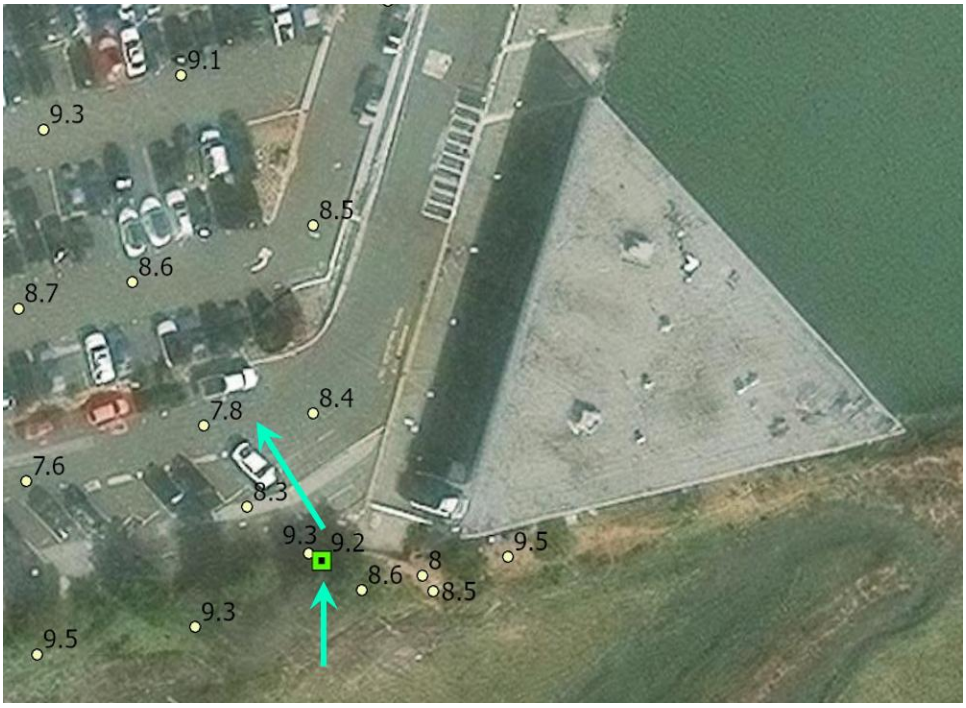


Figure 36. Location and elevation of the floodwater breaching point (▣) in the Marsh area at the eastern landward edge of the marsh close to the Administration Building and elevations in the vicinity

5.2 Risk Aversion Scenarios

Considering the site visit observations, criteria such as consequences of flooding, adaptive capacity, exposure to high TWLs and groundwater emergence, a LFT lifespan of 75 years, and according to the following rationale, the risk-aversion scenarios were selected.

Except for the LFT Buildings area, which is vulnerable to high TWL flooding, all other areas are vulnerable to flooding from both high TWLs and groundwater emergence. In the Paved (i.e., asphalt- and concrete-surfaced) area, including parking lots, roadways, pathways, bike paths, and walkways, flooding caused by groundwater emergence would be difficult to prevent or control. Groundwater may emerge through pavement cracks, edges, drainage structures, utility vaults, and other subsurface pathways, making conventional prevention or control measures largely ineffective.

LFT Buildings Area: The LFT Buildings area includes critical assets like buildings, berths, utilities, walkways and ancillary structures and facilities for passenger loading/offloading and ferry berthing. It is largely built overwater and built on pile-supported concrete decks which would be very difficult to adapt to high TWL flooding. In the event of flooding, damage could be significant and impair the LFT operations. Therefore, a **high** risk aversion scenario was selected for this area.

Undeveloped Area: There are no critical assets in this area and mainly a barren lowland. However, there is a pedestrian pathway, a power transformer, and a couple of utility vaults, all of which can be relocated or adapted to high TWL flooding. To the west of the pathway, the approximately 5-foot-high above-grade vegetated berm that separates the pathway from the main parking lot can be adapted to high TWL flooding, for example, by elevating it or building a floodwall. In the event of flooding, damage would be inconsequential provided that mitigation measures are in place for the utilities. Therefore, a **low** risk aversion scenario was selected for this area.

East SFD Boulevard Area: SFD Boulevard is not part of the LFT, but it provides the only pedestrian and vehicular access to it. No critical assets are in this area. The one-lane main parking lot exit, the three-lane exit and the two-lane entrance that connect SFD Boulevard to the LFT access road can be adapted to high TWL flooding, for example, with ramps or gates to prevent main parking lot flooding. The several utility vaults that are scattered in the vicinity in the main parking lot could be relocated or adapted to high TWL flooding. In the event of flooding, access to the LFT and parking could be impaired and damage would be inconsequential provided that mitigation measures are in place for the utilities. Therefore, an **intermediate** risk aversion scenario was selected for this area.

Creek Area: There are no critical assets in this area. The east bank of the Creek slopes up to the bike path that runs along the western boundary of the LFT and the main parking lot. The bike path is generally level and has an elevation consistent with the adjacent main parking lot. The several utility vaults that are scattered in the vicinity in the main parking lot could be relocated or adapted to high TWL flooding. In the event of flooding, access to the main parking lot and parking could be impaired and damage would be inconsequential provided that mitigation measures are in place for the utilities. This area could be adapted to high TWL flooding, for example, by building a floodwall or a levee with the bike path running on top. Therefore, an **intermediate** risk aversion scenario was selected for this area.

Fuel Tanks Area: The fuel tanks, pipelines and pump station are critical assets. These assets are surrounded by a 4-foot-high engineered concrete levee that encloses a containment area which protects the LFT and Creek from accidental spills and the tanks from flooding. The levee can be raised to prevent high TWL flooding. It is unknown whether the concrete slab (containment area floor) supporting the tanks is impermeable and capable of preventing groundwater emergence flooding. In any case, perhaps given the relatively small area, the concrete slab could be impermeabilized. Therefore, an **intermediate** risk aversion scenario was selected for this area.

Butler Building Area: Assets in this area include the employee parking lot, and the Butler Building where the IT server room is housed and mooring equipment and hardware are stored, the HazMat (oil, paint, etc.) Locker, and the Backup Generator. While the employee parking lot, the mooring equipment and hardware storage are not critical, the IT server room, the Backup Generator and the HazMat Locker are. The employee parking lot is generally level and has an elevation consistent with the adjacent main parking lot. In the event of flooding, access to the employee parking lot and parking will be impaired (as observed during the high tides of January 2 to 4, 2026) and damage would be generally inconsequential. The Butler Building (and the IT server room), HazMat Locker and the Backup Generator can be relocated or adapted to high TWL flooding by raising them. Therefore, an **intermediate** risk aversion scenario was selected for this area.

Marsh Area: There are no critical assets in this area. The bike path borders the marsh. A low, vegetated 3-foot-high above-grade berm separates the bike path from the marsh and Corte Madera Creek. Stormwater collected in an approximately 120-foot-long drain in the LFT access road adjacent to the bike path is conveyed through an underground outfall to the Corte Madera Creek. The outfall provides a path for the Corte Madera Creek to flood the main parking lot in high water events (as observed during the high tides of January 2 to 4, 2026) and impair access to the main parking lot and parking; however, damage would be generally inconsequential provided that mitigation measures are in place for the utilities. This area could be adapted to high TWL flooding, for example, by building a floodwall or raising the berm. The outfall can be removed or plugged so that high TWL flooding of the main parking lot is prevented. Therefore, an **intermediate** risk aversion scenario was selected for this area.

Paved Area: This area, which includes the existing main and employee parking lots, roadways, pathways, bike paths, and walkways, is critical to LFT operations. Several adaptation measures can be implemented to reduce the risk of flooding from high TWLs. However, no practical or cost-effective solutions are

available to prevent flooding caused by groundwater emergence. Groundwater can surface through pavement cracks and edges, drainage structures, utility vaults, and other subsurface pathways, rendering conventional flood prevention and control measures largely ineffective. Given these limitations and the operational importance of this area, a **high** risk aversion scenario was selected.

Table 4 lists the risk aversion scenarios selected for each area.

Table 4. Larkspur Ferry Terminal areas and selected risk aversion scenarios

Area	Risk Aversion Scenario
LFT Buildings	High
Undeveloped	Low
East SFD Boulevard	Intermediate
Creek	Intermediate
Fuel Tanks	Intermediate
Butler Building	Intermediate
Marsh	Intermediate
Paved	High

5.3 Floodwater Pathways

Figure 37 shows the projected TWLs as function of time, obtained by combining the current 100-year TWL and the projected SLR for the low risk aversion scenario, and the breaching point elevation of the Undeveloped area. Figure 38 shows the same for the intermediate risk aversion scenario and the breaching point elevations of the SFD Boulevard, Creek, Fuel Tanks, Butler Building and Marsh areas and Figure 39 for the high risk aversion scenario and the LFT Buildings area.

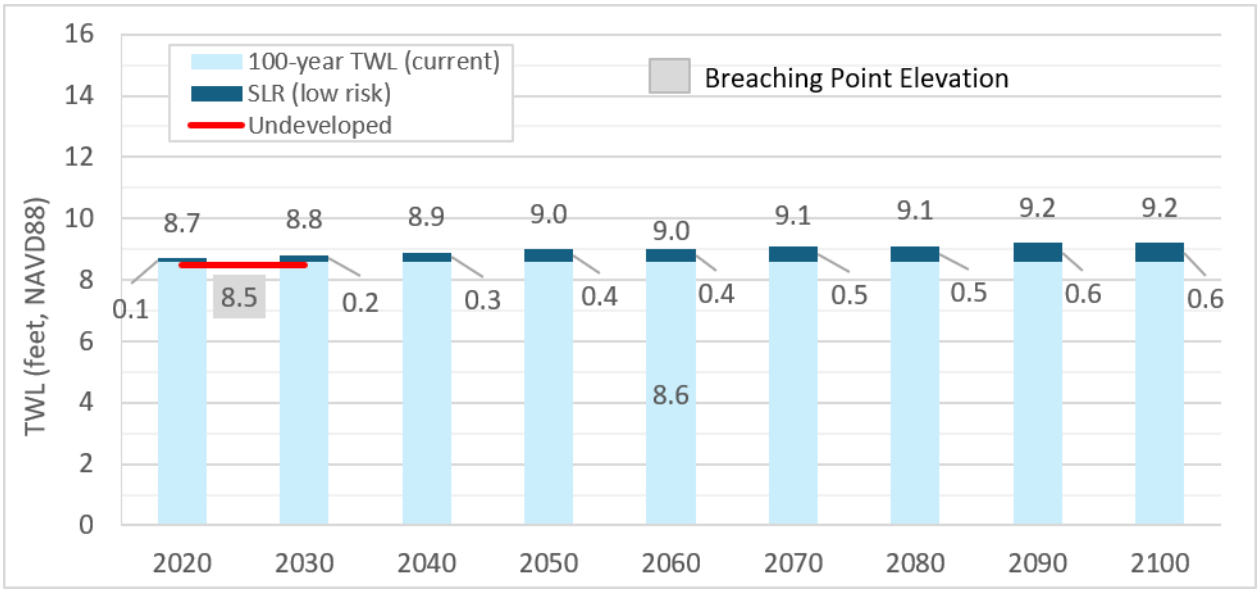


Figure 37. Projected TWLs for the low risk aversion scenario and breaching point elevation of the Undeveloped area

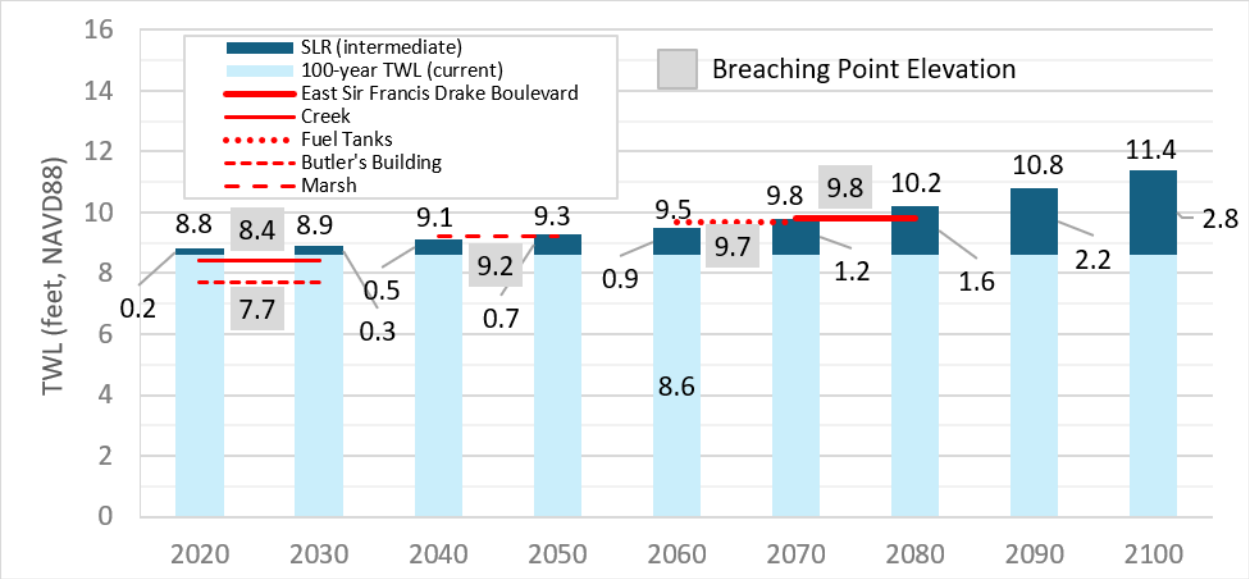


Figure 38. Projected TWLs for the intermediate risk aversion scenario and breaching point elevations of the Sir Francis Drake Boulevard, Creek, Fuel Tanks, Butler Building, and Marsh areas

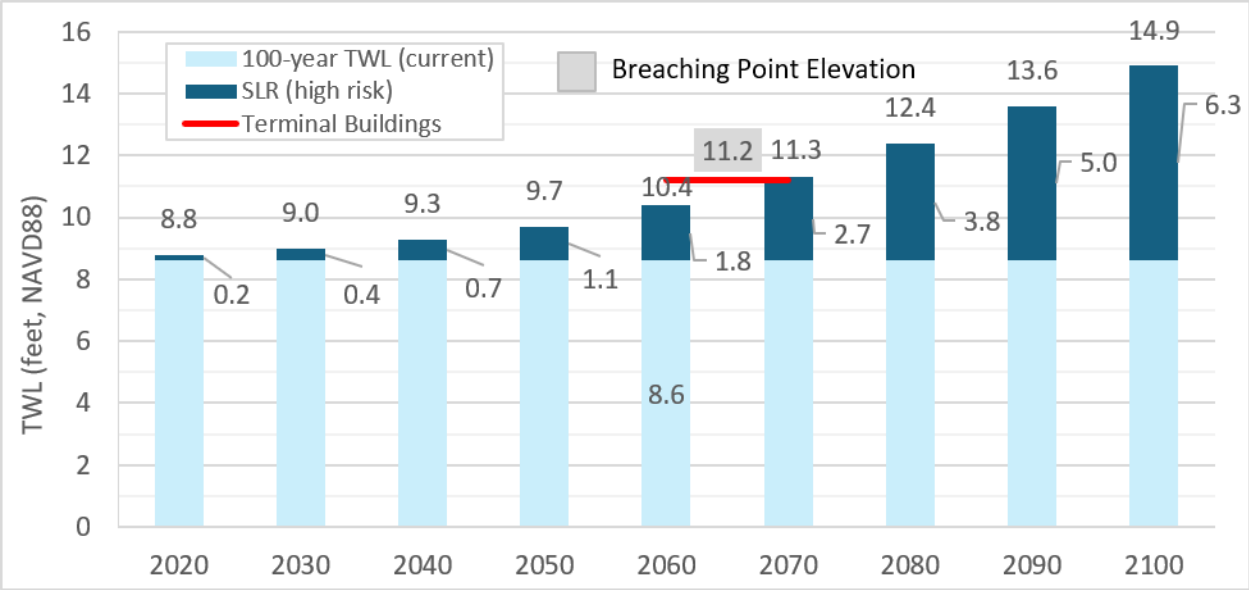


Figure 39. Projected TWLs for the high risk aversion scenario and breaching point elevation of the Larkspur Ferry Terminal Buildings area

Table 5 lists the areas ordered from the earliest to the latest, when the breaching points in each area are expected to be exceeded by the projected TWLs for the selected risk aversion scenarios.

Table 5. Years when the projected TWLs for the selected risk aversion scenarios would exceed the breaching points in each area

Years	Area	Breaching Point Elevation (feet NAVD88)	Risk Aversion Scenario	Projected TWL (feet NAVD88)
2020-2030	Butler Building	7.7	Intermediate	8.8 – 8.9
2020-2030	Creek	8.4	Intermediate	8.8 – 8.9
2020-2030	Undeveloped	8.5	Low	8.7 – 8.8
2040-2050	Marsh	9.2	Intermediate	9.1 – 9.3
2060-2070	Fuel Tanks	9.7	Intermediate	9.5 – 9.8
2060-2070	LFT Buildings	11.2	High	10.4 – 11.3
2070-2080	East SFD Boulevard	9.8	Intermediate	9.8 – 10.2

5.3.1 Butler Building Area

In the Butler Building area, the TWL for the intermediate risk aversion scenario is projected to reach 8.9 feet NAVD88 by 2030 (see Figure 38). Once the projected TWL exceeds the breaching point elevation of 7.7 feet NAVD88, the employee parking lot and adjacent areas will be flooded. The impact of similar extreme high TWLs was observed on January 2 to 4, 2026 when the peak TWL reached 8.73 feet NAVD88. That event could be used as a proxy for this area.

Figure 40 shows a schematic of the potential floodwater pathways in the Butler Building area for the projected 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtopping the 7.7 feet NAVD88 breaching point.

Figure 41 shows the potential extent of flooding (i.e., the area with elevations below the projected TWL) when the 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtops the breaching point and adjacent low-lying areas for an infinite duration. This extent of flooding is unlikely to occur, as the duration of the TWL above the breaching point elevation and adjacent low-lying areas will be limited. Furthermore, the extent of flooding will be controlled not only by the duration of the overtopping but also by site-specific factors affecting floodwater propagation, such as topography, surface permeability, existing structures, flow pathways, and drainage characteristics. Hydrodynamic flood modeling accounting for these factors would be needed to accurately quantify the spatial extent and depth of flooding.

To illustrate the importance of duration, Figure 42 shows the TWLs measured at NOAA station 9414863 Richmond (NOAA 2025b) between January 1 and 6, 2026 (the highest on record and representative of the 100-year TWL) augmented by 0.2 foot to account for SLR by 2030 (intermediate risk aversion). If such event would occur by 2030, the Butler Building area waterfront would be overtopped for approximately 15 hours over the five-day period.



Figure 40. Schematic of potential floodwater pathways in the Butler Building area for the projected 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtopping the 7.7 feet NAVD88 breaching point

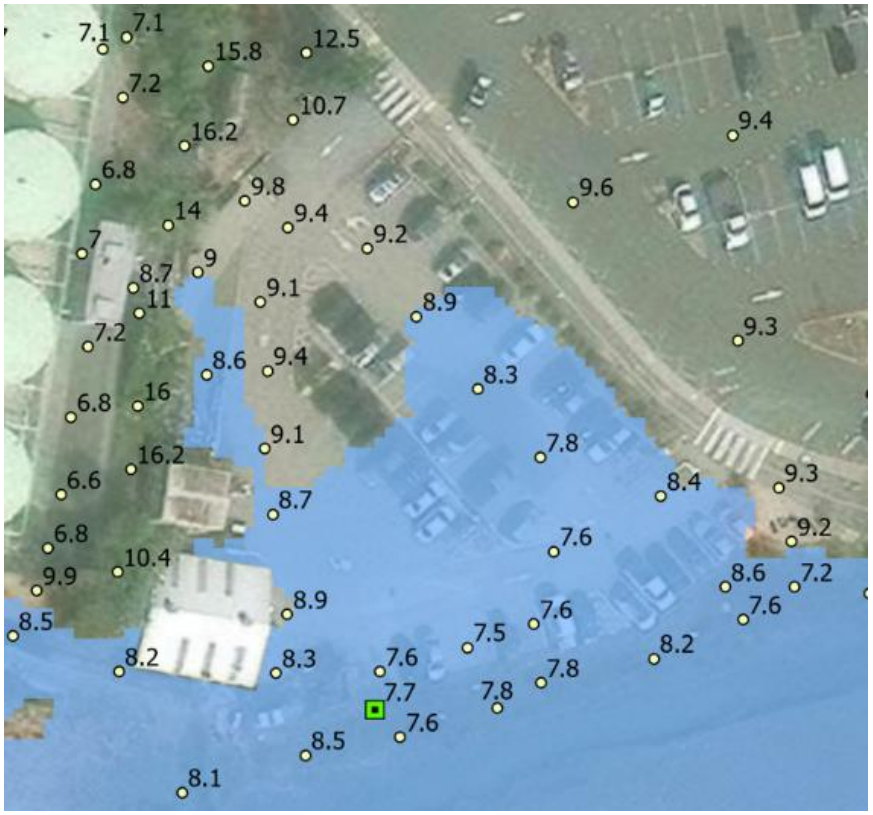


Figure 41. Potential extent of flooding in the Butler Building area assuming infinite duration of the projected 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtopping the 7.7 feet NAVD88 breaching point and low-lying areas

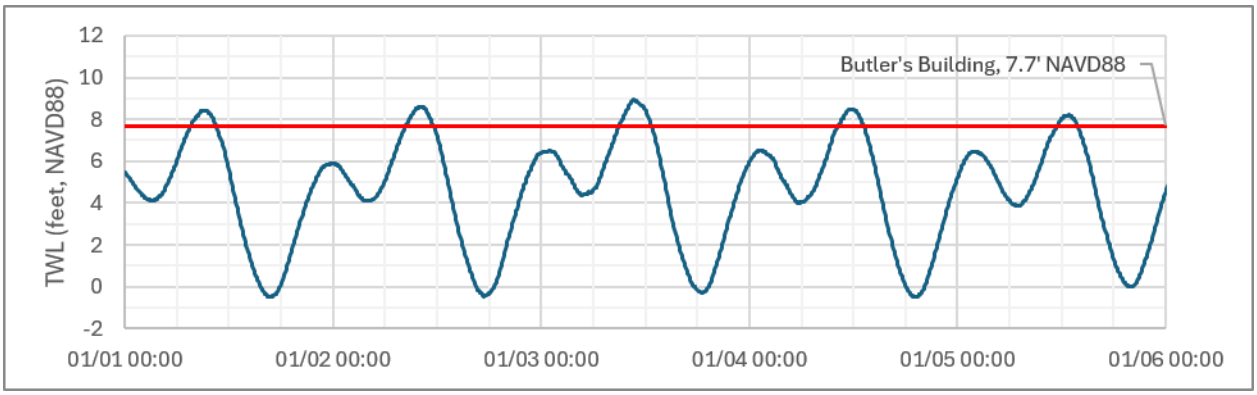


Figure 42. TWL measured at NOAA station 9414863 Richmond between January 1 and 6, 2026, augmented by SLR = 0.2 feet to represent the projected 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtopping the 7.7 feet NAVD88 breaching point (NOAA 2025b)

5.3.2 Creek Area

In the Creek area, the TWL for the intermediate risk aversion scenario is projected to reach 8.9 feet NAVD88 by 2030 (see Figure 38). Once the projected TWL exceeds the breaching point elevation of 8.4 feet NAVD88, the bike path, main parking lot and adjacent areas in the northwest corner of the LFT will be flooded.

Figure 43 shows a schematic of the potential floodwater pathways in the Creek area for the projected 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtopping the 8.4 feet NAVD88 breaching point.

Figure 44 shows the potential extent of flooding (i.e., the area with elevations below the projected TWL) when the 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtops the breaching point and adjacent low-lying areas for an infinite duration. This extent of flooding is unlikely to occur, as the duration of the TWL above the breaching point elevation and adjacent low-lying areas will be limited. Furthermore, the extent of flooding will be controlled not only by the duration of overtopping but also by site-specific factors affecting floodwater propagation, such as topography, surface permeability, existing structures, flow pathways, and drainage characteristics. Hydrodynamic flood modeling accounting for these factors would be needed to accurately quantify the spatial extent and depth of flooding.

To illustrate the importance of duration, Figure 45 shows the TWLs measured at NOAA station 9414863 Richmond (NOAA 2025b) between January 1 and 6, 2026 (the highest on record and representative of the 100-year TWL) augmented by 0.3 foot to account for SLR by 2030 (intermediate risk aversion). If such event would occur by 2030, the Creek area waterfront would be overtopped for approximately 6.5 hours over the five-day period.



Figure 43. Schematic of potential floodwater pathways in the Creek area for the projected 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtopping the 8.4 feet NAVD88 breaching point



Figure 44. Potential extent of flooding in the Creek area assuming infinite duration of the projected 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtopping the 8.4 feet NAVD88 breaching point and adjacent low-lying areas

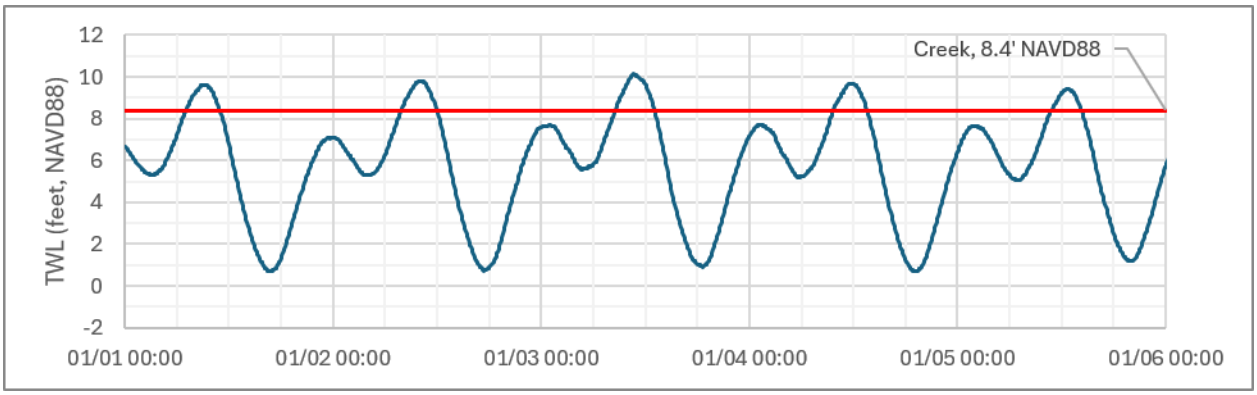


Figure 45. TWL measured at NOAA station 9414863 Richmond between January 1 and 6, 2026, augmented by SLR = 0.3 feet to represent the projected 8.9 feet NAVD88 TWL by 2030 (intermediate risk aversion) overtopping the 8.4 feet NAVD88 breaching point (NOAA 2025b)

5.3.3 Undeveloped Area

In the Undeveloped area, the TWL for the low risk aversion scenario is projected to reach 8.8 feet NAVD88 by 2030 (see Figure 37). Once the projected TWL exceeds the breaching point elevation of 8.5 feet NAVD88, the low-lying areas at the north end of the LFT basin will be flooded.

Figure 46 shows a schematic of the potential floodwater pathways in the Undeveloped area for the projected 8.8 feet NAVD88 TWL by 2030 (low risk aversion) overtopping the 8.5 feet NAVD88 breaching point.

Figure 47 shows the potential extent of flooding (i.e., the area with elevations below the projected TWL) when the 8.8 feet NAVD88 TWL by 2030 (low risk aversion) overtops the breaching point and adjacent low-lying areas for an infinite duration. This extent of flooding is unlikely to occur, as the duration of the TWL above the breaching point elevation and adjacent low-lying areas will be limited. Furthermore, the extent of flooding will be controlled not only by the duration of overtopping but also by site-specific factors affecting floodwater propagation, such as topography, surface permeability, existing structures, flow pathways, and drainage characteristics. Hydrodynamic flood modeling accounting for these factors would be needed to accurately quantify the spatial extent and depth of flooding.

To illustrate the importance of duration, Figure 48 shows the TWLs measured at NOAA station 9414863 Richmond (NOAA 2025b) between January 1 and 6, 2026 (the highest on record and representative of the 100-year TWL) augmented by 0.1 foot to account for SLR by 2030 (low risk aversion). If such event would occur by 2030, the Undeveloped area would be overtopped for approximately 2 hours over the five-day period.



Figure 46. Schematic of potential floodwater pathways in the Undeveloped area for the projected 8.8 feet NAVD88 TWL by 2030 (low risk aversion) overtopping the 8.5 feet NAVD88 breaching point

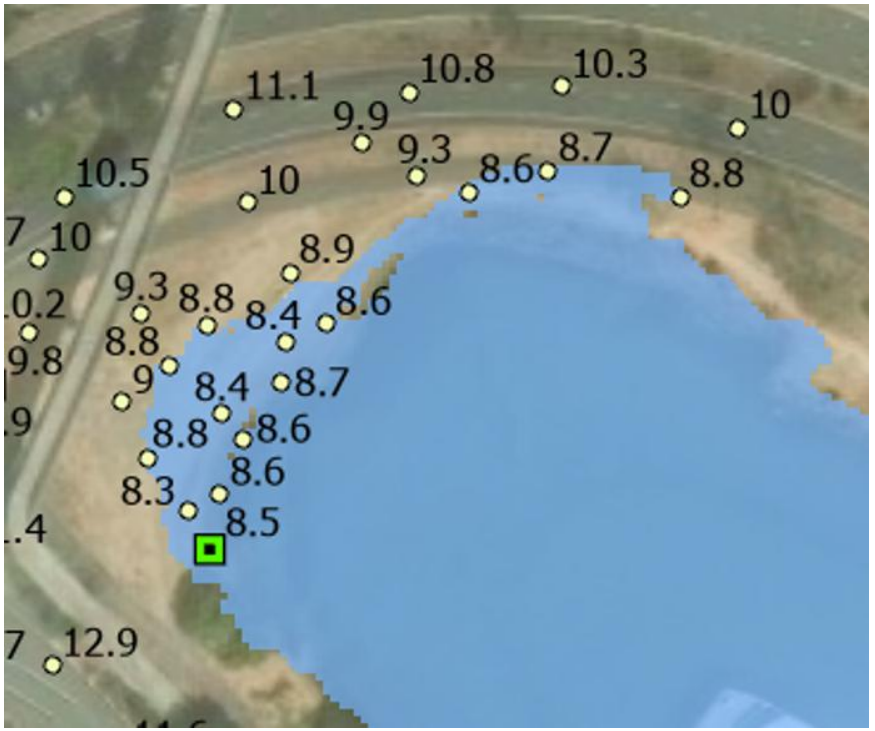


Figure 47. Potential extent of flooding in the Undeveloped area assuming infinite duration of the projected 8.8 feet NAVD88 TWL by 2030 (low risk aversion) overtopping the 8.5 feet NAVD88 breaching point and adjacent low-lying areas

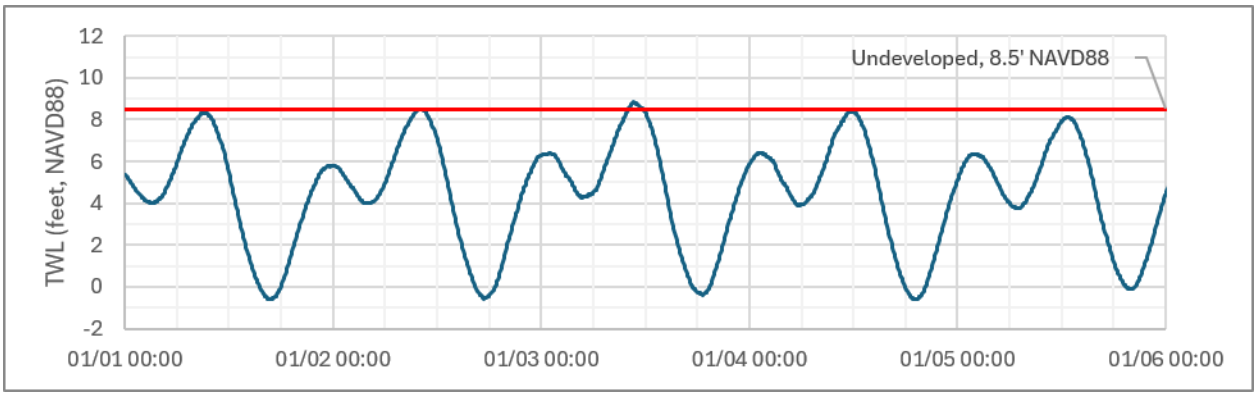


Figure 48. TWL measured at NOAA station 9414863 Richmond between January 1 and 6, 2026, augmented by SLR = 0.1 feet to represent the projected 8.8 feet NAVD88 TWL by 2030 (low risk aversion) overtopping the 8.5 feet NAVD88 breaching point (NOAA 2025b)

5.3.4 Marsh Area

In the Marsh area, the TWL for the intermediate risk aversion scenario is projected to reach 9.3 feet NAVD88 by 2050 (see Figure 38). Once the projected TWL exceeds the breaching point elevation of 9.2 feet NAVD88, the bike path, adjacent access road and main parking lot in the southern area of the LFT will be flooded.

Figure 49 shows a schematic of the potential floodwater pathways in the Marsh area for the projected 9.3 feet NAVD88 TWL by 2050 (intermediate risk aversion) overtopping the 9.2 feet NAVD88 breaching point.

Figure 50 shows the potential extent of flooding (i.e., the area with elevations below the projected TWL) when the 9.3 feet NAVD88 TWL by 2050 (intermediate risk aversion) overtops the breaching point and adjacent low-lying areas for an infinite duration. This extent of flooding is unlikely to occur, as the duration of the TWL above the breaching point elevation and adjacent low-lying areas will be limited. Furthermore, the extent of flooding will be controlled not only by the duration of overtopping but also by site-specific factors affecting floodwater propagation, such as topography, surface permeability, existing structures, flow pathways, and drainage characteristics. Hydrodynamic flood modeling accounting for these factors would be needed to accurately quantify the spatial extent and depth of flooding.

To illustrate the importance of duration, Figure 51 shows the TWLs measured at NOAA station 9414863 Richmond (NOAA 2025b) between January 1 and 6, 2026 (the highest on record and representative of the 100-year TWL) augmented by 0.6 foot to account for SLR by 2050 (intermediate risk aversion). If such event would occur by 2050, the Marsh area would be overtopped for approximately 1 hour over the five-day period

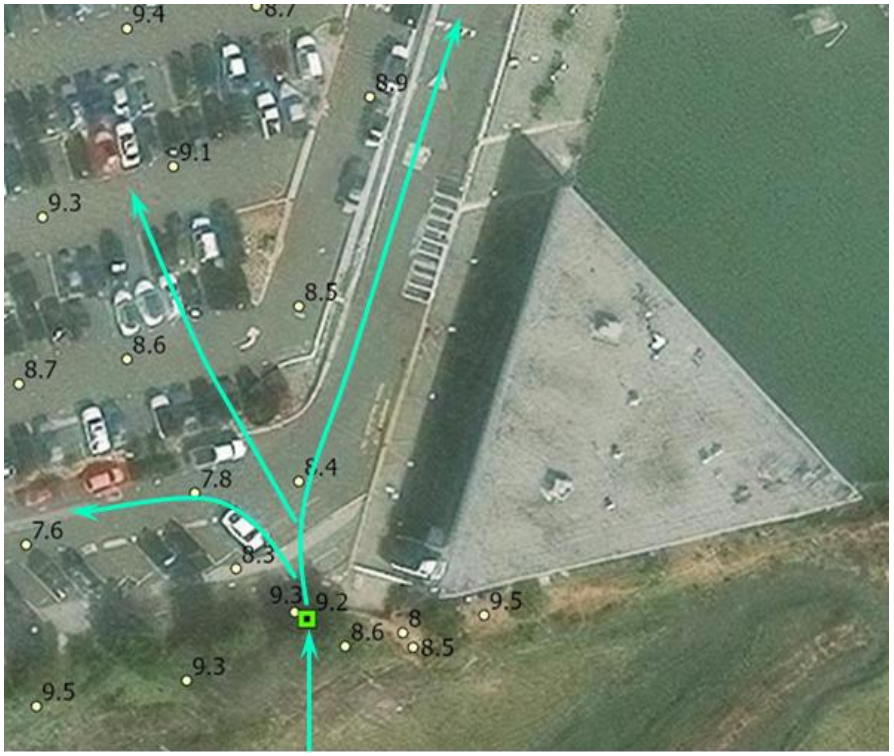


Figure 49. Schematic of potential floodwater pathways in the Marsh area for the projected 9.3 feet NAVD88 TWL by 2050 (intermediate risk aversion) overtopping the 9.2 feet NAVD88 breaching point

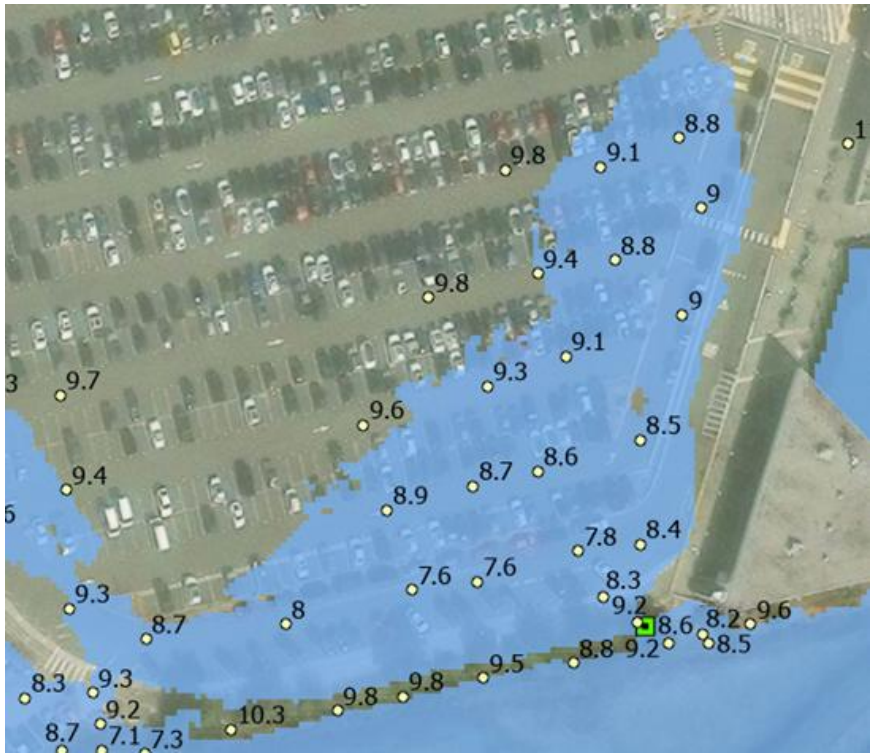


Figure 50. Potential extent of flooding in the Marsh area assuming infinite duration of the projected 9.3 feet NAVD88 TWL by 2050 (intermediate risk aversion) overtopping the 9.2 feet NAVD88 breaching point and adjacent low-lying areas

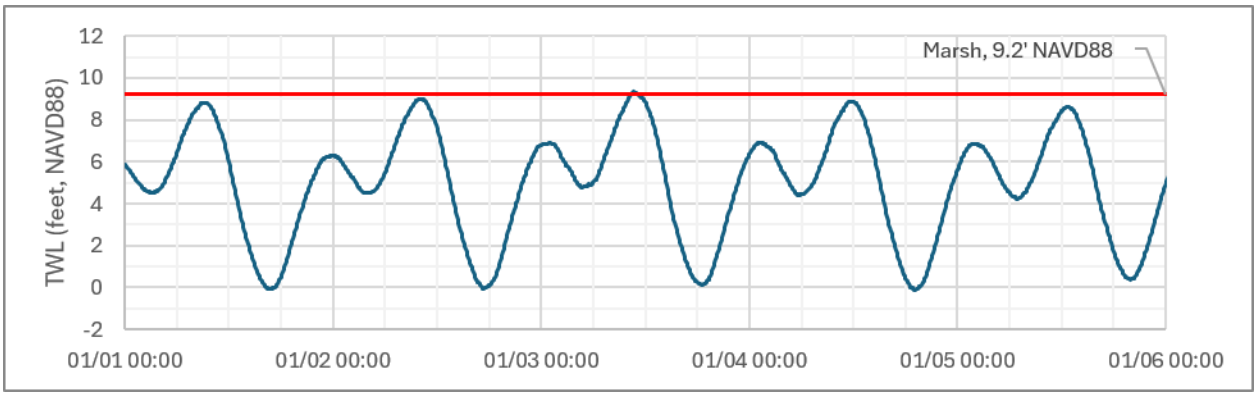


Figure 51. TWL measured at NOAA station 9414863 Richmond between January 1 and 6, 2026, augmented by SLR = 0.6 feet to represent the projected 9.3 feet NAVD88 TWL by 2050 (intermediate risk aversion) overtopping the 9.2 feet NAVD88 breaching point (NOAA 2025b)

5.3.5 Fuel Tanks Area

In the Fuel Tanks area, the TWL for the intermediate risk aversion scenario is projected to reach 9.8 feet NAVD88 by 2070 (see Figure 38). Once the projected TWL exceeds the breaching point elevation of 9.7 feet NAVD88 (top of the engineered levee), the tanks containment area will be flooded.

Figure 52 shows a schematic of the potential floodwater pathways in the Fuel Tanks area for the projected 9.8 feet NAVD88 TWL by 2070 (intermediate risk aversion) overtopping the 9.7-foot NAVD88 high engineered levee.

Figure 53 shows the potential extent of flooding (i.e., the area with elevations below the projected TWL) when the 9.8 feet NAVD88 TWL by 2070 (intermediate risk aversion) overtops the engineered levee. Hydrodynamic flood modeling would be needed to determine the volume and depth of floodwater in the containment area.

To illustrate the importance of duration, Figure 54 shows the TWLs measured at NOAA station 9414863 Richmond (NOAA 2025b) between January 1 and 6, 2026 (the highest on record and representative of the 100-year TWL) augmented by 1.1 feet to account for SLR by 2070 (intermediate risk aversion). If such event would occur by 2070, the Fuel Tanks area would be overtopped for approximately 1 hour over the five-day period.



Figure 52. Schematic of potential floodwater pathways in the Fuel Tanks area for the projected 9.8 feet NAVD88 TWL by 2070 (intermediate risk aversion) overtopping the 9.7-foot NAVD88 high engineered levee

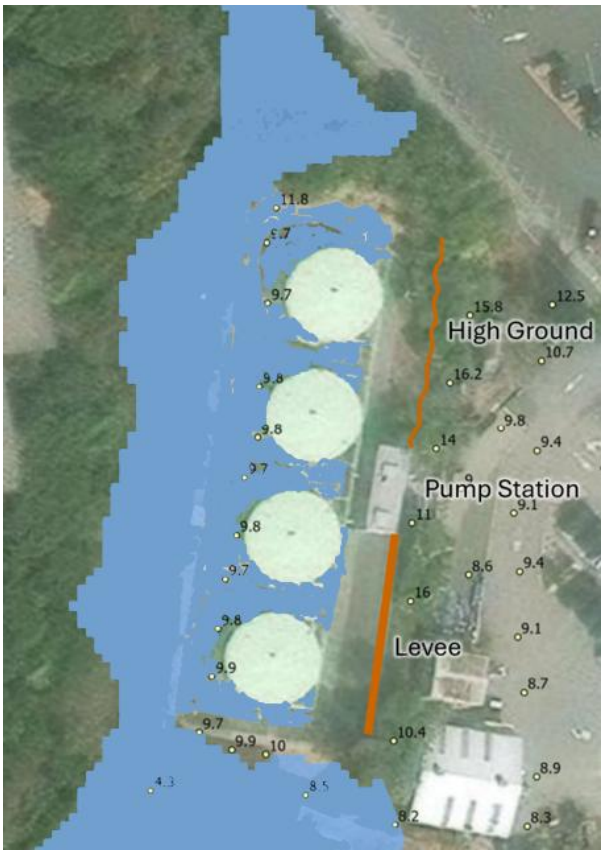


Figure 53. Potential extent of flooding of the Fuel Tanks area and tanks containment area assuming infinite duration of the projected 9.8 feet NAVD88 TWL by 2070 (intermediate risk aversion) overtopping the 9.7-foot NAVD88 high engineered levee and adjacent low-lying areas

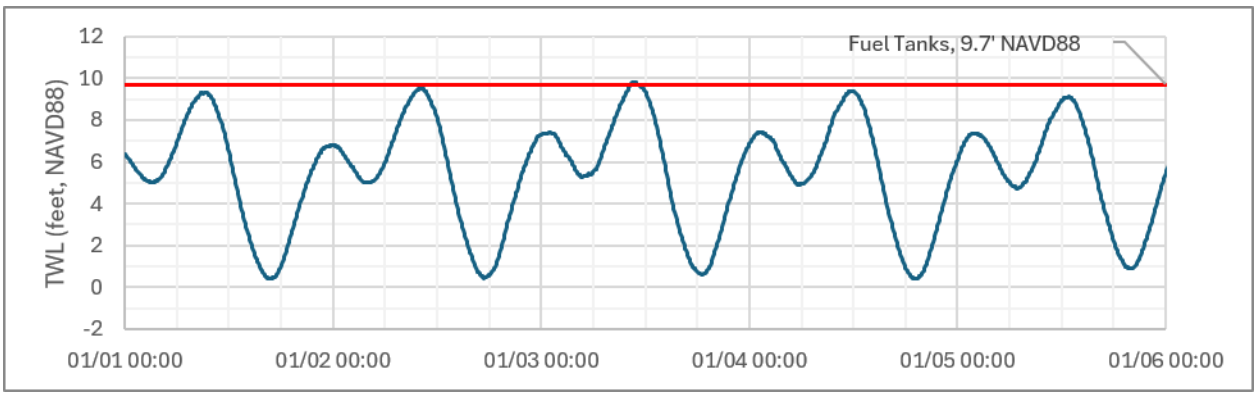


Figure 54. TWL measured at NOAA station 9414863 Richmond between January 1 and 6, 2026, augmented by SLR = 1.1 feet to represent the projected 9.8 feet NAVD88 TWL by 2070 (intermediate risk aversion) overtopping the 9.7-foot NAVD88 high engineered levee (NOAA 2025b)

5.3.6 Larkspur Ferry Terminal Buildings Area

In the LFT Buildings area, the TWL for the high risk aversion scenario is projected to reach 11.3 feet NAVD88 by 2070 (see Figure 39). Once the projected TWL exceeds the breaching point elevation of 11.2 feet NAVD88 at Berth 3, the landside areas to the north and south, including the access road and main parking lot, will be flooded.

Figure 55 shows a schematic of the potential floodwater pathways in the Berth 3 area for the projected 11.3 feet NAVD88 TWL by 2070 (high risk aversion) overtopping the 11.2 feet NAVD88 breaching point.

Figure 56 shows the potential extent of flooding (i.e., the area with elevations below the projected TWL) when the 11.3 feet NAVD88 TWL by 2070 (high risk aversion) overtops the breaching point and adjacent low-lying areas for an infinite duration. This extent of flooding is unlikely to occur, as the duration of the TWL above the breaching point elevation and adjacent low-lying areas will be limited. Furthermore, the extent of flooding will be controlled not only by the duration of the overtopping but also by site-specific factors affecting floodwater propagation, such as topography, surface permeability, existing structures, flow pathways, and drainage characteristics. Hydrodynamic flood modeling accounting for these factors would be needed to accurately quantify the spatial extent and depth of flooding.

To illustrate the importance of duration, Figure 57 shows the TWLs measured at NOAA station 9414863 Richmond (NOAA 2025b) between January 1 and 6, 2026 (the highest on record and representative of the 100-year TWL) augmented by 2.6 feet to account for SLR by 2070 (high risk aversion). If such event would occur by 2070, the Berth 3 area would be overtopped for approximately 1 hour over the five-day period.

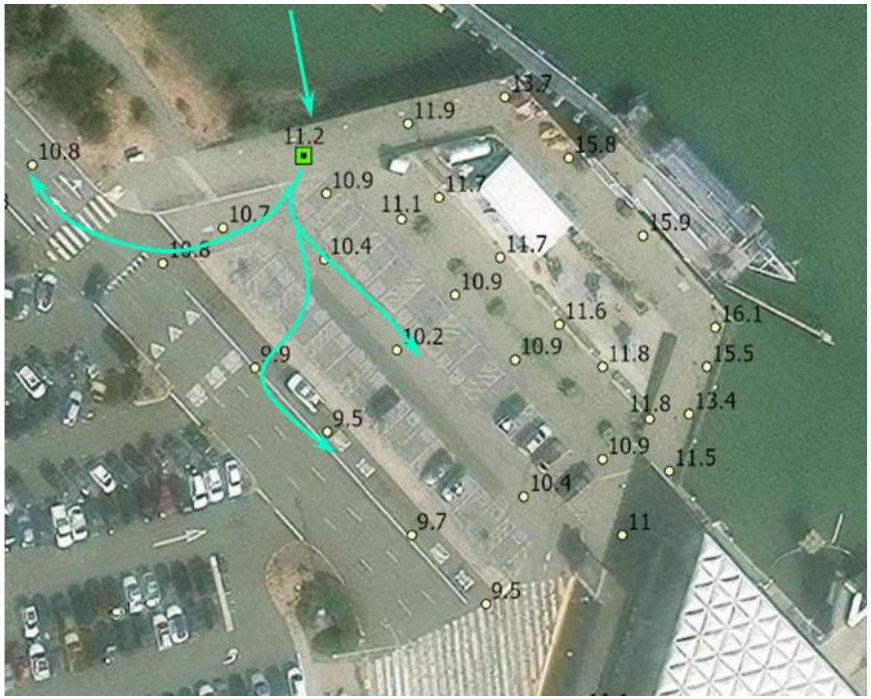


Figure 55. Schematic of potential floodwater pathways in the Larkspur Ferry Terminal Buildings Berth 3 for the projected 11.3 feet NAVD88 TWL by 2070 (high risk aversion) overtopping the 11.2 feet NAVD88 breaching point

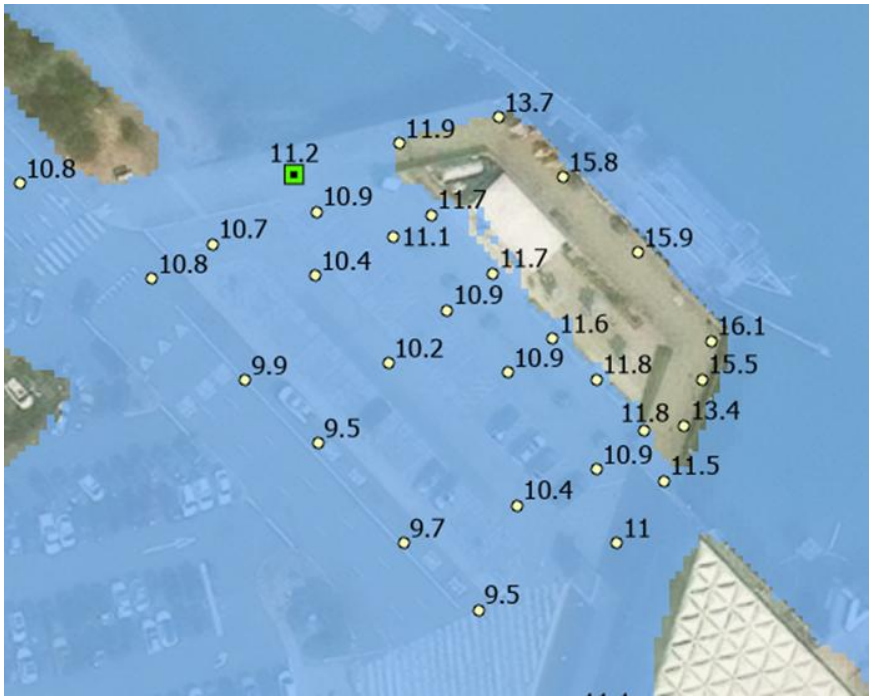


Figure 56. Potential extent of flooding in the Larkspur Ferry Terminal Buildings Berth 3 assuming infinite duration of the projected 11.3 feet NAVD88 TWL by 2070 (high risk aversion) overtopping the 11.2 feet NAVD88 breaching point and low-lying areas

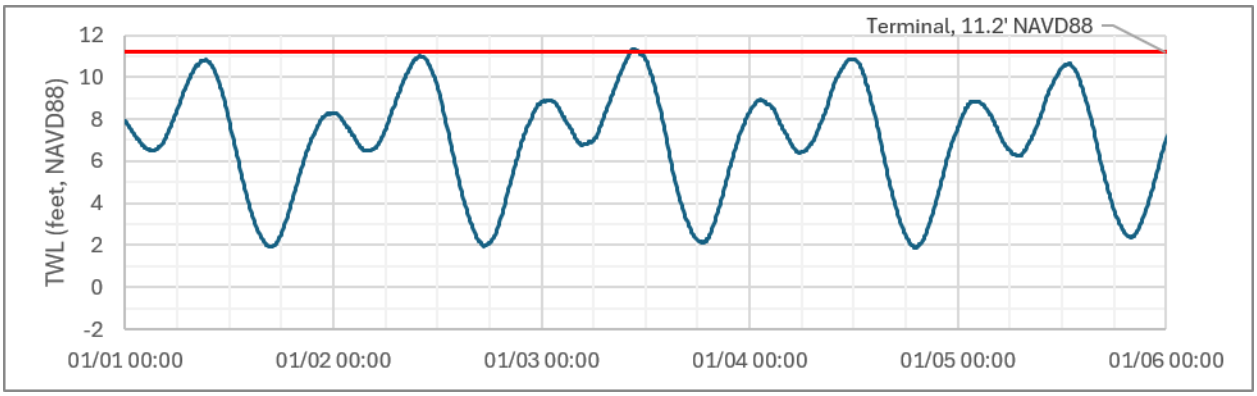


Figure 57. TWL measured at NOAA station 9414863 Richmond between January 1 and 6, 2026, augmented by SLR = 2.6 feet to represent the projected 11.3 feet NAVD88 TWL by 2070 (high risk aversion) overtopping the 11.2 feet NAVD88 breaching point (NOAA 2025b)

5.3.7 East Sir Francis Drake Boulevard Area

In the SFD Boulevard area, the TWL for the intermediate risk aversion scenario is projected to reach 10.2 feet NAVD88 by 2080 (see Figure 38). Once the projected TWL exceeds the breaching point elevation of 9.8 feet NAVD88, the LFT access/exit roads lot will be flooded.

Figure 58 shows a schematic of the potential floodwater pathways in the SFD Boulevard area for the projected 10.2 feet NAVD88 TWL by 2080 (intermediate risk aversion) overtopping the 9.8 feet NAVD88 breaching point.

Figure 59 shows the potential extent of flooding (i.e., the area with elevations below the projected TWL) when the 10.2 feet NAVD88 TWL by 2080 (intermediate risk aversion) overtops the breaching point and adjacent low-lying areas for an infinite duration. This extent of flooding is unlikely to occur, as the duration of the TWL above the breaching point elevation and adjacent low-lying areas will be limited. Furthermore, the extent of flooding will be controlled not only by the duration of overtopping but also by site-specific factors affecting floodwater propagation, such as topography, surface permeability, existing structures, flow pathways, and drainage characteristics. Hydrodynamic flood modeling accounting for these factors would be needed to accurately quantify the spatial extent and depth of flooding.

To illustrate the importance of duration, Figure 60 shows the TWLs measured at NOAA station 9414863 Richmond (NOAA 2025b) between January 1 and 6, 2026 (the highest on record and representative of the 100-year TWL) augmented by 1.5 feet to account for SLR by 2080 (intermediate risk aversion). If such event would occur by 2080, the SFD Boulevard area would be overtopped for approximately 3 hours over the five-day period

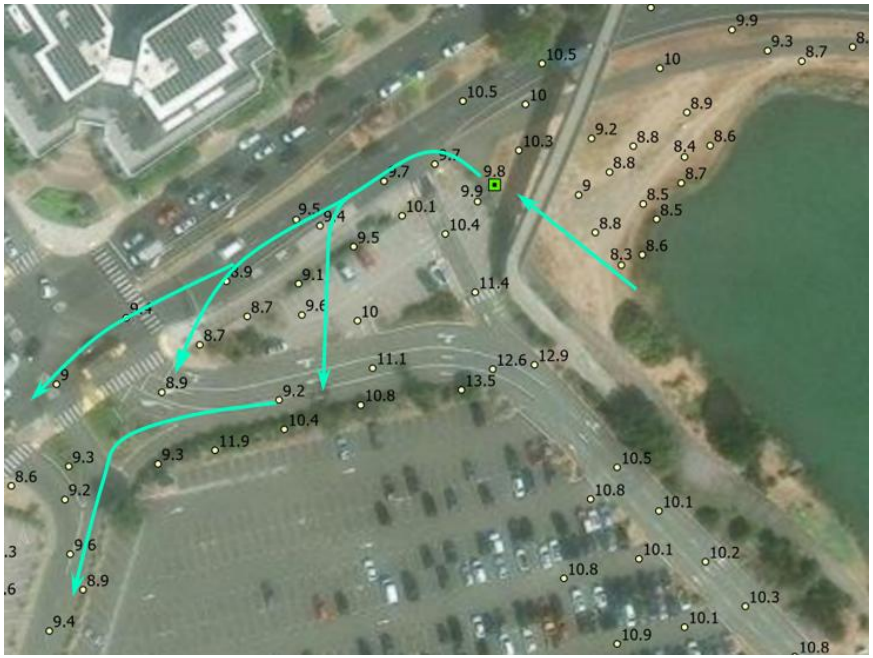


Figure 58. Schematic of potential floodwater pathways in the Sir Francis Drake Boulevard area for the projected 10.2 feet NAVD88 TWL by 2080 (intermediate risk aversion) overtopping the 9.8 feet NAVD88 breaching point



Figure 59. Potential extent of flooding in the Sir Francis Drake Boulevard area assuming infinite duration of the projected 10.2 feet NAVD88 TWL by 2080 (intermediate risk aversion) overtopping the 9.8 feet NAVD88 breaching point and adjacent low-lying areas

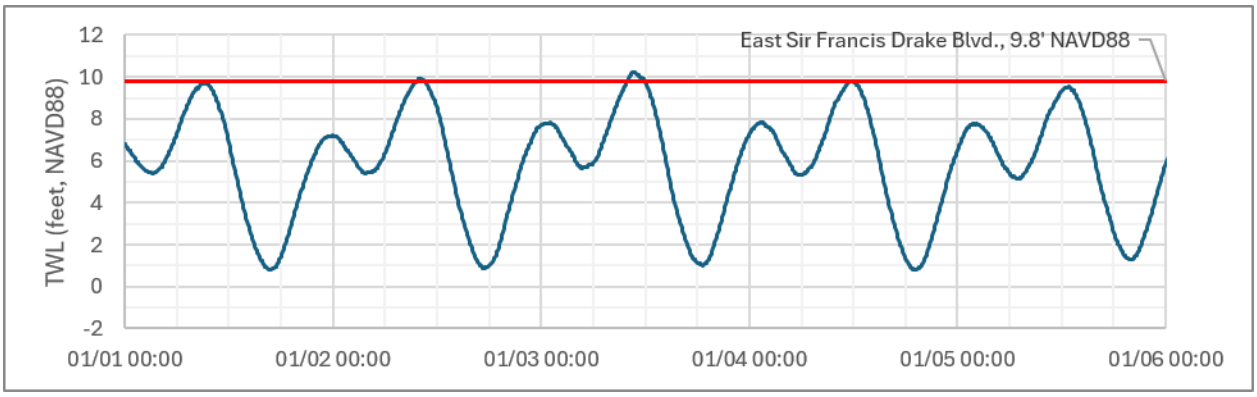


Figure 60. TWL measured at NOAA station 9414863 Richmond between January 1 and 6, 2026, augmented by SLR = 1.5 feet to represent the projected 10.2 feet NAVD88 TWL by 2080 (intermediate risk aversion) overtopping the 9.8 feet NAVD88 breaching point (NOAA 2025b)

5.4 Groundwater Emergence

The Paved area is vulnerable to groundwater emergence flooding. Due to the LFT's proximity and its direct hydraulic connection to the Corte Madera Creek, coupled with the absence of cut-off walls or other subsurface barriers, the LFT soils are not expected to significantly impede landward groundwater flows. As a result, and in the long term, GLs are anticipated to track changes in MSL closely, with negligible lag attributable to soil hydraulic conductivity.

Therefore, projected long-term GLs due to SLR were estimated combining the current MSL at NOAA station 9414863 Richmond (NOAA 2025b) (3.3 feet NAVD88, see Table 2) with the high risk scenario SLR projections (see Table 3). Groundwater emergence was estimated by subtracting the projected long-term GLs from the ground elevations in the NOAA DEM.

The assessment showed that, in the Paved area and for the high risk scenario, no groundwater would emerge before the year 2080. However, groundwater is expected to emerge within the fuel tank containment area between 2070 and 2080, as the elevation of the containment area floor (approximately 6 to 7 feet NAVD88) is lower than the projected groundwater elevation of 7.1 feet NAVD88 in 2080.

Table 6 lists the GLs for years 2080 through 2100 for the high risk aversion scenario. Figure 61 and Figure 62 show the perimeter of the planned Main Lot Garage and the GLs in feet below ground level (BGL) for years 2080, 2090 and 2100 for the high risk aversion scenario. Within the Main Lot Garage perimeter, Figure 61 shows the GLs when the first floor of the Main Lot Garage is at the current ground elevation, which ranges between 8.4 and 14 feet NAVD88 and averages 10.5 feet NAVD88. Figure 62 shows the GLs when the first floor of the Main Lot Garage is built at 11.4 feet NAVD88.

If the first floor of the Main Lot Garage is built at the current ground elevation, Figure 61 shows that by 2080, the GLs within the perimeter of the Main Lot Garage would be 1 to 2 feet BGL in the southern area of the Main Lot Garage and within 1 foot or at the ground level by 2090, and groundwater would emerge by 2100. However, it is important to note that the GLs shown are long-term averages and that the temporary increases in GL due to extreme high TWLs would result in episodic groundwater emergence. Figure 62 shows that if the first floor of the Main Lot Garage is built at 11.4 feet NAVD88 the groundwater emergence could be prevented but only within the Main Lot Garage perimeter.

Additionally, both figures show that by 2080 and beyond, groundwater would emerge in the fuel tanks containment area.

Table 6. Current MSL, high risk aversion scenario SLR projections and GLs for years 2080 through 2100

Year	MSL (feet NAVD88)	SLR (feet NAVD88)	Groundwater Level (feet NAVD88)
2080	3.3	3.8	7.1
2090	3.3	5.0	8.3
2100	3.3	6.3	9.6

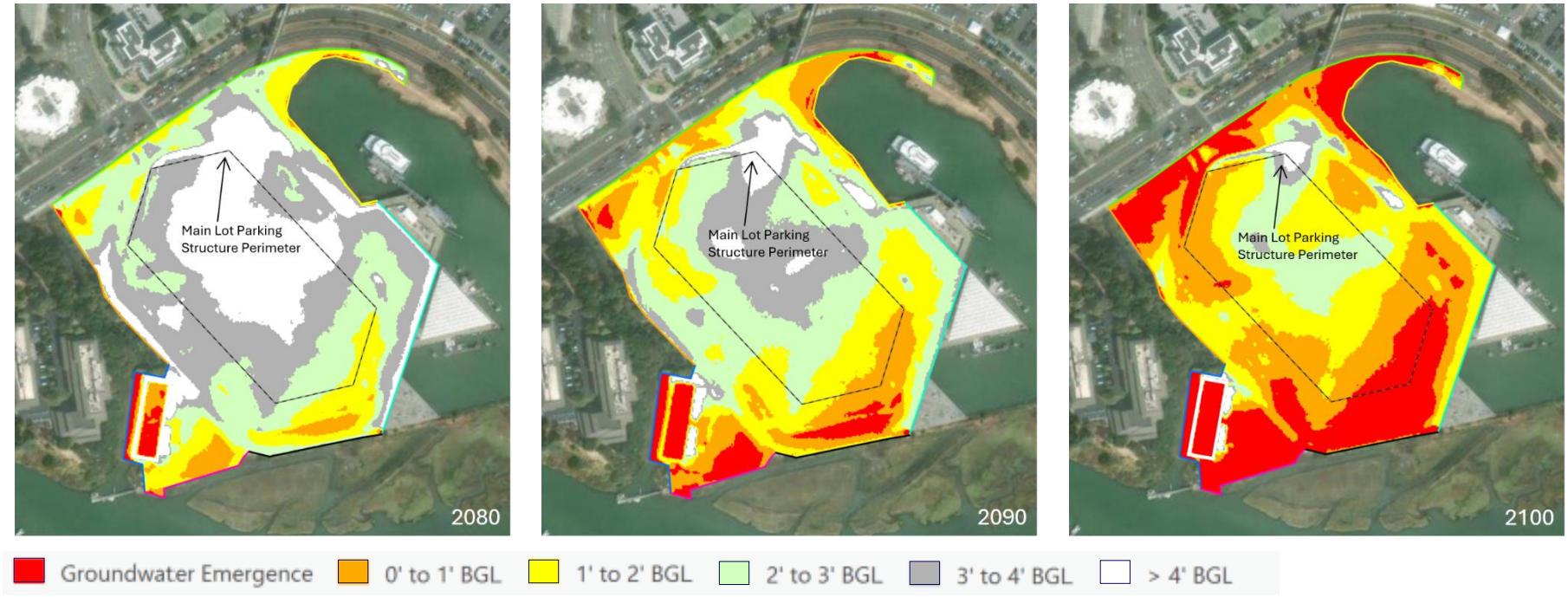


Figure 61. Depth of groundwater (feet, BGL) for years 2080 (left), 2090 (center) and 2100 (right) for the high risk aversion scenario, first floor of the Main Lot Parking Garage built at the ground elevation

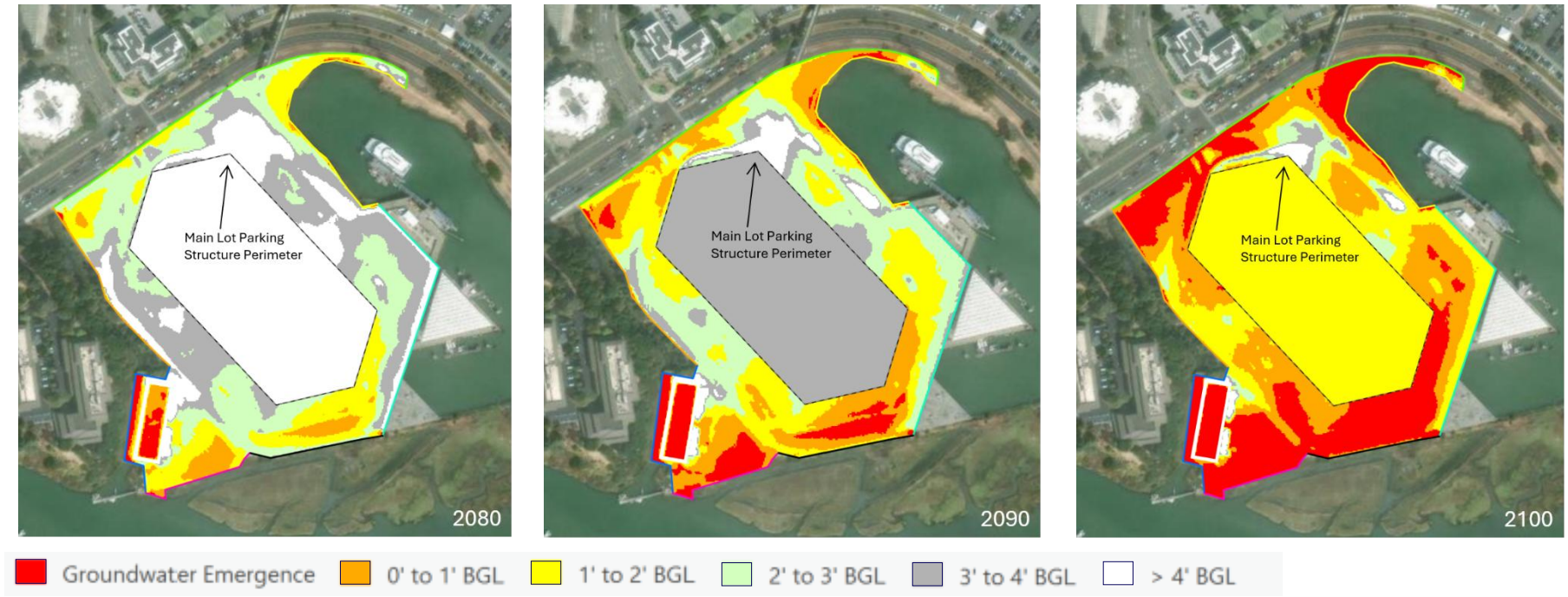


Figure 62. Depth of groundwater (feet, BGL) for years 2080 (left), 2090 (center) and 2100 (right) for the high risk aversion scenario, first floor of the Main Lot Parking Garage built at 11.4 feet NAVD88

5.5 Summary

Table 7 presents a summary of the vulnerability assessment. Figure 63 shows the breaching points at each area selected for the assessment and potential extent of high TWL flooding from 2030 to 2080. The potential areas extent of groundwater emergence flooding is shown in Figure 62. Hydrodynamic flood modeling accounting for factors such as floodwater overtopping duration, topography, surface permeability, existing structures, flow pathways, and drainage characteristics would be needed to accurately determine flooding pathways and quantify spatial extent and depth of flooding.

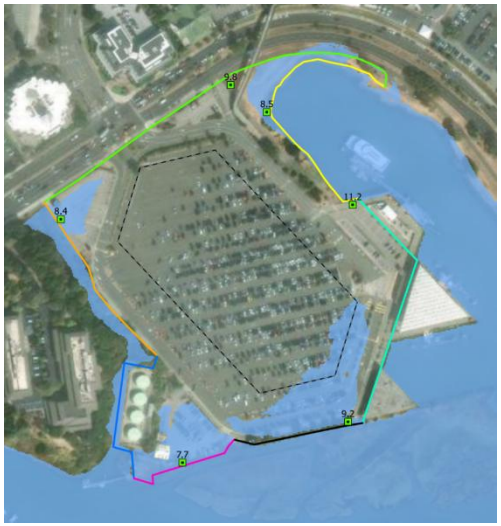
Table 7. Summary of vulnerability assessment

Years	Area	Hazard	Breaching Point Elevation (feet NAVD88)	Projected TWL (feet NAVD88)	Vulnerable Assets
2020-2030	Butler Building	High TWL	7.7	8.8 – 8.9	Employee parking lot
2020-2030	Creek	High TWL	8.4	8.8 - 8.9	Northwest corner of the LFT: bike path, main parking lot and utility vaults
2020-2030	Undeveloped	High TWL	8.5	8.7 – 8.8	None
2040-2050	Marsh	High TWL	9.2	9.1 - 9.3	Southern area of the LFT: main parking lot, road and utility vaults
2060-2070	Fuel Tanks	High TWL	9.7	9.5 – 9.8	Fuel tanks, pipelines
2060-2070	LFT Buildings	High TWL	11.2	10.4 – 11.3	Buildings, passenger and ferry boarding areas, utility vaults
2070-2080	East SFD Boulevard	High TWL	9.8	9.8 – 10.2	Roads, main parking lot and utility vaults
2080	Fuel Tanks	Groundwater Emergence	N/A	N/A	Containment area
2090	Butler Building, Marsh, Paved	Groundwater Emergence	N/A	N/A	Employee and main (south) parking lots, bike path, utility vaults
2100	Paved	Groundwater Emergence	N/A	N/A	Main parking lot (north) and Main Lot Garage [a]

[a] Groundwater emergence flooding if first floor of Main Lot Garage is built at existing ground level, not vulnerable if built at 11.4 feet NAVD88



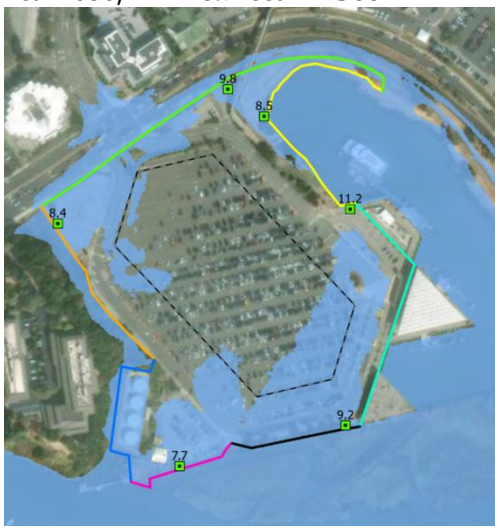
Year 2030, TWL = 8.9 feet NAVD88



Year 2050, TWL = 9.3 feet NAVD88



Year 2070, TWL = 9.8 feet NAVD88



Year 2080, TWL = 10.2 feet NAVD88



Year 2070, TWL = 11.3 feet NAVD88

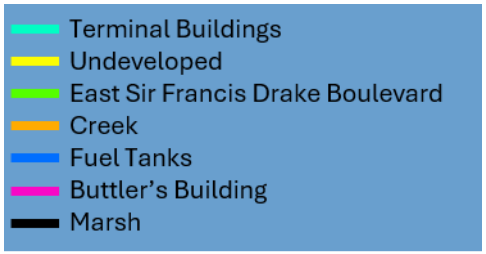


Figure 63. Breaching points and potential extent of flooding from 2030 to 2080 assuming no adaptation measures are implemented, year 2030 low and intermediate risk aversion scenarios, years 2050 and 2070 intermediate, and year 2080 high risk aversion scenario

6. Risk Assessment and Adaptation Plan

6.1 Risk Assessment

The vulnerability assessment identified the LFT;s vulnerabilities and established, for the selected risk aversion scenarios and associated SLR projections, the timeline by which adaptation measures must be operational. The risk assessment complemented the vulnerability assessment by evaluating the significance of those vulnerabilities based on the likelihood of the flood hazards and their potential consequences, providing a basis for prioritizing areas and adaptation measures and allocating resources.

The likelihood of a hazard is inversely related to the level of risk aversion of the selected scenario. For example, SLR projections for a high-risk aversion scenario are based on highly conservative assumptions intended to reflect extreme, very low probability conditions. Within a standard risk framework, where risk is assessed as a function of both the likelihood of occurrence and the consequences of the hazard, the very low likelihood associated with the high-risk aversion scenario means that the overall risk will remain relatively low, even though the potential consequences may be severe.

The risk assessment was based on qualitative ratings of likelihood and consequences. Table 8 lists the qualitative levels of likelihood, corresponding risk aversion scenarios and ratings, and Table 9 lists the qualitative levels of consequence and ratings. Table 10 shows the risk assessment matrix (per PIANC 2020) used to derive the qualitative risk levels for each LFT area. Table 11 describes recommended adaptation actions for each risk level.

Table 8. Qualitative levels of likelihood, risk aversion scenarios and ratings

Likelihood	Risk Aversion Scenario	Rating
Rare, very unlikely	High	1
Unlikely, could occur but not expected	Intermediate high	2
Possible, might occur	Intermediate	3
Likely, expected to occur	Intermediate low	4
Almost certain, will occur	Low	5

Table 9. Qualitative levels of consequence and ratings

Consequence	Description	Rating
Insignificant	Negligible operational disruption, no damage	1
Minor	Limited operational disruption, minor repairs	2
Moderate	Noticeable operational disruption, moderate damage	3
Major	Significant operational disruption, substantial damage	4
Severe	Operations shutdown, major damage/loss	5

Table 10. Typical risk assessment matrix, risk level = likelihood x consequence (PIANC 2020)

Likelihood → / Consequence ↓	Rare (1)	Unlikely (2)	Possible (3)	Likely (4)	Almost Certain (5)
Insignificant(1)	1	2	3	4	5
Minor (2)	2	4	6	8	10
Moderate (3)	3	6	9	12	15
Major (4)	4	8	12	16	20
Severe (5)	5	10	15	20	25

Risk Level	low	moderate	high	very high

Table 11. Risk levels and recommended actions

Risk Level	Recommended Action
Low	Monitoring and management
Moderate	Adaptation required within existing asset management cycles
High	Adaptation required as high priority
Very High	Immediate adaptation required

Table 12 presents the risk assessment for the selected LFT areas. The likelihood rankings due to high TWL and groundwater emergence flooding were determined based on the criteria presented in Table 4 and Table 8. Consequences were assessed by considering the presence of critical assets and the potential impacts of flooding on LFT operations, including service disruptions and damage to assets (infrastructure, utilities). According to the risk assessment, the following actions are recommended:

- High Risk Level: East SFD Boulevard, Fuel Tanks and Butler Building areas: adaptation required as a high priority.
- Moderate Risk Level: LFT Buildings, Undeveloped, Creek, Marsh and Paved areas: adaptation required within existing asset management (maintenance, repair, rehabilitation, and replacement) cycles.

Table 12. Larkspur Ferry Terminal Risk Assessment Summary

Area	Risk Aversion Scenario	Likelihood Rating	Consequence		Risk Level	
LFT Buildings: includes critical assets: buildings, berths, utilities, walkways, structures and facilities for passenger loading/offloading and ferry berthing, built overwater on pile-supported concrete decks	High	1	Operations shutdown, major damage/loss to structures and utilities	5	5	Moderate
Undeveloped: no critical assets, mainly a barren lowland.	Low	5	None	1	5	Moderate
East SFD Boulevard: no critical assets, but the only pedestrian and vehicular (cars, buses, bikes, etc.) access to the LFT	Intermediate	3	Significant operational disruption due to impaired access and parking, substantial damage to utilities	4	12	High
Creek: no critical assets, but pedestrian and bike access at the northwest corner of the LFT, and small parking area	Intermediate	3	Limited operational disruption, minor repairs	2	6	Moderate
Fuel Tanks: includes critical assets: fuel tanks, pipelines and pump station	Intermediate	3	Operations shutdown, major damage/loss	5	15	High
Butler Building: includes critical assets: IT server room, backup generator and HazMat locker	Intermediate	3	Operations shutdown, major damage/loss, potential hazmat leaks	5	15	High
Marsh: no critical assets, but pedestrian and vehicular access at the southern boundary of the LFT, and small parking area	Intermediate	3	Limited operational disruption, minor repairs	2	6	Moderate
Paved: includes critical assets: main and employee parking lots, roadways, pathways, bike paths, walkways and the planned Main Lot Garage	High	1	Operations shutdown, major damage/loss to structures and utilities	5	5	Moderate

6.2 Adaptation Plan

The vulnerability and risk assessments serve complementary but distinct purposes in supporting SLR adaptation planning for the LFT. The vulnerability assessment identified when specific areas of the LFT will become susceptible to flooding under the selected SLR projections and risk aversion scenarios. By comparing projected high TWLs to the waterfront breaching point elevations and GLs to the existing ground elevations, the ultimate horizon years by which adaptation measures must be fully operational were established. This approach effectively created a reverse-engineered timeline, working backward from the time flooding is expected to occur to determine when planning, design, permitting, funding, and construction work must begin.

The emphasis on a reverse-engineered timeline is particularly important when the implementation of adaptation measures will require lengthy design, environmental review and permitting processes, funding and construction. In order for an adaptation measure to be recognized as meeting the minimum standards under the National Flood Insurance Program, coordination with the Federal Emergency Management Agency for accreditation under Code of Federal Regulations 44 §65.10 will be required. This together with review by agencies such as the California Coastal Commission, the U.S. Army Corps of Engineers, and local permitting authorities can easily require five to ten years (or longer) from project inception to completion.

Consequently, the vulnerability assessment does more than identify future flooding thresholds; it provides the engineering justification necessary to trigger decisions and work well before floodwaters are expected to reach critical elevations. In this sense, the vulnerability assessment defines not only when a vulnerability may be realized, but also when work must commence to ensure the adaptation measures are operational on time.

The risk assessment adds another layer of information by evaluating the significance of the identified vulnerabilities based on both the likelihood of future flooding and the consequences if flooding would occur. While a vulnerability assessment may indicate that an asset will not be exposed until a time far into the future, the risk assessment may identify that asset as a high priority because of its critical physical and operational characteristics, the severe consequences if impacted by the hazard, and/or the long lead time required to develop the adaptation measure. This does not necessarily imply that a particular adaptation measure should be implemented immediately. Rather, it indicates that immediate actions (planning, design, etc.) are warranted to ensure that the measure can be delivered before the identified vulnerability threshold is reached. Therefore, the vulnerability assessment defines the adaptation measure operational deadline, whereas the risk assessment helps determine the urgency and prioritization of actions needed to meet that deadline.

The need for prioritization is particularly important because the LFT waterfront contains a wide range of elevations, asset types and criticalities, and operational functions. Combined with the progressive nature of SLR, these differences result in varying vulnerability timeframes across the LFT. As shown in Table 7, some areas may require adaptation measures immediately, while others may not face significant exposure until mid- or end of the century. As a result, adaptation measures will not all need to be implemented at the same time, nor will doing so be practical or cost-effective.

This reality supports the adoption of a phased approach to SLR adaptation planning. A phased approach ensures that adaptation measures are implemented in a timely, cost-effective, and flexible manner while reducing uncertainty and avoiding premature investment. Rather than attempting to protect the entire LFT at once, adaptation actions can be sequenced according to the projected vulnerability timelines and risk priorities.

A phased approach offers the following important advantages:

- It aligns adaptation investments with projected vulnerability timeframes, avoiding over-investment too early before it is needed while also reducing the risk of delayed action.
- Implementing all adaptation measures upfront can be prohibitively expensive, particularly when some impacts may not materialize for many decades and future conditions remain uncertain.
- Allows costs to be distributed over time, improving affordability and providing flexibility as conditions evolve.
- Incorporates adaptive management principles. SLR projections are subject to inherent uncertainty, and scientific understanding continues to evolve. A phased approach allows decisions to be revisited as new climate information becomes available, SLR projections are updated, and monitoring data provides greater confidence regarding future conditions. This flexibility can reduce the risk of either under-designing or over-designing adaptation measures.
- Allows early actions to focus on lower-cost or temporary measures while preserving the opportunity to implement larger and more expensive measures later if conditions warrant.
- Provides opportunities to integrate adaptation measures with existing asset management (maintenance, repair, rehabilitation, and replacement) cycles. By coordinating adaptation investments with planned upgrades, disruption to LFT operations can be minimized and overall project costs reduced.

Table 7 and Table 12 provide the basis for the adaptation plan. The analysis of alternatives, selection of preferred and design of adaptation measures is not within the scope of the assessment. However, in principle and except for the LFT Buildings area, the use of floodwalls (I or T-type walls), gates and ramps, and elevating existing levees and ground appear as feasible alternatives. Measures requiring encroaching into the Corte Madera Creek will not be permitted under the McAteer-Petris Act.

In alignment with a phased approach, the following is recommended.

- Perform hydrodynamic flood modeling to determine the duration of high TWLs exceeding the breaching point elevations, and to determine flooding pathways and quantify spatial extent and depth of flooding. This would assist in the definition of adaptation measures.
- Decommission (plug, remove) the underground outfall that conveys the stormwater collected by the approximately 120-foot-long drain in the southern area of the main parking lot to the Corte Madera Creek. The outfall constitutes a path for the Corte Madera Creek seawater to flood the main parking lot in high TWLs.
- Given that it does not have adaptation capacity, design and build the **Main Lot Garage** (planned to be in operation by 2040) so that its first floor is at the 11.4 feet NAVD88 elevation to prevent groundwater emergence flooding by 2100.
- **Butler Building** is a high risk area; commence work toward the immediate implementation of an adaptation measure for high TWL flooding by 2030 and for groundwater emergence flooding by 2090.
- **Creek** and **Undeveloped** are moderate risk areas; within an existing asset management cycle, commence work toward implementing adaptation measures for high TWL flooding by 2030.
- **Marsh** is a moderate risk area; within an existing asset management cycle, commence work toward implementing an adaptation measure for high TWL flooding by 2040 - 2050 and for groundwater emergence flooding by 2090.

- **Fuel Tanks** is a high risk area; commence work toward the implementation of an adaptation measure for high TWL flooding by 2060 – 2070 and for groundwater emergence flooding by 2080.
- **LFT Buildings** is a moderate risk area; within an existing asset management cycle, commence work toward implementing an adaptation measure for high TWL flooding by 2060 - 2070.
- **East SFD Boulevard** is a high risk area; commence work toward the implementation of an adaptation measure for high TWL flooding by 2070 – 2080.
- **Paved** is a moderate risk area; within an existing asset management cycle, commence work toward implementing an adaptation measure for groundwater emergence flooding by 2090.

7. Conclusions and Recommendations

The following conclusions and recommendations were made:

1. The site visit was very beneficial. It allowed for gaining first-hand knowledge about the characteristics and condition of the LFT waterfront and the impact of the high TWLs of January 2 to 4, 2026, and allowed the team to perform spot elevation measurements to verify the NOAA DEM.
2. The NOAA DEM showed good agreement with the spot elevation measurements and was adopted for the identification of potential floodwater breaching points and pathways and flooding areas for the different SLR projections selected.
3. High TWLs flooding and groundwater emergence flooding were identified as the principal hazards.
4. The LFT was divided into eight areas, where each area shares similar physical and operational conditions, asset types, levels of criticality, and adaptive capacities. These were the LFT Buildings, Undeveloped, East SFD Boulevard, Creek, Fuel Tanks, Butler Building, Marsh and Paved.
5. For the waterfront areas, floodwater breaching points (lowest) elevations were identified, risk aversion scenarios and SLR projections were selected, floodwater pathways and flood maps delineated and ultimate horizon years by which adaptation measures must be fully operational were determined.
6. For the Paved area within the LFT, a risk aversion scenario and SLR projections were selected, projected long-term GLs and groundwater emergence locations and years were defined.
7. The vulnerability assessment showed that:
    a. The Butler Building and the Undeveloped and Marsh areas are currently vulnerable to high TWL flooding.
    b. Adaptation measures for high TWL flooding will be needed in the:
        i. Marsh area by 2040 –2050 (southern area of the LFT: main parking lot, road and utility vaults)
        ii. Fuel Tanks area by 2060 – 2070 (fuel tanks, pipelines)
        iii. LFT Buildings area by 2060 – 2070 (buildings, passenger and ferry boarding areas, utility vaults)
        iv. East SFD Boulevard area by 2070 – 2080 (roads, main parking lot and utility vaults)
    c. Adaptation measures for groundwater emergence flooding will be needed in the:

i. Fuel Tanks area by 2080 (containment area)

ii. Butler Building, Marsh, Paved areas by 2090 (employee and main (south) parking lots, bike path, utility vaults)

iii. Paved area by 2100 (main parking lot (north), Main Lot Garage)

8. The risk assessment complemented the vulnerability assessment by evaluating the significance of the vulnerabilities based on the likelihood of the flood hazards and their potential consequences, providing a basis for prioritizing areas and adaptation measures and allocating resources.

9. Based on qualitative ratings of likelihood and consequences, the risk assessment showed that:

   a. The East SFD Boulevard, Fuel Tanks and Butler Building are areas at high risk and adaptation is recommended as a high priority.
   b. The LFT Buildings, Undeveloped, Creek, Marsh and Paved are areas at moderate risk and adaptation within existing asset management cycles is recommended.

10. While a vulnerability assessment may indicate that an asset will not be exposed until a time far into the future, the risk assessment may identify that asset as a high priority because of its critical physical and operational characteristics, the severe consequences if impacted by the hazard, and/or the long lead time required to develop the adaptation measure. This does not necessarily imply that a particular adaptation measure should be implemented immediately. Rather, it indicates that immediate actions (planning, design, etc.) are warranted to ensure that the measure can be delivered before the identified vulnerability threshold is reached.

11. A phased approach to adaptation is recommended. A phased approach recognizes both the long implementation timelines associated with waterfront adaptation measures and the varying vulnerability timeframes across the LFT. It enables proactive, cost-effective, and adaptive decision-making, ensuring that adaptation measures are delivered when needed while maintaining flexibility in the face of future uncertainty.

12. In alignment with a phased approach, the following is recommended:

    a. Perform hydrodynamic flood modeling to determine the duration of high TWLs exceeding the breaching point elevations, and to determine flooding pathways and quantify spatial extent and depth of flooding. This would assist in the definition of adaptation measures.

    b. Decommission (plug, remove) the underground outfall that conveys the stormwater collected by the approximately 120-foot-long drain in the southern area of the main parking lot to the Corte Madera Creek. The outfall constitutes a path for the Corte Madera Creek seawater to flood the main parking lot in high TWLs.

    c. Given that it does not have adaptation capacity, design and build the Main Lot Garage (planned to be in operation by 2040) so that its first floor is at the 11.4 feet NAVD88 elevation to prevent groundwater emergence flooding by 2100.

    d. Butler Building is a high risk area; commence work toward the immediate implementation of an adaptation measure for high TWL flooding by 2030 and for groundwater emergence flooding by 2090.

    e. Creek and Undeveloped are moderate risk areas; within an existing asset management cycle, commence work toward implementing adaptation measures for high TWL flooding by 2030.

f. Marsh is a moderate risk area; within an existing asset management cycle, commence work toward implementing an adaptation measure for high TWL flooding by 2040 - 2050 and for groundwater emergence flooding by 2090.

g. Fuel Tanks is a high risk area; commence work toward the implementation of an adaptation measure for high TWL flooding by 2060 – 2070 and for groundwater emergence flooding by 2080.

h. LFT Buildings is a moderate risk area; within an existing asset management cycle, commence work toward implementing an adaptation measure for high TWL flooding by 2060 - 2070.

i. East Sir SFD Boulevard is a high risk area; commence work toward the implementation of an adaptation measure for high TWL flooding by 2070 – 2080.

j. Paved is a is a moderate risk area; within an existing asset management cycle, commence work toward implementing an adaptation measure for groundwater emergence flooding by 2090.

8. References

Bay Area Conservation and Development Commission (BCDC). 2021. Adapting To Rising Tides. Bay Shoreline Flood Explorer. May 19. Accessed December 2025. https://gis.data.ca.gov/datasets/BCDC::shoreline-vulnerability-index-bcdc-2021/about.

Befus, K.M., Barnard, P.L., Hoover, D.J., Finzi Hart, J., and C.I. Voss. 2020. "Increasing Threat of Coastal Groundwater Hazards from Sea-Level Rise in California." *Nature Climate Change*. Vol. 10, 946–952.

Golden Gate Bridge and Highway Transportation District (District). 2026. AutoCAD file 2026-04-01 Larkspur - Mixed Alternative - Corrected Coordinates.dwg. Personal communication (email) with Cole Hendricks, DLR Group, April 1.

National Oceanic and Atmospheric Administration (NOAA). 2025a. 2009 - 2011 California Coastal Conservancy Coastal Lidar Project: Hydro-flattened Bare Earth DEM. Accessed in December 2025. https://coast.noaa.gov/dataviewer/#/lidar/search/.

National Oceanic and Atmospheric Administration (NOAA). 2025b. Tides and Currents. NOAA station 9414863 Richmond https://tidesandcurrents.noaa.gov/stationhome.html?id=9414863 and NOAA station 9414290 San Francisco https://tidesandcurrents.noaa.gov/stationhome.html?id=9414290. Accessed in December 2025.

National Oceanic and Atmospheric Administration (NOAA). 2025c. NOAA station TIBC1 Tiburon Pier https://www.ndbc.noaa.gov/station_history.php?station=tibc1. Accessed in December 2025.

Ocean Protection Council (OPC). 2024. *State of California Sea Level Rise Guidance*. 2024 Science and Policy Update. https://opc.ca.gov/wp-content/uploads/2024/05/California-Sea-Level-Rise-Guidance-2024-508.pdf. Accessed in September 2025.

PIANC. 2020. Climate Change Adaptation Planning for Ports and Inland Waterways. PIANC Report No. 178. Environmental Commission.

Appendix F. Noise Modeling Data

Appendix F1. Noise Measurement Data Sheets

Noise Measurement Data Sheet				
Conducted by: Jacobs Engineering Group				**Date:** Wed 6/18/2026
Project Name: Larkspur Ferry Terminal				
Site Location: Park benches along trail opposite ferry loading Area				**Site Id:** ST-1
Noise Meter Model:	**Response** Fast ☐ Slow ☒	**Weighting** A ☒ C ☐	**Calibrator** Model: TSI Calibrator QC-10	Calibrator @ 114.0 dBA Start: 113.9 End: 114.0
Weather Data Temp: 65°F Humidity: 68% Wind Speed: 7 mph				

Measurement Data			
Event #:	Begin Time:	End Time:	L_{eq} (dBA):
	10:26 AM	10:41 AM	62.4

Site Sketch



Notes

Bird noise, 9:39 pedestrian passing on cell phone, wind rustling in tress, traffic from SFD Blvd. dominant.

Noise Measurement Data Sheet				
Conducted by: Jacobs Engineering Group			**Date:** Wed 6/17/2026	
Project Name: Larkspur Ferry Terminal				
Site Location: Southwest conrer of existing main lot, adjacent to marsh			**Site Id:** ST-2	
Noise Meter Model:	**Response** Fast ☐ Slow ☒	**Weighting** A ☒ C ☐	**Calibrator** Model: TSI Calibrator QC-10	Calibrator @ 114.0 dBA Start: 114.1 End: 114.0
Weather Data Temp: 70°F Humidity: 64% Wind Speed: 15 mph				

Measurement Data			
Event #:	Begin Time:	End Time:	L_{eq} (dBA):
	4:26 PM	4:41 PM	56.3

Site Sketch



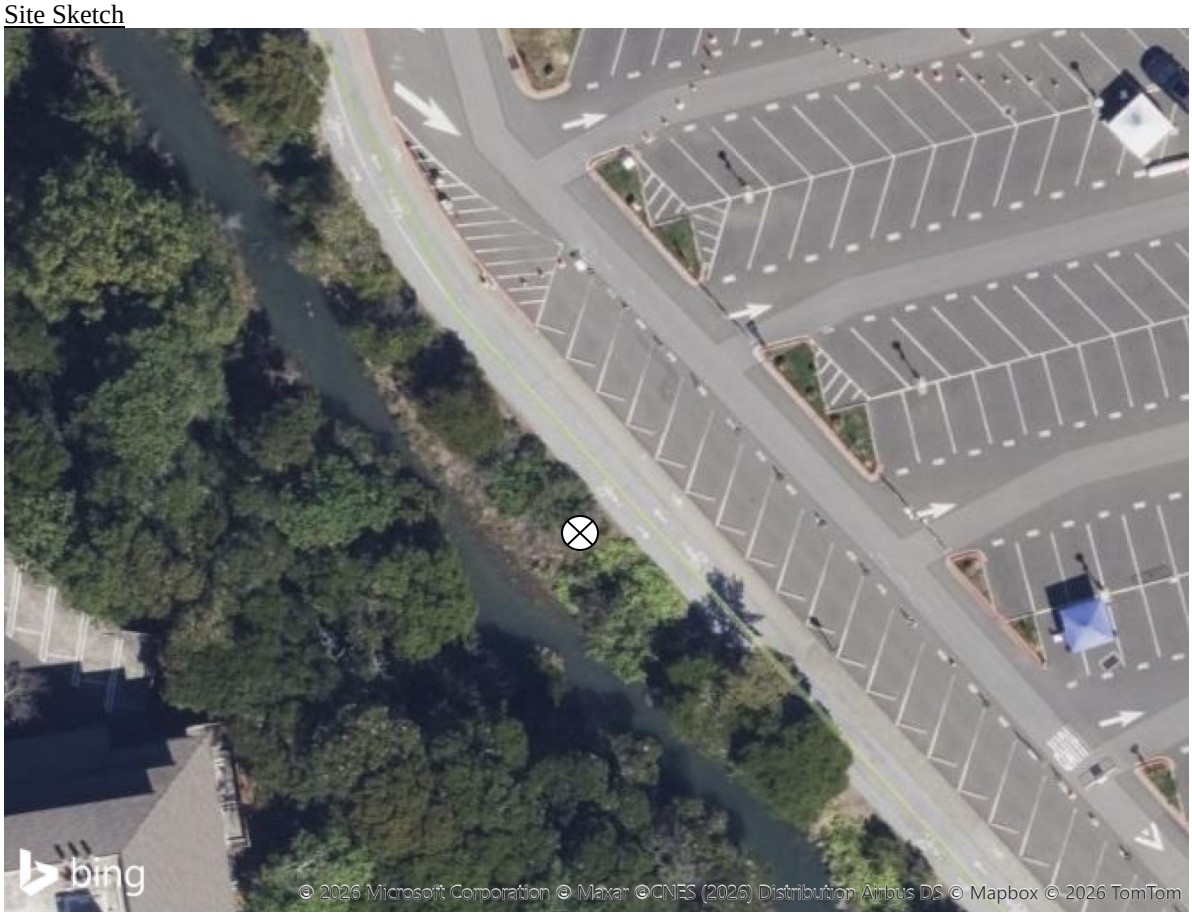
Notes

Bird noise, wind rustling trees, cars passing in parking lot, bicylces passing, aircraft overflight @ 4:34

Noise Measurement Data Sheet				
Conducted by: Jacobs Engineering Group				**Date:** Wed 6/17/2026
Project Name: Larkspur Ferry Terminal				
Site Location: West edge of existing main lot				**Site Id:** ST-3
Noise Meter Model:	**Response** Fast ☐ Slow ☒	**Weighting** A ☒ C ☐	**Calibrator** Model: TSI Calibrator QC-10	Calibrator @ 114.0 dBA Start: 114.1 End: 114.0
Weather Data Temp: 71°F Humidity: 61% Wind Speed: 16 mph				

Measurement Data			
Event #:	Begin Time:	End Time:	L_{eq} (dBA):
	4:08 PM	4:23 PM	52.4

Site Sketch



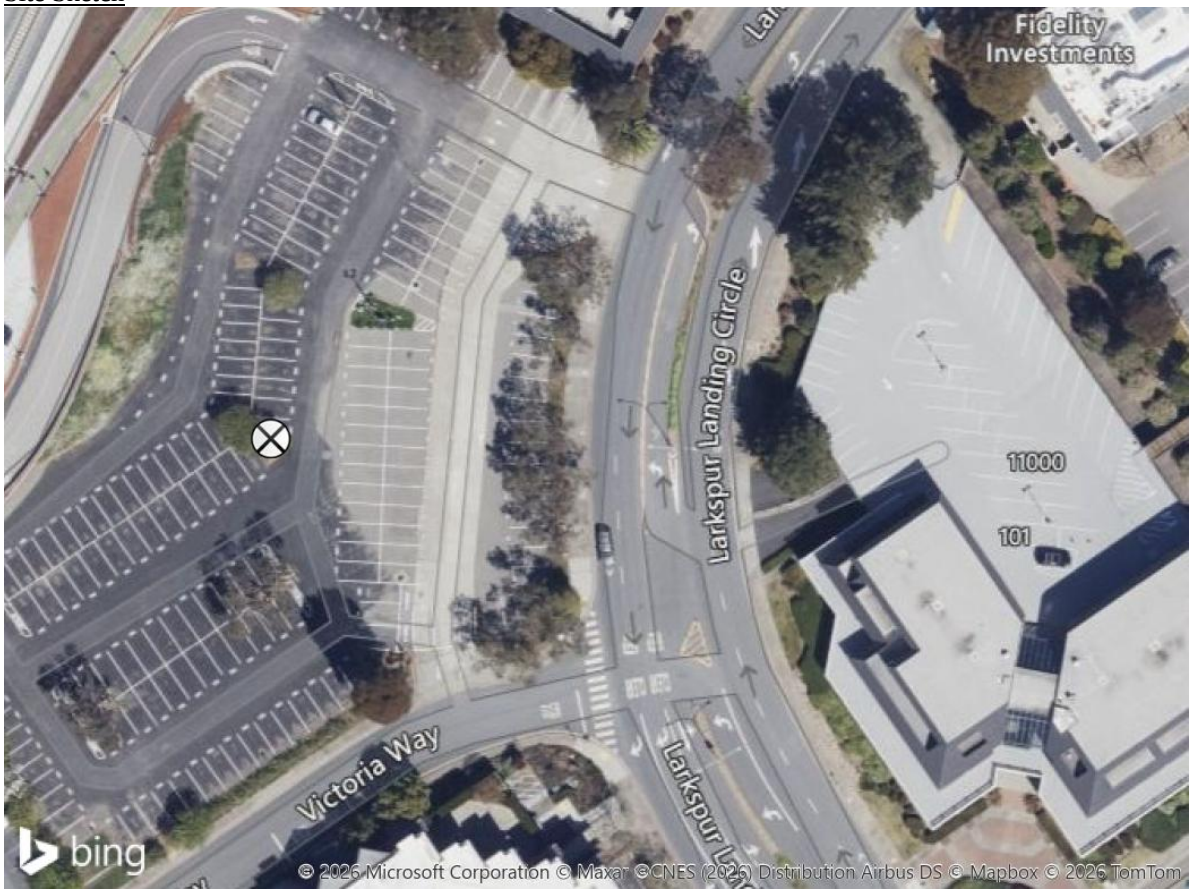
Notes

Honking on Francis Drake Blvd, bird noise, wind rustling trees, cars passing in parking lot

Noise Measurement Data Sheet				
Conducted by: Jacobs Engineering Group				**Date:** Wed 6/18/2026
Project Name: Larkspur Ferry Terminal				
Site Location: Shopping Center				**Site Id:** ST-4
Noise Meter Model:	**Response** Fast ☐ Slow ☒	**Weighting** A ☒ C ☐	**Calibrator** Model: TSI Calibrator QC-10	Calibrator @ 114.0 dBA Start: 113.9 End: 114.0
Weather Data Temp: 70°F Humidity: 63% Wind Speed: 14 mph				

Measurement Data			
Event #:	Begin Time:	End Time:	L_{eq} (dBA):
	12:12 PM	12:27 PM	62.5

Site Sketch



Notes

101 Freeway noise dominant, motorcycles and music audible from SFD Blvd.

Noise Measurement Data Sheet				
Conducted by: Jacobs Engineering Group				**Date:** Wed 6/18/2026
Project Name: Larkspur Ferry Terminal				
Site Location: Shopping Center				**Site Id:** ST-5
Noise Meter Model:	**Response** Fast ☐ Slow ☒	**Weighting** A ☒ C ☐	**Calibrator** Model: TSI Calibrator QC-10	Calibrator @ 114.0 dBA Start: 113.9 End: 114.0
Weather Data Temp: 67°F Humidity: 63% Wind Speed: 6 mph				

Measurement Data			
Event #:	Begin Time:	End Time:	L_{eq} (dBA):
	11:25 AM	11:47 AM	59.6

Site Sketch



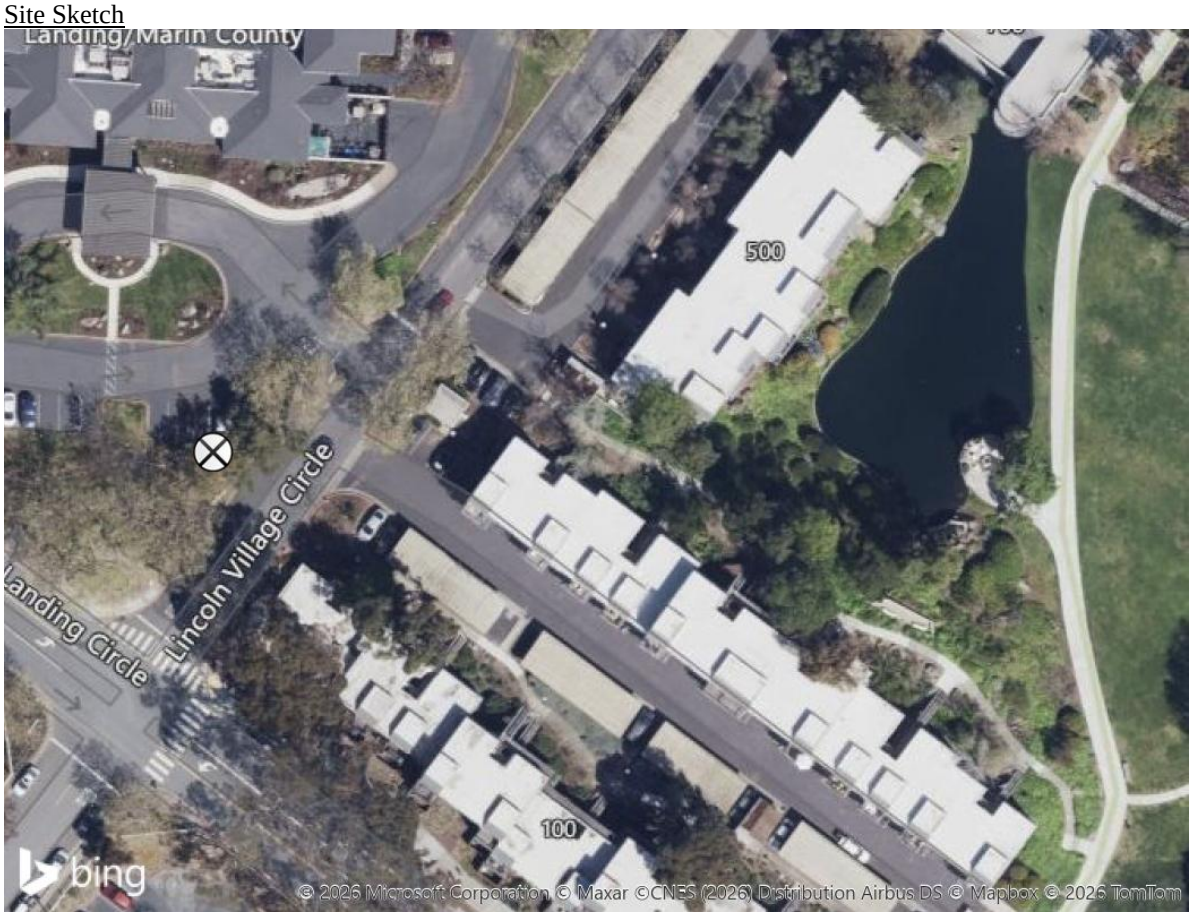
Notes

Marin Airporter stopped and loaded 11:28-32, SMART train arrival @11:32. Dogs barking in distance, pedestrians talking in parking lot

Noise Measurement Data Sheet				
Conducted by: Jacobs Engineering Group				**Date:** Wed 6/17/2026
Project Name: Larkspur Ferry Terminal				
Site Location: Courtyard by Marriott/Apartment Homes				**Site Id:** ST-6
Noise Meter Model:	**Response** Fast ☐ Slow ☒	**Weighting** A ☒ C ☐	**Calibrator** Model: TSI Calibrator QC-10	Calibrator @ 114.0 dBA Start: 114.1 End: 114.0
Weather Data Temp: 70°F Humidity: 64% Wind Speed: 15 mph				

Measurement Data			
Event #:	Begin Time:	End Time:	L_{eq} (dBA):
	4:52 PM	5:07 PM	56.8

Site Sketch



Notes

Passing MC @ 4:52, wind rustling trees and banners, 4:56 passing pedestrians talking, cars passing in driveway, freeway noise audible/dominant

Noise Measurement Data Sheet				
Conducted by: Jacobs Engineering Group				**Date:** Wed 6/18/2026
Project Name: Larkspur Ferry Terminal				
Site Location: Green Brae Brick Kiln				**Site Id:** ST-7
Noise Meter Model:	**Response** Fast ☐ Slow ☒	**Weighting** A ☒ C ☐	**Calibrator** Model: TSI Calibrator QC-10	Calibrator @ 114.0 dBA Start: 113.9 End: 114.0
Weather Data Temp: 66°F Humidity: 68% Wind Speed: 6 mph				

Measurement Data			
Event #:	Begin Time:	End Time:	L_{eq} (dBA):
	10:55 AM	11:15 AM	55.2

Site Sketch



Notes

Bird and insect noise, HVAC nearby from 11:04-11:09 (meter paused)

Noise Measurement Data Sheet				
Conducted by: Jacobs Engineering Group				**Date:** Wed 6/18/2026
Project Name: Larkspur Ferry Terminal				
Site Location: Remilliard Park				**Site Id:** ST-8
Noise Meter Model:	**Response** Fast ☐ Slow ☒	**Weighting** A ☒ C ☐	**Calibrator** Model: TSI Calibrator QC-10	Calibrator @ 114.0 dBA Start: 113.9 End: 114.0
Weather Data Temp: 65°F Humidity: 70% Wind Speed: 7 mph				

Measurement Data			
Event #:	Begin Time:	End Time:	L_{eq} (dBA):
	9:31 AM	9:46 AM	55.4

Site Sketch



Notes

Bird noise, 9:39 pedestrian passing on cell phone, wind rustling in tress, traffic from SFD Blvd. dominant.

Appendix F2. Federal Transit Administration Calculations

Federal Transit Administration
Noise Impact Assessment Spreadsheet

version: 1/29/2019

Project:	Larkspur Ferry Terminal

Receiver Parameters	
Receiver:	Greenbrae - Closest Receptor (Existing)
Land Use Category:	2. Residential
Existing Noise (Measured or Generic Value):	56 dBA

Noise Source Parameters	
Number of Noise Sources:	2

Noise Source Parameters		Source 1
	Source Type:	Stationary Source
	Specific Source:	Ferry Terminal (w/ fog horn)
Daytime hrs	Avg. Number Ferry Landings/hr	2
Nighttime hrs	Avg. Number Ferry Landings/hr	0.22
Distance	Distance from Source to Receiver (ft)	750
	Number of Intervening Rows of Buildings	0
Adjustments	Noise Barrier?	No

Noise Source Parameters		Source 2
	Source Type:	Stationary Source
	Specific Source:	Parking Garage
Daytime hrs	Avg. Number of Autos/hr	72.32
Nighttime hrs	Avg. Number of Autos/hr	8.04
Distance	Distance from Source to Receiver (ft)	500
	Number of Intervening Rows of Buildings	
Adjustments	Noise Barrier?	

Project Results Summary

Existing Ldn:	56 dBA
Total Project Ldn:	32 dBA
Total Noise Exposure:	56 dBA
Increase:	0 dB
Impact?:	None

Distance to Impact Contours

Dist to Mod. Impact Contour (Sources 1+2):	--
Dist to Sev. Impact Contour (Sources 1+2):	--

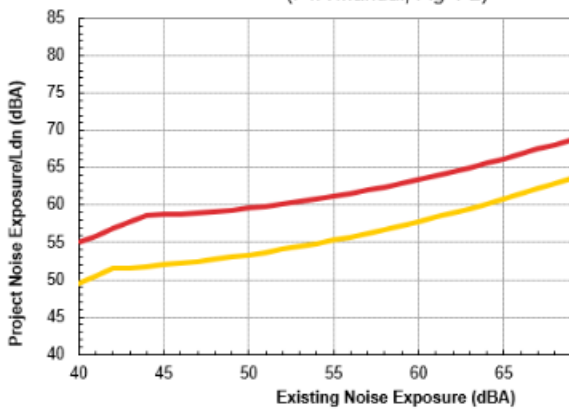
Source 1 Results

Leq(day):	32.0 dBA
Leq(night):	22.4 dBA
Ldn:	32.1 dBA

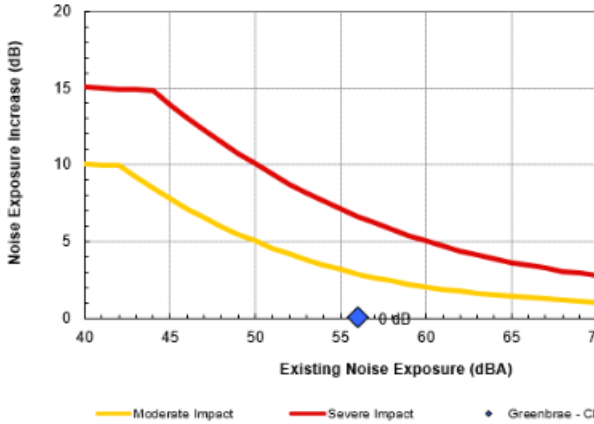
Source 2 Results

Leq(day):	20.0 dBA
Leq(night):	10.5 dBA
Ldn:	20.2 dBA
Incremental Ldn (Src 1-2):	32.4 dBA

Noise Impact Criteria
(FTA Manual, Fig 4-2)



Increase in Cumulative Noise Levels Allow
(FTA Manual, Figs 4-3 and 4-4)



version: 1/29/2019

Project:	Larkspur Ferry Terminal

Receiver Parameters	
Receiver:	Greenbrae - Closest Receptor (2050)
Land Use Category:	2. Residential
Existing Noise (Measured or Generic Value):	56 dBA

Noise Source Parameters	
Number of Noise Sources:	2

Noise Source Parameters		Source 1
	Source Type:	Stationary Source
	Specific Source:	Ferry Terminal (w/ fog horn)
Daytime hrs	Avg. Number Ferry Landings/hr	4.67
Nighttime hrs	Avg. Number Ferry Landings/hr	0.67
Distance	Distance from Source to Receiver (ft)	750
	Number of Intervening Rows of Buildings	0
Adjustments	Noise Barrier?	No

Noise Source Parameters		Source 2
	Source Type:	Stationary Source
	Specific Source:	Parking Garage
Daytime hrs	Avg. Number of Autos/hr	240.63
Nighttime hrs	Avg. Number of Autos/hr	26.74
Distance	Distance from Source to Receiver (ft)	500
	Number of Intervening Rows of Buildings	
Adjustments	Noise Barrier?	

Project Results Summary

Existing Ldn:	56 dBA
Total Project Ldn:	37 dBA
Total Noise Exposure:	56 dBA
Increase:	0 dB
Impact?:	None

Distance to Impact Contours

Dist to Mod. Impact Contour (Sources 1+2):	--
Dist to Sev. Impact Contour (Sources 1+2):	--

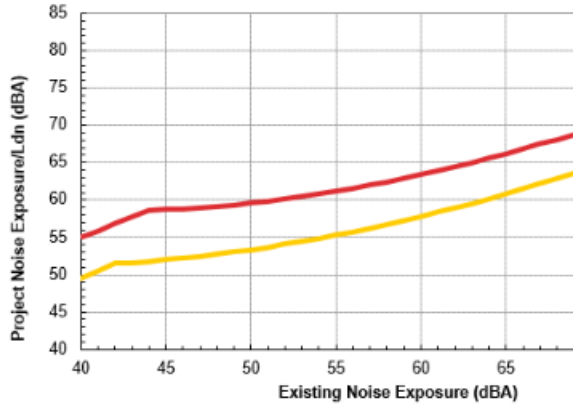
Source 1 Results

Leq(day):	35.7 dBA
Leq(night):	27.2 dBA
Ldn:	36.3 dBA

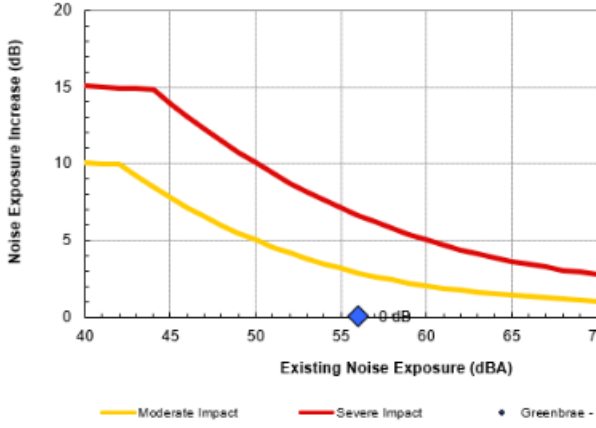
Source 2 Results

Leq(day):	25.2 dBA
Leq(night):	15.7 dBA
Ldn:	25.4 dBA
Incremental Ldn (Src 1-2):	36.7 dBA

Noise Impact Criteria
(FTA Manual, Fig 4-2)



Increase in Cumulative Noise Levels Allow
(FTA Manual, Figs 4-3 and 4-4)



Larkspur Ferry Service Expansion and Parking Project Transportation Impact Analysis

Golden Gate Bridge, Highway and Transportation District

October 5, 2026

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Acronyms and Abbreviations

Caltrans	California Department of Transportation
CEQA	California Environmental Quality Act
CMP	Congestion Management Program
CTP 2050	*Marin Countywide Transportation Plan 2050*
District	Golden Gate Bridge, Highway and Transportation District
HCM	Highway Capacity Manual
I-580	Interstate 580
LCI	Office of Land Use and Climate Innovation
LFT	Larkspur Ferry Terminal
LOS	Level of Service
MTC	Metropolitan Transportation Commission
Project	Larkspur Ferry Service Expansion and Parking Project
SMART	Sonoma–Marin Area Rail Transit
TAM	Transportation Authority of Marin
TDM	transportation demand management
TCP	Traffic Control Plan
TMP	Transportation Management Plant
SB 743	Senate Bill 743
SFO	San Francisco International Airport
US 101	United States Highway 101
VMT	vehicle miles traveled

1. Introduction

1.1 Project Description

This transportation impact analysis evaluates potential transportation impacts associated with the Larkspur Ferry Service Expansion and Parking Project (Project) in Larkspur, California.

The Project site includes the Larkspur Ferry Terminal (LFT) and associated landside facilities, including the internal access roadway, bicycle and pedestrian facilities, passenger loading areas, and two surface parking lots: the Main Lot and the North Lot. Figure 1-1 illustrates the Project location.

The LFT and the Main Lot are south of East Sir Francis Drake Boulevard, approximately 1,000 feet east of United States Highway 101 (US 101). The site is generally bounded by East Sir Francis Drake Boulevard to the north, Corte Madera Creek to the south, a channel for ferry boats to the east, and an office property to the west.

The North Lot is approximately 250 feet north of the East Sir Francis Drake Boulevard/Larkspur Landing Circle West intersection. It is generally bounded by Victoria Way to the south, the CinemaWest theater to the north, Larkspur Landing Circle West to the east, and Cal Park Hill Pathway and the Sonoma–Marin Area Rail Transit (SMART) station to the west. The North Lot has vehicular access from Larkspur Landing Circle West and Victoria Way.

The Golden Gate Bridge, Highway and Transportation District (District) operates Golden Gate Ferry service from the LFT, providing regular ferry service to San Francisco and special event service to Oracle Park and Chase Center. The District proposes to expand ferry service capacity and associated landside facilities to meet increasing demand for ferry travel between Marin County and existing and planned ferry terminals in the Bay Area. The Project also includes parking and access improvements to accommodate additional passengers accessing expanded ferry service.

1.2 Alternatives

Alternatives 1, 2, and 3, along with No-Project Alternative, were developed to accommodate projected ferry ridership demand while recognizing uncertainty around future travel behaviors and commute patterns. The No-Project Alternative would maintain existing ferry service and landside access conditions. Alternatives 1, 2, and 3 would increase ferry service while differing mainly in the extent of parking expansion, multimodal access improvements, and transportation demand management (TDM) strategies.



SITE LOCATION

LARKSPUR FERRY
SERVICE EXPANSION
AND PARKING STUDY

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LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

Figure 1-1. Project Site Location

1.2.1 No-Project Alternative

The No-Project Alternative assumes that ferry service would continue at current operating levels, with no increase in ferry revenue trips beyond the existing 42 daily revenue trips. On the landside, the No-Project Alternative would not add parking spaces or implement new TDM improvements. Parking fees for the Main Lot and North Lot would continue to be adjusted only for inflation, such that the fee would remain equivalent to the current $2 weekday parking rate.

In addition, a new District-provided peak-period feeder shuttle service along Sir Francis Drake Boulevard is assumed to be implemented as a background improvement. Accordingly, the service is assumed to be in operation under both the No-Project Alternative and the three Project alternatives.

1.2.2 Alternative 1 – Expand Ferry Service with Future Parking Garages Built in Phases According to Demand

Alternative 1 would incrementally expand ferry service up to 76 daily revenue trips. To support the anticipated ridership, Alternative 1 would include phased construction of parking garages on the North Lot and Main Lot. Phase I would include construction of an 850-space parking garage on the North Lot. Construction is anticipated to last up to 18 months and be completed by 2035. Phase II would include construction of a 3,998-space parking garage on the Main Lot. Construction of the Main Lot garage is anticipated to last up to 24 months.

Alternative 1 would also include the following TDM measures to improve access to the ferry terminal and encourage the use of alternative travel modes:

- A bike room with capacity for approximately 350 bicycles
- Additional carpool parking spaces located on the ground floor in the Main Lot parking garage
- Increased parking fees, adjusted beyond inflation to help recover a portion of the capital costs associated with parking garage construction

These measures are intended to accommodate increased ferry ridership while supporting multimodal access to the terminal. The phased implementation approach provides flexibility to respond to future travel demand and evolving passenger preferences.

1.2.3 Alternative 2 – Expand Ferry Service with Improved Bicycle, Pedestrian, Transit Access and Parking Garages Built in Phases According to Demand

Alternative 2 would be similar to Alternative 1 in that it would incrementally expand ferry service up to 76 daily revenue trips. Alternative 2 would also include phased parking development. Phase I would consist of constructing a 850-space parking garage on the North Lot. Phase II would consist of constructing a 3,258-space parking garage on the Main Lot (reduced from 3,998 parking stalls under Alternative 1). The design of the Main Lot garage would be re-evaluated before Phase 2 to confirm whether the proposed capacity remains appropriate or whether design adjustments are needed. Alternative 2 would also place greater emphasis on improving bicycle, pedestrian, and transit access to the ferry terminal and include the following TDM measures:

- A bike hub with capacity for approximately 350 bicycle parking spaces, including bicycle repair services

- Two additional all-day feeder shuttle services (in addition to peak-period feeder shuttle service assumed under No-Project Alternative)
- Additional carpool parking spaces on the ground floor of the Main Lot parking garage, providing more carpool spaces than Alternative 1
- Increased parking fees, adjusted beyond inflation to help recover a portion of the capital costs associated with parking garage construction and contribution to shuttle operating costs

1.2.4 Alternative 3 – Expand Ferry Service with Only Bicycle, Pedestrian, and Transit Access Improvements

Alternative 3 would incrementally expand ferry service up to 66 daily revenue trips. Unlike Alternatives 1 and 2, Alternative 3 would not construct parking garages on either the North Lot or Main Lot and would not increase parking capacity. Instead, Alternative 3 would rely on the following multimodal access improvements and TDM strategies to support expanded ferry service and encourage passengers to access the terminal by modes other than driving and parking:

- Improved pedestrian connections between the North Lot and the ferry terminal
- A bike hub with capacity for approximately 400 bicycles, including bicycle repair services
- Two additional all-day feeder shuttle services (in addition to peak-period feeder shuttle service assumed under No-Project Alternative)
- Additional carpool parking spaces located on the ground floor in the Main Lot parking garage, providing more carpool spaces than Alternative 1
- Peak-period District-operated microtransit service
- Demand-based parking fees with revenues contributing to shuttle operating costs

Figure 1-2 through Figure 1-5 present the Project site plan under each alternative.



Figure 1-2. Site Plan – No-Project Alternative

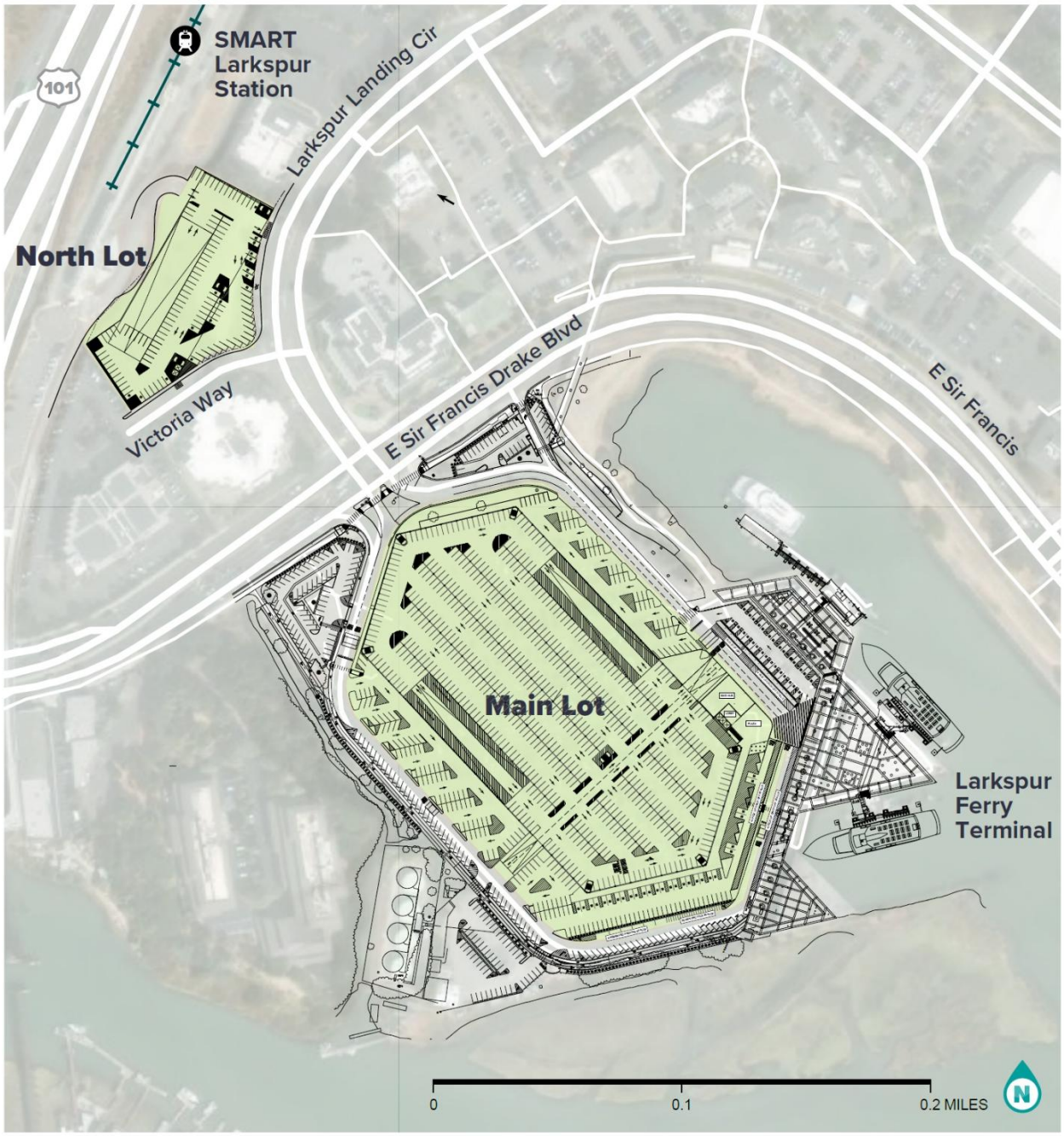


Figure 1-3. Site Plan – Alternative 1

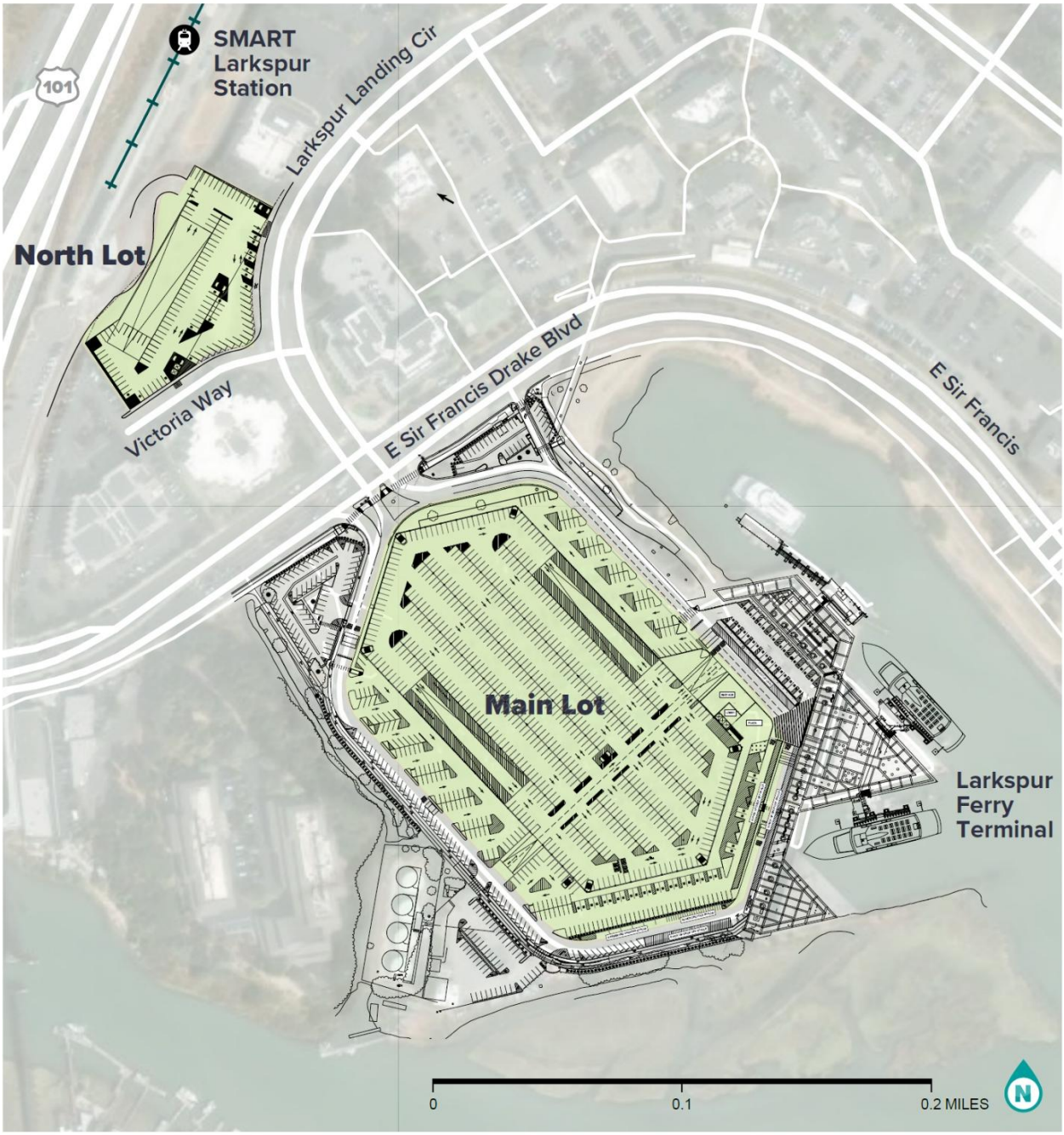
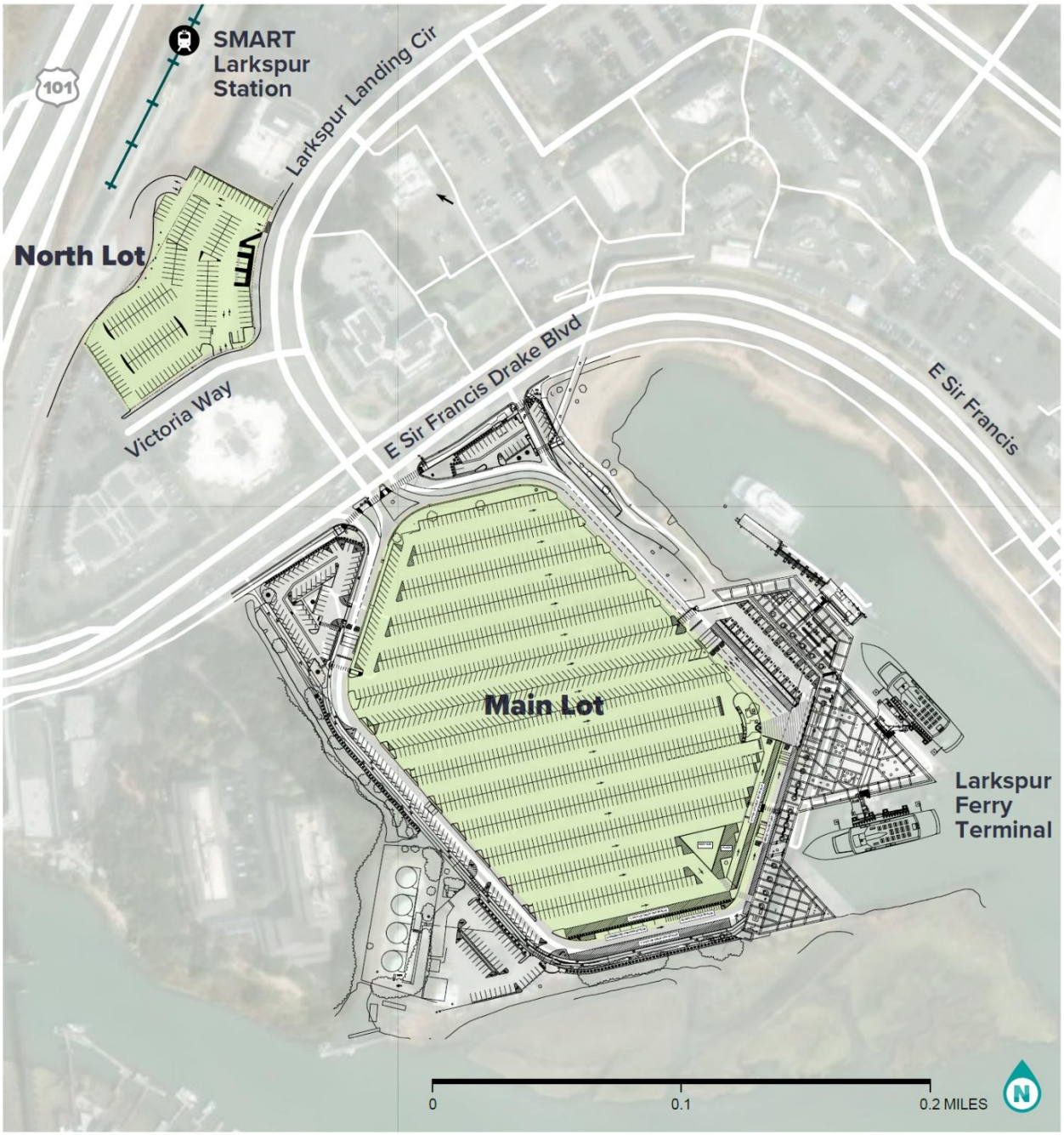


Figure 1-4. Site Plan – Alternative 2



Site Plan -
Alternative 3 (2050)

LARKSPUR FERRY
SERVICE EXPANSION
AND PARKING STUDY

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LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

Figure 1-5. Site Plan – Alternative 3

Parking Construction

Construction of parking garages in Alternatives 1 and 2 (called the Build Alternatives) require additional Board approval, final design, and securing of Project funding before commencement; if federal funds are used, then National Environmental Policy Act clearance will also be necessary. The Build Alternatives would involve construction of parking garages in both the North Lot and Main Lot, while Alternative 3 would not construct parking garages in either lot and would be limited to the proposed multimodal access improvements.

The Build Alternatives would have similar construction phases, activities, and construction footprints. The primary difference would be the construction duration for Alternative 2, which would be slightly shorter during Main Lot construction because it would require less concrete due to one fewer parking level. Construction activities for the Build Alternatives would generally include mobilization, demolition and site preparation, utility work, excavation and hauling, foundation and structural construction, parking lot improvements, and mechanical, electrical, plumbing, architectural, and site finishes.

Construction of the North Lot and Main Lot under the Build Alternatives would occur in the following two phases:

- Phase I – North Lot: Construction is anticipated to begin in 2033 and require up to 18 months. Activities would include demolition of approximately 37,000 square feet of asphalt, excavation of approximately 3,700 cubic yards of material, import and compaction of approximately 7,400 cubic yards of base material, and construction of a six-level, approximately 260,000-square-foot parking garage with 850 stalls.
- Phase II – Main Lot: Construction could begin as early as 2037 and require up to 36 months. Activities would include demolition of approximately 240,000 square feet of asphalt, offsite hauling of approximately 67,000 cubic yards of excavated material, and import and compaction of approximately 67,000 cubic yards of engineered backfill. An additional approximately 19,000 cubic yards of engineered base would be imported and compacted to prepare the site for the foundation. The Main Lot would include construction of up to a five-level, approximately 1.2-million-square-foot concrete parking garage with approximately 3,597 parking stalls.

Construction would temporarily affect parking and circulation at the LFT. Phased closure of the North and Main Lots would result in estimated parking shortfalls of up to 290 spaces during North Lot construction (Phase I) and up to 1,700 spaces during Main Lot construction (Phase II). A Traffic Management Plan (TMP) and Traffic Control Plans (TCPs) would be implemented throughout construction to maintain safe and efficient access for transit, pedestrians, bicyclists, emergency vehicles, and private vehicles, while managing temporary closures, detours, construction traffic, and traveler delays.

1.3 Significance Criteria

Transportation impacts of the three alternatives are considered significant under California Environmental Quality Act (CEQA) if any of the following thresholds of significance are exceeded, per Appendix G of the CEQA Guidelines:

- Conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities
- Conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b) – Transportation projects that reduce, or have no impact on, vehicle miles traveled (VMT) should be presumed to cause a less than significant transportation impact

- Substantially increase hazards due to a geometric design feature (for example, sharp curves or dangerous intersections) or incompatible uses (for example, farm equipment)
- Result in inadequate emergency access

The City of Larkspur considers VMT to be the primary measure of transportation impacts under CEQA. However, the City maintains level of service (LOS) standards in its General Plan Policy CIR-3.2 for evaluating local circulation and roadway operations. Accordingly, a traffic operational analysis is provided in Section 6 for informational purposes and to assess consistency with applicable General Plan policies (City of Larkspur 2024).

2. Environmental Setting

This section describes the existing transportation setting near the LFT. The discussion summarizes the roadway network, transit service, and pedestrian and bicycle facilities that provide access to and from the terminal. It also describes passenger loading areas and parking conditions in the terminal.

2.1 Street System

The LFT is along the western shoreline of the San Francisco Bay, east of US 101 and south of the US 101/Interstate 580 (I-580) interchange in San Rafael. East Sir Francis Drake Boulevard provides direct access to the ferry terminal and to both US 101 and I-580 freeway ramps. Figure 2-1 presents the key roadways providing access to the terminal.

2.1.1 Regional Access

US 101 is a north–south freeway extending from Los Angeles through the San Francisco Bay Area and continuing north to the Pacific Northwest. In the vicinity of the LFT, US 101 generally provides four lanes in each direction. The nearest ramps serving the terminal are at Sir Francis Drake Boulevard, approximately 1,000 feet west of the ferry terminal. Average daily traffic on US 101 is approximately 102,000 vehicles (data collected from California Department of Transportation [Caltrans] Performance Measurement System from May 2024 to May 2025) (Caltrans 2026).

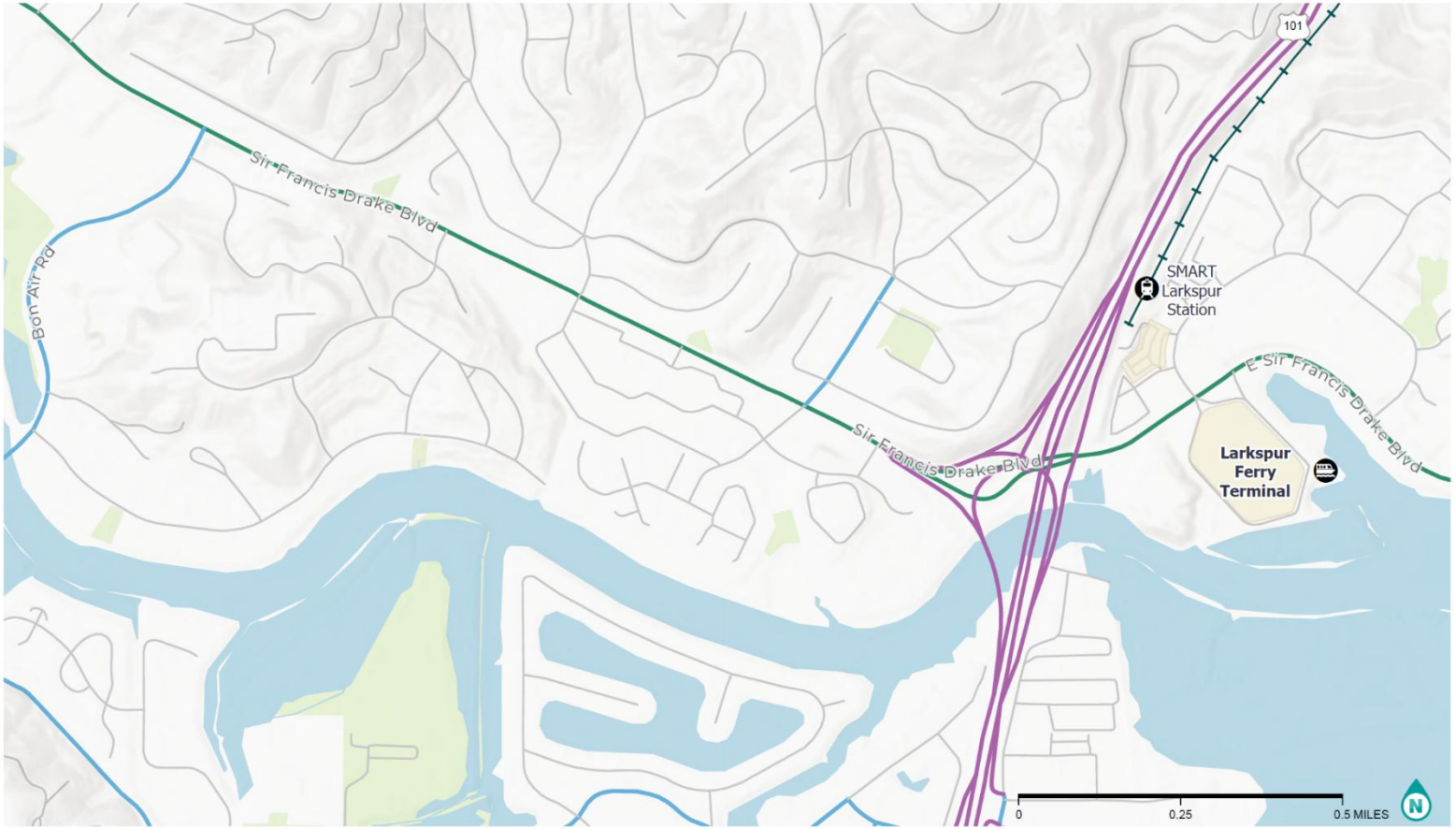
I-580 is an east–west highway extending from the US 101/I-580 interchange in San Rafael through the East Bay toward the Central Valley. In the vicinity of the LFT, I-580 has four lanes in each direction. The nearest ramps serving the terminal via Sir Francis Drake Boulevard are approximately 1 mile east of the ferry terminal. Average daily traffic on I-580 is approximately 53,000 vehicles (Caltrans 2026).

2.1.2 Local Access

East Sir Francis Drake Boulevard is an east–west road extending between US 101 and I-580 in Larkspur. East Sir Francis Drake Boulevard becomes Sir Francis Drake Boulevard west of US 101 extending to West Marin. East Sir Francis Drake Boulevard has two travel lanes in each direction and provides direct access to the LFT. There are sidewalks on the north side of the street and a shared pedestrian/bicycle path (Class I facility) on the south side adjacent to the ferry terminal. East Sir Francis Drake Boulevard is designated as an Arterial Roadway in *The City of Larkspur 2040 General Plan* (City of Larkspur 2024). AM and PM peak-hour volumes are approximately 2,860 and 3,580 vehicles, respectively.[1]

Larkspur Landing Circle is a 1/2-mile-long circular roadway serving the Larkspur Landing commercial area. It provides one travel lane in each direction and provides a bicycle route (Class III bikeway) identified by pavement markings and supported by a designation in the *City of Larkspur Bicycle and Pedestrian Master Plan* (City of Larkspur 2017). AM and PM peak-hour volumes are approximately 380 and 590 vehicles, respectively.[1]

[1] Counts collected on Tuesday October 28, 2025, and Wednesday, October 29, 2025 and 2026.



ROADWAY CLASSIFICATIONS

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LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Parking Lot

Roadway Classifications

- Freeway
- Arterial
- Collector
- Local

Figure 2-1. Roadway Classifications

Victoria Way is a 300-foot-long east–west access roadway connecting Larkspur Landing Circle to two office buildings. It provides one travel lane in each direction. AM and PM peak-hour volumes are approximately 60 and 40 vehicles, respectively.[1]

Eliseo Drive is a north–south street that crosses Sir Francis Drake Boulevard west of US 101, connecting to the Greenbrae and Southern Heights neighborhoods in Kentfield, an unincorporated community in Marin County. Eliseo Drive generally provides one travel lane in each direction and bike lanes on both sides. AM and PM peak-hour volumes are approximately 430 and 530 vehicles, respectively.[1]

Bon Air Road is a north–south street extending between Magnolia Avenue in Larkspur to Sir Francis Drake Boulevard in Kentfield. Near Sir Francis Drake Boulevard, Bon Air Road provides two travel lanes in each direction, and bike lanes are provided on the west side (southbound direction) only. Bon Air Road is designated as a Collector Roadway in *The City of Larkspur 2040 General Plan* (City of Larkspur 2024). AM and PM peak-hour volumes are approximately 1,340 and 1,320 vehicles, respectively.[1]

2.2 Transit Network and Service

The LFT is a regional multimodal hub served by ferry, bus, rail, shuttle, paratransit, and private transportation providers. Golden Gate Ferry provides ferry service between Larkspur and San Francisco. Golden Gate Transit and Marin Transit provide bus service in the vicinity of the terminal. SMART provides rail service to the Larkspur SMART Station, located north of Sir East Francis Drake Boulevard. Additional services include the Muir Woods Shuttle, Marin Airporter, Marin Access Paratransit, and occasional charter or tour buses.

There are two bus stop locations for passengers transferring between ferries and ground transportation. A bus boarding island north of the ferry terminal primarily serves paratransit vehicles, Muir Woods Shuttle, and other intermittent shuttle activity. A bus stop on East Sir Francis Drake Boulevard, approximately 850 feet from the ferry terminal, serves fixed-route transit provided by Golden Gate Transit, Marin Transit, and Marin Airporter. Existing transit service is summarized in Table 2-1 and shown on Figure 2-2.

2.2.1 Golden Gate Transit and Golden Gate Ferry

Golden Gate Ferry operates ferry service between the LFT and the San Francisco Ferry Building. Ferry service generally operates between 5:45 AM and 8:30 PM on weekdays, with approximately 40-minute headways during the AM and PM peak periods. As of October 2025, the Larkspur ferry route carries approximately 3,600 passengers on a typical weekday.

Golden Gate Transit operates Route 132 serving the ferry terminal. Route 132 provides a weekday commuter connection between the ferry terminal, San Anselmo, and San Francisco, with an early morning southbound trip serving the terminal at approximately 5:00 AM.

Historically, Golden Gate Transit operated feeder bus routes serving the ferry terminal, including Routes 25 and 31, connecting nearby communities such as Fairfax and San Rafael, as well as commuter-oriented service between the ferry terminal and San Francisco's Financial District. These services were discontinued during and following the COVID-19 pandemic because of changes in regional transit demand and commuting patterns.



Figure 2-2. Transit Network

2.2.2 Marin Transit

Marin Transit operates fixed-route bus and paratransit services in the vicinity of the ferry terminal. Fixed-route bus services stop at the East Sir Francis Drake Boulevard/Larkspur Landing Circle intersection, approximately 850 feet from the ferry terminal. Paratransit service uses the bus boarding island north of the terminal. Services are as follows:

- Route 17 (Downtown San Rafael – Sausalito) provides service between downtown San Rafael, Mill Valley, Marin City, and Sausalito. Service generally operates between 5:30 AM and 11:30 PM. However, service to Larkspur Landing is provided between 9:16 PM and 11:16 PM with 60-minute headways.
- Route 228 (Downtown San Rafael – Fairfax Manor) provides service between downtown San Rafael, Mill Valley, Marin City, and Fairfax Manor. Service generally operates between 6:30 AM and 7:30 PM, with approximately 60-minute headways throughout the day.
- The Muir Woods Shuttle, operated by Marin Transit in partnership with the National Park Service, provides seasonal service between the ferry terminal and Muir Woods National Monument from early spring through October. The shuttle generally operates Fridays through Sundays and on federal holidays between 8:00 AM and 6:30 PM with service frequencies ranging from 20 to 30 minutes.
- Marin Access Paratransit provides pre-scheduled transportation for people with disabilities and occasionally picks up or drops off riders at the LFT bus boarding island.

2.2.3 Sonoma Marin Area Rail Transit

SMART operates commuter rail service between Larkspur and Windsor, with planned future extensions to Healdsburg and Cloverdale. The Healdsburg extension is currently under development and is anticipated to begin service in late 2028 (MTC 2026).

The Larkspur SMART Station is north of East Sir Francis Drake Boulevard, approximately 2,500 feet from the ferry terminal, and is connected to the terminal via a dedicated pedestrian pathway. SMART rail service generally operates between 4:00 AM and 11:00 PM with approximately 40-minute headways during the AM and PM peak periods (SMART 2026). SMART schedules are generally coordinated with Golden Gate Ferry arrival and departure times to facilitate timed transfers between rail and ferry services.

SMART also operates a service called "SMART Connect" that shuttles customers between the SMART Train terminus and the ferry terminal. The fare is $1.50 each way for adults, 75 cents for disabled adults, and free for youth (0 to 18 years old) and seniors (65 years and older). The service reduces the barrier to transferring between the two transit systems by bridging the 0.4-mile walk.

2.2.4 Private Shuttles

Several private and specialized transportation providers also serve the ferry terminal area, described as follows:

- Marin Airporter operates airport shuttle service between Marin County and San Francisco International Airport (SFO). Marin Airporter serves the East Sir Francis Drake Boulevard/Larkspur Landing Circle stop and generally operates at 30- to 60-minute headways throughout the day.

- Tour buses, charter buses, and other occasional shuttles may use the bus boarding island north of the terminal. These activities are generally infrequent, and no permit is currently required.

Table 2-1. Summary of Existing Larkspur Ferry Terminal Transit Service

Route	Hours of Operation	Headway	Service Area
Golden Gate Larkspur Ferry	5:45 AM and 8:30 PM	40 minutes	Larkspur and San Francisco
GGT 132	5:16 AM	Once a day	San Anselmo, San Rafael, Larkspur, Tiburon, San Francisco
MT 17	6:30 AM to 10:30 PM	60 minutes	San Rafael, Mill Valley, Marin City, Sausalito (only stops at LFT between 9:16 PM to 11:16 PM)
MT 228	6:30 AM to 7:30 PM	60 minutes	San Rafael, Greenbrae, Marin General, College, San Anselmo, Manor
MT Paratransit	5:00 AM to 11:00 PM	On demand	Local and Regional
Muir Woods	8:00 AM to 6:30 PM	20 to 30 minutes (seasonal)	Larkspur and Muir Woods National Monument
SMART	4:00 AM to 11:00 PM	40 minutes	Larkspur, Windsor, Santa Rosa, Rohnert Park, Cotati, Petaluma
Marin Airporter	4:00 AM to 11:00 PM	30 to 60 minutes	Marin County and SFO

GGT = Golden Gate Transit

MT = Marin Transit

2.3 Pedestrian Facilities

Pedestrian facilities in the vicinity of the LFT include sidewalks, crosswalks, multi-use paths, and pedestrian overcrossings. These facilities support walking trips between the ferry terminal, nearby bus stops, the SMART station, Larkspur Landing commercial area, and parking facilities.

East Sir Francis Drake Boulevard has continuous sidewalks on the north side and a shared pedestrian/bicycle path along the south side adjacent to the ferry terminal site. Pedestrians traveling from the north side of East Sir Francis Drake Boulevard to the ferry terminal can use three primary crossings: (1) the Cal Park Hill Pathway overcrossing connecting the Larkspur SMART Station to the south side of East Sir Francis Drake Boulevard, (2) the at-grade signalized crossing at the Sir Francis Drake Boulevard/Larkspur Landing Circle intersection, and (3) the pedestrian overcrossing connecting the Larkspur Landing commercial area to the ferry terminal.

At the East Sir Francis Drake Boulevard/Larkspur Landing Circle intersection, high-visibility crosswalks are provided on the north, east, and south legs of the intersection, with pedestrian signal heads and push

buttons and curb ramps. Pedestrian crossing volumes are approximately 20 and 40 pedestrians during AM and PM peak hours, respectively.

2.4 Bicycle Facilities

Bicycle facilities in the vicinity of the LFT include shared-use paths, bicycle lanes, bicycle routes, and bicycle parking. Existing and planned bicycle facilities near the ferry terminal are shown on Figure 2-3. The *City of Larkspur Bicycle and Pedestrian Master Plan* (City of Larkspur 2017) recognizes the following bicycle facility classifications:

- Class I Bikeway, typically called a shared-use path, provides bicycle travel on a paved right-of-way completely separated from any street or highway. It is usually shared with pedestrians and other active transportation users.
- Class II Bikeway, often referred to as a bicycle lane, provides a striped and stenciled lane for one-way bicycle travel on a street or highway.
- Class III Bikeway, generally referred to as a bicycle route, provides shared use with motor vehicle traffic and is identified only by signing or pavement markings.
- Class IV Bikeway, often referred to as protected bicycle lanes or bicycle tracks, are located within a street or highway right-of-way, provide a designated area for one-way or two-way bicycle travel, and offer physical protection from adjacent motor vehicle traffic using barriers, bollards, curbing, parked cars, posts, planters, or other vertical elements.

East Sir Francis Drake Boulevard provides shared pedestrian and bicycle access along the south side adjacent to the ferry terminal, where two-way bicycle travel is allowed. From East Sir Francis Drake Boulevard, two-way bicycle facilities along the west and south perimeter of the ferry terminal parking lot provide direct access to the ferry terminal. The pedestrian overcrossings connecting the SMART station and Larkspur Landing commercial area to the ferry terminal also allow bicycle access.

The ferry terminal currently provides approximately 140 bicycle parking spaces, including the following:

- 20 spaces (10 U-racks) near the terminal entrance
- 40 spaces (20 U-racks) within the Americans with Disabilities Act (ADA) parking lot
- 80 spaces (continuous wave bicycle racks) located inside the terminal paid boarding area

Based on field observations conducted in March 2025, the bicycle parking spaces outside the terminal were typically less than 20% occupied. Bicycle parking inside the terminal is considered more secure because the terminal gates are locked between ferry departures or arrivals. Occupancy of the interior bicycle parking area was observed to reach approximately 50%.

In addition, each ferry vessel provides approximately 30 onboard bicycle parking spaces. During peak commute periods, onboard bicycle parking utilization was observed to exceed approximately 80% occupancy.

Redwood Bikeshare, a regional bikeshare program serving North Bay communities, launched in November 2024. A bikeshare station is within the terminal ADA parking lot and includes approximately 10 bicycles. The service area currently includes Greenbrae, Larkspur, and San Rafael. Redwood Bikeshare charges

non-members $0.25 per minute, while members pay a monthly fee of $20 for unlimited rides under 60 minutes. Based on observations conducted in February 2025, bikeshare usage at the terminal was relatively low.

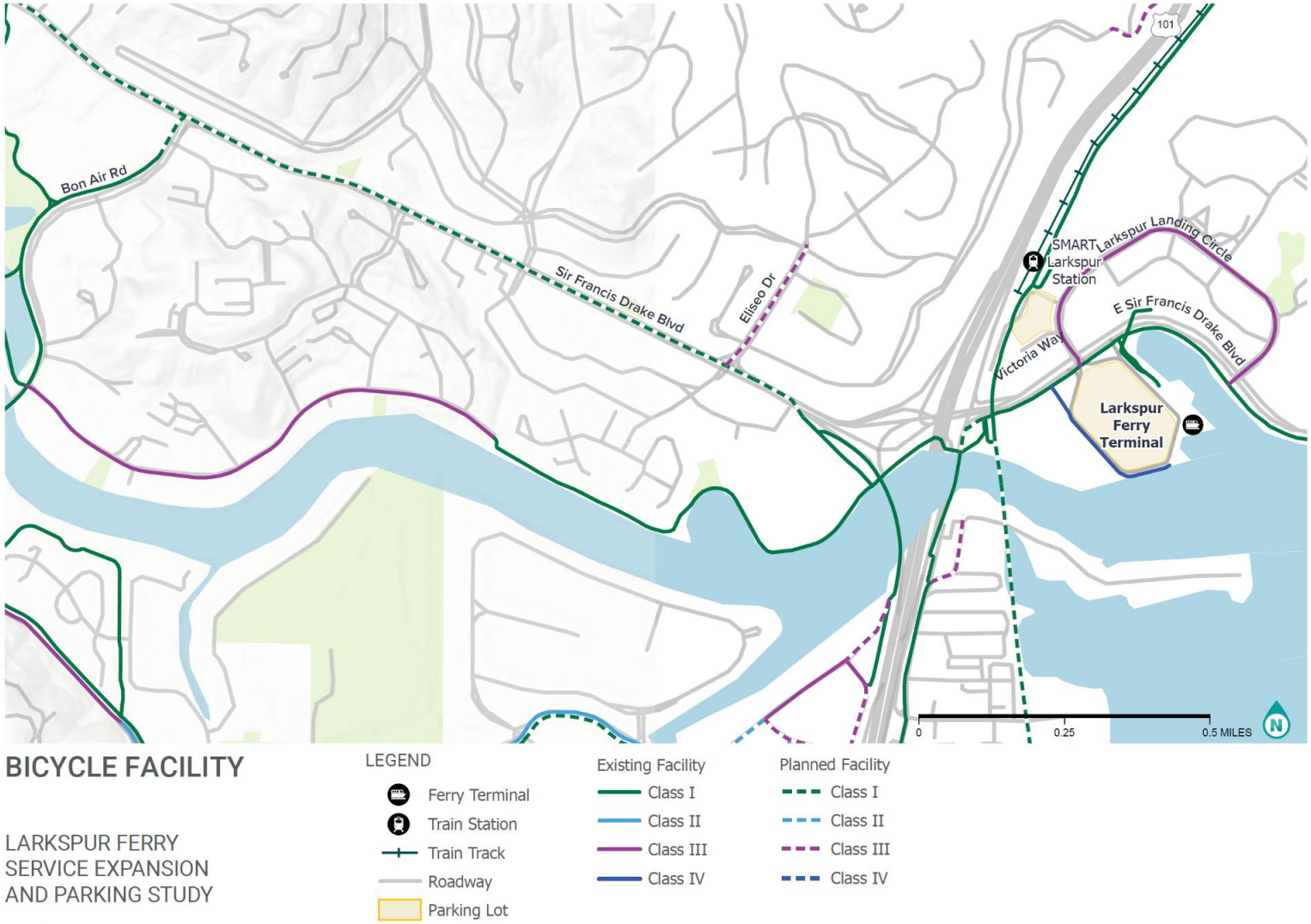


Figure 2-3. Bicycle Facility

2.5 Passenger Loading

Passenger loading activities are accommodated along the curb south of the terminal. The existing loading area includes approximately 145 feet of white curb, consisting of one 95-foot segment and one 50-foot segment separated by a crosswalk. The curb is designated for passenger pickup and drop-off activities with a posted 10-minute time limit and is used by private vehicles, taxis, and transportation network companies such as Uber and Lyft.

A curbside loading survey conducted in February 2025 showed that up to five vehicles during the AM peak hour and up to 12 vehicles during the PM peak hour were simultaneously engaged in passenger loading and unloading activities.

2.6 Parking

The Main Lot adjacent to the ferry terminal provides approximately 1,808 parking spaces, including 28 ADA-accessible spaces and 30 carpool-designated spaces. An overflow parking lot (the North Lot) near the Larkspur SMART Station provides approximately 215 additional spaces.

A drone-based parking survey conducted in February 2025 showed that the Main Lot operated at approximately 64% occupancy during the survey period. The North Lot has not been actively used since 2020.

3. Regulatory Setting

This section describes federal, state, regional, and local regulations that may apply to the Project relative to transportation.

3.1 Federal Regulations

3.1.1 Americans with Disabilities Act

The ADA of 1990 (revised 2010) is a landmark civil rights law that prohibits discrimination based on disability. Titles I, II, III, and V of the act have been codified in Title 42 of the United States Code, beginning at Section 12101. Title III prohibits discrimination on the basis of disability in "places of public accommodation" (businesses and non-profit agencies that serve the public) and "commercial facilities" (other businesses). The regulation includes Appendix 3.3-A to Part 36 (Standards for Accessible Design; U.S. Department of Justice 2010), which establishes minimum standards for ensuring accessibility for the disabled when designing and constructing a new facility or altering an existing facility, including roadways, parking lots, and sidewalks.

3.2 State Regulations

3.2.1 Senate Bill 743

Senate Bill 743 (SB 743) changed the way public agencies evaluate the transportation impacts of projects under CEQA, recognizing that road congestion or delay to vehicles, while potentially inconvenient to drivers, do not themselves constitute an environmental impact. Under SB 743, the Office of Land Use and Climate Innovation (LCI), formerly known as the Governor's Office of Planning and Research, established VMT as the preferred metric for measuring transportation impacts under CEQA, replacing vehicle LOS and similar congestion-based measures as the primary metric. However, the legislation does not preclude local jurisdictions from continuing to use LOS or other locally appropriate operational metrics for planning, engineering, or policy purposes outside of the CEQA process.

While SB 743 primarily focuses on residential, office, and retail development projects because they have the greatest influence on VMT, the legislation also provides guidance for the review of transportation projects under CEQA. Transportation projects that may induce additional vehicle travel are required to evaluate and document the increase in VMT. However, transportation projects that increase roadway capacity while substantially improving conditions for pedestrians, bicyclists, and, where applicable, transit users are not likely to result in a substantial or measurable increase in vehicle travel. In particular, transit and active transportation projects are generally presumed to reduce VMT, and therefore, are typically considered to have a less-than-significant transportation impact under CEQA. LCI guidance also identifies improving or increasing access to public transit as a potential mitigation strategy for reducing VMT impacts.

Caltrans has developed the *Transportation Analysis under CEQA* and *Transportation Analysis Framework* to address VMT impacts on the state highway system consistent with the requirements of SB 743 and the LCI Technical Advisory. Under SB 743, Caltrans no longer considers automobile delay or roadway congestion to constitute a significant impact under CEQA. The *Transportation Analysis under CEQA* provides guidance for evaluating transportation impacts and making CEQA significance determinations for projects affecting the state highway system, while the *Transportation Analysis Framework* outlines

Caltrans' preferred methodologies for analyzing the VMT impacts in various contexts, with particular emphasis on roadway capacity expansion projects.

3.2.2 Caltrans Local Development Review Safety Review

Caltrans adopted the Local Development Review Safety Review Practitioner's Guidance in 2024 to provide a framework for evaluating potential safety impacts of land use and transportation projects affecting the state highway system. The guidance supports Caltrans' goal of eliminating traffic-related fatalities and serious injuries by 2050 and complements the transportation impact analysis process under CEQA.

The guidance identifies circumstances under which a safety review may be required for projects that generate additional trips on the state highway system and provides procedures for evaluating freeway exit-ramp queue spillback conditions. A safety review may be warranted when project-generated traffic adds two or more vehicle lengths to an off-ramp queue that extends beyond the available ramp storage and onto the freeway mainline, particularly where no such queue exists under baseline conditions. Caltrans recommends evaluating the speed differential between queued vehicles and freeway traffic during the period of queue overflow. The guidance identifies a potential safety concern when the speed differential is 30 miles per hour or greater because larger speed differentials may increase the severity of rear-end collisions. Where potential safety impacts are identified, Caltrans may recommend operational improvements, TDM measures, transit improvements, or other strategies intended to reduce Project-related safety risks and/or minimize queue spillback onto the freeway mainline.

3.3 Regional Regulations

3.3.1 Metropolitan Transportation Commission Plan Bay Area 2050+

The Metropolitan Transportation Commission (MTC) is the transportation planning, financing, and coordinating agency for the nine-county San Francisco Bay Area, including Marin County and the City of Larkspur. MTC, in partnership with the Association of Bay Area Governments, prepares and periodically updates the Bay Area's regional transportation plan and sustainable communities strategy.

Plan Bay Area 2050+ was adopted in March 2026 and establishes the region's long-range transportation and land use vision through 2050. The plan identifies strategies and policies to improve access to opportunity, reduce greenhouse gas emissions, support more frequent and reliable transit service, and enhance safety for people walking and bicycling. Transportation strategies relevant to the proposed Project include enhancing transit frequency, capacity, and reliability (Strategy T11) and expanding transit services throughout the region (Strategy T12). (MTC and ABAG 2026)

Plan Bay Area 2050+ identifies ferry-related investments serving LFT, including new ferry service between Larkspur and San Francisco's Mission Bay and improvements to existing Larkspur–San Francisco ferry service, such as potential frequency upgrades. These improvements are included among the region's prioritized long-range transportation investments anticipated through 2050 and provide a framework for future funding, project development, and regulatory review (MTC and ABAG 2026).

Plan Bay Area 2050+ serves as a regional policy and investment roadmap; it does not, by itself, fund specific projects or alter local land use authority. Local jurisdictions retain responsibility for land use decisions, while individual transportation projects identified in the plan would require separate funding decisions, project-level planning, design, environmental review, and approvals before implementation.

3.3.2 Transportation Authority of Marin

The Transportation Authority of Marin (TAM) coordinates and funds transportation projects and programs throughout Marin County to improve mobility for all users, including roadway, highway, transit, bicycle, pedestrian, Safe Routes to Schools, and TDM improvements.

3.3.2.1 Congestion Management Plan 2021

As the Congestion Management Agency for Marin County, TAM maintains the countywide Congestion Management Program (CMP), which establishes minimum LOS standards for designated facilities in the CMP network. The 2021 CMP identifies minimum of LOS D for urban and suburban arterials and LOS E for freeways, including US 101 and I-580.

In the vicinity of the LFT, East Sir Francis Drake Boulevard is part of the CMP network. According to the 2021 CMP, East Sir Francis Drake Boulevard between US 101 and Larkspur Landing Circle currently operates at LOS B eastbound and LOS C westbound during the PM peak period. This segment is considered to satisfy the applicable minimum LOS standard, and no deficiency actions are identified for this location.

3.3.2.2 Getting Around Marin – Strategic Vision Plan

TAM's *Getting Around Marin – Strategic Vision Plan*, updated in 2017, presents a long-term vision for Marin County's transportation system based on input from transportation users, service providers, and local jurisdictions. The plan is organized around three guiding principles supporting a strong economy by improving access for residents, visitors, and workers; promoting equity by ensuring transportation is accessible, affordable, and convenient; and advancing sustainability by providing travel choices that reduce reliance on driving alone.

Strategies and programs relevant to the LFT include increasing ferry service; expanding park-and-ride opportunities to support carpooling and transit trips to San Francisco; providing safe and accessible pathways to transit; improving first- and last-mile connections to regional transit services such as SMART and ferry service; and protecting transportation assets from sea level rise.

3.3.2.3 Marin Countywide Transportation Plan 2050

The Marin Countywide Transportation Plan 2050 (CTP 2050), adopted December 2024 by TAM, combines two previously separate planning efforts: the Marin Countywide Transportation Plan and the Countywide Community-Based Transportation Plan. The plan is based on MTC's CTP guidelines for countywide transportation plans and is intended to align local, regional, and state transportation policies and priorities.

CTP 2050 identifies strategies to advance a safe, equitable, and sustainable transportation system in Marin County. One relevant regional strategy supports coordinated regional connectivity through freeway, bridge, rail, and ferry connections serving multiple travel modes and linking Marin County with surrounding counties. The proposed Project is identified as an exemplary project supporting this regional connectivity strategy.

3.3.2.4 Marin County Mobility Hub Plan

The *Marin County Mobility Hub Plan* (MHP), adopted September 2026 by TAM, supports Marin County's implementation of the Transit-Oriented Communities Policy adopted by MTC in 2022. The

Transit-Oriented Communities policy identified nine Tier 4 transit service areas, applying a 1/2-mile radius around regional rail and ferry terminals or stations, including the LFT and Larkspur SMART Station. The MHP aligns with the Accessible and Walkable Communities strategy in the CTP and is an implementation activity of the CTP.

The MHP identifies strategies to improve access to the LFT and the Larkspur SMART Station. These include improving connectivity between the LFT and Larkspur SMART Station, including improving pedestrian and bicycle connectivity, wayfinding and improving transit reliability for bus connections. The MHP references the Project and examines expansion of landside access and forecast future traffic circulation from increased ferry demand.

3.4 Local Regulations

3.4.1 City of Larkspur 2040 General Plan

The *City of Larkspur 2040 General Plan* was adopted in September 2024 by the City of Larkspur and establishes the City's long-term vision for future growth. The Circulation Chapter reaffirms the City's commitment to a balanced, multimodal transportation system that serves the needs of all users through an integrated network of roadways, bicycle facilities, pedestrian paths, public transit, and TDM programs.

The Circulation Chapter considers local travel patterns, roadway constraints, and multimodal access needs for future conditions analysis. While regional and state transportation planning increasingly focuses on VMT as the primary measure of transportation impact under CEQA, LOS analysis remains relevant in Larkspur for evaluating local circulation, roadway operations, and the potential effects of significant development projects. Relevant policies and principles identified in *The City of Larkspur 2040 General Plan* include the following (City of Larkspur 2024):

- **Policy CIR-2.2:** Sir Francis Drake Boulevard and East Sir Francis Drake Boulevard shall not be widened to allow additional through traffic lanes.
  - Action Program CIR-2.2.a: Actively cooperate with the County of Marin to seek workable capacity improvements to the portion of Sir Francis Drake Boulevard in the County's jurisdiction that are not disruptive to the community.
- **Policy CIR-3.2:** Where feasible, given the needs of all users listed in Policy CIR-3.1, maintain standards for acceptable traffic Levels of Service during peak periods. Where these standards cannot be feasibly maintained due to new traffic generated by a proposed project, require other measures to reduce peak traffic and/or reduce the VMT generated by the new development.
  - Action Program CIR-3.2.a: Strive to maintain no less than Level of Service (LOS) at the D level for signalized and unsignalized intersections by using planning procedures defined in up-to-date releases from the Transportation Research Board. The City acknowledges that in 2020, LOS E or lower exists during the PM peak hour at the East Sir Francis Drake Boulevard/Larkspur Landing West intersection and that most measures which would alleviate traffic congestion there would not be desirable.
  - Action Program CIR-3.2.b: When maintaining an acceptable LOS at an intersection is not feasible, the City will consider requiring new projects to provide off-site mitigations such as a TDM program; ridesharing programs; SMART, ferry, and bus vouchers for employees; jitney/van connections to mass transit stops; yellow school bus programs; bicycle and pedestrian facilities listed in the City's BPMP; and other alternative transportation (see additional discussion of transportation alternatives under Goal 6).

- **Policy CIR-4.2:** Require a traffic impact analysis for any project generating significant additional peak hour PM trips to prevent a significant increase in peak hour traffic on City arterials.
- **Policy CIR-4.5:** Establish parking requirements for vehicles and bicycles and for parking programs that enhance local economic vitality and manage parking demand and capacity and avoid, where possible, impacts on surrounding residential neighborhoods.
  - Action Program CIR-4.5.b: Update regulations that incorporate effective parking management strategies and best practices (e.g., allow shared and reciprocal use of public and private parking spaces that serve more than a single location or use).
  - Action Program CIR-4.5.e: Per the City of Larkspur Bicycle and Pedestrian Master Plan, ensure provision of secure bicycle parking downtown and near popular citywide destinations, including public facilities, schools, commercial and business centers, transit stops, and recreational areas.
- **Policy CIR-4.6:** Strive to reduce the amount of land and infrastructure devoted to parking through such measures as development of consolidated parking facilities, the application of shared parking for mixed-use developments, car share programs, alternative investment in bike and pedestrian facilities, and the implementation of Transportation Demand Management programs to reduce parking demand.
- **Policy CIR-6.4:** Encourage increased transit service and ridership and other innovative programs and alternative transportation solutions to reduce single occupancy vehicle use.
  - Action Program CIR-6.4.f: Cooperate with the transit agencies to provide amenities at transit stops, such as benches, shelters, lights, maps, and bicycle parking.
  - Action Program CIR-6.5-g: Encourage shared-ride and jitney services to and from transportation terminals.
- **Policy CIR-6.5:** Cooperate with TAM, SMART, the County of Marin, and any other agencies to support the development of a rail transit corridor and associated multi-use path to Larkspur Landing and ensure impacts on Larkspur are appropriately studied and mitigated.
- **Policy CIR-6.7:** Encourage continuation of the Larkspur Ferry Terminal at its present site.
  - Action Program CIR-6.7.a: Support improvement of bicycle and pedestrian connectivity between the planned Larkspur SMART Station and the ferry terminal.
- **Policy CIR-6.8:** Support the development of park and ride facilities in Larkspur along transit routes.
  - Action Program CIR-6.8.a: Coordinate with Caltrans, Marin County, and the transit agencies to expand opportunities for park and ride, shared ride, and bicycle parking areas in or around Larkspur, particularly in conjunction with any reconfiguration of interchanges and on- and off-ramps.
  - Action Program CIR-6.8.b: Work with transit operators to resolve parking difficulties through designation of parking facilities controls as needed.

3.4.2 City of Larkspur Bicycle and Pedestrian Master Plan

The City of Larkspur updated its *City of Larkspur Bicycle and Pedestrian Master Plan* in 2017. The plan identifies bicycle and pedestrian improvements intended to enhance safety, close gaps in the active transportation network, and improve access to key local and regional destinations, including the LFT, SMART station, surrounding commercial areas, and nearby residential neighborhoods.

In the vicinity of the LFT, the plan recommends the following projects:

- **3A North Segment (off ramp)**: Corte Madera Creek bridge widening between US 101 overcrossing (Lucky Drive bicycle and pedestrian bridge) and the Central Marin Ferry Connection (bridge over East Sir Francis Drake Boulevard connecting to SMART station). This project created a new multi-use path between the Lucky Drive bridge and the US 101 northbound off-ramp and widened the existing path on the northbound off-ramp to current standards. The project was completed in 2022.
- **3B South Segment**: This project will connect Redwood Highway at Wornum Drive to the north–south path on top of the levee and the new Corte Madera Creek crossing (project 3C). There is an existing informal path. The project is funded and is in preliminary design.
- **3C North Segment (new Corte Madera Creek Crossing)**: A new bridge is proposed on the site of a disused railway bridge. It would connect between the levee path south segment (project 3B) and the Central Marin Ferry Connection (bridge over East Sir Francis Drake Boulevard connecting to the SMART station). The project is currently unfunded and subject to feasibility analysis.

3.4.3 City of Larkspur Municipal Code

Section 18.14 of the City of Larkspur Municipal Code includes provisions intended to support the goals and objectives of the General Plan (City of Larkspur 2024), including preserving the historic character of the community by avoiding disruption to neighborhoods from through traffic.

The Municipal Code defines "acceptable level of service" for most signalized intersections on the primary circulation system as LOS D during peak-hour conditions, as measured using the planning procedures in Transportation Research Circular 212 or its successor. The Code also recognizes that the following intersections currently operate at LOS E or F and should not be improved if the improvements would cause undesirable community impacts:

- Sir Francis Drake Boulevard at Eliseo Drive
- Sir Francis Drake Boulevard at La Cuesta Drive
- Sir Francis Drake Boulevard at Bon Air Road

4. Project Travel Demand

This section describes the methodology and results used to estimate future ferry ridership, passenger mode of arrival, and Project-generated vehicle trips for each alternative.

Project travel demand was estimated using the following four-step process:

1) Ridership forecast estimates future ferry passenger demand in person-trips in 2035 and 2050
2) Mode of arrival analysis estimates how passengers are expected to travel to and from the terminal
3) Trip distribution estimates the general direction of travel to and from the terminal
4) Trip assignment allocates Project vehicle trips to specific roadway segments and study intersection turning movements

4.1 Ridership Demand Forecast

The TAM travel demand model was used to develop ferry ridership forecast and to inform assumptions regarding travel behavior, including trip distribution and VMT. The model incorporates regional population and employment forecasts, travel patterns, and transportation network conditions. Key forecast assumptions include projected regional growth and work-from-home trends reflected in the *Plan Bay Area 2050+* (MTC and ABAG 2026), as well as future congestion conditions in the Golden Gate Bridge corridor.

The ferry ridership forecast was developed for Year 2050 and then prorated for Year 2035 based on anticipated growth patterns and future congestion levels in the Golden Gate Bridge corridor. Special event ridership was estimated separately based on historical trends and is not included in the daily ridership forecast for regular commute service.

The TAM model indicates that, among person-trips between Marin and Sonoma Counties and San Francisco, approximately 82% are projected to travel by private vehicle across the Golden Gate Bridge, 12% are expected to use the Larkspur ferry, and the remaining 6% are projected to use Golden Gate Transit bus service or other ferry routes (for example, Sausalito Ferry and Tiburon Ferry). Based on these projections, daily Larkspur ferry ridership is forecast to reach approximately 7,500 passengers in 2035 and 17,600 passengers in 2050. These totals include approximately 3,750 southbound trips in 2035 and 8,800 southbound trips in 2050.

It is noted that before the COVID-19 pandemic, the 85th percentile daily ferry ridership at the LFT was approximately 6,348 passengers in 2019, including 3,120 southbound trips. During the pandemic, Larkspur ferry ridership decreased substantially in 2020 and 2021, then gradually recovered in subsequent years. By October 2025, average daily ridership had recovered to approximately 3,600 passengers.

4.2 Mode of Arrival

4.2.1 Existing Mode of Arrival

A ferry passenger survey was conducted in September 2024 to collect information on how passengers currently access the LFT. Passengers were invited to complete the survey through QR codes displayed at

the terminal, social media outreach, and District email distribution lists. A total of 615 responses were collected.

The survey results were adjusted using the following observed data to better reflect existing conditions:

- Larkspur ferry ridership data from 2024 and 2025
- Parking accumulation based on drone imagery collected on February 11, 2025
- Drop-off and pickup counts collected on February 11, 2025
- SMART Clipper transfer data and combo ticket activation data from July 2024 to October 2025
- Bicycle onboard counts and terminal parking counts collected in March 2025

As shown in Table 4-1, approximately 73% of ferry passengers currently drive and park at the terminal; 9% arrive by bicycle or scooter; 8% arrive by SMART; 6.5% are dropped off or picked up by a family, friend, or transportation network company; 1% arrive by bus; and 2.5% walk.

Table 4-1. Existing Mode of Arrival

Mode	Percent
Park	73.0%
Drop-Off	6.50%
Bike/Scooter	9.00%
SMART	8.00%
Bus	1.00%
Walk	2.50%
Total	100%

4.2.2 2035 Mode of Arrival and Vehicle Trips

Future mode-of-arrival assumptions for 2035 were developed based on the existing mode-of-arrival data, planned transportation improvements, and anticipated changes in land use and travel behavior. Background improvements considered in the analysis include planned bicycle and pedestrian network enhancements in Marin County and local jurisdictions, the SMART rail extension to Healdsburg, regional transit fare integration through Clipper 2.0, Marin Transit service improvements, additional housing development near the terminal, restoration of a peak-period ferry feeder shuttle route, and deployment of higher-capacity Liwa-class ferry vessels. Consistent with regional transportation and mobility trends, the 2035 analysis assumes a gradual shift from drive-alone access toward alternative modes, including bicycle, transit, walking, and carpool.

Daily Larkspur ferry ridership in 2035 is projected to reach approximately 7,500 passengers, including approximately 3,750 southbound passengers. Under the No-Project Alternative, existing ferry access conditions would continue with no Project-specific bicycle, pedestrian, transit, or parking improvements beyond planned background projects. Parking supply would remain constrained, and parking fees would increase in line with inflation. As a result, ferry ridership under the No-Project Alternative is expected to be constrained at approximately 7,130 daily passengers because of limited terminal access capacity.

Alternatives 1, 2, and 3 are expected to accommodate the full ridership demand of 7,500 passengers through different combinations of expanded ferry parking capacity and multimodal access improvements. The Build Alternatives would provide a parking garage in the North Lot with approximately 850 parking spaces, along with improved pedestrian connections between the North Lot and the ferry terminal.

Alternative 3 would place a greater emphasis on bicycle, pedestrian, transit, and first-/last-mile access improvements.

Table 4-2 summarizes the estimated 2035 daily mode of arrival for each alternative. The mode shares shown are daily averages; mode shares by hour may vary depending on parking availability, transit operating hours, ferry schedules, and traffic conditions.

Table 4-2. 2035 Mode of Arrival and Daily Riders by Alternative

Mode	No Project		Alternative 1		Alternative 2		Alternative 3	
	Daily Riders	Percent	Daily Riders	Percent	Daily Riders	Percent	Daily Riders	Percent
Park	4,840	67.9%	5,210	69.5%	5,100	68.0%	4,910	65.5%
Pickup/ Drop-Off	490	6.9%	490	6.5%	490	6.5%	490	6.5%
Bike/Scooter	740	10.4%	740	9.8%	810	10.8%	810	10.8%
SMART	640	9.0%	640	8.5%	640	8.5%	640	8.5%
Bus	230	3.2%	230	3.0%	260	3.5%	450	6.0%
Walk	200	2.8%	200	2.7%	200	2.7%	200	2.7%
Total	7,130	100.0%	7,500	100.0%	7,500	100.0%	7,500	100.0%

Hourly ridership was assumed to follow the existing hourly distribution pattern. These person-trips were then allocated to access modes based on the estimated mode-of-arrival shares for each hour. Project vehicle trips include drive-and-park trips, passenger pickup/drop-off trips, and Golden Gate Transit bus trips. Drive-and-park trips were counted in one direction only, while pickup/drop-off and transit vehicle trips were counted in both directions.

Table 4-3 summarizes 2035 Project vehicle trips during AM and PM peak hours.

Table 4-3. 2035 Project Vehicle Trips during AM and PM Peak Hours by Alternative

	No Project	Alternative 1	Alternative 2	Alternative 3
AM Peak Hour				
Inbound Vehicle Trips	826	896	862	819
Outbound Vehicle Trips	110	125	125	125
PM Peak Hour				
Inbound Vehicle Trips	91	91	91	90
Outbound Vehicle Trips	605	693	663	620

4.2.3 2050 Mode of Arrival and Vehicle Trips

Daily Larkspur ferry ridership in 2050 is projected to reach approximately 17,600 passengers, including 8,800 southbound passengers. Future mode-of-arrival assumptions for 2050 were developed based on the 2035 mode-of-arrival estimates and additional parking, bicycle, pedestrian, and transit access improvements associated with each Project alternative.

Consistent with the 2035 analysis, the No-Project Alternative assumes continuation of existing ferry access conditions with no substantial Project-specific bicycle, pedestrian, transit, or parking improvements beyond planned background projects. Parking supply would remain constrained, and parking fees would continue to increase only in line with inflation. As a result, ferry ridership under the No-Project Alternative is expected to be constrained at approximately 8,800 daily passengers, which is approximately half of the projected unconstrained ridership demand in 2050.

The Build Alternatives are expected to accommodate the full projected 2050 ridership demand of approximately 17,600 daily passengers through expanded ferry service, phased parking expansion, and multimodal access improvements. Both Build Alternatives assume incrementally expanded ferry service of up to 76 daily revenue trips and phased construction of parking garages. In addition to the North Lot parking garage completed by 2035, Alternative 1 would include a Main Lot parking garage with approximately 3,998 spaces, while Alternative 2 would include a smaller Main Lot parking garage with approximately 3,258 spaces. Alternative 1 primarily focuses on accommodating future ridership growth through expanded parking capacity. Alternative 2 would include more multimodal access improvements, including expanded bicycle amenities and additional feeder shuttle service.

Alternative 3 would not include parking expansion. Instead, this alternative would rely on TDM measures, including enhanced bicycle facilities, expanded feeder shuttle service, and peak-period microtransit service. These TDM measures are expected to accommodate more ridership than the No-Project Alternative, but ridership under Alternative 3 is still projected to be constrained at approximately 14,000 daily passengers because of limited parking capacity. Alternative 3 would accommodate these passengers through expanded ferry service levels of 66 daily revenue trips.

Table 4-4 summarizes the estimated 2050 daily mode of arrival for each alternative.

Table 4-4. 2050 Mode of Arrival and Daily Riders by Alternative

Mode	No Project		Alternative 1		Alternative 2		Alternative 3	
	Daily Riders	Percent	Daily Riders	Percent	Daily Riders	Percent	Daily Riders	Percent
Park	4,970	56.5%	11,440	65.0%	9,860	56.0%	5,600	40.0%
Pickup/ Drop-Off	660	7.5%	1,140	6.5%	1,230	7.0%	1,320	9.4%
Bike/Scooter	1,280	14.5%	1,940	11.0%	2,290	13.0%	2,460	17.6%
SMART	1,010	11.5%	1,670	9.5%	1,760	10.0%	1,850	13.2%
Bus	530	6.0%	880	5.0%	1,940	11.0%	2,240	16.0%
Walk	350	4.0%	530	3.0%	530	3.0%	530	3.8%
Total	**8,800**	**100.0%**	**17,600**	**100.0%**	**17,600**	**100.0%**	**14,000**	**100.0%**

Hourly ridership was assumed to follow the existing hourly distribution pattern, with adjustments to account for the assumed maximum hourly ferry capacity of 2,000 passengers in each direction, based on 500 passengers per vessel and four trips per hour. These person-trips were then allocated to access modes based on the estimated mode-of-arrival shares for each hour. Vehicle trips include drive-and-park trips, passenger pickup/drop-off trips, and Golden Gate Transit bus trips. Drive-and-park trips were counted in one direction only, while pickup/drop-off and transit vehicle trips were counted in both directions.

Table 4-5 summarizes 2050 Project vehicle trips during AM and PM peak hours.

Table 4-5. 2050 Project Vehicle Trips during AM and PM Peak Hours by Alternative

	No Project	Alternative 1	Alternative 2	Alternative 3
AM Peak Hour				
Inbound Vehicle Trips	851	1,229	1,163	738
Outbound Vehicle Trips	134	205	225	242
PM Peak Hour				
Inbound Vehicle Trips	116	217	248	227
Outbound Vehicle Trips	540	1,356	1,118	634

4.3 Trip Distribution and Assignment

Ferry passenger trip distribution was estimated using origin-destination data from the TAM travel demand model and cross-checked against the 2024 ferry passenger survey, which included questions regarding passengers' trip origins. Both data sources indicate that approximately one-third of ferry passengers originate from communities located more than 6 miles from the terminal, including Novato, Petaluma, Santa Rosa, Rohnert Park, and beyond. The remaining two-thirds originate within approximately 6 miles of the terminal, including San Rafael (approximately 30%); nearby communities (approximately 20%), such as Larkspur, Corte Madera, and Greenbrae; communities along the Sir Francis Drake Boulevard corridor (approximately 15%,) such as Fairfax, San Anselmo, and Kentfield; and communities to the south such as Mill Valley (less than 5%).

The initial trip distribution was refined to account for available transit and bicycle networks serving each origin area. As shown on Figure 4-1, approximately 72% of Project vehicle trips are projected to approach the terminal via US 101 from the north, 6% via US 101 from the south, 20% via Sir Francis Drake Boulevard west of US 101, and the remaining 2% from areas east of the terminal and Larkspur Landing. The relative attractiveness of the Main Lot and North Lot to ferry riders was also considered. Based on parking supply under each alternative, approximately 10% to 15% of drivers are assumed to use the North Lot during the peak hours.

Using the projected vehicle trips and trip distribution assumptions described above, Project vehicle trips were assigned to the nearby intersections for each alternative under 2035 and 2050 conditions. These project vehicle trips are over and above the existing level of ferry-related vehicle trips.

Figure 4-2 through

Figure 4-9 illustrate the Project vehicle trips.



Figure 4-1. Project Trip Distribution

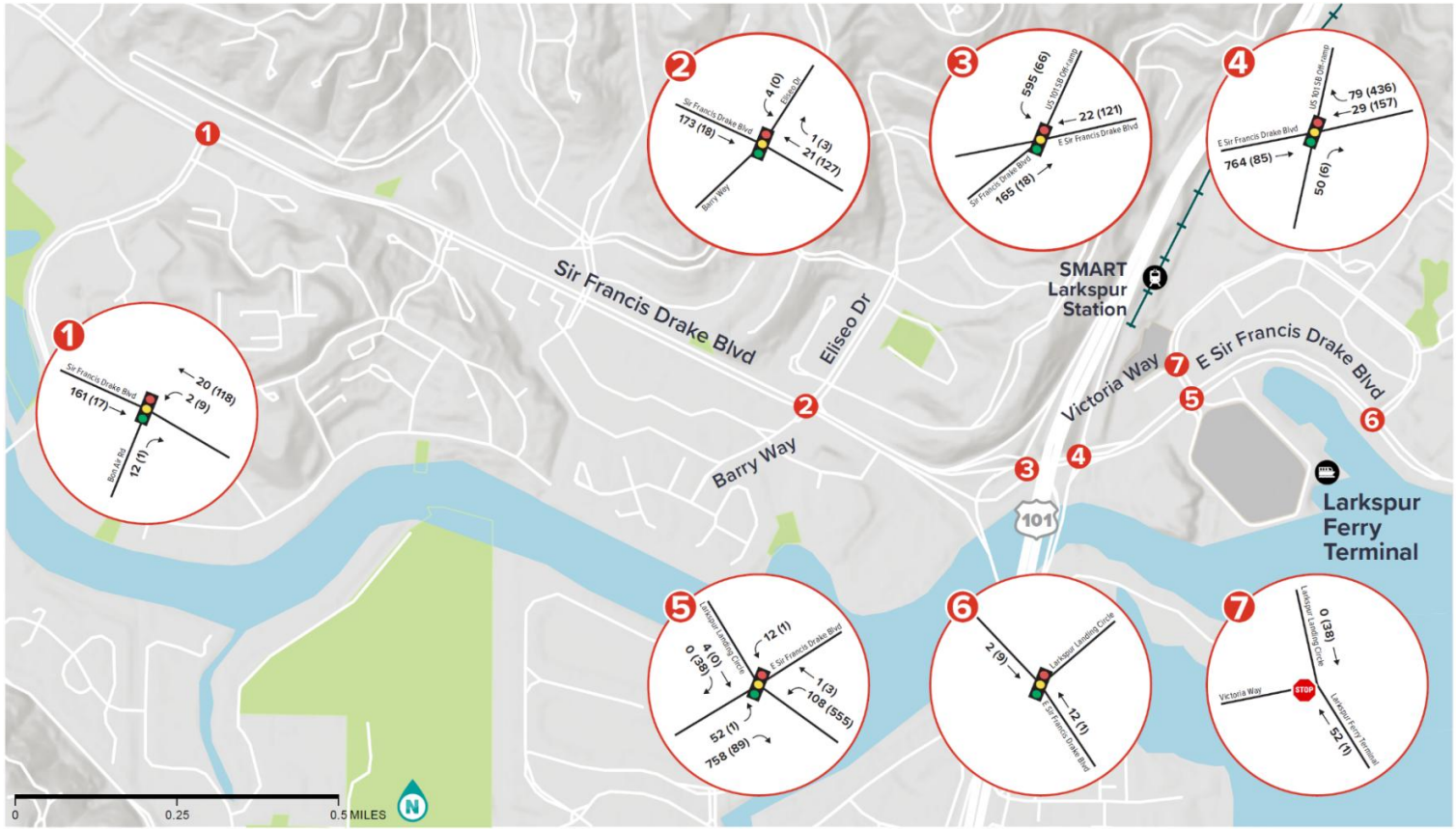
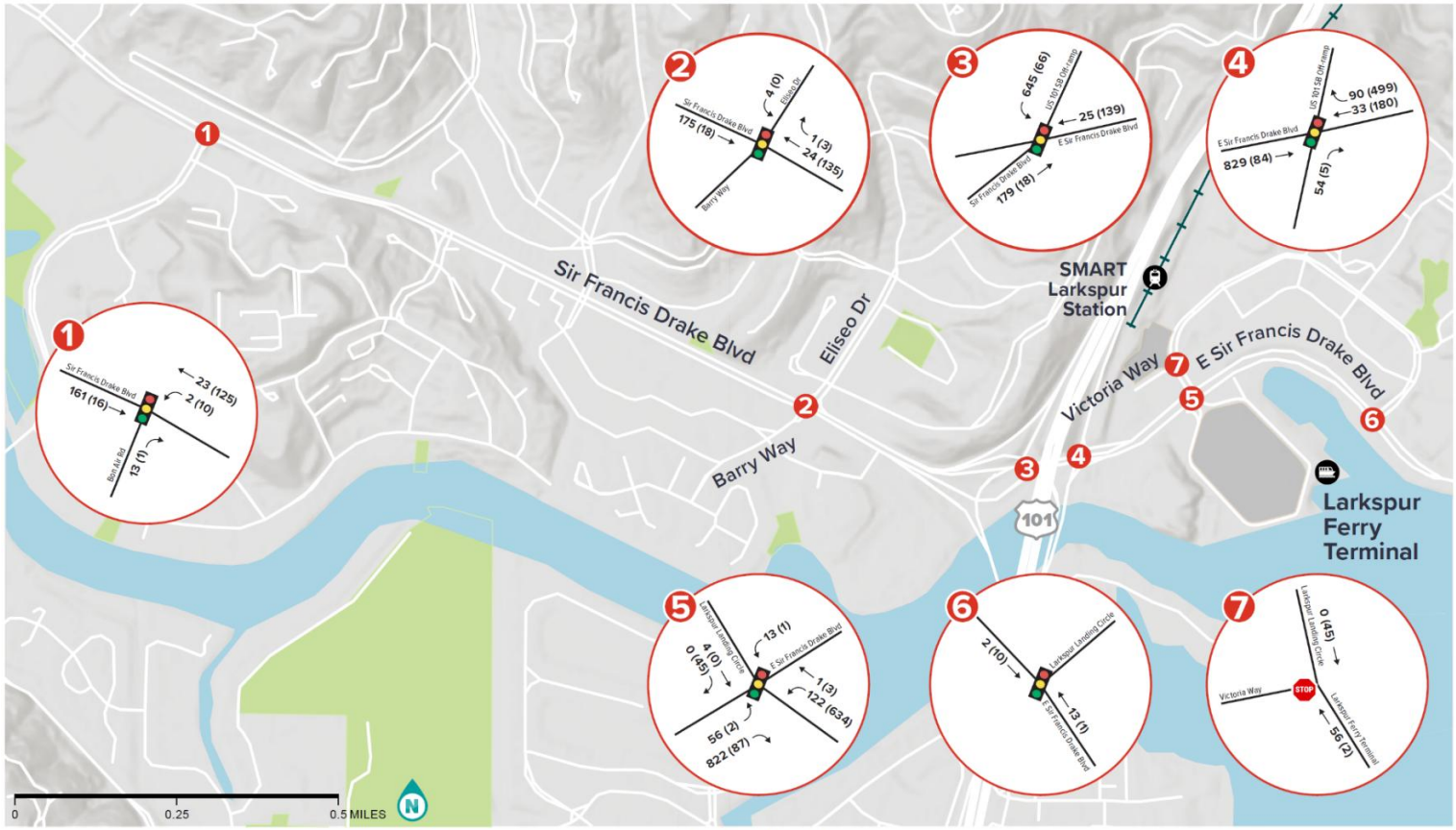


Figure 4-2. Project Vehicle Trips – No Project (2035)



PROJECT VEHICLE TRIPS
ALTERNATIVE 1 (2035)

LARKSPUR FERRY
SERVICE EXPANSION
AND PARKING STUDY

alta

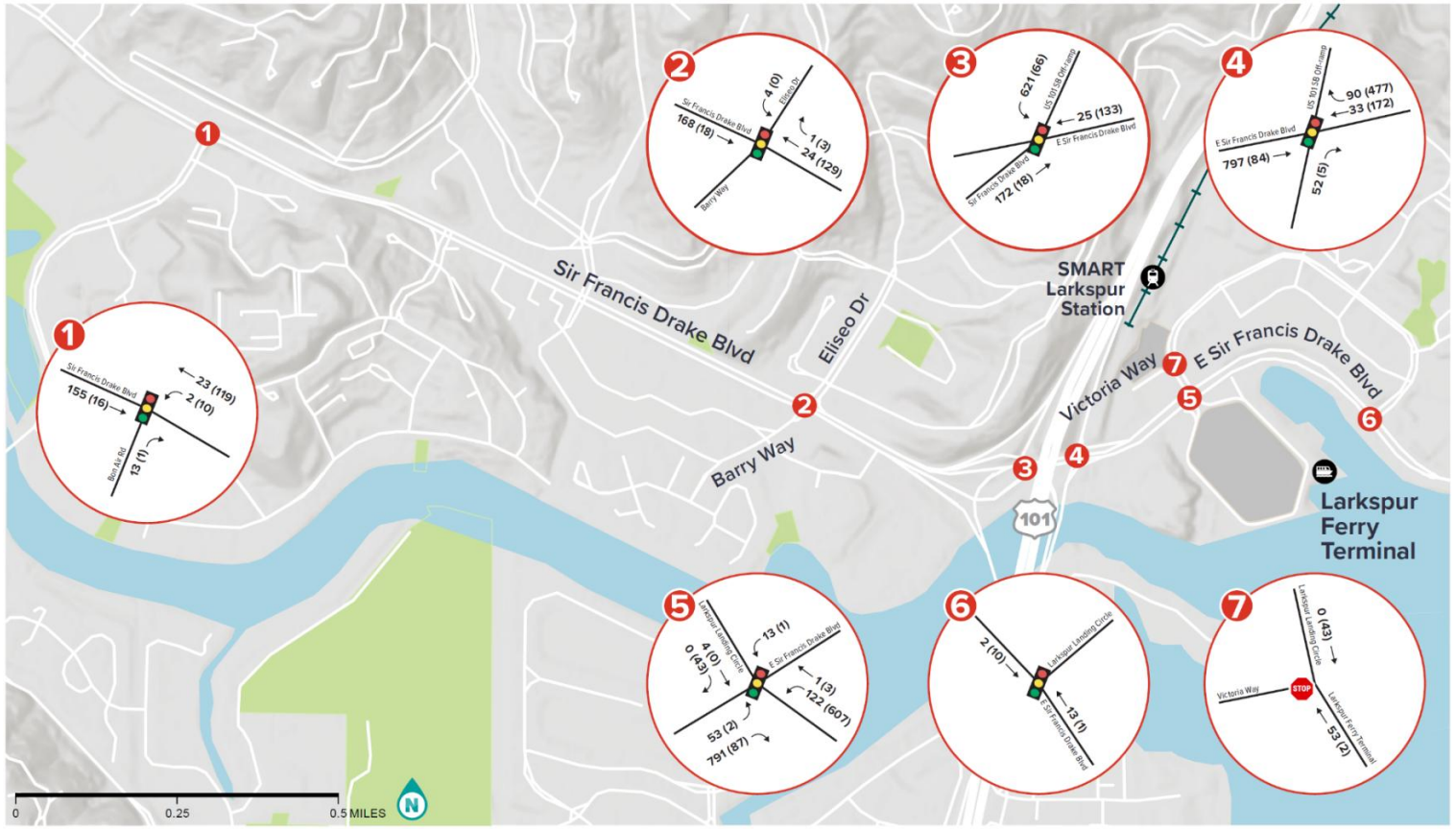
LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

TRAFFIC VOLUME

123 (123) Peak AM (Peak PM)

Figure 4-3. Project Vehicle Trips – Alternative 1 (2035)



PROJECT VEHICLE TRIPS
ALTERNATIVE 2 (2035)

LARKSPUR FERRY
SERVICE EXPANSION
AND PARKING STUDY

alta

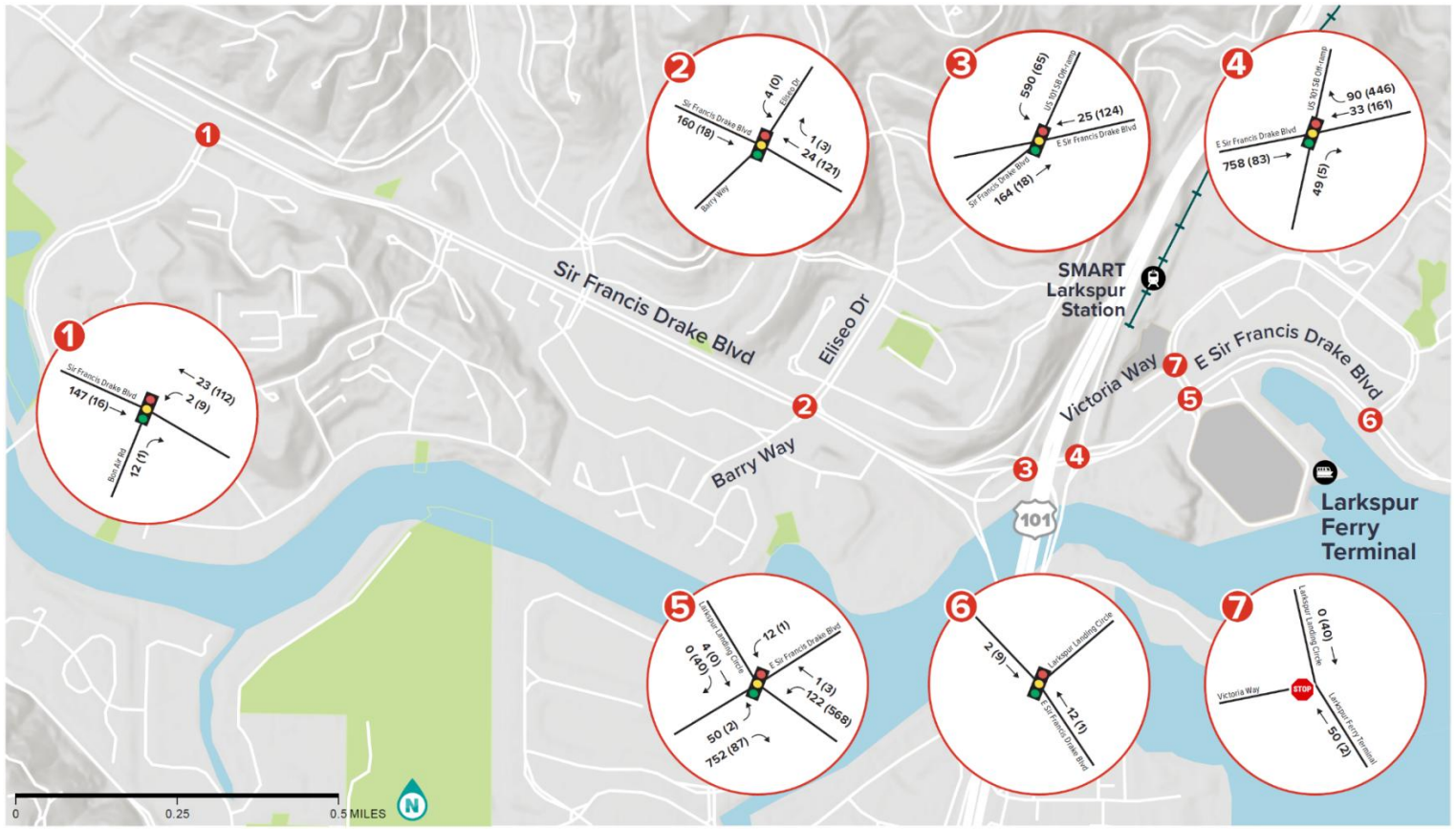
LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

TRAFFIC VOLUME

123 (123) AM Peak (PM Peak)

Figure 4-4. Project Vehicle Trips – Alternative 2 (2035)



PROJECT VEHICLE TRIPS
ALTERNATIVE 3 (2035)

LARKSPUR FERRY
SERVICE EXPANSION
AND PARKING STUDY

alta

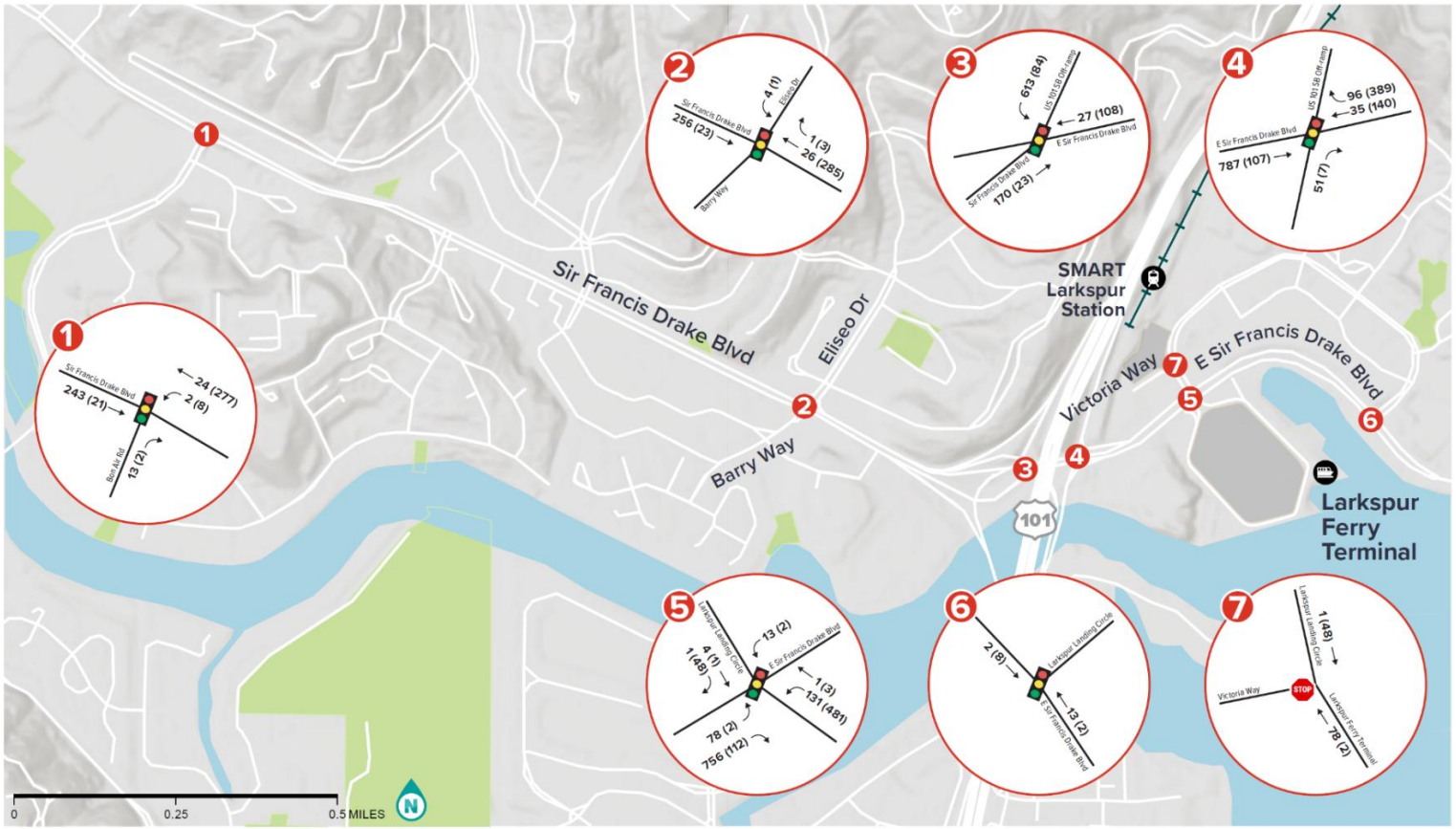
LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

TRAFFIC VOLUME

123 (123) AM Peak (PM Peak)

Figure 4-5. Project Vehicle Trips – Alternative 3 (2035)



PROJECT VEHICLE TRIPS
NO PROJECT (2050)

LARKSPUR FERRY
SERVICE EXPANSION
AND PARKING STUDY

alta

LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

TRAFFIC VOLUME

123 (123) AM Peak (PM Peak)

Figure 4-6. Project Vehicle Trips – No Project (2050)

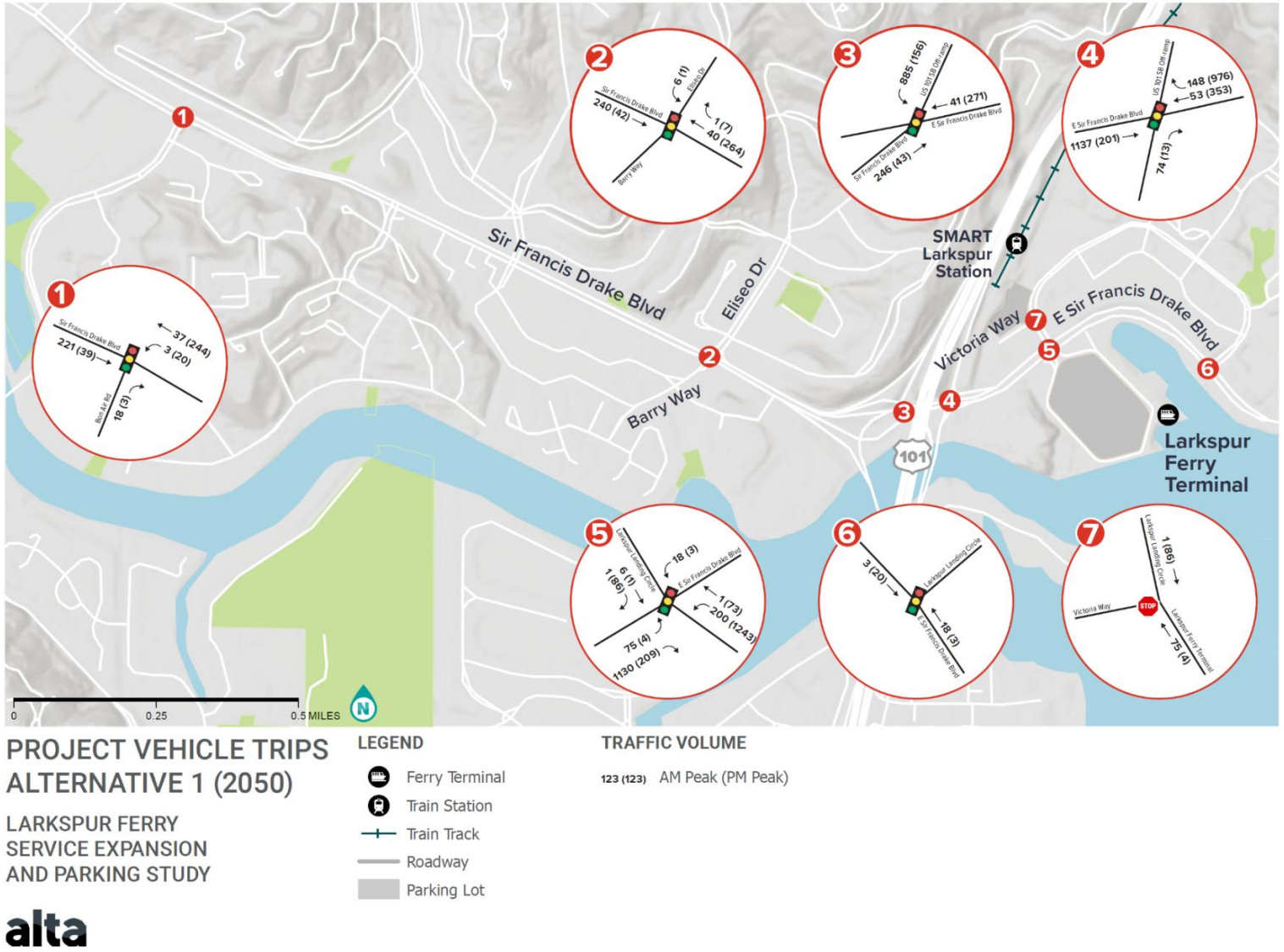


Figure 4-7. Project Vehicle Trips – Alternative 1 (2050)

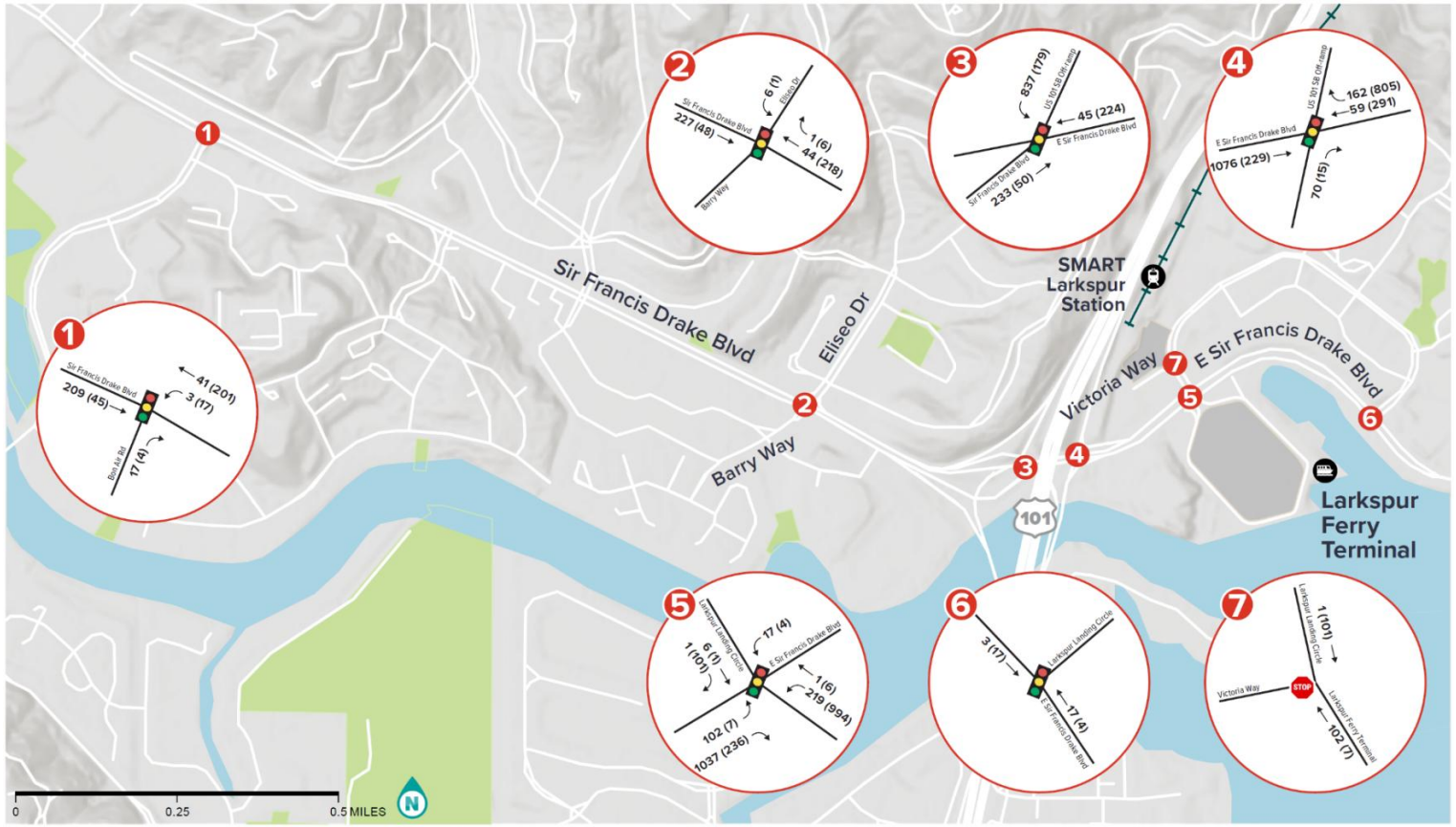
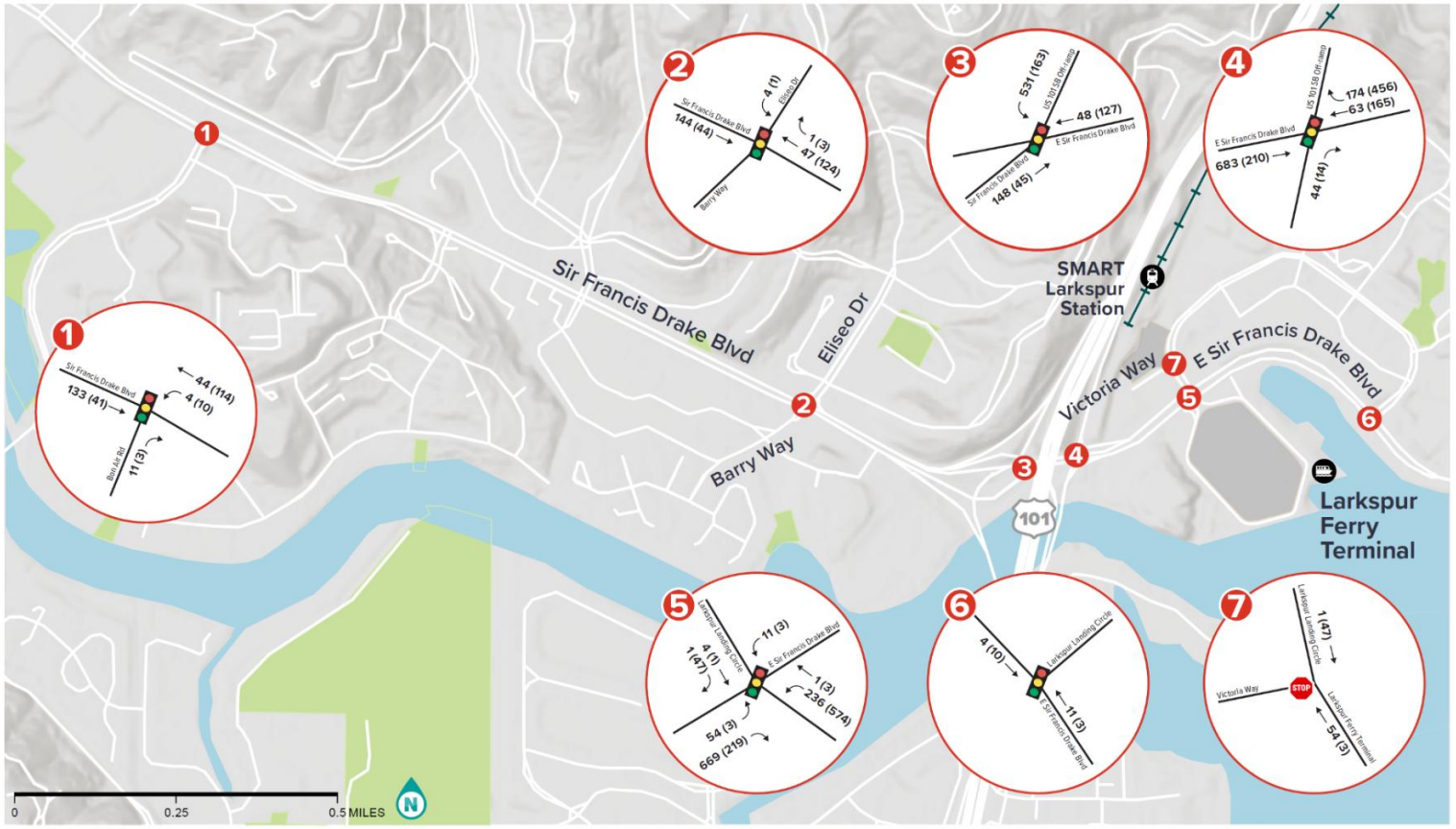


Figure 4-8. Project Vehicle Trips – Alternative 2 (2050)



PROJECT VEHICLE TRIPS
ALTERNATIVE 3 (2050)

LARKSPUR FERRY
SERVICE EXPANSION
AND PARKING STUDY

alta

LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

TRAFFIC VOLUME

123 (123) AM Peak (PM Peak)

Figure 4-9. Project Vehicle Trips – Alternative 3 (2050)

5. CEQA Transportation Analysis

This section evaluates the Project's potential transportation impacts under CEQA, including both operational and construction impacts. These impacts are evaluated based on the applicable significance criteria, including the consistency with plans and policies, VMT, design hazards, and emergency access.

5.1 Operational Impacts

5.1.1 Consistency with Plans and Policies

Section 3 summarizes the applicable regional, countywide, and local transportation plans, ordinances, and policies that guide performance of the circulation system. This section evaluates whether the Project would conflict with those transportation plans and policies.

Consistency with Regional Plans and Policies

Plan Bay Area 2050+ supports reduced greenhouse gas emissions, increased transit frequency and capacity, and expanded transit service throughout the region. The Project would directly support these regional objectives by expanding ferry service between Larkspur and San Francisco, improving access to regional transit, and enhancing multimodal access to the terminal. *Plan Bay Area 2050+* also identifies improved ferry connections between Larkspur and San Francisco; therefore, the Project would advance identified regional transit investment priorities (MTC and ABAG 2026).

TAM's 2017 *Getting Around Marin – Strategic Vision Plan* supports increased ferry service, expanded park-and-ride opportunities, improved first- and last-mile connections to regional transit services, and safe and accessible pathways to transit. The Project would support these objectives by expanding ferry capacity, providing parking capacity to accommodate ferry demand, and improving multimodal access to the terminal.

TAM's 2024 *Marin Countywide Transportation Plan 2050* supports coordinated regional connectivity through freeway, bridge, rail, and ferry connections serving multiple travel modes and linking Marin County with surrounding counties. The Project is specifically identified as an exemplary project supporting this regional connectivity strategy.

With respect to TAM's 2021 CMP, Sir Francis Drake Boulevard is part of the CMP network near the Project site. The CMP identifies LOS D as the minimum standard for arterials. It is anticipated that the traffic operations on Sir Francis Drake Boulevard would likely fall below the CMP LOS standard in the future with or without the Project depending on the horizon year and the alternatives considered. As a result, the City may be subject to CMP monitoring requirements and development of deficiency plans, as applicable. However, the Project would not directly conflict with the objectives of the CMP because it is intended to improve regional transit access and support multimodal transportation connections to the LFT. In addition, while LOS continues to be used within the CMP framework for evaluating roadway operating conditions, transportation impacts under CEQA are now evaluated primarily using VMT pursuant to SB 743. Further, the source of congestion on East Sir Francis Drake Boulevard is not local traffic; it is regional traffic bypassing the 101/580 interchange in San Rafael, and implementation of other planned projects are the proper means to alleviate this congestion.

Consistency with Local Plans and Policies

The Project would generally be consistent with the circulation and transportation policies of *The City of Larkspur 2040 General Plan* (City of Larkspur 2024). As described in Section 1, all three alternatives would expand ferry service, increase bicycle parking, and provide multimodal access improvements to support expanded ferry ridership. All three alternatives are also expected to reduce VMT compared with the No-Project Alternative by shifting regional trips from automobile travel to ferry transit.

The Build Alternatives would provide additional parking capacity to accommodate anticipated ferry passenger demand while also incorporating multimodal access improvements. Alternatives 2 and 3 would provide additional feeder shuttle service along with TDM measures intended to encourage ferry passengers to access the terminal by transit, bicycle, walking, shared ride, or other non-drive-alone modes. Alternative 3 would not increase parking capacity but would include substantial multimodal access improvements and TDM measures. Therefore, the Project would be consistent with Policies CIR-2.2, 4.5, 4.6, 6.4, 6.5, and 6.7 (City of Larkspur 2024).

The Build Alternatives would include construction of parking garages in the North Lot and Main Lot. These improvements would be consistent with Policy CIR-6.8, which supports development of park-and-ride facilities along transit routes and encourages coordination with transit agencies to expand opportunities for shared-ride facilities, bicycle parking, and parking management (City of Larkspur 2024).

All three alternatives would increase localized vehicle traffic on Sir Francis Drake Boulevard (focused on the segment between the ferry terminal and the US 101 interchange), and intersections along the corridor may operate below the City's LOS standard under future conditions. However, the City acknowledges that certain constrained intersections already operate deficiently or may not be feasible to improve through traditional roadway capacity measures. In such cases, the General Plan identifies TDM programs, ridesharing, transit incentives, shuttle or van connections to transit, and bicycle and pedestrian improvements as appropriate measures. The Project's emphasis on ferry service expansion, multimodal access improvements, feeder shuttle service, bicycle and pedestrian improvements, parking management, and TDM would be consistent with this policy direction. Therefore, the Project would be consistent with Policy CIR-3.2 (City of Larkspur 2024).

Impact Determination

The Project would be consistent with the regional transportation goals and strategies identified in *Plan Bay Area 2050+*, TAM's *Marin Countywide Transportation Plan 2050*, as well as local circulation and transportation policies in *The City of Larkspur 2040 General Plan* (MTC and ABAG 2026; TAM 2024; City of Larkspur 2024). Therefore, the Project would not conflict with applicable local transportation plans and policies, addressing transit, roadway, bicycle, or pedestrian circulation. The impact would be ***less than significant***.

5.1.2 Vehicle Miles Traveled

The City of Larkspur has adopted VMT as the primary metric for evaluating transportation impacts under CEQA. The City relies on guidance from the LCI, formerly the Governor's Office of Planning and Research, including the *Technical Advisory on Evaluating Transportation Impacts in CEQA* (LCI 2018), for evaluating VMT impacts on transportation projects.

LCI guidance identifies certain transportation projects that are generally presumed to reduce VMT and therefore are typically considered to have a less-than-significant transportation impact under CEQA. These include transit and active transportation projects, such as passenger rail, bus and bus rapid transit, bicycle,

and pedestrian infrastructure projects. The LCI further identifies improving or increasing access to public transit as a potential mitigation strategy for reducing VMT impacts.

As described in Section 1, the Project would expand ferry service and improve multimodal access to the LFT through a combination of ferry service increases, parking improvements, pedestrian and bicycle access enhancements, transit connections, and TDM measures. Because the Project would improve access to public transit and support travel by ferry, transit, walking, and bicycling, it is consistent with the types of transportation projects that LCI guidance identifies as generally VMT-reducing. Therefore, the Project may be presumed to have a less-than-significant VMT impact and may be screened from further VMT analysis.

However, the City of Larkspur's guidance also states that transportation projects may be evaluated on a case-by-case basis. For transportation projects, the appropriate metric is the change in total VMT, which compares VMT under conditions without the project to VMT under conditions with the project. The difference between the two represents the VMT attributable to the Project.

Vehicle Miles Traveled Analysis Methodology

Although the Project is intended to reduce regional automobile travel by expanding ferry service between Marin County and San Francisco, the Project would also generate vehicle trips to and from the terminal, including drive-and-park trips and passenger pickup/drop-off trips. Therefore, to provide a conservative assessment of potential VMT effects, this analysis estimates the net change in VMT under each alternative.

VMT associated with ferry access trips was estimated by multiplying the projected daily private vehicle trips and first-/last-mile transit trips such as feeder shuttle or microtransit trips to and from the LFT by the average trip distance between ferry riders' origins and the terminal. Daily private vehicle trips and transit trips were based on the mode-of-arrival assumptions for each alternative, as described in Section 4. Average trip distances were obtained from the TAM travel demand model. For transit trips, average trip distances were estimated based on the anticipated transit catchment area.

Based on the 2022 model, the average vehicle trip distance under existing conditions is approximately 9.6 miles. The average trip distance is projected to increase to approximately 11.6 miles based on the 2050 model, likely reflecting a greater share of ferry riders traveling from areas farther north such as Santa Rosa and Rohnert Park. The average trip distance for 2035 was interpolated at approximately 10.2 miles.

For the No-Project Alternative, projected ferry demand would not be fully accommodated because ferry service and landside access capacity would remain constrained. Forecast trips that could not be accommodated by ferry were reassigned to drive directly to San Francisco. Under this assumption, the additional driving distance from the terminal area to San Francisco is estimated at approximately 15.5 miles. Therefore, the total vehicle trip distance for unmet ferry riders is estimated at approximately 25.7 miles in 2035 and approximately 27.1 miles in 2050.

Year 2035 Vehicle Miles Traveled

Table 5-1 summarizes projected daily ridership, private vehicle trips, and VMT for each alternative in 2035. Under the No-Project Alternative, ferry ridership would be constrained to approximately 7,130 daily riders, leaving approximately 370 potential ferry riders unmet. These unmet riders were assumed to drive to San Francisco, resulting in additional regional VMT.

Compared with the No-Project Alternative, the three alternatives would reduce total VMT by accommodating additional ferry trips that would otherwise occur as longer automobile trips to San

Francisco. Alternative 1 would reduce VMT by approximately 2,165 daily miles, Alternative 2 by approximately 4,930 daily miles, and Alternative 3 by approximately 10,061 daily miles. Alternative 3 would result in the greatest VMT reduction in 2035 due to its lower drive-and-park mode share and greater reliance on TDM, transit, bicycle, and pedestrian access.

Table 5-1. 2035 Daily Vehicle Miles Traveled by Alternative

Measure	No Project	Alternative 1	Alternative 2	Alternative 3
Ferry Ridership	7,130	7,500	7,500	7,500
Private Vehicle Trips to/from LFT	10,060	10,780	10,500	9,980
Private Vehicle Trip VMT to/from LFT	102,612	109,956	107,100	101,796
Transit Trip VMT to/from LFT	195	195	286	459
Unmet Ferry Ridership	370	-	-	-
VMT by Unmet Ferry Riders Driving to San Francisco	9,509	-	-	-
Total VMT	112,316	110,151	107,386	102,255
VMT Reduction compared with No Project	-	2,165	4,930	10,061

Year 2050 Vehicle Miles Traveled

By 2050, ferry demand is projected to increase substantially, in part because of regional growth and anticipated congestion in the Golden Gate Bridge corridor. Under the No-Project Alternative, ferry ridership would be constrained to approximately 8,800 daily riders, which is substantially below the projected unconstrained demand of approximately 17,600 daily riders. Riders who could not be accommodated by ferry were assumed to drive directly to San Francisco, resulting in substantial additional regional VMT.

As shown in Table 5-2, the three alternatives would reduce total VMT compared with the No-Project Alternative. Alternative 1 would reduce VMT by approximately 85,887 daily miles and Alternative 2 by approximately 124,749 daily miles. Ferry ridership under Alternative 3 would be constrained to approximately 119,507 daily riders because of limited parking capacity at the terminal despite stronger emphasis on TDM and multimodal connections and results in the least VMT reductions.

Table 5-2. 2050 Daily Vehicle Miles Traveled by Alternative

Measure	No Project	Alternative 1	Alternative 2	Alternative 3
Ferry Ridership	8,800	17,600	17,600	14,000
Private Vehicle Trips to/from LFT	10,520	23,660	20,220	12,300
Private Vehicle Trip VMT to/from LFT	122,032	274,456	234,552	142,680
Transit Trip VMT to/from LFT	195	364	1,406	960
Unmet Ferry Ridership	8,800	0	0	3,600
VMT by Unmet Ferry Riders Driving to San Francisco	238,480	-	-	97,560
Total VMT	360,707	274,820	235,958	241,200
VMT Reduction compared with No Project	-	85,887	124,749	119,507

Impact Determination

The Project would expand ferry service and improve multimodal access to the LFT, thereby shifting trips from longer automobile travel to public transit. Although the Project would increase localized vehicle activity to and from the terminal, including drive-and-park and pickup/drop-off trips, the regional VMT reduction associated with accommodating additional ferry riders would more than offset the VMT generated by terminal access trips.

Therefore, compared with the No-Project Alternative, the three alternatives would result in a net reduction in total VMT in both 2035 and 2050. Consistent with State CEQA Guidelines Section 15064.3, subdivision (b), the Project would not increase VMT. The Project's VMT impact would be ***less than significant***.

5.1.3 Design Hazards

This section evaluates whether the Project would substantially increase transportation hazards because of geometric design features, multimodal circulation conflicts, or incompatible uses. The evaluation considers pedestrian and bicycle circulation, transit and passenger loading, parking and vehicle circulation, and vehicle queuing.

Pedestrian and Bicycle Facilities

All three alternatives would improve pedestrian connections between the North Lot and the ferry terminal, including high-visibility mid-block crosswalks along Larkspur Landing Circle West. Under the two Build Alternatives, pedestrian connections between the terminal and the Main Lot garage would also be improved to reduce conflicts and enhance pedestrian visibility and safety.

All three alternatives would include upgraded bicycle parking facilities, including a bicycle room in the Main Lot parking garage or a stand-alone bicycle hub. The proposed bicycle facilities would require bicyclists and pedestrians to cross the terminal loop driveway in front of the terminal entrance. To minimize potential conflicts among vehicles, bicyclists, and pedestrians, the Project would include high-visibility bicycle and pedestrian crossings and other safety treatments, as appropriate.

Pedestrian and bicycle improvements would be designed to be consistent with applicable local and District standards and would not introduce hazardous geometric conditions and would support safer multimodal access to the ferry terminal.

Passenger Loading Zones

All three alternatives would provide designated bus boarding space along the curb fronting the terminal, based on proposed bus service needs. Alternative 3 would also accommodate microtransit loading activity in front of the terminal.

Passenger pickup/drop-off curb space would be expanded under all three alternatives to improve circulation and reduce vehicle queuing and conflicts within the terminal area. Passenger loading areas would be designed to be consistent with applicable local and District standards for curbside loading, transit vehicle access, and ADA accessibility, and would not introduce hazardous conditions.

Parking and Vehicle Circulation

The two Build Alternatives would include construction of new parking garages in the Main Lot and North Lot. The parking garages would be designed in accordance with applicable local and District standards.

Surface parking areas outside the Main Lot parking garage would generally maintain existing circulation patterns.

The alternatives would not substantially change overall vehicular circulation patterns within the terminal area. Access to the Main Lot and ferry terminal would continue to operate generally as it does today, using the existing terminal loop driveway and the Sir Francis Drake Boulevard/Larkspur Landing Circle West intersection. Access to the North Lot would continue to be provided from Larkspur Landing Circle West.

Under the Build Alternatives, the parking garages in the Main Lot and North Lot would not be gated. Users would pay after parking rather than at the entry, which would minimize the potential for vehicle queues at the garage entrances. The existing service lanes are expected to provide sufficient vehicle storage for entering traffic and would avoid queue spillback into through travel lanes.

Freeway Exit-Ramp Queuing

A focused queuing analysis was conducted for the US 101 southbound off-ramp at Sir Francis Drake Boulevard to determine whether Project-related traffic could cause queues to extend beyond the available ramp storage and spill back onto the US 101 mainline.

The Project is expected to increase vehicle queues on westbound Sir Franciso Drake Boulevard leading to the US 101 northbound on-ramp during the PM peak hour. However, vehicle queuing on local streets is generally an operational condition related to congestion and delay and does not, by itself, create a safety hazard. Therefore, this section focuses on off-ramp queuing where spillback onto the freeway mainline could create potential safety concern.

More than 70% of Project-related vehicle trips are projected to originate from areas north of the LFT. These trips would generally use the US 101 southbound off-ramp to reach Sir Franciso Drake Boulevard during the AM peak hour. As a result, all three alternatives would increase demand at the Sir Francis Drake Boulevard/US 101 southbound on- and off-ramp intersection.

A queuing analysis was conducted using Synchro Version 12 to evaluate future queue lengths at this intersection. The available storage length on the US 101 southbound off-ramp is approximately 1,150 feet. Although a free-flow right-turn lane is provided from the off-ramp to westbound Sir Francis Drake Boulevard, this movement is not controlled by the traffic signal and therefore does not contribute to queue lengths associated with signal operations at the intersection.

Table 5-3 includes the 95th percentile queue length at the US 101 southbound off-ramp during the AM peak hour. Under all 2035 scenarios, as well as the 2050 No-Project Alternative and Alternative 3, projected queues would remain within the available ramp storage and would not extend onto the freeway mainline. However, under the 2050 Build Alternatives scenarios, projected 95th percentile queue lengths are expected to exceed the available ramp storage and extend onto the US 101 mainline. Detailed Synchro queuing reports are included in Appendix B.

Table 5-3. 95th Percentile Queue Length (feet) at US 101 Southbound Off-Ramp During AM Peak

Year	Storage	No Project	Alternative 1	Alternative 2	Alternative 3
2035	1,150	715	783	762	718
2050		1,122	**1,521**	**1,416**	1,010

Note: **Bold** indicates exceeding the storage length.

The analysis indicates that 2050 Build Alternatives scenario could result in queue spillback from the US 101 off-ramp onto the US 101 mainline during the AM peak hour. While the reported queue results focus on the 95th percentile condition, the analysis indicates that spillback could also occur under the 50th-percentile queue condition, suggesting that mainline spillback could occur with some regularity during the peak period. The alternatives would contribute up to approximately 26% of the total queue (for example, 399 feet of the 1,521 feet queue under Alternative 1), spillback onto the freeway mainline could create a potential safety concern and therefore represents a significant impact.

The Project's contribution to the queue would be relatively small but could contribute to conditions in which the off-ramp queue extends onto the US 101 mainline. Improvements to address the queue are outside the District's jurisdiction and have not been defined. Potential improvements could include signal timing adjustments at the ramp terminal intersection, increased ramp storage, striping or geometric modifications, access management, active warning, or other operational strategies, subject to Caltrans approval. TAM's 2022 *Highway 101 Interchange & Approaching Roadway Study* evaluated improvements at this location; however, the improvement was not advanced to the Project Initiation Phase for future funding consideration. Therefore, the timing and feasibility of implementing any future improvements remain uncertain.

Because the Project would contribute to a condition in which queues could extend onto the US 101 mainline during the AM peak period, the potential safety effects cannot be fully avoided through improvement within the District's control. Therefore, the impact would be considered significant and unavoidable. Continued coordination with Caltrans and other applicable agencies is recommended to monitor operating conditions and identify feasible improvements through future regional or corridor planning efforts. No impact would occur until both phases of the Project are complete.

Impact Determination

The Project does not include sharp curves, unsafe intersection geometry, incompatible uses, or circulation changes that would create unusual transportation hazards. The proposed multimodal access and passenger loading improvements are intended to improve access to the terminal, reduce conflicts among travel modes, and enhance circulation within the Project site. In addition, final design would be required to comply with applicable local District standards, including standards related to access, internal circulation, pedestrian and bicycle facilities, passenger loading, parking layout, emergency access, and accessibility. Compliance with these standards would help ensure that Project design elements operate safely for motorists, pedestrians, bicyclists, transit riders, and ferry passengers. The US 101 southbound off-ramp queues at Sir Francis Drake Boulevard are expected to spill over to the freeway mainline during the AM peak hour under the two Build Alternatives. This impact is considered ***significant and unavoidable*** because no feasible improvement within the District's control has been identified to avoid this potential safety hazard.

5.1.4 Emergency Access

This section evaluates whether the Project would result in inadequate emergency access or otherwise interfere with emergency response to the Project site or surrounding roadway network.

Access to the Main Lot and ferry terminal area would continue to operate as it does today, using the existing terminal loop driveway and the Sir Francis Drake Boulevard/Larkspur Landing Circle West intersection. Access to the North Lot would continue to be provided from Larkspur Landing Circle West. Under the two Build Alternatives, the proposed parking garages would be designed to provide adequate emergency vehicle access in accordance with applicable fire and building code requirements, including

appropriate vehicle turning clearance and vertical clearances for emergency response vehicles. Emergency access through the North Lot parking garage to the SMART station and parking lot would also be maintained.

The Project would not result in roadway closures or modifications that would substantially affect emergency access routes serving the Project vicinity. Emergency response services are currently provided by Larkspur Fire Department Station 16 at 15 Barry Way in Greenbrae, the Central Marin Police Authority at 250 Doherty Drive in Larkspur, and Marin Health Medical Center at 250 Bon Air Road in Greenbrae. Emergency vehicles would continue to access the Project site from the surrounding roadway network, including US 101 and Sir Francis Drake Boulevard.

Although the Project would generate additional vehicle traffic associated with increased ferry ridership, it would not alter the surrounding roadway network, eliminate existing access points, or restrict emergency vehicle circulation in the Project vicinity. Emergency vehicles would continue to have multiple access routes available during emergency response conditions, and the final design would be reviewed for compliance with applicable emergency access requirements.

Therefore, the Project would not affect emergency vehicle access or emergency response times, and impacts related to emergency access would be ***less than significant***.

5.2 Construction Impacts

5.2.1 Consistency with Plans and Policies

Construction of the three alternatives would be subject to City of Larkspur requirements governing construction management, traffic control, and work within the public right-of-way. Before construction activities, the Project would be required to obtain an encroachment permit and applicable City approval of TCPs. The TCPs would comply with the latest California *Manual on Uniform Traffic Controls* and address traffic control devices, lane closures and tapers, work near intersections, pedestrian access, flagging, and other measures necessary to maintain safe and efficient circulation during construction. The City may also require a TMP to reduce traveler delays, address construction-related circulation, and maintain the safety of motorists, pedestrians, and bicyclists.

The Project's TMP/TCPs would be developed and implemented in accordance with applicable City requirements and guidance. With implementation of these requirements, construction of the Build Alternatives would not conflict with applicable local transportation plans, ordinances, or policies, and the impact would be ***less than significant***.

5.2.2 Vehicle Miles Traveled

Construction of the alternatives would generate temporary vehicle trips associated with construction workers, material deliveries, construction equipment, and haul activities. The amount of construction-related VMT would vary by construction phase and would be greatest during excavation, hauling, and delivery of construction materials. These trips would increase vehicle travel in the Project vicinity during construction but would cease once construction is complete.

Construction would also temporarily displace existing parking at the LFT, particularly during Main Lot construction. The resulting parking shortfall could affect how ferry passengers travel to the terminal. Potential responses could include arriving earlier to secure available parking, driving farther to find alternative parking, using nearby parking where permitted, using SMART or bus service, arranging

alternative parking or rides, or shifting some trips to telework. While some of these responses could increase vehicle travel, others could reduce vehicle travel by encouraging transit, carpooling, or telework.

Overall, the increase in VMT associated with construction activities and temporary parking displacement is expected to be limited in magnitude and temporary. These changes would not substantially affect the Project's long-term VMT. Therefore, the construction-related VMT impact would be ***less than significant***.

5.2.3 Design Hazards

Construction of the alternatives would temporarily alter vehicle, pedestrian, and bicycle circulation within and around the LFT, which could result in temporary conflicts between construction activities and other roadway users.

A qualified traffic engineer would develop a TMP and TCPs during final design to establish measures to safely guide vehicles, pedestrians, and bicyclists through or around work areas, protect construction workers, maintain circulation, and minimize construction-related conflicts and delays. The TMP would include public and motorist information strategies, incident management, construction strategies, demand management, and alternate-route strategies. Depending on the final construction plans and schedule, the TMP could also establish restrictions on construction truck hauling and material deliveries during peak travel periods or identify alternative construction methods that reduce the need for hauling or deliveries. The TCPs would identify specific traffic control measures, such as temporary closures, detours, signage, and channelization, to safely manage circulation during construction. The TMP/TCPs would be subject to review and approval by applicable agencies and incorporated into the Project's construction plans and specifications.

With implementation of the approved TMP/TCPs, construction activities would be managed to minimize potential conflicts and maintain safe circulation for vehicles, pedestrians, bicyclists, transit users, and emergency responders. Therefore, construction of the alternatives would not substantially increase transportation hazards, and the impact would be ***less than significant***.

5.2.4 Emergency Access

Emergency responders, including police, fire, and ambulance services, would be notified in advance of any construction activities requiring full or partial roadway closures. Emergency access routes and any necessary detours would be coordinated with emergency responders as part of the construction planning process. Temporary barricades, cones, and other traffic control devices that can be readily removed would be used to maintain emergency access during temporary roadway closures. With these measures, construction activities would not result in inadequate emergency access, and the impact would be ***less than significant***.

6. Traffic Operations Analysis

This section evaluates the Project's effects on the roadway operations, consistent with the City of Larkspur's General Plan Policy CIR-3.2 (City of Larkspur 2024).

6.1 Approach and Methodology

The City of Larkspur maintains a LOS standard of LOS D for signalized and unsignalized intersections. The City also recognizes that certain intersections currently operate at LOS E or F and that physical alterations to improve operations at those intersections may not be feasible or desirable due to potential community impacts. These intersections include the following:

- East Sir Francis Drake Boulevard/Larkspur Landing West
- Sir Francis Drake Boulevard/Eliseo Drive
- Sir Francis Drake Boulevard/Bon Air Road

The study intersections were selected in coordination with the City of Larkspur and the District based on the understanding of the Project's anticipated trip distribution and assignment. The following seven study intersections were analyzed, including three intersections under the City of Larkspur jurisdiction, two US 101 ramp intersections under Caltrans jurisdiction, and two intersections managed by County of Marin. All seven intersections are signalized except for the Larkspur Landing Circle/Victoria Way, which is sidestreet stop controlled on Victoria Way.

- Sir Francis Drake Boulevard/Bon Air Road (County)
- Sir Francis Drake Boulevard/Eliseo Drive / Barry Way (County)
- Sir Francis Drake Boulevard/US 101 Southbound On/Off-ramps (Caltrans)
- East Sir Francis Drake Boulevard/US 101 Northbound On/Off-ramps (Caltrans)
- East Sir Frais Drake Boulevard/Larkspur Landing Circle West (City)
- East Sir Francis Drake Boulevard/Larkspur Landing Circle East (City)
- Larkspur Landing Circle/Victoria Way (City)

Traffic operations were evaluated using the Highway Capacity Manual (HCM), implemented through Synchro Version 12 traffic analysis software. The analysis applies HCM 7th Edition methodology where available and HCM 2000 methodology where required based on intersection configurations or signal control (TRB 2022).

The HCM methodology evaluates the capacity and delay characteristics of each directional approach and calculates LOS based on average control delay per vehicle. For signalized intersections, LOS is reported for the overall intersection. For the sidestreet stop-controlled intersection, LOS is reported for the stop-controlled approach, consistent with HCM guidance because delay is primarily experienced by vehicles on the minor street while major-street through traffic generally operates without control.

While Synchro provides a standard methodology for evaluating intersection operations, it generally evaluates isolated intersection performance and may not fully capture the effects of congestion, queue spillback, or constrained freeway ramp operations. To better reflect observed congestion along US 101 and potential queue spillback from freeway ramps onto the local roadway network, reduced ideal saturation flow rates were applied at the US 101 ramp intersections and the Eliseo Drive intersection, as appropriate.

LOS ranges from A, which indicates free flow or excellent conditions with minimal delay, to LOS F, which indicates congested or oversaturated conditions with substantial delay. Table 6-1 summarizes the LOS thresholds used in the analysis.

Table 6-1. Intersection Levels of Service and Delay Thresholds

LOS	Seconds of Delay per Vehicle	
	Signalized Intersection	Unsignalized Intersection
A	≤ 10	≤ 10
B	10 to 20	10 to 15
C	20 to 35	15 to 25
D	35 to 55	25 to 35
E	55 to 80	35 to 50
F	>80	>50

6.2 Analysis Scenario

The Project's effects on roadway operations were evaluated under the following scenarios:

- Existing Conditions
- Year 2035 Baseline Conditions (No Project)
- Year 2035 Baseline plus Project alternatives
- Year 2050 Baseline Conditions (No Project)
- Year 2050 Baseline plus Project alternatives

Existing Conditions are based on the counts collected on Tuesday October 28, 2025, and Wednesday, October 29, 2025, during the AM peak period from 7 AM to 9 AM and the PM peak period from 4 PM to 6 PM. Future traffic volumes were developed using the TAM travel demand model. Year 2050 conditions were based on traffic volume changes between the 2022 and 2050 TAM models. Year 2035 conditions were interpolated between existing conditions and Year 2050 conditions.

The 2050 TAM model incorporates anticipated regional housing, population, and employment growth, as well as reasonably foreseeable transportation network improvements. The following assumptions are directly related to the Project and traffic conditions in the Project vicinity:

- Population growth in North Bay between 2022 and 2050, including more than 8,000 new residents in the Larkspur, Corte Madera, and Greenbrae areas; more than 2,500 new residents in the Kentfield, San Anselmo, and Fairfax areas; more than 7,000 new residents in Downtown San Rafael and the North San Rafael Town Center area; and more than 23,000 new residents in cities farther north, including Novato, Petaluma, Rohnert Park, and Santa Rosa
- Employment growth of over 315,000 jobs in San Francisco between 2022 and 2050
- Transportation infrastructure improvements, including the US 101/I-580 Multimodal and Local Access Improvement Project, which is expected to reduce traffic congestion along westbound East Sir Francis Drake Boulevard approaching southbound US 101
- Increased Larkspur ferry service, with 15-minute peak-period headways; the TAM model assumes no parking constraint at the LFT

Traffic volume differences between the 2022 and 2050 TAM model scenarios were applied to the Existing Conditions turning movement counts to develop Year 2050 traffic volumes. Because the 2050 TAM model assumes unconstrained ferry parking supply and increased ferry service levels consistent with Alternative 1, the resulting traffic volumes are considered to represent the Year 2050 Baseline plus Alternative 1 scenario, rather than Year 2050 Baseline (No-Project) Condition.

For access points serving the ferry terminal (including Main Lot), Project-specific vehicle trips developed in Section 4 were used for associated turning movements at the East Sir Francis Drake Boulevard/Larkspur Landing Circle West intersection. North Lot-related vehicle trips were also added to the East Sir Francis Drake Boulevard/Larkspur Landing Circle West intersection and the Larkspur Landing Circle West/Victoria Way intersection.

For the Year 2050 Baseline Conditions and Year 2050 Baseline plus Project scenarios under Alternatives 2 and 3, differences in Project vehicle trips relative to Alternative 1 were applied to the corresponding Year 2050 traffic volumes. A similar methodology was used for Year 2035 conditions, with 2035 traffic volumes interpolated between Existing Conditions and Year 2050 traffic volumes.

No geometric changes are assumed at the study intersections for the traffic operations analysis. Signal timing splits were optimized for future-year conditions.

Figure 6-1 illustrates the existing lane configurations at the study intersections.

Figure 6-2,

Figure 6-3, and

Figure 6-4 show AM and PM peak-hour vehicle turning movement volumes for existing conditions, 2035 baseline conditions, and 2050 baseline conditions, respectively. Intersection turning movement counts are provided in Appendix A.

6.3 Existing Intersection Operations

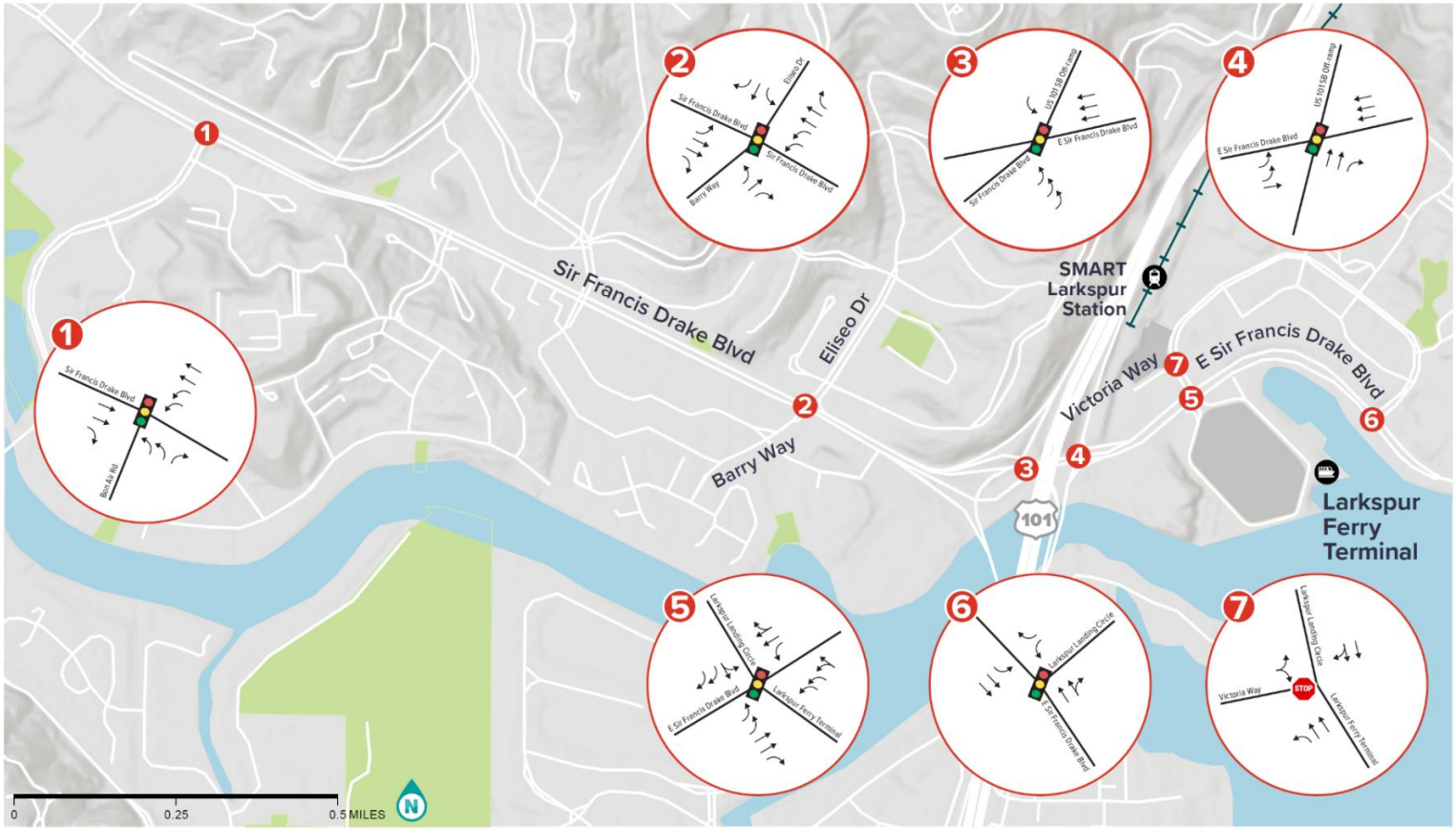
Intersection LOS was evaluated for the highest-volume 60-minute period observed during each count period. Table 6-2 summarizes the existing LOS and average delay results for the study intersections during the AM and PM peak hours. It shows that all study intersections currently operate at LOS D or better during both the AM and PM peak hours. Some individual movements may experience longer delays and LOS E or F, but overall intersection operations remain at LOS D or better at all study intersections under Existing Conditions. Detailed LOS calculation worksheets are provided in Appendix C.

Table 6-2. Peak Hour Intersections Levels of Service Results – Existing Conditions

No	Intersection	Control Type	LOS (Delay)[a]	
			AM Peak	PM Peak
1	Sir Francis Drake Boulevard/Bon Air Road	Signal	C (29.2)	C (32.5)
2	Sir Francis Drake Boulevard/Eliseo Drive	Signal	D (45.5)	D (39.1)
3	Sir Francis Drake Boulevard/US 101 Southbound Ramps	Signal	D (50.3)	B (18.3)
4	East Sir Francis Drake Boulevard/US 101 Northbound Ramps	Signal	D (41.6)	C (29.8)
5	East Sir Francis Drake Boulevard/Larkspur Landing Circle West	Signal	C (33.4)	D (52.6)
6	East Sir Francis Drake Boulevard/Larkspur Landing Circle East	Signal	A (7.1)	A (4.9)

No	Intersection	Control Type	LOS (Delay)[a]	
			AM Peak	PM Peak
7	Larkspur Landing Circle/Victoria Way	SSSC	A (9.9)	A (9.6)

[a] Delay = Average control delay in seconds per vehicle
SSSC = Side Street Stop Controlled



PROJECT
LANE CONFIGURATION

LARKSPUR FERRY
SERVICE EXPANSION
AND PARKING STUDY

alta

LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

Figure 6-1. Lane Configuration

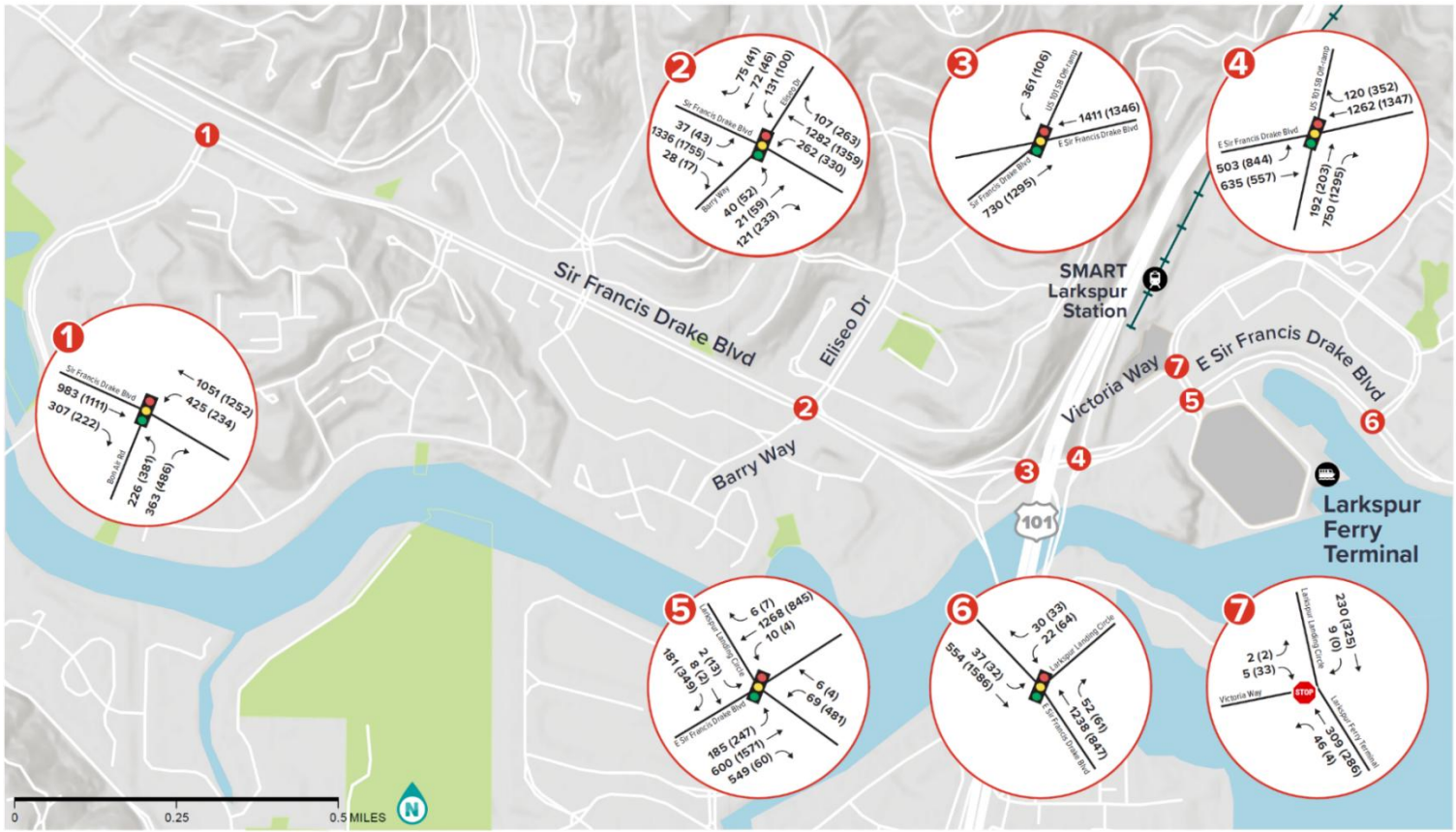
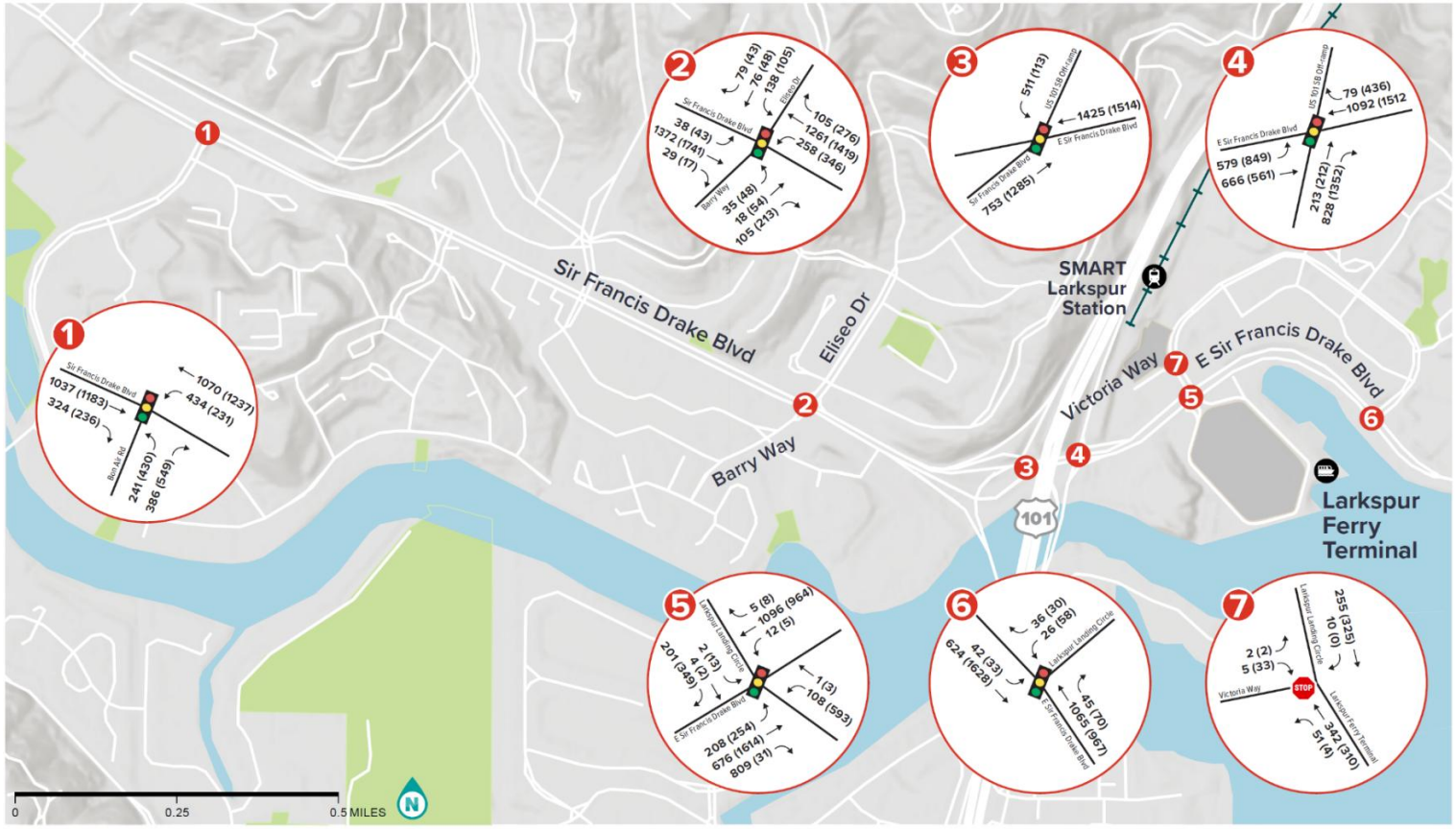


Figure 6-2. Existing Traffic Volumes



TRAFFIC VOLUMES
2035 BASELINE

LARKSPUR FERRY SERVICE EXPANSION AND PARKING STUDY

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LEGEND

- Ferry Terminal
- Train Station
- Train Track
- Roadway
- Parking Lot

TRAFFIC VOLUME

123 (123) AM Peak (PM Peak)

Figure 6-3. 2035 Baseline Traffic Volumes

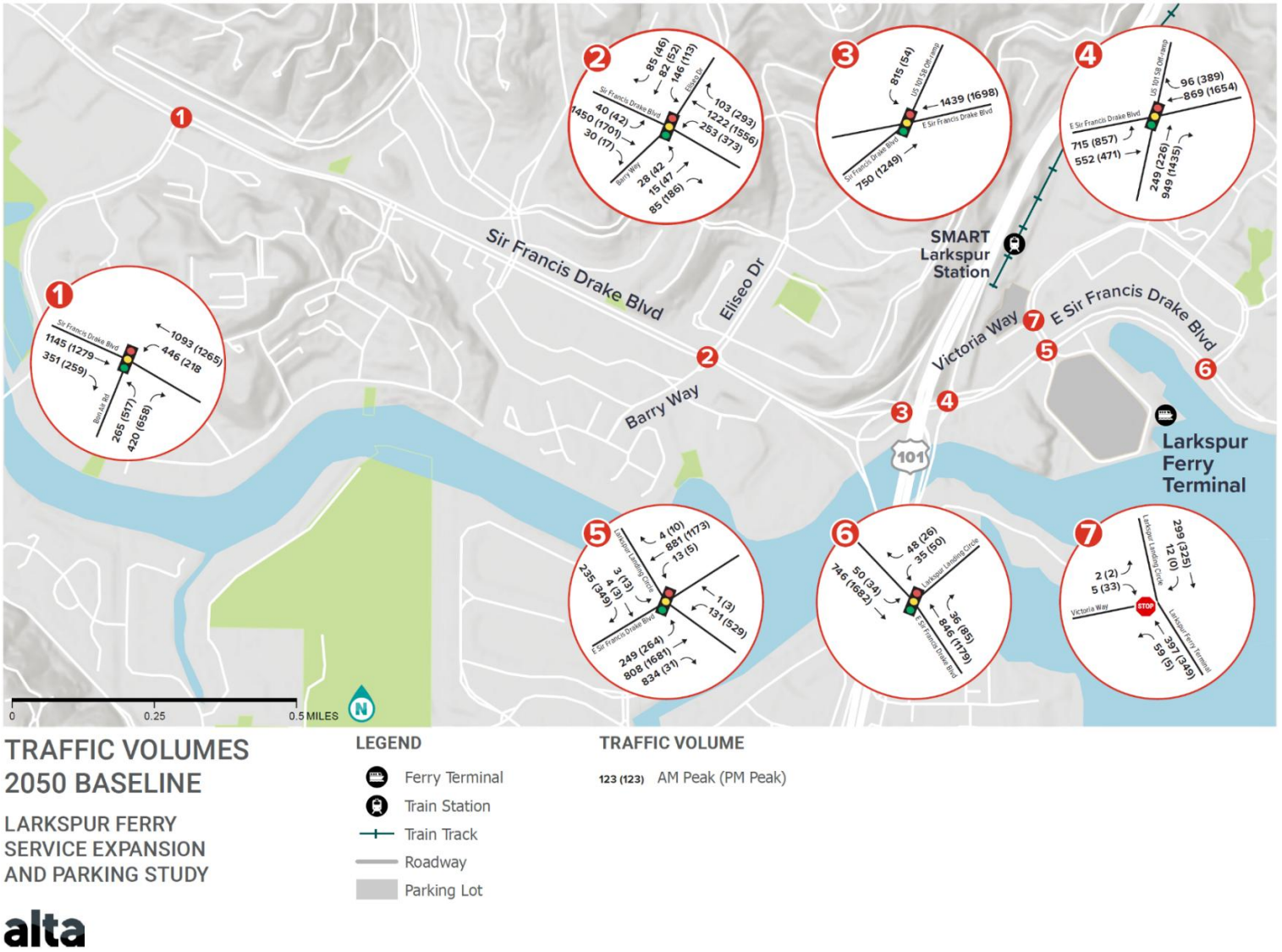


Figure 6-4. 2050 Baseline Traffic Volumes

6.4 Year 2035 Intersection Operations

Table 6-3 and Figure 6-5 and

Figure 6-6 summarize the LOS and delay results for 2035 Baseline Conditions and 2035 plus Project alternatives. It shows that most of the study intersections would operate at LOS D or better during both the AM and PM peak hours, except for the following:

- The Sir Francis Drake Boulevard/US 101 Southbound On/Off-ramps intersection would operate at LOS E under the No-Project Alternative and Alternative 3, and at LOS F under Alternatives 1 and 2 during the AM peak hour. It would also operate at LOS E under Alternatives 1 and 2 during the PM peak hour.

Detailed LOS calculation worksheets are provided in Appendix C.

Table 6-3. Peak Hour Intersections Levels of Service Results – Year 2035 Conditions

No	Intersection	Peak Hour	No Project	Alternative 1	Alternative 2	Alternative 3
1	Sir Francis Drake Boulevard/Bon Air Road	AM	C (31.2)	C (31.3)	C (31.2)	C (32.9)
		PM	D (38.4)	D (37.6)	D (37.6)	D (45)
2	Sir Francis Drake Boulevard/Eliseo Drive/Barry Way	AM	D (46.4)	D (46.5)	D (45.9)	D (39.9)
		PM	D (39.2)	D (39.3)	D (39.2)	D (45.8)
3	Sir Francis Drake Boulevard/US 101 Southbound On/Off-ramps	AM	E (74.8)	F (85.2)	F (78.3)	E (73.1)
		PM	D (47.4)	E (62.4)	E (62.4)	E (63.2)
4	East Sir Francis Drake Boulevard/US 101 Northbound On/Off-ramps	AM	D (37.8)	D (37.5)	C (30.5)	C (34.5)
		PM	C (25.7)	C (25.4)	C (25.3)	C (25.1)
5	East Sir Francis Drake Boulevard/Larkspur Landing Circle West	AM	C (26.2)	C (33.8)	C (29.7)	C (26.1)
		PM	C (34)	D (49.9)	D (47.9)	D (45.6)
6	East Sir Francis Drake Boulevard/Larkspur Landing Circle East	AM	A (7)	A (7)	A (7)	A (7)
		PM	A (4.9)	A (4.8)	A (4.9)	A (4.9)
7	Larkspur Landing Circle Victoria Way	AM	B (10.2)	B (10.3)	B (10.3)	B (10.2)
		PM	A (9.6)	A (9.8)	A (9.8)	A (9.8)

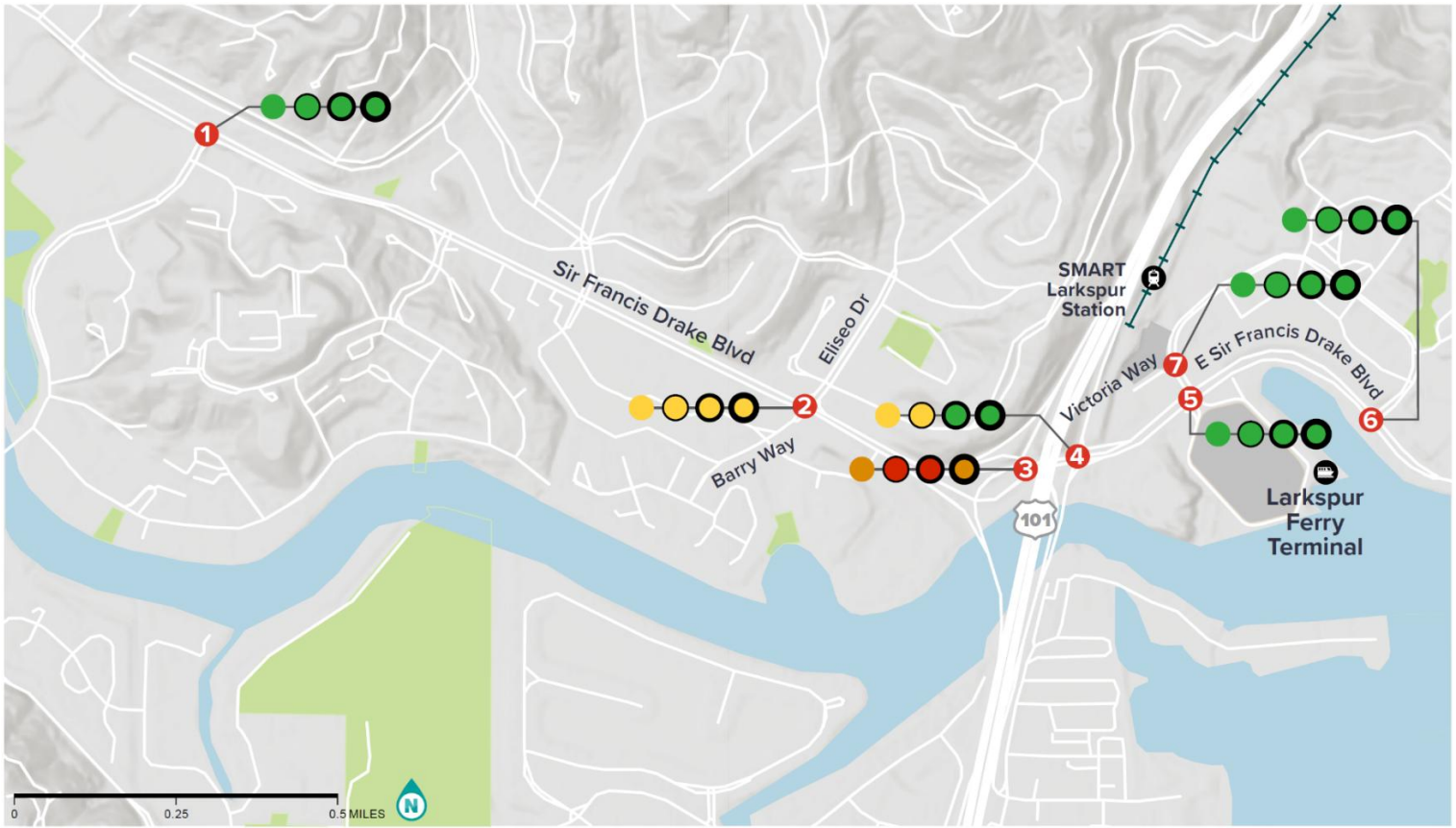


Figure 6-5. 2035 Level of Service Results – AM Peak

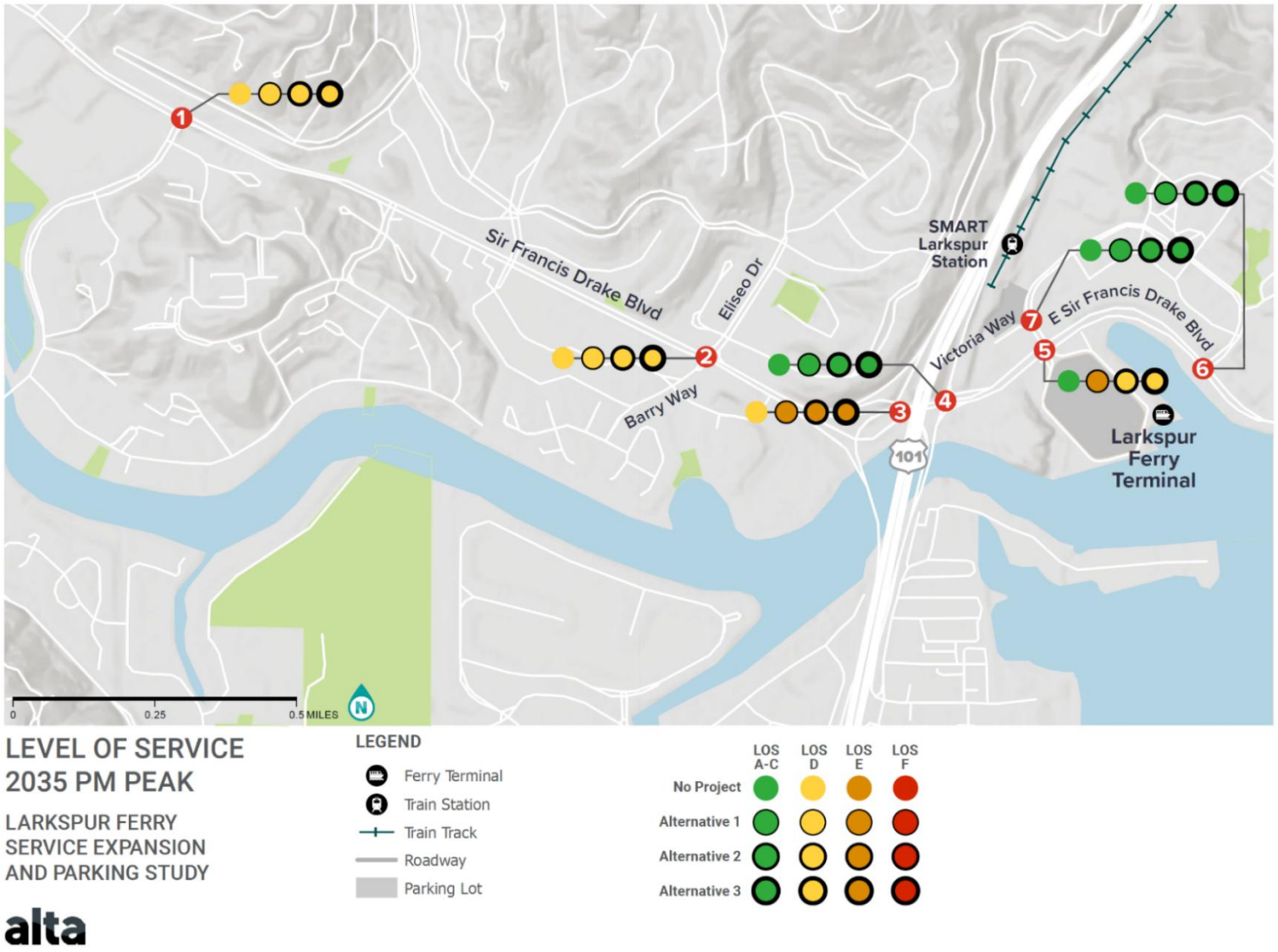


Figure 6-6. 2035 Level of Service Results – PM Peak

6.5 Year 2050 Intersection Operations

Table 6-4 and Figure 6-7 and

Figure 6-8 summarize the LOS and delay results for 2050 Baseline Conditions and 2050 plus Project alternatives. It shows that the majority of the study intersections would operate at LOS D or better during both the AM and PM peak hours, except for the following:

- The Sir Francis Drake Boulevard/US 101 Southbound On/Off-ramps intersection would operate at LOS F under No Project and all Build Alternatives during the AM peak hour
- The East Sir Francis Drake Boulevard/US 101 Northbound On/Off-ramps intersection would operate at LOS E under Alternative 1 during the AM peak hour
- The East Sir Francis Drake Boulevard/Larkspur Landing Circle East intersection would operate at LOS F under Alternative 1 and at LOS E under Alternative 2 during the PM peak hour

Detailed LOS calculation worksheets are provided in Appendix C.

Table 6-4. Peak Hour Intersections Level of Service Results – Year 2050 Conditions

No	Intersection	Peak Hour	No Project	Alternative 1	Alternative 2	Alternative 3
1	Sir Francis Drake Boulevard/Bon Air Road	AM	C (33.1)	C (33.4)	C (33.2)	C (32.9)
		PM	D (44.3)	D (45.2)	D (45)	D (45)
2	Sir Francis Drake Boulevard/Eliseo Drive/Barry Way	AM	D (48.4)	D (47.8)	D (47.2)	D (39.9)
		PM	D (44)	D (52.8)	D (46.2)	D (45.8)
3	Sir Francis Drake Boulevard/US 101 Southbound On/Off-ramps	AM	F (153.8)	F (222.8)	F (210.5)	F (137.5)
		PM	D (35.2)	D (52)	D (47.3)	D (52.6)
4	East Sir Francis Drake Boulevard/US 101 Northbound On/Off-Ramps	AM	D (45.6)	E (57.3)	D (53.3)	D (46.8)
		PM	D (35.5)	D (40.7)	D (37.1)	C (34.1)
5	East Sir Francis Drake Boulevard/Larkspur Landing Circle West	AM	C (30.8)	D (49.5)	D (43.8)	C (33.5)
		PM	D (36.2)	F (81.8)	E (72.4)	D (51.9)
6	East Sir Francis Drake Boulevard/Larkspur Landing Circle East	AM	A (7)	A (7)	A (7)	A (7)
		PM	A (5)	A (4.9)	A (5)	A (5)
7	Larkspur Landing Circle/Victoria Way	AM	B (10.7)	B (10.9)	B (10.9)	B (10.7)
		PM	A (9.6)	B (10.1)	B (10.1)	B (9.6)

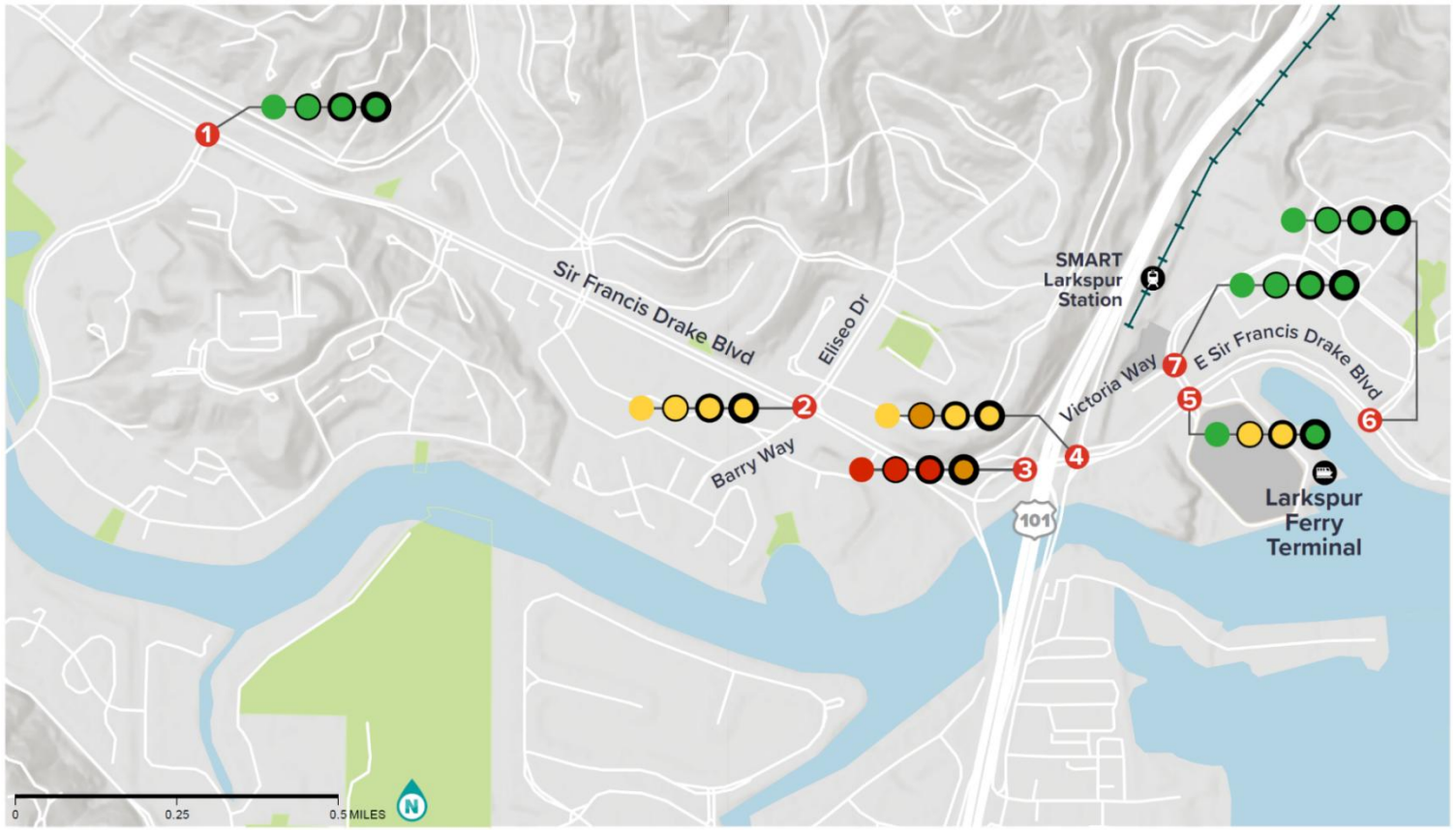


Figure 6-7. 2050 Level of Service Results – AM Peak

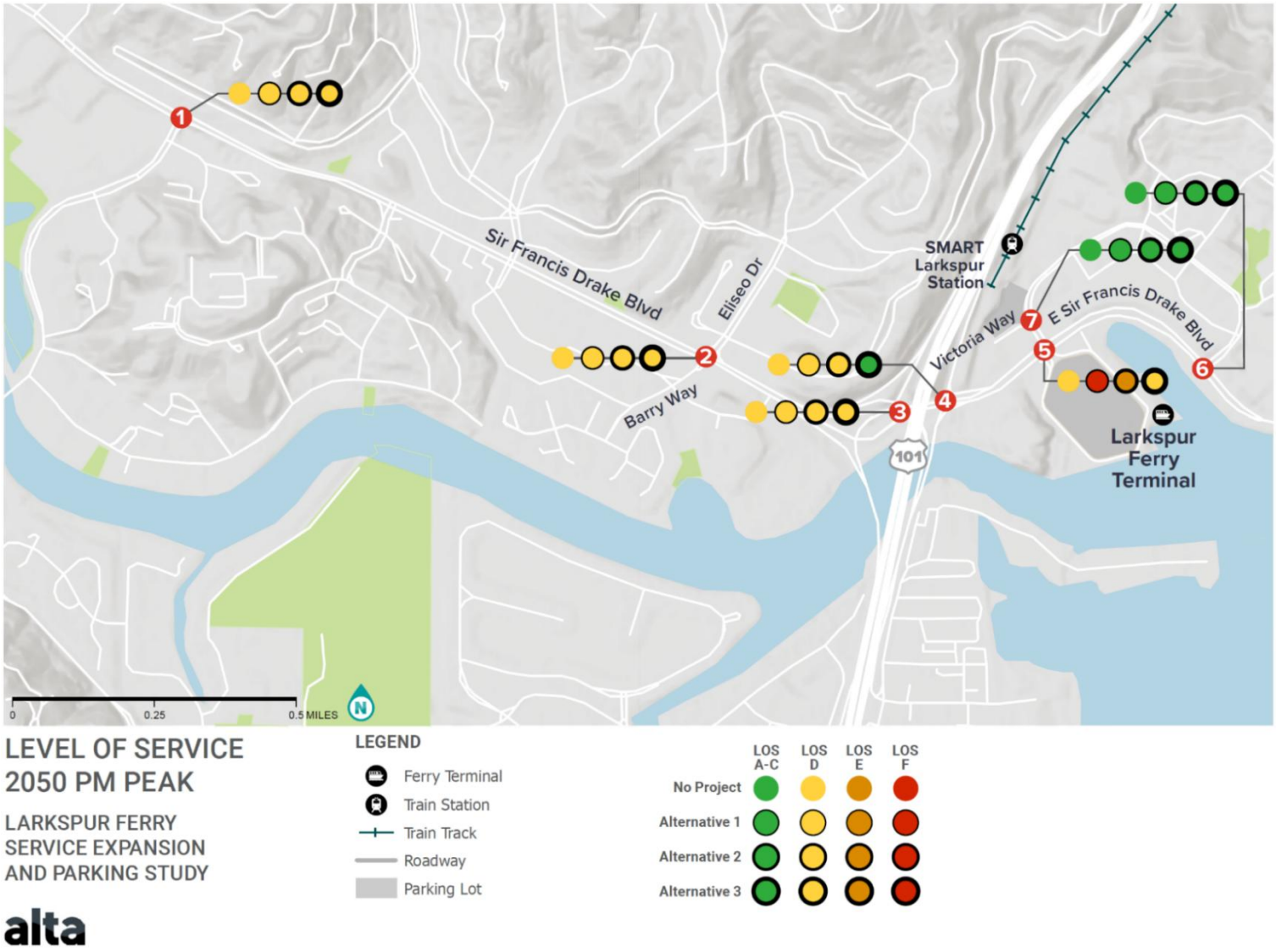


Figure 6-8. 2050 Level of Service Results – PM Peak

7. References

California Department of Transportation (Caltrans). 2024. *Local Development Review (LDR) Safety Review Practitioner's Guide*. February. Available: https://dot.ca.gov/-/media/dot-media/programs/safety-programs/documents/202402-ldr-safety-review-practitioners-guidance-a11y.pdf.

———. n.d. Caltrans Performance Measurement System. Accessed May 2026. Available: https://pems.dot.ca.gov/.

City of Larkspur. 2017. *City of Larkspur Bicycle and Pedestrian Master Plan.* February 23, 2017. Available: https://www.tam.ca.gov/wp-content/uploads/2017/08/Larkspur-Bike-Ped-Master-Plan-2017.pdf.

———. 2024. *City of Larkspur 2040 General Plan*. September 4. Available: https://cityoflarkspur.org/DocumentCenter/View/20545/2040-General-Plan-Adopted.

Metropolitan Transportation Commission (MTC). 2026. "SMART Celebrates Project Extending Service to Healdsburg." May 8. Available: https://mtc.ca.gov/news/smart-celebrates-project-extending-service-healdsburg.

Metropolitan Transportation Commission (MTC) and Association of Bay Area Governments (ABAG). 2026. *Plan Bay Area 2050+*. Available: https://planbayarea.org/sites/default/files/documents/Final_Plan_Bay_Area_2050_Plus_0.pdf?cb=c85e41cb.

———. 2026. Transit-Oriented Communities (TOC) Policy. July 10. Available: https://mtc.ca.gov/planning/land-use/transit-oriented-communities-toc-policy.

Office of Land Use and Climate Innovation (LCI). 2018. *Technical Advisory on Evaluating Transportation Impacts in CEQA.* December 1. Available: https://mtc.ca.gov/sites/default/files/20190122-743_Technical_Advisory.pdf?cb=2a6007b7.

Sonoma–Marin Area Rail Transmit (SMART). 2026. Marin–Sonoma Coordinated Transit Service (MASCOTS) Plan. Accessed May 2026. Available: https://www.sonomamarintrain.org/mascots.

Transportation Authority of Marin (TAM). 2017. *Getting Around Marin – Strategic Vision Plan*. Draft. Available: https://www.tam.ca.gov/wp-content/uploads/2017/07/TAM-SVP-GettingAroundMarin_072617.pdf.

———. 2022. *Highway 101 Interchange & Approaching Roadway Study*. Available: https://www.tam.ca.gov/wp-content/uploads/2025/10/TAM_Hwy101_Implementation-Plan_Final_20220804_red_compressed.pdf.

———. 2024. *Marin Countywide Transportation Plan 2050*. December. Available: https://www.tam.ca.gov/wp-content/uploads/2025/03/Final_CTP_Report_20250305.pdf.

———. 2026. *Marin County Mobility Hub Plan*. May. Available: https://www.tam.ca.gov/wp-content/uploads/2026/05/2026-05-01-Marin-County-Mobility-Hub-Plan_Final-Report_With-Appendices-optimized.pdf.

Transportation Research Board (TRB). 2022. *Highway Capacity Manual 7th Edition*.

U.S. Department of Justice. 2010. 2010 *ADA Standards for Accessible Design*.