CITY OF REDDING
Development Services Planning Division
777 Cypress Avenue, Redding, CA 96001
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Phone: 530-225-4022
cityofredding.gov

MITIGATED NEGATIVE DECLARATION

Permit No. S-2023-00803 and PD-2025-00483
State Clearinghouse No. ____________

SUBJECT

The Cottages at Bel Air Subdivision and Planned Development

PROJECT DESCRIPTION

Subdivision Map Application S-2023-00803 and Planned Development Application P-2025-00483, submitted by Cottages at Bel Air, LLC, proposes to subdivide approximately 24.5 acres into 55 single family residential lots as well as roadways and other infrastructure. Residential lot sizes are approximately 4,500 square feet. The project proposes a density of 6.3 units per net developable acre.

The subdivision proposal consists of three neighborhoods: Neighborhoods “B” and “C” propose to take direct access off of Quartz Hill Road, and Neighborhood “A” proposes to take access off of Stone Canyon Drive. Off-site improvements include a meandering sidewalk along Quartz Hill Road and an enhanced pedestrian crossing at the east leg of Stone Canyon Drive. The storm drain system will be connecting to Dix Creek by constructing a new storm drain system within the development as well as tying in the existing storm drain system that was constructed with the Bel Air Subdivision.

ENVIRONMENTAL SETTING

The property site is located on a series of ridges adjacent to Quartz Hill Road and above the historical Sacramento River floodplain (i.e., pre-Shasta Dam). Single-family residential subdivisions – River Ridge Park Subdivision, Bel-Air Estates, River Park Highlands, and Lake Redding Estates Subdivision – lie immediately to the west, east, and south, respectively. These subdivisions are built out with single-family homes and have similar lot sizes. To the north across Quartz Hill Road lies The Vistas Subdivision. Open spaces associated with the surrounding subdivisions consist of slopes in excess of 20 percent, with vegetation cover dominated by blue oak, grey pine, and manzanita.

FINDINGS AND DETERMINATION

The City of Redding conducted an Initial Study (attached), which determined that the proposed project could have significant environmental effects. Subsequent revisions in the project proposal create the specific mitigation measures identified below. The project, as revised and as agreed to by the applicant, avoids or mitigates the potentially significant environmental effects identified, and the preparation of an environmental impact report will not be required. There is no substantial evidence, in light of the whole record before the City, that the project as revised may have a significant effect on the environment. If there are substantial changes that alter the character or impacts of the proposed project, another environmental impact determination will be necessary.

The project includes measures to mitigate potentially significant impacts of development on biological resources.

Prior to approval of the project, the lead agency may conclude, at a public hearing, that certain mitigation measures identified in the Mitigated Negative Declaration are infeasible or undesirable. In accordance with CEQA Section 15074.1, the lead agency may delete those mitigation measures and substitute other measures which it determines are equivalent or more effective. The lead agency would adopt written findings that the new measure is equivalent or more effective in mitigating or avoiding potential significant effects and that it, in itself, would not cause any potentially significant effect on the environment.

1. **Based on the whole record (including the Initial Study and any supporting documentation) and the mitigation measures incorporated into the project, the City of Redding has determined that a Mitigated Negative Declaration is appropriate. All potentially significant impacts would be reduced to less than significant.**

2. **The Mitigated Negative Declaration, with its supporting documentation, fully incorporated herein, reflects the independent judgment and analysis of the lead agency, which is the City of Redding.**

DOCUMENTATION

The attached Initial Study documents the reasons to support the above determination.

MITIGATION MEASURES

M Bio-1. If vegetation removal or construction activities will occur during the nesting season for migratory birds or raptors (February 1 through August 31), a qualified biologist shall conduct a preconstruction survey seven days before construction activities begin. If nesting birds or raptors are found, CDFW will be notified and consulted. An appropriate buffer, as determined by CDFW and the qualified biologist, will be placed around the nest until the young have fledged. If construction activities cease for a period greater than seven days, additional preconstruction surveys will be required.

MM-Bio-2. If construction (including the removal of large trees) occurs during the bat non-volant season (March 1 through August 31), a qualified professional shall conduct a pre-construction survey of the study area to locate maternity colonies and identify measures to protect colonies from disturbance. The preconstruction survey will be performed no more than seven days prior to the implementation of construction activities. If a maternity colony is located within the study area, or adjacent to the study area, a disturbance free buffer shall be established by a qualified professional, in consultation with CDFW, to ensure the colony is protected from project activities.

MM-Bio-3. Any impacts to the detention basin identified in the biological report or drainages on the project site shall have a pre-construction rare plant survey for the Red Bluff dwarf rush conducted by a qualified botanist during the appropriate survey window (blooming period) for rare plants that have the potential to occur within the project site, as deemed appropriate by the California Department of Fish and Wildlife. Any required survey shall be in accordance with California Native Plant Society *Botanical Survey Guidelines* (CNPS 2001), California Department of Fish and Wildlife *Protocols for Surveying and Evaluating Impacts to Special Status Plant Species Native Plant Populations and Natural Communities* (CDFW 2009), and U.S. Fish and Wildlife's *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 2000). If present, special status plant species plant populations will be flagged and, if possible, avoided during construction. If the population cannot be avoided during construction, a mitigation plan which could include transplanting the plant population or compensation will be developed for approval by the California Department of Fish and Wildlife.

PUBLIC REVIEW DISTRIBUTION

Draft copies or notice of this Mitigated Negative Declaration were distributed to:

- State Clearinghouse
- Shasta County Clerk
- U.S. Army Corp of Engineers, Redding
- California Department of Fish and Wildlife, Redding
- Central Valley Regional Water Quality Control Board, Redding
- California Native Plant Society, Shasta County
- Shasta Environmental Alliance
- All property owners within 300 feet of the property boundary
- Applicant
- Property Owner
- Representative

PUBLIC REVIEW

(X) Draft document referred for comments

( ) No comments were received during the public review period.

( ) Comments were received but did not address the draft Mitigated Negative Declaration findings or the accuracy/completeness of the Initial Study. No response is necessary. The letters are attached.

( ) Comments addressing the findings of the draft Mitigated Negative Declaration and/or accuracy or completeness of the Initial Study were received during the public review period. The letters and responses follow (see Response to Comments, attached).

Copies of the Mitigated Negative Declaration, the Initial Study, documentation materials, and the Mitigation Monitoring Program may be obtained at the Planning Division of the Development Services Department, City of Redding, 777 Cypress Avenue, Redding, CA 96001 and online on the Planning/Projects page of the Development Services website at: www.cityofredding.gov. Contact: Drew Morgan, Assistant Planner at (530) 255-4407.

Lily Toy, Planning Manager

April 10, 2025

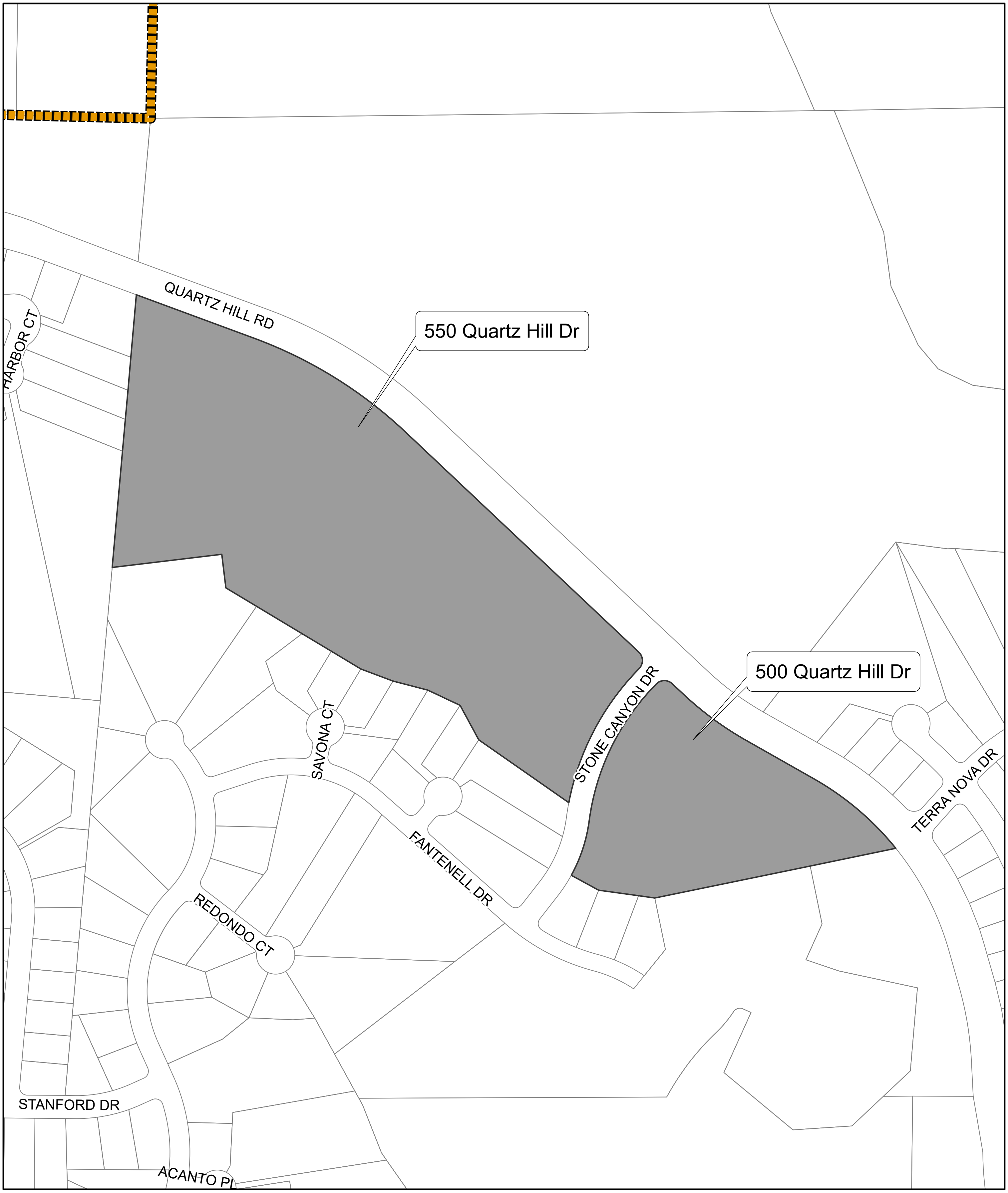
Date

April 9, 2025

Date of Final Report

Attachments:

A. Location map
B. Initial Study
C. Mitigation Monitoring Program



N W E S	**GIS DIVISION** INFORMATION TECHNOLOGY DEPARTMENT	**LOCATION MAP**	MTG. DATE:
	DATE PRODUCED: JUNE 7, 2023	S-2023-00803 COTTAGES AT BELL AIR, LLC 500 & 550 QUARTZ HILL DR AP# 113-190-020 & -019	ITEM:
	0 200 400 Feet		ATTACHMENT:
P:\Planning\ProProjects\S\S-2023-00803.aprx			

ENVIRONMENTAL INITIAL STUDY

INITIAL STUDY CHECKLIST

References and Documentation

The Cottages at Bel Air Subdivision and Planned Development
Tentative Subdivision Map Application S-2023-00803
Planned Development Application PD-2025-00483

Prepared by:
CITY OF REDDING
Development Services Department
Planning Division
777 Cypress Avenue
Redding, California 96001

April 9, 2025

CITY OF REDDING
ENVIRONMENTAL CHECKLIST FORM

1. **Project Title:**

   The Cottages at Bel Air Subdivision and Planned Development
   Tentative Subdivision Map Application S-2023-00803 and Planned Development Application PD-2025-00483

2. **Lead agency name and address**:

   City of Redding
   Development Services Department, Planning Division
   777 Cypress Avenue
   Redding, CA 96001

3. **Contact Person and Phone Number:** Drew Morgan, Assistant Planner, (530) 225-4407

4. **Project Location:** Portions of Assessor's Parcel No. 113-190-019 and 113-190-020

5. **Applicant's Name and Address:**

   Cottages at Bel Air, LLC
   2040 Trefoil Road
   San Ramon CA, 94582

   Representative's Name and Address:

   Sharrah Dunlap Sawyer, Inc.
   320 Hartnell Avenue
   Redding CA 96002

6. **General Plan Designation:** Residential, 6 to 10 units per acre

7. **Zoning:** RM-9-PD

8. **Description of Project:** The Project applicant is requesting approval of the tentative map to divide 24.5 acres to create 55 single-family residential lots. The developable area of the subdivision consists of 11.6 acres, divided between three neighborhoods, the majority of which is proposed to be cleared and graded (cut and/or fill) to create the streets and lots. The remaining 12.9 acres is to be placed in open space. The typical lot size is 4,570 square feet, with a typical lot width of 50 feet and depth of 90 feet. The streets, central landscape islands, and open-space areas within the subdivision will be private and maintained by a homeowners association. The Project area is located adjacent to Quartz Hill Road and is the designated remainder parcel on the tentative map for Bel Air Estates Subdivision, Units 1 and 2, approved by the City in April 2003. Access to Neighborhood "A" will be provided from Stone Canyon Drive. Neighborhoods "B" and "C" will take access directly from Quartz Hill Road. Off-site improvements necessary to serve the subject project, such as improvements to Quartz Hill Road, extension of sanitary sewer service, and provision of storm-water detention, have previously been evaluated in the Negative Declaration approved for Bel Air Estates Subdivision Units 1 and 2.

9. **Surrounding Land Uses and Setting:** The property site is located on a series of ridges adjacent to Quartz Hill Road and above the historical Sacramento River floodplain (i.e., pre-Shasta Dam). Single-family residential subdivisions – River Ridge Park Subdivision and Bel-Air Estates, River Park Highlands, and Lake Redding Estates Subdivision – lie immediately to the west, east, and south, respectively. These subdivisions are built out with single-family homes and have similar lot sizes. To the north across Quartz Hill Road lies The Vistas Subdivision. Open spaces associated with the surrounding subdivisions of the developed area of the proposed lots consist of slopes in excess of 20 percent, with vegetation cover dominated by blue oak, grey pine, and manzanita.

10. **Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement):** The Project must obtain a General Construction Stormwater Permit and prepare a Stormwater Pollution Prevention Plan in accordance with the requirements of the California Regional Water Quality Board (RWQCB). The Project may also be subject to permit approvals from the U.S. Army Corps of Engineers (ACOE) and California Department of Fish and Wildlife (CDFW).

11. **Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1? If so, is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?**

    There was no request for consultation from Native American tribes.

    Note: *Conducting consultation early in the CEQA process allows tribal governments, lead agencies, and project proponents to discuss the level of environmental review, identify and address potential adverse impacts to tribal cultural resources, and reduce the potential for delay and conflict in the environmental review process. (See Public Resources Code section 21080.3.2.) Information may also be available from the California Native American Heritage Commission's Sacred Lands File per Public Resources Code section 5097.96 and the California Historical Resources Information System administered by the California Office of Historic Preservation. Please also note that Public Resources Code section 21082.3(c) contains provisions specific to confidentiality.*

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact or Potentially Significant Unless Mitigation Incorporated" as indicated by the checklist on the following pages.

	Aesthetics		Agricultural and Forestry Resources		Air Quality
X	Biological Resources		Cultural Resources		Energy
	Geology / Soils		Greenhouse Gas Emissions		Hazards & Hazardous Materials
	Hydrology / Water Quality		Land Use / Planning		Mineral Resources
	Noise		Population / Housing		Public Services
	Recreation		Transportation		Tribal Cultural Resources
	Utilities / Service Systems		Wildfire		Mandatory Findings of Significance

DETERMINATION: (To be completed by the Lead Agency)

On the basis of the initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☒ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR of NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Copies of the Initial Study and related materials and documentation may be obtained at the Planning Division of the Development Services Department, 777 Cypress Avenue, Redding, CA 96001. Contact Drew Morgan at (530) 225-4407.

April 9, 2025

Drew Morgan
Development Services Department

Date

EVALUATION OF ENVIRONMENTAL IMPACTS:

This section analyzes the potential environmental impacts associated with the proposed project. The issue areas evaluated in this Initial Study include:

- Aesthetics
- Agricultural and Forestry Resources
- Air Quality
- Biological Resources
- Cultural Resources
- Energy
- Geology/Soils
- Greenhouse Gas Emissions
- Hazards & Hazardous Materials
- Hydrology/Water Quality
- Land Use/Planning
- Mineral Resources
- Noise
- Population/Housing
- Public Services
- Recreation
- Transportation
- Tribal Cultural Resources
- Utilities/Service Systems
- Wildfire
- Mandatory Findings of Significance

The environmental analysis in this section is patterned after the Initial Study Checklist recommended by the State *CEQA Guidelines* and used by the City of Redding in its environmental review process. For the preliminary environmental assessment undertaken as part of this Initial Study's preparation, a determination that there is a potential for significant effects indicates the need to more fully analyze the development's impacts and to identify mitigation.

For the evaluation of potential impacts, the questions in the Initial Study Checklist are stated and an answer is provided according to the analysis undertaken as part of the Initial Study. The analysis considers the long-term, direct, indirect, and cumulative impacts of the development. To each question, there are four possible responses:

- **No Impact.** The development will not have any measurable environmental impact on the environment.

- **Less Than Significant Impact.** The development will have the potential for impacting the environment, although this impact will be below established thresholds that are considered to be significant.

- **Potentially Significant Impact Unless Mitigation Incorporated.** The development will have the potential to generate impacts which may be considered as a significant effect on the environment, although mitigation measures or changes to the development's physical or operational characteristics can reduce these impacts to levels that are less than significant.

- **Potentially Significant Impact**. The development will have impacts which are considered significant, and additional analysis is required to identify mitigation measures that could reduce these impacts to less than significant levels.

Where potential impacts are anticipated to be significant, mitigation measures will be required, so that impacts may be avoided or reduced to insignificant levels.

Prior environmental evaluations applicable to all or part of the Project site:

- *City of Redding General Plan 2045*
- *City of Redding General Plan Update Final Environmental Impact Report*, 2024, SCH #2022050300
- CEQA Findings of Fact and Statement of Overriding Considerations for the *City of Redding General Plan Update Final Environmental Impact Report*, as adopted by the Redding City Council on March 13, 2024, by Resolution 2024-027

List of attachments/references:

Attachment A – Figure 1 – Location Map
Figure 2 – Tentative Subdivision Map Sheets (Pages 1 through 9)
Figure 3 – Planned Development Plan Booklet

Attachment B – *Biological Resource Assessment*, prepared by Gallaway Enterprises, December 2022

Attachment C – *Western Spadefoot Survey Report*, prepared by Gallaway Enterprises, February 13, 2023

Attachment D – *Draft Delineation of Aquatic Resources*, prepared by Gallaway Enterprises, November 2022

Attachment E – *Storm Drain Analysis*, prepared by Sharrah Dunlap Sawyer, January 2007

Attachment F – *Traffic Impact Study*, prepared by W-Trans, March 21, 2024

Attachment G – *Cultural Resources Inventory Survey*, prepared by Gallaway Enterprises, December 6, 2022

Attachment H – *Tree Inventory Canopy Assessment*, prepared by Gallaway Enterprises, December 9, 2022

Attachment I – *Tree Health Assessment*, prepared by Gallaway Enterprises, April 9, 2024

SUMMARY OF MITIGATION MEASURES:

I. **AESTHETICS**: *Except as provided in Public Resources Code Section 21099, would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Have a substantial adverse effect on a scenic vista?			X	
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a State scenic highway?			X	
c) In nonurbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? *(Public views are those that area experienced from publicly accessible vantage point).* If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?			X	
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?			X	

Discussion:

a) Scenic resources identified in the General Plan Environmental Impact Report include the Sacramento River and its tributaries, mountains and foothill, and open hillsides. Development of the Project would not obstruct a scenic vista identified in the *City of Redding General Plan 2045* and would be consistent with development pattern established on nearby properties. Although new development would alter the appearance of the existing conditions, it would not create a substantial adverse impact on scenic vistas or degrade the City's visual character or quality due to the existing urbanized character of the City. The Project will comply with the City's development ordinances, including the Zoning Ordinance and Subdivision Ordinance. The proposed Project would not represent a significant change to the overall scenic quality of the area.

b) The Project site is not located adjacent to a state-designated scenic highway. In addition, the Project would be consistent with the surrounding land uses and the Project would not substantially obstruct, interrupt, or detract from identified scenic resources. There are not prominent rock outcroppings, visually-significant tree stands, or historic buildings in the vicinity of the Project.

c) The Project will be compatible with the existing developed visual character of the adjacent/nearby development. The Project is consistent with the General Plan density allowed on-site and the Project site is located within the area which is developed with similar uses. The location, size, and design of the proposed use would be compatible with uses in the immediate area.

d) The Project would generate light that is customary for development and comply with the Zoning Ordinance light standards. There would not be an adverse effect on day or nighttime views in the area.

Documentation:
City of Redding General Plan 2045, Community Development and Design Element 2045
City of Redding General Plan 2045, Natural Resources Element 2045
City of Redding Zoning Ordinance, Chapter 18.40.090

Mitigation:
None necessary.

II. <u>AGRICULTURE RESOURCES</u>: *In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural, Land Evaluation and Site Assessment Mode (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided bin Forest Protocols adopted by the California Air Resources Board. Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Convert Prime Farmland, Unique Farmland, or Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?				**X**
b) Conflict with existing zoning for agricultural use, or a Williamson Act Contract?				**X**
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code Section 12220(g)), timberland (as defined by Public Resources Code Section 4526), or timberland zoned Timberland Production (as defined by Government Code Section 5110(g))?				**X**
d Result in the loss of forest land or conversion of forest land to non-forest use?				**X**
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland to non-agricultural use or conversion of forest land to non-forest land?				**X**

Discussion:

a-e) The Project site does not contain designated farmland, forest land, or timberlands. The Project site has not been historically used for agricultural purposes, nor does it possess soils that are prime for agricultural production. The site is not located within an area of Prime Farmland as identified by the California Department of Conservation's Important Farmland Series Mapping and Monitoring Program and is not under Williamson Act contract. The Project would not convert or rezone any farmland to non-agricultural use, or any forest land to non-forest use.

Documentation:
City of Redding General Plan 2045, Natural Resources Element 2045
California Department of Conservation's Farmland Mapping and Monitoring Program
United States Department of Agriculture, Soil Conservation Service and Forest Service, Soil Survey of Shasta County Area.

Mitigation:
None necessary.

III. <u>AIR QUALITY</u>: *Where available, the significance criteria established by the applicable air quality management district or air pollution control district may be relied upon to make the following determinations. Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Conflict with or obstruct implementation of the applicable air quality plan?			X	
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable Federal or State ambient air quality standard			X	
c) Expose sensitive receptors to substantial pollutant concentrations?				X
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?				X

Discussion:

a) Shasta County, including the far northern Sacramento Valley, currently exceeds the state's ambient standards for ozone (smog) and particulates (fine, airborne particles). Consequently, these pollutants are the focus of local air quality policy, especially when related to land use and transportation planning. Even with application of measures to reduce emissions for individual projects, cumulative impacts are unavoidable when ozone and/or particulate emissions are involved. For example, the primary source of emissions contributing to ozone is from vehicles. Any project that generates vehicle trips has the potential of contributing incrementally to the problem.

The City of Redding General Plan (GP) Environmental Impact Report (EIR) concluded that cumulative impacts would be significant and unavoidable *on a City-wide basis* and those impacts are addressed in the adopted CEQA Findings of Fact and Statement of Overriding Considerations. The GP EIR estimated areawide and mobile source emissions under the General Plan 2045 and compared the estimates to the estimated area and mobile source emissions projected in the 2021 Air Quality Attainment Plan (AQAP) for year 2025, which is the time horizon of the AQAP. The analysis concluded that the *cumulative* ROG and NOX emissions that would be generated by activity under the GP in 2045 would exceed the projections in the AQAP for year 2025 resulting in a very conservative determination. The GP EIR mirrors GP policies by requiring Mitigation Measures AQ-1 and AQ-2. AQ-1 requires that "Standard Mitigation Measures" (SMMs) be applied to all discretionary projects. AQ-2 requires the use of Best Available Mitigation Measures (BAMMs) recommended by SCAQMD which has the ability to provide recommendations for each discretionary project. The requirement of SMMs are also required by the City's Standard Conditions of Approval (SCOA) for discretionary projects including subdivisions. Because the Project would generate the type of construction and traffic emissions projected for the land use types and density set forth for the Project site by the GP EIR, the Project would not conflict with the SCAQMD plans and impacts would be less than significant.

b) The GP EIR concluded that cumulative impacts would be significant and unavoidable on a City-wide basis and those impacts are addressed in the adopted CEQA Findings of Fact and Statement of Overriding Considerations. The GP EIR concluded that implementation of the GP would cumulatively generate construction-related emissions of criteria air pollutants and precursors, including ROG, NOX, PM10, and PM2.5 from site preparation (e.g., excavation, clearing), off-road equipment, material delivery, worker commute trips, and other activities (e.g., building construction, asphalt paving, application of architectural coatings). Implementation of the construction-related SMMs as required by the City's SCOA for discretionary projects would reduce construction-generated emissions of criteria air pollutants and precursors. However, due to Shasta County's nonattainment-transitional status for ozone, construction activities associated with the Project would add to the cumulative impacts, and the GP EIR acknowledges that implementation of the GP may result in adverse air quality impacts to surrounding land uses and may contribute to the existing air quality condition in the City. There are no components of the proposed Project that would result in increased construction-related air quality emissions beyond what was previously evaluated and disclosed by the GP EIR for the Project site. Nonetheless, and consistent with the findings of the GP EIR, Project-related air quality emissions during construction activities would contribute to the significant and unavoidable construction-related air quality impact identified by the GP EIR (Impact AQ-2), However, the Project would not result in increased impacts or increased cumulatively-considerable impacts due to construction-related emissions beyond what was evaluated and disclosed by the GP EIR and would not exceed the thresholds established by the GP.

The *City of Redding General Plan 2045*, Natural Resources Element 2045 establishes emission thresholds that have been adopted by regional agencies when determining air quality impacts of discretionary projects for the important regional/local pollutants, including: Reactive Organic Gases (ROG) and Oxides of Nitrogen (NOx), which are ozone precursors, and Inhalable Particulate Matter, 10 Micron (PM_{10}) and 2.5 Micron ($PM_{2.5}$) as follows:

Level "A"	**Level "B"**
25 pounds per day of NOx	137 pounds per day of NOx
25 pounds per day of ROG	137 pounds per day of ROG
80 pounds per day of PM_{10}	137 pounds per day of PM_{10}
80 pounds per day of $PM_{2.5}$	

The process of applying SMM and BAMM is to apply appropriate SMM to all projects based on potential air quality impacts and to help contribute to reducing cumulative impacts. If the project exceeds Level "A" threshold, then BAMM will be applied based on the unique characteristics of the project selected from a list of measures provided by AQMD. If a project exceeds Level "B" thresholds, SMM, BAMM, and appropriate special BAMM would be applied and the City will seek recommendations of the AQMD regarding the efficiency of proposed emissions measures beyond BAMM. If a project's emission cannot be reduced to below Level "B" thresholds, emission offsets will be required. If, after applying emission offsets, the project still exceeds the Level "B" threshold, then an Environmental Impact Report is required.

The current Project has the potential to impact air quality primarily in two ways: (1) the Project would generate vehicle trip emissions (with NOx, ROG, and PM_{10}) that contribute cumulatively to local and regional air quality conditions; and (2) fugitive dust (particulate/$PM_{10\text{ and }}$ $PM_{2.5}$) emissions are possible during construction activities. As a residential development, the Project does not have the potential to generate significant emission concentrations of other pollutants subject to state and federal ambient air quality standards and no recommendation for BAMM were made by the SCAQMD.

Application of the SMMs and the outlined below would reduce the Project's potential air quality impacts to a level less than significant.

1. Apply nontoxic soil stabilizers according to manufacturer's specification to all inactive construction areas (previously graded areas inactive for ten days or more).

2. Reestablish ground cover on the construction site through seeding and watering prior to final occupancy.

3. All grading operations shall be suspended by the City Engineer when winds (as instantaneous gusts) exceed 20 miles per hour as directed by the AQMD.

4. Provide temporary traffic control as appropriate during all phases of construction to improve traffic flow (e.g. flag person) as approved by the City Engineer.

5. Schedule construction activities that affect traffic flow to off-peak hours as determined by the City Engineer.

6. Water active construction sites at least twice daily or as directed by the Public Works Department.

7. Reestablish ground cover on the construction site through seeding and watering prior to final occupancy.

8. All truck hauling dirt, sand, soil, or other loose materials shall be covered or maintain at least two feet of freeboard (i.e., minimum vertical distance between top of the load and the trailer) in accordance with the requirements of CVC Section 23114. This provision is enforced by local law enforcement agencies.

9. Sweep streets at the end of the day if visible soil materials are carried onto adjacent public paved roads (recommend water sweeper with reclaimed water).

10. Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving the site each trip.

c-d) The GP EIR concluded that cumulative impacts would be significant and unavoidable on a City-wide basis and those are addressed in the adopted CEQA Findings of Fact and Statement of Overriding Considerations. However, the document notes that the SCAQMD identified the following types of land use conflicts that could result in the exposure of sensitive receptors to excessive pollutant concentrations in their CEQA Land Use Protocol Guidelines:

- Development projects with sensitive receptors in close proximity to a congested intersection or roadway with high levels of emissions from motor vehicles. High concentrations of carbon monoxide, fine particulate matter, or toxic air contaminants are the most common concerns.
- Development projects with sensitive receptors close to an industrial source of toxic air contaminants.
- Development projects with sensitive receptors close to a source of odorous emissions. Although odors generally do not pose a health risk, they can be quite unpleasant and often lead to citizen complaints to the District and to local governments.

The Project does not meet any of these criteria. Further, the Project is not located in proximity to any of the land uses types noted.

Documentation:
City of Redding General Plan 2045, Natural Resources Element 2045
City of Redding General Plan Update Final Environmental Impact Report, 2024, SCH #2022050300
CEQA Findings of Fact and Statement of Overriding Considerations for the *City of Redding General Plan Update Final Environmental Impact Report*, as adopted by the Redding City Council on March 13, 2024, by Resolution 2024-027

Mitigation:
None necessary.

IV. **BIOLOGICAL RESOURCES**: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?		X		
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local of regional plans, policies, regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?			X	
c) Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?			X	
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?		X		
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?			X	
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community, Conservation Plan, or other approved local, regional, or State habitat conservation plan?				X

Discussion:

a-d) The Project site is primarily composed of blue oak-foothill pine woodland and some sections of annual grasslands in the western portion of the Project site. A biological report was prepared by Gallaway Enterprises, dated December 2022 (Attachment B). The biologist obtained lists of special-status species that occur in the vicinity of the biological survey area (BSA) and consulted the California Natural Diversity Database (CNDDB) Geographic Information System (GIS) and showed special-status species within a 5-mile radius of the BSA. Other primary sources of information cited in the report regarding the occurrence of federally listed threatened, endangered, proposed, and candidate species and their habitats within the BSA were U.S. Fish and Wildlife Service (USFWS) *Information for Planning and Consultation* (IPaC), California Department of Fish and Wildlife (CDFW) CNDDB, RareFind 5, California Native Plant Society's (CNPS) *Inventory of Rare and Endangered Vascular Plants*, and the USFWS Critical Habitat Portal. The study contains the following determinations in regard to special-status species:

Plants

- **Red Bluff dwarf rush** – Has a low potential of occurrence within the survey area. The Red Bluff dwarf rush's habitat is in vernal pools and vernally mesic sites, it is Class 1B.1 according to CNPS and is classified as Rare or Endangered in California or elsewhere and is Seriously Threatened.

  Due to the uncertainty of the Red Bluff dwarf rush's presence on the site, a pre-construction survey during the bloom period for the plant will have to be conducted to verify the presence or lack of presence of the plant species. If the special status botanical species is observed within the survey area, then mitigation measures recognized by the California Fish and Wildlife Department will be implemented based on the level of potential impacts (BIO-3).

Animals

- **Western spadefoot toad** – Has a low potential for occurrence within the survey area. The Western Spadefoot occurs primarily in grassland habitats. Vernal pools and seasonal drainages are typically used for breeding and egg-laying. It is a State Species of Special Concern (SSC).

  On January 31, 2023 and February 6, 2023, a focused survey was conducted for western spadefoot toads within the Project boundary (Attachment C). The method of testing included utilizing a flashlight to detect "eye-shine" in adult spadefoots and an investigation for the presence of egg masses and/or tadpoles within suitable aquatic habitats. Additionally, an acoustic survey was conducted to determine the presence of spadefoots throughout the Project area. No western spadefoot was observed or acoustically detected.

- **Pallid bat** – Has a low potential for occurrence within the survey area. Habitat suitable for the pallid bat is rocky outcroppings to open, sparsely vegetated grasslands with a nearby water source. Day and night roosts include crevices in rocky outcrops and cliffs, caves, mines, trees (e.g., cavities and exfoliating bark), and various human structures (i.e., bridges). Although there are no CNDDB occurrences of this species within five miles of the BSA, there are some suitable tree cavities that could provide roosting habitat.

- **Western red bat** – Has a low potential for occurrence within the survey area. Habitat for the western red bat are riparian areas dominated by walnuts, oaks, willows, cottonwoods, and sycamores where they roost in these broad-leafed trees. The survey area contains some mature trees that could potentially provide roosting habitat; however, there is no riparian habitat.

  In response to comments regarding the potential for habitat for occurrence of Crotch's bumble bee, Gallaway Enterprises updated their biological report and conducted a habitat assessment specifically for special-status bumble bees. It was determined that, due to the lack of abundance of supporting floristic and water resources to support bumble bee nesting year-round, the BSA does not provide suitable habitat for special-status bumble bees.

Migratory Birds, Raptors, and Special Status Bat Species

The natural oak woodland on-site provides attractive habitat for nesting and migratory birds. While many trees located within the dog park and open space areas associated with the Project will be preserved from development, there is the potential that raptors and migratory birds could be impacted by tree removal and other major land-clearing activity necessary to construct the subdivision. To minimize impacts from construction, mitigation is provided below (BIO-1) to encourage mass tree removal and other land-clearing work to be conducted outside the main nesting period of February 1 through August 31, and requiring a nest survey and appropriate nest-avoidance measures, if any work must occur during the nesting season.

Likewise, the site has the potential to support roosting, solitary, and colonial bats, including special-status bat species. Therefore, mitigation is provided below (BIO-2) that if construction or removal of trees will occur during the bat maternity season, when the young are non-volant, March 1 through August 31, a qualified professional shall conduct a pre-construction survey of the study area to locate maternity colonies and identify measures to protect colonies from disturbance in order to avoid impacts (BIO-2).

Wetlands

The Project site is situated on an upland oak woodland terrace north of the Sacramento River. There is an intermittent drainage, Dix Creek, lying just outside the boundary of the Project, that flows south to east. Several on-site ephemeral creeks drain to the larger creek from the open-space ravine areas located between the three neighborhoods. The Delineation of Aquatic Resources (Attachment D) identifies nine aquatic features on the Project site. The current subdivision minimally impacts the natural on-site drainage and environmentally sensitive portions of the site mainly due to the ridge-top development design. A single seasonal wetland feature, approximately 3,050 square feet, occurring within the ridge top of Neighborhood “B” has been identified and is proposed to be filled with construction of the Project. The delineation of aquatic resources report stated no wetland features that meet the definition of Waters of the United States were observed within the Project site; final determination will need to be made by the California Regional Water Quality Control Board and U.S. Army Corps of Engineers.

e) The City has adopted a Tree Management Ordinance (Chapter 18.45 of the RMC) that promotes the conservation of mature, healthy trees in the design of new development. The ordinance also recognizes that the preservation of trees will sometimes conflict with necessary land-development requirements. The *City’s General Plan EIR* further acknowledges that preservation of native trees will sometimes conflict with normal land development and that implementation of the *General Plan* will ultimately set aside over 7,000 acres of open space, much of which contains oak habitat. However, efforts must still be made to retain existing trees if reasonably possible, and to sufficiently plant new trees in the context of the new development. A tree survey is required to identify natural trees and tree groups most suitable for preservation or "candidate trees/groups." Where all identified candidate trees/groups cannot be preserved, the set-aside of a natural area or areas within a project site that is particularly suitable for the planting, retention, and/or natural regeneration of trees is considered to be a desirable means of accomplishing the goals of the ordinance.

Tree coverage on the site ranges from dense pockets of oak trees with a moderate canopy to sparser tree cover over other areas which are dominated by annual grasses. While the Tree Management Ordinance requires initial mapping of a development site, on sites of five (5) acres or more, at the discretion of the Development Services Director, regulations allow for the qualified professional to consult with staff to determine the appropriate level of detail. Arborist reports which contained a tree canopy assessment (Attachment H) and a tree health assessment (Attachment I) were prepared for the Project by Gallaway Enterprises. The canopy area of the oak woodland was analyzed through a combination of remote sensing in Geographic Information Systems (GIS). There is an estimated 1,098 oak trees within the property and an estimated 11 pine trees within the property. An additional tree health assessment was submitted to the City and this identified the health of the trees within the Project area on a scale from 0 to 5, with 0 being dead trees and 5 being excellent trees in all aspects. The survey results identified that no tree was exceptionally healthy and mature within the survey area. For this particular project, all trees on the parcel outside of the Project area will be left untouched and preserved as open space.

In addition to tree retention efforts, the developer is also obligated to replant suitable new trees at the time of home construction for shade and the enjoyment of residents. The Tree Management Ordinance identifies minimum planting criteria of one tree per 500 square feet of gross living area. Thus, with retention of trees in the proposed private open space easements and the planting of new trees as a standard condition of development, the Project is consistent with the intent of the Tree Management Ordinance.

f) No habitat conservation plans or other similar plans have been adopted for the Project site or project area. No impact would occur in this regard.

Documentation:

City of Redding General Plan 2045, Natural Resources Element 2045
City of Redding General Plan Update Final Environmental Impact Report, 2024, SCH #2022050300
City of Redding Municipal Code, Chapter 18.45, Tree Management Ordinance
California Department of Fish and Wildlife: Natural Diversity Data Base
Biological Resource Assessment, by Gallaway Enterprises, dated December 2022.
Tree Inventory Assessments, by Gallaway Enterprises, dated December 9, 2022 and April 9, 2024

Mitigation:

M Bio-1. If vegetation removal or construction activities will occur during the nesting season for migratory birds or raptors (February 1 through August 31), a qualified biologist shall conduct a preconstruction survey seven days before construction activities begin. If nesting birds or raptors are found, CDFW will be notified and consulted. An appropriate buffer, as determined by CDFW and the qualified biologist, will be placed around the nest until the young have fledged. If construction activities cease for a period greater than seven days, additional preconstruction surveys will be required.

MM-Bio-2. If construction (including the removal of large trees) occurs during the bat non-volant season (March 1 through August 31), a qualified professional shall conduct a pre-construction survey of the study area to locate maternity colonies and identify measures to protect colonies from disturbance. The preconstruction survey will be performed no more than seven days prior to the implementation of construction activities. If a maternity colony is located within the study area, or adjacent to the study area, a disturbance-free buffer shall be established by a qualified professional, in consultation with CDFW, to ensure the colony is protected from project activities.

MM-Bio-3. Any impacts to the detention basin identified in the biological report or drainages on the Project site shall have a pre-construction rare plant survey for the Red Bluff dwarf rush conducted by a qualified botanist during the appropriate survey window (blooming period) for rare plants that have the potential to occur within the Project site, as deemed appropriate by the California Department of Fish and Wildlife. Any required survey shall be in accordance with California Native Plant Society *Botanical Survey Guidelines* (CNPS 2001), California Department of Fish and Wildlife *Protocols for Surveying and Evaluating Impacts to Special Status Plant Species Native Plant Populations and Natural Communities* (CDFW 2009), and U.S. Fish and Wildlife's *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 2000). If present, special status plant species plant populations will be flagged and, if possible, avoided during construction. If the population cannot be avoided during construction, a mitigation plan, which could include transplanting the plant population or compensation, will be developed for approval by the California Department of Fish and Wildlife.

V. CULTURAL RESOURCES: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Cause a substantial adverse change in the significance of a historical resource pursuant to Section 15064.5?			X	
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?			X	
c) Disturb any human remains, including those interred outsides of dedicated cemeteries?			X	

Discussion

a-c) The project site has a potential for the presence of historic or prehistoric cultural resources due to its location on an upland above the historic seasonal floodplain of the Sacramento River, and the property is considered to have moderate archaeological sensitivity. The official Shasta County archaeological records were examined for the property on October 26, 2022 through Northeast Information Center Records (NEIC). Between 1976 and 2016, six cultural resources investigations have been conducted on the property and there have been no cultural resources documented in NEIC records. Consequently, fieldwork was undertaken on December 5, 2022 to survey the property for cultural resources and no special problems were encountered, and all survey objectives were satisfactorily achieved (Attachment G).

There is always a possibility of discovering potentially significant archeological, historical, or paleontological resources during grading activities and construction. Due to the absence of historic properties, significant historical resources, and unique archeological resources within the property identified within the Cultural Resources Inventory Survey, the City has a standard condition of approval for Cultural Resources if there is discovery of archeological, historical, or paleontological resources during construction activities, as follows: If, during the course of development, any archaeological, historical, or paleontological resources are uncovered or otherwise detected or observed, construction activities in the area affected shall cease and the City shall be notified immediately. A qualified archaeological professional must then be retained by the developer to investigate the discovered cultural object to determine its significance. If the cultural object is deemed potentially significant by the archaeologist, appropriate treatment and measures shall be followed in accordance with applicable laws, as reviewed and approved by the City, prior to the resumption of work in the affected area.

Documentation:
City of Redding General Plan 2045, Natural Resources Element 2045
Cultural Resources Inventory Survey, by Gallaway Enterprises dated December 6, 2022.

Mitigation:
None necessary.

VI. Energy: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?			X	
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?				X

Discussion:

a) The project would not result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources during project construction or operation. Direct energy use would involve the short-term use of energy for construction activities. Project construction would primarily consume diesel and gasoline through operation of construction equipment, material deliveries, and debris hauling. Construction is estimated to result in a short-term consumption of energy, representing a small demand on local and regional fuel supplies that would be easily accommodated and would be temporary.

b) The project will not conflict with any State or local plans for renewable energy or energy efficiency.

Documentation:
City of Redding General Plan 2045, Natural Resources Element 2045

Mitigation:
None necessary.

VII. GEOLOGY AND SOILS: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving: i) Rupture of a known earthquake, fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publications 42. ii) Strong seismic ground shaking? iii) Seismic-related ground failure, including liquefaction? iv) Landslides?				X
b) Result in substantial soil erosion or the loss of topsoil?			X	

VII. GEOLOGY AND SOILS: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?				**X**
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?				**X**
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of waste water?				**X**
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?				**X**

Discussion:

a, c, d) There are no Alquist-Priolo earthquake faults designated in the Redding area of Shasta County. There are no other documented earthquake faults in the immediate vicinity that pose a significant risk, and the site is located in an area designated in the Health and Safety Element of the *General Plan* as having a low ground-shaking potential. The Project is not located on or near any documented landslide hazard areas, and there is no evidence of ground slippage or subsidence occurring naturally on the site. The type of soils and underlying geology are identified as having low potential for liquefaction. No portion of the site falls within the 100-year floodplain of the Sacramento River or any creek.

b) The Project site contains two primary soil classifications: Red Bluff Loam (RdB) and Newtown Gravelly Loam (NeG). Red Bluff Loam is characterized by slope of 3 to 8 percent with moderate to slow permeability, slow runoff, and minimal erosion potential. These soils are found in the three ridge-top areas adjacent to Quartz Hill Road to be developed with lots. Newtown Gravelly Loam is characterized by slopes of 15 to 30 percent with slow permeability, rapid runoff, and high erosion potential. These soils are those found in the large area surrounding the area proposed for development and characterized by slopes of 20 percent or greater and proposed to be placed in open space.

As shown on the preliminary grading plan, most grading would be limited to the 9-acre area of the three neighborhoods for street and lot development. Minor grading encroachment will occur on slopes in excess of 20 percent to accommodate installation of utility infrastructure and the trails linking Neighborhoods “B” and “C” to Bel Air Drive; but for the most part, the areas of steep slope and the drainages would be preserved as open space and left undeveloped. Therefore, the Project would not result in substantial soil erosion or loss of topsoil that would pose a significant impact. The project is subject to certain erosion-control requirements mandated by existing City and State regulations. These requirements include:

- *City of Redding Grading Ordinance.* This ordinance requires the application of “Best Management Practices” (BMPs) in accordance with the City Erosion and Sediment Control Standards Design Manual (Redding Municipal Code Section 16.12.060, Subsections C, D, E). In practice, specific erosion-control measures are determined upon review of the final project improvement plans and are tailored to project-specific grading impacts.

- *California Regional Water Quality Board “Construction Activity Storm Water Permit.*” This permit somewhat overlaps the City’s Grading Ordinance provision by applying state standards for erosion-control measures during construction of the Project.

- *California Regional Water Quality Control Board “Project Storm Water Pollution Prevention Plan (SWPPP).*” This plan emphasizes stormwater best management practices and is required as part of the Construction Activity Storm Water Permit. The objectives of the SWPPP are to identify the sources of sediment and other pollutants that affect the quality of stormwater discharges and to describe and ensure the implementation of practices to reduce sediment and other pollutants in stormwater discharges.

- *California Department of Fish and Wildlife "1600 Agreement."* This notification is required for any work within a defined streambed and will be applicable to impacts to any work within a bed, channel, or bank of any perennial, intermittent, or ephemeral creeks.

- *U.S. Army Corps of Engineers Nationwide Permit or Individual Permit* to address impacts to jurisdictional waters.

Actions for compliance with these regulations are addressed under standard conditions of approval, which are uniformly applied to all land development projects. Since the Project is subject to uniformly applied ordinances and policies and the overall risk of erosion is low, potential impacts related to soil erosion and sedimentation are less than significant.

f) The proposed project does not involve the use of septic tanks or alternative wastewater disposal. No impact has been identified.

g) No unique geologic features, fossil-bearing strata, or paleontological sites are known to exist on the Project site.

Documentation:
City of Redding General Plan 2045, Public Safety Element 2045*, figures PS-1 (Ground Shaking Potential) and PS-2 (Liquefaction Potential)*
City of Redding General Plan Update Final Environmental Impact Report, 2024, SCH #2022050300
City of Redding *Grading Ordinance*, RMC Chapter 16.12
City of Redding *Standard Specifications, Grading Practices*
City of Redding *Standard Development Conditions for Discretionary Approvals*
Soil Survey of Shasta County Area, United States Department of Agriculture, Soil Conservation Service and Forest Service, August 1974
Division of Mines and Geology Special Publication 42
State Regional Water Quality Control Board, Central Valley Region, *Regulations Related to Construction Activity Storm Water Permits* and *Storm Water Pollution Prevention Plans*

Mitigation:
None necessary.

VIII. GREENHOUSE GAS EMISSIONS: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?			**X**	
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?				**X**

Discussion:

a, b) The City of Redding General Plan (GP) and Environmental Impact Report (EIR) concluded this impact is cumulatively significant and unavoidable as pertains to buildout of the GP and is addressed in the GP EIR's CEQA Findings of Fact and Statement of Overriding Considerations. The EIR indicates that greenhouse gas (GHG) emissions are projected to result in a slight decrease in emissions from the CEQA baseline established by the GP EIR but not result in the 85 percent reduction from existing conditions necessary to ensure the City is on a trajectory to achieve the long-term reductions goals AB 1279 and substantial progress toward the State's carbon neutrality goals for year 2045.

The City has not adopted a numerical significance threshold for assessing impacts related to GHG emissions. Similarly, neither the SCAQMD, CARB, nor any other state or regional agency has yet adopted a numerical significance threshold for assessing GHG emissions that applies to the Project. Since there is no applicable adopted or accepted numerical threshold of significance for GHG emissions, the methodology for evaluating the Project's impacts related to GHG emissions focuses on its consistency with statewide, regional, and local plans adopted for the purpose of reducing and/or mitigating GHG emissions. This consistency with such plans is the sole basis for determining the significance of the Project's GHG-related impacts on the environment.

The Project is consistent with numerous policies of the GP that address lowering VMT through infill development, including, but not limited to the following:

- Establishing the "Primary and Secondary Growth Areas" intended to focus future development and annexations in proximity to existing services and infrastructure.
- Increasing residential densities along transit corridors.
- Prioritizing infill development.
- Working to complete the City's "Complete Streets" system to provide multimodal transportation opportunities.
- Strategically locating parks, trails, and similar facilities throughout the community to result in such facilities being located within ¼ mile of residents.
- Establishing identified "Opportunity Areas" to encourage redevelopment of older strip commercial centers to provide additional housing and mixed-use developments.
- Allowing neighborhood commercial services to be established within residential neighborhoods.

The Project is also consistent with the applicable Shasta Regional Transportation Agency's Regional Transportation Plan's goals, including:

- Encouraging transportation-efficient growth and development where it is supported by current or planned mobility options.
- Ensuring historically-marginalized and otherwise disadvantaged communities have an equitable role in planning and decision-making processes.

With regard to consistency with the California Air Resources Board's 2017 Scoping Plan, the Scoping Plan addresses a broad range of actions and strategies intended to reduce greenhouse gases such as increasing stringency of carbon fuel standards, adding additional zero-emission vehicles on the state's roadways, and similar broad-based programs which are not applicable to the Project.

As demonstrated by the above and the analysis provided in the GP EIR, the Project complies with or exceeds the plans, policies, regulations and GHG reduction actions/strategies outlined in the GP, the SRTA RTP, and CARB's 2017 Scoping Plan. Therefore, the Project would not conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing emissions of GHGs.

Documentation:
City of Redding General Plan 2045, Natural Resources Element 2045

Mitigation:
None necessary.

IX. <u>HAZARDS AND HAZARDOUS MATERIALS</u>: *Would the project:*	Potentially Significant Impact	Less-Than-Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?				X
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?				X
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				X

IX. **HAZARDS AND HAZARDOUS MATERIALS**: *Would the project:*	Potentially Significant Impact	Less-Than-Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?				X
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				X
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury, or death involving wildland fires?			X	

Discussion:

a-d) The nature of the Project as a single-family subdivision does not present a significant risk related to hazardous materials or emissions. There are no documented hazardous material sites located on or near the Project.

e) The Project is not located within an airport land use plan or within two miles of a public airport or public use airport and would not result in a safety hazard for people residing or working in the Project area. There would be no impact on public safety.

f) The Project does not involve a use or activity that could interfere with emergency-response or emergency-evacuation plans for the area.

g) While the Project site is located within the Very High Fire Severity Zone, the nature of the Project will require extensive grading, removal of trees and other natural fire fuels throughout the site to accommodate potential housing development. City and State ordinances require, for a residential development of this size, multiple secondary access points. Secondary access points allow residents to safely remove themselves from potential harmful or fatal situations involving fires. Additionally, California Residential Building Code requires dwellings to be constructed using flame-resistant materials and include fire sprinklers within the dwelling and under the roof. Impacts would be considered less than significant.

Documentation:
City of Redding General Plan 2045, Public Safety Element, 2045, *including figures PS-4 (Very High Fire Severity Zone) and PS-6 (Wildfire Evacuation Routes)*

Mitigation:
None necessary. With the conditions incorporated into the Project as outlined above, the impacts associated with fire hazards would be considered less than significant, and no mitigation measures are necessary.

X. **HYDROLOGY AND WATER QUALITY**: *Would the project:*	Potentially Significant Impact	Less-Than-Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?			X	
b) Substantially decease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?				X
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:				

X. HYDROLOGY AND WATER QUALITY: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
i) Result in substantial erosion or siltation on- or off-site;			X	
ii) Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;			X	
iii) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or			X	
iv) Impede or redirect flood flows?				X
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?				X
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?				X

Discussion:

a) Since the Project would be served by City sanitary sewer service, the Project would not involve any permitted discharges of waste material into ground or surface waters. Construction and operation of the Project would not violate any water quality standards established by the Central Valley Regional Water Quality Control Board (RWQCB) in its Basin Plan for the Sacramento River and San Joaquin River Basins. Water pollution best management practices are required and will be incorporated into the improvement plans for the Project. The City's construction standards require that all projects prepare an erosion and sediment control plan (ESCP) prior to construction to address water pollution control. The ESCP will ensure that water quality standards are not substantially affected by the Project during construction.

b) The Project would utilize City water service for domestic uses and fire protection. The proposed Project would not impact groundwater supplies.

c) Stormwater runoff from the site currently drains in a southeasterly direction to a series of on-site gullies and the ravine lying below Quartz Hill and within Bel Air Estates Subdivision, Unit 1. At the bottom of Quartz Hill, Dix Creek crosses Quartz Hill Road and travels to Benton Drive in a 6-foot by 8-foot underground concrete-bottom/steel-arch structure. This structure also accepts flows from the River Park Highlands Subdivision.

The Project is subject to standard requirements defined under Section VII., *Geology and Soils*, and mitigation measures (if any) under Section IV., *Biological Resources*, above, that minimize the potential for erosion or siltation on- or off-site. Prior to the issuance of a clearing and/or grading permit, an Erosion and Sediment Control Plan shall be included and approved by the City Engineer as part of all clearing and grading permit applications, in conformance with RMC Title 16.12, the City's *Small Phase II Municipal Separate Storm Sewer System (MS4) General Permit* issued by the State Water Resources Control Board (No. 2013-0001-DWQ), and the requirements of the NPDES Construction General Permit (CGP) (No. 2022-0057-DWQ). Best Management Practices (BMPs) shall be utilized and followed in all Project site development activities. Sites under an acre will provide an Erosion Control Plan in compliance with the City of Redding Construction Standards, Section 800.

City of Redding Policy 1806 requires that all subdivision development include stormwater detention facilities designed to maintain existing predevelopment rates of runoff during a 10-, 25-, and 100-year storm event with a six-hour duration. The Project application includes a stormwater hydrology analysis prepared by Sharrah Dunlap Sawyer and dated January 2007 (Attachment E) that concludes that the detention basin was designed to limit post-development runoff from the larger Bel Air Subdivision and the proposed Project, as well as to provide additional detention value in order to reduce current flows during a 100-year-storm event.

d) The Project site is not located in a flood hazard, tsunami or seiche zone.

e) The Project would not conflict with a water quality control plan or groundwater management plan.

Documentation:
City of Redding General Plan 2045, Natural Resources Element 2045
City of Redding General Plan 2045, Public Safety Element 2045
Storm Drain Analysis, by Sharrah Dunlap Sawyer, Dated January 2007
Federal Emergency Management Agency Floodplain regulations, FIRM map 06089C1535G and 06089C1537G dated March 17, 2011
City of Redding Storm Drain Master Plan, Montgomery-Watson Engineers 1993

Mitigation:
None necessary.

XI. LAND USE AND PLANNING: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Physically divide an established community?				**X**
b) Cause a significant environmental impact due to conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?				**X**

Discussion:

a) The Project does not have the potential to physically divide an established community. The Project site is surrounded by existing residential subdivisions (River Ridge Park, River Park Highlands, Lake Redding Estates, Bel Air Estates, and The Vistas). The Project will be connected to Quartz Hill Road and the Bel Air Estates Subdivision and River Ridge Park Subdivisions. Development is limited to ridge-top areas separated by open spaces dictated by steep slope.

b) The Project is compatible with the applicable policies and regulations of the City General Plan and Zoning Ordinance and is not in conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect. Under the City's Zoning Ordinance, the developable area of the Project is zoned "RM-9-PD" Multiple Family Residential District and is designated "Residential, 6 to 10 units per acre" on the Redding General Plan. Although the zoning would allow for multiple-family development, the proposed Project is for a small-lot single-family subdivision within the density allowed by the multiple-family zoning. The proposed average lot size of 4,570 square feet provides a net density of approximately 6.3 units per acre for the Project. Section 17.04.100 of the City's Subdivision Ordinance allows private residential streets and lot sizes that do not meet the City size and street-frontage standards within a planned development project.

Documentation:
City of Redding General Plan 2045, Community Development and Design Element, 2045
City of Redding General Plan 2045, Natural Resources Element, 2045

Mitigation:
None necessary.

XII. MINERAL RESOURCES: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant With Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State?				**X**
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local General Plan, specific plan or other land use plan?				**X**

Discussion:

a, b) The Project site is not identified in the General Plan as having any known mineral-resource value or as being located within any "Critical Mineral Resource Overlay" area.

Documentation:
City of Redding General Plan 2045, Natural Resources Element, 2045
City of Redding General Plan Land Use 2045 Diagram

Mitigation:
None necessary.

XIII. NOISE: *Would the project result in:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?			**X**	
b) Generation of excessive ground-borne vibration or ground-borne noise levels?				**X**
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				**X**

Discussion:

a, b) Due to the nature of the Project as a subdivision, it would not result in a permanent increase in ambient noise levels and would not result in generation of excessive ground-borne vibration or ground-borne noise levels.

During the construction of the proposed Project, there will be a temporary increase in noise in the Project vicinity above existing ambient noise levels. The most noticeable construction noise will be related to grading, utility excavation, and land-clearing activity. The City's Grading Ordinance (RMC Chapter 16.12.120.H) limits grading-permit-authorized activities to between the hours of 7:00 a.m. and 7:00 p.m., Monday through Saturday. No operations are allowed on Sunday. Since heavy construction work associated with the Project is limited in scope and by existing regulation, the anticipated noise impact to neighboring residents is considered less than significant.

The City of Redding *General Plan* Noise Element establishes 60 dB Ldn as the standard acceptable exterior noise level for residential land use and 45dB Ldn for interior noise levels (40dB in sleeping areas). With the installation of an appropriate noise barrier such as a six-foot-high solid wall, to be conditioned with this Project, as determined by the Project noise analysis previously submitted with the original subdivision application, traffic noise would be attenuated to an acceptable level. The Noise Element of the *General Plan* also allows for higher exterior noise level than 60dB, provided that practical noise-level reduction measures are implemented and that interior noise levels are 45dB or less.

c) The proposed subdivision site is not located within any of the noise contours of Redding Municipal Airport and is located over two miles north of Benton Airpark. There are no private airstrips in the vicinity of the Project site.

Documentation:
City of Redding General Plan 2045, Noise Element, 2045
City of Redding General Plan 2045, Transportation Element, 2045

City of Redding Zoning Ordinance Redding Municipal Code, Section 18.40.100
City of Redding Grading Ordinance Redding Municipal Code, Section 16.12.120
City of Redding Municipal Airport Area Plan

Mitigation:
None necessary.

XIV. POPULATION AND HOUSING: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Induce substantial unplanned population growth in an area, either directly *(for example, by proposing new homes and businesses)* or indirectly *(for example, through extension of roads or other infrastructure)*?				**X**
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?				**X**

Discussion:

a, b) The Project would create opportunity for the construction of 55 new homes as planned and anticipated by the Redding *General Plan*. As previously noted, the Project is similar in character to that in the surrounding area. The Project would not induce unplanned population growth and does not propose the extension of any new roads or utilities not anticipated by the *General Plan*. The Project does not displace substantial numbers of people or housing. The Project will provide housing.

Documentation:
City of Redding General Plan 2045, Housing Element, 2020-2028

Mitigation:
None necessary.

XV. PUBLIC SERVICES: *Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
Fire Protection?				**X**
Police Protection?				**X**
Schools?				**X**
Parks?				**X**
Other public facilities?				**X**

Discussion:

Fire and Police Protection:

The City would provide police and fire protection to the Project from existing facilities and under existing service levels. The size of the Project would not mandate the need for additional police or fire facilities.

The Project is subject to Chapter 16.20 of the Redding Municipal Code, which requires new development to pay a citywide fire facilities-impact fee calculated to mitigate a project's fair share of cumulative impacts to the City's fire-protection infrastructure based upon improvements necessary to accommodate new development under the City's *General Plan*.

Schools:

The Project is located in the Redding Elementary School District and Shasta Union High School District and may contribute to the total student enrollment in these districts. However, a school-facility impact (in-lieu) fee exists, as provided under State law, that is paid prior to the issuance of a building permit for each residential unit to address school-facility funding necessitated by the effects of growth citywide.

Parks:

The Project will not cause a physical deterioration of an existing park facility or cause an adverse physical impact associated with a new park facility. The Project is subject to Chapter 16.20 of the Redding Municipal Code, which requires new residential development to pay a citywide park and recreation-facilities impact fee calculated to mitigate a project's fair share of cumulative impacts to the City's parks and recreation infrastructure based upon improvements necessary to accommodate new development under the City's General Plan. See discussion under Item XVI (Recreation) below.

Other public facilities:

See discussion under Item XIX (Utilities and Service Systems) below.

Documentation:
City of Redding General Plan 2045, Public Facilities and Services Element 2045

Mitigation:
None necessary.

XVI. RECREATION:	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?			**X**	
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?			**X**	

Discussion:

a) The Project will not cause a physical deterioration of an existing recreation facility or cause an adverse physical impact associated with a new recreation facility.

b) Chapter 17.54 of the City's Subdivision Ordinance, *Park and Recreational Land Dedications and In-Lieu Fees*, requires that as a condition of approval of a tentative map, a subdivider shall either dedicate land or pay a fee in lieu thereof for park or recreation purposes. In accordance with state subdivision law, only projects containing 50 or more lots may be *required* to dedicate land for park development. Due to the fact that the large neighborhood park in Bel Air Estates Subdivision would serve this and the surrounding developments, only in-lieu fees would be collected. Additional recreational development fees are collected by the City at the time of issuance of a building permit on an individual lot. This Project includes both private and public open-space areas. Within each neighborhood pod, there is a small central landscape area that will include a walking trail connecting the three neighborhoods internally and making a connection through the open-space areas as well. The largest area – centrally located in Neighborhood "B" – is approximately .64 acre in size and will include a gathering area such picnic tables, play equipment, or gazebo. A sitting area will also be provided along the trail in the open space to take advantage of the views. Undeveloped area within the subdivision that will be dedicated as open space includes approximately 15 acres.

Documentation:
City of Redding General Plan 2045, Natural Resources Element, 2045
City of Redding General Plan, Parks, Trails, and Recreation Element, 2045
City of Redding General Plan 2045, Public Facilities and Services Element, 2045

Mitigation:
None necessary.

XVII. <u>TRANSPORTATION</u>: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?			X	
b) Conflict or be inconsistent with CEQA Guidelines Section 15064.3, Subdivision (b)?			X	
c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?			X	
d) Result in inadequate emergency access?				X

Discussion:

a-c) The General Plan (GP) Environmental Impact Report (EIR) concluded this impact to be less than significant. Local programs, plans, ordinances, and policies are consistent with the Regional Transportation Plan (RTP) and Sustainable Communities Strategy (SCS) for the Shasta Region; the Redding Active Transportation Plan (ATP); the Redding Area Bus Authority (RABA) *Short Range Transit Plan*; Title 11, *Vehicles and Traffic* of the Redding Municipal Code; and the Redding Complete Streets Policy. The GP focuses on increasing options for alternative transportation (public transit, walking, and bicycling); ensuring that pedestrian and bicycle systems connect residential neighborhoods to public facilities and services, schools, parks, and shopping areas; and other means to develop a multi-modal transportation system that meets the needs of all members of the community.

Access to the subdivision would be derived from Quartz Hill Road, which is identified in the Transportation Element of the General Plan as an arterial street. Access from Quartz Hill Road to Neighborhood "A" will be provided from Stone Canyon Drive, while Neighborhood "B" and "C" will take access from Quartz Hill Road directly opposite of Sensation Drive, to be constructed with The Vistas Subdivision, Unit 3, and an unnamed street, to be constructed with the Vistas Subdivision, Unit 4, respectively. These access points would satisfy General Plan Policy PS4L and the City's Subdivision Ordinance Chapter 17.60 *Subdivision Design*, that requires at least two connected points of public-street access for subdivisions with 50 or more dwelling units. In addition, the subdivision design includes dedication of right-of-way for future road widening and improvements.

The potential for the Project to conflict or be inconsistent with CEQA Guidelines § 15064.3, subdivision (b) was evaluated based the Project's anticipated Vehicle Miles Traveled (VMT). Senate Bill (SB) 743 established VMT as the metric to be applied for determining transportation impacts associated with development projects. Like many other jurisdictions in California, the City of Redding has not yet adopted a policy or thresholds of significance regarding VMT so the Project-related VMT impacts were assessed based on guidance provided by the California Governor's Office of Planning and Research (OPR) in the publication *Technical Advisory on Evaluating Transportation Impacts (SB 743) CEQA Guidelines Update and Technical Advisory*, 2018. This document identifies several criteria that may be used by jurisdictions to identify certain types of projects that are unlikely to have a VMT impact and can be "screened" from further VMT analysis. Additionally, absent substantial evidence indicating that a project would generate a potentially significant level of VMT, or inconsistency with a Sustainable Communities Strategy (SCS) or general plan, projects that generate or attract fewer than 519 trips per day generally may be assumed to cause a less-than significant transportation impact. As stated above, the City's Traffic Engineer has determined that the number of average vehicle trips that would be generated with development of the Project would not have the potential to cause a significant impact. The Project would not conflict with any program, plan, ordinance, or policy addressing the circulation system. Therefore, the Project will not conflict with CEQA guidelines section 15064.3(b).

To help assess potential traffic impacts, a Traffic Impact Study for the Cottages at Bel Air Subdivision was prepared by W-trans dated March 21, 2024 (Attachment F). The study analyzed Project impacts during both AM and PM peak hour for both Existing Conditions, Baseline Conditions (existing plus approved project's conditions), Future Conditions, and Future Plus Project conditions.

Intersections Studied

Quartz Hill Road/Stone Canyon Drive
Market Street/Benton Drive
Quartz Hill Road/Benton Drive
Quartz Hill Road/Market Street

In its review of the noted intersections and streets, the study arrives at the following conclusions:

- The Project is expected to generate an average of 519 trips per day, including 39 a.m. peak hour trips and 52 p.m. peak hour trips.
- The Project site plan is a tentative map and does not identify any pedestrian facilities such as sidewalks, crosswalks, or curb ramps. While construction of sidewalks along the Project frontage would close an existing sidewalk gap and improve pedestrian access in the study area, pedestrians traveling east of the Project site would have to cross Quartz Hill Road without a crosswalk, resulting in a potentially significant impact.
- Existing bicycle facilities serving the Project site are adequate and would be improved with the installation of planned buffered bicycle lanes on Quartz Hill Road. The units would have private garages and therefore separate bicycle parking would not be required.
- The lack of transit facilities serving the Project site is adequate given the location of the Project site.
- The Project is expected to have a less-than-significant impact on VMT.
- Sight lines at the two proposed street connections to Quartz Hill Road and one proposed street connection to Stone Canyon Drive are adequate to accommodate all turns into and out of the Project streets as well as for following drivers to react to a vehicle slowing to turn into one of the new streets.
- A left-turn lane would not be warranted at any of the proposed street connections based on projected future vehicle volumes.
- Emergency access and circulation within the Project sites would be adequate with incorporation of applicable design standards into the site plans. The Project would have a less-than-significant impact on emergency response times.
- All four study intersections would operate at acceptable Levels of Service under Existing, Baseline, and Future conditions, without and with traffic generated by the Project.
- The proposed vehicle parking supply would be adequate to meet City requirements.

Based on these conclusions, the study recommends the following improvements to be made:

- Sidewalks and street lighting should be installed along the Project streets and frontage on Quartz Hill Road, as well as ADA-compliant curb ramps at the proposed street connections and intersections of Project streets.
- To mitigate a potentially significant impact, a new enhanced pedestrian crossing should be installed on the east leg of the Quartz Hill Road/Stone Canyon Drive intersection. The crossing should include the following design features:

a. Double-sided pedestrian-activated Rectangular Rapid Flashing Beacons (RRFBs);
b. High visibility crosswalk markings;
c. Advance yield markings;
d. Pedestrian crossing signage; and
e. Advance pedestrian crossing signage.

- The Project frontage on Quartz Hill Road should be designed with sufficient roadway width to accommodate the future provision of buffered bicycle lanes as planned by the City.
- New signage, monuments, or other structures near the Project entrances should be positioned outside the sight triangles of a driver waiting on the minor street approaches.

- A condition will be added to the permit to include an enhanced pedestrian crossing to be installed across Quartz Hill Road for connectivity and pedestrian safety.

d) Access to Neighborhood “A” will be provided from Stone Canyon Drive and access to Neighborhood “B” and “C” will be taken directly from Quartz Hill Road. The Redding Fire Marshal has deemed this to be adequate access for emergency access and fire protection.

General Plan Health and Safety Policies HS4J and HS4I generally require that residential neighborhoods having 50 or more dwelling units have at least two points of public street access and that cul-de-sac or dead-end street lengths not exceed 600 feet. With the three access points for this 55-lot subdivision, the secondary access is satisfied and complies with *General Plan* Policy HS4J.

Documentation:
City of Redding General Plan 2045, Transportation Element, 2045
City of Redding General Plan 2045, Parks, Trails, and Recreation Element 2045
City of Redding Parks, Trails, and Open Space Master Plan, Update
City of Redding Traffic Impact Fee Program
City of Redding Active Transportation Plan, 2018
Redding Area Bus Authority Short Range Transit Plan, January 2024
Traffic Impact Study for the Cottages at Bel Air, prepared by W-Trans, March 21, 2024

Mitigation:
None necessary.

<u>XVIII. TRIBAL CULTURAL RESOURCES</u>: *Would the project cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or				**X**
b) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.				**X**

Discussion:

a, b) The project was referred to the appropriate tribal entities and no request for consultation was received.

Documentation:
Letters sent to Redding Rancheria, the Wintu Tribe of Northern California, and Paskenta Band of Nomlaki Indians, dated December 10, 2024. (On file at the City of Redding Planning Division.)
Cultural Resources Inventory Survey, by Gallaway Enterprises dated December 6, 2022.

Mitigation:
None necessary.

XIX. UTILITIES AND SERVICE SYSTEMS: *Would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Require or result in the relocation or construction of new or expanded water or wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?				X
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?				X
c) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?				X
d) Generate solid waste in excess of State or local standards, or infrastructure, or otherwise impair the attainment of solid waste reduction goals?				X
e) Comply with Federal, State, and local management and reduction statutes and regulations related to solid waste?				X

Discussion:

a) The proposed development does not generate the need for relocation or construction of new or expanded water or wastewater treatment or stormwater drainage, electric power, natural gas, or telecommunications facilities. As discussed under Section X, *Hydrology and Water Quality*, this project site drains to Dix Creek located just south of the subdivision boundary. Storm-water runoff collected from the Project's storm-drain system would be discharged into the open-space areas and the storm-water detention basin at Bel Air Estates Subdivision, Unit 1. Hydrology calculations and design include this Project in the larger subdivision basin. No additional requirements are needed under this section.

b) Potable water is available from the City to serve the Project with adequate pressure and flows for fire suppression. The demands of the Project can be accommodated within the City's existing water resources. Sufficient water supplies are available to serve the Project and reasonably foreseeable future development during normal, dry, and multiple dry years.

c) The Project will utilize the City's sanitary sewer system to dispose of wastewater. Adequate sewer capacity and wastewater treatment is available in the City's existing system to accommodate the 55 single-family homes that would result from the Project.

d) The Project would not generate solid waste in excess of State or local standards, or infrastructure, or otherwise impair the attainment of solid waste reduction goals. The City provides solid waste disposal (curbside pick-up) service, which homes in the subdivision would utilize. Adequate capacity is available to serve the needs of the Project without need of special accommodation.

e) The Project will comply with Federal, State, and local management and reduction statutes and regulations related to solid waste. The City regulates and operates programs that promote the proper disposal of toxic and hazardous materials from households, including those created by the Project.

Documentation:
City of Redding General Plan 2045, Public Facilities and Services Element, 2045
City of Redding Water and Sewer Atlas

Mitigation:
None necessary.

XX. WILDFIRE: *If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:*	**Potentially Significant Impact**	**Less-Than-Significant with Mitigation Incorporated**	**Less-Than-Significant Impact**	**No Impact**
a) Substantially impair an adopted emergency response plan or emergency evacuation Plan?			**X**	
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose projects occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of wildfire?			**X**	
c) Require installation or maintenance of associated infrastructure (such as roads, fuel sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?				**X**
d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result, post-fire slope instability, or drainage changes?				**X**

Discussion:

a) While the Project is located within a mapped Very High Fire Severity Zone, it would not impair an emergency response plan or emergency evacuation plan. The subdivision design includes three smaller neighborhoods with a 16-foot wide fire lane between neighborhoods which will serve as a pedestrian trail in non-emergency situations. Neighborhood “A” has 18 lots, Neighborhood “B” has 24 lots, and Neighborhood “C” has 14 lots, and each individual neighborhood provides access to Quartz Hill Road.

b) The neighborhood pods will be graded to accommodate future development and the trees where the neighborhood pods will be located will be removed. The Dix Creek open space area will be placed in a Landscape Maintenance District that will include fire fuel management of the natural greenbelt area. The Project would not exacerbate wildfire risks or expose project occupants to pollutant concentrations from a wildfire.

c) The Project would not require the installation or maintenance of associated infrastructure that could exacerbate wildfire risks.

d) The Project would not expose people or structures to downstream flooding or landslides.

Documentation:
City of Redding General Plan 2045, Public Safety Element 2045

Mitigation:
None necessary.

XXI. MANDATORY FINDINGS OF SIGNIFICANCE:	Potentially Significant Impact	Less-Than-Significant with Mitigation Incorporated	Less-Than-Significant Impact	No Impact
a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below the self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?		X		
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?			X	
c) Does the project have potential environmental effects which may cause substantial adverse effects on human beings, either directly or indirectly?				X

Discussion:

a) As discussed under *Biological Resources*, if unmitigated, the Project has the potential to impact special status plant and animal species. Mitigation Measures listed have been established to reduce potential impacts to less than significant. The Project also has the potential to degrade wildlife habitat in general due to erosion and sedimentation resulting from grading and construction of Project infrastructure. However, the Project conditions as identified under *Hydrology/Water Quality* have been established to reduce potential impacts to a level less than significant.

b) As discussed in Item III, the Project will contribute to regionwide cumulative air quality impacts. However, under policy of the *General Plan*, application of Standard Mitigation Measures (SMMs) and Best Available Mitigation Measures (BAMMS) will reduce potential impacts from this Project to a level less than significant.

c) As discussed herein, the Project does not have characteristics which could cause substantial adverse effects on human beings, either directly or indirectly.

Documentation:
See all Sections above.

Mitigation:

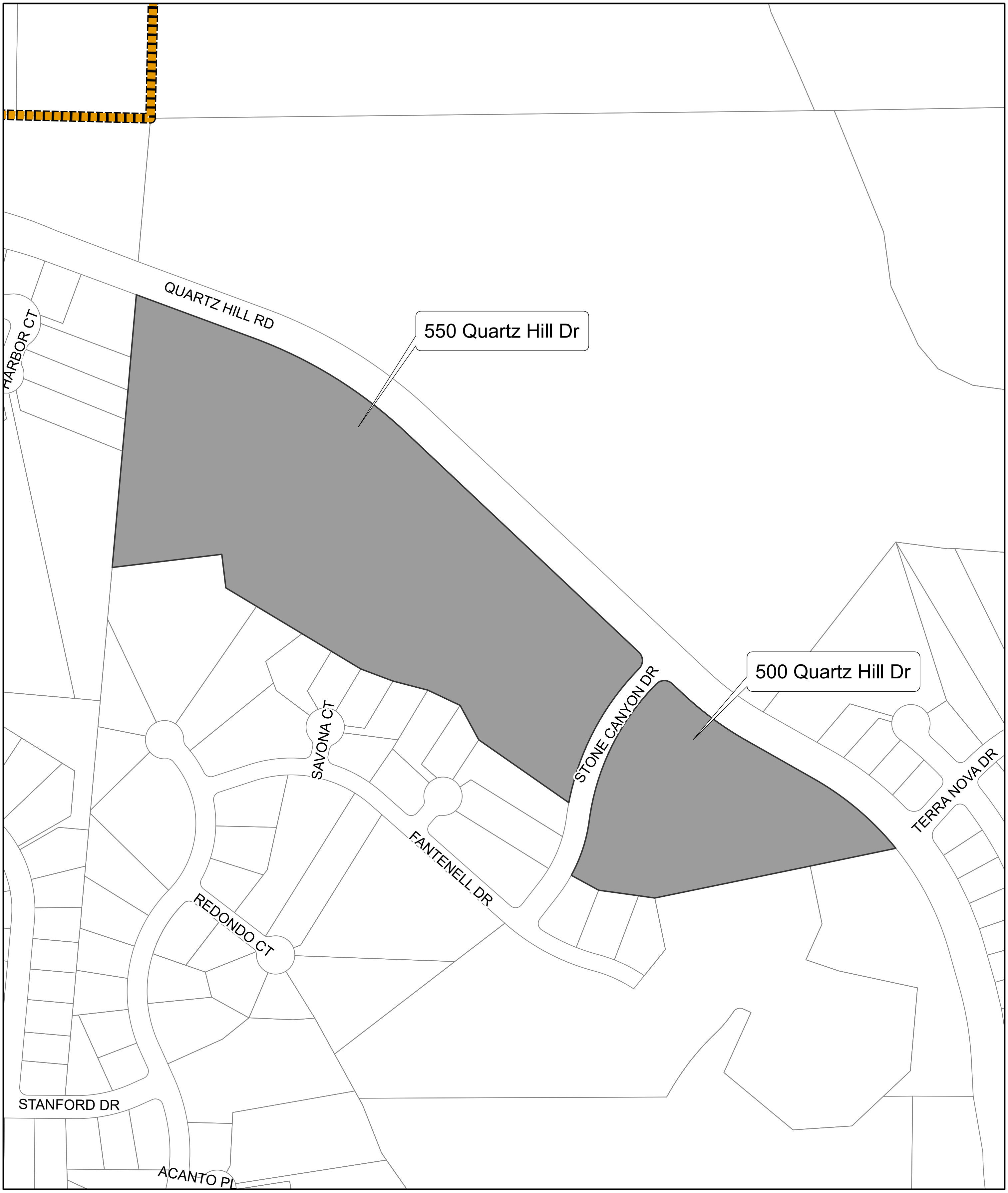
M Bio-1. If vegetation removal or construction activities will occur during the nesting season for migratory birds or raptors (February 1 through August 31), a qualified biologist shall conduct a preconstruction survey seven days before construction activities begin. If nesting birds or raptors are found, CDFW will be notified and consulted. An appropriate buffer, as determined by CDFW and the qualified biologist, will be placed around the nest until the young have fledged. If construction activities cease for a period greater than seven days, additional preconstruction surveys will be required.

MM-Bio-2. If construction (including the removal of large trees) occurs during the bat non-volant season (March 1 through August 31), a qualified professional shall conduct a pre-construction survey of the study area to locate maternity colonies and identify measures to protect colonies from disturbance. The preconstruction survey will be performed no more than seven days prior to the implementation of construction activities. If a maternity colony is located within the study area, or adjacent to the study area, a disturbance-free buffer shall be established by a qualified professional, in consultation with the CDFW, to ensure the colony is protected from Project activities.

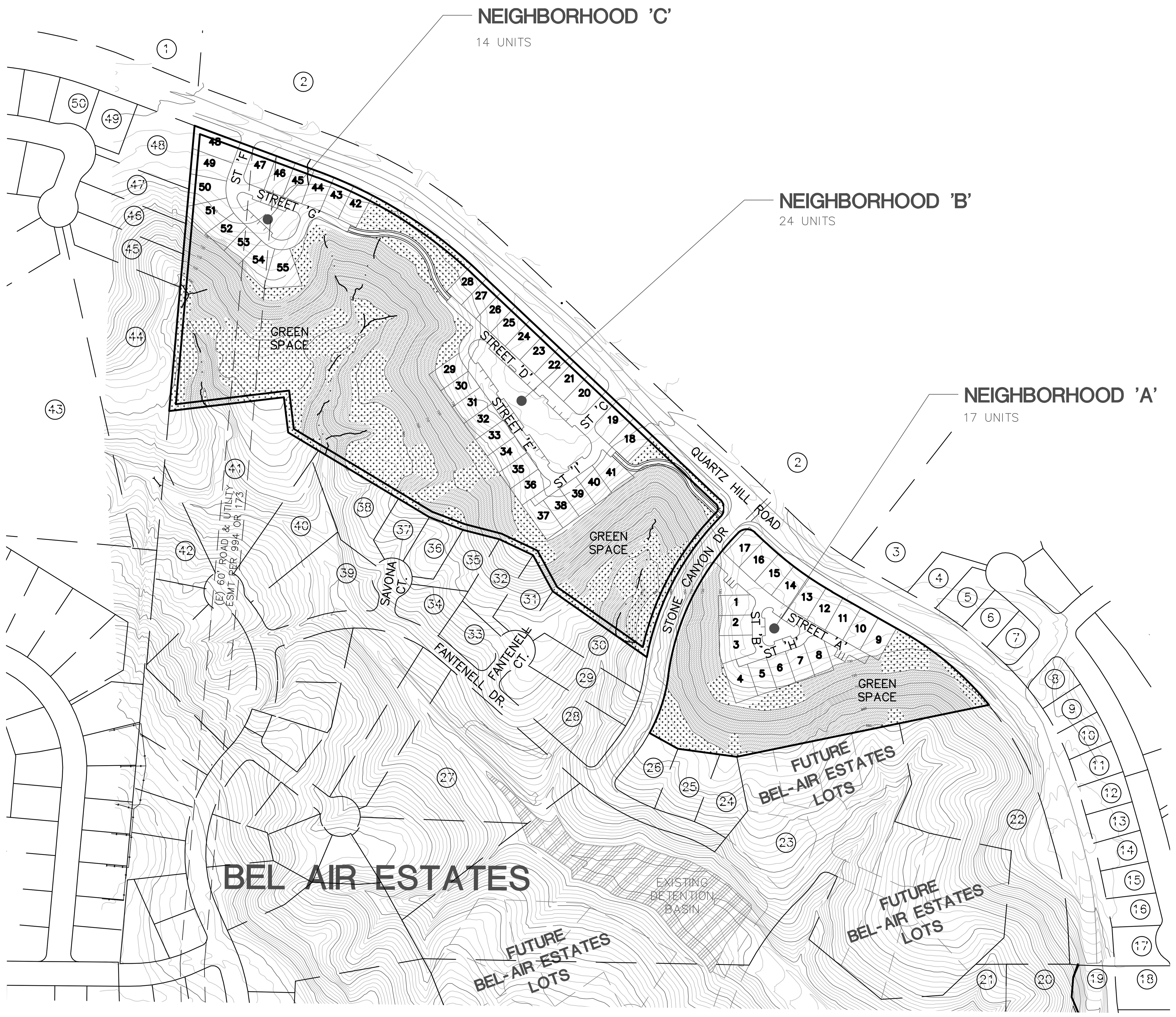
MM-Bio-3. Any impacts to the detention basin identified in the biological report or drainages on the Project site shall have a pre-construction rare plant survey for the Red Bluff dwarf rush conducted by a qualified botanist during the appropriate survey window (blooming period) for rare plants that have the potential to occur within the Project site, as deemed appropriate by the California Department of Fish and Wildlife. Any required survey shall be in accordance with California Native Plant Society *Botanical Survey Guidelines* (CNPS 2001), California Department of Fish and Wildlife *Protocols for Surveying and Evaluating Impacts to Special Status Plant Species Native Plant Populations and Natural Communities* (CDFW 2009), and U.S. Fish and Wildlife's *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 2000). If present, special status plant species plant populations will be flagged and if possible avoided during construction. If the population cannot be avoided during construction a mitigation plan, which could include transplanting the plant population or compensation, will be developed for approval by the California Department of Fish and Wildlife.

Attachment A

Figure 1 – Location Map
Figure 2 – Tentative Subdivision Map Sheets (Pages 1 through 9)
Figure 3 – Planned Development Plan Booklet

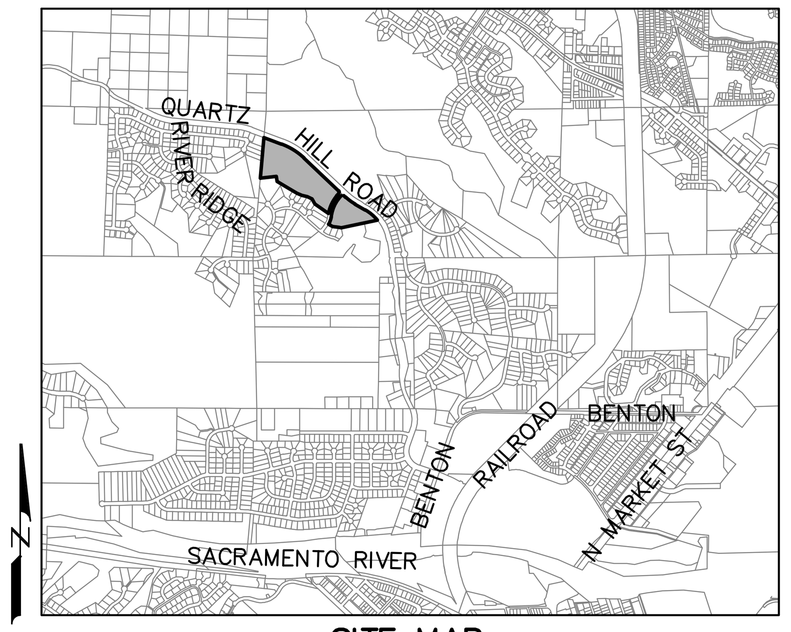


N / W E / S	GIS DIVISION INFORMATION TECHNOLOGY DEPARTMENT	**LOCATION MAP**	MTG. DATE:
	DATE PRODUCED: JUNE 7, 2023	S-2023-00803 COTTAGES AT BELL AIR, LLC 500 & 550 QUARTZ HILL DR AP# 113-190-020 & -019	ITEM:
	0 200 400 Feet		ATTACHMENT:
P:\Planning\ProProjects\S\S-2023-00803.aprx			



LEGEND

- 20%+ SLOPES
- TREE PRESERVATION AREAS
- AQUATIC FEATURES PER GALLAWAY DELINEATION DATED NOVEMBER 2022



SITE MAP
SCALE: NTS

DEVELOPMENT STANDARDS

FRONT YARD BUILDING SETBACK: 12'
FRONT YARD GARAGE SETBACK: 20'
REAR YARD (ADJ. TO GREEN SPACE): 10'
REAR YARD (ADJ. TO QUARTZ HILL): 15'
SIDE YARD: 5'
CORNER SIDE YARD: 12'
INTERNAL STREETS: 24' MIN. – 36'
MIN. LOT WIDTH (AT BLDG SETBACK): 50'

PARKING STANDARDS

GARAGE SPACES: 2 PER UNIT
GUEST SPACES: ON-STREET

CLIENT:

COTTAGES AT BEL AIR, LLC
2040 TREFOIL RD
SAN RAMON, CA 94582

OWNER:

COTTAGES AT BEL AIR, LLC
2040 TREFOIL RD
SAN RAMON, CA 94582

ENGINEER:

SHARRAH DUNLAP SAWYER, INC.
320 HARTNELL AVE
REDDING, CA 96002

SITE DATA

A.P.# 113-190-019, 113-190-020
GENERAL PLAN: RES 6-10
ZONING: RM-9-PD
EXISTING USE: VACANT
PROPOSED USE: 55 LOT SUBDIVISION
SITE AREA: 24.5 AC
GREEN SPACE:
20% & GREATER SLOPES: 7.8 AC
TREE PRESERVATION: 5.1 AC
PROJECT AREA: 11.6 AC
AREA IN ROADS: 1.9 AC
INTERIOR GREEN SPACE: 1.0 AC
NET PROJECT AREA: 8.7 AC
DENSITY: 6.3 DU/AC
ELECTRICITY: CITY OF REDDING
WATER: CITY OF REDDING
SEWER: CITY OF REDDING
TELEPHONE: AT&T

ADJACENT PARCEL OWNERS

1. 115-170-014
QUARTZ HILL LAND, LLC
2040 TREFOIL RD
SAN RAMON, CA 94582
2. 113-190-014
WALKER REV TRUST
555 QUARTZ HILL RD
REDDING, CA 96003
3. 113-350-008
KELLIHER
595 RIVER PARK DR
REDDING, CA 96003
4. 113-350-007
RATHBUN 2012 TRUST
592 RIVER PARK DRIVE
5. 113-350-006
SCHAARSCHMIDT
562 RIVER PARK DR
REDDING, CA 96003
6. 113-350-005
GOMES
532 RIVER PARK DR
REDDING, CA 96003
7. 113-350-004
THOMPSON
502 RIVER PARK DR
REDDING, CA 96003
8. 113-350-003
BARAJAS
18375 MEADOW RIDGE DR
SALINAS, CA 93907
9. 113-350-002
BOONE REV TRUST
20279 ENGINEERS LN
REDDING, CA 96002
10. 113-350-001
HAAGENSON
490 RIVER PARK DR
REDDING, CA 96003
11. 113-360-001
COFFEE FAMILY LIV TRUST
486 RIVER PARK DR
REDDING, CA 96003
12. 113-360-002
PARKER FAMILY 1995 TRUST
1767 LAKESIDE DR
REDDING, CA 96001
13. 113-360-003
SEAMANS
3643 SUNBIRD CT
REDDING, CA 96001
14. 113-360-004
MAWMAN
478 RIVER PARK DR
REDDING, CA 96003
15. 113-360-005
WATSON LIVING TRUST
476 RIVER PARK DR
REDDING CA 96003
16. 113-360-006
GERMANN
474 RIVER PARK DR
REDDING, CA 96003
17. 113-360-007
GRUTTER TRUST 2008
PO BOX 726
PALERMO, CA 95968
18. 112-010-020
GAYNOR REV TRUST
4258 DORGAN DR
REDDING, CA 96002
19. CITY OF REDDING
(QUARTZ HILL RD)
20. 112-010-006
TAGLIAFERRI TRUST
79 DAILY DR, STE 277
CAMARILLO, CA 93010
21. 113-190-032
CHJ BEL AIR PROPERTIES
PO BOX 989
SHINGLE SPRINGS, 95682
22. 113-190-021
CHJ BEL AIR PROPERTIES
PO BOX 989
SHINGLE SPRINGS, 95682
23. 113-190-030
CHJ BEL AIR PROPERTIES
PO BOX 989
SHINGLE SPRINGS, 95682
24. 113-400-022
COREY
PO BOX 993591
REDDING, CA 96099
25. 113-400-021
MIDDLETON HOMES CORP
16555 CELTIC CT
REDDING, CA 96001
26. 113-400-020
ERKSKINE REV TRUST
2894 FANTANELL CT
REDDING, CA 96003
27. 113-390-031
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3128 REDONDO CT
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DOBSON 2016 TRUST
947 FANTANELL CT
REDDING, CA 96003-5430
30. 113-400-017
RHODERICK
997 FANTANELL CT
REDDING, CA 96003
31. 113-400-016
SILVERIA
992 FANTANELL CT
REDDING, CA 96003
32. 113-400-015
BROWN
956 FANTANELL CT
REDDING, CA 96003
33. 113-400-014
LAUGHLIN TRUST
926 FANTANELL CT
REDDING, CA 96003-5430
34. 113-400-013
HILDEBRAND
911 SAVONA CT
REDDING, CA 96003
35. 113-400-012
TWEEDY
PO BOX 5001
SAN LUIS OBISPO, CA 96403
36. 113-400-011
TOTH
991 SAVONA CT
REDDING, CA 96003
37. 113-400-010
THAO
996 SAVONA CT
REDDING, CA 96003
38. 113-400-009
HENRY
976 SAVONA CT
REDDING, CA 96003
39. 113-400-008
CHIMENTI
925 BELLAGIO TERRACE
REDDING, CA 96003
40. 113-400-007
HALTER
961 BELLAGIO TERRACE
REDDING, CA 96003
41. 113-400-006
HILL
PO BOX 991065
REDDING, CA 96099
42. 113-400-005
GWIN
990 BELLAGIO TERRACE
REDDING, CA 96003
43. 115-490-003
HOUSTON
1409 HARBOR CT
REDDING, CA 96003
44. 115-490-002
DEFILIPPO
1427 HARBOR CT
REDDING, CA 96003
45. 115-490-001
IVICEVICH TRUST
19533 SAN VINCENTE DR
REDDING, CA 96003
46. 115-400-029
PARKER FAMILY TRUST
1767 LAKESIDE
REDDING, CA 96001
47. 115-400-028
RUFFCORN
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REDDING, CA 96003
48. 115-400-027
KELLY
1499 HARBOR CT
REDDING, CA 96003
49. 115-400-026
HAMILTON
3312 OLD LANTERN DR
REDDING, CA 96003
50. 115-400-025
LOPEZ REV LIV TRUST
3318 OLD LANTERN DR
REDDING, CA 96003

N

200 0 100 200
1 INCH = 200 FEET

THE COTTAGES AT BEL AIR TENTATIVE SUBDIVISION MAP & PLANNED DEVELOPMENT COVER SHEET

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

FOR

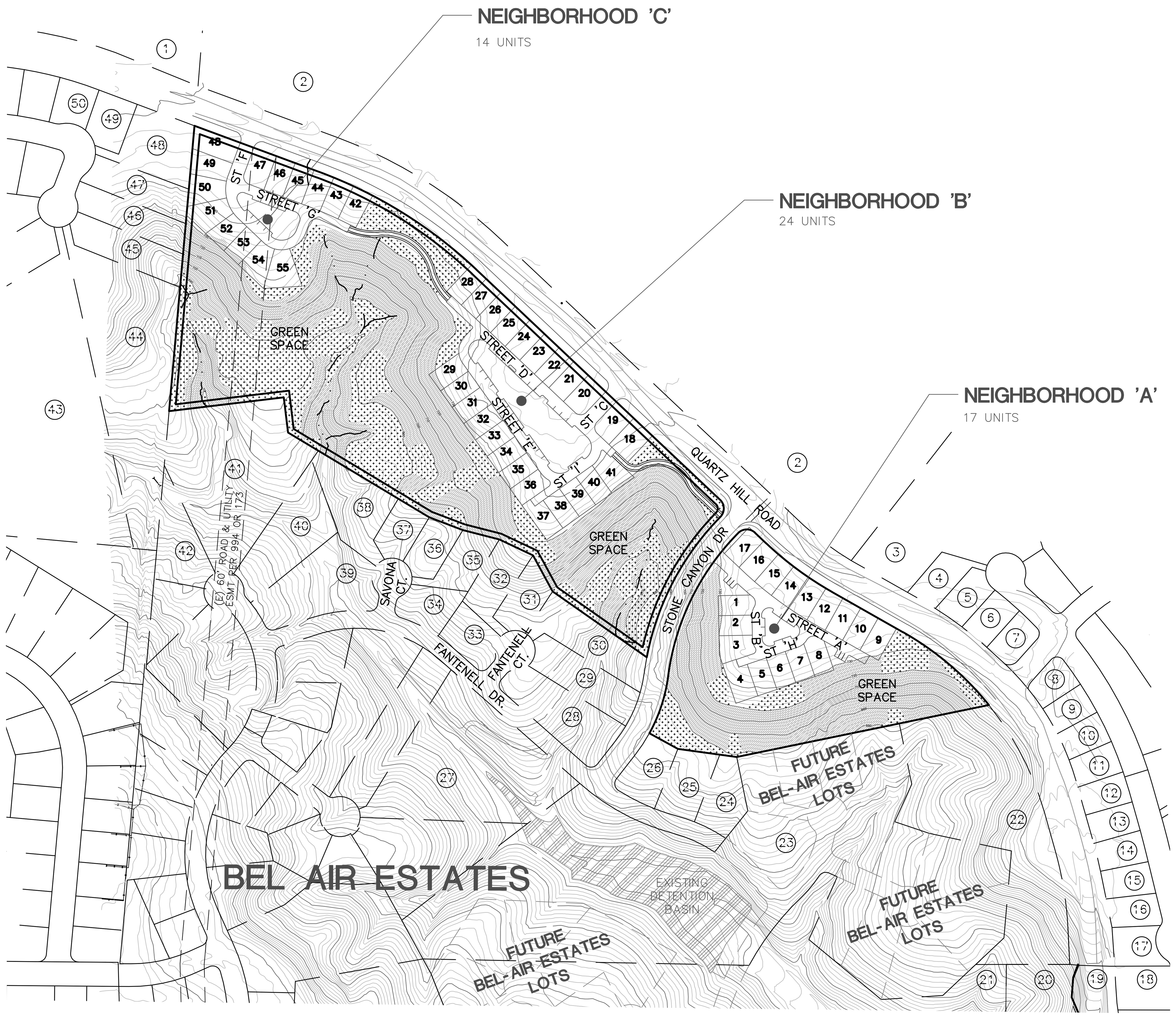
COTTAGES AT BEL AIR, LLC

BY

SHARRAH DUNLAP SAWYER, INC.
Civil Engineering • Land Planning • Surveying & Mapping
Landscape Architecture • Presentation Graphics
320 Hartnell Avenue, Redding, CA 96002
530.221.1792 voice • info@sdsengineering.com

DATE: OCTOBER 25, 2024 SCALE: 1"=200' SHEET 1 OF 8

TLM/NLD P: /proj/p/22165/dwg/22165tm.dwg 22165

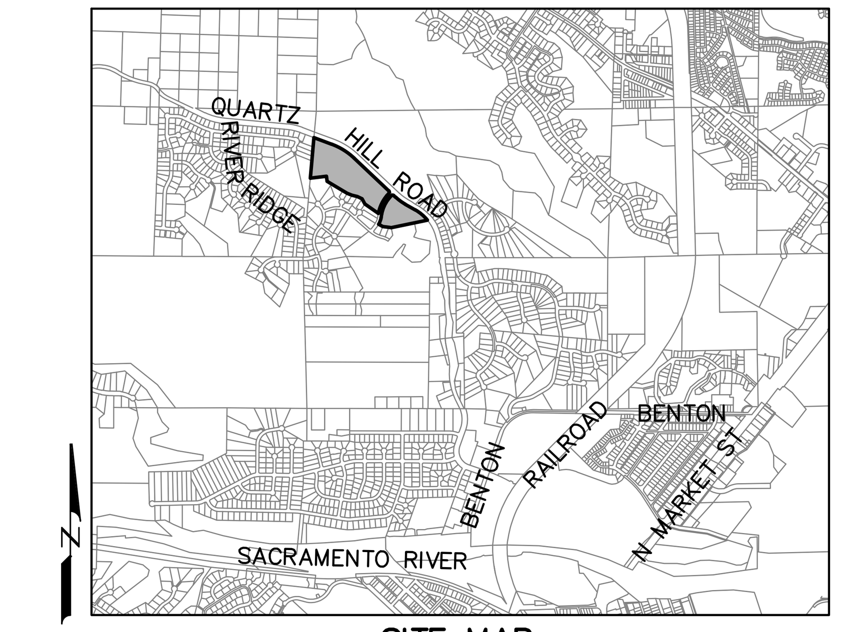


LEGEND

20%+ SLOPES

TREE PRESERVATION AREAS

AQUATIC FEATURES PER GALLAWAY DELINEATION DATED NOVEMBER 2022



SITE MAP
SCALE: NTS

DEVELOPMENT STANDARDS

FRONT YARD BUILDING SETBACK: 12'
FRONT YARD GARAGE SETBACK: 20'
REAR YARD (ADJ. TO GREEN SPACE): 10'
REAR YARD (ADJ. TO QUARTZ HILL): 15'
SIDE YARD: 5'
CORNER SIDE YARD: 12'
INTERNAL STREETS: 24' MIN. – 36'
MIN. LOT WIDTH (AT BLDG SETBACK): 50'

PARKING STANDARDS

GARAGE SPACES: 2 PER UNIT
GUEST SPACES: ON-STREET

CLIENT:

COTTAGES AT BEL AIR, LLC
2040 TREFOIL RD
SAN RAMON, CA 94582

OWNER:

COTTAGES AT BEL AIR, LLC
2040 TREFOIL RD
SAN RAMON, CA 94582

ENGINEER:

SHARRAH DUNLAP SAWYER, INC.
320 HARTNELL AVE
REDDING, CA 96002

SITE DATA

A.P.# 113–190–019, 113–190–020
GENERAL PLAN: RES 6–10
ZONING: RM–9–PD
EXISTING USE: VACANT
PROPOSED USE: 55 LOT SUBDIVISION
SITE AREA: 24.5 AC
GREEN SPACE:
20% & GREATER SLOPES: 7.8 AC
TREE PRESERVATION: 5.1 AC
PROJECT AREA: 11.6 AC
AREA IN ROADS: 1.9 AC
INTERIOR GREEN SPACE: 1.0 AC
NET PROJECT AREA: 8.7 AC
DENSITY: 6.8 DU/AC
ELECTRICITY: CITY OF REDDING
WATER: CITY OF REDDING
SEWER: CITY OF REDDING
TELEPHONE: AT&T

ADJACENT PARCEL OWNERS

1. 115–170–014
QUARTZ HILL LAND, LLC
2040 TREFOIL RD
SAN RAMON, CA 94582

2. 113–190–014
WALKER REV TRUST
555 QUARTZ HILL RD
REDDING, CA 96003

3. 113–350–008
KELLIHER
595 RIVER PARK DR
REDDING, CA 96003

4. 113–350–007
RATHBUN 2012 TRUST
592 RIVER PARK DRIVE

5. 113–350–006
SCHAARSCHMIDT
562 RIVER PARK DR
REDDING, CA 96003

6. 113–350–005
GOMES
532 RIVER PARK DR
REDDING, CA 96003

7. 113–350–004
THOMPSON
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REDDING, CA 96003

8. 113–350–003
BARAJAS
18375 MEADOW RIDGE DR
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1767 LAKESIDE DR
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SEAMANS
3643 SUNBIRD CT
REDDING, CA 96001

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REDDING, CA 96003

15. 113–360–005
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16. 113–360–006
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CHJ BEL AIR PROPERTIES
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SHINGLE SPRINGS, 95682

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COREY
PO BOX 993591
REDDING, CA 96099

25. 113–400–021
MIDDLETON HOMES CORP
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49. 115–400–026
HAMILTON
3312 OLD LANTERN DR
REDDING, CA 96003

50. 115–400–025
LOPEZ REV LIV TRUST
3318 OLD LANTERN DR
REDDING, CA 96003

200 0 100 200
1 INCH = 200 FEET

THE COTTAGES AT BEL AIR TENTATIVE SUBDIVISION MAP & PLANNED DEVELOPMENT COVER SHEET

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

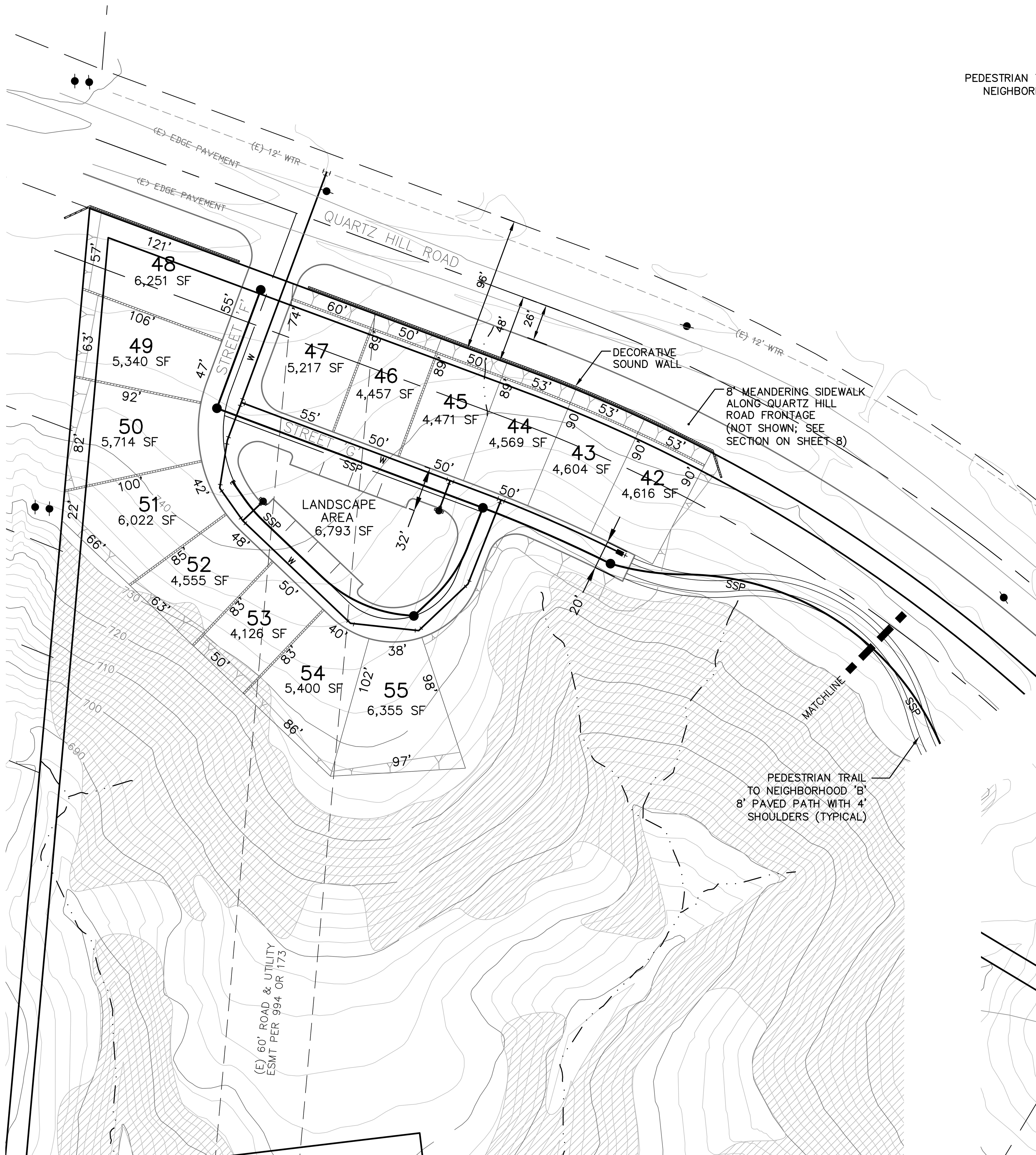
FOR

COTTAGES AT BEL AIR, LLC

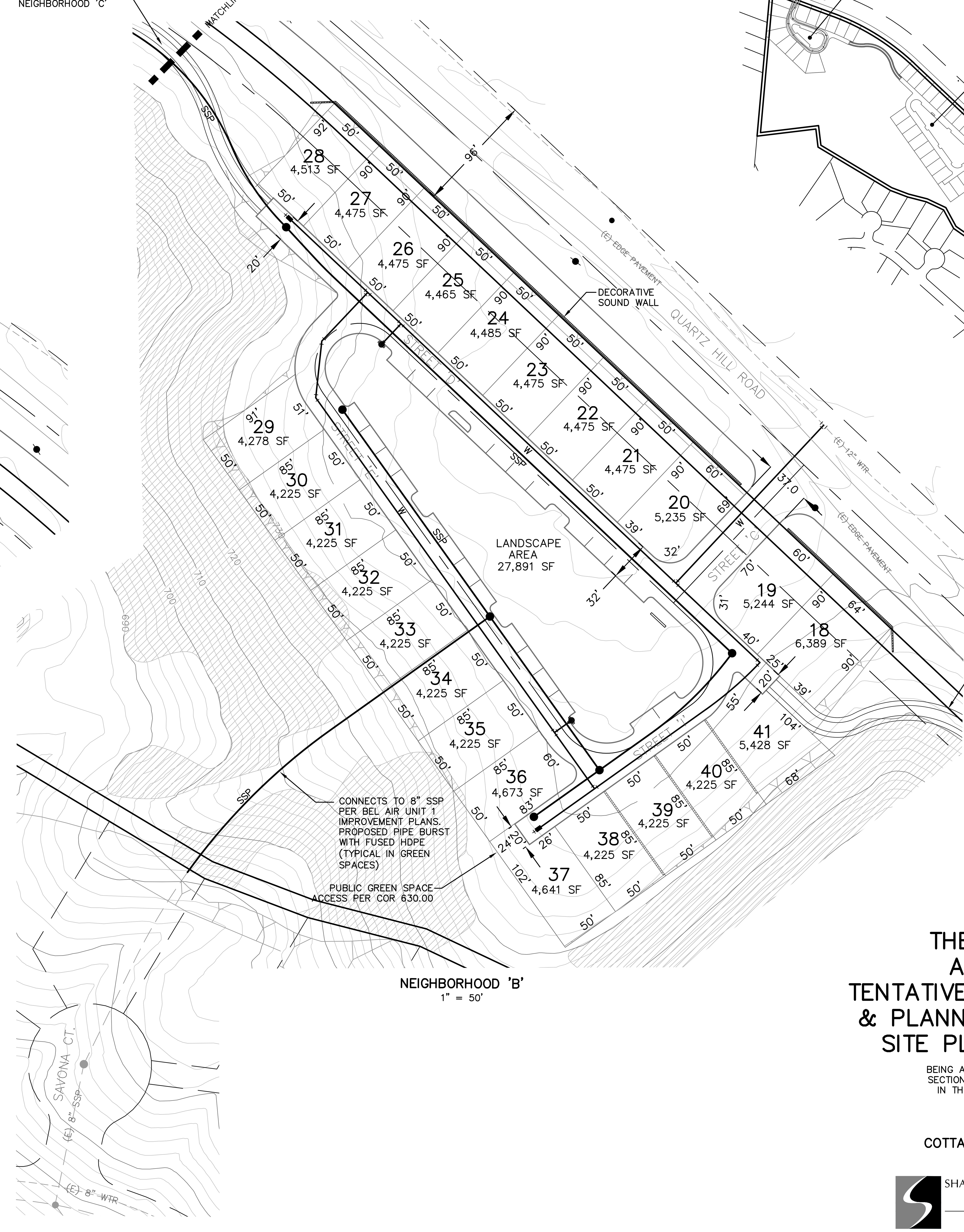
BY

SHARRAH DUNLAP SAWYER, INC.
Civil Engineering • Land Planning • Surveying & Mapping
Landscape Architecture • Presentation Graphics
320 Hartnell Avenue, Redding, CA 96002
530.221.1792 voice • info@sdsengineering.com

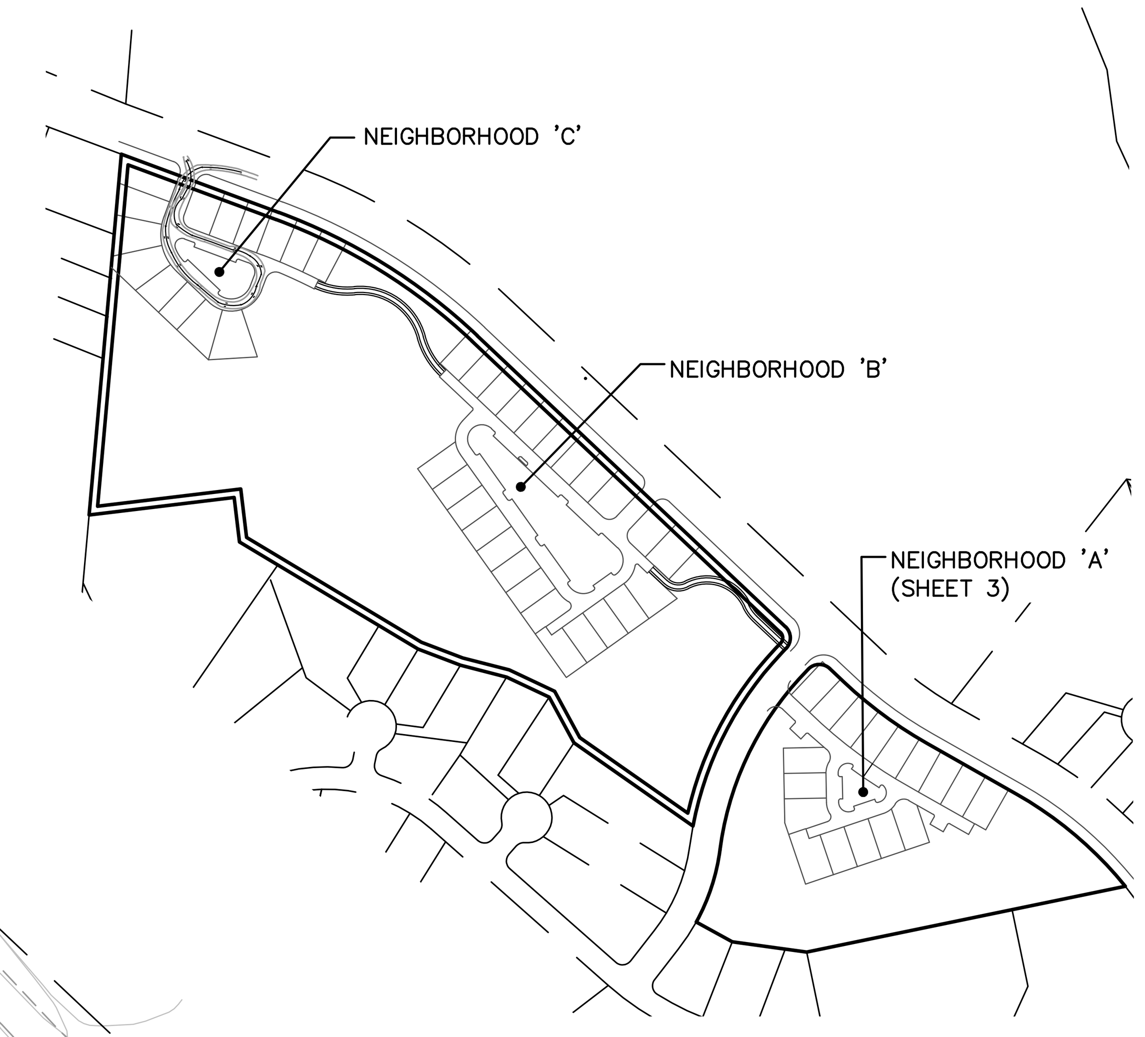
DATE: OCTOBER 25, 2024 SCALE: 1"=200' SHEET 1 OF 8
TLM/NLD P:/proj/p/22165/dwg/22165tm.dwg 22165



NEIGHBORHOOD 'C'
1" = 50'



NEIGHBORHOOD 'B'
1" = 50'



KEY MAP
1" = 300'

LEGEND

- 20% & GREATER SLOPES
- PROPOSED WATER LINE (WITH TEE & BLOWOFF)
- PROPOSED SEWER LINE (WITH MANHOLE)
- EXISTING POWER POLE
- AQUATIC FEATURES PER GALLAWAY DELINEATION DATED NOVEMBER 2022

50 0 25 50
1 INCH = 50 FEET

THE COTTAGES AT BEL AIR TENTATIVE SUBDIVISION MAP & PLANNED DEVELOPMENT SITE PLAN & UTILITIES

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

FOR

COTTAGES AT BEL AIR, LLC

BY

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Landscape Architecture • Presentation Graphics
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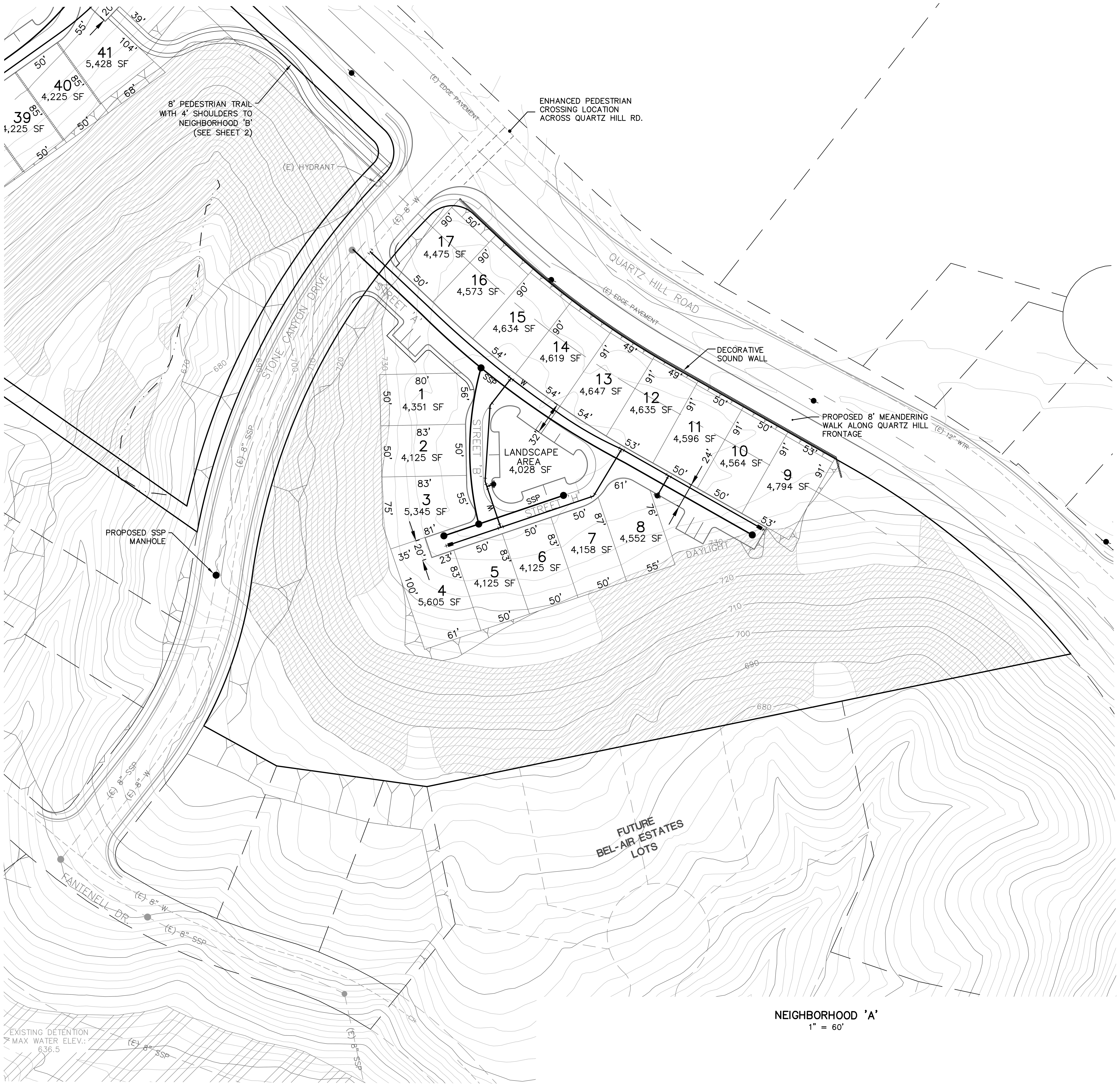
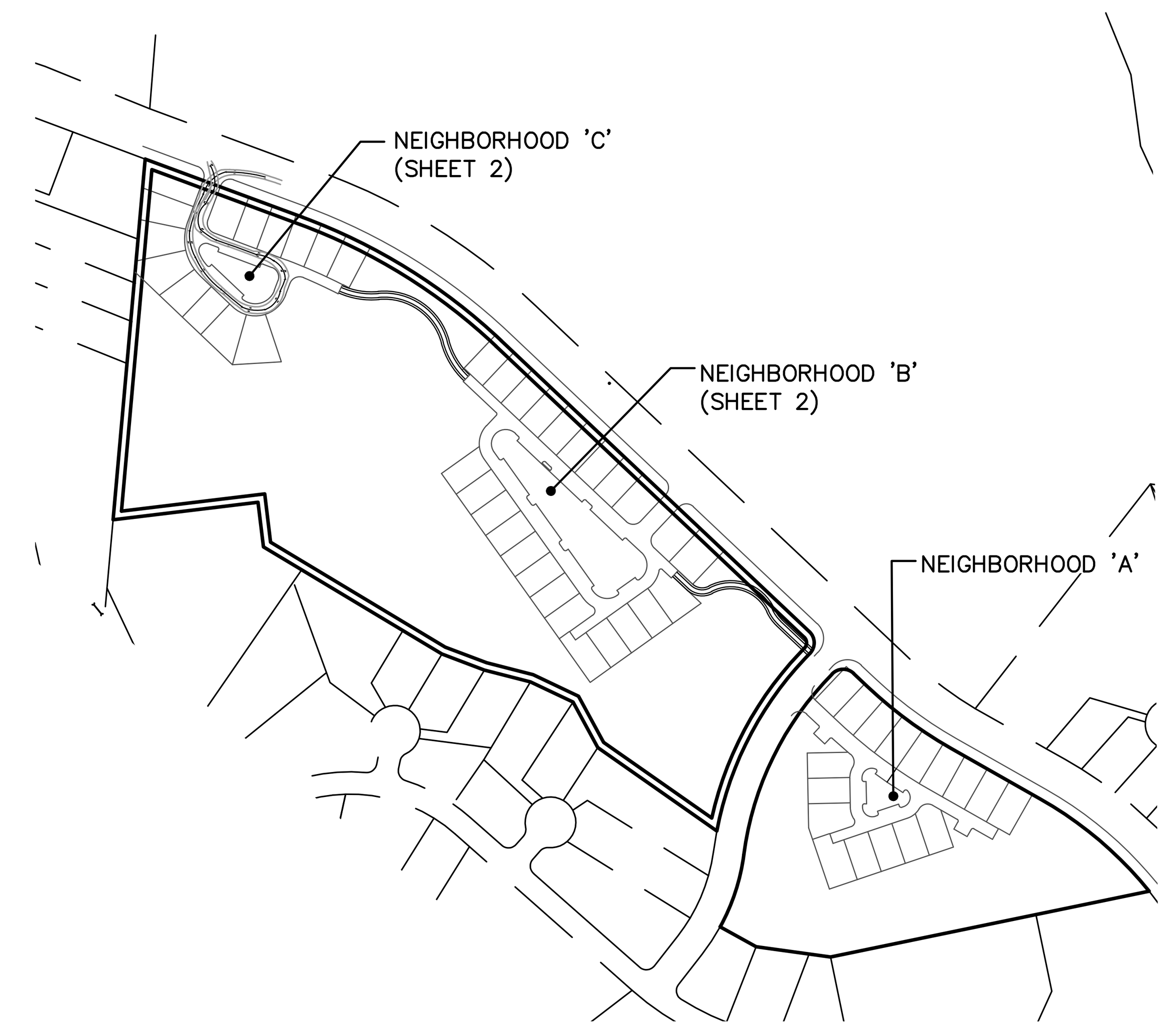
DATE:	OCTOBER 25, 2024	SCALE: 1"=50'	SHEET 2 OF 8
TLM/NLD		P: /proj/p/22165/dwg/22165tm.dwg	22165



NEIGHBORHOOD 'A'
1" = 60'



KEY MAP
1" = 300'

LEGEND

(hatch)	20% & GREATER SLOPES
W	PROPOSED WATER LINE (WITH TEE & BLOWOFF)
SSP	PROPOSED SEWER LINE (WITH MANHOLE)
	EXISTING POWER POLE
	AQUATIC FEATURES PER GALLAWAY DELINEATION DATED NOVEMBER 2022

N

50 0 25 50
1 INCH = 50 FEET

THE COTTAGES AT BEL AIR TENTATIVE SUBDIVISION MAP & PLANNED DEVELOPMENT SITE PLAN & UTILITIES

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA
FOR

COTTAGES AT BEL AIR, LLC

BY

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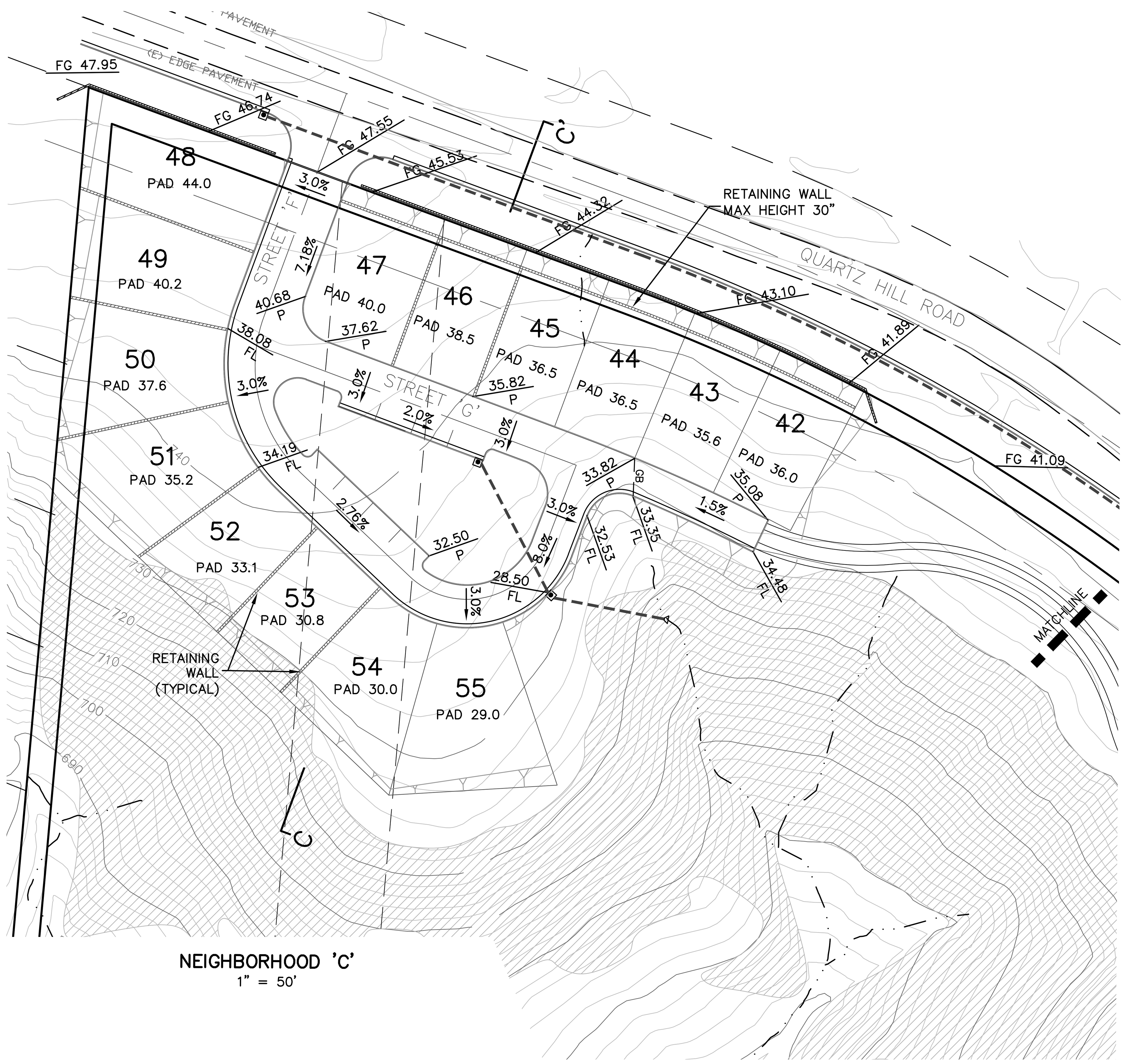
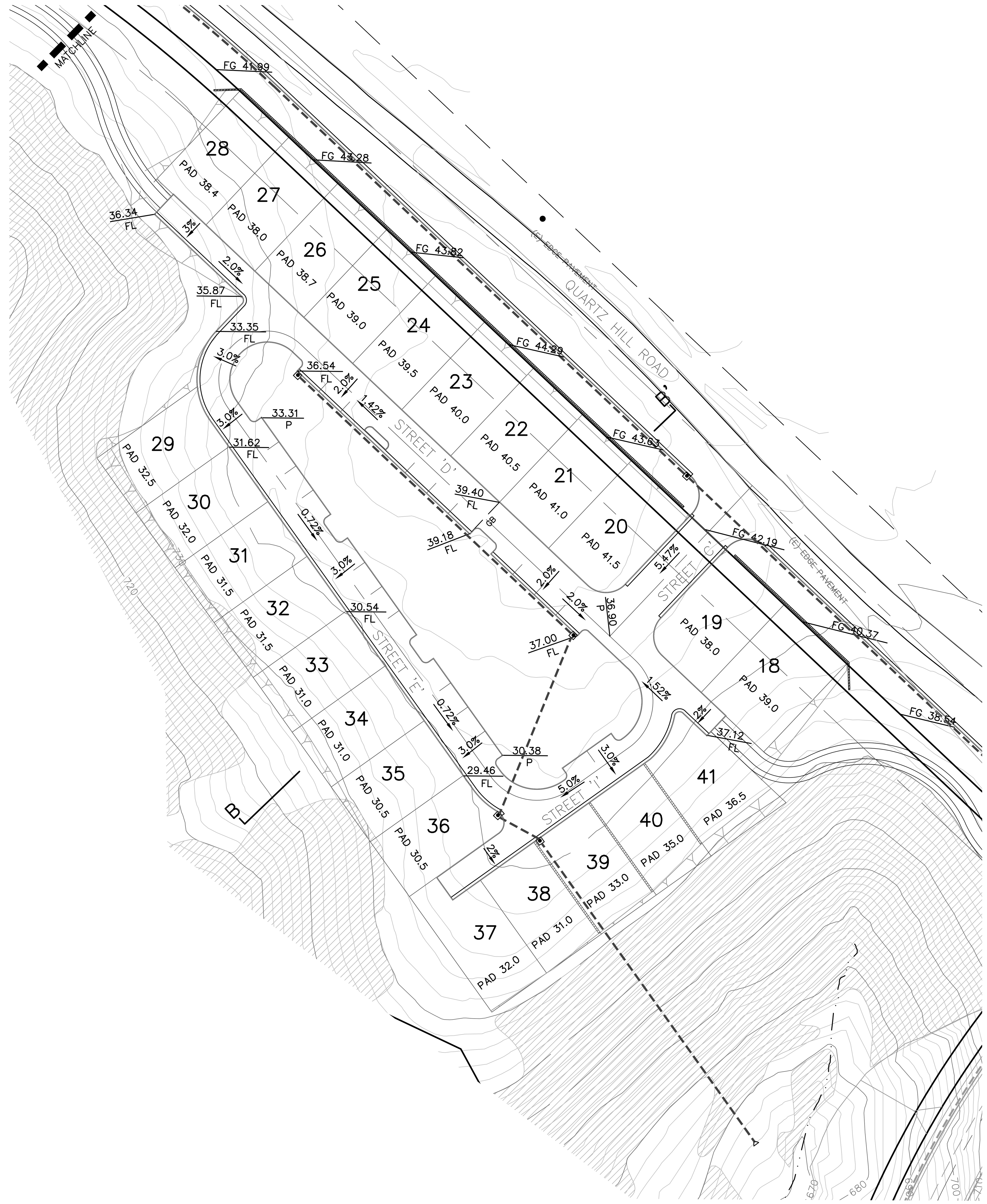
DATE: OCTOBER 25, 2024 SCALE: 1"=50' SHEET 3 OF 8
TLM/NLD P:/proj/p/22165/dwg/22165tm.dwg 22165



NEIGHBORHOOD 'C'
1" = 50'



NEIGHBORHOOD 'B'
1" = 50'

LEGEND

(hatched area)	20% & GREATER SLOPES
(dashed line)	PROPOSED STORM DRAIN LINE
(dash-dot line)	AQUATIC FEATURES PER GALLAWAY DELINEATION DATED NOVEMBER 2022

NOTE: SECTION LINES REFER TO CROSS SECTIONS ON SHEET 6 OF 6

N

50 0 25 50
1 INCH = 50 FEET

THE COTTAGES AT BEL AIR PRELIMINARY GRADING PLAN

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

FOR

COTTAGES AT BEL AIR, LLC

BY

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Civil Engineering • Land Planning • Surveying & Mapping
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320 Hartnell Avenue, Redding, CA 96002
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DATE: OCTOBER 25, 2024 SCALE: 1"=50' SHEET 4 OF 8
TLM/NLD P:/proj/s/22165/dwg/22165tm.dwg 22165

NEIGHBORHOOD A

LEGEND

20% & GREATER SLOPES

PROPOSED STORM DRAIN LINE

EXISTING STORM DRAIN LINE

AQUATIC FEATURES PER GALLAWAY DELINEATION DATED NOVEMBER 2022

EXISTING DETENTION BASIN PER GALLAWAY DELINEATION

NOTE: SECTION LINES REFER TO CROSS SECTIONS ON SHEET 6 OF 6

N

50 0 25 50
1 INCH = 50 FEET

THE COTTAGES AT BEL AIR PRELIMINARY GRADING PLAN

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

FOR

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DATE:	OCTOBER 25, 2024	SCALE: 1"=50'	SHEET 5 OF 8
TLM/NLD	P:/proj/p/22165/dwg/22165tm.dwg		22165

LEGEND

- 20% SLOPE (7.8 AC)
- TREE PRESERVATION OUTSIDE OF STEEP SLOPE (5.1 AC)
- TREE CANOPY PER TREE ASSESSMENT BY GALLAWAY ENTERPRISES DATED NOVEMBER 2022 (5.98 AC)
- AQUATIC FEATURES PER GALLAWAY DELINEATION DATED NOVEMBER 2022
- TS# — TREE STAND IDENTIFICATION PER TREE HEALTH ASSESSMENT BY GALLAWAY DATED APRIL 2024 – SEE TREE RESOURCES HEALTH ASSESSMENT TABLE THIS SHEET

TREE DATA

BASED ON THE DATA WITHIN THE TREE ASSESSMENT:

NUMBER OF TREES TO BE REMOVED:	350
NUMBER OF TREES TO REMAIN:	759 (68% OF EXISTING TREES TO REMAIN) 459 WITHIN 20% SLOPE 300 OUTSIDE OF 20% SLOPE
TOTAL NUMBER OF EXISTING TREES:	1109

FUTURE PLANTING:

QUARTZ HILL ROAD FRONTAGE:	80
WITHIN PARK SPACES & TRAIL:	55
ON LOTS (3 TREES PER LOT):	165
TREES TO BE PLANTED WITH DEVELOPMENT:	300

NOTES:

NUMBER OF TREES TO BE REMOVED AND TO REMAIN ARE ESTIMATES BASED ON THE EXTRAPOLATION USED TO ASSESS THE TREES ON SITE.

FUTURE PLANTING NUMBERS ARE ESTIMATES.

TREE RESOURCES HEALTH ASSESSMENT

TREE STAND #	SPECIES	RATING
TS1	BLUE OAK	3
TS2	BLUE OAK & GRAY PINE	2
TS3	BLUE OAK & GRAY PINE	3
TS4	BLUE OAK	1
TS5	BLUE OAK & GRAY PINE	3
TS6	BLUE OAK	1
TS7	BLUE OAK & INTERIOR LIVE OAK	2
TS8	BLUE OAK	1
TS9	BLUE OAK	3

THE COTTAGES AT BEL AIR NATURAL RESOURCES DIAGRAM

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

FOR

COTTAGES AT BEL AIR, LLC

100 0 50 100
1 INCH = 100 FEET

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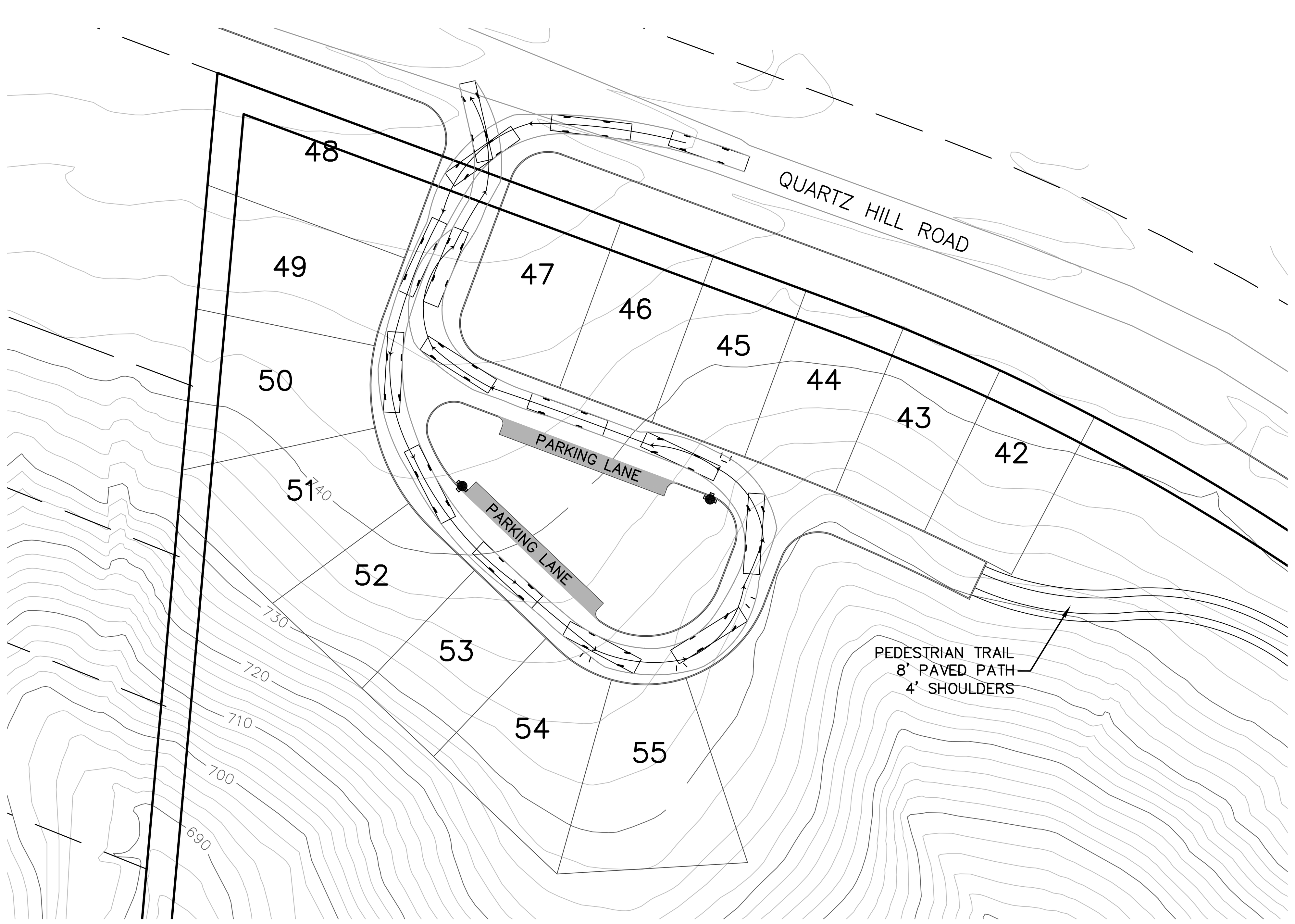
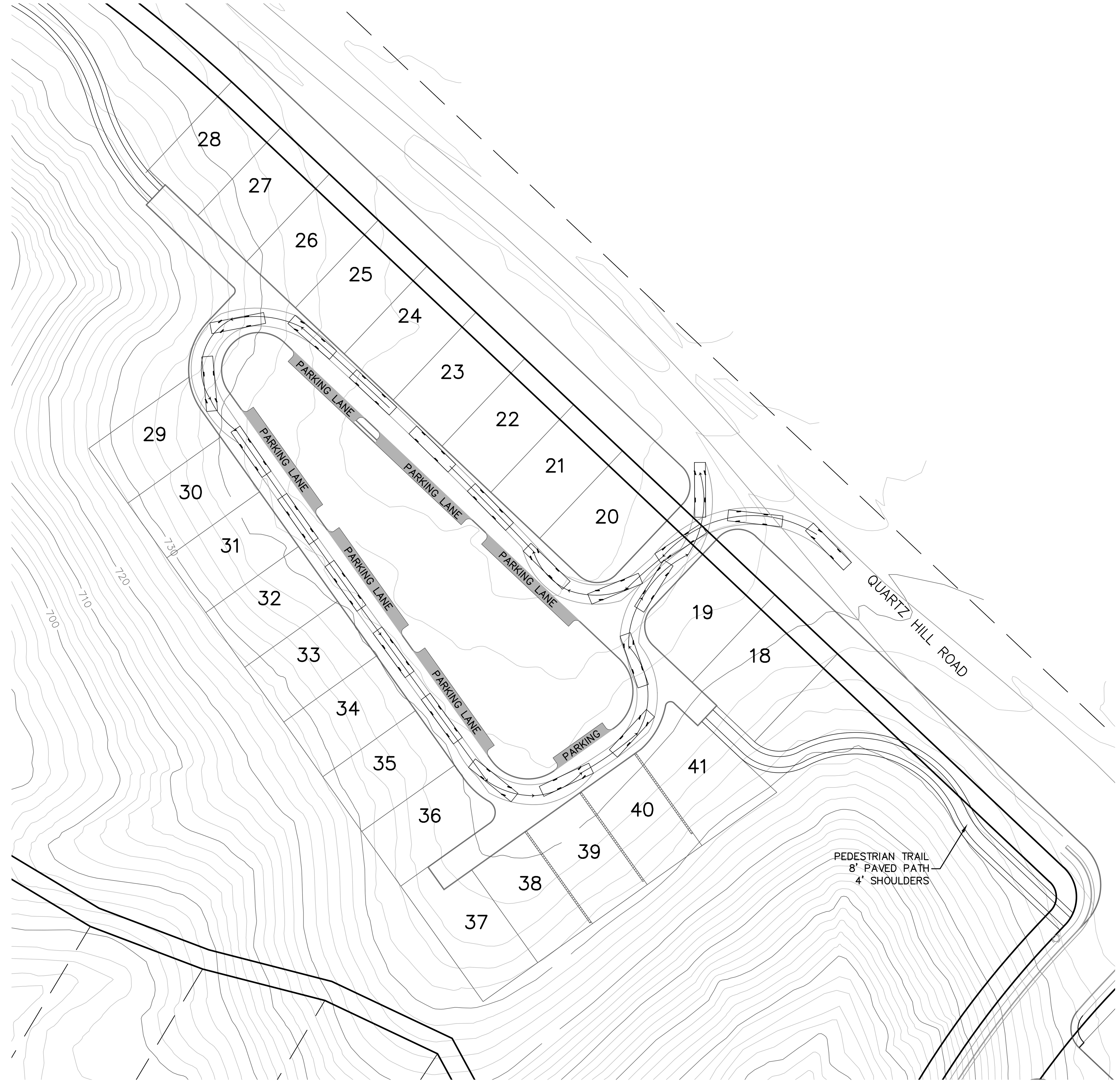
DATE: OCTOBER 25, 2024 SCALE: 1"=100' SHEET 6 OF 8

TLM/NLD P:/proj/p/22165/dwg/22165tm.dwg 22165

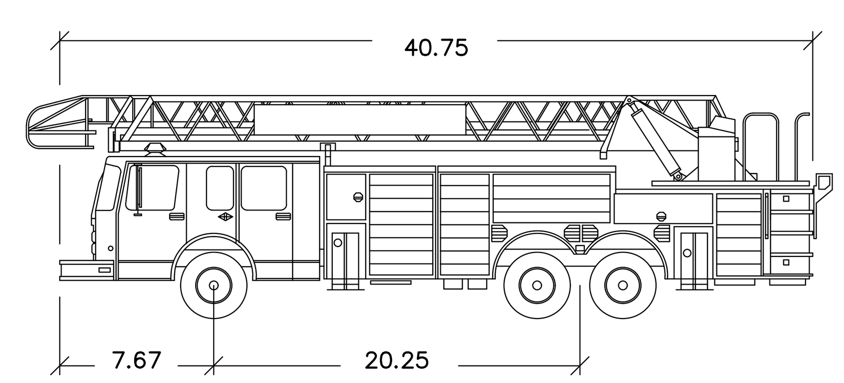


NEIGHBORHOOD C

NEIGHBORHOOD A

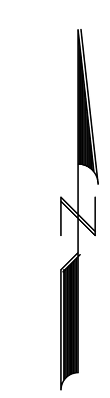


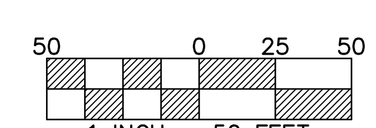
NEIGHBORHOOD B



COR "FIRE 2"

WIDTH	:	8.17'
TRACK	:	8.17'
STEERING ANGLE	:	29.30'





THE COTTAGES AT BEL AIR FIRE ACCESS EXHIBIT

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

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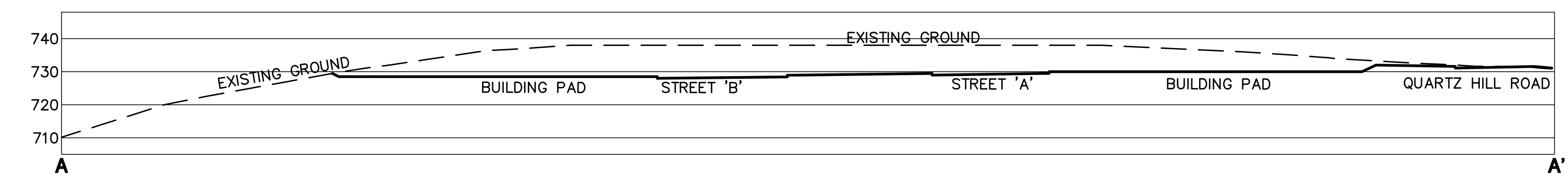
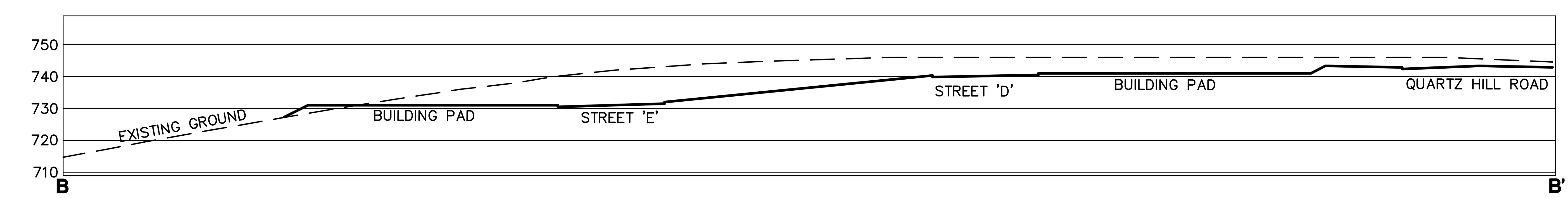


NEIGHBORHOOD A
1'=30"



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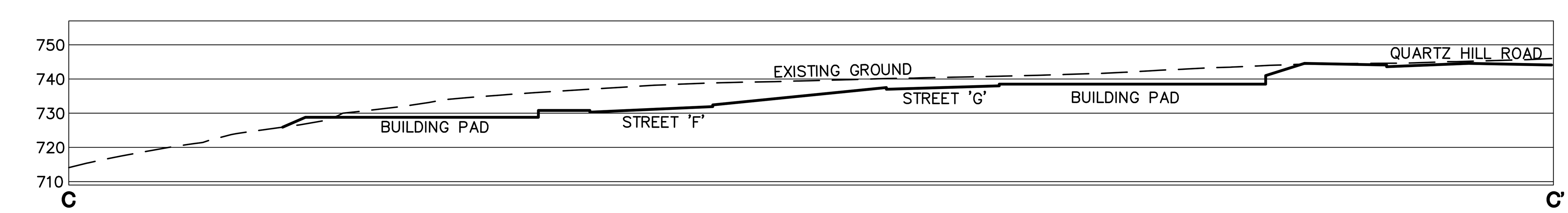
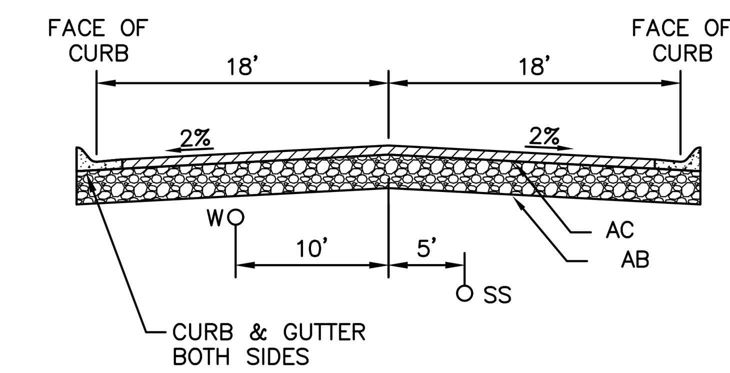
1'=30"

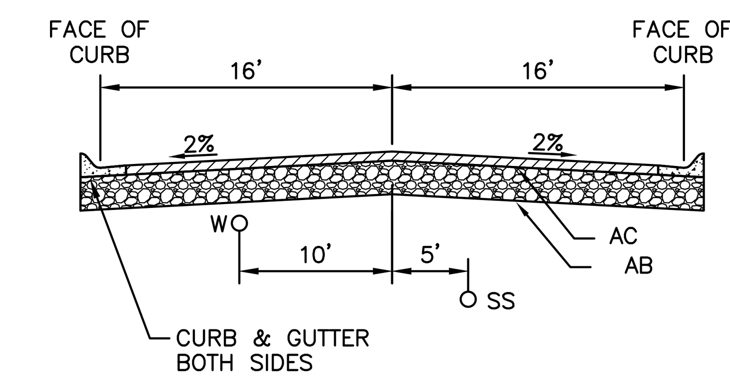


NEIGHBORHOOD C
1'=30"

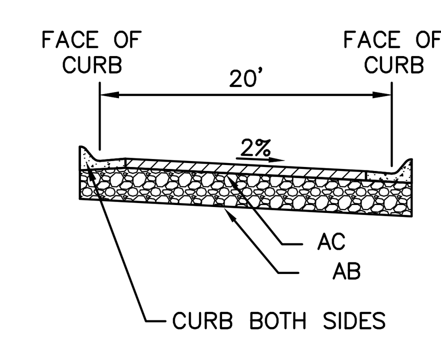
PRIVATE ROAD SECTIONS



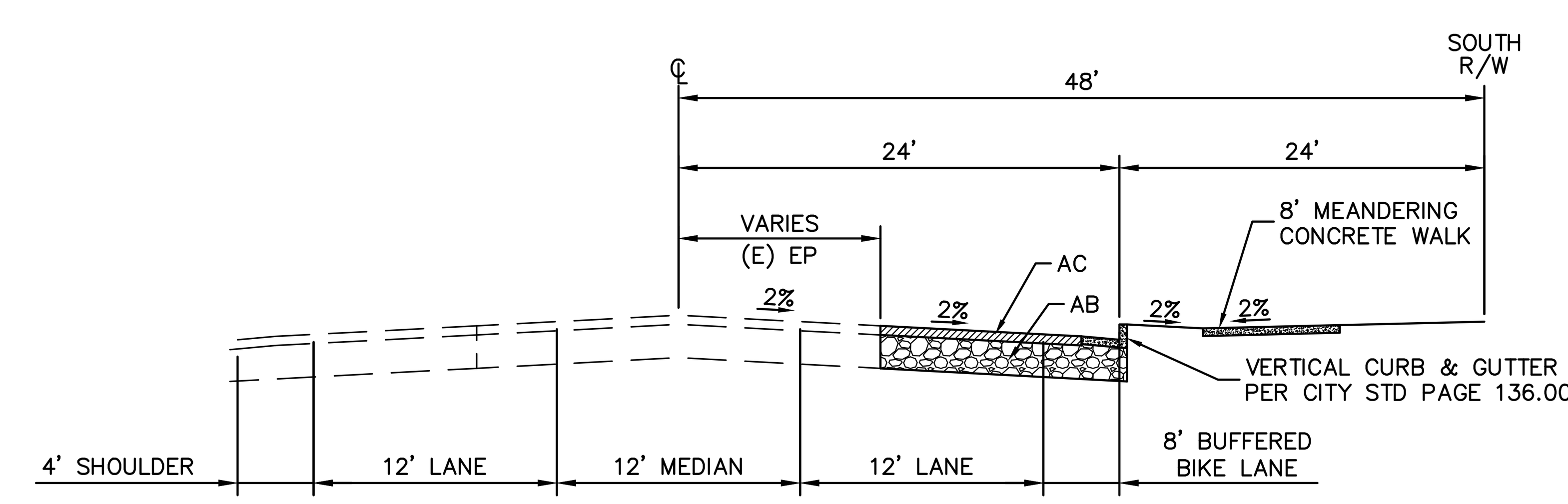
TYPICAL 36' SECTION
PORTIONS OF A,F ALL OF C
N.T.S.



TYPICAL 32' SECTION
PORTIONS OF A,D,F,G,H,I ALL OF B, E
N.T.S.



TYPICAL NARROW SECTION
PORTIONS OF A,D,G,H,I
N.T.S.



TYPICAL STREET SECTION
QUARTZ HILL RD.
N.T.S.

THE COTTAGES AT BEL AIR CROSS SECTIONS

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

FOR

COTTAGES AT BEL AIR, LLC

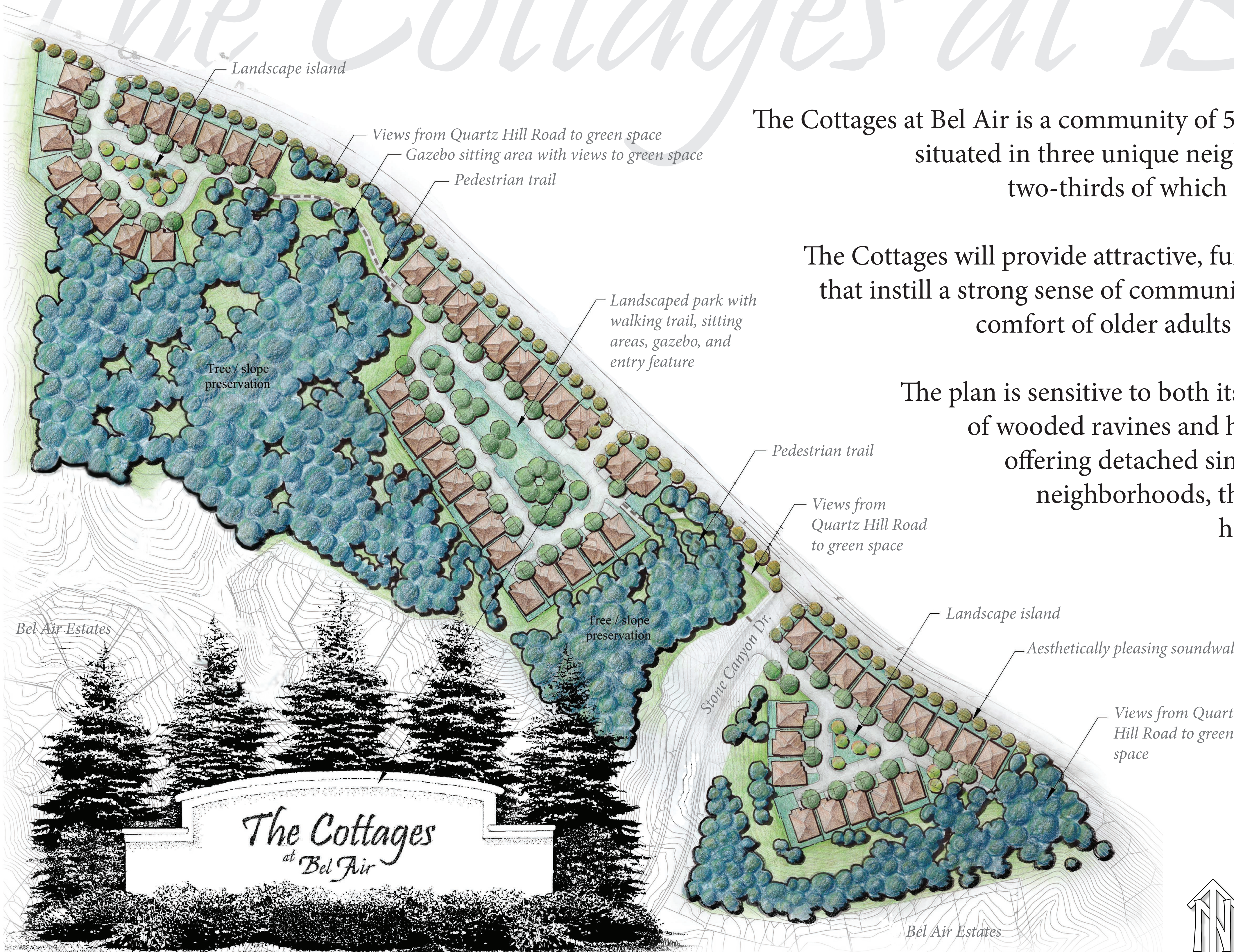
BY

SHARRAH DUNLAP SAWYER, INC.
Civil Engineering • Land Planning • Surveying & Mapping
Landscape Architecture • Presentation Graphics
320 Hartnell Avenue, Redding, CA 96002
530.221.1792 voice • info@sdsengineering.com

DATE: OCTOBER 25, 2024 SCALE: 1"=30' SHEET 8 OF 8

TLM/NLD P:/proj/p/22165/dwg/22165tm.dwg 22165

The Cottages at Bel Air



The Cottages at Bel Air is a community of 55 finely crafted single-story cottage homes situated in three unique neighborhoods. The site consists of 24.1 acres, two-thirds of which will remain in tree and slope preservation.

The Cottages will provide attractive, functional, and efficient living environments that instill a strong sense of community and place. Houses are designed for the comfort of older adults and for the convenience of young parents.

The plan is sensitive to both its natural and built environment consisting of wooded ravines and high-end single-family neighborhoods. By offering detached single-family homes within uniquely distinct neighborhoods, the Cottages modifies an existing successful housing type to allow a density usually seen in a multi-family project.

The Cottages at Bel Air

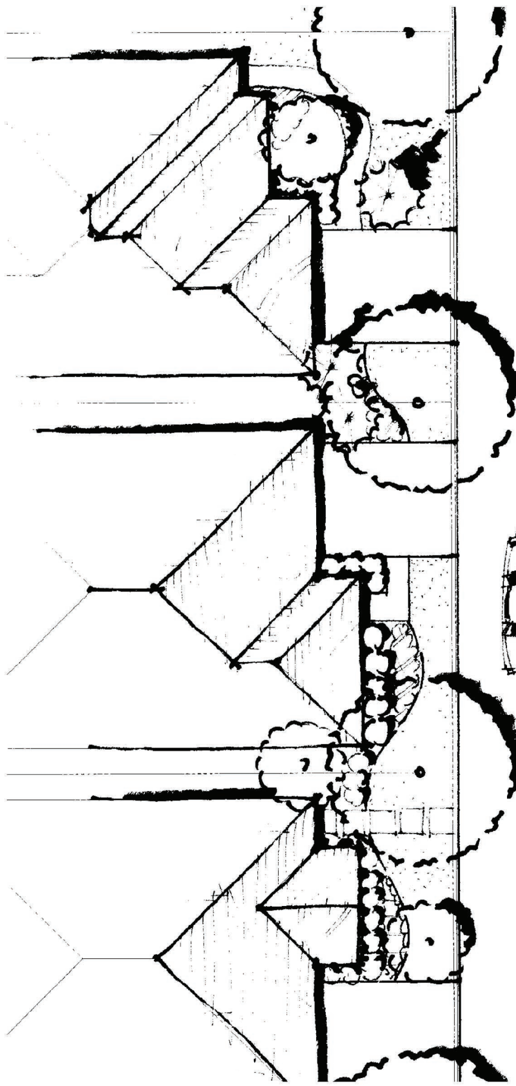
Prepared for:

The Cottages at Bel Air, LLC

Prepared by:

SHARRAH DUNLAP SAWYER INCORPORATED

October 25, 2024

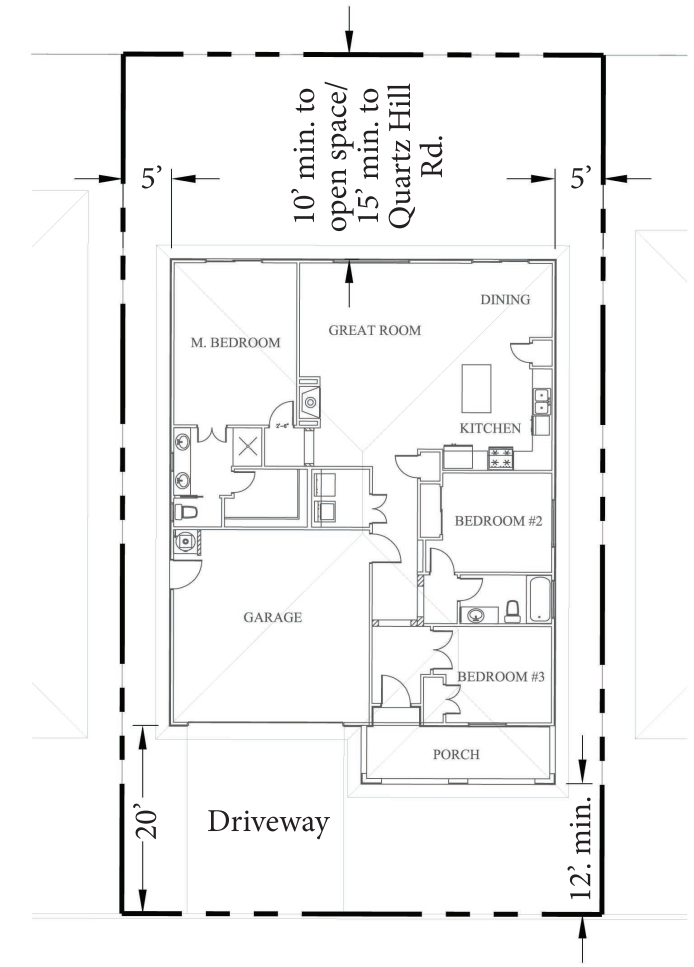


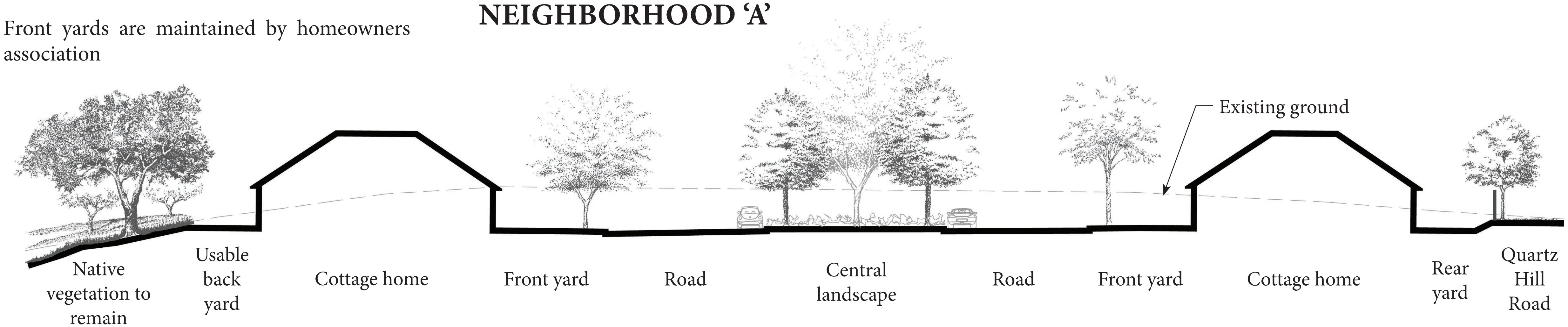
- Front yard landscaping designed and installed as an integral part of the overall neighborhood to acheieve a cohesive design and to promote a strong sense of community.
- Front yards are maintained by homeowners association

NEIGHBORHOOD 'A'

Development Standards

Front Yard (to house)	12'
Front Yard (to garage)	20'
Side Yard	5'
Corner Side	12'
Rear Yard *(adjacent to green space)*	10'
Rear Yard *(adjacent to Quartz Hill Road)*	15'





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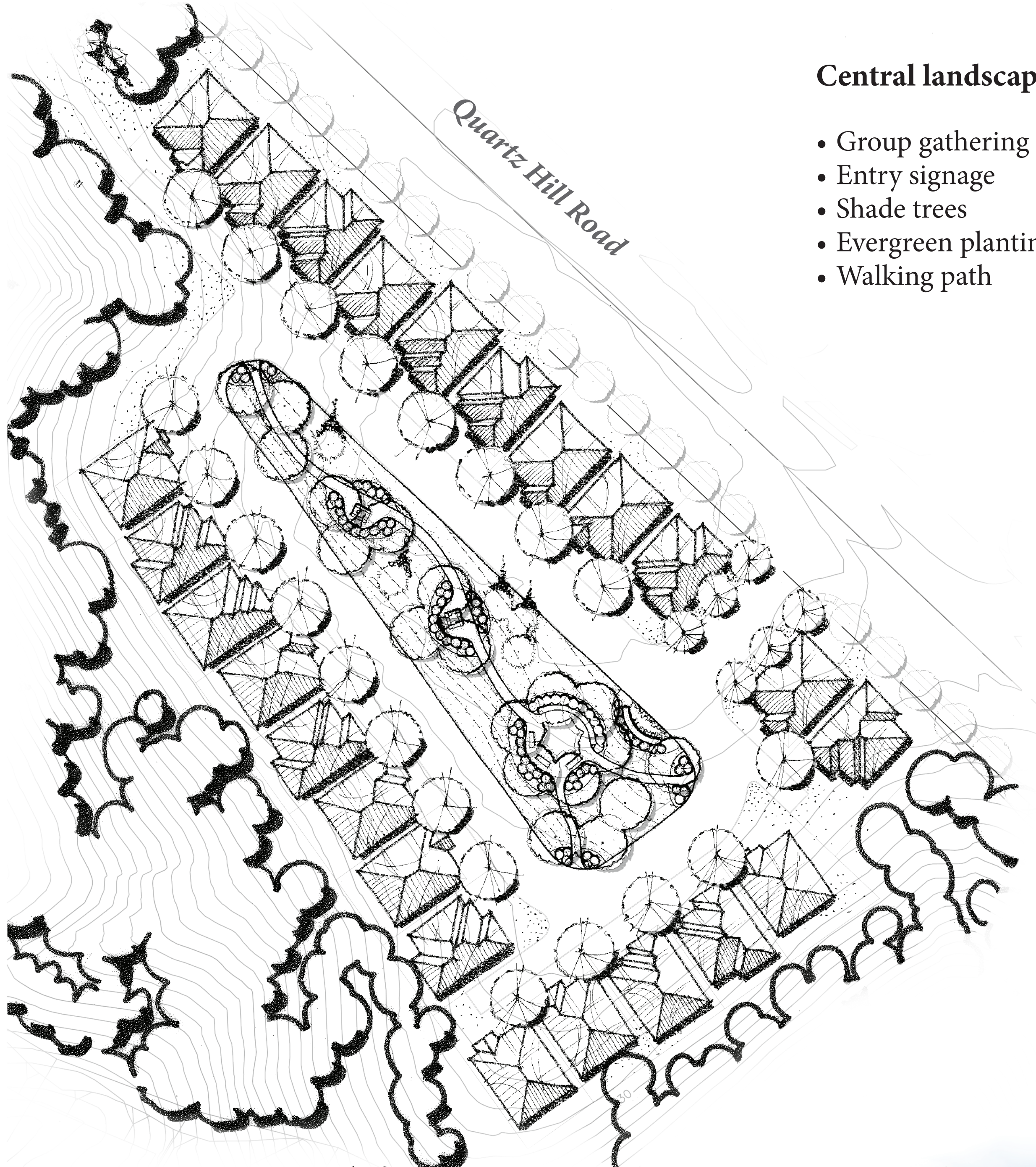
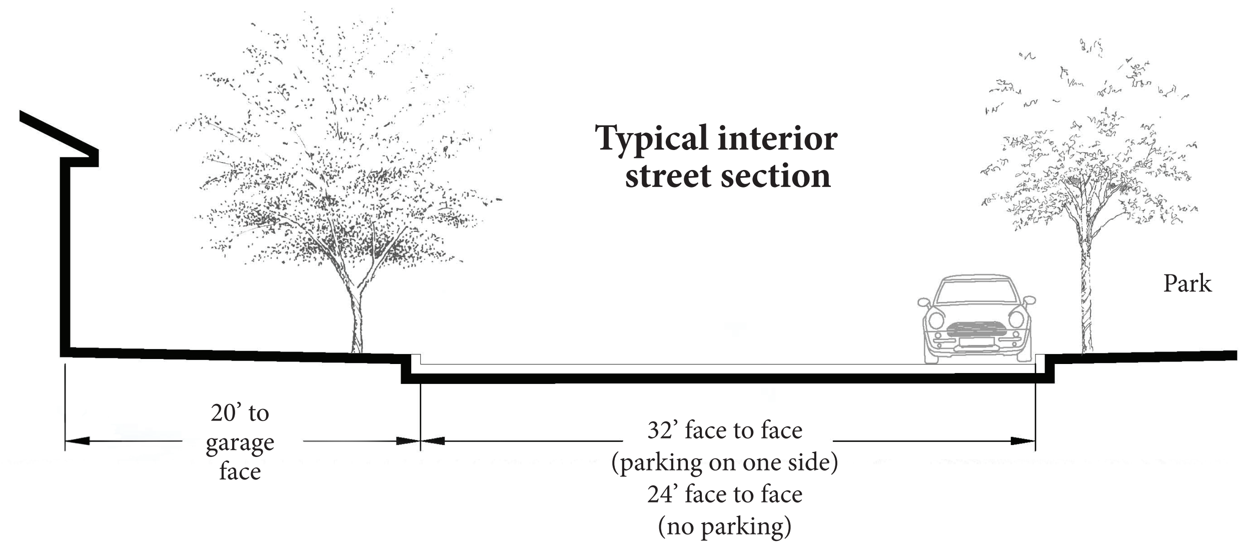
October 25, 2024

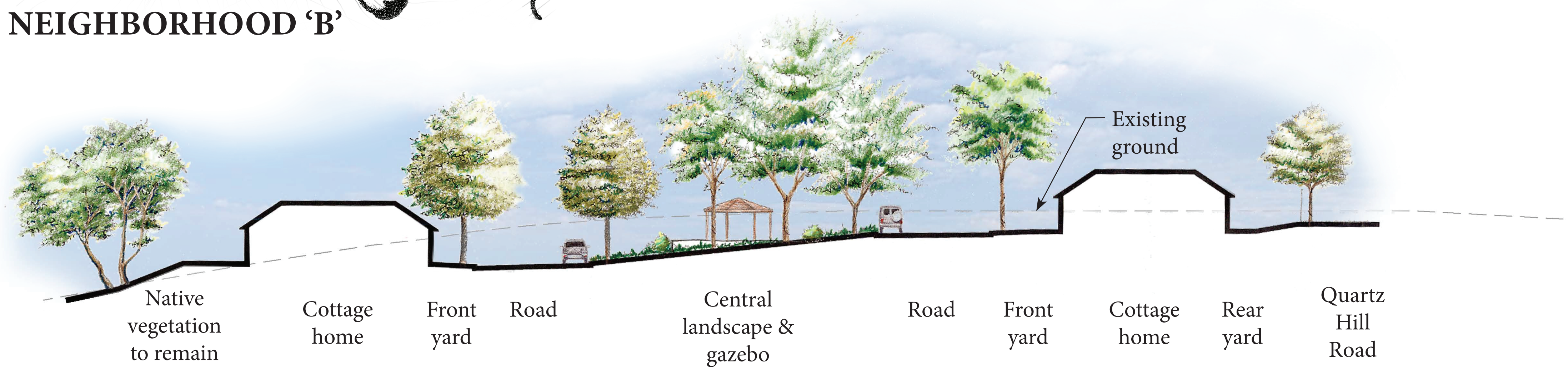


Central landscaped park includes:

- Group gathering area
- Entry signage
- Shade trees
- Evergreen planting
- Walking path



NEIGHBORHOOD 'B'



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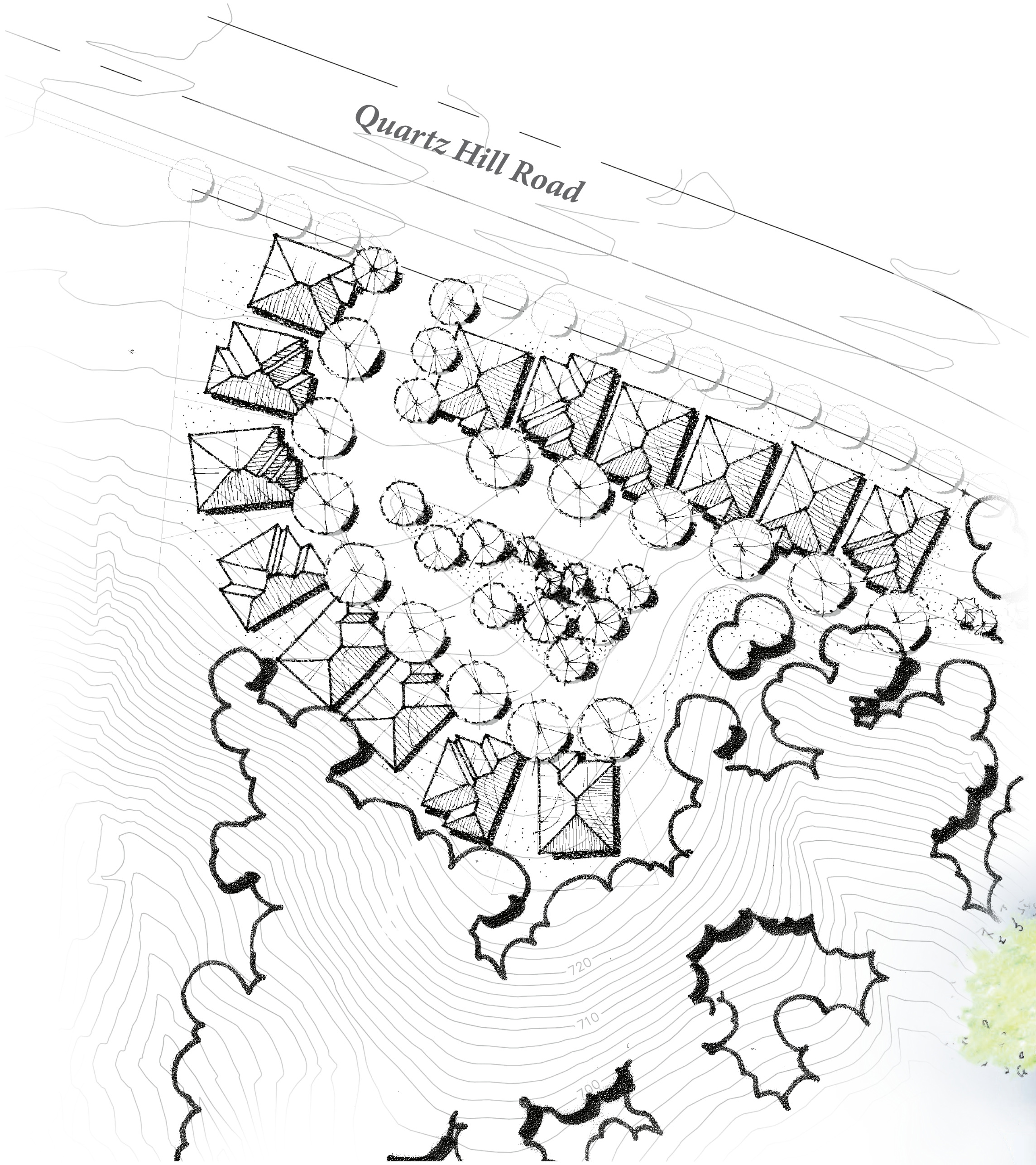
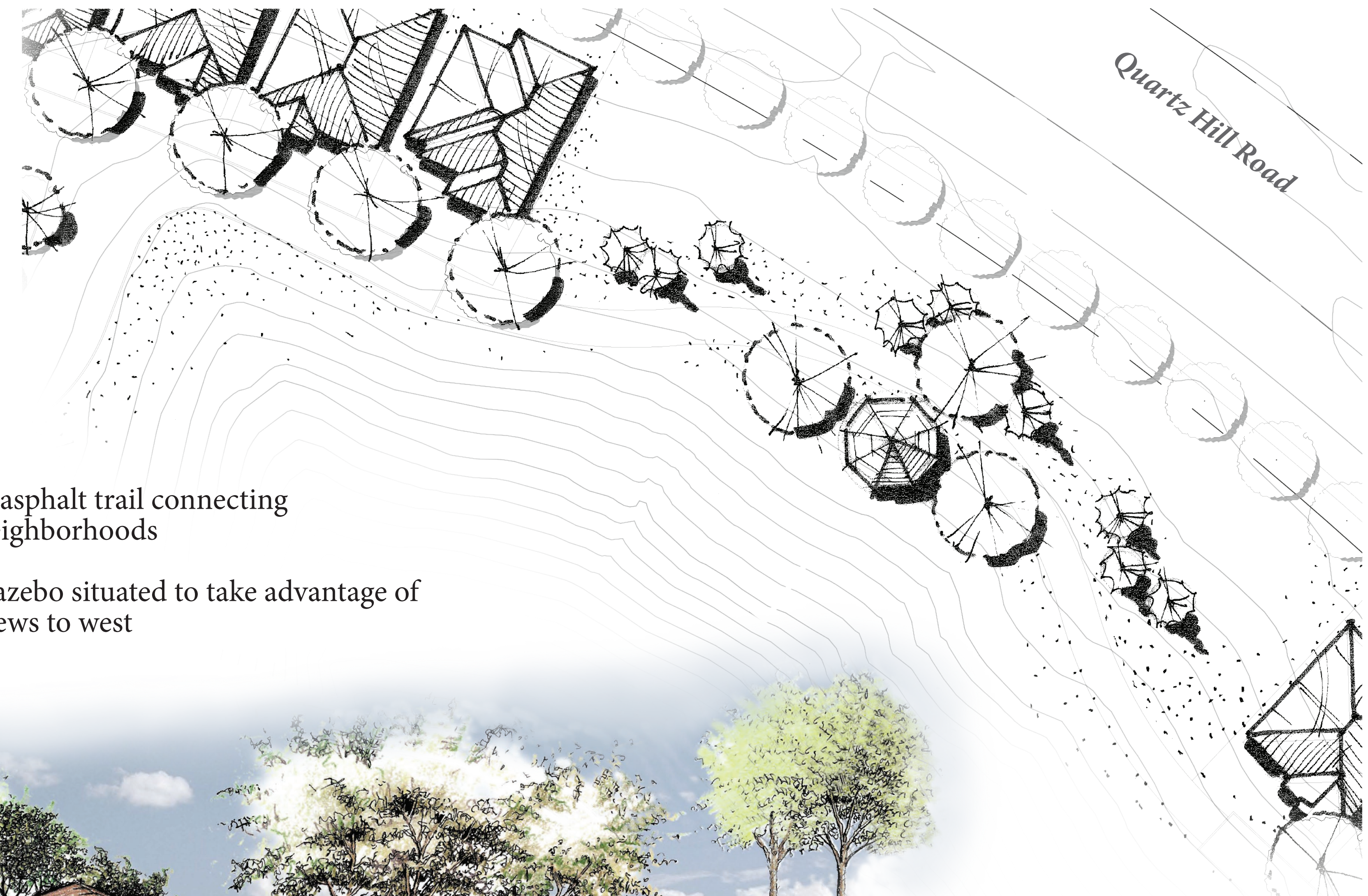
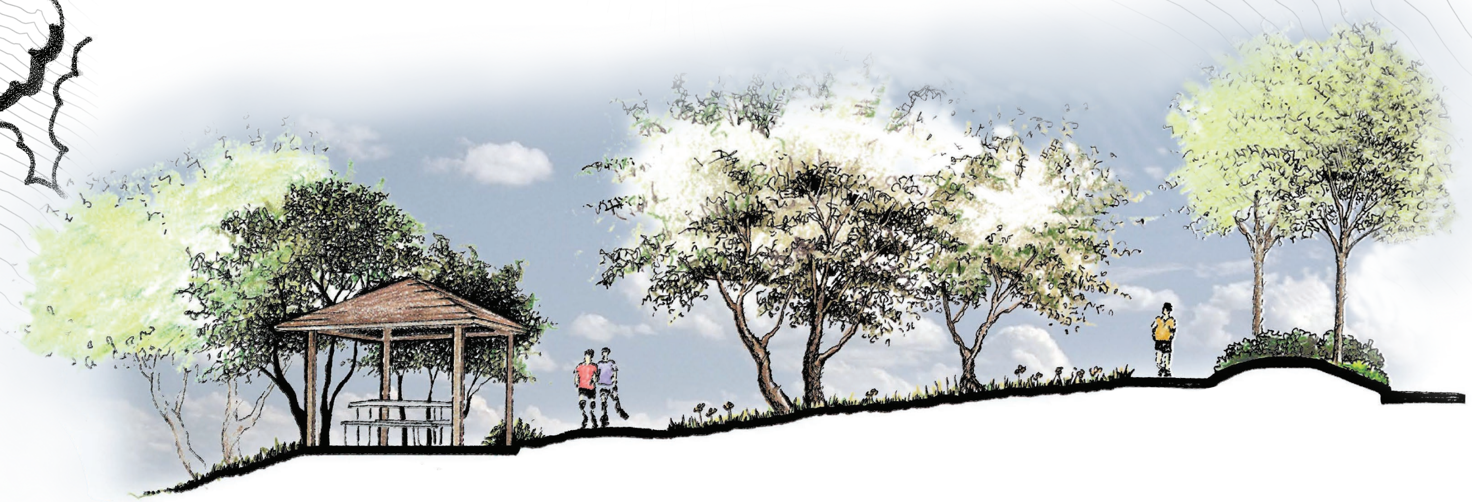
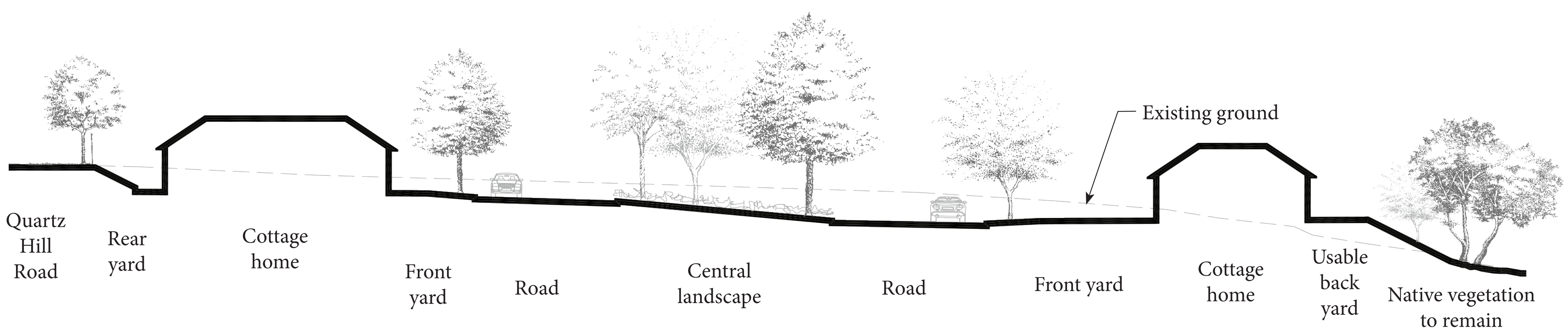




- 8' asphalt trail connecting neighborhoods
- Gazebo situated to take advantage of views to west



NEIGHBORHOOD 'C'



The Cottages at Bel Air

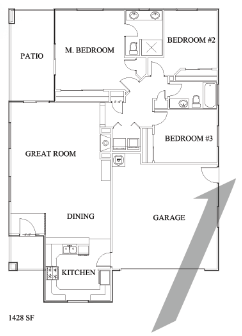
Prepared for:

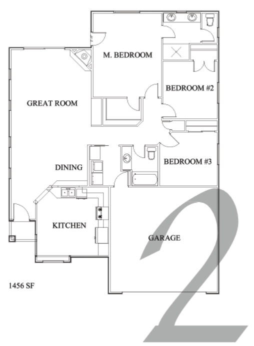
The Cottages at Bel Air, LLC

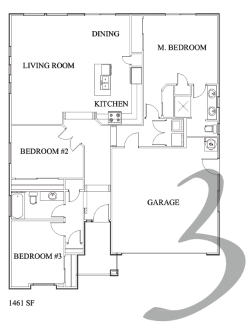
Prepared by:

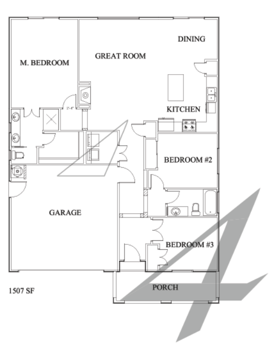
SHARRAH DUNLAP SAWYER INCORPORATED

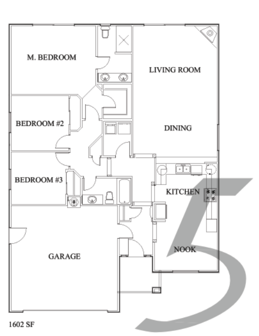
October 25, 2024

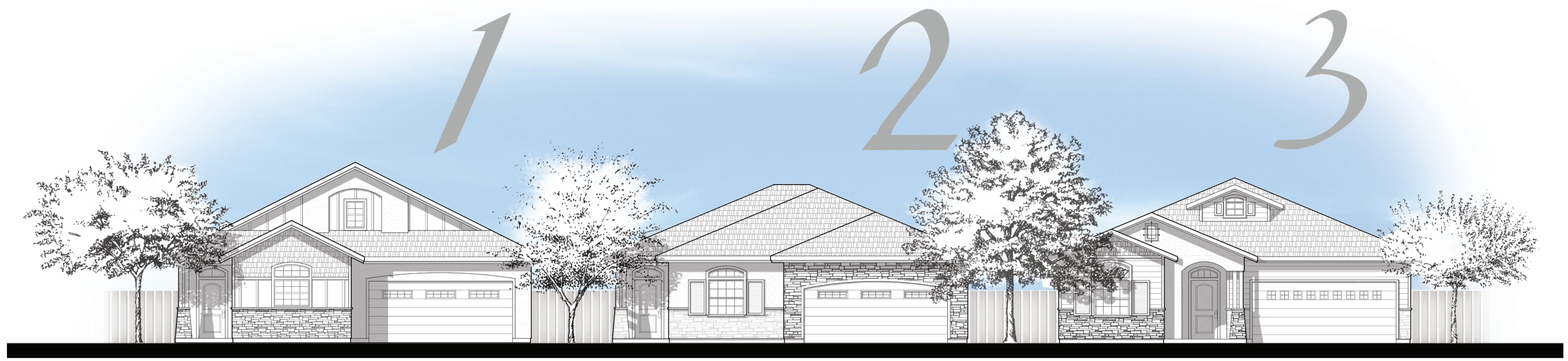












1,428 s.f. 1,456 s.f. 1,461 s.f.

SITE AMENITIES

- Privately maintained central landscape feature within each neighborhood
- Over 18 acres of green space
- Trails connect the neighborhoods with sitting areas, taking advantage of the views
- Ample views to green space within the project from Quartz Hill Road
- Neighborhood entries include enhanced landscape and signage
- Privately maintained roads with minimized pavement widths
- Diverse home facades utilize high-end materials and designs
- Over half of the homes abut green space
- The majority of homes face a centrally located landscape island

ARCHITECTURAL ELEMENTS

1 3 bedroom, 2 bath home
Garage back design
Large rear patio

2 3 bedroom, 2 bath home
Great room design
Mud room off garage

3 3 bedroom, 2 bath home
Garage back design
Split floor plan

4 3 bedroom, 2 bath home
Split floor plan
Front porch design

5 3 bedroom, 2 bath home
1600 square feet
Formal dining & nook

The Cottages at Bel Air

Prepared for:

The Cottages at Bel Air, LLC

Prepared by:

SHARRAH DUNLAP SAWYER INCORPORATED

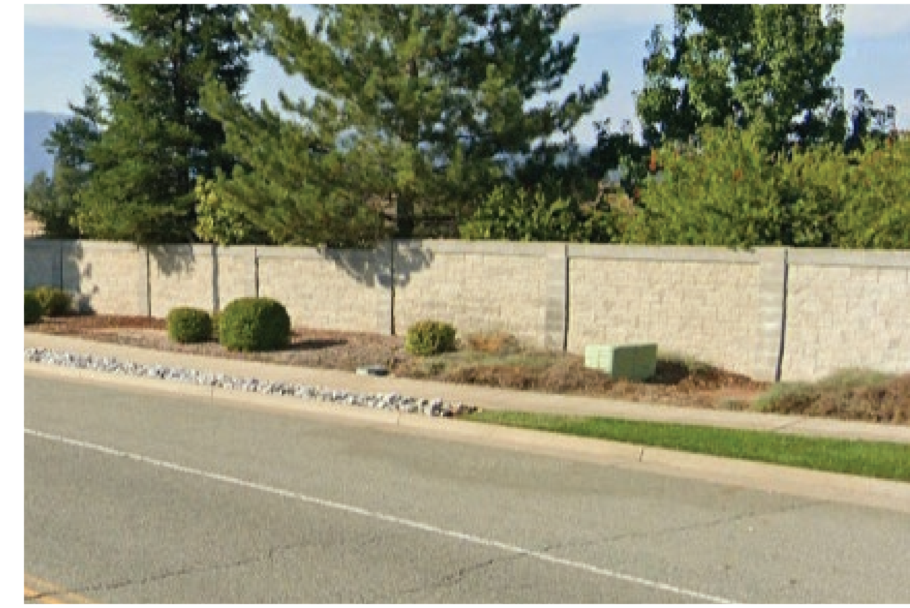
October 25, 2024

1,507 s.f. 1,602 s.f.

Note: Architecture is preliminary and final design may vary. Designs by Semingson Architecture & Engnieering

River Ridge Terrace

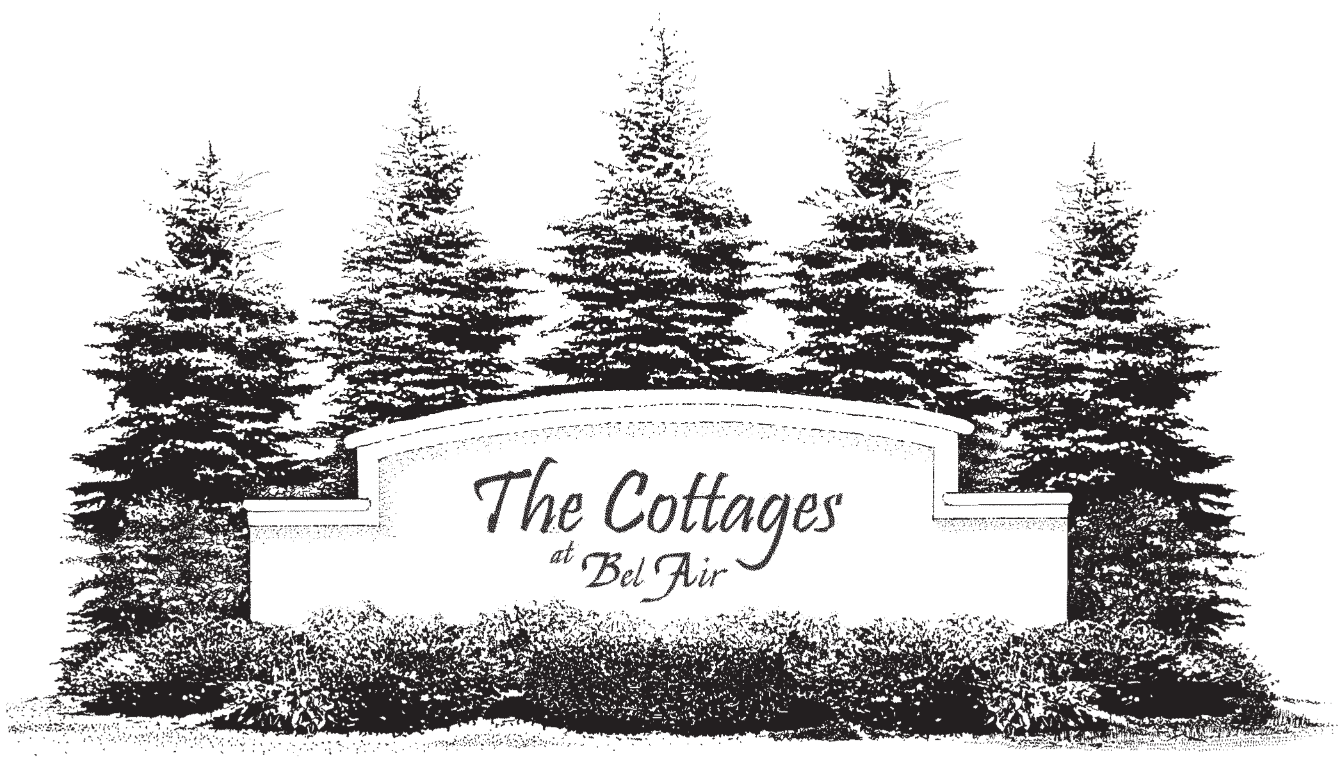
River Ridge Park



The Vistas

WALLS AND FENCES

Wall and entry feature design is proposed to be similar in character to other walls and fences along Quartz Hill Road for aesthetic continuity.



Conceptual Entry Feature
and Landscaping

Existing Bel Air Estates
Entry Feature

The Cottages at Bel Air

Prepared for:

The Cottages at Bel Air, LLC

Prepared by:

SHARRAH DUNLAP SAWYER INCORPORATED

Note: Concept is for illustrative purposes only and final design may vary

October 25, 2024

Attachment B

Biological Resource Assessment, prepared by Gallaway Enterprises, December 2022

gallaway
ENTERPRISES

BIOLOGICAL RESOURCES ASSESSMENT

Aquatic, Terrestrial, and Botanical Resources

Cottages at Bel Air Development Project

City of Redding, Shasta County, California

December 2022 (updated September 2023)

Prepared for:
Zovest Capital LLC.
1309 Coffeen Avenue
Suite 1200
Sheridan, WY 82801

Prepared by:
Gallaway Enterprises
117 Meyers Street, Suite 120
Chico, CA 95928
(530) 332-9909
www.gallawayenterprises.com

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BIOLOGICAL RESOURCES ASSESSMENT

Cottages at Bel Air Development Project

City of Redding, California

Section 23, Township 32N, Range 05W

INTRODUCTION

Purpose and Overview

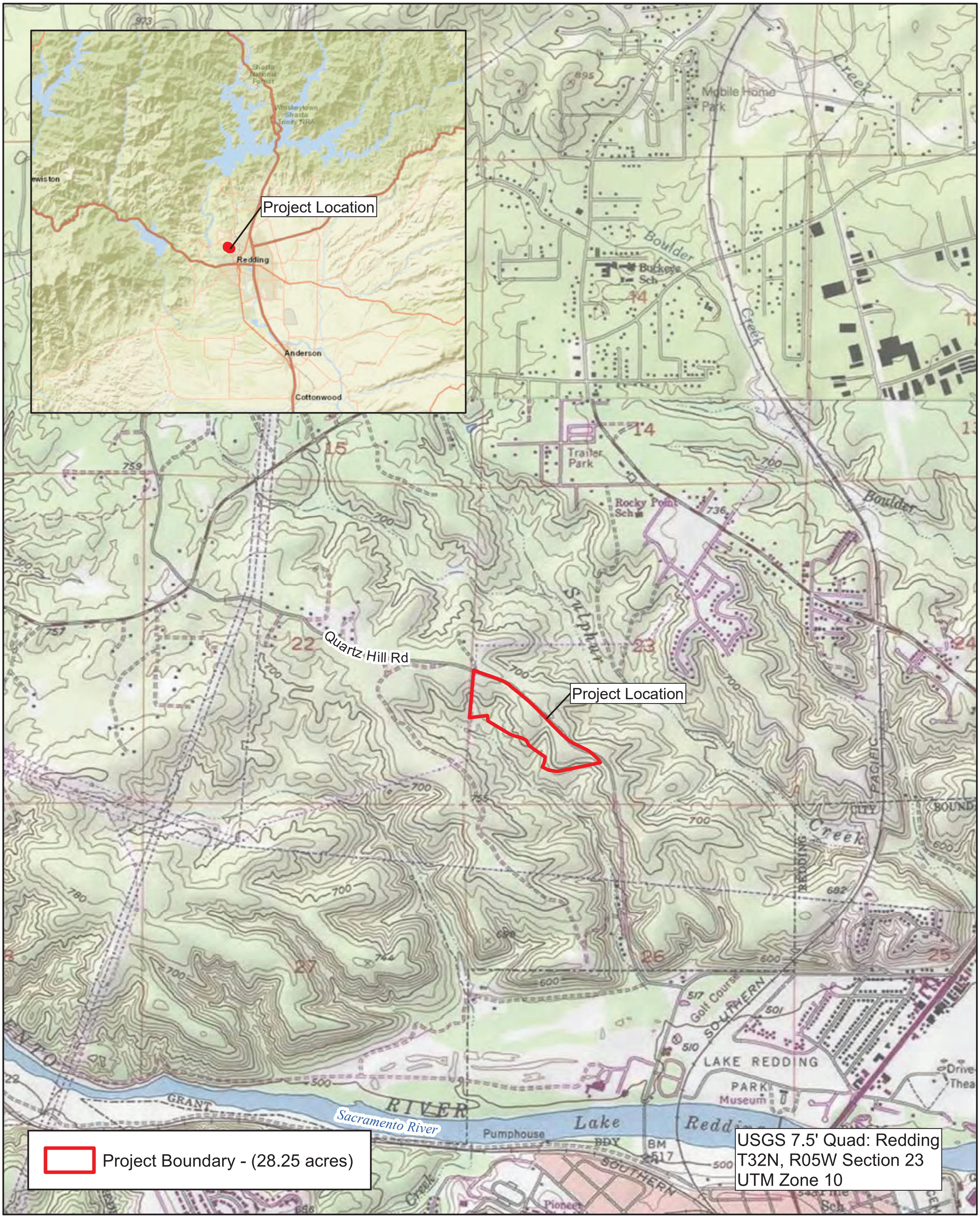
The purpose of this biological resources assessment (BRA) is to document the endangered, threatened, sensitive, and rare species and their habitats that occur or may occur in the biological survey area (BSA) of the Cottages at Bel Air Development Project (Project), located immediately south of Quartz Hill Road at Stone Canyon Drive in Redding, Shasta County, California (**Figure 1**)**.** The BSA is approximately 28.25 acres. The proposed Project involves the construction of a residential development.

The BSA is the area where biological assessments are conducted and includes all areas to be affected directly or indirectly by proposed Project activities (**Figure 2**). Gallaway Enterprises conducted habitat assessments and botanical surveys within the BSA to evaluate site conditions and potential for special-status biological and botanical species to occur. Other primary references consulted included species lists and information gathered using the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC), the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) portals, California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database (CNDDB), the California Native Plant Society's (CNPS) Inventory of Rare and Endangered Plants of California, and literature review. The results of the BRA are the findings of habitat assessments and field surveys, and the recommendations for avoidance and minimization measures.

Project Location and Environmental Setting

The BSA is located within the foothills of the Klamath Mountain Range in the City of Redding. The BSA is located within the "Redding" United States Geological Survey (USGS) quadrangle, Section 23, Township 32N, Range 05W. The BSA is adjacent to a few existing rural residences and a residential subdivision to the west. Three (3) unnamed, ephemeral drainages running north to south are present in western portion of the BSA. A detention basin, measuring approximately 0.070 acres is present west of Stone Canyon Drive. The BSA is primarily composed of blue oak-foothill pine woodland and some sections of annual grasslands in the western portion of the BSA.

The average annual precipitation is 33.68 inches and the average annual temperature is 62.45°F in the region where the Project site is located (WRCC 2022). The Project site occurs at an elevation of approximately 750 feet above sea level. The site is sloped between 0 and 30 percent. Soils within the site were gravelly loams.



1:24,000

0 0.25 0.5 Miles

NORTH

Data Sources: ESRI, USGS
SDS Engineering

Cottages at Bel Air
Regional Location
Figure 1

gallaway ENTERPRISES

GE: #22-130 Map Date: 10/10/2022

NORTH

1:4,250

0 250 500 Feet

Data Sources: ESRI, SDS Engineering, City of Redding GIS 05/27/2020

Cottages at Bel Air
Biological Survey Area
Figure 2

gallaway ENTERPRISES

GE: #22-130 Map Date: 10/21/2022

Project Description

The proposed Project will involve the development of a residential subdivision and appurtenant infrastructure **(Appendix A: Proposed Site Development Plan).**

METHODS

References Consulted

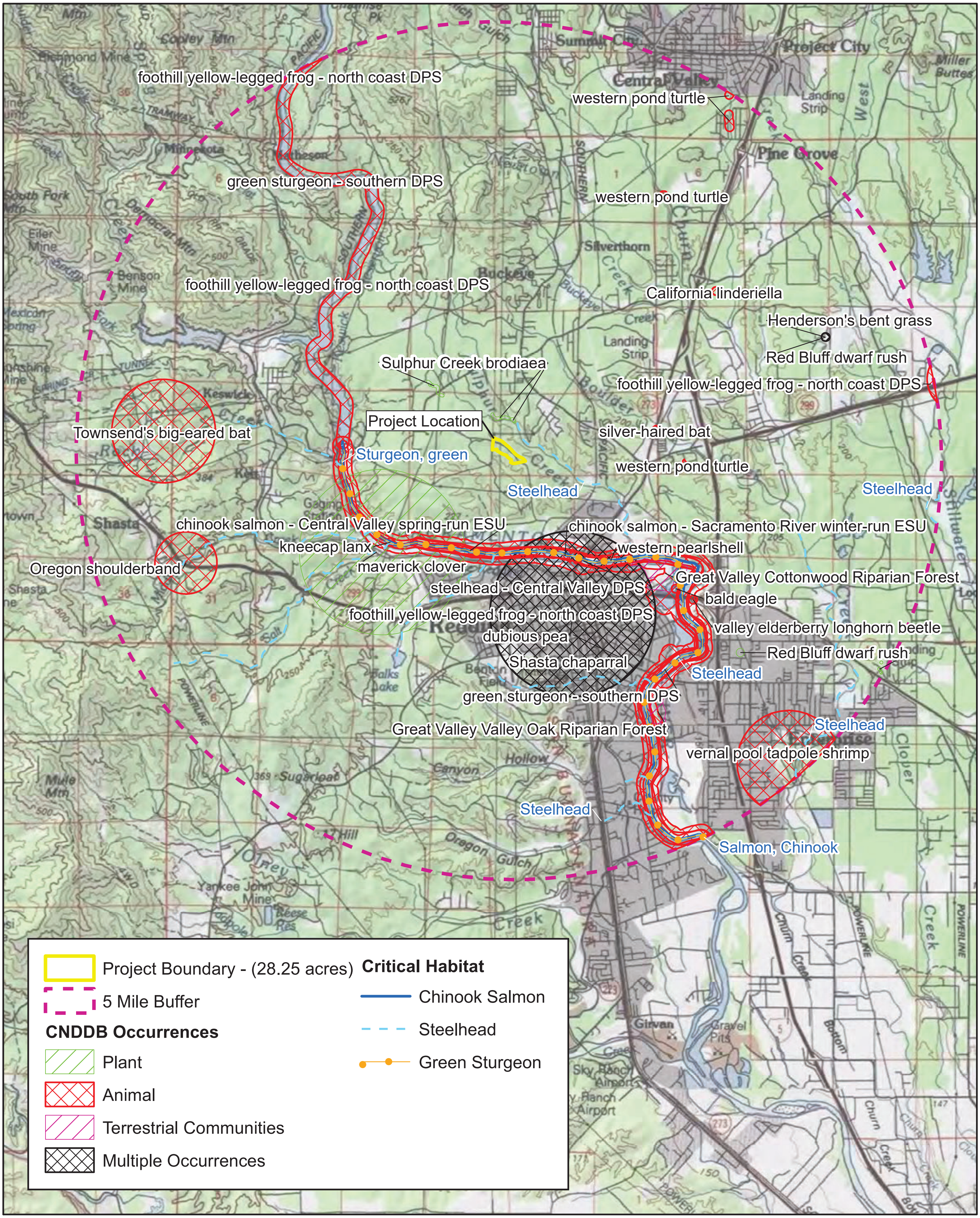
Gallaway Enterprises obtained lists of special-status species that occur in the vicinity of the BSA. The CNDDB Geographic Information System (GIS) was also consulted and showed special-status species within a 5-mile radius of the BSA (**Figure 3**). Other primary sources of information regarding the occurrence of federally listed threatened, endangered, proposed, and candidate species and their habitats within the BSA used in the preparation of this BRA are:

- The USFWS IPaC Official Species List for the Project area, September 12, 2023, Project Code: 2023-0007537 (**Appendix B: Official Species Lists**);
- The results of a species record search of the CDFW CNDDB, RareFind 5, for the 7.5-minute USGS Whiskeytown (4012265), Shasta Dam (4012264), Project City (4012263), Igo (4012255), Redding (4012254), and Enterprise (4012253) quadrangles (**Appendix B: Official Species Lists**);
- The CNPS Inventory of Rare and Endangered Vascular Plants of California for the 7.5-minute USGS Whiskeytown (4012265), Shasta Dam (4012264), Project City (4012263), Igo (4012255), Redding (4012254), and Enterprise (4012253) quadrangles (**Appendix B: Official Species Lists**);
- USFWS Critical Habitat Portal, September 12, 2023;
- Results from the general botanical survey and habitat assessment conducted by Gallaway Enterprises on November 15, 2022 and September 7, 2023 (**Appendix C: Observed Species Lists; Appendix D: Project Site Photos**); and
- Results from the Delineation of Aquatic Resources conducted by Gallaway Enterprises on October 21, 2022 (**Appendix E: Draft Delineation of Aquatic Resources**).

Special-Status Species

Special-status species that are considered in this BRA are those that fall into one of the following categories:

- Listed as threatened or endangered, or are proposed or candidates for listing under the California Endangered Species Act (CESA, 14 California Code of Regulations 670.5) or the Federal Endangered Species Act (ESA, 50 Code of Federal Regulations 17.12);
- Listed as a State Species of Special Concern (SSC) by CDFW or protected under the California Fish and Game Code (CFGC) (i.e., Fully Protected species);
- Ranked by the CNPS as 1A, 1B, or 2;
- Protected under the Migratory Bird Treaty Act (MBTA);
- Protected under the Bald and Golden Eagle Protection Act; or
- Species that are otherwise protected under policies or ordinances at the local or regional level as required by the California Environmental Quality Act (CEQA, §15380).



NORTH

1:95,000

0 1 2 Miles

Data Sources: ESRI, USGS, CDFW, CNDDB, USFW, NMFS, Shasta County

Cottages at Bel Air
CNDDB Occurrances
Figure 3

gallaway ENTERPRISES

GE: #22-130 Map Date: 10/21/2022

Critical Habitat

The ESA requires that critical habitat be designated for all federally listed species. Critical habitat is designated for areas that provide essential habitat elements that enable a species' survival, and which are occupied by the species during the species listing under the ESA. For the purposes of designating critical habitat only, habitat is the abiotic and biotic setting that currently or periodically contains the resources and conditions necessary to support one or more life processes of a species.

The USFWS Critical Habitat Portal was accessed on September 12, 2023 to determine whether critical habitat occurs within the BSA. Appropriate Federal Registers were also used to confirm the presence or absence of critical habitat.

Sensitive Natural Communities

Sensitive Natural Communities (SNCs) are monitored by CDFW with the goal of preserving these areas of habitat that are rare or ecologically important. Many SNCs are designated as such because they represent a historical landscape and are typically preserved as valued components of California's diverse habitat assemblage. The CNDDB was accessed on September 12, 2023 to determine whether the BSA occurs within a mapped SNC.

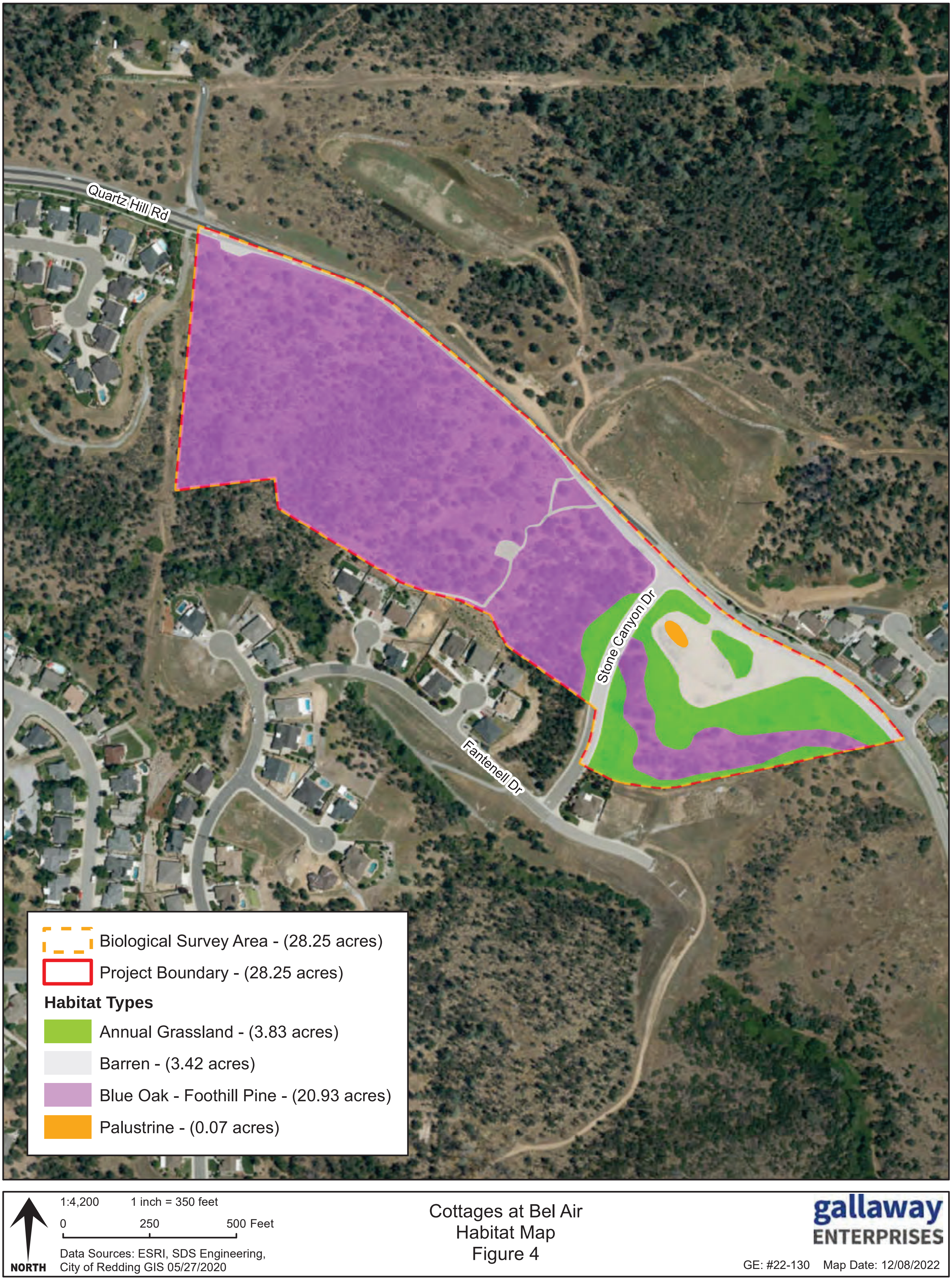
Aquatic Resources

A formal delineation of aquatic resources was conducted by Gallaway Enterprises on October 21, 2022 (**Appendix E: Draft Delineation of Aquatic Resources Map).**

Habitat Assessments and Protocol-level Rare Plant Survey

Habitat assessments were conducted by Gallaway Enterprises staff (**Figure 4**). The wildlife habitat assessment was conducted by Biologist Daviel Vazquez and the botanical habitat assessment was conducted by Senior Botanist Elena Gregg on November 15, 2022. Additionally, Mrs. Gregg conducted a late-season botanical survey for all plant species with blooming periods that overlapped the survey date. Lists of all species observed within the BSA are included as **Appendix C**. The City of Redding received an early consultation letter from CDFW. CDFW requested that species lists be updated and the potential for special-status bumble bee habitat within the BSA be assessed. On September 7, 2023, Gallaway Enterprises Biologist Cassie Corridoni conducted a habitat assessment to survey for potential special-status bumble bee habitat.

Habitat assessments for botanical and wildlife species were conducted to determine if suitable habitat elements for special-status species occur within the BSA. The habitat assessments and protocol-level survey were conducted by walking the entire BSA and recording observed species and specific habitat types and elements. If habitat was observed for special-status species, it was then evaluated for quality based on vegetation composition and structure, physical features (e.g., soils, elevation), microclimate, surrounding area, presence of predatory species and available resources (e.g., prey items, nesting substrates), and land use patterns.



Cottages at Bel Air
Habitat Map
Figure 4

gallaway ENTERPRISES

GE: #22-130 Map Date: 12/08/2022

RESULTS

Terrestrial Habitat

Blue Oak-Foothill Pine

The majority of the BSA is composed of blue oak-foothill pine woodland (**Figure 4**). Blue oak-foothill pine woodland within the BSA is characterized by an overstory of primarily blue oaks (*Quercus douglasii*) and scattered foothill pines (*Pinus sabiniana*) and a sparse to moderately dense understory dominated by whiteleaf manzanita (*Arctostaphylos viscida* ssp. *viscida*) and poison oak (*Toxicodendron diversilobum*). This habitat type is typically diverse in structure, consisting of a mix of hardwoods, conifers, and shrubs. This habitat type provides valuable breeding, nesting, and foraging opportunities for migratory birds. Common wildlife species that utilize in blue oak-foothill pine woodlands include California scrub-jay (*Aphelocoma californica*), acorn woodpecker (*Melanerpes formicivorus*), and western gray squirrel (*Sciurus griseus*).

Annual Grassland

Annual grassland occurs throughout the site, primarily as the herbaceous layer of blue oak-foothill pine woodland, but also in a few patches where the tree canopy opens (**Figure 4**). Annual grassland habitats and species composition depend largely on annual precipitation, fire regimes, and grazing practices (Mayer and Laudenslayer 1988). Species observed in the annual grassland in the BSA include greater rattlesnake grass (*Briza maxima*), wild oat (*Avena barbata*), medusahead (*Elymus caput-medusae*), smooth cat's ear (*Hypochaeris glabra*), rattlesnake weed (*Daucus pusillus*), and soft chess (*Bromus hordeaceus*). Most wildlife species use grassland habitat for foraging, but generally require some other habitat characteristic such as rocky outcrops, cliffs, caves, or ponds in order to find shelter and cover for escapement. Some rodents, such as ground squirrel (*Otospermophilus beecheyi*), utilize annual grasslands for burrowing.

Barren

Barren habitat within the BSA is comprised of the unpaved gravel and dirt roads. Barren habitat is typified by non-vegetated soil, rock, paved roads, and gravel areas void of vegetation. It is typically considered low-quality habitat for most wildlife species, although some ground nesting avian species such as killdeer (*Charadrius vociferous*) and small reptiles such as western fence lizard (*Sceloporus occidentalis*) can be found breeding in barren habitat.

Aquatic Habitat

Palustrine

According to the Cowardin classification system, palustrine habitats are inland, nontidal depressions containing standing water that vary in size from small ponds to large areas that cover many acres. Typical palustrine habitats include floodplains, inland marshes, and wetlands including vernal and seasonal wetlands. Within the BSA, palustrine habitat occurs in the form of a detention basin, approximately 0.070 acers, located within Barren habitat along Quartz Hill Drive, in the eastern portion of the BSA. The detention basin is typically dry during the summer months, and exhibit impacts from vehicular traffic. The detention basin feature was vegetated with hyssop loosestrife (*Lythrum hyssopifolium*), perennial rye-grass (*Festuca perennis*), popcorn flower (*Plagiobothrys stipitatus*), pale spike-rush (*Eleocharis macrostachya*), and Mediterranean barley (*Hordeum marinum ssp. gussoneanum*). The typically calm waters of palustrine habitats offer environmental conditions that contrast sharply with those of running water and may provide breeding and foraging habitat for a number of amphibians, reptiles, and birds.

Critical Habitat

There is no critical habitat present within the BSA.

Sensitive Natural Communities

No CDFW-designated SNCs occur within the BSA.

Special-Status Species

A summary of special-status species assessed for potential occurrence within the BSA based on the USFWS IPaC species list, NMFS species list, CNDDB species list, and the CNPS inventory of rare and endangered plants within the Whiskeytown (4012265), Shasta Dam (4012264), Project City (4012263), Igo (4012255), Redding (4012254), and Enterprise (4012253) USGS 7.5-minute quadrangles and their potential to occur within the BSA are described in **Table 1**. Potential for occurrence was determined by reviewing database queries from federal and state agencies and performing field surveys to evaluate habitat characteristics.

Table 1. Special-status species and Sensitive Natural Communities and their potential to occur in the BSA

Common Name *(Scientific Name)*	**Status** Fed/State/CNPS	**Associated Habitats**	**Potential for Occurrence**
SENSITIVE NATURAL COMMUNITIES			
Great Valley Cottonwood Riparian Forest	_/SNC/_	Riparian forest.	None. There is no designated Great Valley Cottonwood Riparian Forest within the BSA.
Great Valley Oak Riparian Forest	_/SNC/_	Riparian forest.	None. There is no designated Great Valley Oak Riparian Forest within the BSA.
Great Valley Willow Scrub	_/SNC/_	Riparian scrub.	None. There is no designated Great Valley Willow Scrub within the BSA.

Common Name *(Scientific Name)*	**Status** Fed/State/CNPS	**Associated Habitats**	**Potential for Occurrence**
		PLANTS	
Canyon Creek stonecrop (*Sedum obtusatum* ssp. *paradisum*)	_/_/1B.3	Rock faces and crevices of exposed granite. (Blooming Period [BP]: May – Jun)	None. No suitable rock habitat present and not observed during the botanical survey.
Hairy marsh hedge-nettle *(Stachys Pilosa)*	_/_/2B.3	Meadows and seeps, sagebrush and Great Basin scrub usually associated with lake margins. (BP: Jun-Aug [Sep])	None. There is no suitable habitat present within the BSA.
Legenere (*Legenere limosa*)	_/_/1B.1	Vernal pools. (BP: Apr – Jun)	None. There is no suitable habitat present within the BSA.
Maverick clover (*Trifolium piorkowskii*)	_/_/1B.2	Shallow vernal depressions on volcanic flats or the open banks of intermittent or perennial streams in the foothills of Shasta County. (BP: Apr – May)	None. There is no suitable soils or stream habitat present within the BSA.
Nuttall's ribbon-leaved pondweed (*Potamogeton epihydrus*)	_/_/2B.2	Assorted shallow freshwater marshes and swamps. (BP: [Jun]Jul – Sep)	None. No suitably wet habitat present and not observed during botanical surveys.
Pink creamsacs *(Castilleja rubicundula var. rubicundula)*	_/_/1B.2	Meadows and mesic openings in chaparral or grasslands on serpentine. (annual herb, BP: Apr – Jun)	None. There is no suitable habitat present within the BSA.
Red Bluff dwarf rush (*Juncus leiospermus* var. *leiospermus*)	_/_/1B.1	Vernal pools or wet seasonal depressions, in chaparral, valley/foothill grassland, or cismontane woodland. (BP: Mar – Jun)	**Low**. There is marginal habitat present along the edges of the the detention basin.

Common Name *(Scientific Name)*	**Status** Fed/State/CNPS	**Associated Habitats**	**Potential for Occurrence**
PLANTS			
Sanford's arrowhead (*Sagittaria sanfordii*)	_/_/1B.2	In standing or slow-moving freshwater ponds, marshes, and ditches. (BP: May – Oct [Nov])	None. No suitably wet habitat present and not observed during botanical surveys.
Shasta huckleberry (*Vaccinium shastense* ssp. *shastense*)	_/_/1B.3	Microhabitat is acidic, mesic; often streambanks; sometimes seeps, rocky outcrops, roadsides, and disturbed areas. (BP: Dec – May [Sep])	None. There is no suitable habitat present within the BSA and no species of *Vaccinium* was observed during botanical surveys.
Shasta snow-wreath (*Neviusia cliftonii*)	_/SC/1B.2	In the mountains around Lake Shasta on shaded, north facing, or sheltered canyons. Often found by stream sides, sometimes on limestone or volcanic soils. (BP: Apr – Jun)	None. There is no suitable habitat present within the BSA.
Silky cryptantha (*Cryptantha crinita*)	_/_/1B.2	Gravelly streambeds and wetland swales. (BP: Apr – May)	None. There is no suitable habitat within the drainage present.
Slender Orcutt grass (*Orcuttia tenuis*)	FT/SE/1B.1	Deep vernal pools. (BP: May – Sep [Oct])	None. The species was not observed during the botanical survey.
Sulphur Creek brodiaea (*Brodiaea matsonii*)	_/_/1B.1	Streambanks. In cracks and crevices of metamorphic amphibolite schist. (BP: May – Jun)	None. There are no suitable substrates or streambank habitat present within the drainage in the BSA.
INVERTEBRATES			
Monarch butterfly *(Danaus plexippus)*	FC/_/_	Egg and larval stage dependent upon milkweed. Adults migrate seasonally, amassing in in dense tree canopies; e.g., eucalyptus.	None. The is no suitable habitat within the BSA. No milkweed plants were observed within the BSA.

Common Name *(Scientific Name)*	Status Fed/State/CNPS	Associated Habitats	Potential for Occurrence
INVERTEBRATES			
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	FT/_/_	Blue elderberry shrubs; usually associated with riparian areas.	None. No elderberry shrubs were observed within the BSA.
Vernal pool fairy shrimp *(Branchinecta lynchi)*	FT/_/_	Vernal pools and seasonally ponded areas.	None. There are no vernal pools or suitable hydrological features within the BSA.
Vernal pool tadpole shrimp *(Lepidurus packardi)*	FE/_/_	Deep vernal pools.	None. There are no vernal pools within the BSA.
FISH			
Chinook salmon Central Valley spring-run Evolutionarily Significant Unit (ESU) *(Oncorhynchus tshawytscha)*	FT/ST/_	Sacramento River and its tributaries.	None. The drainages within the BSA are too ephemeral to support this species.
Chinook salmon Sacramento River winter-run ESU *(Oncorhynchus tshawytscha)*	FE/SE/_	Sacramento River and its tributaries.	None. The drainages within the BSA are too ephemeral to support this species.
Green sturgeon Southern Distinct Population Segment (DPS) *(Acipenser medirostris)*	FT/_/_	Spawns in the Sacramento, Feather and Yuba Rivers, site fidelity. Non spawning adults occupy marine/estuarine waters. Delta Estuary is important for rearing juveniles.	None. The drainages within the BSA are too ephemeral to support this species.
FISH			
Steelhead Central Valley DPS *(Oncorhynchus mykiss irideus)*	FT/_/_	Sacramento and San Joaquin rivers and their tributaries.	None. The drainages within the BSA are too ephemeral to support this species.

Common Name *(Scientific Name)*	**Status** Fed/State/CNPS	**Associated Habitats**	**Potential for Occurrence**
		HERPTILES	
Foothill yellow-legged frog North Coast Clade (*Rana boylii)*	_/SSC/_	Perennial, shallow streams and riffles with rocky substrates and partial shade; commonly found in canyons and narrow streams.	None. The drainages within the BSA are too ephemeral to support this species (USFWS 2021).
Pacific tailed frog (*Ascaphus truei*)	_/SSC/_	Perennial montane streams. Tadpoles require water below 15 degrees Celsius.	None. The drainages within the BSA are too ephemeral to support this species.
Shasta salamander (*Hydromantes shastae*)	_/ST/_	Occurs in rocky, limestone talus near Lake Shasta.	None**.** No suitable habitat occurs within the BSA and the BSA is located outside of the known range of this species (Gogol-Prokurat 2016).
Western pond turtle (*Emys marmorata*)	_/SSC/_	Bodies of water with deep pools, emergent vegetation for foraging and cover, and locations for basking and nesting.	None. There is no suitable habitat present within the BSA.
Western spadefoot (*Spea hammondii)*	_/SSC/_	Occurs primarily in grassland habitats. Vernal pools and seasonal drainages are typically used for breeding and egg-laying.	**Low**. Impacted aquatic features by vehicular traffic could present potentially suitable breeding habitat when ponded water is present for 30 days or longer. Suitable aestivation habitat is also present in the surrounding areas of annual grassland.
		BIRDS	
Bald eagle *(Haliaeetus leucocephalus)*	_/SE, FP/_	Coasts, large lakes, and river systems with open forests with large trees and snags.	None. There is no suitable habitat present within the BSA.
Bank swallow (*Riparia riparia*)	_/ST/_	Requires vertical banks or cliffs with fine-textured sandy soils near streams, rivers, lakes, ocean to dig nesting burrow.	None. There is no suitable habitat present within the BSA.

Common Name *(Scientific Name)*	Status Fed/State/CNPS	Associated Habitats	Potential for Occurrence
BIRDS			
Northern spotted owl (*Strix occidentalis caurina*)	FT/ST/_	Forests characterized by dense canopy closure of mature and old-growth trees, abundant logs, standing snags, and live trees with broken tops.	None. There is no suitable habitat present within the BSA.
Tricolored blackbird *(Agelaius tricolor)*	_/ST/_	Colonial nester in large freshwater marshes. Requires open, accessible water source and does most of its foraging in open habitats such as farm fields, pastures, cattle pens, large lawns.	None. There is no suitable nesting habitat within or adjacent to the BSA.
MAMMALS			
Fisher West Coast DPS *(Pekania pennanti)*	_/SSC/_	Intermediate to large-tree stages of coniferous forests and deciduous-riparian areas with high percent canopy closure. Uses cavities, snags, logs and rocky areas for cover and denning. Needs large areas of mature, dense forest.	None. There is no suitable habitat present within the BSA.
Pallid bat *(Antrozous pallidus)*	_/SSC/_	Rocky outcroppings to open, sparsely vegetated grasslands with nearby water source. Day and night roosts include crevices in rocky outcrops and cliffs, caves, mines, trees (e.g., cavities and exfoliating bark), and various human structures (i.e., bridges).	**Low**. Although there are no CNDDB occurrences of this species within 5 miles of the BSA, there are some suitable tree cavities that could provide roosting habitat.
Townsend's big-eared bat *(Corynorhinus townsendii)*	_/SSC/_	Roost in caves and cave-like cavities, occasionally in bridges.	None. There is no suitable habitat present within the BSA.
Western red bat *(Lasiurus blossevillii)*	_/SSC/_	Riparian areas dominated by walnuts, oaks, willows, cottonwoods, and sycamores where they roost in these broad-leafed trees.	**Low**. The BSA contains some mature trees that could potentially provide roosting habitat; however, there is no riparian habitat.

CODE DESIGNATIONS	
FE or FT = Federally listed as Endangered or Threatened **FC** = Federal Candidate Species **SE or ST=** State Listed as Endangered or Threatened **SC** = State Candidate Species **SSC** = State Species of Special Concern **FP** = State Fully Protected Species **SNC** = CDFW Sensitive Natural Community	**CNPS California Rare Plant Rank (CRPR):** **CRPR 1B** = Rare or Endangered in California or elsewhere **CRPR 2** = Rare or Endangered in California, more common elsewhere **CRPR 3** = More information is needed **CRPR 4** = Plants with limited distribution **0.1** = Seriously Threatened **0.2** = Fairly Threatened **0.3** = Not very Threatened
Potential for Occurrence: for plants it is considered the potential to occur during the survey period; for birds and bats it is considered the potential to breed, forage, roost, or over-winter in the BSA during migration. Any bird or bat species could fly over the BSA, but this is not considered a potential occurrence. The categories for the potential for occurrence include: **None:** The species or natural community is known not to occur and has no potential to occur in the BSA based on sufficient surveys, the lack suitable habitat, and/or the BSA is well outside of the known distribution of the species. **Low:** Potential habitat in the BSA is sub-marginal and/or the species is known to occur in the vicinity of the BSA. **Moderate:** Suitable habitat is present in the BSA and/or the species is known to occur in the vicinity of the BSA. Pre-construction surveys may be required. **High:** Habitat in the BSA is highly suitable for the species and there are reliable records close to the BSA, but the species was not observed. Pre-construction surveys required, with the exception of indicators for foraging habitat. **Known:** Species was detected in the BSA, or a recent reliable record exists for the BSA.	

Endangered, Threatened, and Rare Plants

A botanical habitat assessment and general botanical survey was conducted within the BSA on November 15, 2022 by Gallaway Enterprises Senior Botanist Elena Gregg. No special-status plant species were observed within the BSA; however, potentially suitable habitat was identified for Red Bluff dwarf rush. As their blooming periods did not occur at the time of the site visit, these species were unable to be identified within the BSA. A list of all plant species observed during the survey is provided in **Appendix C**.

Red Bluff Dwarf Rush

Red Bluff dwarf rush is ranked by the CNPS as a 1B.1 plant species. It is an annual monocot that is endemic to California and blooms from March through May. Red Bluff dwarf rush is found between elevations of 155-4100 feet in mesic annual grasslands, meadows, seeps, vernal pools, and other wet seasonal depressions in caparral, valley/foothill grasslands, or cismontane woodland.

CNDDB occurrences

There are two (2) CNDDB occurrences of Red Bluff dwarf rush within 5 miles of the BSA (#20, 2), both located approximately between 4 - 5 miles southeast of the BSA.

Status of Red Bluff dwarf rush occurring in the BSA

The BSA contains a detention basin that could potentially provide suitable habitat for Red Bluff dwarf rush. However, the detention basin is largely man-made and highly disturbed and there are no recorded CNDDB occurrences in close proximity to the BSA. As such, there is **low** potential for Red Bluff dwarf rush to occur within the BSA.

Endangered, Threatened, and Special-Status Wildlife

A wildlife habitat assessment was conducted within the BSA on November 15, 2022 by Gallaway Enterprises Biologist Daviel Vazquez. Potentially suitable habitat was identified for western spadefoot, western red bat, pallid bat, and avian species protected under the MBTA and CFGC. In addition, a special-status bumble bee habitat assessment was conducted on September 7, 2023 by Gallaway Enterprises Biologist, Cassie Corridoni. A complete list of wildlife species observed within the BSA can be found in **Appendix C.**

Western spadefoot

The western spadefoot is a SSC in California. It is an endemic species in California. The western spadefoot toad ranges from the northern point of the Central Valley south to the western corner of California. They are a stocky, small toad that varies in colors from gray, green and brown and typically have four irregular spots or stripes on their back. Their eyes are described as being golden with vertical pupils. The most distinguishing feature of the toad is a hardened, black spade on the hind foot. The spade is used for burrowing into moist soils. Suitable habitat consists of open grasslands with intermittent streams and vernal pools. Vernal pools and water sources that are ponded for a minimum of 30 days are essential for breeding and depositing eggs. Current threats facing the western spadefoot toad are loss of habitat, changes in hydrological regimes, and human disturbances.

CNDDB occurrences

There are no occurrences of this species within 5 miles of the BSA. The nearest occurrence (#462) of western spadefoot was recorded in 2006, approximately 10 miles southeast of the BSA. This occurrence was recorded within the aquatic habitat of the Stillwater Plains Conservation Bank located directly east of the Redding Municipal Airport.

Status of western spadefoot toad occurring in the BSA

The BSA features aquatic resources that could support breeding habitat for western spadefoot when water is ponded for 30 days or longer during the western spadefoot breeding season, and adjacent grasslands could provide suitable aestivation habitat. Western spadefoot has not been observed north of occurrences #462 and #1404, which are located 10 miles southeast of the BSA. Additionally, the aquatic features area greatly impacted by vehicular traffic and, it cannot be confirmed whether or not the aquatic resources onsite pond for the required duration to support this species. Due to the lack of nearby occurrences, marginally suitable habitat, and vehicular impacts, there is **low** potential for western spadefoot to occur within the BSA.

Pallid bat

Pallid bats are designated as a CDFW SSC. Pallid bats roost alone, in small groups (2 to 20 bats), or gregariously (hundreds of individuals). Day and night roosts include crevices in rocky outcrops and cliffs, caves, mines, trees (e.g., basal hollows of coast redwoods and giant sequoias, bole cavities of oaks, exfoliating Ponderosa pine [*Pinus ponderosa*] and valley oak [*Quercus lobata*] bark, deciduous trees in riparian areas, and fruit trees in orchards), and various human structures such as bridges (especially wooden and concrete girder designs), barns, porches, bat boxes, and human-occupied as well as vacant buildings. Roosts generally have unobstructed entrances/exits, are high above the ground, warm, and inaccessible to terrestrial predators. However, this species has also been found roosting on or near the ground under burlap sacks, stone piles, rags, and baseboards. Lewis 1996 found that pallid bats have low roost fidelity and both pregnant and lactating pallid bats changed roosts an average of once every 1.4 days throughout the summer. Overwintering roosts have relatively cool, stable temperatures and are located in protected structures beneath the forest canopy or on the ground, out of direct sunlight. In other parts of the species' range, males and females have been found hibernating alone or in small groups, wedged deeply into narrow fissures in mines, caves, and buildings. At low latitudes, outdoor winter activity has been reported at temperatures between –5 and 10 °C (WBWG 2022).

CNDDB Occurrences

The nearest occurrence of pallid bat is located approximately 7 miles west of the BSA (#111). This occurrence states that pallid bats were observed in riparian woodland habitat under Brady Creek Bridge on Kennedy Memorial Drive in 2002.

Status of pallid bat occurring in the BSA

Mature trees within the BSA could potentially provide suitable roosting habitat for pallid bat. Evidence of roosting (i.e., urine stains and guano) was not observed during the biological habitat assessment. There is **low** potential for pallid bat to occur within the BSA.

Western red bat

Western red bat is designated as a CDFW SSC. Western red bats are typically solitary, roosting primarily in the foliage of trees or shrubs. Day roosts are commonly in edge habitats adjacent to streams or open fields, in orchards, and sometimes in urban areas. There may be an association with intact riparian habitat (particularly willows, cottonwoods, and sycamores). Roost sites are generally hidden from view from all directions except below; lack obstruction beneath, allowing the bat to drop downward for flight; lack lower perches that would allow visibility by predators; have dark ground cover to minimize solar reflection; have nearby vegetation to reduce wind and dust; and are generally located on the south or southwest side of a tree. Red bats generally begin to forage one to two hours after sunset. Although some may forage all night, most typically have an initial foraging period corresponding to the early period of nocturnal insect activity, and a minor secondary activity period corresponding to insects that become active several hours before sunrise. Red bats mate in late summer or early fall. Females become pregnant in spring and have a pregnancy that lasts 80 to 90 days. Females may have litters of up to five (5) pups per year. This species is considered to be highly migratory. Although generally solitary, red bats appear to migrate in groups and forage in close association with one another in summer. The timing of migration and the summer ranges of males and females seem to be different. Winter behavior of this species is poorly understood (WBWG 2021).

CNDDB Occurrences

The closest CNDDB occurrence of western red bat is located approximately 6 miles west (#4) of the BSA, where an adult western red bat was captured at the Whiskeytown National Recreation Area in 2002.

Status of western red bats occurring within the BSA

Oak trees occur within the BSA and could potentially provide suitable roosting habitat for western red bats. Western red bats are closely associated with riparian habitat, which does not occur within the BSA; therefore, there is **low** potential for western red bat to occur within the BSA.

Migratory birds and raptors

Nesting birds are protected under the MBTA (16 USC 703) and the CFGC (§3503). The MBTA (16 USC §703) prohibits the killing of migratory birds or the destruction of their occupied nests and eggs except in accordance with regulations prescribed by the USFWS. The bird species covered by the MBTA includes nearly all of those that breed in North America, excluding introduced (i.e., exotic) species (50 Code of Federal Regulations §10.13). Activities that involve the removal of vegetation including trees, shrubs, grasses, and forbs or ground disturbance has the potential to affect bird species protected by the MBTA. The CFGC (§3503.5) states that it is "unlawful to take, possess, or destroy any birds in the order Falconiformes (hawks, eagles, and falcons) or Strigiformes (owls) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Take includes the disturbance of an active nest resulting in the abandonment or loss of young. The CFGC (§3503) also states that "it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto."

CNDDB occurrences

The majority of migratory birds and raptors protected under the MBTA and CFGC are not recorded on the CNDDB because they are abundant and widespread.

Status of migratory birds and raptors occurring in the BSA

There is suitable nesting habitat for a variety of nesting avian species throughout the BSA.

Special-status bumble bees

Bumble bees typically live an annual life cycle, and nest in colonies from 50-500 individuals. They occupy nests underground that help them survive throughout the winter months. Bumble bees do not create their own cavities and require existing rodent burrows, cavities, thick bunchgrasses, or man-made structures to nest. Bumble bees often choose a nest site with a sufficient supply of floral resources that have overlapping bloom periods, ensuring year round food for the colony. They prefer sites with a diverse selection of flowers as well as a water source and will not establish anywhere with a lack of food and water.

CNDDB occurrences

The American bumble bee (*Bombus* pensylvanicus) was last reported on the CNDDB database in 1978 roughly two miles from the project site and is presumed extant. No other special-status bumble bees were reported near the BSA.

Status of special-status bumble bees occurring in the BSA

The City of Redding received an early consultation letter from CDFW regarding the potential for special-status bumble bee habitat to occur within the BSA. In response to the early consultation letter, Gallaway Enterprises queried updated species lists and performed a habitat assessment on September 7, 2023, specifically for special-status bumble bees. Although there was an excess of rodent burrows potentially suitable for nesting habitat, there was a lack of floral resources which would not provide enough food to support a colony year-round. There was also a lack of a perennial water source, therefore, the BSA does not provide suitable habitat for special-status bumblebees.

REGULATORY FRAMEWORK

The following describes federal, state, and local environmental laws and policies that may be relevant if the BSA were to be developed or modified.

Federal

Waters of the United States, Clean Water Act, Section 404

The Corps and the U.S. Environmental Protection Agency (EPA) regulate the discharge of dredged or fill material into jurisdictional waters of the United States, under the Clean Water Act (§404). The term “waters of the United States” is an encompassing term that includes “wetlands” and “other waters.” Wetlands have been defined for regulatory purposes as follows: “those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3, 40 CFR 230.3). Wetlands generally include swamps, marshes, bogs, and similar areas.” Other waters of the United States are intermittent or perennial tributaries and impoundments including lakes, ponds, and other surface water features, that exhibit an ordinary high-water mark but lack positive indicators for one or more of the three wetland parameters (i.e., hydrophytic vegetation, hydric soil, and wetland hydrology) (33 CFR 328.4).

The Corps may issue either individual permits on a case-by-case basis or general permits on a program level. General permits are pre-authorized and are issued to cover similar activities that are expected to cause only minimal adverse environmental effects. Nationwide permits are general permits issued to cover particular fill activities. All nationwide permits have general conditions that must be met for the permits to apply to a particular Project, as well as specific conditions that apply to each nationwide permit.

Clean Water Act, Section 401

The Clean Water Act (§401) requires water quality certification and authorization for placement of dredged or fill material in WOTUS. In accordance with the Clean Water Act (§401), criteria for allowable discharges into surface waters have been developed by the State Water Resources Control Board, Division of Water Quality. The resulting requirements are used as criteria in granting National Pollutant Discharge Elimination System (NPDES) permits or waivers, which are obtained through the Regional Water Quality Control Board (RWQCB) per the Clean Water Act (§402). Any activity or facility that will discharge waste (such as soils from construction) into surface waters, or from which waste may be discharged, must obtain an NPDES permit or waiver from the RWQCB. The RWQCB evaluates an NPDES permit application to determine whether the proposed discharge is consistent with the adopted water quality objectives of the basin plan.

Migratory Bird Treaty Act

The MBTA (16 USC §703) prohibits the killing of migratory birds or the destruction of their occupied nests and eggs except in accordance with regulations prescribed by the USFWS. The bird species covered by the MBTA includes nearly all of those that breed in North America, excluding introduced (i.e., exotic) species (50 Code of Federal Regulations §10.13).

Federal Endangered Species Act

The United States Congress passed the ESA in 1973 to protect species that are endangered or threatened with extinction. The ESA is intended to operate in conjunction with the National Environmental Policy Act (NEPA) to help protect the ecosystems upon which endangered and threatened species depend.

Under the ESA, species may be listed as either "endangered" or "threatened." Endangered means a species is in danger of extinction throughout all or a significant portion of its range. Threatened means a species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. All species of plants and animals, except non-native species and pest insects, are eligible for listing as endangered or threatened. The USFWS also maintains a list of "candidate" species. Candidate species are species for which there is enough information to warrant proposing them for listing, but that have not yet been proposed. "Proposed" species are those that have been proposed for listing but have not yet been listed.

The ESA makes it unlawful to "take" a listed animal without a permit. Take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." Through regulations, the term "harm" is defined as "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering."

State of California

California Endangered Species Act

The California Endangered Species Act (CESA) is similar to the ESA, yet it pertains to state-listed endangered and threatened species. The CESA requires state agencies to consult with the CDFW when preparing documents to comply with the CEQA. The purpose is to ensure that the actions of the lead agency do not jeopardize the continued existence of a listed species or result in the destruction, or adverse modification of habitat essential to the continued existence of those species. In addition to formal listing under the federal and state endangered species acts, "species of special concern" receive consideration by CDFW. Species of special concern are those whose numbers, reproductive success, or habitat may be threatened.

California Fish and Game Code (§3503.5)

The CFGC (§3503.5) states that it is "unlawful to take, possess, or destroy any birds in the order Falconiformes (hawks, eagles, and falcons) or Strigiformes (all owls except barn owls) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Take includes the disturbance of an active nest resulting in the abandonment or loss of young. The CFGC (§3503) also states that "it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto."

California Migratory Bird Protection Act

The CMBPA amends the CFGC (§3513) to mirror the provisions of the MBTA and allow the State of California to enforce the prohibition of take or possession of any migratory nongame bird as designated in the federal MBTA, including incidental take.

Activities that involve the removal of vegetation including trees, shrubs, grasses, and forbs or ground disturbance have the potential to affect bird species protected by the MBTA and CFGC. Thus, vegetation removal and ground disturbance in areas with breeding birds should be conducted outside of the breeding season (approximately March 1 through August 31). If vegetation removal or ground-disturbing activities are conducted during the breeding season, then a qualified biologist must determine if there are any nests of bird species protected under the MBTA and CFGC present in the Project area prior to commencement of vegetation removal or ground-disturbing activities. If active nests are located or presumed present, then appropriate avoidance measures (e.g., spatial or temporal buffers) must be implemented.

California Environmental Quality Act Guidelines §15380

Although threatened and endangered species are protected by specific federal and state statutes, CEQA Guidelines §15380(d) provides that a species not listed on the federal or state list of protected species may be considered rare or endangered if the species can be shown to meet certain specified criteria. These criteria have been modeled based on the definition in the ESA and the section of the CFGC dealing with rare, threatened, and endangered plants and animals. The CEQA Guidelines (§15380) allows a public agency to undertake a review to determine if a significant effect on species that have not yet been listed by either the USFWS or CDFW (e.g., candidate species, species of concern) would occur. Thus, CEQA provides an agency with the ability to protect a species from a project's potential impacts until the respective government agencies have an opportunity to designate the species as protected, if warranted.

Lake and Streambed Alteration Agreement, CFGC (§1602)

The CDFW is a trustee agency that has jurisdiction under the CFGC (§1600 et seq.). The CFGC (§1602), requires that a state or local government agency, public utility, or private entity must notify CDFW if a proposed Project will "substantially divert or obstruct the natural flow or substantially change the bed, channel, or bank of any river, stream, or lake designated by the department, or use any material from the streambeds… except when the department has been notified pursuant to Section 1601." If an existing fish or wildlife resource may be substantially adversely affected by the activity, CDFW may propose reasonable measures that will allow protection of those resources. If these measures are agreeable to the parties involved, they may enter into an agreement with CDFW identifying the approved activities and associated mitigation measures.

Rare and Endangered Plants

The CNPS maintains a list of plant species native to California with low population numbers, limited distribution, or otherwise threatened with extinction. This information is published in the Inventory of Rare and Endangered Vascular Plants of California. Potential impacts to populations of CNPS California Rare Plant Rank (CRPR) plants receive consideration under CEQA review. The CNPS CRPR categorizes plants as follows:

- Rank 1A: Plants presumed extinct in California;
- Rank 1B: Plants rare, threatened, or endangered in California or elsewhere;
- Rank 2A: Plants presumed extirpated or extinct in California, but not elsewhere;
- Rank 2B: Plants rare, threatened, or endangered in California, but more numerous elsewhere;
- Rank 3: Plants about which we need more information; and
- Rank 4: Plants of limited distribution.

The California Native Plant Protection Act (CFGC §1900-1913) prohibits the taking, possessing, or sale within the state of any plants with a state designation of rare, threatened, or endangered as defined by CDFW. An exception to this prohibition allows landowners, under specific circumstances, to take listed plant species, provided that the owners first notify CDFW and give the agency at least 10 days to retrieve (and presumably replant) the plants before they are destroyed. Fish and game Code §1913 exempts from the 'take' prohibition "the removal of endangered or rare native plants from a canal, lateral channel, building site, or road, or other right of way."

CONCLUSIONS AND RECOMMENDATIONS

Endangered, Threatened, and Rare Plants

Red Bluff dwarf rush

If impacts to the detention basin present within the BSA are proposed, it is recommended that pre-construction CDFW protocol-level surveys be conducted during the appropriate survey windows (i.e., blooming periods) for Red Bluff dwarf rush by a qualified botanist to determine presence or absence within the BSA.

If special-status botanical species are observed within the BSA, then mitigation measures that are recognized by CDFW will be implemented based on the level of potential impacts. Mitigation options recognized include:

1. The applicant shall design the Project to avoid or minimize impacts to areas where special-status botanical species occur and maintain protective elements such as, fencing, open space or conservation easements, and/or buffer zones around suitable habitat where special-status

botanical species occur prior to construction activities and throughout construction activities and/or;

2. If the applicant cannot completely avoid impacts to special-status botanical species then consultation with the CDFW must be conducted and on-site or off-site compensation (such as through a mitigation bank) may be required to mitigate for impacts. Mitigation measures could include collecting seed and/or transplanting the impacted plants.

Endangered, Threatened, and Special-status Wildlife

The following minimization and mitigation measures further reduce or eliminate Project-associated impacts to special-status wildlife species.

Western spadefoot

- One (1) nighttime pre-construction surveys shall be conducted by a qualified biologist during and/or immediately following a precipitation event that occurs between October and May when ponded water is present.
- Should any life stages of western spadefoot be found within the Project boundary, CDFW shall be consulted prior to the initiation of Project activities.

Pallid bat and western red bat

- If mature trees are proposed for removal, they should be removed and/or fallen between September 16 – March 15 outside of the bat maternity season.
- Trees should be removed at dusk to minimize impacts to roosting bats. If trees cannot be removed during dusk, then a qualified biologist shall be onsite to monitor for the presence of bats during tree removal activities.

Migratory birds and raptors

- Project activities including site grubbing and vegetation removal shall be initiated outside of the bird nesting season (February 1 – August 31).
- If Project activities cannot be initiated outside of the nesting season, the following will occur:
    - A qualified biologist will conduct a pre-construction survey within 250 feet of the BSA, where accessible, within 7 days prior to the start of Project activities.
    - If an active nest (i.e., containing egg[s] or young) is observed within the BSA or in an area adjacent to the BSA where impacts could occur, a species protection buffer will be established. The species protection buffer will be defined by the qualified biologist based on the species, nest type and tolerance to disturbance. Construction activity shall be prohibited within the buffer zones until the young have fledged or the nest fails as determined by a qualified biologist. Nests shall be monitored by a qualified biologist to determine the status of nest activity.

Other Natural Resources

Waters of the United States

If activities occur within the ordinary high-water mark and/or result in fill or discharge to any waters of the U.S which include but are not limited to, intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, "wetlands," sloughs, prairie potholes, wet meadows, playa lakes, vernal pools, or natural ponds, then the following will need to be obtained:

- Prior to any discharge or fill material into Waters of the U.S, authorization under a Nationwide Permit or Individual Permit shall be obtained from the Corps. For fill requiring a Corps permit, a water quality certification from the Regional Water Quality Board (Clean Water Act §401) shall also be obtained prior to discharge of dredged or fill material.
- Prior to any activities that would obstruct the flow of or alter the bed, channel, or bank of any perennial, intermittent or ephemeral creeks, notification of streambed alteration shall be submitted to the CDFW, and, if required, a Lake and Streambed Alteration Agreement (§1602) shall be obtained.

Oak Woodlands and Tree Removal

Impacts to oaks within the BSA must be mitigated as required by the City of Redding. The City of Redding enacted a Tree Preservation Ordinance (Chapter 18.45 of the Municipal Code) and oak tree preservation guide.[1] Prior to Project entitlement a Tree Protection Plan, which includes a tree delineation, impacts assessment, tree health survey, and tree protection requirements will be required. The Tree Protection Plan will identify the type, location, and number of trees that will be preserved onsite.

[1] City of Redding. Trees & Construction, A Guide to Preservation. Document retrieved from: http://www.cityofredding.org/home/showdocument?id=3720

REFERENCES

Baldwin, B. G., D. H. Goldman, D. J. Keil, R. Patterson, T. J. Rosatti, and D. H. Wilken, editors. 2012. The Jepson Manual: vascular plants of California, second edition. University of California Press, Berkeley.

California Department of Fish and Wildlife (CDFW). 2018. Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities. State of California; California Natural Resources Agency.

California Native Plant Society, Rare Plant Program. 2023. Rare Plant Inventory (online edition, v9-01 1.5). Website. https://www.rareplants.cnps.org [accessed 12 September 2023].

California Natural Diversity Database (CNDDB). 2022. Rarefind 5. California Department of Fish and Wildlife. Sacramento, California [accessed 12 September 2023].

Gogol-Prokurat, Melanie. 2016. Shasta Salamander Range - CWHR A024 [ds1153]. California Department of Fish and Wildlife. Biogeographic Information and Observation System (BIOS). Retrieved August 15, 2022 from https://apps.wildlife.ca.gov/bios/

Lewis, Susan. 1996. Low Roost-Site Fidelity in Pallid Bats: Associated Factors and Effect on Group Stability. Behavioral Ecology and Sociobiology Vol. 39, No. 5, pp. 335-344.

Mayer, K. E. and Laudenslayer, W. F. 1988. A Guide to Wildlife Habitats of California. State of California, Resources Agency, Department of Fish and Game. Sacramento, CA. 166 pp.

USFWS. 2005. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. U.S. Fish and Wildlife Service; Portland, Oregon.

USFWS. 2021. Species status assessment report for the foothill yellow-legged frog (*Rana boylii*), Version 2.0. October 2021. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California.

Western Bat Working Group (WBWG). 2022. Western Bat Species Accounts. Available: http://wbwg.org/western-bat-species [15 August 2022].

Western Regional Climate Center (WRCC). 2022. Period of Record Monthly Climate Summary for Redding Muni AP, California (047304). Available: http:// wrcc.dri.edu [17 August 2022].

Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White, eds. 1990. California's Wildlife. Vol. I-III. California Depart. of Fish and Game, Sacramento, California.

LIST OF PREPARERS

Daviel Vazquez. Biologist. B.S. in Wildlife Conservation and Management, Cal Poly Humboldt. Mr. Vazquez has more than 5 years of experience conducting protocol-level wildlife surveys and biological habitat assessments, collecting field data, and preparing technical documents, and reports.

Elena Gregg. Senior Botanist. B.S. in Environmental Biology and Management, University of California, Davis. Mrs. Gregg has over 16 years of experience conducting protocol-level botanical surveys, botanical habitat assessments, arborist surveys, and wetland delineations.

Anthony McLaughlin. GIS Analyst and Environmental Planning. B.A. in Human Geography with certificates in Geographical Information Systems and Environmental and Land Use Planning, California State University, Chico. Anthony has more than 5 years of experience conducting spatial analysis, drafting technical reports, and producing high quality cartographic outputs.

Cassie Corridoni. Cassie Corridoni. Biologist. M.S. in Wildland Management, California State University, Chico. Ms. Corridoni brings five years of experience carrying out habitat restoration, native plant propagation and invasive species management. Ms. Corridoni has three years of conducting protocol-level bird surveys including experience with several special status species. In addition, Ms. Corridoni has surveyed for California listed wildflowers.

Appendix A

Proposed Site Development Plan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DAYLIGHT

Appendix B

Official Species Lists

Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Quad IS (Whiskeytown (4012265) OR Shasta Dam (4012264) OR Project City (4012263) OR Igo (4012255) OR Redding (4012254) OR Enterprise (4012253))

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	
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	Threatened	G1G2	S2	SSC
Agrostis hendersonii Henderson's bent grass	PMPOA040K0	None	None	G2Q	S2	3.2
Anomobryum julaceum slender silver moss	NBMUS80010	None	None	G5?	S2	4.2
Anthicus antiochensis Antioch Dunes anthicid beetle	IICOL49020	None	None	G3	S3	
Anthicus sacramento Sacramento anthicid beetle	IICOL49010	None	None	G4	S4	
Antrozous pallidus pallid bat	AMACC10010	None	None	G4	S3	SSC
Ardea alba great egret	ABNGA04040	None	None	G5	S4	
Ascaphus truei Pacific tailed frog	AAABA01010	None	None	G4	S3S4	SSC
Atractelmis wawona Wawona riffle beetle	IICOL58010	None	None	G3	S1S2	
Bombus pensylvanicus American bumble bee	IIHYM24260	None	None	G3G4	S2	
Branchinecta lynchi vernal pool fairy shrimp	ICBRA03030	Threatened	None	G3	S3	
Brodiaea matsonii Sulphur Creek brodiaea	PMLIL0C0H0	None	None	G1	S1	1B.1
Clarkia borealis ssp. borealis northern clarkia	PDONA05062	None	None	G3T4	S4	4.3
Corynorhinus townsendii Townsend's big-eared bat	AMACC08010	None	None	G4	S2	SSC
Cryptantha crinita silky cryptantha	PDBOR0A0Q0	None	None	G2	S2	1B.2
Desmocerus californicus dimorphus valley elderberry longhorn beetle	IICOL48011	Threatened	None	G3T3	S3	
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Great Valley Cottonwood Riparian Forest Great Valley Cottonwood Riparian Forest	CTT61410CA	None	None	G2	S2.1	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Great Valley Valley Oak Riparian Forest Great Valley Valley Oak Riparian Forest	CTT61430CA	None	None	G1	S1.1	
Great Valley Willow Scrub Great Valley Willow Scrub	CTT63410CA	None	None	G3	S3.2	
Haliaeetus leucocephalus bald eagle	ABNKC10010	Delisted	Endangered	G5	S3	FP
Helminthoglypta hertleini Oregon shoulderband	IMGASC2280	None	None	G3Q	S1S2	
Hydromantes shastae Shasta salamander	AAAAD09030	None	Threatened	G3	S3	
Juncus leiospermus var. leiospermus Red Bluff dwarf rush	PMJUN011L2	None	None	G2T2	S2	1B.1
Lanx patelloides kneecap lanx	IMGASL7030	None	None	G2?	S2	
Lasionycteris noctivagans silver-haired bat	AMACC02010	None	None	G3G4	S3S4	
Lasiurus frantzii western red bat	AMACC05080	None	None	G4	S3	SSC
Lathyrus sulphureus var. argillaceus dubious pea	PDFAB25101	None	None	G5T1T2Q	S1S2	3
Legenere limosa legenere	PDCAM0C010	None	None	G2	S2	1B.1
Lepidurus packardi vernal pool tadpole shrimp	ICBRA10010	Endangered	None	G3	S3	
Linderiella occidentalis California linderiella	ICBRA06010	None	None	G2G3	S2S3	
Margaritifera falcata western pearlshell	IMBIV27020	None	None	G4G5	S1S2	
Monadenia troglodytes wintu Wintu sideband	IMGASC7092	None	None	G1G2T1T2	S2	
Myotis evotis long-eared myotis	AMACC01070	None	None	G5	S3	
Myotis yumanensis Yuma myotis	AMACC01020	None	None	G5	S4	
Neviusia cliftonii Shasta snow-wreath	PDROS14020	None	Threatened	G2	S2	1B.2
Oncorhynchus mykiss irideus pop. 11 steelhead - Central Valley DPS	AFCHA0209K	Threatened	None	G5T2Q	S2	
Oncorhynchus tshawytscha pop. 11 chinook salmon - Central Valley spring-run ESU	AFCHA0205L	Threatened	Threatened	G5T2Q	S2	
Oncorhynchus tshawytscha pop. 7 chinook salmon - Sacramento River winter-run ESU	AFCHA0205B	Endangered	Endangered	G5T1Q	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
Orcuttia tenuis slender Orcutt grass	PMPOA4G050	Threatened	Endangered	G2	S2	1B.1
Pekania pennanti Fisher	AMAJF01020	None	None	G5	S2S3	SSC
Potamogeton epihydrus Nuttall's ribbon-leaved pondweed	PMPOT03080	None	None	G5	S2S3	2B.2
Rana boylii pop. 1 foothill yellow-legged frog - north coast DPS	AAABH01051	None	None	G3T4	S4	SSC
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S3	
Sagittaria sanfordii Sanford's arrowhead	PMALI040Q0	None	None	G3	S3	1B.2
Sedum paradisum ssp. paradisum Canyon Creek stonecrop	PDCRA0A0U3	None	None	G3G4T3	S3	1B.3
Spea hammondii western spadefoot	AAABF02020	None	None	G2G3	S3S4	SSC
Stachys pilosa hairy marsh hedge-nettle	PDLAM1X1A0	None	None	G5	S3	2B.3
Trifolium piorkowskii maverick clover	PDFAB40410	None	None	G2	S2	1B.2
Trilobopsis roperi Shasta chaparral	IMGASA2030	None	None	G2	S1	
Vaccinium shastense ssp. shastense Shasta huckleberry	PDERI181Z1	None	None	G4T3	S3	1B.3
Vespericola shasta Shasta hesperian	IMGASA4070	None	None	G3	S3	

Record Count: 53

CNPS Rare Plant Inventory

CALIFORNIA NATIVE PLANT SOCIETY

Search Results

32 matches found. Click on scientific name for details

Search Criteria: 9-Quad include [**4012243:4012253:4012264:4012255:4012244:4012245:4012263:4012254:4012265**]

▲ SCIENTIFIC NAME	COMMON NAME	FAMILY	LIFEFORM	BLOOMING PERIOD	FED LIST	STATE LIST	STATE RANK	CA RARE PLANT RANK
Adiantum shastense	Shasta maidenhair fern	Pteridaceae	perennial herb	Apr-Aug	None	None	S3	4.3
Agrostis hendersonii	Henderson's bent grass	Poaceae	annual herb	Apr-Jun	None	None	S2	3.2
Allium sanbornii var. sanbornii	Sanborn's onion	Alliaceae	perennial bulbiferous herb	May-Sep	None	None	S3S4	4.2
Anomobryum julaceum	slender silver moss	Bryaceae	moss		None	None	S2	4.2
Arctostaphylos malloryi	Mallory's manzanita	Ericaceae	perennial evergreen shrub	Apr-Jul	None	None	S3	4.3
Arnica venosa	Shasta County arnica	Asteraceae	perennial rhizomatous herb	May-Jul(Sep)	None	None	S3	4.2
Astragalus pauperculus	depauperate milk-vetch	Fabaceae	annual herb	Mar-Jun	None	None	S4	4.3
Brodiaea matsonii	Sulphur Creek brodiaea	Themidaceae	perennial bulbiferous herb	May-Jun	None	None	S1	1B.1
Bulbostylis capillaris	thread-leaved beakseed	Cyperaceae	annual herb	Jun-Aug	None	None	S3	4.2
Castilleja rubicundula var. rubicundula	pink creamsacs	Orobanchaceae	annual herb (hemiparasitic)	Apr-Jun	None	None	S2	1B.2
Clarkia borealis ssp. borealis	northern clarkia	Onagraceae	annual	Jun-Sep	None	None	S4	4.3
Cryptantha crinita	silky cryptantha	Boraginaceae	annual herb	Apr-May	None	None	S2	1B.2
Eriogonum congdonii	Congdon's buckwheat	Polygonaceae	perennial deciduous shrub	(May)Jun-Aug(Sep)	None	None	S4	4.3
Eriogonum tripodum	tripod buckwheat	Polygonaceae	perennial deciduous shrub	May-Jul	None	None	S4	4.2
Erythranthe glaucescens	shield-bracted monkeyflower	Phrymaceae	annual herb	Feb-Aug(Sep)	None	None	S3S4	4.3
Iris bracteata	Siskiyou iris	Iridaceae	perennial rhizomatous herb	May-Jun	None	None	S3	3.3
Juncus leiospermus var. leiospermus	Red Bluff dwarf rush	Juncaceae	annual herb	Mar-Jun	None	None	S2	1B.1
Lathyrus sulphureus var. argillaceus	dubious pea	Fabaceae	perennial herb	Apr-May	None	None	S1S2	3
Legenere limosa	legenere	Campanulaceae	annual herb	Apr-Jun	None	None	S2	1B.1

Leptosiphon latisectus	broad-lobed leptosiphon	Polemoniaceae	annual herb	Apr-Jun	None	None	S4	4.3
Limnanthes floccosa ssp. floccosa	woolly meadowfoam	Limnanthaceae	annual herb	Mar-May(Jun)	None	None	S3	4.2
Neviusia cliftonii	Shasta snow-wreath	Rosaceae	perennial deciduous shrub	Apr-Jun	None	CT	S2	1B.2
Orcuttia tenuis	slender Orcutt grass	Poaceae	annual herb	May-Sep(Oct)	FT	CE	S2	1B.1
Potamogeton epihydrus	Nuttall's ribbon-leaved pondweed	Potamogetonaceae	perennial rhizomatous herb (aquatic)	(Jun)Jul-Sep	None	None	S2S3	2B.2
Sagittaria sanfordii	Sanford's arrowhead	Alismataceae	perennial rhizomatous herb (emergent)	May-Oct(Nov)	None	None	S3	1B.2
Sedum paradisum ssp. paradisum	Canyon Creek stonecrop	Crassulaceae	perennial herb	May-Jun	None	None	S3	1B.3
Sidalcea celata	Redding checkerbloom	Malvaceae	perennial herb	Apr-Aug	None	None	S2S3	3
Stachys pilosa	hairy marsh hedge-nettle	Lamiaceae	perennial rhizomatous herb	Jun-Aug	None	None	S3	2B.3
Trifolium piorkowskii	maverick clover	Fabaceae	annual herb	Apr-May	None	None	S2	1B.2
Vaccinium shastense ssp. shastense	Shasta huckleberry	Ericaceae	perennial deciduous shrub	(Jun-Sep)Dec-May	None	None	S3	1B.3
Viburnum ellipticum	oval-leaved viburnum	Viburnaceae	perennial deciduous shrub	May-Jun	None	None	S3?	2B.3
Wolffia brasiliensis	Brazilian watermeal	Araceae	perennial herb (aquatic)	Apr-Dec	None	None	S2	2B.3

Showing 1 to 32 of 32 entries

Suggested Citation:
California Native Plant Society, Rare Plant Program. 2023. Rare Plant Inventory (online edition, v9.5). Website https://www.rareplants.cnps.org [accessed 12 September 2023].

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: September 12, 2023
Project Code: 2023-0127809
Project Name: Cottages at Bel Air

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, intentional or unintentional, 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.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. 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.

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".

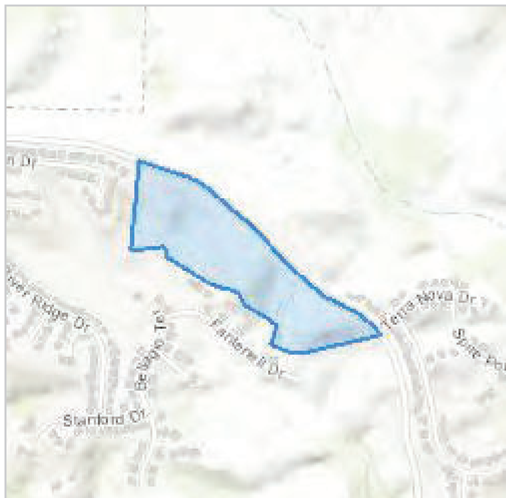
This species list is provided by:

Sacramento Fish And Wildlife Office
Federal Building
2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846
(916) 414-6600

PROJECT SUMMARY

Project Code: 2023-0127809
Project Name: Cottages at Bel Air
Project Type: New Constr - Above Ground
Project Description: 117 Meyers St, STE 120
Chico, CA 95928
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@40.61068135,-122.40905968271191,14z



Counties: Shasta County, California

ENDANGERED SPECIES ACT SPECIES

There is a total of 5 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.

BIRDS

NAME	STATUS
Northern Spotted Owl *Strix occidentalis caurina* 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	Threatened

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate
Valley Elderberry Longhorn Beetle *Desmocerus californicus dimorphus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/7850	Threatened

CRUSTACEANS

NAME	STATUS
Vernal Pool Fairy Shrimp *Branchinecta lynchi* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/498	Threatened
Vernal Pool Tadpole Shrimp *Lepidurus packardi* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2246	Endangered

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.

IPAC USER CONTACT INFORMATION

Agency: Private Entity
Name: Cassie Corridoni
Address: 117 Meyers Street, STE 120
City: Chico
State: CA
Zip: 95928
Email cassiecorridoni@gmail.com
Phone: 5303329909

From:	Cassie Corridoni
To:	"nmfs.wcrca.specieslist@noaa.gov"
Subject:	NMFS
Date:	Tuesday, September 12, 2023 8:43:00 AM

Quad Name **Redding**

Quad Number **40122-E4**

ESA Anadromous Fish

SONCC Coho ESU (T) -

CCC Coho ESU (E) -

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) -

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 -

CC Chinook Salmon Critical Habitat -

CVSR Chinook Salmon Critical Habitat - **X**

SRWR Chinook Salmon Critical Habitat - **X**

NC Steelhead Critical Habitat -

CCC Steelhead Critical Habitat -

SCCC Steelhead Critical Habitat -

SC Steelhead Critical Habitat -

CCV Steelhead Critical Habitat - **X**

Eulachon Critical Habitat -

sDPS Green Sturgeon Critical Habitat - **X**

ESA Marine Invertebrates

Range Black Abalone (E) -

Range White Abalone (E) -

ESA Marine Invertebrates Critical Habitat

Black Abalone Critical Habitat -

ESA Sea Turtles

East Pacific Green Sea Turtle (T) -
Olive Ridley Sea Turtle (T/E) -
Leatherback Sea Turtle (E) -
North Pacific Loggerhead Sea Turtle (E) -

ESA Whales

Blue Whale (E) -
Fin Whale (E) -
Humpback Whale (E) -
Southern Resident Killer Whale (E) -
North Pacific Right Whale (E) -
Sei Whale (E) -
Sperm Whale (E) -

ESA Pinnipeds

Guadalupe Fur Seal (T) -
Steller Sea Lion Critical Habitat -

Essential Fish Habitat

Coho EFH -
Chinook Salmon EFH - **X**
Groundfish EFH -
Coastal Pelagics EFH -
Highly Migratory Species EFH -

MMPA Species (See list at left)

ESA and MMPA Cetaceans/Pinnipeds

See list at left and consult the NMFS Long Beach office 562-980-4000

MMPA Cetaceans -
MMPA Pinnipeds -

Cassie Corridoni
Biologist
Gallaway Enterprises
(530) 332-9909

Appendix C

Observed Species Lists

Plant Species Observed within the Cottages at Bel Air BSA on November 15, 2022	
Scientific Name	**Common Name**
Acmispon americanus	Spanish lotus
Aegilops triuncialis	Barbed goatgrass
Arctostaphylos viscida ssp. viscida	White-leaved manzanita
Aristida oligantha	Oldfield 3-awn
Avena barbata	Wild oats
Brachypodium distachyon	False brome
Briza maxima	Greater quaking-grass
Bromus diandrus	Rip-gut brome
Bromus hordeaceus	Soft chess
Bromus rubens	Red brome
Calycadenia fremontii	Klamath calycadenia
Centaurea solstitialis	Yellow star thistle
Centromadia fitchii	Fitch's spikeweed
Croton setiger	Turkey-mullein
Crucianella angustifolia	Crosswort
Cynosurus echinatus	Hedgehog dogtail
Daucus pusillus	Rattlesnake weed
Eleocharis macrostachya	Pale spike-rush
Elymus caput-medusae	Medusahead
Elymus multisetus	Big squirreltail grass
Epilobium brachycarpum	Tall willowherb
Eragrostis sp.	Lovegrass
Eriodictyon californicum	Yerba santa
Erodium botrys	Long-beaked stork's-bill
Euphorbia maculata	Spotted spurge
Festuca perennis	Rye-grass
Gastridium phleoides	Nitgrass
Grindelia hirsutula var. davyi	Foothill gumplant
Heliotropium europaeum	European heliotrope
Hordeum marinum ssp. *gussoneanum*	Mediterranean barley
Hordeum murinum	Wall hare barley
Hypericum perforatum	Klamathweed
Hypochaeris glabra	Smooth cat's ear
Leontodon saxatilis	Hawkbit
Logfia gallica	Narrowleaf cottonrose
Lythrum hyssopifolia	Hyssop loosestrife
Navarretia sp.	Pincushion plant
Odontostomum hartwegii	Hartweg's odontostomum
Pentagramma triangularis ssp. triangularis	Gold-backed fern
Pinus sabiniana	Gray pine
Pistacia chinensis	Chinese pistache
Plagiobothrys sp.	Common popcorn flower
Plantago coronopus	Cut-leaf plantain

Scientific Name	Common Name
Polygonum aviculare	Prostrate knotweed
Quercus douglasii	Blue oak
Raphanus sp.	Wild radish
Sisymbrium officinale	Hedge mustard
Spergularia sp.	Sandspurry
Torilis arvensis	Hedge parsley
Toxicodendron diversilobum	Poison oak
Trifolium glomeratum	Sessile-headed clover
Trifolium hirtum	Rose clover
Vicia sp.	Winter vetch
Zeltnera venusta	June centaury

Wildlife Species Observed within the Cottages at Bel Air Project BSA on November 15, 2022	
Scientific Name	**Common Name**
Aphelocoma californica	California scrub-jay
Calypte anna	Anna's hummingbird
Cathartes aura	Turkey vulture
Colaptes auratus	Northern flicker
Meleagris gallopavo	Wild turkey
Odocoileus hemionus columbianus	Columbian black-tailed deer
Sceloporus occidentalis	Western fence lizard

Appendix D

Project Site Photos

Project Site Photos

Taken November 15, 2022

	
Facing south-east toward Quarts Hill Drive and annual grasslands.	Facing north-east toward the detention basin within the BSA.
	
Facing south-west toward blue oak-foothill pine habitat.	Blue oak- foothill pine habitat, facing south-west within the BSA.

Appendix E

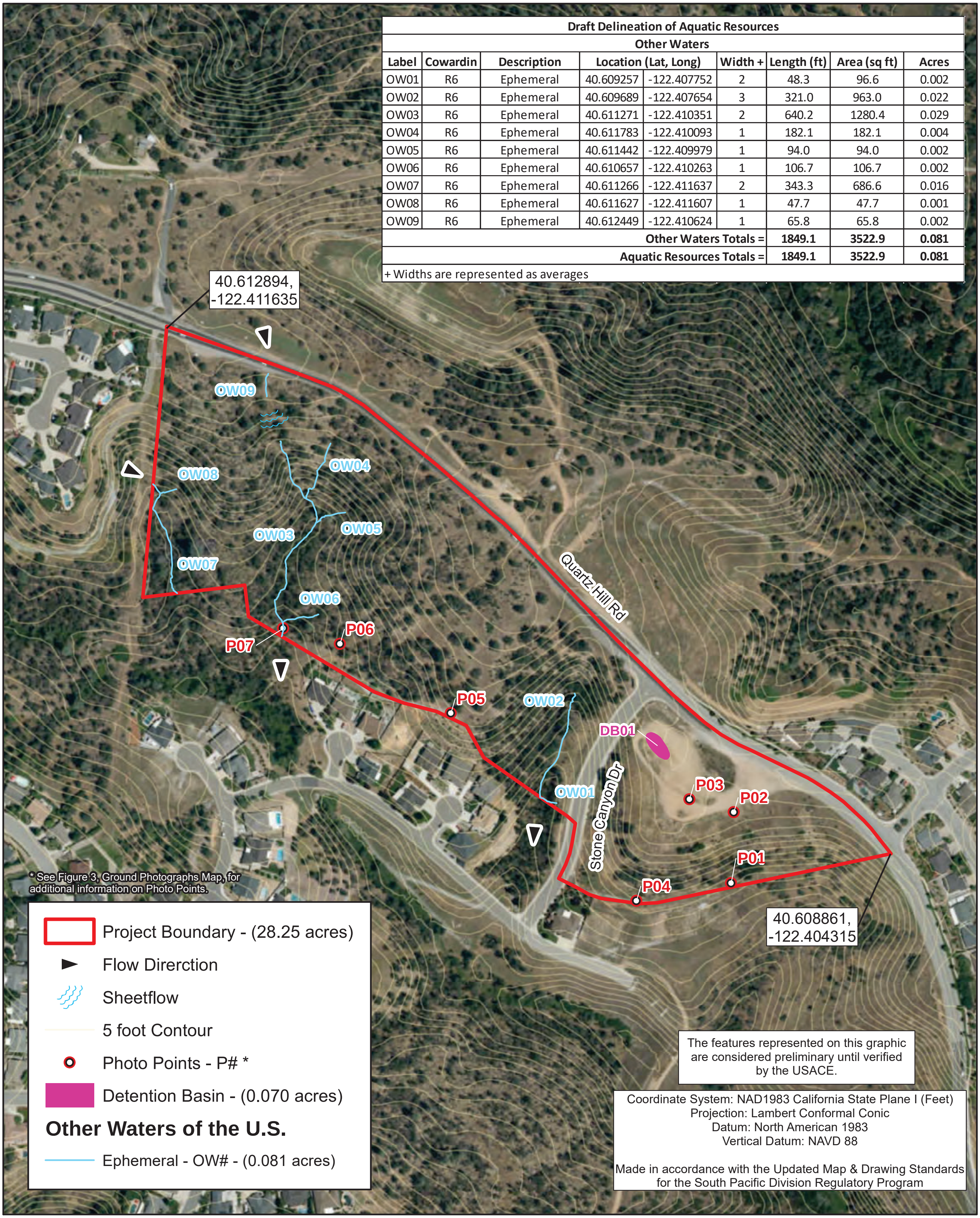
Draft Delineation of Aquatic Resources Map

Draft Delineation of Aquatic Resources

Other Waters

Label	Cowardin	Description	Location (Lat, Long)		Width +	Length (ft)	Area (sq ft)	Acres
OW01	R6	Ephemeral	40.609257	-122.407752	2	48.3	96.6	0.002
OW02	R6	Ephemeral	40.609689	-122.407654	3	321.0	963.0	0.022
OW03	R6	Ephemeral	40.611271	-122.410351	2	640.2	1280.4	0.029
OW04	R6	Ephemeral	40.611783	-122.410093	1	182.1	182.1	0.004
OW05	R6	Ephemeral	40.611442	-122.409979	1	94.0	94.0	0.002
OW06	R6	Ephemeral	40.610657	-122.410263	1	106.7	106.7	0.002
OW07	R6	Ephemeral	40.611266	-122.411637	2	343.3	686.6	0.016
OW08	R6	Ephemeral	40.611627	-122.411607	1	47.7	47.7	0.001
OW09	R6	Ephemeral	40.612449	-122.410624	1	65.8	65.8	0.002
					Other Waters Totals =	**1849.1**	**3522.9**	**0.081**
					Aquatic Resources Totals =	**1849.1**	**3522.9**	**0.081**

+ Widths are represented as averages



NORTH

1:4,200 1 inch = 350 feet

0 250 500 Feet

Data Sources: ESRI, SDS Engineering, City of Redding GIS 05/27/2020

Cottages at Bel Air
Draft Delineation of Aquatic Resources
Appendix E

gallaway ENTERPRISES

GE: #22-130 Map Date: 12/08/2022

Attachment C

Western Spadefoot Survey Report, prepared by Gallaway Enterprises, February 13, 2023

gallaway
ENTERPRISES

117 Meyers Street • Suite 120 • Chico CA 95928 • 530-332-9909

February 13, 2023

Nicole Dues
Sharrah Dunlap Sawyer, Inc.
320 Hartnell Avenue
Redding, CA 96002

RE: WESTERN SPADEFOOT SURVEY FOR THE COTTAGES AT BEL AIR DEVELOPMENT PROJECT, SHASTA COUNTY, CALIFORNIA.

Gallaway Enterprises' (GE) biologists, Jessica Sellers and Alexander Smither, conducted focused biological surveys for western spadefoot toads (*Spea hammondii*) on January 31 and February 6, 2023, for the Cottages at Bel Air Development, APN 113-190-020-000 and APN 113-190-019-000 (Project) in Shasta County, California. The purpose of the surveys was to determine the presence or absence of western spadefoot within the Project boundary. The surveys were conducted in compliance with existing state and federal environmental laws and regulations. The following are the methods, results, and recommendations of the surveys.

METHODS

Nighttime focused surveys for western spadefoot were conducted on January 31 and February 6, 2023, following recent precipitation events and when ambient temperatures were above 49˚F. The surveys began after local sunset time (approximately 5:30 pm) and were conducted on foot in all areas of suitable aquatic habitat within the Project limits. A flashlight was used to detect "eye-shine" in adult spadefoots and investigate for the presence of egg masses and/or tadpoles within suitable aquatic habitats. Additionally, an acoustic survey was conducted to determine the presence of spadefoots throughout the Project area.

A wetland delineation map produced by Gallaway Enterprises (December 2022) was used to locate aquatic features that provided potential habitat within the Project boundaries. These aquatic features were investigated for the presence of all life stages of western spadefoot. Western spadefoot observations and acoustic detections were recorded.

RESULTS

No western spadefoot were observed or acoustically detected.

RECOMMENDATIONS

Gallaway Enterprises has no recommendations at this time as no regulated species were observed during the biological surveys.

If you have any questions, please do not hesitate to contact Gallaway Enterprises at (530) 332-9909, or Jessica@gallawayenterprises.com.

Sincerely,

Jessica Sellers, Biologist
Gallaway Enterprises

Attached:

- Project Site Photos
- Draft Delineation of Aquatic Resources Map

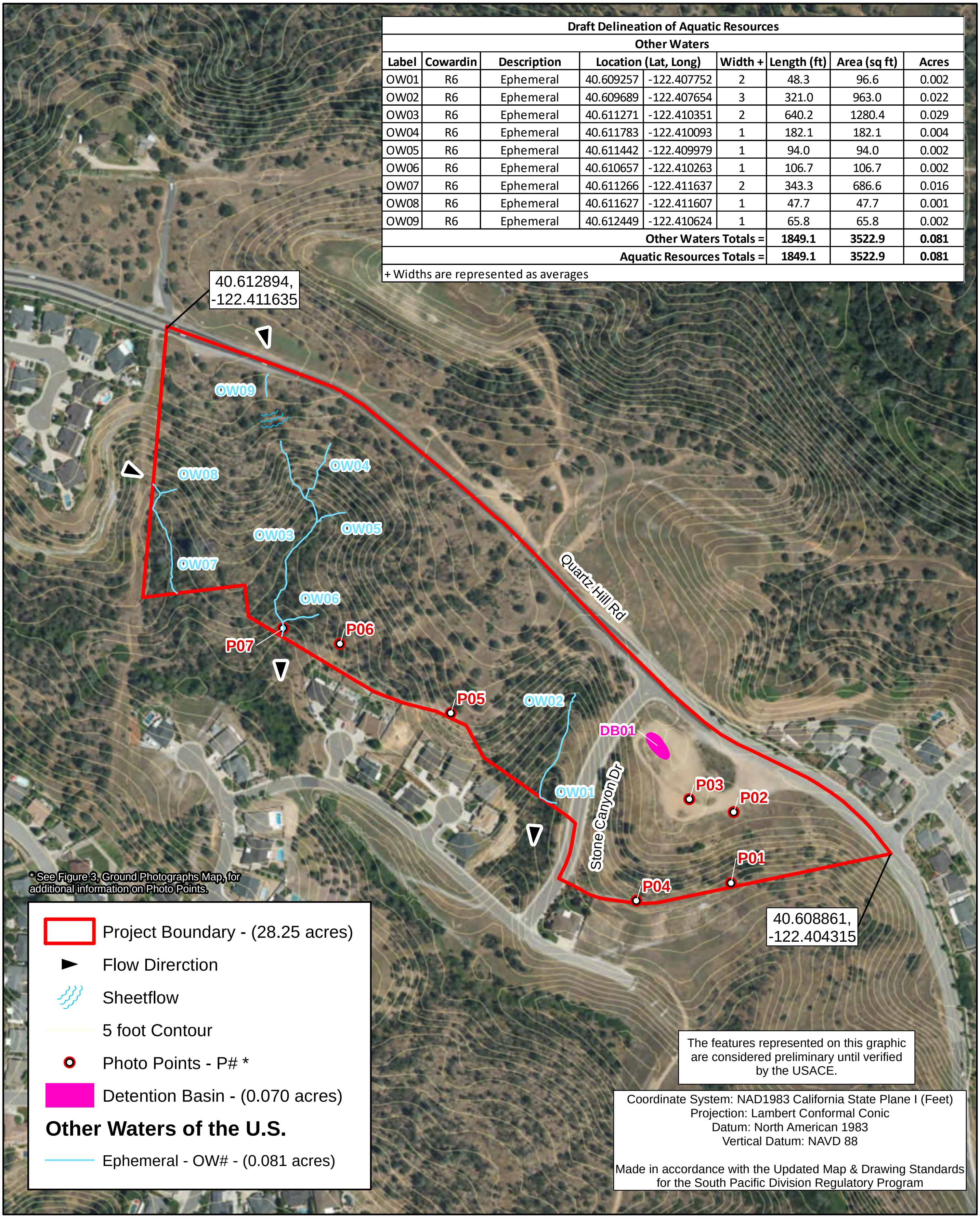
Project Site Photos

1/30: Facing southeast, DB01 (40.6097, -122.4066).

2/06: Facing northwest, DB01.

Draft Delineation of Aquatic Resources								
Other Waters								
Label	Cowardin	Description	Location (Lat, Long)		Width +	Length (ft)	Area (sq ft)	Acres
OW01	R6	Ephemeral	40.609257	-122.407752	2	48.3	96.6	0.002
OW02	R6	Ephemeral	40.609689	-122.407654	3	321.0	963.0	0.022
OW03	R6	Ephemeral	40.611271	-122.410351	2	640.2	1280.4	0.029
OW04	R6	Ephemeral	40.611783	-122.410093	1	182.1	182.1	0.004
OW05	R6	Ephemeral	40.611442	-122.409979	1	94.0	94.0	0.002
OW06	R6	Ephemeral	40.610657	-122.410263	1	106.7	106.7	0.002
OW07	R6	Ephemeral	40.611266	-122.411637	2	343.3	686.6	0.016
OW08	R6	Ephemeral	40.611627	-122.411607	1	47.7	47.7	0.001
OW09	R6	Ephemeral	40.612449	-122.410624	1	65.8	65.8	0.002
					Other Waters Totals =	**1849.1**	**3522.9**	**0.081**
					Aquatic Resources Totals =	**1849.1**	**3522.9**	**0.081**

+ Widths are represented as averages



NORTH

1:4,200 1 inch = 350 feet

0 250 500 Feet

Data Sources: ESRI, SDS Engineering, City of Redding GIS 05/27/2020

Cottages at Bel Air
Draft Delineation of Aquatic Resources
Figure 4

gallaway ENTERPRISES

GE: #22-130 Map Date: 12/08/2022

Attachment D

Draft Delineation of Aquatic Resources, prepared by Gallaway Enterprises, November 2022

DRAFT DELINEATION OF AQUATIC RESOURCES

Cottages at Bel Air

City of Redding, Shasta County, California

November 2022

Prepared for:
Zovest Capital, LLC 1309
Coffeen Ave., Suite 1200
Sheridan, WY 82801

Prepared by:
Gallaway Enterprises
117 Meyers Street, Suite 120
Chico, CA 95928
(530) 332-9909
www.gallawayenterprises.com

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Appendix A: NRCS Soils Map and Soil Series Description

DRAFT DELINEATION OF AQUATIC RESOURCES,

Cottages at Bel Air Project, Redding, Shasta County, California

Introduction and Project Location

Gallaway Enterprises conducted a Delineation of Aquatic Resources including waters of the United States (WOTUS) for the Cottages at Bel Air Project (Project) site consisting of a 28.25-acre survey area located off of Quartz Hill Road in Redding, Shasta County, California (**Figure 1 and 2**). The Project site is located within the United States Geologic Survey (USGS) Redding Quadrangle, within Section 23, Township 32N, Range 5W.

To access the site from Interstate 5 heading north in the Redding area, take exit 680 for Lake Boulevard. Turn left onto Lake Boulevard and drive for 0.8 mile. Turn left onto North Market Street and drive 0.8 mile. Turn right onto Benton Drive and drive one mile. Turn right onto Quartz Hill Road and drive 1.3 miles. The Project site is on the southwest side of Quartz Hill Road with access via a dirt road.

A survey of WOTUS was conducted on October 21, 2022, by Senior Biologist Jinnah Benn. Data regarding the location and extent of waters of the United States and other aquatic resources were collected using a Trimble Geo Explorer 6000 Series GPS Receiver. The survey involved an examination of botanical resources, soils, hydrological features, and determination of wetland characteristics based on the *United States Army Corps of Engineers Wetlands Delineation Manual* (1987) (1987 Delineation Manual); the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region* (2008) (Arid West Manual); the *U.S. Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook* (2007); the *Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States* (2008), and the *2020 Arid West Regional Wetland Plant List* and the *2020 National Wetland Plant List.* Gallaway Enterprises has prepared this report in compliance with the Minimum Standards for Acceptance of Aquatic Resources Delineation Reports (January 2016).

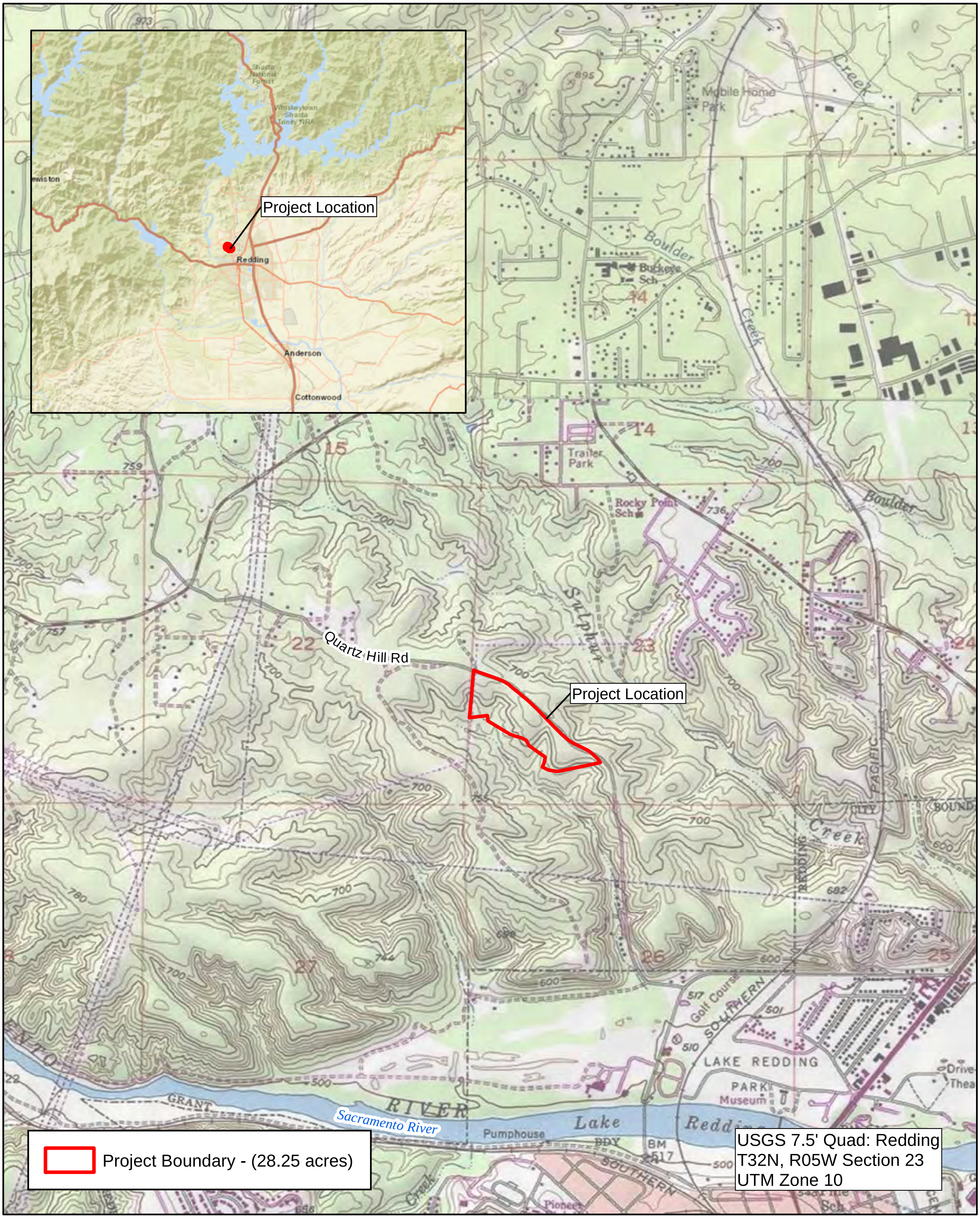
Environmental Setting and Site Conditions

The Project site is located within the northwestern city limits of Redding, California within the foothills associated with the eastern Klamath Range. The site is primarily composed of annual grassland and blue oak-foothill pine woodland. Several dirt roads cross the site. The terrain within the Project site is varied with some areas having steep slopes. The site primarily slopes southwest towards an offsite intermittent drainage known as Dix Creek that flows south towards the Sacramento River.

The Project site is bound to the northeast by Quartz Hill Road. Stone Canyon Drive cuts across the southeast corner of the Project site. A large detention basin, graded access roads, and staging areas have been constructed just south of the intersection of Stone Canyon Drive and Quartz Hill Road. This area is comprised of scrapped and compacted dirt with sparse vegetation.

The surrounding area is comprised of a mixture of undeveloped oak woodland and annual grassland habitat on steep slopes and small developments constructed along the hilltops and ridge lines where terrain is flat to gently sloped.

The average annual precipitation is 33.68 inches, and the average annual temperature is 62.45° F (WRCC 2022) in the region where the Project is located. The Project occurs at an elevation ranging from 735 feet above sea level in the northwest corner to 652 feet above sea level along the southeastern Project boundary. The site is sloped between 0 and 30 percent. Soils within the site are primarily gravelly and sandy loams with a restrictive layer that starts at 80 inches.



Data Sources: ESRI, USGS
SDS Engineering

Cottages at Bel Air
Regional Location
Figure 1

gallaway ENTERPRISES

GE: #22-130 Map Date: 10/10/2022

NORTH

1:4,250

0 250 500 Feet

Data Sources: ESRI, SDS Engineering, City of Redding GIS 05/27/2020

Cottages at Bel Air
Project Location
Figure 2

gallaway ENTERPRISES

GE: #22-130 Map Date: 10/10/2022

Survey Methodology

The entire Project site was surveyed on-foot by Gallaway Enterprises staff on October 21, 2022, to identify any potentially jurisdictional features. The survey, mapping efforts, and report production were performed according to the current valid legal definitions of WOTUS in effect as of September 20, 2021. The boundaries of non-tidal, non-wetland waters, when present, were delineated at the ordinary high water mark (OHWM) as defined in 33 Code of Federal Regulations (CFR) 328.3. The OHWM represents the limit of United States Army Corps of Engineers (Corps) jurisdiction over non-tidal waters (e.g., streams and ponds) in the absence of adjacent wetlands (33 CFR 328.04) (Curtis, et. al. 2011). Historic aerial photographs available on Google Earth were analyzed prior to conducting the field visit. Areas identified as having potential wetland or unusual aerial signatures were assessed in the field to determine the current conditions.

Wetland perimeters based on the 1987 Delineation Manual and the Arid West Manual were recorded, if observed, and defined according to their topographic and hydrologic orientation. Only areas exhibiting the necessary wetland parameters according to the 1987 Delineation Manual and Arid West Manual on the date surveyed were mapped as wetlands. Photographs were taken to show wetland features and/or areas identified as having unusual aerial signatures. The locations of the photo points are depicted in **Figure 3** and the associated photographs are provided at the end of this report.

Many of the terms used throughout this report have specific meanings relating to the federal wetland delineation process. Term definitions are based on the Corps 1987 Delineation Manual; the Arid West Manual; *Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States, (*Lichvar and McColley 2008*)* and the Corps *Jurisdictional Determination Form Instructional Guidebook* (2007). The terms defined below have specific meaning relating to the delineation of WOTUS as prescribed by §404 of the Clean Water Act (CWA) and described in 33 CFR Part 328 and 40 CFR Parts 110, 112, and 116, and 122.

Determination of Hydrophytic Vegetation

The presence of hydrophytic vegetation was determined using the methods outlined in the 1987 Delineation Manual and the Arid West Manual. Areas were considered to have positive indicators of hydrophytic vegetation if they pass the dominance test, meaning more than 50 percent of the dominant species are obligate wetland, facultative wetland and facultative plants. Plant species were identified to the lowest taxonomy possible. Plant indicator status was determined by reviewing the 2020 Arid West Region Wetland Plant List and the 2020 National Wetland Plant List. In situations where dominance can be misleading due to seasonality, the prevalence index will be used to determine hydrophytic status of the community surrounding sample sites.

Plant indicator status categories:

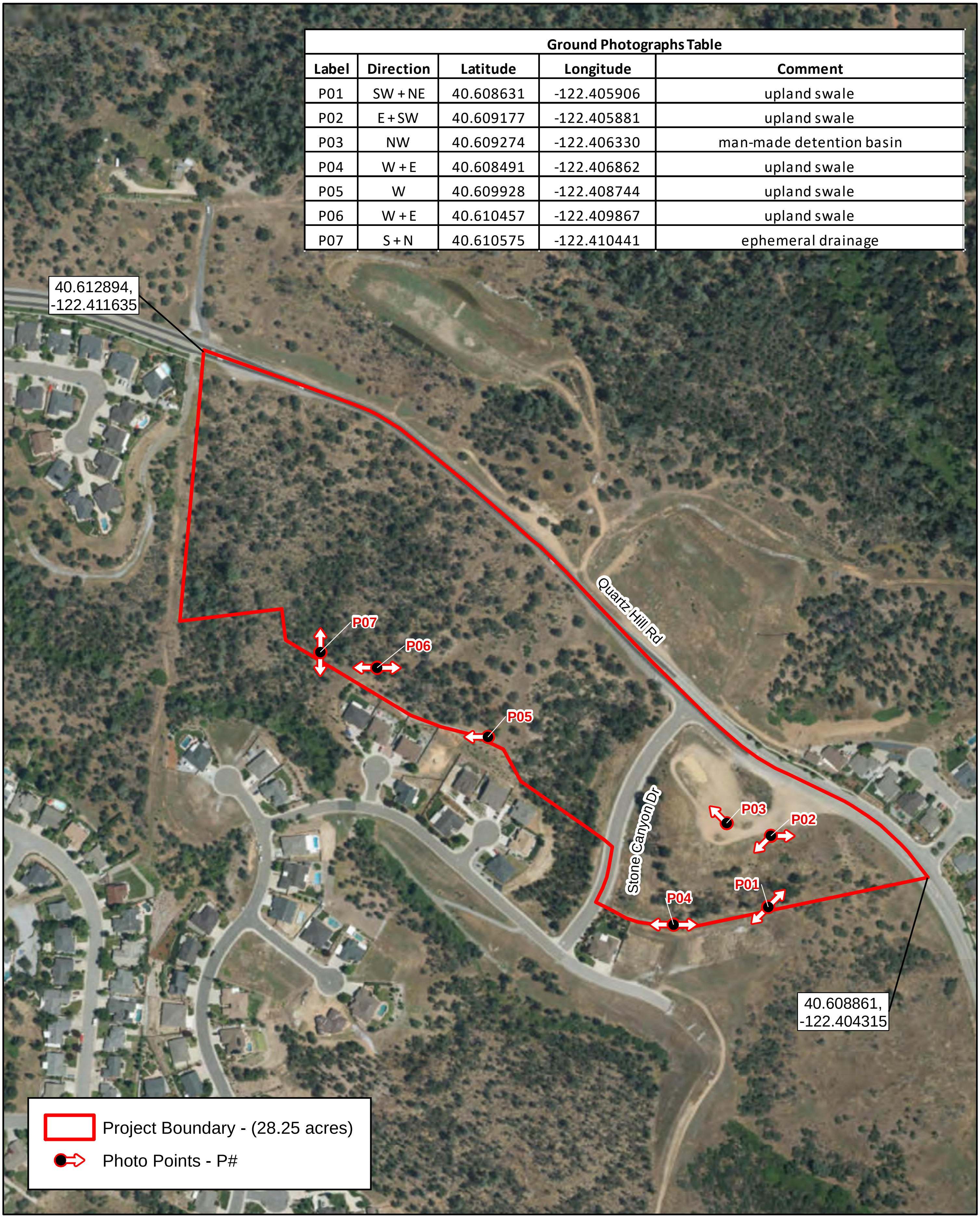
Obligate wetland plants (OBL) – plants that occur almost always (estimated probability 99%) in wetlands under normal conditions, but which may also occur rarely (estimated probability 1%) in non-wetlands.

Facultative wetland plants (FACW) - plants that usually occur (estimated probability 67% to 99%) in wetlands under normal conditions, but also occur (estimated probability 1% to 33%) in non-wetlands.

Facultative plants (FAC) – Plants with a similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and non-wetlands.

Facultative upland plants (FACU) – Plants that occur sometimes (estimated probability1% to 33%) in wetlands but occur more often (estimated probability 67% to 99%) in non-wetlands.

Ground Photographs Table				
Label	Direction	Latitude	Longitude	Comment
P01	SW + NE	40.608631	-122.405906	upland swale
P02	E + SW	40.609177	-122.405881	upland swale
P03	NW	40.609274	-122.406330	man-made detention basin
P04	W + E	40.608491	-122.406862	upland swale
P05	W	40.609928	-122.408744	upland swale
P06	W + E	40.610457	-122.409867	upland swale
P07	S + N	40.610575	-122.410441	ephemeral drainage



NORTH

1:4,200 1 inch = 350 feet

0 250 500 Feet

Data Sources: ESRI, SDS Engineering, City of Redding GIS 05/27/2020

Cottages at Bel Air
Ground Photographs
Figure 3

gallaway ENTERPRISES

GE: #22-130 Map Date: 11/15/2022

Obligate upland plants (UPL) – Plants that occur rarely (estimated probability 1%) in wetlands but occur almost always (estimated probability 99%) in non-wetlands under natural conditions.

Determination of Hydric Soils

Soil survey information was reviewed for the current site condition. Field samples, when taken, were evaluated by using the Munsell soil color chart (2009 Edition), hand texturing, and assessing soil features (e.g. oxidized root channels, evidence of hardpan, Mn and Fe concretions). Field observations of soil characteristics included soil color, texture, structure, and the visual assessment of soil features (e.g. the presence, or absence of redoximorphic features and the depth of restrictive layers such as hardpans).

Information regarding local soil and series descriptions is provided in **Appendix A.** The current Natural Resources Conservation Service (NRCS) *Field Indicators of Hydric Soils in the United States, Version 8.2* (NRCS 2018) was used in conjunction with the Arid West Manual to determine the presence of hydric soil indicators when necessary.

Determination of Wetland Hydrology

Wetland hydrology was determined to be present if a site supported one or more of the following characteristics:

- Landscape position and surface topography (e.g. position of the site relative to an up-slope water source, location within a distinct wetland drainage pattern, and concave surface topography),
- Inundation or saturation for a long duration either inferred based on field indicators or observed during repeated site visits, and
- Residual evidence of ponding or flooding resulting in field indicators such as scour marks, sediment deposits, algal matting, surface soil cracks and drift lines.

The presence of water or saturated soil for approximately 12% or 14 consecutive days during the growing season typically creates anaerobic conditions in the soil, and these conditions affect the types of plants that can grow and the types of soils that develop (Wetland Training Institute 1995).

Historic aerial photographs were analyzed to look for primary and secondary wetland hydrology indicators of inundation or saturation. The historic aerial imagery reviewed was the public, readily available imagery provided on Google Earth. If aerial signatures demonstrated the presence of surface water on 1 or more of the historic aerial photographs viewed, inundation and a primary indicator of wetland hydrology was determined to be present. Saturation, a secondary indicator of wetland hydrology, was determined to be present if saturation, “darker patches within the field,” were observed on 1 or more of the historic aerial photographs viewed and the presence of hydric soils was confirmed in these areas during the field survey.

Determination of Ordinary High Water Mark

Gallaway utilized methods consistent with the Arid West Manual and *Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States, (2008)* to determine the OHWM. The lateral extents of non-tidal water bodies (e.g. intermittent and ephemeral streams) were based on the OHWM, which is “the line on the shore established by the fluctuations of water” (Corps 2005). The OHWM was determined based on multiple observed physical characteristics of the area, which can include scour, multiple observed flow events (from current and historical aerial photos), shelving, and changes in the character of soil, presence of mature vegetation, deposition, and topography. Due to the wide extent of some floodplains, adjacent riparian scrub areas characterized by hydric soils, hydrophytic vegetation, and hydrology may be included within the OHWM of a non-tidal water body (Curtis, et. al. 2011). Inclusion of minor special aquatic areas is an acceptable practice as outlined in the Arid West Manual.

Representative OHWM widths were measured in the field in feet incrementally throughout each drainage feature mapped as required by the Corps *Final Map and Drawing Standards for the South Pacific Division Regulatory Program* (2012). The widths measured in the field were used to ensure that other waters of the United States identified within the Project are mapped and calculated at the appropriate average width for each channel segment based on the Corps definition of OHWM as defined in the Arid West OHWM Field Guide and the *Ordinary High Water Mark Identification RGL 05-05 (2005)* (RGL 05-05). When the average width of a feature changes, this change is shown on the delineation map as a feature transition and a new average channel width is determined.

Determination of Wetland Boundaries in Difficult Wetland Situations

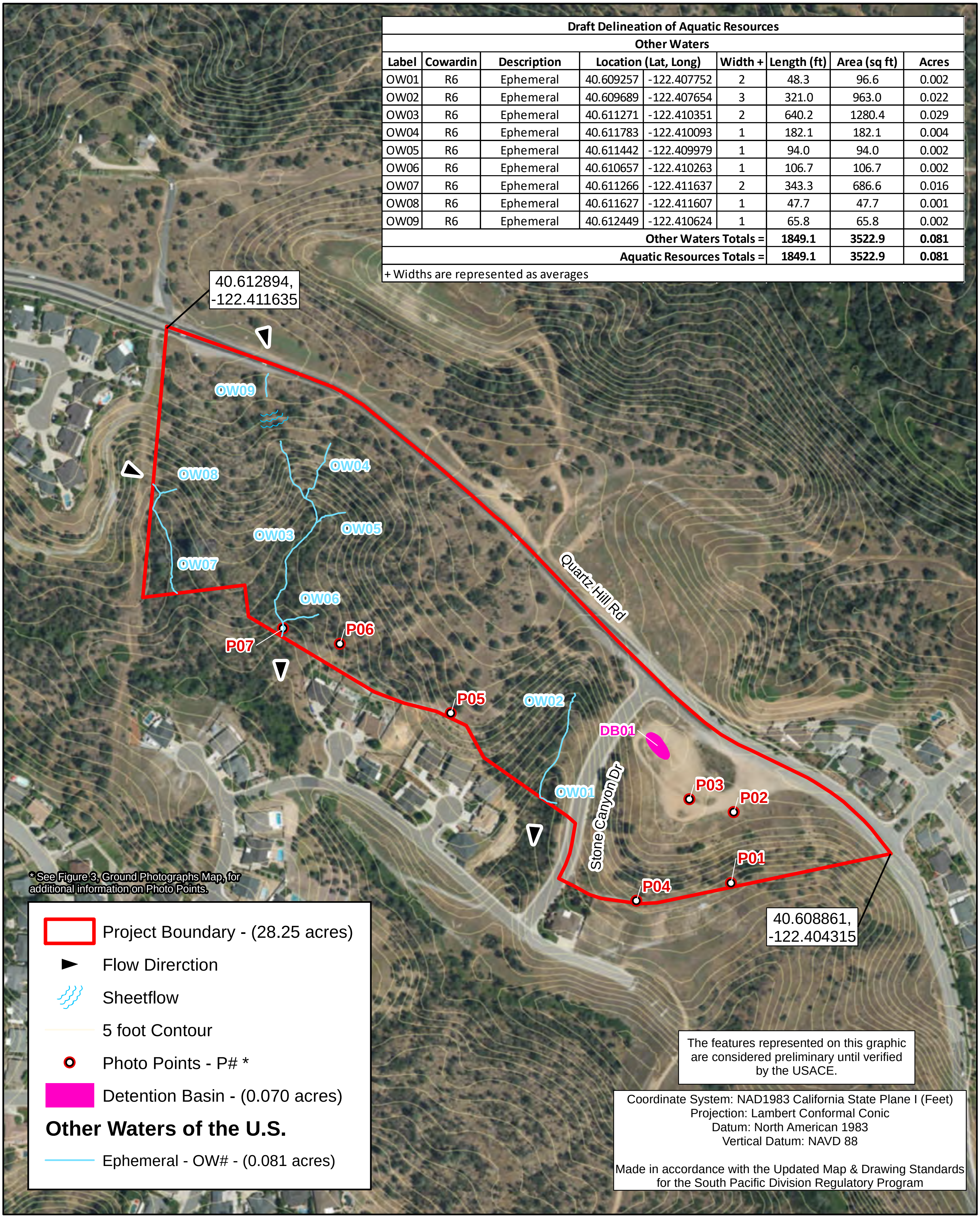
The difficult wetland situation procedures for determining hydrophytic vegetation were used when mapping the boundary of wetlands within the Project due to the extreme drought conditions experienced in California in 2022 (NOAA 2022). To aid in the determination, spatial patterns, analysis of aerial photographs, topography, and landscape position were used in conjunction with vegetation data to determine the wetland boundary. Areas where wetland vegetation or wetland hydrology was lacking but where the landscape position was likely to concentrate water were closely inspected. Gallaway Enterprises mapped these areas as wetlands if hydric soil indicators were detected and at least one other hydric indicator was present (i.e. wetland hydrology or hydrophytic vegetation).

Aquatic Resource Boundary Determination and Acreage Calculation

The wetland-upland boundary was determined based on the presence or inference of positive indicators of all mandatory criteria. The site was traversed on foot to identify wetland features and boundaries. The spatial data obtained during the preparation of this wetland delineation was collected using a Trimble Geo Explorer 6000 Series GPS Receiver. No readings were taken with fewer than 5 satellites. Point data locations were recorded for at least 25 seconds at a rate of 1 position per second. Area and line data were recorded at a rate of 1 position per second while walking at a slow pace. All GPS data were differentially corrected for maximum accuracy. In some cases, when visual errors and degrees of precision are identified due to environmental factors negatively influencing the precision of the GPS instrument (i.e. dense tree cover, steep topography, and other factors affecting satellite connection) mapping procedures utilized available topographic and aerial imagery datasets in order to improve accuracy in feature alignment and location.

Non-Wetland and Non-Jurisdictional Feature Boundary Determination

Areas were determined to be non-wetlands if they did not meet the necessary wetland test parameters (hydrophytic vegetation, hydric soil, and wetland hydrology) (33 CFR 328.4) and were determined to be potentially non-jurisdictional if they were consistent with the description of non-jurisdictional features as presented in the *Corps Jurisdictional Determination Form Instructional Guidebook* (2007).



Draft Delineation of Aquatic Resources

Other Waters

Label	Cowardin	Description	Location (Lat, Long)		Width +	Length (ft)	Area (sq ft)	Acres
OW01	R6	Ephemeral	40.609257	-122.407752	2	48.3	96.6	0.002
OW02	R6	Ephemeral	40.609689	-122.407654	3	321.0	963.0	0.022
OW03	R6	Ephemeral	40.611271	-122.410351	2	640.2	1280.4	0.029
OW04	R6	Ephemeral	40.611783	-122.410093	1	182.1	182.1	0.004
OW05	R6	Ephemeral	40.611442	-122.409979	1	94.0	94.0	0.002
OW06	R6	Ephemeral	40.610657	-122.410263	1	106.7	106.7	0.002
OW07	R6	Ephemeral	40.611266	-122.411637	2	343.3	686.6	0.016
OW08	R6	Ephemeral	40.611627	-122.411607	1	47.7	47.7	0.001
OW09	R6	Ephemeral	40.612449	-122.410624	1	65.8	65.8	0.002
					Other Waters Totals =	**1849.1**	**3522.9**	**0.081**
					Aquatic Resources Totals =	**1849.1**	**3522.9**	**0.081**

+ Widths are represented as averages

NORTH

1:4,200 1 inch = 350 feet

0 250 500 Feet

Data Sources: ESRI, SDS Engineering, City of Redding GIS 05/27/2020

Cottages at Bel Air
Draft Delineation of Aquatic Resources
Figure 4

gallaway ENTERPRISES

GE: #22-130 Map Date: 12/08/2022

Results

Table 1 Summarizes the area calculations for the pre-jurisdictional features within the Project site. A complete Draft Delineation of Aquatic Resources map, utilizing a 1" to 350' scale, is included as **Figure 4**.

Table 1. Summary of the Draft Delineation of Aquatic Resources Results for the Cottages at Bel Air Project.

Draft Delineation of Aquatic Resources						
Other Waters						
Label	**Cowardin**	**Description**	**Width +**	**Length (ft)**	**Area (sq ft)**	**Acres**
OW01	R6	Ephemeral	2	48.3	96.6	0.002
OW02	R6	Ephemeral	3	321.0	963.1	0.022
OW03	R6	Ephemeral	2	640.2	1280.3	0.029
OW04	R6	Ephemeral	1	182.1	182.1	0.004
OW05	R6	Ephemeral	1	94.0	94.0	0.002
OW06	R6	Ephemeral	1	106.7	106.7	0.002
OW07	R6	Ephemeral	2	343.3	686.5	0.016
OW08	R6	Ephemeral	1	47.7	47.7	0.001
OW09	R6	Ephemeral	1	65.8	65.8	0.002
Other Waters Totals =				**1849.1**	**3522.9**	**0.081**
Aquatic Resources Totals =				**1849.1**	**3522.9**	**0.081**
+ Widths are represented as averages						

Waters of the United States: Other Waters

There are eight features identified as "other waters of the United States" (OW) within the Project site (**Figure 4**). The area and linear footage data associated with these features are provided in **Table 1**. Other waters of the United States are seasonal or perennial water bodies, including lakes, stream channels, ephemeral and intermittent drainages, ponds, and other surface water features that exhibit an ordinary high-water mark but lack positive indicators for one or more of the three wetland parameters (hydrophytic vegetation, hydric soil, and wetland hydrology) (33 CFR 328.4). The boundaries of all other waters identified within the Survey Area were delineated based on the observed OHWM, including physical characteristics such as natural lines impressed on the bank, shelving, changes in the character of the soil, the destruction of terrestrial vegetation, debris lines and other appropriate indicators.

Eight OW features have been identified as ephemeral drainages (OW01- OW08). All of these ephemeral drainages (OW01 – OW08) within the Project site are directly connected to an intermittent drainage known as Dix Creek that flows southeast of the Project boundary. The ephemeral drainages identified on the Project site are classified as Non-Relatively Permanent Waters (NRPW). Non-Relatively Permanent Waters are defined as tributaries that typically flow for less than 3 months of the year and have a documented hydrologic connection to a Traditionally Navigable Water (TNW). These eight drainages (OW01 – OW08 on **Figure 4**) within the Project site have a hydrologic connection to an offsite intermittent drainage that has a documented hydrologic connection to the Sacramento River, a TNW. These OW features identified within the Project were observed to contain appropriate morphology of bed, bank and scour.

Waters of the United States: Wetlands

No wetland features that meet the definition of jurisdictional WOTUS were observed within the Project site. Photo points were taken throughout the Project site to demonstrate the site conditions (**Figure 3**).

Non-Wetland and Non-Jurisdictional Features

Several man-made features have been constructed in uplands throughout the Project site. These include a large detention basin (DB01) located just south of the intersection of Stone Canyon Drive and Quartz Hill Road (PO3 on **Figure 3**). Based on a review of aerial photography, the detention basin was constructed in uplands between 2006 and 2007. In addition, five upland swales (PO1, PO2, PO4 – PO6 on **Figure 3**) have been constructed throughout the Project site for the purpose of directing drainage away from steep slopes and the developments downslope of the Project site. None of the man-made features connect to any other drainages, wetlands, or waters.

One ephemeral drainage within the Project site (OW09 on **Figure 4**) has bank and a bed with scour. However, no evidence of an OHWM was observed within this erosional feature. As such, this feature meets the definition of a non-jurisdictional erosional feature. This feature sheet flows and dissipate without connecting directly to another aquatic resource.

Photo points were taken throughout the Project site to document these man-made features and demonstrate the site conditions (**Figure 3**). These features do not meet the criteria set forth in the *Corps Jurisdictional Determination Form Instructional Guidebook* (2007) to be considered jurisdictional. Primarily, they do not connect to a TNW. Determination of jurisdiction of these features is the responsibility of the Corps.

Soils

No test pits were dug as there were no potential wetlands within the Project site. Gallaway observed the soil texture to be sandy and gravelly loam.

The soils within the Project site are from a fan remnant landform. They are both well-drained with a restrictive layer more than 80 inches deep. The Redding gravelly loams, 0 to 15 percent slopes comprises the flatter portions of the Project site that runs along Quartz Hill Road following the ridge line. The Newtown gravelly loam, 15 to 30 percent slopes occupies the steeper portions of the Project site.

Gallaway queried the National Cooperative Soil Survey database to further evaluate the current soil conditions. A copy of the soil survey map and a description of mapped soil units for the Project site are included as **Appendix A**. Two soil map units occur within the Project site. The two map units are listed below in **Table 2**. Based on Gallaway's review, none of the soil map units identified within the site contain hydric components.

Table 2. Soil Map Units, NRCS hydric soil designation, and approximate totals for the Cottages at Bel Air Project.

Map Unit Symbol	Map Unit Name	% Hydric Component in Map Unit	Landform of Hydric Component	% Map Unit in Project
NeD	Newtown gravelly loam, 15 to 30 percent slopes	N/A	N/A	57.8%
ReB	Redding gravelly loams, 0 to 15 percent slopes	N/A	N/A	42.2%

Vegetation

The ephemeral drainages present within the Project site generally lacked vegetation or contained only sparse vegetation including greater rattlesnake grass (*Briza maxima*) (UPL) and hedgehog dogtail grass (*Cynosurus echinatus*) (NL).

The blue oak-foothill woodland was dominated by a moderately dense tree canopy of blue oaks (*Quercus douglasii*) (UPL), and a sparse to moderately dense shrub layer composed of whiteleaf manzanita (*Arctostaphylos viscida*) (UPL). The understory is comprised of poison oak (*Toxicodendron diversilobum*) (FACU) and annual grassland as described below.

The dominant vegetation within the annual grassland habitat included greater rattlesnake grass, Medusahead grass (*Elymus caput-medusae*) (NL), soft chess brome (*Bromus hordeaceous*) (FACU), wild oats (*Avena fatua*) (NL) and hedgehog dogtail grass.

Hydrology

Precipitation and localized surface runoff provide the main hydrological inputs for the aquatic resources within the Project site. Moderately to steep sloped topography directs the surface runoff into ephemeral drainages. All the drainages except for OW-09 exit the Project site and converge with an offsite intermittent drainage (Dix Creek). Dix Creek flows south for approximately 0.6 mile before entering a culvert under Quartz Hill Road. From there it travels east and south for approximately 1, 700 feet underground before daylighting in Lake Redding Park. The water then flows through the park and into the Sacramento River (a TNW).

Site Photos Taken on October 21, 2022

P01 – In southern portion of Project site looking northeast at manmade upland swale

P02 – Man-made upland swale at crest of hill looking southwest

P01 – In southern portion of Project site looking southwest at manmade upland swale

P03 – Looking northwest at man-made detention basin (DB01) south of the intersection of Stone Canyon Drive and Quartz Hill Road

P02 – Man-made upland swale at crest of hill looking northeast

P04 – In southern portion of project site looking west at manmade upland drainage

P04 – In southern portion of Project site looking east at manmade upland drainage

P06 – Uphill end of manmade upland swale looking east

P05 – In central portion of Project site looking east as manmade upland drainage

P07 – Down slope end of ephemeral drainage (OW03) looking south

P06 – Lower (east) end of manmade upland swale looking west

P07 – Down slope end of ephemeral drainage (OW03) looking north

Glossary

Abutting: When referring to wetlands that are adjacent to a tributary, abutting defines those wetlands that are not separated from the tributary by an upland feature, such as a berm or dike.

Adjacent: Adjacent as used in “Adjacent to traditional navigable water,” is defined in Corps and EPA regulations as “bordering, contiguous, or neighboring.” Wetlands separated from other waters of the U.S. by man-made dikes or barriers, natural river berms, beach dunes and the like are ‘adjacent wetlands. A wetland “abuts” a tributary if it is not separated from the tributary by uplands, a berm, dike, or similar feature.

While all wetlands that meet the agencies' definitions are considered adjacent wetlands, only those adjacent wetlands that have a continuous surface connection because they directly abut the tributary (e.g., they are not separated by uplands, a berm, dike, or similar feature) are considered jurisdictional under the plurality standard. (CWA Jurisdiction Following Rapanos v US and Carabell v US 12-02-08).

The regulations define “adjacent” as follows: “[t]he term adjacent means bordering, contiguous, or neighboring. Wetlands separated from other waters of the United States by man-made dikes or barriers, natural river berms, beach dunes and the like are ‘adjacent wetlands.’” Under this definition, a wetland does not need to meet all criteria to be considered adjacent. The agencies consider wetlands to be bordering, contiguous, or neighboring, and therefore “adjacent” if at least one of following three criteria is satisfied:

(1) There is an unbroken surface or shallow sub-surface hydrologic connection between the wetland and jurisdictional waters; or

(2) The wetlands are physically separated from jurisdictional waters by “manmade dikes or barriers, natural river berms, beach dunes, and the like;” or,

(3) Where a wetland’s physical proximity to a jurisdictional water is reasonably close, that wetland is “neighboring” and thus adjacent. For example, wetlands located within the riparian area or floodplain of a jurisdictional water will generally be considered neighboring, and thus adjacent. One test for whether a wetland is sufficiently proximate to be considered “neighboring” is whether there is a demonstrable ecological interconnection between the wetland and the jurisdictional waterbody. For example, if resident aquatic species (e.g., amphibians, reptiles, fish, mammals, or waterfowl) rely on both the wetland and the jurisdictional waterbody for all or part of their life cycles (e.g., nesting, rearing, feeding, etc.), that may demonstrate that the wetland is neighboring and thus adjacent. The agencies recognize that as the distance between the wetland and jurisdictional water increases, the potential ecological interconnection between the waters is likely to decrease.

The agencies will also continue to assert jurisdiction over wetlands “adjacent” to traditional navigable waters as defined in the agencies’ regulations. Under EPA and Corps regulations and as used in this guidance, “adjacent” means “bordering, contiguous, or neighboring.” Finding a continuous surface connection is not required to establish adjacency under this definition. The Rapanos decision does not affect the scope of jurisdiction over wetlands that are adjacent to traditional navigable waters. The agencies will assert jurisdiction over those adjacent wetlands that have a continuous surface connection with a relatively permanent, non-navigable tributary, without the legal obligation to make a significant nexus finding.

Atypical situation (significantly disturbed): In an atypical (significantly disturbed) situation, recent human activities or natural events have created conditions where positive indicators for hydrophytic vegetation, hydric soil, or wetland hydrology are not present or observable.

Channel. "An open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water" (Langbein and Iseri 1960:5).

Channel bank. The sloping land bordering a channel. The bank has steeper slope than the bottom of the channel and is usually steeper than the land surrounding the channel.

Cobbles. Rock fragments 7.6 cm (3 inches) to 25 .4 cm (10 inches) in diameter.

Debris flow. A moving mass of rock fragments, soil, and mud where more than 50% of the particles are larger than sand-sized.

Ditch. A constructed or excavated channel used to convey water.

Drift. Organic debris oriented to flow direction(s) (larger than small twigs).

Ephemeral stream. An ephemeral stream has flowing water only in direct response to precipitation events in a typical year. Ephemeral streambeds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

Facultative wetland (FACW). Wetland indicator category; species usually occurs in wetlands (estimated probability 67–99%) but occasionally found in non-wetlands.

Flat. A level landform composed of unconsolidated sediments usually mud or sand. Flats may be irregularly shaped or elongate and continuous with the shore, whereas bars are generally elongate, parallel to the shore, and separated from the shore by water.

Gravel. A mixture composed primarily of rock fragments 2mm (0 .08 inch) to 7.6 cm (3 inches) in diameter. Usually contains much sand.

Growing season. The frost-free period of the year (see U.S. Department of Interior, National Atlas 1970:110-111 for generalized regional delineation).

Herbaceous. With the characteristics of an herb; a plant with no persistent woody stem above ground.

Hydric soil. Soil is hydric that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic (oxygen-depleted) conditions in its upper part (i.e., within the shallow rooting zone of herbaceous plants).

Hydrophyte, **hydrophytic.** Any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.

Intermittent stream. An intermittent stream has flowing water during certain times of the year and more than in direct response from precipitation, when elevated groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water.

Jurisdictional Waters. Features that meet the definition of waters of the Unites States provided below and that fall under Corps regulations pursuant to Section 404 of the CWA are considered jurisdictional features.

Litter. Organic debris oriented to flow direction(s) (small twigs and leaves).

Man-induced wetlands. A man-induced wetland is an area that has developed at least some characteristics of naturally occurring wetlands due to either intentional or incidental human activities.

Non-Relatively Permanent Water: A non-relatively permanent water (NRPW) is defined as a tributary that is not a TNW and that typically flows for periods for less than 3 months. NRPWs are jurisdictional when they have a documented significant nexus to TNWs. All NRPWs must also contain appropriate morphology of bed, bank and scour and be clearly connected to a TNW.

Normal circumstances. This term refers to the soil and hydrologic conditions that are normally present, without regard to whether the vegetation has been removed.

Obligate hydrophytes. Species that are found only in wetlands e.g., cattail (*Typha latifolia*) as opposed to ubiquitous species that grow either in wetland or on upland-e .g., red maple (*Acer rubrum*).

Obligate wetland (OBL). Wetland indicator category; species occurs almost always (estimated probability 99%) under natural conditions in wetlands.

Other Waters of the United States. Other waters of the United States are seasonal or perennial water bodies, including lakes, stream channels, drainages, ponds, and other surface water features, that exhibit an ordinary high-water mark but lack positive indicators for one or more of the three wetland parameters (hydrophytic vegetation, hydric soil, and wetland hydrology) (33 CFR 328.4).

Palustrine the Palustrine System includes all nontidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean derived salts is below 0.5 parts per thousand. It also includes wetlands lacking such vegetation, but with all of the following four characteristics: (1) area less than 8 ha (20 acres); (2) active wave-formed or bedrock shoreline features lacking; (3) water depth in the deepest part of basin less than 2 m (6.6 feet) at low water; and (4) salinity due to ocean-derived salts is less than 0.5 parts per thousand.

Perennial stream. A perennial stream has flowing water year-round during atypical year. The water table is located above the stream bed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

Ponded. Ponding is a condition in which free water covers the soil surface (e.g., in a closed depression) and is removed only by percolation, evaporation, or transpiration.

Problem area. Problem areas are those where one or more wetland parameters may be lacking because of normal seasonal or annual variations in environmental conditions that result from causes other than human activities or catastrophic natural events**.**

Relatively Permanent Waters of the U.S. Non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically three months).

Scour. Soil and debris movement.

Sheetflow. Overland flow occurring in a continuous sheet; a relatively high-frequency, low-magnitude event.

Shrub. A woody plant which at maturity is usually less than 6 m(20 feet) tall and generally exhibits several erect, spreading, or prostrate stems and has a bushy appearance ; e.g., speckled alder (*Alnus rugosa*) or buttonbush (*Cephalanthus occidentalis*).

Succession. Changes in the composition or structure of an ecological community.

Traditional Navigable Waters (TNWs)."[a]ll waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide." These waters are referred to in this guidance as traditional navigable waters. The traditional navigable waters include all of the "navigable waters of the United States," as defined in

33 C.F.R. Part 329 and by numerous decisions of the federal courts, plus all other waters that are navigable-in-fact (for example, the Great Salt Lake, UT, and Lake Minnetonka, MN). Thus, the traditional navigable waters include, but are not limited to, the "navigable waters of the United States" within the meaning of Section 10 of the Rivers and Harbors Act of 1899 (also known as "Section 10 waters").

Tree. A woody plant which at maturity is usually 6 m (20 feet) or more in height and generally has a single trunk, unbranched for 1 m or more above the ground, and a more or less definite crown; e.g., red maple (*Acer rubrum*), northern white cedar (*Thuja occidentalis*).

Typical Year. Defined by the EPA and Corps as meaning when precipitation and other climactic variables are within the normal periodic range for the geographic area based on a rolling thirty-year period.

Water table. The upper surface of a zone of saturation. No water table exists where that surface is formed by an impermeable body.

Waters of the United States (WOTUS). This is the encompassing term for areas under federal jurisdiction pursuant to Section 404 of the CWA. Waters of the United States are divided into "wetlands" and "other waters of the United States."

Watershed (drainage basin). An area of land that drains to a single outlet and is separated from other watersheds by a divide.

Wetland. Wetlands are defined as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR 328.3 [b], 40 CFR 230.3). To be considered under potential federal jurisdiction, a wetland must support positive indicators for hydrophytic vegetation, hydric soil, and wetland hydrology.

Woody plant. A seed plant (gymnosperm or angiosperm) that develops persistent, hard, fibrous tissues, basically xylem; e.g., trees and shrubs.

Xeric. Relating or adapted to an extremely dry habitat.

References

Cheatham, N.H., and J.R. Haller. 1975. An annotated list of California habitat types. Univ. of California Natural Land and Water Reserve System, unpubl. manuscript.

Cowardin, Lewis M., Virginia Carter, Francis C. Golet and Edward T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C.

Curtis, Katherine E., Robert W. Lichvar. 2010. Updated Datasheet for the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States. ERDC/CRREL TN-10-1. U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH

Curtis, Katherine E., Robert W. Lichvar, Lindsey E. Dixon. 2011. Ordinary High Flows and the Stage-Discharge Relationship in the Arid West Region (Technical Report). U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH

Environmental Laboratory 1987. U.S. Army Corps of Engineers wetlands delineation manual. (Technical Report Y-87-1). U.S. Army Waterways Experiment Station. Vicksburg, MS.

Lichvar, R.W., and J.S. Wakeley, ed. 2004. Review of Ordinary High Water Mark indicators for delineating arid streams in the southwestern United States. ERDC/CRREL TR-04-1. Hanover, NH: U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory. (http://www.crrel.usace.army.mil/techpub/CRREL _Reports/reports/TR04-21.pdf).

Lichvar, R.W., D. Finnegan, M. Ericsson, and W. Ochs. 2006. Distribution of Ordinary High Water Mark (OHWM) indicators and their reliability in identifying the limits of "Waters of the United States" in arid southwestern channels. ERDC/CRREL TR-06-5. Hanover, NH: U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory. (http://www.crrel.usace.army.mil/techpub/CRREL_Reports/ reports/TR06-5.pdf).

Lichvar, R.W. and S.M. McColley. 2008. A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Western Region of the Western United States. ERDC/CRREL TR-08-12. Hanover, NH: U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory.

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. State of California 2016 Wetland Plant List: The National Wetland Plant List: 2016 wetland ratings. Phytoneuron 2016-30: 1-17. U.S. Army Corps of Engineers. ISSN 2153 733X.

Mayer, K.E. and W.F. Laudenslayer. 1988. A Guide to Wildlife Habitats of California. California Department of Forestry and Fire Protection. Sacramento, CA.

National Oceanic and Atmospheric Administration (NOAA). 2022. National Integrated Drought Information System. U.S. Drought Monitor. Accessed online through the U.S. Drought Portal (www.drought.gov).

Natural Resources Conservation Service (NRCS). 2022. Custom Soil Resource Report for Shasta County Area, California. Accessed through the NRCS Web Soil Survey website (http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm).

Soil Survey Staff. 2010. Keys to Soil Taxonomy, 11th ed. USDA-Natural Resources Conservation Service, Washington, DC.

U.S. Army Corps of Engineers (Corps). 2007. U.S. Army Corps of Engineers Jurisdictional Determination Form Instructional Guidebook. Prepared jointly by the U.S. Army Corps of Engineers and the Environmental Protection Agency. May 30, 2007.

U.S. Army Corps of Engineers. 2008. Regional supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region. J.S. Wakeley, R.W. Lichvar, and C.V. Noble, ed. ERDC/EL TR-06-16. Vicksburg, MS: U.S. Army Engineer Research and Development Center, Environmental Laboratory.

U.S. Army Corps of Engineers, South Pacific Division. 2001. Final summary report: Guidelines for jurisdictional determinations for water of the United States in the arid Southwest. San Francisco, CA: U.S. Army Corps of Engineers, South Pacific Division. (http://www.spl.usace.army.mil/regulatory/lad.htm).

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://soils.usda.gov/

United States Department of Agriculture, Natural Resources Conservation Service. 2018. Field Indicators of Hydric Soils in the United States, Version 8.2. L.M. Vasilas, G.W. Hurt, and J.F. Berkowitz (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils.

Western Regional Climate Center, Desert Research Institute. 2022. http://www.wrcc.dri.edu. Local Climate Summary for the Redding Muni AP, California (047304) NOAA Cooperative Station.

Wetland Training Institute. 1995. Field guide for wetland delineation: 1987 Corps of Engineers manual. (WTI 95-3). Poolsville, MD.

Appendix A: NRCS Soils Map and Soil Series Description

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Shasta County Area, California

Cottages at Bel Air

November 8, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,160 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Shasta County Area, California
Survey Area Data: Version 18, Sep 2, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 8, 2019—Jun 21, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NeD	Newtown gravelly loam, 15 to 30 percent slopes	16.3	57.8%
RdB	Redding gravelly loam, 0 to 15 percent slopes, moist, MLRA 17	11.9	42.2%
Totals for Area of Interest		**28.3**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Shasta County Area, California

NeD—Newtown gravelly loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: hfr8
Elevation: 600 to 1,000 feet
Mean annual precipitation: 30 inches
Mean annual air temperature: 61 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Newtown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newtown

Setting

Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 10 inches: gravelly loam
H2 - 10 to 18 inches: very gravelly clay loam
H3 - 18 to 35 inches: clay loam
H4 - 35 to 65 inches: silty clay loam
H5 - 65 to 72 inches: gravelly silty clay loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R017XD088CA - UPLAND TERRACE
Hydric soil rating: No

Minor Components

Perkins

Percent of map unit: 10 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Red bluff

Percent of map unit: 5 percent
Landform: Fan remnants
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

RdB—Redding gravelly loam, 0 to 15 percent slopes, moist, MLRA 17

Map Unit Setting

National map unit symbol: 2w8bn
Elevation: 430 to 1,100 feet
Mean annual precipitation: 28 to 48 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 310 to 335 days
Farmland classification: Not prime farmland

Map Unit Composition

Redding and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Redding

Setting

Landform: Fan remnants
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium derived from igneous, metamorphic and sedimentary rock over clayey alluvium derived from igneous, metamorphic and sedimentary rock over cemented alluvium derived from igneous, metamorphic and sedimentary rock over tehama formation

Typical profile

A1 - 0 to 5 inches: gravelly loam
A2 - 5 to 6 inches: loam

Bt - 6 to 13 inches: clay
Btqm - 13 to 28 inches: cemented very gravelly material
2C - 28 to 60 inches: stratified sand to loam to clay

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches; 10 to 30 inches to duripan
Drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: About 5 to 13 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.2 to 0.5 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 0.9 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R017XD089CA - ACID TERRACE
Hydric soil rating: No

Minor Components

Newtown

Percent of map unit: 5 percent
Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Red bluff

Percent of map unit: 5 percent
Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Clough

Percent of map unit: 5 percent
Landform: Fan remnants
Landform position (two-dimensional): Summit, toeslope
Landform position (three-dimensional): Tread
Microfeatures of landform position: Swales
Down-slope shape: Linear
Across-slope shape: Linear, concave
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Attachment E

Storm Drain Analysis, prepared by Sharrah Dunlap Sawyer, January 2007

January 2007
06.0102.000

THE COTTAGES AT BEL-AIR
REDDING, CA

STORM DRAIN ANALYSIS

APN 113-190-011

Prepared by

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SIGNED: 3/14/07
DATE

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USBR Type VI Energy Dissipator Detail

EXECUTIVE SUMMARY

SITE LOCATION:

The proposed Cottages at Bel-Air development is located within the limits of the City of Redding. Figure 1 – Vicinity Map shows the project location south of Quartz Hill Road.

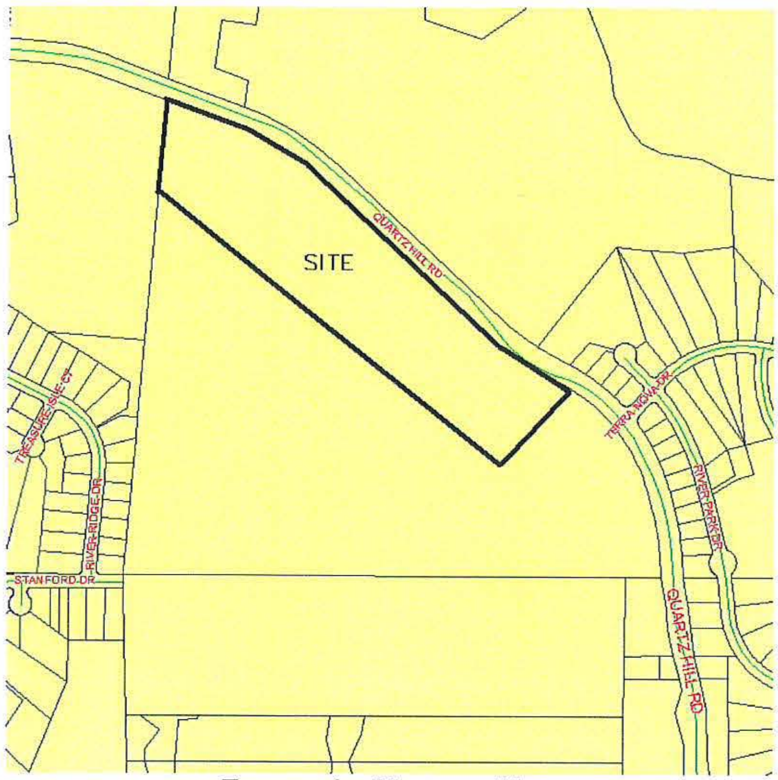


FIGURE 1 – VICINITY MAP

DESIGN CRITERIA:

To meet CEQA, City Council Policy 1806, and City of Redding Engineering Division requirements for protection of floodplains and downstream drainage concerns, the design is required to maintain or reduce pre-development peak flows for the 10-, 25-, and 100-year design storm events. Runoff from the Cottages project will be detained in the proposed detention facility located in Bel Air Estates, GP-11-05, just south of the project. See the *Bel Air Estates Drainage Report* for details.

Facilities within the development draining areas less than 40 acres are designed to convey the 10-year peak flows without surcharging per City of Redding Construction Standards 2004 requirements. City of Redding Construction Standards 2004 also require that the storm drain infrastructure for areas or combination of areas less than 10 acres should be analyzed using the Rational Method. Since all basins or combination of basins are less than 10 acres the Rational Method was used for design.

1/29/07

CONCLUSION:

The proposed storm drainage system is designed in accordance with CEQA, City Council Policy 1806, and City of Redding Engineering Division requirements for protection of floodplains and downstream drainage concerns.

1/29/07

ON-SITE HYDROLOGY AND HYDRAULICS

City of Redding Construction Standards 2004 require that a frequency of ten years for areas less than 40 acres be used in the design of the storm drain infrastructure. City of Redding Construction Standards 2004 also require that the storm drain infrastructure for areas or combination of areas less than 10 acres should be analyzed using the Rational Method. Areas or combination of areas in excess of 10 acres should be analyzed using the HEC-1 program.

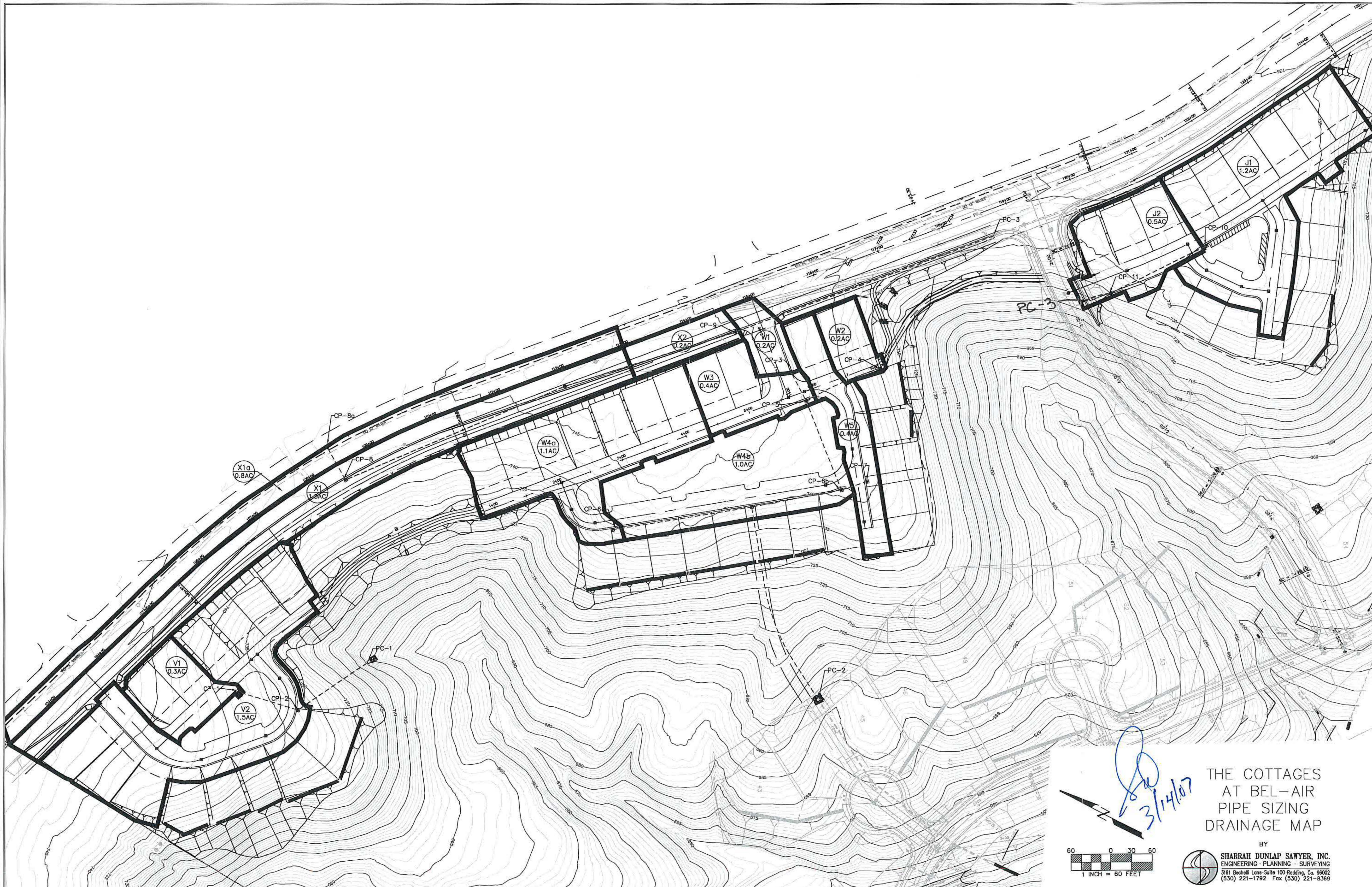
Stormwater on-site will be captured by various inlets and conveyed through storm drain pipes to the proposed Bel Air Estates storm drain system and ultimately to the proposed detention facility located within the Bel Air estates development. For the purpose of sizing the inlets and storm drain pipes, the project was broken into several subbasins. These subbasins are shown in the *Cottages at Bel Air Pipe Sizing Drainage Basin Map* which can be found in Appendix A.

Since the sub-basins are draining areas less than 40 acres, a frequency of 10 years was used for inlet design. See Appendix A for the *Cottages at Bel Air Pipe Sizing Drainage Basin Map* for inlet identification and inlet capacity calculations.

The Rational Method was used to size the on-site storm drain pipes. See Appendix A for basin characteristics and pipe sizing calculations.

1/29/07

APPENDIX A



3/14/07

THE COTTAGES
AT BEL-AIR
PIPE SIZING
DRAINAGE MAP

BY

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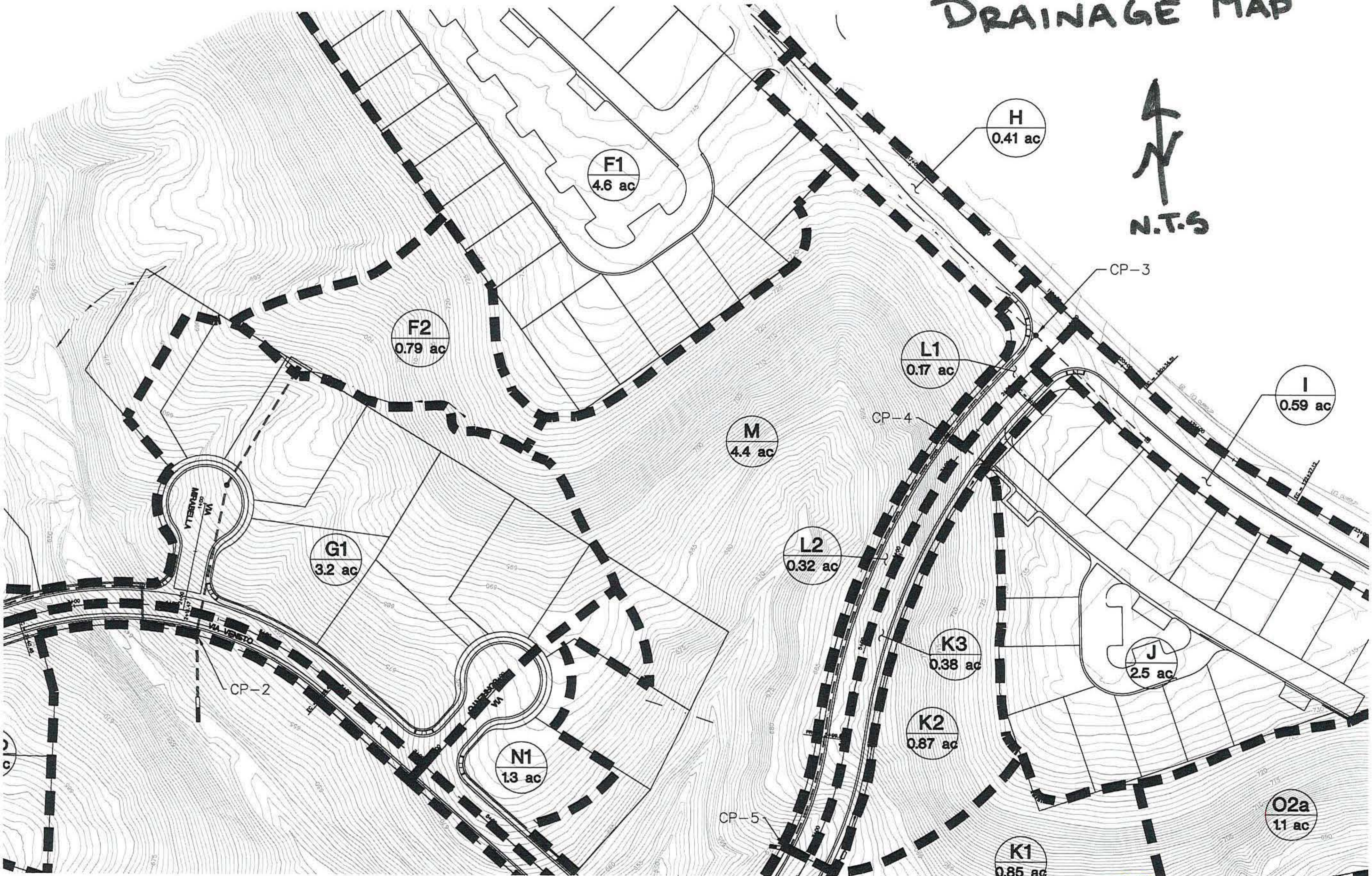
DATE: MARCH, 2007 SCALE: 1"=60' SHEET 1 OF 1

P:\PROJ\P\06102\DWG\06102B-PIPE.DWG 06.102

BEL- AIR
DRAINAGE MAP



3/14/01

The Cottages at Bel-Air
Calcs By: A. Corey
Sharrah, Dunlap, Sawyer, Inc
Date: January 2007

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

V1

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	5,880 SF	1.00
Concrete Area	1,100 SF	0.95
Asphalt Area	3,500 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	3,200 SF	0.25
	13,680 SF	
Total Area	0.3 acres	0.79

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 8.1 min
* Tco = 8.1 min

L = 95 ft   H = 2 ft
S = 0.02 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR   FCT = 1.45
PWR = -0.54
i = 4.28 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 0.2 min

L = 115 ft (Flowpath)
ΔH = 6.5 ft
S_{ave} = 0.057 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 8.3 min => 0.14 Hr   V = 8.4 fps

Intensity; City of Redding, Ca   Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54   Tc(10yr) = 8.3   I: 10yr = 4.2 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.79	4.2	0.3	$\boxed{1.0}$ cfs

1/29/07

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

INLET SIZING
CB#3 in Sag Condition
10 year - Postdeveloped Flows

Contribution from Street to Catch Basin

CP-1
Drainage Basin V1
Street Capacity and Depth of Flow
6" vertical curb & gutter

Gutter flow (Q) =	1 cfs
Longitudinal Slope (s) =	0.074 ft/ft
Q/s^1/2 factor =	3.7
Depth =	0.18 ft.
Area of Flow (A) =	0.22 sf
Top width (T) =	2.8 ft.
(From C.O.R. Street Capacity Chart)	

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 20 feet.

Weir flow governs at depth of 0.18 ft.
Total head (H) = 4"depression + depth = 0.51 ft.
Weir equation: Q=CLH^(3/2)
where: C = 3.2 (weir coefficient)
L = length of inlet (3.5' for std. CB#3)

Solve for length: L = Q/(C*H^(3/2))
L = 0.9 ft. Minimum length to capture 100% flow

Therefore use standard CB#3

1/29/07

Drainage Basin V1
CP-1 to CP-2

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....1.0000 cfs
Slope ....0.0610 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....2.5459 in
Area 1.2272 ft2
Wetted Area 0.1380 ft2
Wetted Perimeter ....12.7388 in
Perimeter ....47.1239 in
Velocity..................................7.2454 fps
Hydraulic Radius ....1.5602 in
Percent Full ....16.9728 %
Full flow Flowrate...................15.9545 cfs
Full flow velocity....................13.0009 fps

Critical Information

Critical depth...........................4.7163 in
Critical slope ....0.0052 ft/ft
Critical velocity.......................3.0264 fps
Critical area 0.3304 ft2
Critical perimeter ....17.8581 in
Critical hydraulic radius..........2.6644 in
Critical top width ....13.9285 in
Specific energy........................1.0280 ft
Minimum energy.....................0.5895 ft
Froude number........................3.3309
Flow condition ....Supercritical

1/29/07

The Cottages at Bel-Air
Calcs By: A. Corey
Sharrah, Dunlap, Sawyer, Inc
Date: January 2007

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

V2

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1 * C_1 + A_2 * C_2 + A_3 * C_3 + A_4 * C_4 + A_5 * C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	13,000 SF	1.00
Concrete Area	4,000 SF	0.95
Asphalt Area	15,200 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	33,500 SF	0.25
	65,700 SF	
Total Area	1.5 acres	0.59

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 9.7 min
* Tco = 9.7 min

L = 120 ft H = 2.3 ft
S = 0.02 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 3.88 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 0.8 min

L = 357 ft (Flowpath)
ΔH = 15 ft
S_{ave} = 0.042 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 10.5 min => 0.18 Hr V = 7.2 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 10.5 I: 10yr = 3.7 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.59	3.7	1.5	$\boxed{3.3}$ cfs

1/29/07

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

INLET SIZING
CB#3 in Sag Condition
10 year - Postdeveloped Flows

Contribution from Street to Catch Basin

CP-2
Drainage Basin V2
<u>Street Capacity and Depth of Flow</u>
6" vertical curb & gutter

Gutter flow (Q) =	3.3	cfs
Longitudinal Slope (s) =	0.008	ft/ft
Q/s^1/2 factor =	36.9	
Depth =	0.35	ft.
Area of Flow (A) =	1.50	sf
Top width (T) =	11.6	ft.
(From C.O.R. Street Capacity Chart)		

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 12 feet.

Weir flow governs at depth of 0.35 ft.
Total head (H) = 4"depression + depth = 0.68 ft.
Weir equation: Q=CLH^(3/2)
where: C = 3.2 (weir coefficient)
L = length of inlet (3.5' for std. CB#3)

Solve for length: L = Q/(C*H^(3/2))
L = 1.8 ft. Minimum length to capture 100% flow

Therefore use standard CB#3

1/29/07

Drainage Basin V2
CP-2 to PC-1

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....4.2000 cfs
Slope ....0.1570 ft/ft
Manning's n 0.0130

Computed Results:

Depth......................................4.1096 in
Area..1.2272 ft2
Wetted Area 0.2729 ft2
Wetted Perimeter ....16.5260 in
Perimeter ....47.1239 in
Velocity ....15.3929 fps

USE USBR TYPE 6
ENERGY DISSIPATOR

Hydraulic Radius .... 2.3775 in
Percent Full ....27.3973 %
Full flow Flowrate ....25.5958 cfs
Full flow velocity....................20.8573 fps

Critical Information

Critical depth...........................10.0735 in
Critical slope ....0.0066 ft/ft
Critical velocity ....4.7637 fps
Critical area 0.8817 ft2
Critical perimeter ....28.7088 in
Critical hydraulic radius ....4.4223 in
Critical top width ....15.0000 in
Specific energy........................4.0247 ft
Minimum energy ....1.2592 ft
Froude number 5.4858
Flow condition ....Supercritical

1/29/07

SHARRAH DUNLAP SAWYER, INC.
Civil Engineering Structural Engineering Planning Surveying
3161 BECHELLI LN. SUITE 100, REDDING, CA 96002
TEL. 530-221-1792/FAX 530-221-8369/ Email: info@sdsengineering.com

USBR TYPE VI ENERGY DISSIPATOR DESIGN CALCULATIONS

- Determine the minimum width required USBR Type VI Energy Dissipator (Impact Basin) per ADOT Hydraulics Manual design procedure.

PC-1

- Given: D = 15 inch, $S = 0.157$, $L = 121'$
  $Q = 4.2$ cfs, $n = 0.013$, $V_o = 15.4$ fps

- Calculate Equivalent Depth, d_E

$$d_E = \left(\frac{A}{2}\right)^{1/2} \qquad A = \frac{Q}{V_o} = \frac{4.2 \text{ cfs}}{15.4 \text{ fps}} = 0.27 \text{ ft}^2$$

$$d_E = \left(\frac{0.27}{2}\right)^{1/2} \Rightarrow \underline{d_E = 0.37 \text{ ft}}$$

- Determine Input Flow

$$\text{Froude Number, } Fr = \frac{V_o}{(g d_E)^{1/2}} = \frac{15.4}{[(32.2)(.37)]^{1/2}} \Rightarrow Fr = 4.5$$

$$\text{Specific Energy, } H_o = d_E + \frac{V_o^2}{2g} = 0.37' + \frac{15.4^2}{2(32.2)} \Rightarrow H_o = 4.1 \text{ ft}$$

- Determine Basin Width

From Figure 9-6: $\frac{H_o}{W} = 1.4$

$$W = H_o/(H_o/W) = \frac{4.1 \text{ ft}}{1.4} = 3 \text{ ft} \rightarrow \text{Min. Width} = 4 \text{ ft}$$

3/14/07

Use W = 4ft [remaining dimensions per detail]

SHARRAH DUNLAP SAWYER, INC.
Civil Engineering Structural Engineering Planning Surveying
3161 BECHELLI LN. SUITE 100, REDDING, CA 96002
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- Determine critical depth and velocity @ rock outfall

From Retangular channel Calculator:

critical depth: 3.9 in
critical velocity: 3.2 fps

∴ Use facing class rock, method 'B' placement per Caltrans std. spec. 72-2.02 with L = 4dia = 5ft, W = 5 ft and D = 1.8 ft min.

Placement of rock slope protection fabric per Caltrans std. spec. 88-1.04.

3/19/07

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

W1

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1 * C_1 + A_2 * C_2 + A_3 * C_3 + A_4 * C_4 + A_5 * C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	0 SF	1.00
Concrete Area	1,250 SF	0.95
Asphalt Area	4,250 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	1,250 SF	0.25
	6,750 SF	
Total Area	0.2 acres	0.79

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 2.1 min
* Tco = 2.1 min

L = 15 ft H = 0.5 ft
S = 0.03 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 8.86 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 0.1 min

L = 63 ft (Flowpath)
ΔH = 3.6 ft
S_{ave} = 0.057 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 5.0 min => 0.08 Hr V = 8.4 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 5.0 I: 10yr = 5.5 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.79	5.5	0.2	0.7 cfs

Jul 1/29/07

INLET SIZING

10 year - Postdeveloped Flows

Find efficiency of CB#4 curb inlet on a slope per HEC-12 given a grate per City of Redding Construction Standard Pg. 210.10 that's 2 feet wide and 3.33 feet long:

HEC-12 Equation (11), pg 56:

$E = R_f{*}E_o + R_s(1-E_o)$ where: E = Efficiency
R_f = Ratio of frontal flow intercepted
R_s = Ratio of side flow intercepted
E_o = Ratio of flow in frontal section (gutter)

Find R_f using Chart 7
Need velocity - use City of Redding Street Capacity Tables (6" curb and gutter)

CP-3
Drainage Basin W1
Q= 0.7
S= 0.057

Per City of Redding Construction Standards, a minimum of 12 feet shall be clear of ponding. The allowable top width, **T**, for the Cottages project is **12 feet**.

Q/(S^0.5) = 2.9

Per COR chart: T = 2.8 < 12'; therefore o.k.
d, depth = 0.18 ft
A, area = 0.22 ft^2

V = Q/A = 3.18 fps

From Chart 7 (HEC-12) Rf = 1.0 (P-1 7/8-4 grate)

Find R_s using equation (10)

$$R_s = \frac{1}{1 + (0.15{*}V^{\wedge}1.8)/S_x{*}L^{\wedge}2.3)}$$

where: S_x = street cross slope, 0.02 typical
V = velocity, fps
L = length of grate, 3.33'

R_s = 0.21

Find E_o using Chart 4
S_w/S_x = 3.35
W/T = 0.71

where: S_w = depressed gutter cross slope (0.067)
W = 2 ft typical

Eo (from Chart 4) = 1.00

Find grate efficiency, E E = 1.00

Therefore use a standard CB#4

1/29/07

Drainage Basin W1
CP-3 to CP-5

Manning Pipe Calculator

Given Input Data:

- Shape ....Circular
- Solving for ....Depth of Flow
- Diameter ....15.0000 in
- Flowrate ....0.7000 cfs
- Slope ....0.0340 ft/ft
- Manning's n 0.0130

Computed Results:

- Depth.......................................2.4672 in
- Area 1.2272 ft2
- Wetted Area 0.1319 ft2
- Wetted Perimeter ....12.5278 in
- Perimeter ....47.1239 in
- Velocity ....5.3070 fps
- Hydraulic Radius ....1.5161 in
- Percent Full ....16.4481 %
- Full flow Flowrate ....11.9113 cfs
- Full flow velocity....................9.7062 fps

Critical Information

- Critical depth ....3.9246 in
- Critical slope ....0.0052 ft/ft
- Critical velocity.......................2.7367 fps
- Critical area 0.2558 ft2
- Critical perimeter ....16.1081 in
- Critical hydraulic radius ....2.2866 in
- Critical top width ....13.1858 in
- Specific energy ....0.6433 ft
- Minimum energy.....................0.4906 ft
- Froude number 2.4801
- Flow condition ....Supercritical

1/29/07

The Cottages at Bel-Air
Calcs By: A. Corey
Sharrah, Dunlap, Sawyer, Inc
Date: January 2007

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

W2

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1 * C_1 + A_2 * C_2 + A_3 * C_3 + A_4 * C_4 + A_5 * C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	2,000 SF	1.00
Concrete Area	750 SF	0.95
Asphalt Area	1,200 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	3,550 SF	0.25
	7,500 SF	
Total Area	0.2 acres	0.62

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 8.0 min
* Tco = 8.0 min

L = 90 ft H = 1.8 ft
S = 0.02 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 4.30 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 0.3 min

L = 103 ft (Flowpath)
ΔH = 2.2 ft
S_{ave} = 0.021 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 8.3 min => 0.14 Hr V = 5.1 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 8.3 I: 10yr = 4.2 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.62	4.2	0.2	$\boxed{0.5}$ cfs

Sel
1/29/07

INLET SIZING

10 year - Postdeveloped Flows

Find efficiency of CB#4 curb inlet on a slope per HEC-12 given a grate per City of Redding Construction Standard Pg. 210.10 that's 2 feet wide and 3.33 feet long:

HEC-12 Equation (11), pg 56:

$E = R_f{*}E_o + R_s(1-E_o)$ where: E = Efficiency
R_f = Ratio of frontal flow intercepted
R_s = Ratio of side flow intercepted
E_o = Ratio of flow in frontal section (gutter)

Find R_f using Chart 7
Need velocity - use City of Redding Street Capacity Tables (6" curb and gutter)

CP-4
Drainage Basin W2
Q= 0.5
S= 0.016

Per City of Redding Construction Standards, a minimum of 12 feet shall be clear of ponding. The allowable top width, **T**, for the Cottages project is **12 feet**.

Q/(S^0.5) = 4.0

Per COR chart: T = 3 < 12'; therefore o.k.
d, depth = 0.18 ft
A, area = 0.22 ft^2

V = Q/A = 2.27 fps

From Chart 7 (HEC-12) Rf = 1.0 (P-1 7/8-4 grate)

Find R_s using equation (10)

$$R_s = \frac{1}{1 + (0.15{*}V\text{^}1.8)/S_x{*}L\text{^}2.3)}$$

where: S_x = street cross slope, 0.02 typical
V = velocity, fps
L = length of grate, 3.33'

R_s = 0.33

Find E_o using Chart 4
S_w/S_x = 3.35
W/T = 0.67

where: S_w = depressed gutter cross slope (0.067)
W = 2 ft typical

Eo (from Chart 4) = 1.00

Find grate efficiency, E E = 1.00

Therefore use a standard CB#4

1/29/07

Drainage Basin W2
CP-4 to CP-5

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....0.5000 cfs
Slope ....0.0110 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....2.7577 in
Area 1.2272 ft2
Wetted Area 0.1548 ft2
Wetted Perimeter ....13.2941 in
Perimeter ....47.1239 in
Velocity ....3.2289 fps
Hydraulic Radius ....1.6773 in
Percent Full ....18.3848 %
Full flow Flowrate ....6.7751 cfs
Full flow velocity ....5.5208 fps

Critical Information

Critical depth ....3.3027 in
Critical slope ....0.0053 ft/ft
Critical velocity ....2.4949 fps
Critical area 0.2004 ft2
Critical perimeter ....14.6527 in
Critical hydraulic radius ....1.9695 in
Critical top width ....12.4310 in
Specific energy ....0.3918 ft
Minimum energy ....0.4128 ft
Froude number 1.4236
Flow condition .... Supercritical

1/29/07

The Cottages at Bel-Air
Calcs By: A. Corey
Sharrah, Dunlap, Sawyer, Inc
Date: January 2007

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

W3

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	4,500 SF	1.00
Concrete Area	2,750 SF	0.95
Asphalt Area	5,000 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	3,300 SF	0.25
	15,550 SF	
Total Area	0.4 acres	0.80

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 7.6 min
* Tco = 7.6 min

L = 90 ft H = 2 ft
S = 0.02 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 4.43 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 0.7 min

L = 150 ft (Flowpath)
ΔH = 1.5 ft
S_{ave} = 0.010 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 8.4 min => 0.14 Hr V = 3.5 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 8.4 I: 10yr = 4.2 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.80	4.2	0.4	1.2 cfs

JD
1/29/07

INLET SIZING

10 year - Postdeveloped Flows

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

Find efficiency of CB#3 curb inlet on a slope per HEC-12 given 4.5' open area and 4" depression:

HEC-12 Equation (14), p60:

E = 1-(1-L/Lt)^1.8 where: E = Efficiency
L = Length of curb opening (typically 4.5')
Lt - Length required for total interception

HEC-12 Equation (16) p60:

Lt = K*Q^0.42*S^0.3*(1/(n*Se))^0.6 where: K = 0.6 (constant)
Q = cfs
S = Longitudinal slope
n = Mannings friction coefficient (typically 0.015)
Se = Equivalent cross slope = Sx+S'w*Eo
Sx = Street cross slope (typically 0.02)
Eo - Fraction of flow in gutter (Chart 4)
S'w = Depressed gutter cross slope (0.23)
Se = 0.02+0.23*Eo

CP-5
Drainage Basin W3
Parameters for this project:

K=	0.6
Q=	1.2
S=	0.016
n=	0.015
Sx=	0.02
S'w=	0.23

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 12 feet.

Find Eo ==> need top width "T" ==> Use City of Redding charts for gutter flow (6" standard curb & gutter)

Q/(S^0.5) = 9.5

Per COR chart: T = 4.1 < 12', therefore o.k.

From Chart 4 (HEC-12) W = 2.0 (typically 2.0)

W/T = 0.49

Eo (from Chart 4) 1.00

Se = Sx+S'w*Eo = 0.25

Lt = 5.3 Length of required to capture 100% flow

E = 0.96 Efficiency of a 4.5' opening

Bypass = 0.05 CFS = 22gpm
TO CP-7

Therefore use a standard CB#3

1/29/07

Drainage Basin W3
CP-5 to CP-6b

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....2.4000 cfs
Slope ....0.0340 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....4.5668 in
Area 1.2272 ft2
Wetted Area 0.3160 ft2
Wetted Perimeter ....17.5346 in
Perimeter................................ 47.1239 in
Velocity ....7.5943 fps
Hydraulic Radius ....2.5953 in
Percent Full ....30.4452 %
Full flow Flowrate ....11.9113 cfs
Full flow velocity ....9.7062 fps

Critical Information

Critical depth ....7.4378 in
Critical slope ....0.0057 ft/ft
Critical velocity ....3.9531 fps
Critical area............................ 0.6071 ft2
Critical perimeter ....23.4376 in
Critical hydraulic radius ....3.7301 in
Critical top width ....14.9995 in
Specific energy ....1.2768 ft
Minimum energy ....0.9297 ft
Froude number 2.5545
Flow condition . ...Supercritical

1/29/07

The Cottages at Bel-Air
Calcs By: A. Corey
Sharrah, Dunlap, Sawyer, Inc
Date: January 2007

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

W4a

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1*C_1 + A_2*C_2 + A_3*C_3 + A_4*C_4 + A_5*C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	12,000 SF	1.00
Concrete Area	3,850 SF	0.95
Asphalt Area	10,800 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	20,500 SF	0.25
	47,150 SF	
Total Area	1.1 acres	0.65

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 8.0 min
* Tco = 8.0 min

L = 90 ft H = 1.8 ft
S = 0.02 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 4.30 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 1.1 min

L = 365 ft (Flowpath)
ΔH = 8.7 ft
S_{ave} = 0.024 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 9.1 min => 0.15 Hr V = 5.4 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 9.1 I: 10yr = 4.0 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.65	4.0	1.1	$\boxed{2.8}$ cfs

1/29/07

INLET SIZING

10 year - Postdeveloped Flows

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

Find efficiency of CB#3 curb inlet on a slope per HEC-12 given 4.5' open area and 4" depression:

HEC-12 Equation (14), p60:

E = 1-(1-L/Lt)^1.8 where:
E = Efficiency
L = Length of curb opening (typically 4.5')
Lt - Length required for total interception

HEC-12 Equation (16) p60:

Lt = K*Q^0.42*S^0.3*(1/(n*Se))^0.6 where:
K = 0.6 (constant)
Q = cfs
S = Longitudinal slope
n = Mannings friction coefficient (typically 0.015)
Se = Equivalent cross slope = Sx+S'w*Eo
Sx = Street cross slope (typically 0.02)
Eo - Fraction of flow in gutter (Chart 4)
S'w = Depressed gutter cross slope (0.23)
Se = 0.02+0.23*Eo

CP-6a
Drainage Basin W4a
Parameters for this project:

K=	0.6
Q=	2.8
S=	0.007
n=	0.015
Sx=	0.02
S'w=	0.23

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 12 feet.

Find Eo ==> need top width "T" ==> Use City of Redding charts for gutter flow (6" standard curb & gutter)

Q/(S^0.5) = 33.5

Per COR chart: T = 11.1 < 12', therefore o.k.

From Chart 4 (HEC-12) W = 2.0 (typically 2.0)

W/T = 0.18

Eo (from Chart 4) 0.72

Se = Sx+S'w*Eo = 0.19

Lt = 7.1 Length of required to capture 100% flow

E = 0.83 Efficiency of a 4.5' opening

Therefore use a standard CB#3

Flow captured 2.3 cfs

Bypass flow 0.5 cfs to Inlet CP-6b

1/29/07

Drainage Basin W4a
CP-6a to CP-6b

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....2.8000 cfs
Slope . ...0.0060 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....8.0225 in
Area 1.2272 ft2
Wetted Area 0.6680 ft2
Wetted Perimeter ....24.6078 in
Perimeter ....47.1239 in
Velocity ....4.1918 fps
Hydraulic Radius ....3.9089 in
Percent Full ....53.4834 %
Full flow Flowrate................... 5.0037 cfs
Full flow velocity ....4.0774 fps

Critical Information

Critical depth ....8.0687 in
Critical slope ....0.0059 ft/ft
Critical velocity ....4.1615 fps
Critical area 0.6728 ft2
Critical perimeter . ...24.6994 in
Critical hydraulic radius ....3.9227 in
Critical top width ....15.0000 in
Specific energy ....0.9416 ft
Minimum energy ....1.0086 ft
Froude number 1.0110
Flow condition ....Supercritical

1/29/06

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

W4b

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas		"C" values
Roof Area	0	SF	1.00
Concrete Area	2,500	SF	0.95
Asphalt Area	9,400	SF	0.90
Undeveloped Area	0	SF	
Landscaped Area	32,000	SF	0.25
	43,900	SF	
Total Area	1.0	acres	0.43

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 5.0 min
* Tco = 5.0 min

L = 45 ft H = 1 ft
S = 0.02 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 5.55 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 3.0 min

L = 345 ft (Flowpath)
ΔH = 1 ft
S_{ave} = 0.003 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 8.0 min => 0.13 Hr V = 1.9 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 8.0 I: 10yr = 4.3 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.43	4.3	1.0	$\boxed{1.9}$ cfs

Sd
1/29/07

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

INLET SIZING
CB#3 in Sag Condition
10 year - Postdeveloped Flows

Contribution from Street to Catch Basin

CP-6b
Drainage Basin W4b
<u>Street Capacity and Depth of Flow</u>

6" vertical curb & gutter

Gutter flow (Q) =	2.4 cfs (0.5 cfs from CP-6a)
Longitudinal Slope (s) =	0.005 ft/ft
Q/s^1/2 factor =	33.9
Depth =	0.35 ft.
Area of Flow (A) =	1.40 sf
Top width (T) =	11.2 ft.
(From C.O.R. Street Capacity Chart)	

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 12 feet.

Weir flow governs at depth of	0.35 ft.
Total head (H) = 4"depression + depth =	0.68 ft.

Weir equation: Q=CLH^(3/2)

where: C = 3.2 (weir coefficient)
L = length of inlet (3.5' for std. CB#3)

Solve for length: L = Q/(C*H^(3/2))
L = 1.3 ft. Minimum length to capture 100% flow

Therefore use standard CB#3

1/29/07

Drainage Basin W4b
CP-6b to CP-7

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....6.5000 cfs
Slope ....0.0320 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....8.0479 in
Area 1.2272 ft2
Wetted Area 0.6706 ft2
Wetted Perimeter ....24.6587 in
Perimeter ....47.1239 in
Velocity ....9.6926 fps
Hydraulic Radius ....3.9162 in
Percent Full ....53.6527 %
Full flow Flowrate ....11.5556 cfs
Full flow velocity ....9.4164 fps

Critical Information

Critical depth ....12.9339 in
Critical slope .... 0.0076 ft/ft
Critical velocity ....5.5102 fps
Critical area 1.1796 ft2
Critical perimeter ....34.4298 in
Critical hydraulic radius ....4.9337 in
Critical top width ....15.0000 in
Specific energy ....2.1307 ft
Minimum energy ....1.6167 ft
Froude number 2.3331
Flow condition ....Supercritical

1/29/07

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

W5

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	1,800 SF	1.00
Concrete Area	6,000 SF	0.95
Asphalt Area	5,800 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	3,200 SF	0.25
	16,800 SF	
Total Area	0.4 acres	0.80

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 7.1 min
* Tco = 7.1 min

*Tco = 7.5 min

L = 90 ft H = 2.4 ft
S = 0.03 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 4.59 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 0.4 min

L = 140 ft (Flowpath)
ΔH = 4.5 ft
S_{ave} = 0.032 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 7.9 min => 0.13 Hr V = 6.3 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 7.9 I: 10yr = 4.3 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.80	4.3	0.4	$\boxed{1.3}$ cfs

1/29/07

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

INLET SIZING
CB#3 in Sag Condition
10 year - Postdeveloped Flows

Contribution from Street to Catch Basin

CP-7
Drainage Basin W5
Street Capacity and Depth of Flow
6" vertical curb & gutter

Gutter flow (Q) =	1.3	cfs
Longitudinal Slope (s) =	0.017	ft/ft
Q/s^1/2 factor =	10.0	
Depth =	0.25	ft.
Area of Flow (A) =	0.54	sf
Top width (T) =	6.2	ft.
(From C.O.R. Street Capacity Chart)		

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 12 feet.

Weir flow governs at depth of 0.25 ft.
Total head (H) = 4"depression + depth = 0.58 ft.

+ 0.05 CFS FROM CP-5

Weir equation: Q=CLH^(3/2)
where: C = 3.2 (weir coefficient)
L = length of inlet (3.5' for std. CB#3)

Solve for length: L = Q/(C*H^(3/2))
L = 0.9 ft. Minimum length to capture 100% flow

Therefore use standard CB#3

1/29/07

Drainage Basin W5
CP-7 to PC-2

Manning Pipe Calculator

Given Input Data:
- Shape ....Circular
- Solving for ....Depth of Flow
- Diameter ....18.0000 in
- Flowrate ....7.7000 cfs
- Slope ....0.0300 ft/ft ← AT BOT
- Manning's n 0.0130

Computed Results:
- Depth...................................... 8.1734 in
- Area 1.7671 ft2
- Wetted Area 0.7804 ft2
- Wetted Perimeter ....26.6189 in
- Perimeter ....56.5487 in
- Velocity ....9.8668 fps
- Hydraulic Radius ....4.2217 in
- Percent Full ....45.4080 %
- Full flow Flowrate ....18.1940 cfs
- Full flow velocity ....10.2957 fps

Critical Information
- Critical depth ....13.1588 in
- Critical slope ....0.0065 ft/ft
- Critical velocity ....5.4866 fps
- Critical area 1.4034 ft2
- Critical perimeter ....36.5920 in
- Critical hydraulic radius ....5.5229 in
- Critical top width ....18.0000 in
- Specific energy ....2.1940 ft
- Minimum energy ....1.6449 ft
- Froude number 2.4065
- Flow condition ....Supercritical

7/29/07

Drainage Basin W5
CP-7 to PC-2

Manning Pipe Calculator

Given Input Data:

Shape......................................Circular
Solving for ....Depth of Flow
Diameter ....18.0000 in
Flowrate ....7.7000 cfs
Slope ....0.2510 ft/ft ← At slope below lot
Manning's n.............................0.0130

Computed Results:

Depth......................................4.6524 in
Area..1.7671 ft2
Wetted Area 0.3621 ft2
Wetted Perimeter ....19.1996 in
Perimeter.................................56.5487 in
Velocity...................................21.2667 fps
Hydraulic Radius ....2.7156 in
Percent Full ....25.8467 %
Full flow Flowrate...................52.6266 cfs
Full flow velocity....................29.7806 fps

Critical Information

Critical depth...........................13.1588 in
Critical slope ....0.0065 ft/ft
Critical velocity.......................5.4866 fps
Critical area.............................1.4034 ft2
Critical perimeter ....36.5920 in
Critical hydraulic radius..........5.5229 in
Critical top width ....18.0000 in
Specific energy........................7.4162 ft
Minimum energy.....................1.6449 ft
Froude number........................7.1408
Flow condition ....Supercritical

3/14/07

The Cottages at Bel-Air
Calcs By: A. Corey
Sharrah, Dunlap, Sawyer, Inc
Date: March 2007

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

X1a

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas		"C" values
Roof Area	0	SF	1.00
Concrete Area	0	SF	0.95
Asphalt Area	23,350	SF	0.90
Undeveloped Area	0	SF	
Landscaped Area	9,800	SF	0.25
	33,150	SF	
Total Area	0.8	acres	0.71

Per City of Redding Hydrology Manual:

Time of Concentration Ditch/Swale Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 42.0 min

L =	620	ft (Flowpath)
ΔH =	4.5	ft
S_{ave} =	0.007	ft/ft (Slope)
R =	0.44	ft (hydraulic radius = A/P)
A =	2.0	ft^2 (area of flow)
P =	5	ft (wetted perimeter)
n =	0.30	Excavated Earth Chan. (roughr

V = (1.49/n) * R^0.67 * S^0.5

*If Tc < 5 minutes, assume 5 minutes
*Tc = 42.0 min => 0.70 Hr V = 0.2 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 42.0 I: 10yr = 1.8 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.71	1.8	0.8	$\boxed{0.9}$ cfs

3/14/07

Drainage Basin X1a
CP-8a to CP-8

Manning Pipe Calculator

Given Input Data:

Shape...................................... Circular
Solving for ....Depth of Flow
Diameter..................................15.0000 in
Flowrate ....0.9000 cfs
Slope ....0.0050 ft/ft
Manning's n.............................0.0130

Computed Results:

Depth.......................................4.5142 in
Area...1.2272 ft2
Wetted Area 0.3110 ft2
Wetted Perimeter ....17.4203 in
Perimeter................................47.1239 in
Velocity...................................2.8939 fps
Hydraulic Radius ....2.5708 in
Percent Full ....30.0950 %
Full flow Flowrate...................4.5678 cfs
Full flow velocity....................3.7221 fps

Critical Information

Critical depth........................... 4.4666 in
Critical slope ....0.0052 ft/ft
Critical velocity.......................2.9368 fps
Critical area.............................0.3065 ft2
Critical perimeter ....17.3163 in
Critical hydraulic radius..........2.5484 in
Critical top width ....13.7184 in
Specific energy ....0.5063 ft
Minimum energy.....................0.5583 ft
Froude number........................0.9797
Flow condition ....Subcritical

3/14/07

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

X1

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas		"C" values
Roof Area	0	SF	1.00
Concrete Area	8,565	SF	0.95
Asphalt Area	28,950	SF	0.90
Undeveloped Area	0	SF	
Landscaped Area	17,500	SF	0.25
	55,015	SF	
Total Area	1.3	acres	0.70

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 3.7 min
* Tco = 3.7 min

* Tco = 5.0 min

*If Tco < 5 minutes, assume 5 minutes

L = 20 ft H = 0.25 ft
S = 0.01 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 6.53 in/hr

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 3.2 min

L = 620 ft (Flowpath)
ΔH = 5.1 ft
S_{ave} = 0.008 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 8.2 min => 0.14 Hr V = 3.2 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 8.2 I: 10yr = 4.2 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.70	4.2	1.3	$\boxed{3.7}$ cfs

1/29/07

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

INLET SIZING
CB#3 in Sag Condition
10 year - Postdeveloped Flows

Contribution from Street to Catch Basin

CP-8
Drainage Basin X1
<u>Street Capacity and Depth of Flow</u>
6" vertical curb & gutter

Gutter flow (Q) =	3.7 cfs
Longitudinal Slope (s) =	0.008 ft/ft
Q/s^1/2 factor =	41.4
Depth =	0.37 ft.
Area of Flow (A) =	1.64 sf
Top width (T) =	12 ft.
(From C.O.R. Street Capacity Chart)	.

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 12 feet.

Weir flow governs at depth of	0.37 ft.
Total head (H) = 4"depression + depth =	0.70 ft.

Weir equation: Q=CLH^(3/2)
where: C = 3.2 (weir coefficient)
L = length of inlet (3.5' for std. CB#3)

Solve for length: L = Q/(C*H^(3/2))
L = 2.0 ft. Minimum length to capture 100% flow

Therefore use standard CB#3

1/29/07

Drainage Basin X1
CP-8 to CP-9

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....3.7000 cfs
Slope ....0.0050 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....10.2422 in
Area 1.2272 ft2
Wetted Area 0.8927 ft2
Wetted Perimeter ....29.1766 in
Perimeter ....47.1239 in
Velocity ....4.1445 fps
Hydraulic Radius ....4.4061 in
Percent Full ....68.2815 %
Full flow Flowrate ....4.5678 cfs
Full flow velocity ....3.7221 fps

Critical Information

Critical depth ....9.3876 in
Critical slope ....0.0063 ft/ft
Critical velocity ....4.5667 fps
Critical area 0.8102 ft2
Critical perimeter ....27.3372 in
Critical hydraulic radius..........4.2679 in
Critical top width ....15.0000 in
Specific energy ....1.1145 ft
Minimum energy ....1.1735 ft
Froude number 0.8706
Flow condition ....Subcritical

1/29/07

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

X2

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	0 SF	1.00
Concrete Area	1,320 SF	0.95
Asphalt Area	5,400 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	2,030 SF	0.25
	8,750 SF	
Total Area	0.2 acres	0.76

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 4.5 min
* Tco = 4.5 min

* Tco = 5.0 min

L = 24 ft H = 0.25 ft
S = 0.01 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 5.87 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 0.8 min

L = 165 ft (Flowpath)
ΔH = 1.5 ft
S_{ave} = 0.009 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 5.8 min => 0.10 Hr V = 3.4 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 5.8 I: 10yr = 5.1 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.76	5.1	0.2	$\boxed{0.8}$ cfs

1/29/07

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

INLET SIZING

10 year - Postdeveloped Flows

Find efficiency of CB#3 curb inlet on a slope per HEC-12 given 4.5' open area and 4" depression:

HEC-12 Equation (14), p60:

E = 1-(1-L/Lt)^1.8 where: E = Efficiency
L = Length of curb opening (typically 4.5')
Lt - Length required for total interception

HEC-12 Equation (16) p60:

Lt = K*Q^0.42*S^0.3*(1/(n*Se))^0.6 where: K = 0.6 (constant)
Q = cfs
S = Longitudinal slope
n = Mannings friction coefficient (typically 0.015)
Se = Equivalent cross slope = Sx+S'w*Eo
Sx = Street cross slope (typically 0.02)
Eo - Fraction of flow in gutter (Chart 4)
S'w = Depressed gutter cross slope (0.23)
Se = 0.02+0.23*Eo

CP-9
Drainage Basin X2
Parameters for this project:

K=	0.6
Q=	0.8
S=	0.014
n=	0.015
Sx=	0.02
S'w=	0.23

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 12 feet.

Find Eo ==> need top width "T" ==> Use City of Redding charts for gutter flow (6" standard curb & gutter)

Q/(S^0.5) = 6.8

Per COR chart: T = 4.9 < 12', therefore o.k.

From Chart 4 (HEC-12) W = 2.0 (typically 2.0)

W/T = 0.41

Eo (from Chart 4) 0.98

Se = Sx+S'w*Eo = 0.25

Lt = 4.4 Length of required to capture 100% flow

E = 1.00 Efficiency of a 4.5' opening

Therefore use a standard CB#3

1/29/07

Drainage Basin X2
CP-9 to PC-3 (Bel-Air Estates)

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....3.9000 cfs
Slope ....0.0150 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....7.4376 in
Area 1.2272 ft2
Wetted Area 0.6071 ft2
Wetted Perimeter ....23.4372 in
Perimeter ....47.1239 in
Velocity ....6.4241 fps
Hydraulic Radius ....3.7300 in
Percent Full ....49.5841 %
Full flow Flowrate ....7.9116 cfs
Full flow velocity ....6.4470 fps

Critical Information

Critical depth ....9.6654 in
Critical slope ....0.0064 ft/ft
Critical velocity ....4.6475 fps
Critical area 0.8392 ft2
Critical perimeter ....27.8928 in
Critical hydraulic radius ....4.3323 in
Critical top width ....15.0000 in
Specific energy ....1.2611 ft
Minimum energy ....1.2082 ft
Froude number 1.6251
Flow condition ....Supercritical

1/29/07

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

J1

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	11,500 SF	1.00
Concrete Area	9,500 SF	0.95
Asphalt Area	11,800 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	18,700 SF	0.25
	51,500 SF	
Total Area	1.2 acres	0.70

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 8.1 min
* Tco = 8.1 min

L = 95 ft H = 2 ft
S = 0.02 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 4.28 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 1.7 min

L = 300 ft (Flowpath)
ΔH = 2.1 ft
S_{ave} = 0.007 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 9.8 min => 0.16 Hr V = 2.9 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 9.8 I: 10yr = 3.9 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.70	3.9	1.2	$\boxed{3.2}$ cfs

1/29/07

The Cottages at Bel-Air
Job# 06.102
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

INLET SIZING

10 year - Postdeveloped Flows

Find efficiency of CB#3 curb inlet on a slope per HEC-12 given 4.5' open area and 4" depression:

HEC-12 Equation (14), p60:

E = 1-(1-L/Lt)^1.8 where: E = Efficiency
L = Length of curb opening (typically 4.5')
Lt - Length required for total interception

HEC-12 Equation (16) p60:

Lt = K*Q^0.42*S^0.3*(1/(n*Se))^0.6 where: K = 0.6 (constant)
Q = cfs
S = Longitudinal slope
n = Mannings friction coefficient (typically 0.015)
Se = Equivalent cross slope = Sx+S'w*Eo
Sx = Street cross slope (typically 0.02)
Eo - Fraction of flow in gutter (Chart 4)
S'w = Depressed gutter cross slope (0.23)
Se = 0.02+0.23*Eo

CP-10
Drainage Basin J1
Parameters for this project:

K=	0.6
Q=	3.2
S=	0.011
n=	0.015
Sx=	0.02
S'w=	0.23

Per City of Redding Construction Standards, a minimum of 12 feet for collector streets and 24 feet for arterial streets shall be clear of ponding. The allowable top width, T, for the Cottages project is 12 feet.

Find Eo ==> need top width "T" ==> Use City of Redding charts for gutter flow (6" standard curb & gutter)

Q/(S^0.5) = 30.5

Per COR chart: T = 10.7 < 12', therefore o.k.

From Chart 4 (HEC-12) W = 2.0 (typically 2.0)

W/T = 0.19

Eo (from Chart 4) 0.75

Se = Sx+S'w*Eo = 0.19

Lt = 8.4 Length of required to capture 100% flow

E = 0.75 Efficiency of a 4.5' opening

Calculate length required to capture 85% flow
L = 6.00 (length of opening)
E = 0.89

Therefore use a Modified CB#3 with L=6.0'

1/29/07

Flow captured 2.9 cfs

Bypass flow 0.3 cfs to CP-11

Drainage Basin J1
CP-10 to CP-11

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....15.0000 in
Flowrate ....3.2000 cfs
Slope ....0.0210 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....6.0471 in
Area 1.2272 ft2
Wetted Area 0.4632 ft2
Wetted Perimeter ....20.6377 in
Perimeter ....47.1239 in
Velocity ....6.9084 fps
Hydraulic Radius ....3.2320 in
Percent Full ....40.3141 %
Full flow Flowrate ....9.3611 cfs
Full flow velocity...................7.6281 fps

Critical Information

Critical depth ....8.6701 in
Critical slope ....0.0061 ft/ft
Critical velocity ....4.3509 fps
Critical area 0.7355 ft2
Critical perimeter ....25.9021 in
Critical hydraulic radius ....4.0888 in
Critical top width ....15.0000 in
Specific energy ....1.2456 ft
Minimum energy ....1.0838 ft
Froude number 1.9817
Flow condition ....Supercritical

1/29/07

Rational Method

Storm Water Calculations
For Pipe Sizing
Post-Developed Stormwater Runoff

J2

Calculate Composite Post - Development Runoff Coefficient using formula:

$$C\ ave = \frac{A_1{*}C_1 + A_2{*}C_2 + A_3{*}C_3 + A_4{*}C_4 + A_5{*}C_5}{A_T}$$

Surface Type	Areas	"C" values
Roof Area	6,150 SF	1.00
Concrete Area	3,250 SF	0.95
Asphalt Area	6,100 SF	0.90
Undeveloped Area	0 SF	
Landscaped Area	6,800 SF	0.25
	22,300 SF	
Total Area	0.5 acres	0.74

Per City of Redding Hydrology Manual:
Time of Concentration Overland; (Tco) = (0.66 * L^.50 * n^0.52)/(S^0.31 * i^0.38)

Iterative Balance:
Tc Bal = 8.1 min
* Tco = 8.1 min

L = 90 ft H = 1.7 ft
S = 0.02 ft/ft
n = 0.45 residential landscaping
i = FCT*(Tc)^ PWR FCT = 1.45
PWR = -0.54
i = 4.28 in/hr

*If Tco < 5 minutes, assume 5 minutes

Time of Concentration Gutter Flow;

$$Tcg = \frac{L}{V * 60}$$

Tcg = 0.4 min

L = 153 ft (Flowpath)
ΔH = 4.5 ft
S_{ave} = 0.029 ft/ft (Slope)
S_x = 0.02 ft/ft (cross slope)
T = 25 ft (spread of flow)
n = 0.02 pvmt (roughness coefficient)
V = (1.12/n) * S_x^0.67 * S^0.5 * T^0.67

Tc = 8.6 min => 0.14 Hr V = 6.0 fps

Intensity; City of Redding, Ca Average Elevation = 735

I: 10yr = 1.45 * (Tc/60)^ -0.54 Tc(10yr) = 8.6 I: 10yr = 4.1 in/hr

Post-Development Runoff;	C	I	A	Q
Q: 10yr =	0.74	4.1	0.5	$\boxed{1.6}$ cfs

1/29/07

The Cottages at Bel-Air
Job#06.0102.000
Calc'd By: A. Corey
Sharrah Dunlap Sawyer, Inc.
Date: January 2007

INLET SIZING

10 year - Postdeveloped Flows

Find efficiency of CB#4 curb inlet on a slope per HEC-12 given a grate per City of Redding Construction Standard Pg. 210.10 that's 2 feet wide and 3.33 feet long:

HEC-12 Equation (11), pg 56:

$E = R_f * E_o + R_s(1-E_o)$

where:
E = Efficiency
R_f = Ratio of frontal flow intercepted
R_s = Ratio of side flow intercepted
E_o = Ratio of flow in frontal section (gutter)

Find R_f using Chart 7

Need velocity - use City of Redding Street Capacity Tables (6" curb and gutter)

CP-11

Drainage Basin J2

Q= 1.9 (0.3 cfs
S= 0.059 from CP-10)

Per City of Redding Construction Standards, a minimum of 12 feet shall be clear of ponding. The allowable top width, **T**, for the Cottages project is **12 feet**.

Q/(S^0.5) = 7.8

Per COR chart: T = 6.4 < 12'; therefore o.k.

d, depth = 0.23 ft

A, area = 0.44 ft^2

V = Q/A = 4.32 fps

From Chart 7 (HEC-12) Rf = 1.0 (P-1 7/8-4 grate)

Find R_s using equation (10)

$$R_s = \frac{1}{1 + (0.15*V^{1.8})/S_x*L^{2.3})}$$

where:
S_x = street cross slope, 0.02 typical
V = velocity, fps
L = length of grate, 3.33'

R_s = 0.13

Find E_o using Chart 4

S_w/S_x = 3.35
W/T = 0.31

where:
S_w = depressed gutter cross slope (0.067)
W = 2 ft typical

Eo (from Chart 4) = 0.92

Find grate efficiency, E   E = 0.93

0.13 CFS Bypass TO BEL AIR DRIVE BASIN K3

Therefore use a standard CB#4

1/29/07

Drainage Basin J2
CP-11 to CP-4 (Bel-Air Estates)

Manning Pipe Calculator

Given Input Data:

Shape ....Circular
Solving for ....Depth of Flow
Diameter ....24.0000 in
Flowrate . ...4.6000 cfs
Slope ....0.0090 ft/ft
Manning's n 0.0130

Computed Results:

Depth ....7.5451 in
Area 3.1416 ft2
Wetted Area 0.8457 ft2
Wetted Perimeter ....28.5707 in
Perimeter ....75.3982 in
Velocity ....5.4391 fps
Hydraulic Radius ....4.2626 in
Percent Full............................31.4377 %
Full flow Flowrate ....21.4615 cfs
Full flow velocity ....6.8314 fps

Critical Information

Critical depth ....9.0514 in
Critical slope ....0.0045 ft/ft
Critical velocity ....4.2421 fps
Critical area 1.0844 ft2
Critical perimeter ....31.7409 in
Critical hydraulic radius ....4.9194 in
Critical top width ....23.2642 in
Specific energy ....1.0885 ft
Minimum energy ....1.1314 ft
Froude number 1.4209
Flow condition ....Supercritical

1/29/07

STORM DRAIN CALCULATIONS - RATIONAL METHOD

Roof to gutter time ______
Manning's 'n' value 0.013

Job name The Cottages @ Bel-Air
Job number 06.102

Date January 2007
Designed A. Corey
Page 1 of 3

$i_{10} = 1.45(^{Tc}/_{60})^{-0.54}$

Pt. of Conc.	Area Desig.	Area (acres) A	Runoff Coeff. C	A x C	Accumulated ΣA (acres)	Accumulated Σ(AxC)	Time of Conc. (min.)	Rainfall Intensity i	Runoff Q (cfs)	Conduit Size (in.)	Slope SL (ft./ft.)	Length L (ft.)	Velocity VEL (fps)	Time in Section (min.)	H = SL x L	Minimum Elev. HGL	Curb Elev. EGL	Data MTC HGLx1.25	Design TC
CP-1	V1	0.3	0.79	0.24	—	—	8.3	4.2	1.0										
								d/D =	0.17	15"	0.061	86'	7.2	0.2					
CP-2	V1 V2	1.5	0.59	0.89	1.8	1.13	10.5	3.7	4.2										
								d/D =	0.27	15"	0.157	121'	15.4	0.1					
PC-1																			
CP-3	W1	0.2	0.79	0.16	—	—	5.1	5.5	0.7										
								d/D =	0.16	15"	0.034	52'	5.3	0.2					
CP-5																			
CP-4	W2	0.2	0.62	0.12	—	—	8.3	4.2	0.5										
								d/D =	0.18	15"	0.011	114'	3.2	0.6					
CP-5	W1, W2 W3	0.4	0.80	0.32	0.8	0.60	8.9	4.1	2.4										
								d/D =	0.30	15"	0.034	135'	7.6	0.3					
CP-6b																			
CP-6a	W4a	1.1	0.65	0.72	—	—	9.1	4.0	2.8										
								d/D =	0.53	15"	0.006	331'	4.2	1.3					
CP-6b	W1, W2, W3, W4a W4b	1.0	0.43	0.43	2.9	1.75	10.4	3.7	6.5										
								d/D =	0.54	15"	0.032	36'	9.7	0.1					
CP-7																			

1/24/07

STORM DRAIN CALCULATIONS - RATIONAL METHOD

Roof to gutter time ______
Manning's 'n' value 0.013

Job name The Cottages @ Bel-Air
Job number 06.102

Date March 2007
Designed A. Corey
Page ______ of ______

Pt. of Conc.	Area Desig.	Area (acres) A	Runoff Coeff. C	A x C	Accumulated ΣA (acres)	Accumulated Σ(AxC)	Time of Conc. (min.)	Rainfall Intensity i	Runoff Q (cfs)	Conduit Size (in.)	Slope SL (ft./ft.)	Length L (ft.)	Velocity VEL (fps)	Time in Section (min.)	H = SL x L	Minimum Elev. HGL	Curb Elev. EGL	Data MTC HGLx1.25	Design TC
CP-7	W1, W2, W3, W4a, W4b W5	0.4	0.80	0.32	3.3	2.07	10.5	3.7	7.7										
									d/D = 0.78	18"	0.006 0.251	298'	5.2 21.2	0.2					
Bel-Air PC-2	W1-W5 F2	0.8	0.55	0.44	4.1	2.51	10.7	3.7	9.2										
									d/D = 0.35	(E)30"	0.007								
CP-8a	X1a	0.8	0.71	0.57	—	—	42.0	1.8	0.9										
									d/D = 0.30	15"	0.005	51'	2.9	0.3					
CP-8	X1a X1	1.3	0.70	0.91	2.1	1.48	42.3	1.8	2.6										
									d/D = 0.54	15"	0.005	615'	3.8	2.7					
CP-9	X1a, X1 X2	0.2	0.76	0.15	2.3	1.63	45.0	1.8	2.9										
									d/D = 0.42	15"	0.015	403'	5.9	1.1					
Bel-Air PC-3	X1a, X1, X2 H	0.4	0.58	0.24	2.7	1.87	46.1	1.7	3.1										
									d/D = 0.60	(E) 15"	0.005	43'	4.0	0.2					
	I	0.6	0.66	0.4	—	—	6.5	6.0	2.6										
									d/D = 0.54	(E)15"	0.005	155'	3.8	0.7					
Bel-Air CP-3	H, I	—	—	—	3.3	2.27	46.3	1.7	3.8										
									d/D = 0.70	(E)15"	0.15	147'	4.2	0.6					

Bel-Air CP-4

3/14/07

STORM DRAIN CALCULATIONS - RATIONAL METHOD

Roof to gutter time ______
Manning's 'n' value 0.013

Job name The Cottages @ Bel-Air
Job number 06.102

Date March, 2007
Designed A. Corey
Page ______ of ______

Pt. of Conc.	Area Desig.	Area (acres) A	Runoff Coeff. C	A x C	Accumulated ΣA (acres)	Accumulated Σ(AxC)	Time of Conc. (min.)	Rainfall Intensity i	Runoff Q (cfs)	Conduit Size (in.)	Slope SL (ft./ft.)	Length L (ft.)	Velocity VEL (fps)	Time in Section (min.)	H = SL x L	Minimum Elev. HGL	Curb Elev. EGL	Data MTC HGLx1.25	Design TC
CP-10	J1	1.2	0.70	0.84	—	—	9.8	3.9	3.2										
									d/D = 0.40	15"	0.021	151'	6.9	0.4					
CP-11	J1 J2	0.5	0.74	0.37	1.7	1.21	10.2	3.8											
									d/D = 0.31	(E) 24"	0.009	57'	5.4	0.2					
Bel-Air CP-4	H, I, J1, J2 L1	0.2	0.90	0.18	5.2	3.66	46.9	1.7	6.1										
									d/D = 0.19	(E) 24"	0.12	455'	14.8	0.5					
Bel-Air CP-5																			
	K	1.3	0.62	0.80	—	—	11.1	4.4	3.9										
									d/D = 0.71	(E) 15"	0.005	40'	4.2	0.2					
Bel-Air CP-5	H, I, J1, J2 L1, K L2	0.3	0.90	0.27	6.8	4.73	47.4	1.6	7.8										
									d/D = 0.11	(E) 30"	0.50								

3/14/07

Table 819.2B

Runoff Coefficients for Developed Areas

Type of Drainage Area	Runoff Coefficient
Business:	
Downtown areas	0.70 - 0.95
Neighborhood areas	0.50 - 0.70
Residential:	
Single-family areas	0.30 - 0.50
Multi-units, detached	0.40 - 0.60
Multi-units, attached	0.60 - 0.75
Suburban	0.25 - 0.40
Apartment dwelling areas	0.50 - 0.70
Industrial:	
Light areas	0.50 - 0.80
Heavy areas	0.60 - 0.90
Parks, cemeteries:	0.10 - 0.25
Playgrounds:	0.20 - 0.40
Railroad yard areas:	0.20 - 0.40
Unimproved areas:	0.10 - 0.30
Lawns:	
Sandy soil, flat, 2%	0.05 - 0.10
Sandy soil, average, 2-7%	0.10 - 0.15
Sandy soil, steep, 7%	0.15 - 0.20
Heavy soil, flat, 2%	0.13 - 0.17
Heavy soil, average, 2-7%	0.18 - 0.25
Heavy soil, steep, 7%	0.25 - 0.35
Streets:	
Asphaltic	0.70 - 0.95
Concrete	0.80 - 0.95
Brick	0.70 - 0.85
Drives and walks	0.75 - 0.85
Roofs:	0.75 - 0.95

The runoff coefficients given in Figure 819.2A and Table 819.2B are applicable for storms of up to 5 or 10 year frequencies. Less frequent, higher intensity storms usually require modification of the coefficient because infiltration, detention, and other losses have a proportionally smaller effect on the total runoff volume. The adjustment of the rational method for use with major storms can be made by multiplying the coefficient by a frequency factor, C(f). Values of C(f) are given below. Under no circumstances should the product of C(f) times C exceed 1.0.

Frequency (yrs)	C(f)
25	1.1
50	1.2
100	1.25

(2) *Regional Analysis Methods.* Regional analysis methods utilize records for streams or drainage areas in the vicinity of the stream under consideration which would have similar characteristics to develop peak discharge estimates. These methods provide techniques for estimating annual peak stream discharge at any site, gaged or ungaged, for probability of recurrence from 50% (2 years) to 1% (100 years). Application of these methods is convenient, but the procedure is subject to some limitations.

Regional Flood - Frequency equations developed by the U.S. Geological Survey for use in California are given in Figure 819.2C. These equations are based on regional regression analysis of data from 705 gaging stations. Nomographs and complete information on use and development of this method may be found in "Magnitude and Frequency of Floods in California" published in June, 1977 by the U.S. Department of the Interior, Geological Survey.

The Regional Flood-Frequency equations are applicable only to sites within the flood-frequency regions for which they were derived and on streams with virtually natural flows. For example, the equations are not generally applicable to small basins on the floor of the Sacramento and San Joaquin Valleys as the annual peak data which are the basis for the regression analysis were obtained principally in the adjacent mountain and foothill areas. Likewise, the equations are not directly applicable to streams in urban areas affected substantially by urban development. In urban areas the equations

TABLE C-9
PARAMETERS FOR OVERLAND FLOW
(FLOW DEPTHS LESS THAN 2 INCHES)

Surface	Overland n	Distance (ft)
Pavement - smooth	.02	50-200
Pavement - rough/cracked	.05	50-200
Bare soil - newly graded areas	.10	100-300
Range - heavily grazed	.15	100-300
Turf - 1-2"/lawns/golf courses	.20	100-300
Turf - 2-4"/parks/medians/pasture	.30	200-500
Turf - 4-6"/natural grassland	.40	200-500
Residential Landscaping	.30-.60	100-300
Few trees - natural grass undergrowth	.50	300-600
Scattered trees - weed/shrub undergrowth	.60	300-600
Numerous trees - dense undergrowth	.80	300-600

TABLE C-10
OVERLAND FLOW PRECIPITATION INTENSITY (IN/HR)
(BASED ON TABLE C-1)

Recurrence Interval	Intensity Equation	Initial Estimates	
		$T_o = 5$ min	$T_o = 10$ min
10-yr	$i = 13.5 * T_o^{-.61}$	5.1	3.3
25-yr	$i = 18.2 * T_o^{-.61}$	6.8	4.5
100-yr	$i = 25.0 * T_o^{-.61}$	9.4	6.1

RAINFALL INTENSITY EQUATIONS FOR THE REDDING AREA BY ELEVATION

ELEVATION	I_{10}	I_{25}	I_{100}
450	$1.28D^{-0.57}$	$1.56D^{-0.58}$	$2.12D^{-0.60}$
500	$1.31D^{-0.56}$	$1.60D^{-0.58}$	$2.17D^{-0.60}$
550	$1.34D^{-0.56}$	$1.63D^{-0.57}$	$2.21D^{-0.59}$
600	$1.37D^{-0.55}$	$1.67D^{-0.57}$	$2.26D^{-0.58}$
650	$1.40D^{-0.55}$	$1.70D^{-0.56}$	$2.30D^{-0.58}$
700	$1.43D^{-0.54}$	$1.74D^{-0.55}$	$2.34D^{-0.57}$
750	$1.46D^{-0.54}$	$1.77D^{-0.55}$	$2.39D^{-0.57}$
800	$1.49D^{-0.55}$	$1.80D^{-0.55}$	$2.43D^{-0.57}$
850	$1.51D^{-0.53}$	$1.84D^{-0.54}$	$2.47D^{-0.56}$
900	$1.54D^{-0.52}$	$1.87D^{-0.54}$	$2.52D^{-0.56}$
950	$1.57D^{-0.52}$	$1.91D^{-0.53}$	$2.56D^{-0.55}$
1,000	$1.60D^{-0.52}$	$1.94D^{-0.53}$	$2.60D^{-0.55}$
1,050	$1.63D^{-0.51}$	$1.97D^{-0.53}$	$2.64D^{-0.55}$

D = Duration in hours

Compiled from data obtained from the City of Redding Hydrology Manual (October, 1993), by Kathy Eckard

STREET CAPACITY TABLE

CITY OF REDDING STANDARD STREET WITH 6" STANDARD CURB & GUTTER

Depth (Ft.)	Area (Sq. Ft.)	Width of Flooding (Ft.)	$\frac{Q}{S^{1/2}}$	Depth (Ft.)
.18	0.22	2.8	3.8	.18
.20	0.29	3.8	4.9	.20
.22	0.38	4.8	6.6	.22
.24	0.48	5.8	8.7	.24
.26	0.61	6.8	11.7	.26
.28	0.76	7.8	15.4	.28
.30	0.93	8.8	19.9	.30
.32	1.11	9.8	25.0	.32
.34	1.32	10.8	31.3	.34
.36	1.55	11.8	38.6	.36
.38	1.79	12.8	46.5	.38
.40	2.06	13.8	55.9	.40
.42	2.35	14.8	66.5	.42
.44	2.65	15.8	77.9	.44
.46	2.98	16.8	91.0	.46
.48	3.33	17.8	105.4	.48
.50	3.71	18.8	121.7	.50
.52	4.08	19.8	137.9	.52
.54	4.49	20.8	156.6	.54
.56	4.92	21.8	176.8	.56
.58	5.36	22.8	198.0	.58
.60	5.83	23.8	221.4	.60
.62	6.32	24.8	246.5	.62
.64	6.82	25.8	272.7	.64
.66	7.35	26.8	301.3	.66
.68	7.90	27.8	331.7	.68
.70	8.47	28.8	364.0	.70
.72	9.05	29.8	397.4	.72
.74	9.66	30.8	433.5	.74
.76	10.29	31.8	471.6	.76
.78	10.93	32.8	511.0	.78

NOTE: Depth = Depth at Curb
Area = Cross Sectional Area of Flooding
Width = Width of Flooding Measured from Curb
Cross Slope = 2%
Roughness Coefficient = .015

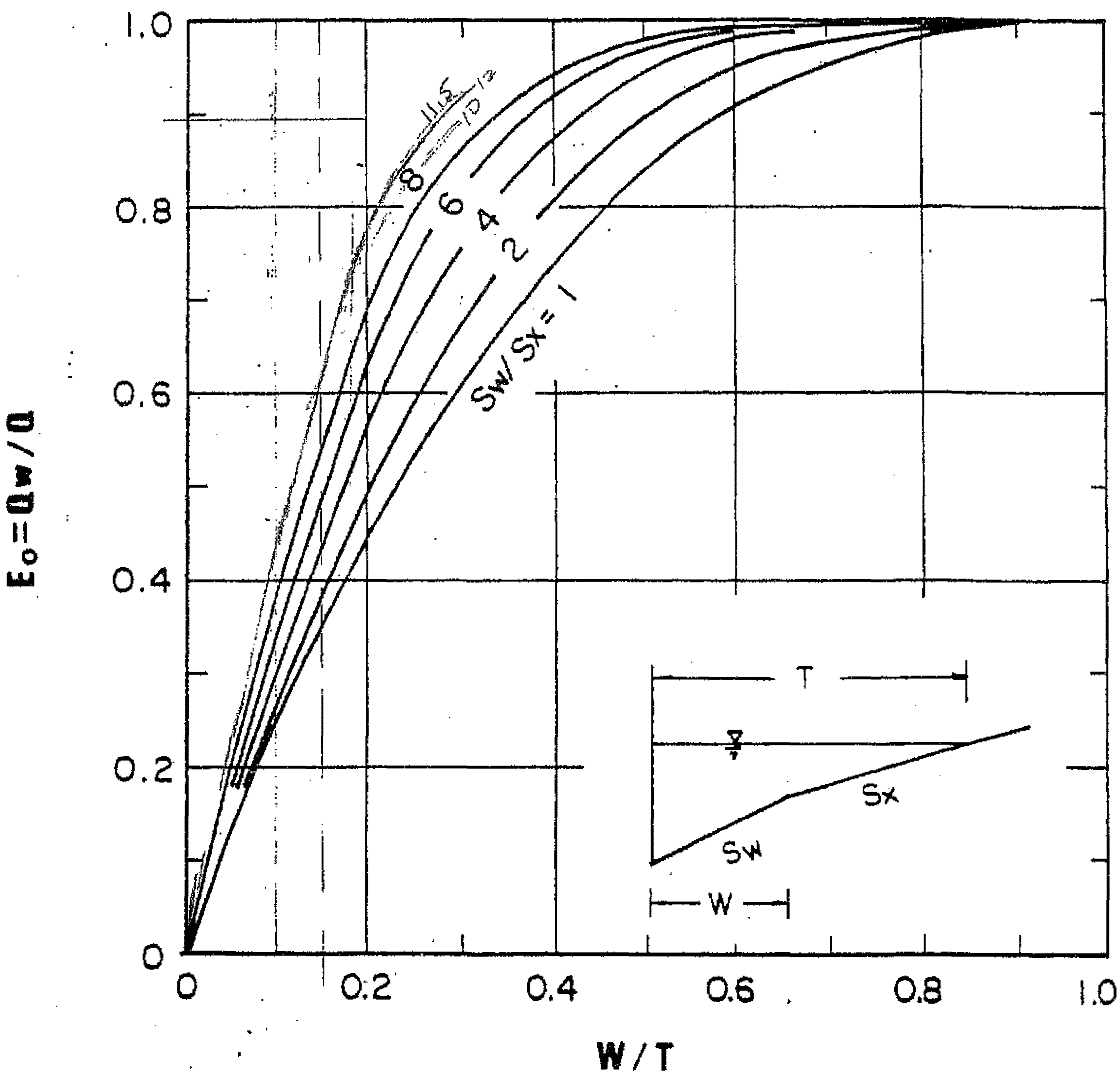


CHART 4. Ratio of frontal flow to total gutter flow.

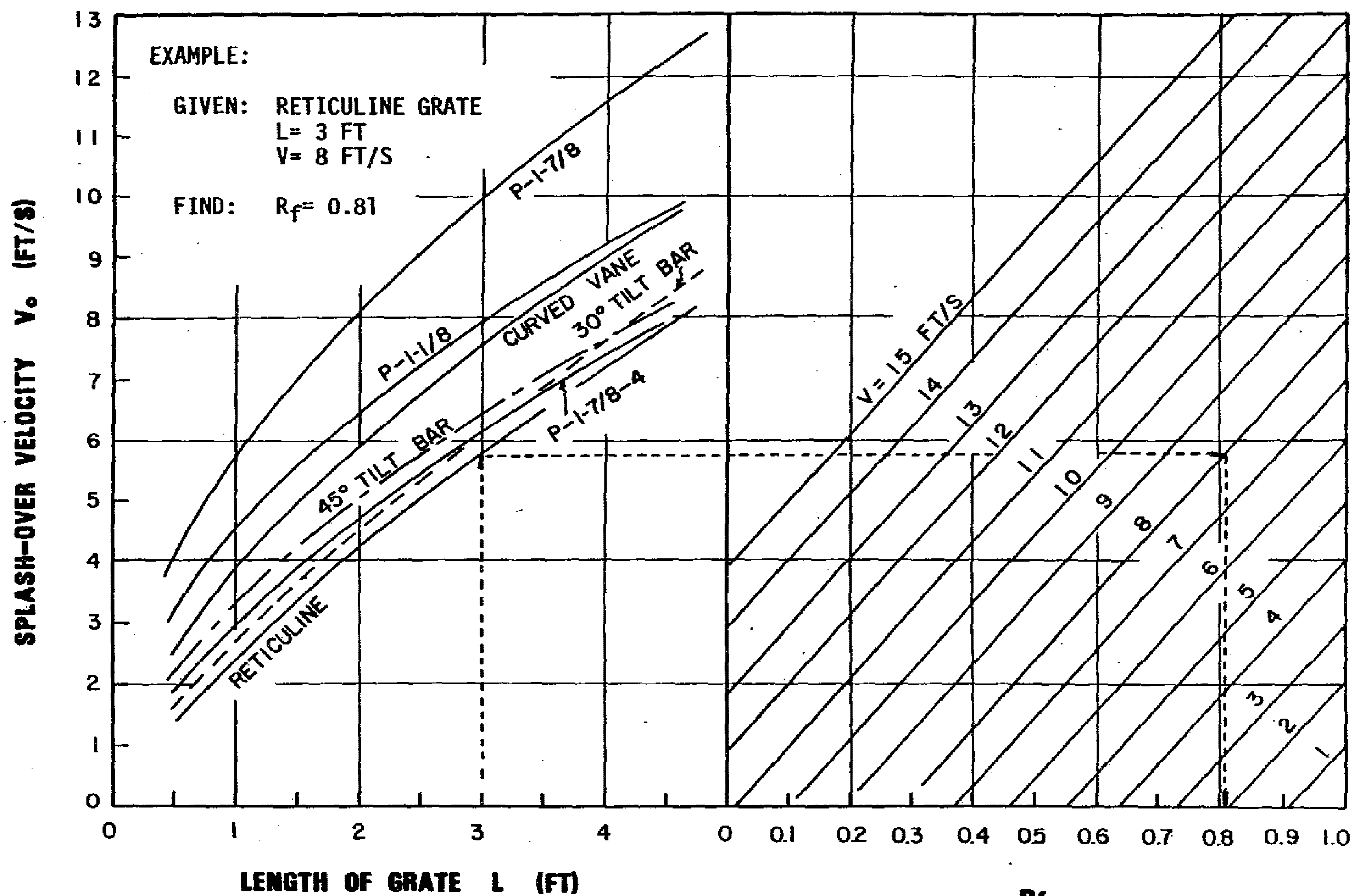


CHART 7. Grate inlet frontal flow interception efficiency.

BEL-AIR ESTATES

Rational Method

Storm Water Calculations

Post-Developed Stormwater Runoff

BASIN K3

Surface Type	Areas	"C" values
Asphalt Area	9600 SF	0.90
Roof / Conc. Area	3800 SF	0.95
Undeveloped Area	0 SF	0.55
Landscaped Area	3000 SF	0.25
Total Area	16400 SF	0.38 acres

Pre - Development Runoff Coefficient

$$\frac{\text{Asphalt Area * Asphalt"C" + Roof Area* Roof"C" + Land Area* Land"C" + Undev Area* Undev"C"}}{\text{Total Area}}$$

$$C\ ave = \frac{9600 \circ 0.9 + 3800 \circ 0.95 + 3000 \circ 0.25 + 0 \circ 0.55}{16400}$$

C ave = 0.79

Time of Concentration Overland; (Tco) = k * (L^3/H)^0.20

Roof to Gutter time = 0.0 Min.

k = 0.938 (Same Flowpath)

H = 0 ft

L = 0 ft (Flowpath)

S ave = 0.000 % (Slope)

Tco = 0.0 min

Tot Area = 0.38 acres

Time of Concentration Pipe/Gutter Flow; (Tcg) = $\frac{L}{V * 60}$

Tcg = $\frac{L}{V * 60}$

L = 604 ft (Flowpath)

H = 57.5 ft

Tcg = 1.6 min

S ave = 0.095 ft/ft (Slope)

Tc = 5.0 min 0.08 Hr

V = 6.2 fps

Intensities; City of Redding, Ca Average Elevation = 703

I: 10yr = 1.43 * (Tc/60)^ -.54 Tc(10yr) = 5.0 I: 10yr = 5.5 in/hr

Post-Dev Runoff;	C_f	C	I	A	Q
Q: 10yr =	1	0.79	5.50	0.38	1.6 cfs

9.7 Impact Basin USBR Type VI (continued)

9.7.1 Overview (continued)

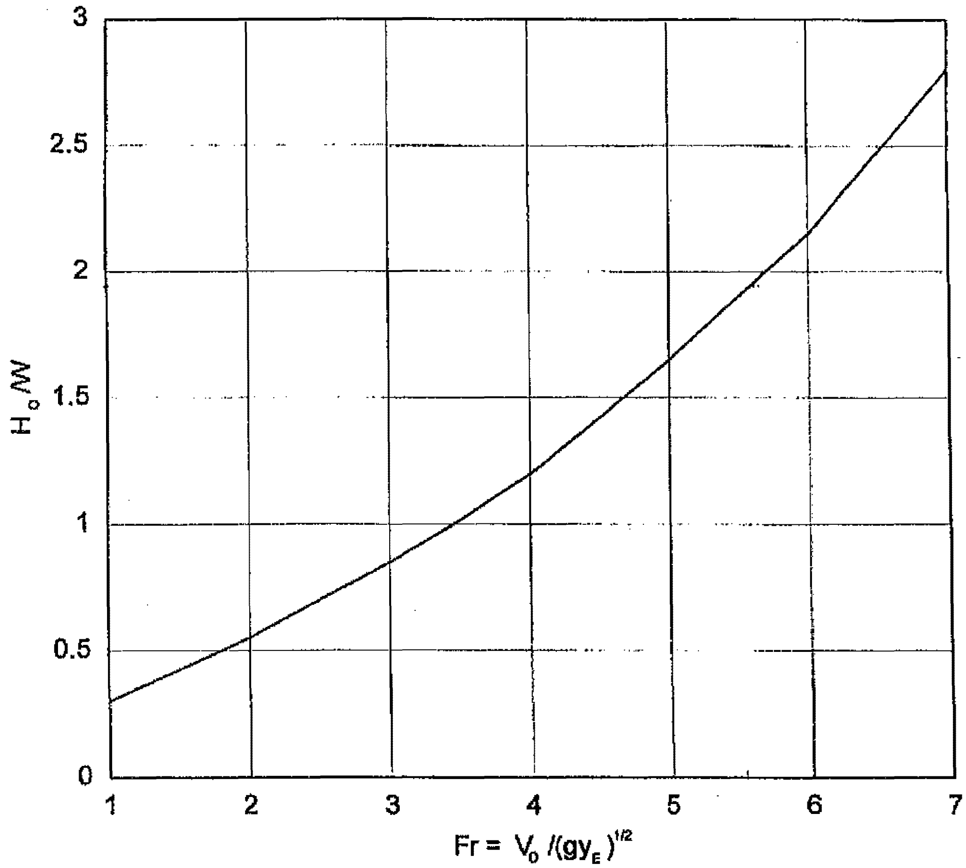
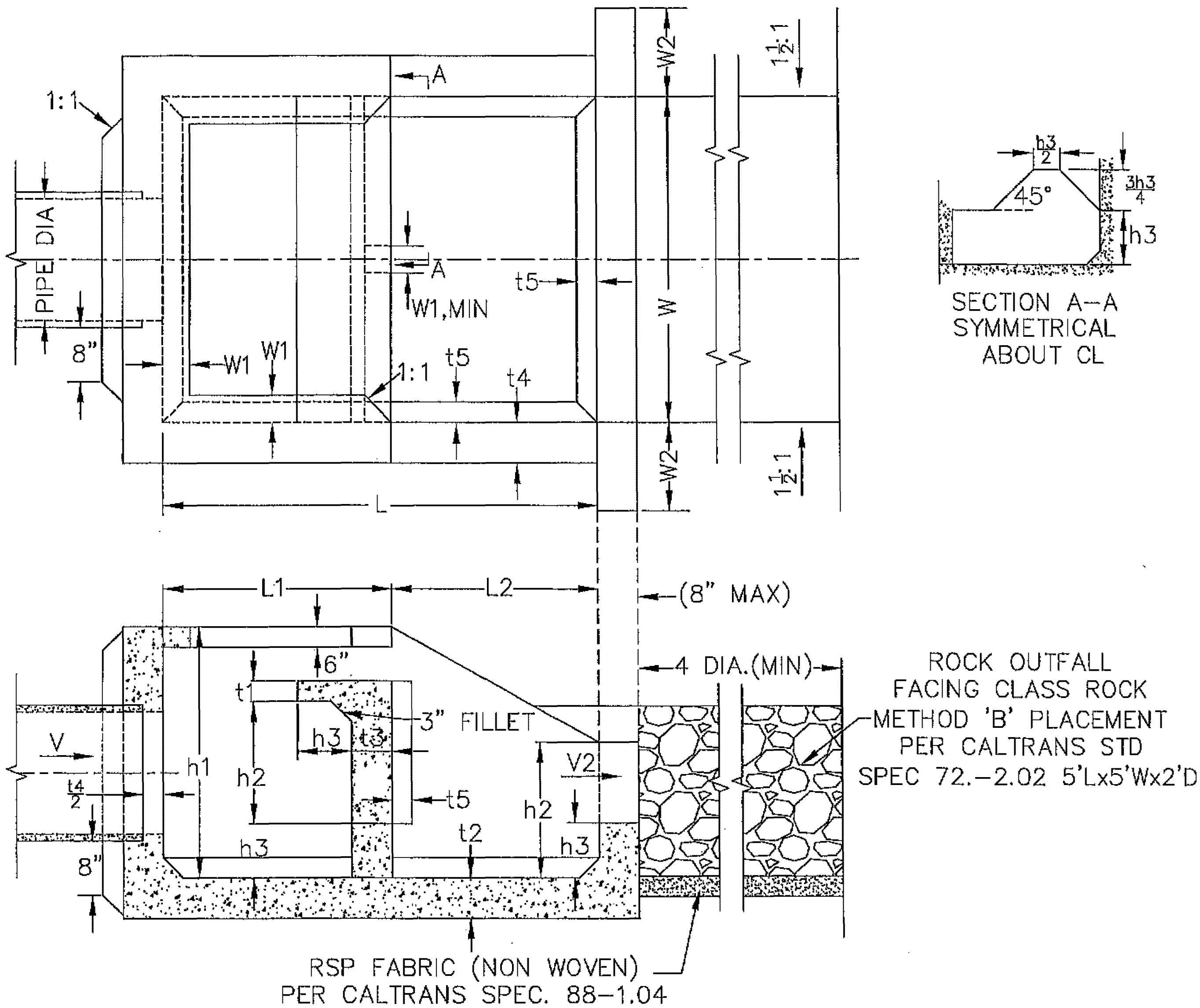


Figure 9-6 Design Curve For USBR Type VI Dissipator



STANDARD DIMENSIONS*							
W	h1	h2	h3	h4	L	L1	L2
4–0	3–2	1–6	0–8	1–8	5–5	2–4	3–1
5–0	3–10	1–11	0–10	2–1	6–8	2–11	3–10
6–0	4–7	2–3	1–0	2–6	8–0	3–5	4–7
7–0	5–5	2–7	1–2	2–11	9–5	4–0	5–5
8–0	6–2	3–0	1–4	3–4	10–8	4–7	6–2

W	W1	W2	t1	t2	t3	t4	t5
4–0	0–4	1–1	0–6	0–6	0–6	0–6	0–3
5–0	0–5	1–5	0–6	0–6	0–6	0–6	0–3
6–0	0–6	1–8	0–6	0–6	0–6	0–6	0–3
7–0	0–6	1–11	0–6	0–6	0–6	0–6	0–3
8–0	0–7	2–2	0–6	0–7	0–7	0–6	0–3

* ALL DIMENSIONS IN FEET AND INCHES

USBR TYPE VI ENERGY DISSIPATOR DETAIL

N.T.S.

Attachment F

Traffic Impact Study, prepared by W-Trans, March 21, 2024

Transportation Impact Study for the Cottages at Bel Air

Prepared for the City of Redding

Submitted by
W-Trans

March 21, 2024

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Executive Summary

The proposed project includes 55 single-family residential units with private garages to be located on the south side of Quartz Hill Road in the City of Redding. The currently vacant sites are divided by Stone Canyon Drive. The project would be expected to generate an average of 519 trips per day, including 39 morning peak hour trips and 52 evening peak hour trips.

While there is an existing network of sidewalks, curb ramps, and streetlighting in the project vicinity, there is a gap in the sidewalk network of about 1,750 feet along the project frontage on Quartz Hill Road west of Stone Canyon Drive. It is recommended that the project include construction of sidewalks and streetlighting along the new project streets and the project frontage on Quartz Hill Road, as well as the provision of ADA-compliant curb ramps at new intersections and street connections to be built within the project site. Even with construction of sidewalks along the project frontage, which would close the existing gap, the walking route for pedestrians traveling between the project site and recreational uses to the east would include crossing Quartz Hill Road where there are currently no crosswalks. As a result, a new enhanced pedestrian crossing should be installed on the east leg of Quartz Hill Road/Stone Canyon Drive.

Existing bicycle facilities in the vicinity of the project site are adequate and would improve with construction of the planned buffered bicycle lanes on Quartz Hill Road. The project should dedicate sufficient space for buffered bicycle lanes along its frontage. Dedicated bicycle parking would not be necessary as the proposed single-family homes would have private garages.

Though transit facilities serving the site are limited, this would be an acceptable condition given the location of the project site and anticipated demand. The City may wish to study adding transit service on Quartz Hill Road west of Benton Drive should more residential projects be constructed in the area.

Based on state guidance and data contained in the countywide travel demand model and the *2018 Regional Transportation Plan and Sustainable Communities Strategy for the Shasta Region* (RTP), the project's impact on vehicle miles traveled (VMT) would be less than significant as the project is expected to have a daily VMT per capita more than 15 percent below the countywide average.

The project site would be accessed by two new street connections to Quartz Hill Road and one new connection to Stone Canyon Drive. Sight distances at the proposed street connections to Quartz Hill Road are adequate for entering and exiting drivers provided that no signage, monuments, landscaping, or structures block sight lines for drivers waiting on the minor street approaches. Left-turn lanes would not be warranted at the proposed street connections to Quartz Hill Road.

Proposed site access and on-site circulation are anticipated to function acceptably for emergency response vehicles with applicable design standards incorporated into the site layout. Traffic from the proposed development would be expected to have a less-than-significant impact on emergency response times.

Project traffic is not expected to cause maximum queues to exceed the available stacking space at any of the study intersections. Therefore, the proposed project would have a less-than-significant impact on queueing. Additionally, all study intersections are expected to operate at acceptable Levels of Service (LOS) without and with the addition of project trips; as a result, the project's effect on operations would be considered acceptable.

The proposed vehicle parking supply would satisfy City requirements as there would be two covered vehicle parking spaces per single-family dwelling.

Introduction

This report presents an analysis of the potential transportation impacts and adverse operational effects that would be associated with development of 55 single-family residences on the south side of Quartz Hill Road west and east of Stone Canyon Drive in the City of Redding. The transportation study was completed in accordance with the criteria established by the City of Redding, reflects a scope of work that was approved by City staff, and is consistent with standard traffic engineering techniques.

Prelude

The purpose of a transportation impact study (TIS) is to provide City staff and policy makers with data that they can use to make an informed decision regarding the potential transportation impacts of a proposed project, and any associated improvements that would be required to mitigate these impacts to an acceptable level under the California Environmental Quality Act (CEQA), the City's General Plan, or other policies. This report provides an analysis of those items that are identified as areas of environmental concern under CEQA and that, if significant, require an Environmental Impact Report (EIR). Impacts associated with access for pedestrians, bicyclists, and to transit; the vehicle miles traveled (VMT) generated by the project; potential safety concerns; and emergency access are addressed in the context of the CEQA criteria. While no longer a part of the CEQA review process, vehicular traffic service levels at key intersections were evaluated for consistency with General Plan policies by determining the number of new trips that the proposed use would be expected to generate, distributing these trips to the surrounding street system based on anticipated travel patterns specific to the proposed project, then analyzing the effect the new traffic would be expected to have on the study intersections and need for improvements to maintain acceptable operation. Adequacy of parking is also addressed as a policy issue.

The report is organized to provide background data that supports the various aspects of the analysis, followed by the assessment of CEQA issues and then evaluation of policy-related issues. The CEQA criteria evaluated are as follows.

Would the project:

a. Conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities?
b. Conflict or be inconsistent with CEQA Guidelines § 15064.3, subdivision (b)?
c. Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?
d. Result in inadequate emergency access?

Project Profile

The proposed project includes 55 single-family residences to be located on the south side of Quartz Hill Road west and east of Stone Canyon Drive in the City of Redding. Each residence would include a garage with two vehicle parking spaces. The subdivision would be organized in three clusters of lots; the eastern cluster would be accessed from Stone Canyon Drive while the middle and western clusters would be accessed via new street connections to Quartz Hill Road. The location of the project site is shown in Figure 1.

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Transportation Impact Study for the Cottages at Bel Air

Figure 1 – Study Area and Existing Lane Configurations

Transportation Setting

Study Area and Periods

The study area varies depending on the topic. For pedestrian trips it consists of all streets within a half-mile of the project site that would lie along primary routes of pedestrian travel, or those leading to nearby generators or attractors. For bicycle trips it consists of all streets within one mile of the project site that would lie along primary routes of bicycle travel. For the safety and operational analyses, the study area consists of the project frontage on Quartz Hill Road and the following intersections:

1. Quartz Hill Road/Stone Canyon Drive
2. Market Street/Benton Drive
3. Quartz Hill Road/Benton Drive
4. Quartz Hill Road/Market Street

Operating conditions during the weekday a.m. and p.m. peak periods were evaluated to capture the highest potential impacts for the proposed project as well as the highest volumes on the local transportation network. The morning peak hour occurs between 7:00 and 9:00 a.m. and reflects conditions during the home to work or school commute, while the p.m. peak hour occurs between 4:00 and 6:00 p.m. and typically reflects the highest level of congestion during the homeward bound commute. Counts were obtained for the study intersections on Thursday, November 3, 2022, while local schools were in session.

Study Intersections

Quartz Hill Road/Stone Canyon Drive is an unsignalized tee intersection with a stop control on the northbound terminating Stone Canyon Drive approach. The intersection has a westbound left-turn lane and acceleration lane and an eastbound right-turn lane. Curb ramps are present on the southeast and southwest corners of the intersection and Class II bicycle lanes are striped on the Quartz Hill Road approaches.

Market Street/Benton Drive is a signalized four-legged intersection with protected left-turn phasing on the northbound and southbound approaches. The east leg is a driveway to A-1 Smog & Auto Repair Center. Marked crosswalks with pedestrian phasing are available on the west and south legs and bicycle lanes are present on the south leg.

Quartz Hill Road/Benton Drive is a signalized four-legged intersection with protected left-turn phasing on the northbound and southbound approaches. There are marked crosswalks with pedestrian phasing on all four legs and bicycle lanes exist on the east and west legs.

Quartz Hill Road/Market Street is a signalized four-legged intersection, which includes protected left-turn phasing on the northbound and southbound approaches. Marked crosswalks with pedestrian phasing are present on all four legs and bicycle lanes are available on the west and north legs.

The locations of the study intersections and the existing lane configurations and controls are shown in Figure 1.

Collision History

The collision history for the study area was reviewed to determine any trends or patterns that may indicate a safety issue. Collision rates were calculated based on records available from the California Highway Patrol (CHP) as published in their Statewide Integrated Traffic Records System (SWITRS) reports. The most current five-year period available is October 1, 2017, through September 30, 2022.

As presented in Table 1, the calculated collision rates for the study intersections were compared to average collision rates for similar facilities statewide, as indicated in *2019 Collision Data on California State Highways*, California Department of Transportation (Caltrans). These average rates statewide are for intersections in the same environment (urban), with the same number of approaches (three or four), and the same controls (two-way stop or traffic signal). The calculated collision rates for the study intersections of Quartz Hill Road/Stone Canyon Drive and Market Street/Benton Drive were slightly above the statewide averages, and the rates for Quartz Hill Road/Benton Drive and Quartz Hill Road/Market Street were less than the statewide averages. For those two intersections with above-average collision rates, the records were further reviewed as detailed below. The collision rate calculations are provided in Appendix A.

Table 1 – Collision Rates for the Study Intersections

Study Intersection	Number of Collisions (2017-2022)	Calculated Collision Rate (c/mve)	Statewide Average Collision Rate (c/mve)
1. Quartz Hill Rd/Stone Canyon Dr	1	**0.13**	0.09
2. Market St/Benton Dr	11	**0.29**	0.24
3. Quartz Hill Rd/Benton Dr	3	0.13	0.24
4. Quartz Hill Rd/Market St	5	0.15	0.24

Note: c/mve = collisions per million vehicles entering; **Bold** text = collision rate exceeds statewide average

At the intersection of Quartz Hill Road/Stone Canyon Drive, there was a single reported hit object collision, which had a primary collision factor of a driver under the influence. As only one collision occurred at the intersection over the five-year study period, no clear pattern or trend was identified that would indicate a safety concern. Typically, a single reported collision within a span of five years does not translate to a safety concern, though in this case the calculated collision rate is higher than the statewide average due to the low traffic volumes.

The recorded collisions at Market Street/Benton Drive included five rear-ends, two broadsides, two hit objects, one sideswipe, and one "other" collision. The rear-end collisions involved motorists traveling on the southbound or northbound approaches and were attributed to unsafe speed. These types of collisions are common at signalized intersections with high approach speeds that can experience congestion during peak hours, such as the subject location. Based on a review of field conditions, sight lines are adequate on both the northbound and southbound approaches and given that the collision rate is only marginally higher than the statewide average, no remedial action appears necessary.

Project Data

The project consists of 55 single-family residential units with private garages. The proposed project site plan is shown in Figure 2.

Trip Generation

The anticipated trip generation for the proposed project was estimated using standard rates published by the Institute of Transportation Engineers (ITE) in *Trip Generation Manual*, 11th Edition, 2021, for "Single Family Detached Housing" (LU #210). Based on the application of these rates, the proposed project would be expected to generate an average of 519 trips per day, including 39 trips during the a.m. peak hour and 52 trips during the p.m. peak hour. These results are summarized in Table 2.

Table 2 – Trip Generation Summary

Land Use	Units	Daily		AM Peak Hour				PM Peak Hour			
		Rate	Trips	Rate	Trips	In	Out	Rate	Trips	In	Out
Single-Family Detached Housing	55 du	9.43	519	0.70	39	10	29	0.94	52	33	19

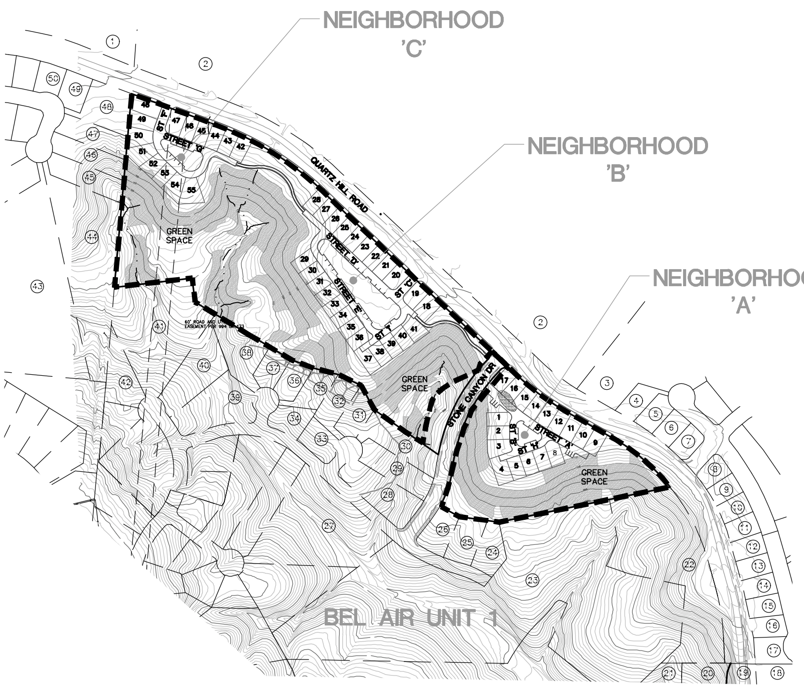
Note: du = dwelling unit

Trip Distribution

Given the location of the project site in the northwestern part of the City, nearly all project trips are anticipated to be to and from the southeast on Quartz Hill Road toward Downtown, Market Street, and the SR 44 and I-5 freeways. As a result, a distribution of 90 percent of project trips was applied to/from the southeast on Quartz Hill Road with 10 percent to/from the northwest. The pattern used to allocate new project trips through the study intersections is consistent with the assumptions applied for the nearby Brentwood Village project. The applied distribution assumptions that were approved by City staff are shown in Table 3.

Table 3 – Trip Distribution Assumptions

Route	Percent
To/From Market St South of Quartz Hill Rd	45
To/From Benton Dr South of Quartz Hill Rd	20
To/From Market St North of Quartz Hill Rd	25
To/From Quartz Hill Rd West of Project Site	10
TOTAL	**100**



LEGEND

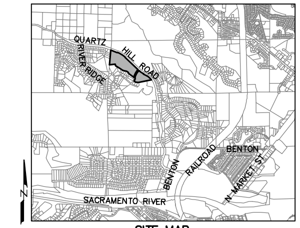
- 20%+ SLOPES
- PROJECT LIMITS
- AQUATIC FEATURES PER GALLAWAY DELINEATION DATED NOVEMBER 2022
- EXISTING DETENTION BASIN PER GALLAWAY DELINEATION

DEVELOPMENT STANDARDS

FRONT YARD BUILDING SETBACK: 12'
FRONT YARD GARAGE SETBACK: 18'
REAR YARD (ADJ. TO GREEN SPACE): 10'
REAR YARD (ADJ. TO QUARTZ HILL): 10'
SIDE YARD: 5'
INTERNAL STREETS: 32'
MIN. LOT WIDTH (AT BLDG SETBACK): 50'

PARKING STANDARDS

GARAGE SPACES: 2 PER UNIT
GUEST SPACES: ON-STREET



SITE MAP
SCALE: NTS

CLIENT:
COTTAGES AT BEL AIR, LLC
2040 TREFOIL RD
SAN RAMON, CA 94582

OWNER:
COTTAGES AT BEL AIR, LLC
2040 TREFOIL RD
SAN RAMON, CA 94582

ENGINEER:
SHARRAH DUNLAP SAWYER, INC.
320 HARTNELL AVE
REDDING, CA 96002

SITE DATA
A.P.# 113-190-019, 113-190-020
GENERAL PLAN: RES 6-10
ZONING: RM-9-PD
EXISTING USE: VACANT
PROPOSED USE: 55 LOT SUBDIVISION
SITE AREA: 24.1 AC
20% & GREATER SLOPES: 9.5 AC
TREE PRESERVATION: 5.5 AC
GREEN SPACE: 15.0 AC
PROJECT AREA: 9.1 AC
AREA IN ROADS: 2.0 AC
NET PROJECT AREA: 7.1 AC
DENSITY: 7.7 DU/AC
ELECTRICITY: CITY OF REDDING
WATER: CITY OF REDDING
SEWER: CITY OF REDDING
TELEPHONE: AT&T

ADJACENT PARCEL OWNERS

1. 115-170-014 QUARTZ HILL LAND, LLC 2040 TREFOIL RD SAN RAMON, CA 94582
2. 113-190-014 WALKER REV TRUST 555 QUARTZ HILL RD REDDING, CA 96003
3. 113-350-008 KELLIHER 595 RIVER PARK DR REDDING, CA 96003
4. 113-350-007 RATHBUN 2012 TRUST 592 RIVER PARK DRIVE
5. 113-350-005 GOMES 532 RIVER PARK DR REDDING, CA 96003
6. 113-350-006 SCHAARSCHMIDT 562 RIVER PARK DR REDDING, CA 96003
7. 113-350-004 THOMPSON 502 RIVER PARK DR REDDING, CA 96003
8. 113-350-003 BARAJAS 18375 MEADOW RIDGE DR SALINAS, CA 93907
9. 113-350-002 BOONE REV TRUST 20279 ENGINEERS LN REDDING, CA 96002
10. 113-350-001 HAAGENSON 490 RIVER PARK DR REDDING, CA 96003
11. 113-360-001 COFFEE FAMILY LIV TRUST 486 RIVER PARK DR REDDING, CA 96003
12. 113-360-002 PARKER FAMILY 1995 TRUST 1767 LAKESIDE DR REDDING, CA 96001
13. 113-360-003 SEAMANS 3643 SUNBIRD CT REDDING, CA 96001
14. 113-360-004 MAWMAN 478 RIVER PARK DR REDDING, CA 96003
15. 113-360-005 WATSON LIVING TRUST 476 RIVER PARK DR REDDING CA 96003
16. 113-360-006 GERMANN 474 RIVER PARK DR REDDING, CA 96003
17. 113-360-007 COX 2110 PINE ST REDDING, CA 96001-9615
18. 112-010-020 GAYNOR REV TRUST 4258 DORGAN DR REDDING, CA 96002
19. CITY OF REDDING (QUARTZ HILL RD)
20. 112-010-006 TAGLIAFERRI TRUST 79 DAILY DR, STE 277 CAMARILLO, CA 93010
21. 113-190-032 CHJ BEL AIR PROPERTIES PO BOX 989 SHINGLE SPRINGS, 95682
22. 113-190-021 CHJ BEL AIR PROPERTIES PO BOX 989 SHINGLE SPRINGS, 95682
23. 113-190-030 CHJ BEL AIR PROPERTIES PO BOX 989 SHINGLE SPRINGS, 95682
24. 113-400-022 COREY PO BOX 993591 REDDING, CA 96099
25. 113-400-021 MIDDLETON HOMES CORP 16555 CELTIC CT REDDING, CA 96001
26. 113-400-020 ERKSKINE REV TRUST 2894 FANTANELL CT REDDING, CA 96003
27. 113-390-031 CANALES 3128 REDONDO CT REDDING, CA 96003
28. 113-400-019 PODLAS 907 FANTANELL CT REDDING, CA 96003
29. 113-400-018 DOBSON 2016 TRUST 947 FANTANELL CT REDDING, CA 96003-5430
30. 113-400-017 RHODERICK 997 FANTANELL CT REDDING, CA 96003
31. 113-400-016 SILVERIA 992 FANTANELL CT REDDING, CA 96003
32. 113-400-015 BROWN 956 FANTANELL CT REDDING, CA 96003
33. 113-400-014 LAUGHLIN TRUST 926 FANTANELL CT REDDING, CA 96003-5430
34. 113-400-013 HILDEBRAND 911 SAVONA CT REDDING, CA 96003
35. 113-400-012 HERITAGE 21 LLC PO BOX 493276 REDDING, CA 96049
36. 113-400-011 TOTH 991 SAVONA CT REDDING, CA 96003
37. 113-400-010 KENG 996 SAVONA CT REDDING, CA 96003
38. 113-400-009 HENRY 976 SAVONA CT REDDING, CA 96003
39. 113-400-008 CHIMENTI 925 BELLAGIO TERRACE REDDING, CA 96003
40. 113-400-007 HALTER 961 BELLAGIO TERRACE REDDING, CA 96003
41. 113-400-006 HILL PO BOX 991065 REDDING, CA 96099
42. 113-400-005 GWIN 990 BELLAGIO TERRACE REDDING, CA 96003
43. HOUSTON 1409 HARBOR CT REDDING, CA 96003
44. 115-490-002 DEFILIPPO 1427 HARBOR CT REDDING, CA 96003
45. 115-490-001 IVICEVICH TRUST 19533 SAN VINCENTE DR REDDING, CA 96003
46. 115-400-029 PARKER FAMILY TRUST 1767 LAKESIDE REDDING, CA 96001
47. 115-400-028 RUFFCORN 1481 HARBOR CT REDDING, CA 96003
48. 115-400-027 KELLY 1499 HARBOR CT REDDING, CA 96003
49. 115-400-026 HAMILTON 3312 OLD LANTERN DR REDDING, CA 96003
50. 115-400-025 LOPEZ REV LIV TRUST 3318 OLD LANTERN DR REDDING, CA 96003

200 0 100 200
1 INCH = 200 FEET

THE COTTAGES AT BEL AIR TENTATIVE SUBDIVISION MAP & PLANNED DEVELOPMENT COVER SHEET

BEING A PORTION OF THE SW 1/4 OF SECTION 23 T. 32 N., R. 5 W. M.D.M. IN THE CITY OF REDDING SHASTA COUNTY, CALIFORNIA

FOR

COTTAGES AT BEL AIR, LLC

BY

SHARRAH DUNLAP SAWYER, INC.
Civil Engineering • Land Planning • Surveying & Mapping
Landscape Architecture • Presentation Graphics
320 Hartnell Avenue, Redding, CA 96002
530.221.1792 voice • 530.221.8369 fax • info@sdsengineering.com

DATE: JANUARY, 2023 SCALE: 1"=200' SHEET 1 OF 8
TLM/NLD P:/proj/p/22165/dwg/22165tm.dwg 22165

Source: Sharrah Dunlap Sawyer, Inc. 2/6

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Figure 2 – Site Plan

Circulation System

This section addresses the first transportation bullet point on the CEQA checklist, which relates to the potential for a project to conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities.

Pedestrian Facilities

Existing and Planned Pedestrian Facilities

Pedestrian facilities include sidewalks, crosswalks, pedestrian signal phases, curb ramps, curb extensions, and various streetscape amenities such as lighting, benches, etc. In the study area, there is a network of sidewalks, curb ramps, and street lighting as a part of the single-family housing developments that would neighbor the project site. However, there is a sidewalk gap of about 1,750 feet on Quartz Hill Road along the project frontage west of Stone Canyon Drive. According to the *City of Redding Active Transportation Plan*, there are plans to install sidewalks on Quartz Hill Road to fill the existing 1,750-foot sidewalk gap.

Pedestrian Safety

The collision history for the study area was reviewed to determine any trends or patterns that may indicate a safety issue for pedestrians. Collision records for the five-year period detailed indicate that there were no reported collisions involving pedestrians at the study intersections.

Project Impacts on Pedestrian Facilities

While the project site is located in a historically rural part of the City, the surrounding area is transitioning to a suburban setting as more residential developments are constructed and the site is located slightly more than one mile away from numerous recreational uses accessed from Quartz Hill Road including Lake Redding Park, Caldwell Park, baseball/softball fields, Redding Aquatic Center, and the Sacramento River so it is reasonable to expect that some residents may want to walk between the project site and these uses. To be consistent with neighboring developments, sidewalks and street lighting should be installed along all project streets and on the south side of Quartz Hill Road along the project frontage. Additionally, ADA-compliant curb ramps should be provided at the new intersections to be built within the project site, at the two new street connections to Quartz Hill Road, and at the new street connection to Stone Canyon Drive. With these improvements, the proposed residences would be connected to other residences in the neighborhood and the surrounding pedestrian network.

Construction of sidewalks along the project frontage on Quartz Hill Road would close the existing 1,750-foot sidewalk gap on Quartz Hill Road and improve pedestrian access for nearby residents, although there would continue to be no sidewalks on the south side of Quartz Hill Road east of the project site. As the walking route between the project site and the aforementioned recreation uses would include crossing Quartz Hill Road where there are no crosswalks, consideration was given to the need for a new pedestrian crossing on Quartz Hill Road near Stone Canyon Drive.

The *National Cooperative Highway Research Program* (NCHRP) Pedestrian Crossing Treatment Worksheet was completed to help determine what pedestrian measures, if any, would be appropriate. The worksheet recommends pedestrian treatment devices such as crosswalks, High Visibility markings, signage, Rectangular Rapid Flashing Beacons (RRFBs), In-Roadway Warning Lights (IRWLs), High Intensity Activated Crosswalk Beacons (HAWKs), and pedestrian signals depending on pedestrian and vehicle volumes, roadway and crosswalk geometrics, vehicle speeds, and anticipated motorist compliance.

A sensitivity analysis was conducted to determine how many pedestrians would need to cross Quartz Hill Road at Stone Canyon Drive for a striped crosswalk or other crossing devices to be considered appropriate. During the critical a.m. peak hour, which is when volumes are highest on the local street network, there would need to be approximately 14 pedestrian crossings for an active or enhanced crossing device such as RRFBs to be warranted. Further, for a crossing device with a circular red indication such as HAWK to be warranted, there would need to be approximately 120 pedestrian crossings. The methodology does not recommend a standard striped crosswalk without enhancement on streets with posted speed limits above 35 mph. The NCHRP Pedestrian Crossing Treatment Worksheet is provided in Appendix B for reference.

Based on a review of existing and potential land uses in the vicinity of the project site, pedestrian volumes crossing Quartz Hill Road are not expected to exceed 120 in a single hour. However, it would be reasonable to expect 14 crossings in an hour especially as closure of the existing sidewalk gap on Quartz Hill Road would connect developments west of the project site with public parks and residences to the east. Therefore, it is recommended that the project include construction of a new enhanced pedestrian crossing at the intersection of Quartz Hill Road/Stone Canyon Drive to increase the visibility of pedestrians crossing between sidewalks on the south and north sides of the street. The preferred placement of this new crossing would be on the east leg of the intersection which would be expected to result in stopping sight distances of approximately 400 feet westbound and 600 feet eastbound, both of which would be adequate for the posted speed limit of 45 miles per hour (mph) for which a minimum of 360 feet of stopping sight distance is needed. The enhanced crosswalk should include high visibility crosswalk markings, double sided RRFBs, advance yield (sharks teeth) markings, pedestrian crossing signage, and advance pedestrian crossing signage. Additionally, the crosswalk should be adequately lit and connect to the existing sidewalk on the north side of the street to create a continuous path of travel.

Finding – The project site plan is a tentative map and does not identify any pedestrian facilities such as sidewalks, crosswalks, or curb ramps. While construction of sidewalks along the project frontage would close an existing sidewalk gap and improve pedestrian access in the study area, pedestrians traveling east of the project site would have to cross Quartz Hill Road without a crosswalk indicating a potentially significant impact.

Recommendations

- Sidewalks and streetlighting should be installed along all project streets, including the south side of Quartz Hill Road along the project frontage.
- ADA-compliant curb ramps should be provided at new intersections and connections to Quartz Hill Road and Stone Canyon Drive.
- A new enhanced pedestrian crossing should be installed on the east leg of Quartz Hill Road/Stone Canyon Drive. The crossing should include:
    - Double-sided pedestrian-activated RRFBs;
    - High visibility crosswalk markings;
    - Advance yield markings;
    - Pedestrian crossing signage;
    - Advance pedestrian crossing signage;
    - Adequate streetlighting; and
    - A connection to the existing sidewalk on the north side of the street.

Bicycle Facilities

Existing and Planned Bicycle Facilities

The *Highway Design Manual*, Caltrans, 2020, classifies bikeways into four categories:

- **Class I Multi-Use Path** – a completely separated right-of-way for the exclusive use of bicycles and pedestrians with cross flows of motorized traffic minimized.
- **Class II Bike Lane** – a striped and signed lane for one-way bike travel on a street or highway.
- **Class III Bike Route** – signing only for shared use with motor vehicles within the same travel lane on a street or highway.
- **Class IV Bikeway** – also known as a separated bikeway, a Class IV Bikeway is for the exclusive use of bicycles and includes a separation between the bikeway and the motor vehicle traffic lane. The separation may include, but is not limited to, grade separation, flexible posts, inflexible physical barriers, or on-street parking.

In the project area there are Class II bicycle lanes on Quartz Hill Road between Stone Canyon Drive and Benton Drive which would service the eastern portion of the project site, and there are buffered Class II bicycle lanes on Quartz Hill Road east of Benton Drive, extending to Market Street. According to the *City of Redding Active Transportation Plan* (ATP), the remaining segment of Quartz Hill Road, which connects to the western and middle portions of the project site, is currently designated as a Class III bicycle route. As outlined in the City's ATP, the existing bicycle lanes on Quartz Hill Road west of Benton Drive would be extended to the City Limit and upgraded to buffered Class II bicycle lanes. Table 4 summarizes the existing and planned bicycle facilities in the project vicinity.

Table 4 – Bicycle Facility Summary

Status Facility	Class	Length (miles)	Begin Point	End Point
Existing				
Sacramento River Trl	I	5.50	Hilltop Dr	City Limit
Quartz Hill Rd	II	1.10	Stone Canyon Dr	Benton Dr
Benton Dr	II	0.47	Riverside Dr	Quartz Hill Rd
Quartz Hill Rd	IIB	0.66	Benton Dr	Market St
Quartz Hill Rd	III	0.72	City Limit	Stone Canyon Dr
Benton Dr	III	1.00	Quartz Hill Rd	Market St
Planned				
Sulphur Creek Trl	I	2.84	Keswick Dam Rd	Market St
Benton Dr	II	1.47	Market St	Riverside Dr
Quartz Hill Rd	IIB	1.82	City Limit	Benton Dr

Notes: IIB = Buffered Bike Lane
Source: *Active Transportation Plan*, City of Redding, 2018

Bicyclist Safety

Collision records for the study area were reviewed to determine if there had been any bicyclist-involved crashes. During the five-year study period previously noted there was a single bicyclist-involved collision reported in the study area, which occurred at the intersection of Market Street/Benton Drive. The broadside collision involved a bicyclist proceeding straight, traveling on the wrong side of the roadway, while the driver turned right; the collision resulted in an injury to the cyclist. As also identified in the *Transportation Impact Study for the Redding School of the Arts*, the City may wish to consider installing citywide signage to warn bicyclists from riding in the wrong direction, such as sign R5-1b in the California *Manual on Uniform Traffic Control Devices* (CA-MUTCD) which depicts a bicycle symbol and says, "WRONG WAY".

Project Impacts on Bicycle Facilities

The existing bicycle facilities together with the shared use of minor streets would provide adequate access for cyclists in the near-term, and connectivity would be further improved with the installation of buffered Class II bicycle lanes on Quartz Hill Road extending to the project site and other improvements to the City's bicycle network. In conjunction with sidewalk improvements at the project site, it is recommended that the project frontage be designed to accommodate future installation of buffered bicycle lanes.

Bicycle Storage

All homes would have private garages with restricted access; therefore, separate bicycle parking is not required.

Finding – The existing bicycle facilities in the project vicinity are adequate and would improve upon completion of planned buffered bicycle lanes on Quartz Hill Road. No additional bicycle parking would be needed as the proposed single-family homes would have private garages.

Recommendation – The project frontage on Quartz Hill Road should be designed with sufficient space for the future provision of buffered bicycle lanes.

Transit Facilities

Existing Transit Facilities

The Redding Area Bus Authority (RABA) provides fixed-route bus service in the City of Redding. As there are no transit stops within a one-half mile walk of the project site, the project is not readily accessible by transit.

Dial-a-ride, also known as paratransit or door-to-door service, is available for those who are unable to independently use the transit system due to a physical or mental disability. RABA offers a dial-a-ride service to sites within 0.75 mile from a transit stop and operates during the same hours as the local bus routes. Segments of Quartz Hill Road along the project frontage and east of Terra Nova Drive are within the service area for RABA's dial-a-ride and would be accessible to residents with the completion of sidewalks on the south side of Quartz Hill Road.

Impact on Transit Facilities

Demand for transit is anticipated to be minimal given the location of the project site. While the nearest bus stop is not within a half-mile walking distance, residents could bike to the nearest stop at Quartz Hill Road/ Benton Drive, which is approximately 1.2 miles away from the site, and board with their bike. Therefore, the limited access to transit in this area of the City is considered acceptable given the minimal expected demand from the project. However, the City may wish to investigate extending transit service to Quartz Hill Road west of Benton Drive should more residential projects be approved and constructed in the area.

Finding – The limited access to transit is considered adequate as minimal demand is expected due to the location and context of the project site.

Vehicle Miles Traveled (VMT)

The potential for the project to conflict or be inconsistent with CEQA Guidelines § 15064.3, subdivision (b) was evaluated based the project's anticipated Vehicle Miles Traveled (VMT).

Background and Guidance

Senate Bill (SB) 743 established VMT as the metric to be applied for determining transportation impacts associated with development projects. Like many other jurisdictions in California, the City of Redding has not yet adopted a policy or thresholds of significance regarding VMT so the project-related VMT impacts were assessed based on guidance provided by the California Governor's Office of Planning and Research (OPR) in the publication *Transportation Impacts (SB 743) CEQA Guidelines Update and Technical Advisory*, 2018. Under this guidance, residential developments that have a VMT per capita that is 15 percent or more below the existing average countywide residential VMT per capita would have a less-than-significant transportation impact.

The Shasta Regional Transportation Agency (SRTA) is in the process of conducting an extensive countywide VMT baseline analysis and updating the travel demand model to include readily available commercial and residential VMT information per capita along with screening maps that can be used to identify certain types of projects that can be presumed to have a less-than-significant impact. The updated model is not yet available; however, the existing model does include sufficient information to estimate a project's total VMT per capita (as opposed to residential VMT per capita) so it was relied on to assess the project's potential impacts. At the direction of City staff and as has been applied for other projects within the City, the "2020 Project Average Daily VMT per capita" published in the SRTA *2018 Regional Transportation Plan and Sustainable Communities Strategy for the Shasta Region* (RTP) was used as the existing countywide baseline number.

Project Impact

The SRTA ShastaSIM travel demand model includes hundreds of traffic analysis zones (TAZs) within the region that contain information for scenario years between 2015 and 2040. The model has aggregate travel data for factors such as trips, distances traveled, total VMT, population, and employment. The project site is located within TAZ 463, which has a total VMT of 14,143 miles per day in 2020 (the closest analysis year to the date of this analysis). For a combined population of 850 persons, the total daily VMT per capita would be 16.6.

As contained in the 2018 RTP, the projected total daily VMT per capita with implementation of the RTP initiatives is 26.8 miles per day in 2020. Applying OPR's guidance, a residential project generating a VMT that is 15 percent or more below this value, or 22.8 miles per capita per day or less, would have a less-than-significant VMT impact. The proposed project is expected to have a daily VMT per capita of 16.6, which is approximately 27 percent below the countywide average. Since this is more than 15 percent below the countywide average value, the project would have a less-than-significant transportation impact on VMT based on OPR's guidance. This information is summarized in Table 5.

Table 5 – Vehicle Miles Traveled Analysis Summary

VMT Metric	Countywide Baseline 2020 VMT Rate	Significance Threshold	TAZ 463 VMT Rate	Resulting Significance
Total VMT per Capita	26.8	22.8	16.6	Less than Significant

Note: VMT Rate is measured in total VMT/Capita, or the number of daily miles driven per resident

Finding – Based on OPR guidance and information contained within the SRTA travel demand model and the 2018 RTP, the project's impact on VMT would be considered less than significant.

Safety Issues

The potential for the project to impact safety was evaluated in terms of the adequacy of sight distance and need for turn lanes at the project accesses, the adequacy of stacking space in dedicated turn lanes at the study intersections to accommodate additional queuing due to adding project-generated trips, and need for additional right-of-way controls. This section addresses the third transportation bullet on the CEQA checklist which is whether or not the project would substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment).

Site Access

The project site would be accessed by two new street connections on Quartz Hill Road and one new street connection on Stone Canyon Drive. The street connections on Quartz Hill Road would serve the middle and western clusters of lots and create two new tee intersections with Quartz Hill Road, and the street connection to the eastern cluster would create a new tee intersection with Stone Canyon Drive. On the project site plan, the clusters of lots are labeled as neighborhoods A, B, and C moving from west to east. While the neighborhoods would be interconnected by pedestrian pathways, no new streets would extend between the neighborhoods.

Sight Distance

At unsignalized intersections, a substantially clear line of sight should be maintained between the driver of a vehicle waiting at the crossroad and the driver of an approaching vehicle. Adequate time should be provided for the waiting vehicle to either cross, turn left, or turn right, without requiring the through traffic to radically alter their speed.

Sight distances along Quartz Hill Road and Stone Canyon Drive at the proposed street connections were evaluated based on sight distance criteria contained in the *Highway Design Manual* published by Caltrans. The recommended sight distance at intersections of public streets is based on corner sight distances, with more sight distance needed for making a left turn versus a right turn. The approach travel speed on the major street is used as the basis for determining the recommended sight distance. The proposed street connections would be stop-controlled minor street approaches so the corner sight distance criteria were applied. Additionally, the stopping sight distance needed for a following driver to stop if there is a vehicle slowing to turn into the side streets was evaluated based on stopping sight distance criterion and the approach speed on the major street.

For the posted speed limit of 45 mph on Quartz Hill Road, the minimum corner sight distances needed are 430 feet for right turns and 500 feet for left turns. Field measurements were obtained to and from the position of a vehicle at the location of the project street approaches and were determined to extend approximately 500 feet in each direction at Project Streets C and F, which are adequate for the posted speed limit. It should be noted that, while currently adequate, sight lines would be expected to improve over existing conditions upon development of the proposed project site because existing bushes and trees on the south side of the street that are currently limiting sight lines would be removed.

Consideration was also given to the adequacy of sight lines at the proposed street connection on Stone Canyon Drive, which would be located approximately 120 feet south of Quartz Hill Road. Given the proximity to the intersection with Quartz Hill Road, approaching motorists would either just have turned from Quartz Hill Road onto Stone Canyon Drive so be driving slowly or they would be decelerating as they approach the stop-controlled intersection in addition to traveling uphill. As a result, motorists would likely be traveling in the 15-mph range in both directions. For speeds of 15 mph, 100 feet of stopping sight distance is needed, which would be available so sight lines would be adequate to accommodate all turns into and out of Project Street A.

Additionally, adequate sight lines are available for a following motorist to notice and react to a preceding vehicle slowing to turn into the project access points. To preserve existing sight lines, any new signage, monuments, or other structures to be placed near the project entrances should be positioned outside of the vision triangles of a driver waiting on the minor street approaches.

Finding – Sight lines at the project connections to Quartz Hill Road and Stone Canyon Drive would be adequate to accommodate all turns into and out of the project site.

Recommendation – To preserve existing sight lines, any new signage, monuments, or other structures to be placed near the project entrances should be positioned outside of the vision triangles of a driver waiting on the minor street approaches.

Left-Turn Lane Warrants

The need for left-turn lanes at the two proposed street connections to Quartz Hill Road was evaluated based on criteria contained in the *Intersection Channelization Design Guide*, National Cooperative Highway Research Program (NCHRP) Report No. 279, Transportation Research Board, 1985, as well as an update of the methodology developed by the Washington State Department of Transportation and published in the *Method for Prioritizing Intersection Improvements*, January 1997. The NCHRP report references a methodology developed by M. D. Harmelink that includes equations that can be applied to expected or actual traffic volumes to determine the need for a left-turn pocket based on safety issues.

Under Future plus Project volumes, which represents worst case conditions, and considering how project trips would be distributed based on the number of residences that would be accessed by each street connection, left-turn lanes would not be warranted at any of the proposed street connections during either peak hour evaluated. Copies of the warrant spreadsheets are provided in Appendix C.

Finding – Left-turn lanes would not be warranted at the proposed street connections to Quartz Hill Road.

Queuing

An increase in queue length due to project traffic was considered a potentially significant impact if the increase would cause the queue to extend out of a dedicated turn lane into a through lane, or the back of queue into a visually restricted area, such as a blind corner. If queues would already be expected to extend past a dedicated turn lane without project traffic, the impact was only considered significant if this would result in the back of queue extending into an adjacent intersection or creating a sight distance impact.

Unsignalized Intersection

Queueing in the existing westbound left-turn lane at the intersection of Quartz Hill Road/Stone Canyon Drive was evaluated using a methodology contained in "Estimating Maximum Queue Length at Unsignalized Intersections," John T. Gard, *ITE Journal*, November 2001. Maximum queue lengths were estimated by assuming vehicle lengths of 25 feet and multiplying that by the number of vehicles expected to queue. Based on Future plus Project volumes, the maximum queue was determined to be no more than one vehicle, or 25 feet, during the a.m. peak hour and two vehicles, or 50 feet, during the p.m. peak hour. The left-turn lane has approximately 260 feet of storage space, which could accommodate up to ten vehicles, and would be more than adequate to accommodate the maximum anticipated queue. Queueing calculations for this unsignalized intersection are provided in Appendix D.

Signalized Intersections

Under each scenario, the projected 95th percentile queues in dedicated turn pockets at the signalized study intersections were determined using Synchro. Summarized in Table 6 are the predicted queue lengths. Copies of the Synchro projections are contained in Appendix E.

Table 6 – 95th Percentile Queues in Turn Pockets at Signalized Intersections													
Study Intersection Approach	**Turn Lane Length**	**95th Percentile Queues**											
		AM Peak Hour						**PM Peak Hour**					
		E	**E+P**	**B**	**B+P**	**F**	**F+P**	**E**	**E+P**	**B**	**B+P**	**F**	**F+P**
Market St/Benton Dr													
Northbound Left Turn	350	81	81	81	81	82	82	62	62	62	62	63	63
Northbound Right Turn	50	0	0	0	0	0	0	0	0	0	0	0	0
Southbound Left Turn	100	14	14	14	14	14	14	0	0	0	0	0	0
Southbound Right Turn	330	73	73	73	74	74	75	54	55	55	55	55	56
Eastbound Left Turn	150	120	123	122	125	123	125	**181**	**183**	**183**	**188**	**200**	**204**
Quartz Hill Rd/Benton Dr													
Northbound Left Turn	105*	89	91	91	93	97	98	196	202	200	205	200	205
Eastbound Left Turn	105	55	67	63	76	63	76	70	80	78	87	96	104
Westbound Left Turn	105*	96	96	96	96	96	96	84	84	84	84	84	84
Westbound Right Turn	300	0	0	0	0	0	0	0	0	0	0	0	0
Quartz Hill Rd/Market St													
Northbound Left Turn	150	**171**	**180**	**180**	**187**	**186**	**195**	**390**	**421**	**409**	**438**	**412**	**443**
Southbound Left Turn	150	44	44	44	44	49	49	50	50	50	50	56	56
Eastbound Left Turn*	130	64	64	64	64	64	64	34	34	34	34	34	34
Eastbound Right Turn	160	47	49	48	50	48	50	42	49	47	53	47	53

Notes: 95th percentile queue based on Synchro output; all distances are measured in feet; E = existing conditions; E+P = existing plus project conditions; B = baseline conditions; B+P = baseline plus project conditions; F = future conditions; F+P = future plus project conditions; ***** = two-way left-turn lane (TWLTL) provides additional storage; **Bold** text = queue length exceeds available storage

Under Existing conditions, the left-turn queue on the eastbound approach to the intersection of Market Street/Benton Drive exceeds storage capacity during the p.m. peak hour, and the left-turn queue on the northbound Market Street approach to the intersection with Quartz Hill Road exceeds storage capacity during both the a.m. and p.m. peak hours. Additionally, the left-turn queue on the northbound approach to Quartz Hill Road/Benton Drive exceeds storage capacity during the p.m. peak hour under Existing conditions; however, as the queue spills back into an existing two-way left-turn lane (TWLTL), it does not impact through traffic. It is noted that the Benton Drive queue blocks left turns from the existing driveway at 2250 Benton Drive and, while this is not ideal operationally for the driveway, there are no safety implications associated with this condition. Storage capacities would continue to be exceeded under Baseline, Future, and “plus Project” conditions. This is considered a less-than-significant impact as the adverse queuing conditions would not be a result of adding project traffic.

Finding – The project would have a less-than-significant impact on queueing as there are no scenarios in which the projected 95th percentile queues exceed the available stacking space specifically due to the addition of project traffic.

Emergency Access

The final transportation bullet on the CEQA checklist requires an evaluation as to whether the project would result in inadequate emergency access or not.

Adequacy of Site Access

The project site would be accessed via three new street connections, two of which would connect to Quartz Hill Road and one of which would connect to Stone Canyon Drive. While the site plan is still preliminary, it is anticipated that all aspects of the site, including street and driveway widths and turning radii, would be designed in accordance with applicable standards; therefore, access would be expected to function acceptably for emergency response vehicles.

Off-Site Impacts

While the project would be expected to result in slight increases in delay for traffic on Quartz Hill Road as detailed in the Capacity Analysis section of this report, emergency response vehicles can claim the right-of-way by using their lights and sirens; therefore, the project would be expected to have a nominal effect on emergency response times.

Finding – Emergency access and site circulation are anticipated to function acceptably with incorporation of applicable design standards into the site layout, and traffic from the proposed development would be expected to have a less-than-significant impact on emergency response times.

Capacity Analysis

Intersection Level of Service Methodologies

Level of Service (LOS) is used to rank traffic operation on various types of facilities based on traffic volumes and roadway capacity using a series of letter designations ranging from A to F. Generally, Level of Service A represents free flow conditions and Level of Service F represents forced flow or breakdown conditions. A unit of measure that indicates a level of delay generally accompanies the LOS designation.

The study intersections were analyzed using methodologies published in the *Highway Capacity Manual* (HCM), Transportation Research Board, 6th Edition. This source contains methodologies for various types of intersection control, all of which are related to a measurement of delay in average number of seconds per vehicle.

The intersection of Quartz Hill Road/Stone Canyon Drive has side-street stop control, so Levels of Service were analyzed using the "Two-Way Stop-Controlled" intersection capacity method from the HCM. This methodology determines a level of service for each minor turning movement by estimating the level of average delay in seconds per vehicle. Results are presented for the minor-street approaches together with the weighted overall average delay for the intersection.

The remaining three study intersections are currently controlled by traffic signals so were evaluated using the signalized methodology from the HCM. This methodology is based on factors including traffic volumes, green time for each movement, phasing, whether the signals are coordinated or not, truck traffic, and pedestrian activity. Average stopped delay per vehicle in seconds is used as the basis for evaluation in this LOS methodology. Delays were calculated using actual signal timing parameters obtained from City of Redding staff.

The ranges of delay associated with the various levels of service are indicated in Table 7.

Table 7 – Intersection Level of Service Criteria

LOS	Two-Way Stop-Controlled	Signalized
A	Delay of 0 to 10 seconds. Gaps in traffic are readily available for drivers exiting the minor street.	Delay of 0 to 10 seconds. Most vehicles arrive during the green phase, so do not stop at all.
B	Delay of 10 to 15 seconds. Gaps in traffic are somewhat less readily available than with LOS A, but no queuing occurs on the minor street.	Delay of 10 to 20 seconds. More vehicles stop than with LOS A, but many drivers still do not have to stop.
C	Delay of 15 to 25 seconds. Acceptable gaps in traffic are less frequent, and drivers may approach while another vehicle is already waiting to exit the side street.	Delay of 20 to 35 seconds. The number of vehicles stopping is significant, although many still pass through without stopping.
D	Delay of 25 to 35 seconds. There are fewer acceptable gaps in traffic, and drivers may enter a queue of one or two vehicles on the side street.	Delay of 35 to 55 seconds. The influence of congestion is noticeable, and most vehicles have to stop.
E	Delay of 35 to 50 seconds. Few acceptable gaps in traffic are available, and longer queues may form on the side street.	Delay of 55 to 80 seconds. Most, if not all, vehicles must stop and drivers consider the delay excessive.
F	Delay of more than 50 seconds. Drivers may wait for long periods before there is an acceptable gap in traffic for exiting the side streets, creating long queues.	Delay of more than 80 seconds. Vehicles may wait through more than one cycle to clear the intersection.

Reference: *Highway Capacity Manual*, Transportation Research Board, 2018

Traffic Operation Standards

City of Redding

Per the *City of Redding 2000-2020 General Plan*, the City strives to maintain LOS C operation for most arterials and their intersections, except within the Downtown area where LOS D is considered acceptable. Additionally, LOS D is considered acceptable for streets and intersections on the state highway network and river-crossing street corridors where capacity is affected by adjacent intersections. This applies to the overall operation of the intersection at signalized locations and to the worst-case movement on the stop-controlled approach(es) at unsignalized locations. A project would have an adverse effect on the surrounding transportation system if it would cause any study intersection to exceed the acceptable threshold for the facility. Based on the City of Redding's General Plan and TIA Guidelines, a standard of LOS C was applied to Quartz Hill Road/Stone Canyon Drive and Quartz Hill Road/Benton Drive, and a standard of LOS D was applied to Market Street/Benton Drive and Market Street/Quartz Hill Road since the latter two intersections are Caltrans facilities. The following thresholds were used to determine if an effect would be considered adverse.

Signalized intersections: The project is considered to have an adverse effect if:

- The project causes an acceptable LOS to decline to an unacceptable LOS; or:
- The project increases the overall average delay by more than 5 seconds per vehicle at an intersection having an unacceptable LOS without project traffic.

Unsignalized Intersections: The project is considered to have an adverse effect if:

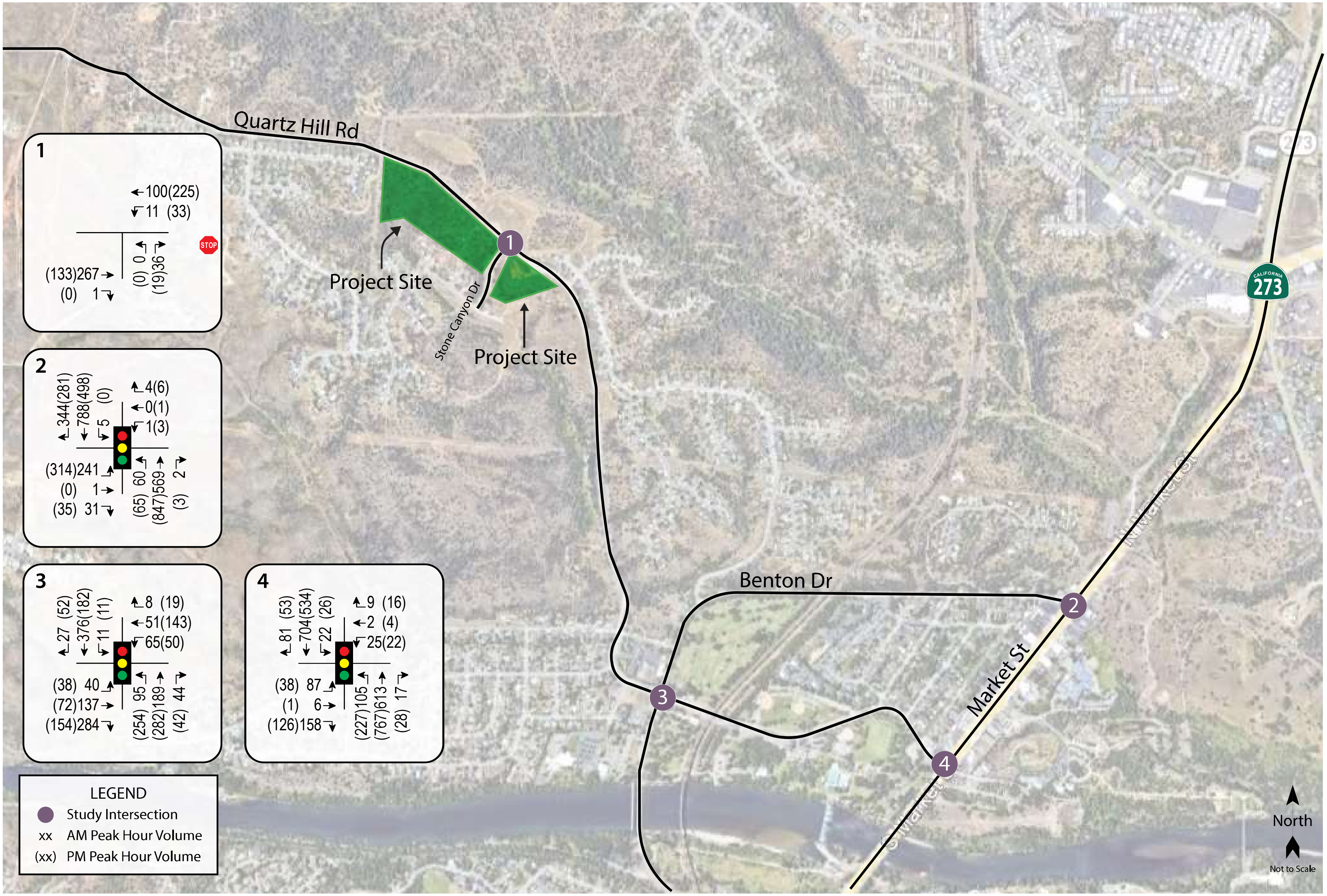
- The LOS declines to an unacceptable LOS; and
- The volume to capacity ratio exceeds 0.75; and
- The 95th percentile queue exceeds 75 feet (3 vehicles); or
- The project causes the worst-case movement's acceptable LOS to decline to an unacceptable LOS and the peak hour volume signal warrant is met; or
- The project increases the average delay for the worst-case movement by more than 5 seconds per vehicle at an intersection that has an unacceptable LOS without the project and the intersection also meets the peak hour volume signal warrant.

The City of Redding allows operational deficiencies attributed to a project in a Cumulative (Baseline or Future) scenario to be adequately addressed via payment of the City's traffic impact fees (TIFs) if the improvement is included in the City's TIF program and the project's proportional share of the total growth in volumes at the intersection is less than 25 percent. However, if the project's proportional share of growth is 25 percent or more, then the necessary improvements must be constructed as part of the project with the potential for reimbursement in the form of impact fee credits.

Existing Conditions

The Existing Conditions scenario provides an evaluation of current operation based on existing traffic volumes during the weekday a.m. and p.m. peak periods. This condition does not include project-generated traffic volumes. Volume data was collected on Thursday, November 3, 2022, during typical traffic conditions and while local schools were in session. Peak hour factors (PHFs) were calculated based on the counts obtained and used in the analysis, unless the PHF was calculated to be less than 0.85 in which case this value was used as a "floor" to avoid overly conservative results.

Under existing conditions, the study intersections operate acceptably at LOS C or better during both peak hours. The existing traffic volumes are shown in Figure 3. A summary of the intersection Level of Service calculations is contained in Table 8, and copies of the calculations for all evaluated scenarios are provided in Appendix F.



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Transportation Impact Study for the Cottages at Bel Air

Figure 3 – Existing Traffic Volumes

Table 8 – Existing Peak Hour Intersection Levels of Service				
Study Intersection	**AM Peak**		**PM Peak**	
Approach	**Delay**	**LOS**	**Delay**	**LOS**
1. Quartz Hill Rd/Stone Canyon Dr	1.2	A	1.1	A
Northbound (Stone Canyon) Approach	*10.8*	*B*	*9.2*	*A*
2. Market St/Benton Dr	16.9	B	14.6	B
3. Quartz Hill Rd/Benton Dr	29.8	C	19.1	B
4. Quartz Hill Rd/Market St	25.6	C	22.8	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Baseline Conditions

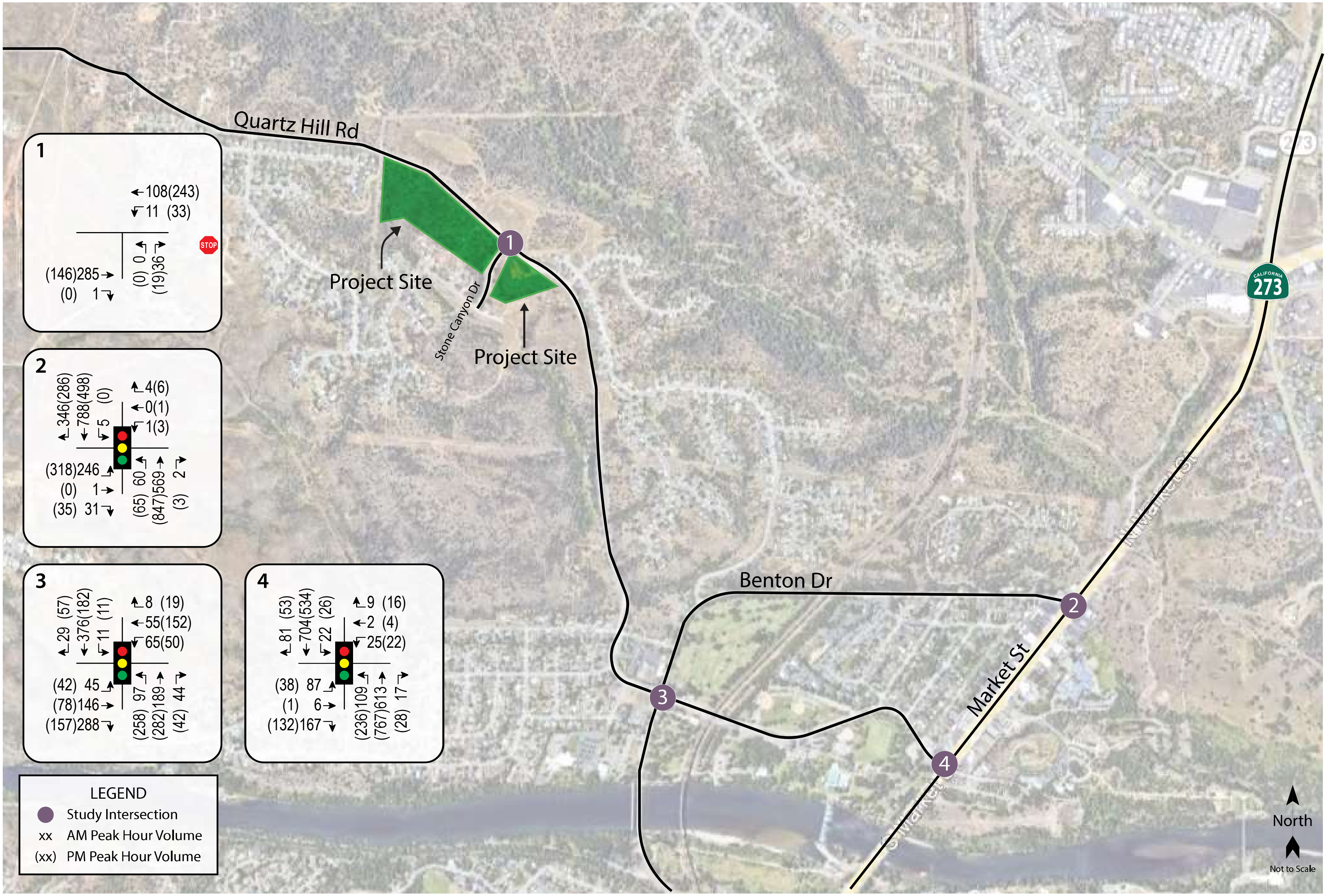
Baseline (Existing plus Approved) operating conditions were assessed with traffic from approved or pending projects in the study area that could be operational in the next two to five years added to the existing volumes. The following development project was identified by City staff to be included in the evaluation of Baseline Conditions.

- **Brentwood Village** is a proposed residential project of 30 duplex units to be located on the north side of Quartz Hill Road near River Ridge Drive to the west of the proposed project site. As identified in the *Draft Transportation Impact Study for the Brentwood Village Project*, W-Trans, March 9, 2023, the project would be expected to generate an average of 432 daily trips, including 29 during the a.m. peak hour and 34 during the p.m. peak hour. The same trip distribution assumptions applied in the project's TIS were applied in this analysis for consistency.

Upon adding trips associated with the pending Brentwood Village project to existing volumes and with no changes to the existing intersection lane configurations and controls, all study intersections would continue to operate acceptably at LOS C or better overall and on the minor street stop-controlled approach. These results are summarized in Table 9 and baseline volumes are shown in Figure 4.

Table 9 – Baseline Peak Hour Intersection Levels of Service				
Study Intersection	**AM Peak**		**PM Peak**	
Approach	**Delay**	**LOS**	**Delay**	**LOS**
1. Quartz Hill Rd/Stone Canyon Dr	1.1	A	1.0	A
Northbound (Stone Canyon) Approach	*11.0*	*B*	*9.3*	*A*
2. Market St/Benton Dr	16.9	B	14.7	B
3. Quartz Hill Rd/Benton Dr	30.0	C	19.9	B
4. Quartz Hill Rd/Market St	25.8	C	23.6	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*



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Transportation Impact Study for the Cottages at Bel Air

Figure 4 – Baseline Traffic Volumes

W-Trans

Future Conditions

Segment volumes for the horizon year of 2040 were obtained from the Shasta Regional Transportation Agency (SRTA) travel demand model and translated to turning movement volumes at each of the study intersections using a combination of the "Furness" method and factoring, depending on how the model was configured at each intersection. The Furness method is an iterative process that employs existing turn movement data, existing link volumes and future link volumes to project likely turning future movement volumes at intersections. In some instances, the model projected a traffic volume decrease compared to Baseline Conditions; rather than assume volume decreases, Baseline volumes were maintained as a "floor." This is a common technique used to ensure that the future projections are conservative.

Under the anticipated future volumes, and with no changes to existing geometrics or controls, the study intersections are expected to operate acceptably at LOS C or better during both peak hours. Operating conditions are summarized in Table 10 and future volumes are shown in Figure 5.

Table 10 – Future Peak Hour Intersection Levels of Service

Study Intersection		AM Peak		PM Peak	
	Approach	**Delay**	**LOS**	**Delay**	**LOS**
1.	Quartz Hill Rd/Stone Canyon Dr	1.2	A	1.1	A
	Northbound (Stone Canyon) Approach	*11.2*	*B*	*9.3*	*A*
2.	Market St/Benton Dr	18.1	B	15.1	B
3.	Quartz Hill Rd/Benton Dr	32.0	C	19.9	B
4.	Quartz Hill Rd/Market St	33.1	C	26.6	C

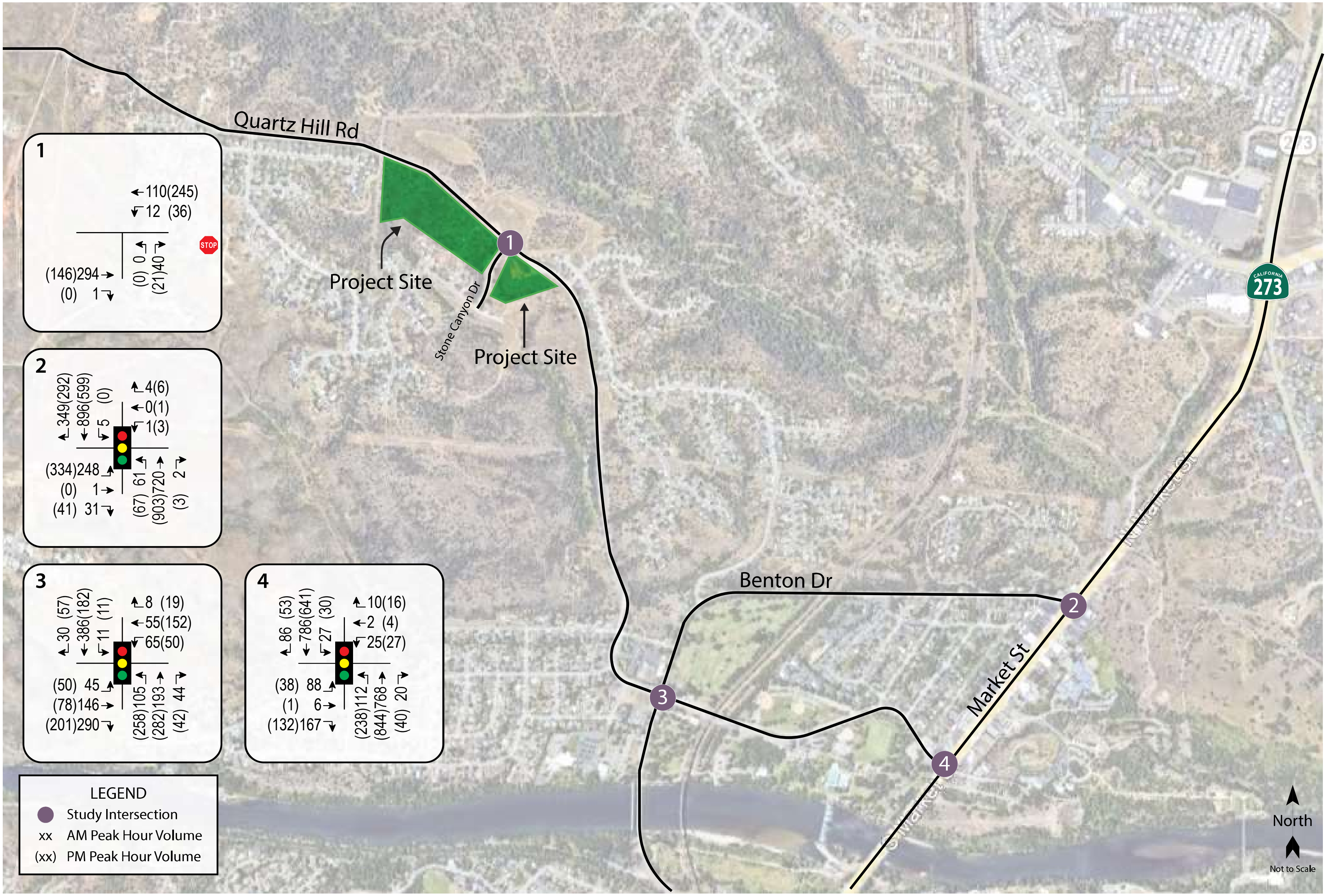
Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Project Conditions

The plus Project Conditions analyses include evaluation of intersection operations with the addition of project-generated trips to the existing, baseline, and future volumes.

Existing plus Project Conditions

Upon the addition of project-related traffic to the existing volumes, the study intersections are expected to continue operating acceptably at LOS C or better with no change or minor increases in delay. Project traffic volumes are shown in Figure 6 and these results are summarized in Table 11.



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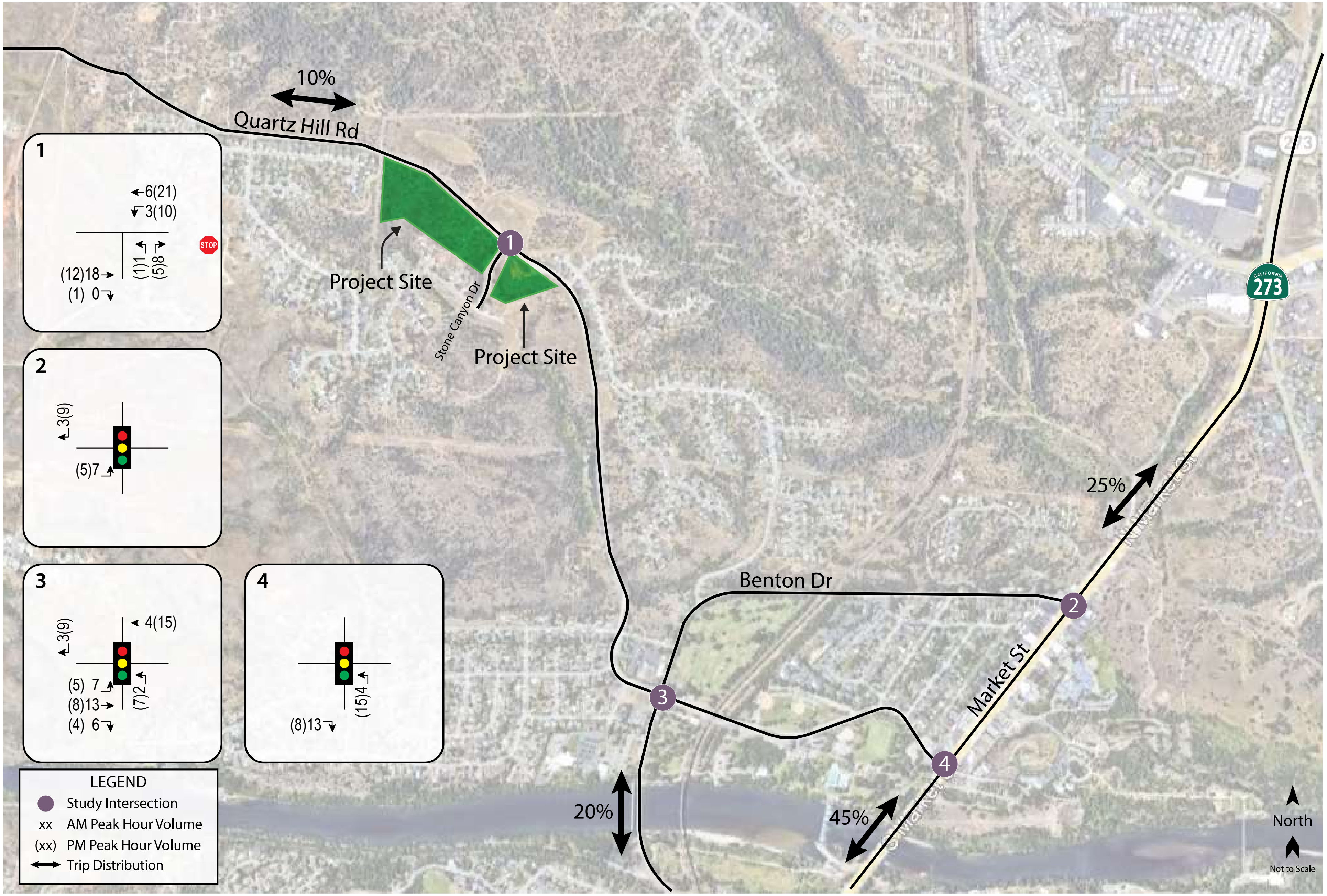
Transportation Impact Study for the Cottages at Bel Air

Figure 5 – Future Traffic Volumes

W-Trans



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Transportation Impact Study for the Cottages at Bel Air

Figure 6 – Project Traffic Volumes and Trip Distribution

Table 11 – Existing and Existing plus Project Peak Hour Intersection Levels of Service									
Study Intersection		**Existing Conditions**				**Existing plus Project**			
	Approach	**AM Peak**		**PM Peak**		**AM Peak**		**PM Peak**	
		Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
1.	Quartz Hill Rd/Stone Canyon Dr	1.2	A	1.1	A	1.4	A	1.2	A
	Northbound (Stone Canyon) Approach	*10.8*	*B*	*9.2*	*A*	*11.2*	*B*	*9.5*	*A*
2.	Market St/Benton Dr	16.9	B	14.6	B	16.9	B	14.7	B
3.	Quartz Hill Rd/Benton Dr	29.8	C	19.1	B	30.2	C	20.5	C
4.	Quartz Hill Rd/Market St	25.6	C	22.8	C	25.9	C	23.9	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Finding – The study intersections are expected to continue operating acceptably upon the addition of project-generated traffic to existing volumes and the project's near-term effect on operations would therefore be considered acceptable.

Baseline plus Project Conditions

With project-related traffic added to baseline volumes, the study intersections are expected to continue operating acceptably. These results are summarized in Table 12.

Table 12 – Baseline and Baseline plus Project Peak Hour Intersection Levels of Service									
Study Intersection		**Baseline Conditions**				**Baseline plus Project**			
	Approach	**AM Peak**		**PM Peak**		**AM Peak**		**PM Peak**	
		Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
1.	Quartz Hill Rd/Stone Canyon Dr	1.1	A	1.0	A	1.3	A	1.2	A
	Northbound (Stone Canyon) Approach	*11.0*	*B*	*9.3*	*A*	*11.5*	*B*	*9.6*	*A*
2.	Market St/Benton Dr	16.9	B	14.7	B	17.0	B	14.7	B
3.	Quartz Hill Rd/Benton Dr	30.0	C	19.9	B	30.7	C	21.4	C
4.	Quartz Hill Rd/Market St	25.8	C	23.6	C	26.0	C	24.7	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Finding – The study intersections are expected to continue operating acceptably with the addition of project-generated traffic to baseline volumes.

Future plus Project Conditions

Upon the addition of project-generated traffic to the anticipated future volumes, the study intersections are expected to continue operating acceptably at LOS C or better overall and on the minor street approach. The Future plus Project operating conditions are summarized in Table 13.

Table 13 – Future and Future plus Project Peak Hour Intersection Levels of Service								
Study Intersection	**Future Conditions**				**Future plus Project**			
Approach	**AM Peak**		**PM Peak**		**AM Peak**		**PM Peak**	
	Delay	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**	**Delay**	**LOS**
1. Quartz Hill Rd/Stone Canyon Dr	1.2	A	1.1	A	1.4	A	1.2	A
Northbound (Stone Canyon) Approach	*11.2*	*B*	*9.3*	*A*	*11.6*	*B*	*9.6*	*A*
2. Market St/Benton Dr	18.1	B	15.1	B	18.1	B	15.1	B
3. Quartz Hill Rd/Benton Dr	32.0	C	19.9	B	32.8	C	21.4	C
4. Quartz Hill Rd/Market St	33.1	C	26.6	C	33.5	C	27.7	C

Notes: Delay is measured in average seconds per vehicle; LOS = Level of Service; Results for minor approaches to two-way stop-controlled intersections are indicated in *italics*

Finding – The study intersections are expected to continue operating acceptably with project traffic added to future volumes; therefore, the project's long-term effect on operations would be considered acceptable.

Parking

Jurisdiction parking supply requirements are based on the City of Redding Municipal Code, Section 18.41.040; Off-Street Parking Spaces Required. City standards require two covered vehicle parking spaces for each single-family dwelling. As the proposed project would consist of 55 single-family dwellings each with two covered garage spaces, the proposed vehicle parking supply would be adequate to satisfy the City's requirements.

Finding – The proposed vehicle parking supply of two covered spaces per residence would satisfy City requirements.

Conclusions and Recommendations

Conclusions

- The project is expected to generate an average of 519 trips per day, including 39 a.m. peak hour trips and 52 p.m. peak hour trips.
- The project site plan is a tentative map and does not identify any pedestrian facilities such as sidewalks, crosswalks, or curb ramps. While construction of sidewalks along the project frontage would close an existing sidewalk gap and improve pedestrian access in the study area, pedestrians traveling east of the project site would have to cross Quartz Hill Road without a crosswalk, resulting in a potentially significant impact.
- Existing bicycle facilities serving the project site are adequate and would be improved with the installation of planned buffered bicycle lanes on Quartz Hill Road. The units would have private garages and therefore separate bicycle parking would not be required.
- The lack of transit facilities serving the project site is adequate given the location of the project site.
- The project is expected to have a less-than-significant impact on VMT.
- Sight lines at the two proposed street connections to Quartz Hill Road and one proposed street connection to Stone Canyon Drive are adequate to accommodate all turns into and out of the project streets as well as for following drivers to react to a vehicle slowing to turn into one of the new streets.
- A left-turn lane would not be warranted at any of the proposed street connections based on projected future vehicle volumes.
- Emergency access and circulation within the project sites would be adequate with incorporation of applicable design standards into the site plans. The project would have a less-than-significant impact on emergency response times.
- All four study intersections would operate at acceptable Levels of Service under Existing, Baseline, and Future conditions, without and with traffic generated by the project.
- The proposed vehicle parking supply would be adequate to meet City requirements.

Recommendations

- Sidewalks and streetlighting should be installed along the project streets and frontage on Quartz Hill Road, as well as ADA-compliant curb ramps at the proposed street connections and intersections of project streets.
- To mitigate a potentially significant impact, a new enhanced pedestrian crossing should be installed on the east leg of the Quartz Hill Road/Stone Canyon Drive intersection. The crossing should include the following design features:
  a. Double-sided pedestrian-activated RRFBs;
  b. High visibility crosswalk markings;
  c. Advance yield markings;
  d. Pedestrian crossing signage; and
  e. Advance pedestrian crossing signage.
- The project frontage on Quartz Hill Road should be designed with sufficient roadway width to accommodate the future provision of buffered bicycle lanes as planned by the City.
- New signage, monuments, or other structures near the project entrances should be positioned outside the sight triangles of a driver waiting on the minor street approaches.

Study Participants and References

Study Participants

Principal in Charge	Dalene J. Whitlock, PE (Civil, Traffic), PTOE
Transportation Engineer	Cameron Nye, PE (Traffic)
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Editing/Formatting	Jessica Bender
Quality Control	Dalene J. Whitlock, PE, PTOE

References

"Estimating Maximum Queue Length at Unsignalized Intersections," *ITE Journal*, John T. Gard, November 2001

2000-2020 General Plan, City of Redding, 2000

2018 Regional Transportation Plan and Sustainable Communities Strategy for the Shasta Region, Shasta Regional Transportation Agency, 2018

2019 Collision Data on California State Highways, California Department of Transportation, 2021

California Manual on Uniform Traffic Control Devices for Streets and Highways Revision 6, California Department of Transportation, 2021

City of Redding Active Transportation Plan, City of Redding, 2018

Draft Transportation Impact Study for the Brentwood Village Project, W-Trans, 2023

Highway Capacity Manual, 6th Edition, Transportation Research Board, 2018

Highway Design Manual, 7th Edition, California Department of Transportation, 2020

Intersection Channelization Design Guide, National Cooperative Highway Research Program (NCHRP) Report No. 279, Transportation Research Board, 1985

Method for Prioritizing Intersection Improvements, Washington State Transportation Center, 1997

Redding Area Bus Authority, https://www.cityofredding.org/departments/redding-area-bus-authority

Redding Municipal Code, Municode, 2022

Statewide Integrated Traffic Records System (SWITRS), California Highway Patrol, 2017-2022

Technical Advisory on Evaluating Transportation Impacts in CEQA, Governor's Office of Planning and Research, 2018

Traffic Impact Analysis Guidelines, City of Redding, 2009

Transportation Impact Study for the Redding School of the Arts, W-Trans, 2022

Trip Generation Manual, 11th Edition, Institute of Transportation Engineers, 2021

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Appendix A

Collision Rate Calculations

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Intersection Collision Rate Worksheet

TIS for the Cottages at Bel Air

Intersection # 1: Quartz Hill Rd & Stone Canyon Dr
Date of Count: Thursday, November 3, 2022

Number of Collisions: 1
Number of Injuries: 0
Number of Fatalities: 0
Average Daily Traffic (ADT): 4100
Start Date: October 1, 2017
End Date: September 30, 2022
Number of Years: 5

Intersection Type: Tee
Control Type: Stop & Yield Controls
Area: Urban

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{1 \quad \text{x} \quad 1{,}000{,}000}{4{,}100 \quad \text{x} \quad 365 \quad \text{x} \quad 5}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.13 c/mve**	**0.0%**	**0.0%**
Statewide Average*	**0.09 c/mve**	**1.2%**	**46.9%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2019 Collision Data on California State Highways, Caltrans

Intersection # 2: Market St & Benton Dr
Date of Count: Thursday, November 3, 2022

Number of Collisions: 11
Number of Injuries: 7
Number of Fatalities: 0
Average Daily Traffic (ADT): 20500
Start Date: October 1, 2017
End Date: September 30, 2022
Number of Years: 5

Intersection Type: Four-Legged
Control Type: Signals
Area: Urban

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{11 \quad \text{x} \quad 1{,}000{,}000}{20{,}500 \quad \text{x} \quad 365 \quad \text{x} \quad 5}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.29 c/mve**	**0.0%**	**63.6%**
Statewide Average*	**0.24 c/mve**	**0.5%**	**46.9%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2019 Collision Data on California State Highways, Caltrans

Intersection Collision Rate Worksheet

TIS for the Cottages at Bel Air

Intersection # 3: Quartz Hill Rd & Benton Dr

Date of Count: Thursday, November 3, 2022

Number of Collisions: 3
Number of Injuries: 1
Number of Fatalities: 0
Average Daily Traffic (ADT): 13000
Start Date: October 1, 2017
End Date: September 30, 2022
Number of Years: 5

Intersection Type: Four-Legged
Control Type: Signals
Area: Urban

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{3 \quad \text{x} \quad 1{,}000{,}000}{13{,}000 \quad \text{x} \quad 365 \quad \text{x} \quad 5}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.13 c/mve**	**0.0%**	**33.3%**
Statewide Average*	**0.24 c/mve**	**0.5%**	**46.9%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2019 Collision Data on California State Highways, Caltrans

Intersection # 4: Quartz Hill Rd & Market St

Date of Count: Thursday, November 3, 2022

Number of Collisions: 5
Number of Injuries: 3
Number of Fatalities: 0
Average Daily Traffic (ADT): 18400
Start Date: October 1, 2017
End Date: September 30, 2022
Number of Years: 5

Intersection Type: Four-Legged
Control Type: Signals
Area: Urban

$$\text{Collision Rate} = \frac{\text{Number of Collisions x 1 Million}}{\text{ADT x Days per Year x Number of Years}}$$

$$\text{Collision Rate} = \frac{5 \quad \text{x} \quad 1{,}000{,}000}{18{,}400 \quad \text{x} \quad 365 \quad \text{x} \quad 5}$$

	Collision Rate	Fatality Rate	Injury Rate
Study Intersection	**0.15 c/mve**	**0.0%**	**60.0%**
Statewide Average*	**0.24 c/mve**	**0.5%**	**46.9%**

Notes
ADT = average daily total vehicles entering intersection
c/mve = collisions per million vehicles entering intersection
* 2019 Collision Data on California State Highways, Caltrans

Appendix B

Pedestrian Crossing Treatment Worksheet

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GUIDELINES FOR PEDESTRIAN CROSSING TREATMENTS

This spreadsheet combines Worksheet 1 and Worksheet 2 (Appendix A, pages 69-70) of TCRP Report 112/NCHRP Report 562 (*Improving Pedestrian Safety at Unsignalized Intersections*) into an electronic format. This spreadsheet should be used in conjunction with, and not independent of, Appendix A documentation.

Key

Blue fields contain descriptive information.
Green fields are required and must be completed.
Tan fields are adjustments that are filled out only under certain conditions (follow instructions to the left of the cell).
Gray fields are automatically calculated and should not be edited.

Analyst and Site Information

Analyst	W-Trans	Major Street	Quartz Hill Road
Analysis Date	March 27, 2023	Minor Street or Location	Stone Canyon Road
Data Collection Date	November 3, 2022	Peak Hour	Existing plus Project AM

Step 1: Select worksheet:

Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)	*1a*	45
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)	*1b*	NO

Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?

Peak-hour pedestrian volume (ped/h), V_p	*2a*	14

Result: Go to step 3.

Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?

Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$	*3a*	379
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant	*3b*	368
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant	*3c*	368
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)	*3d*	NO
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%. — % rate of reduction for *3c* (up to 50%)	*3e*	
Reduced value or *3c*	*3f*	368

Result: The signal warrant is not met. Go to step 4.

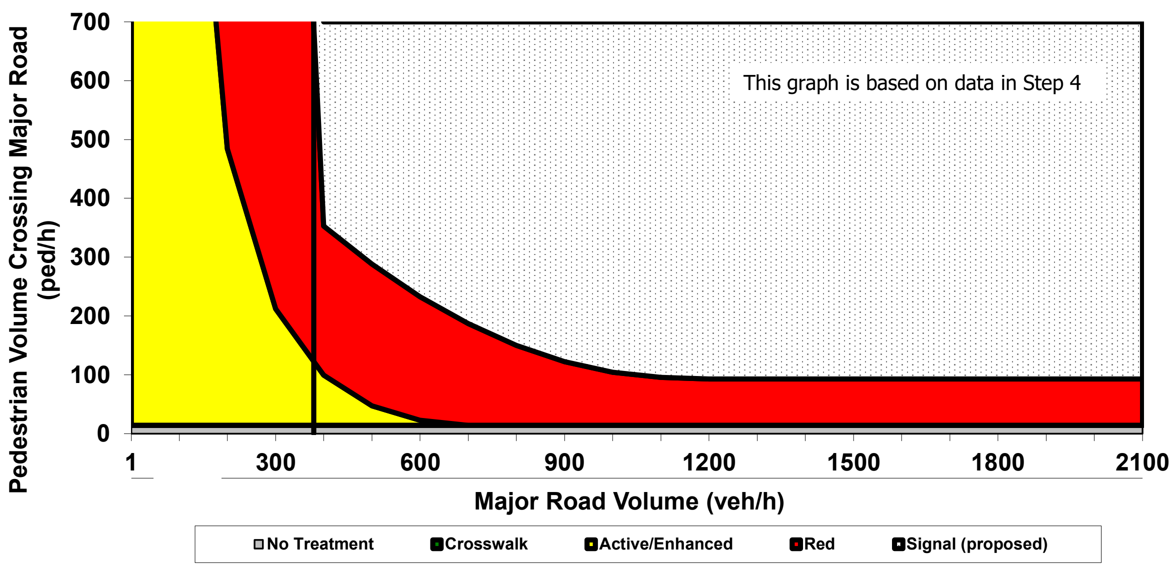
Step 4: Estimate pedestrian delay.

Pedestrian crossing distance, curb to curb (ft), L	*4a*	68
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)	*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)	*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c	*4d*	22.4
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$	*4e*	379
Major road flow rate (veh/s), v	*4f*	0.15
Average pedestrian delay (s/person), d_p	*4g*	163
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the	*4h*	0.6
major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.	*4i*	

Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.

Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***	*5a*	LOW

Treatment Category:	**ACTIVE OR ENHANCED**



This worksheet provides general recommendations on pedestrian crossing treatments to consider at unsignalized intersections; in all cases, engineering judgment should be used in selecting a specific treatment for installation. This worksheet does not apply to school crossings. In addition to the results provided by this worksheet, users should consider whether a pedestrian treatment could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex geometrics, or nearby traffic signals.

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Appendix C

Turn Lane Warrant Spreadsheets

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Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Quartz Hill Road/Western Project Road
Study Scenario: Future AM plus Project

Direction of Analysis Street: East/West

Cross Street Intersects: From the South

Quartz Hill Rd

Eastbound Volumes (veh/hr)

Through Volume = 295
Right Turn Volume = 0

Quartz Hill Rd

Westbound Volumes (veh/hr)

112 = Through Volume
3 = Left Turn Volume

Eastbound Speed Limit: 45 mph
Eastbound Configuration: 2 Lanes - Undivided

Project Driveway

Westbound Speed Limit: 45 mph
Westbound Configuration: 2 Lanes - Undivided

Eastbound Right Turn Lane Warrants

1. Check for right turn volume criteria

NOT WARRANTED Less than 40 vehicles

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	295
If AV<Va then warrant is met		-

Right Turn Lane Warranted: **NO**

Eastbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

2. Check advance volume threshold criteria for taper

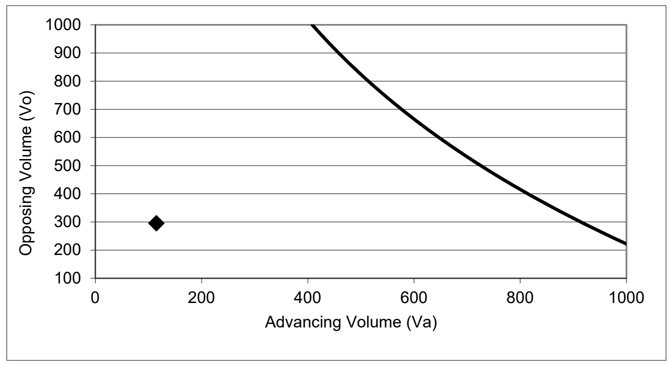
Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	295
If AV<Va then warrant is met		-

Right Turn Taper Warranted: **NO**

Westbound Left Turn Lane Warrants

Percentage Left Turns	%lt	2.6 %
Advancing Volume Threshold	AV	919 veh/hr

If AV<Va then warrant is met



◆ Study Intersection
—— Two lane roadway warrant threshold for: 45 mph
Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements* , January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Quartz Hill Road/Western Project Road
Study Scenario: Future PM plus Project

Direction of Analysis Street: East/West

Cross Street Intersects: From the South

Quartz Hill Rd

Eastbound Volumes (veh/hr)

Through Volume = 148
Right Turn Volume = 1

Quartz Hill Rd

Westbound Volumes (veh/hr)

247 = Through Volume
7 = Left Turn Volume

Project Driveway

Eastbound Speed Limit: 45 mph
Eastbound Configuration: 2 Lanes - Undivided

Westbound Speed Limit: 45 mph
Westbound Configuration: 2 Lanes - Undivided

Eastbound Right Turn Lane Warrants

1. Check for right turn volume criteria

NOT WARRANTED Less than 40 vehicles

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	149
If AV<Va then warrant is met		-

Right Turn Lane Warranted: **NO**

Eastbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

2. Check advance volume threshold criteria for taper

Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	149
If AV<Va then warrant is met		-

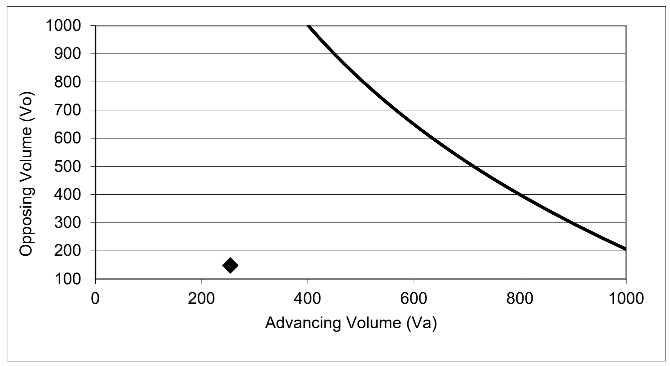
Right Turn Taper Warranted: **NO**

Westbound Left Turn Lane Warrants

Percentage Left Turns %lt 2.8 %

Advancing Volume Threshold AV 1068 veh/hr

If AV<Va then warrant is met



◆ Study Intersection

Two lane roadway warrant threshold for: 45 mph

Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements* , January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Quartz Hill Road/Middle Project Road
Study Scenario: Future AM plus Project

Direction of Analysis Street: East/West

Cross Street Intersects: From the South

Quartz Hill Rd
Eastbound Volumes (veh/hr)
Through Volume = 301
Right Turn Volume = 0

Quartz Hill Rd
Westbound Volumes (veh/hr)
114 = Through Volume
4 = Left Turn Volume

Eastbound Speed Limit: 45 mph
Eastbound Configuration: 2 Lanes - Undivided

Project Driveway

Westbound Speed Limit: 45 mph
Westbound Configuration: 2 Lanes - Undivided

Eastbound Right Turn Lane Warrants

1. Check for right turn volume criteria

NOT WARRANTED Less than 40 vehicles

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	301
If AV<Va then warrant is met		-

Right Turn Lane Warranted: **NO**

Eastbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

2. Check advance volume threshold criteria for taper

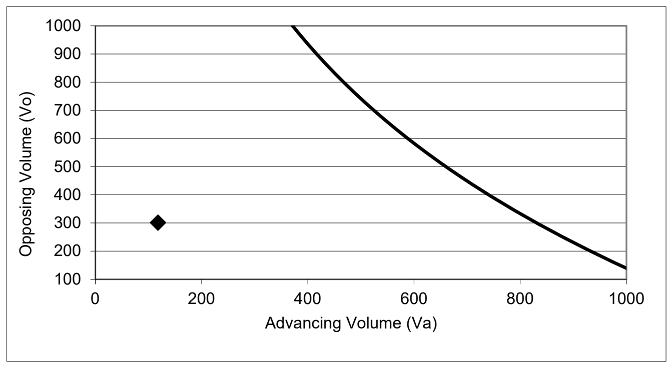
Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	301
If AV<Va then warrant is met		-

Right Turn Taper Warranted: **NO**

Westbound Left Turn Lane Warrants

Percentage Left Turns	%lt	3.4 %
Advancing Volume Threshold	AV	830 veh/hr

If AV<Va then warrant is met



◆ Study Intersection
Two lane roadway warrant threshold for: 45 mph
Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements*, January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Quartz Hill Road/Middle Project Road
Study Scenario: Future PM plus Project

Direction of Analysis Street: East/West

Cross Street Intersects: From the South

Quartz Hill Rd
Eastbound Volumes (veh/hr)
Through Volume = 151
Right Turn Volume = 1

Quartz Hill Rd
Westbound Volumes (veh/hr)
253 = Through Volume
14 = Left Turn Volume

Eastbound Speed Limit: 45 mph
Eastbound Configuration: 2 Lanes - Undivided

Project Driveway

Westbound Speed Limit: 45 mph
Westbound Configuration: 2 Lanes - Undivided

Eastbound Right Turn Lane Warrants

1. Check for right turn volume criteria

NOT WARRANTED Less than 40 vehicles

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	152
If AV<Va then warrant is met		-

Right Turn Lane Warranted: **NO**

Eastbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

2. Check advance volume threshold criteria for taper

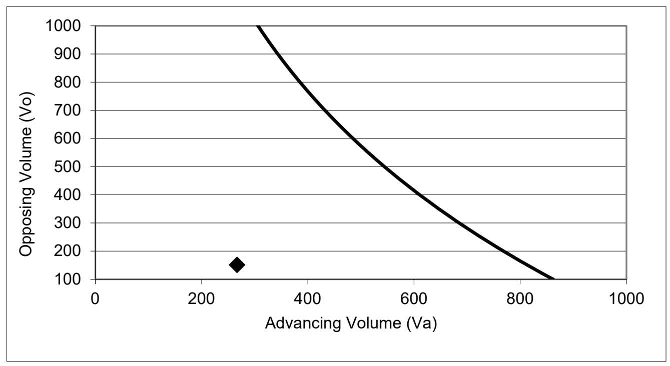
Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	152
If AV<Va then warrant is met		-

Right Turn Taper Warranted: **NO**

Westbound Left Turn Lane Warrants

Percentage Left Turns	%lt	5.2 %
Advancing Volume Threshold	AV	813 veh/hr

If AV<Va then warrant is met



◆ Study Intersection
Two lane roadway warrant threshold for: 45 mph
Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

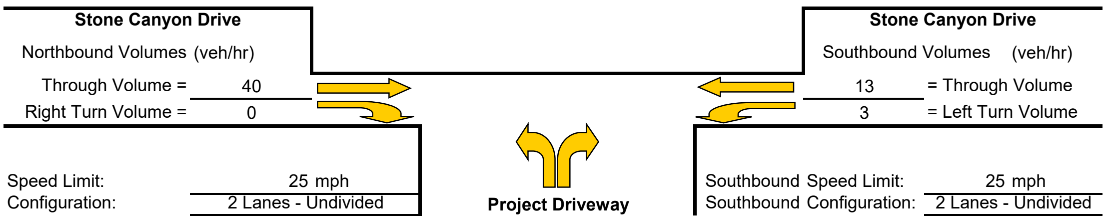
Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements* , January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Stone Canyon Drive/Eastern Project Road
Study Scenario: Future AM plus Project

Direction of Analysis Street: North/South

Cross Street Intersects: From the East



Northbound Speed Limit: 25 mph
Northbound Configuration: 2 Lanes - Undivided

Southbound Speed Limit: 25 mph
Southbound Configuration: 2 Lanes - Undivided

Northbound Right Turn Lane Warrants

1. Check for right turn volume criteria

Thresholds not met, continue to next step

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	1050.1
Advancing Volume	Va =	40
If AV<Va then warrant is met		No

Right Turn Lane Warranted: **NO**

Northbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

2. Check advance volume threshold criteria for taper

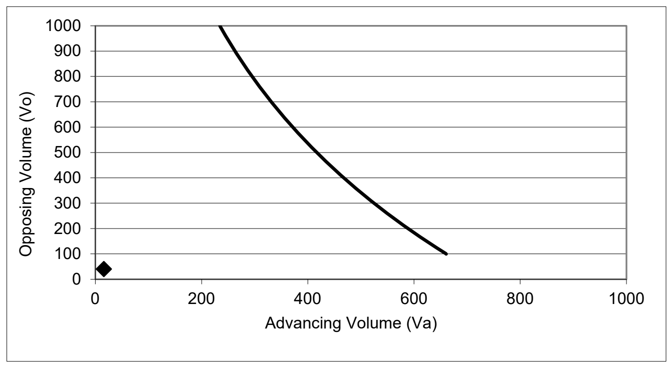
Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	40
If AV<Va then warrant is met		-

Right Turn Taper Warranted: **NO**

Southbound Left Turn Lane Warrants

Percentage Left Turns	%lt	18.8 %
Advancing Volume Threshold	AV	708 veh/hr

If AV<Va then warrant is met



◆ Study Intersection
Two lane roadway warrant threshold for: 25 mph
Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements* , January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

Turn Lane Warrant Analysis - Tee Intersections

Study Intersection: Stone Canyon Drive/Eastern Project Road
Study Scenario: Future PM plus Project

Direction of Analysis Street: North/South

Cross Street Intersects: From the East

Stone Canyon Drive
Northbound Volumes (veh/hr)
Through Volume = 21
Right Turn Volume = 0

Stone Canyon Drive
Southbound Volumes (veh/hr)
36 = Through Volume
10 = Left Turn Volume

Northbound Speed Limit: 25 mph
Northbound Configuration: 2 Lanes - Undivided

Project Driveway

Southbound Speed Limit: 25 mph
Southbound Configuration: 2 Lanes - Undivided

Northbound Right Turn Lane Warrants

1. Check for right turn volume criteria

Thresholds not met, continue to next step

2. Check advance volume threshold criteria for turn lane

Advancing Volume Threshold	AV =	1050.1
Advancing Volume	Va =	21
If AV<Va then warrant is met		No

Right Turn Lane Warranted: **NO**

Northbound Right Turn Taper Warrants
(evaluate if right turn lane is unwarranted)

1. Check taper volume criteria

NOT WARRANTED - Less than 20 vehicles

2. Check advance volume threshold criteria for taper

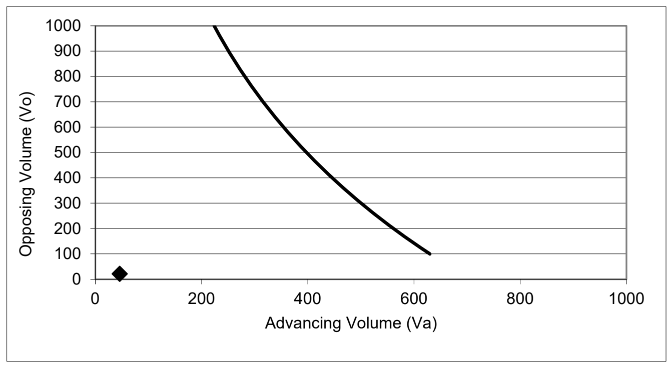
Advancing Volume Threshold	AV =	-
Advancing Volume	Va =	21
If AV<Va then warrant is met		-

Right Turn Taper Warranted: **NO**

Southbound Left Turn Lane Warrants

Percentage Left Turns	%lt	21.7 %
Advancing Volume Threshold	AV	690 veh/hr

If AV<Va then warrant is met



◆ Study Intersection
Two lane roadway warrant threshold for: 25 mph
Turn lane warranted if point falls to right of warrant threshold line

Left Turn Lane Warranted: **NO**

Methodology based on Washington State Transportation Center Research Report *Method For Prioritizing Intersection Improvements*, January 1997.
The right turn lane and taper analysis is based on work conducted by Cottrell in 1981.
The left turn lane analysis is based on work conducted by M.D. Harmelink in 1967, and modified by Kikuchi and Chakroborty in 1991.

Appendix D

Unsignalized Intersection Queueing Calculations

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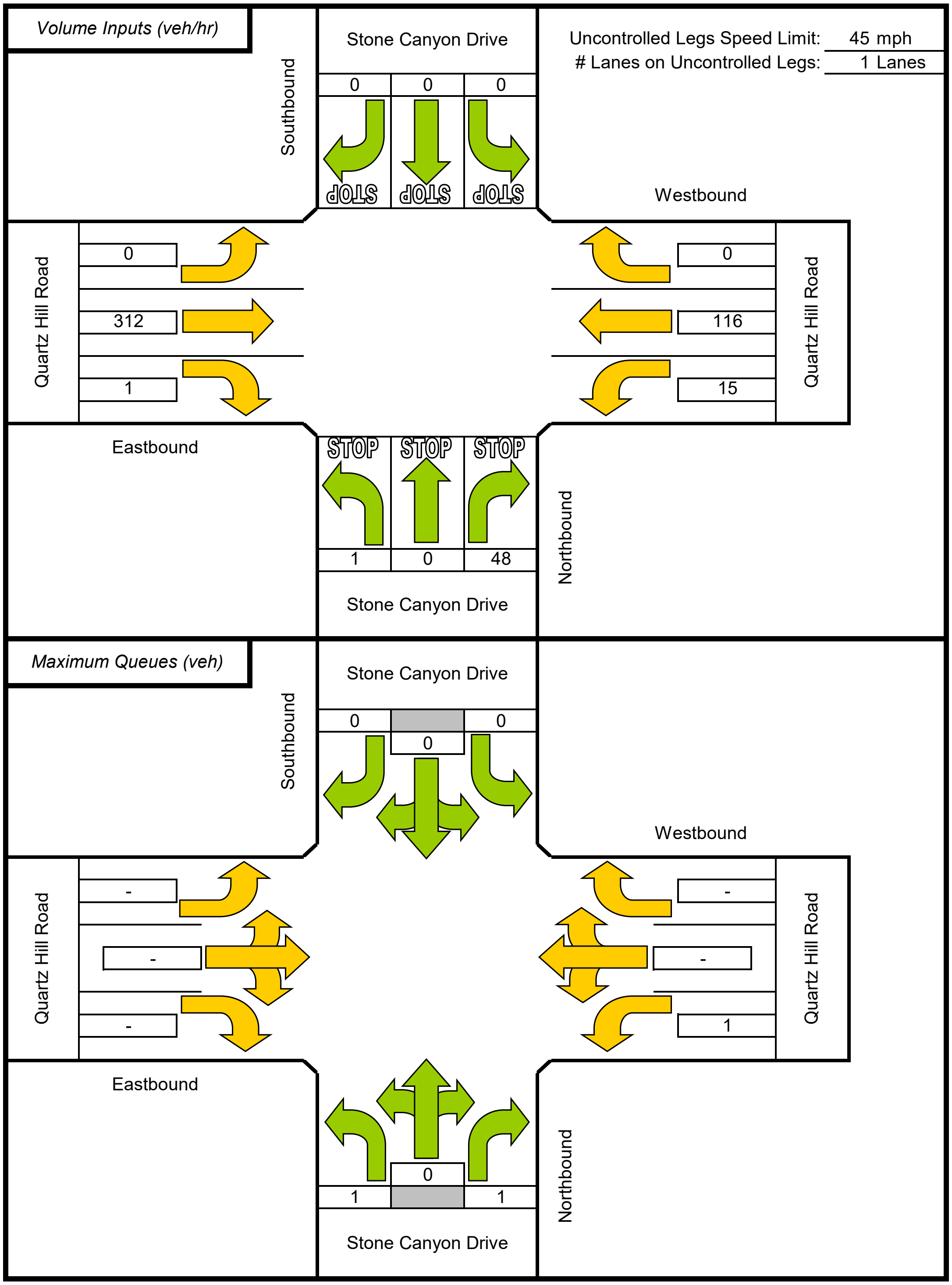
Maximum Queue Length
Two-Way Stop-Controlled Intersections

Through Street: Quartz Hill Road
Side Street: Stone Canyon Drive

Scenario: Future plus Project AM
Stop Controlled Legs: North/South

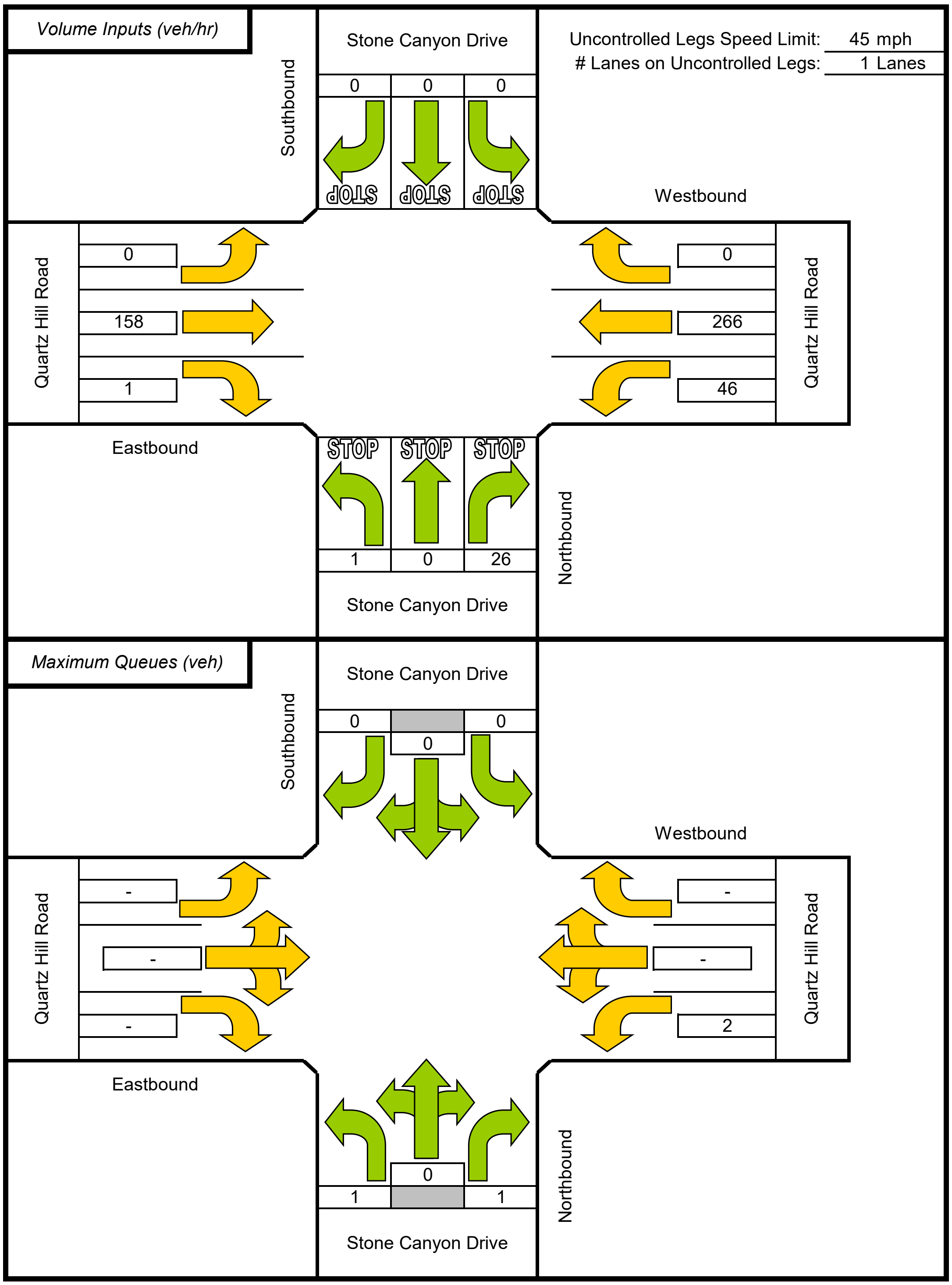


Source: John T. Gard, ITE Journal, November 2001, "Estimating Maximum Queue Length at Unsignalized Intersections"

Maximum Queue Length
Two-Way Stop-Controlled Intersections

Through Street: Quartz Hill Road
Side Street: Stone Canyon Drive

Scenario: Future plus Project PM
Stop Controlled Legs: North/South



Source: John T. Gard, ITE Journal, November 2001, "Estimating Maximum Queue Length at Unsignalized Intersections"

Appendix E

Signalized Intersection Queuing Calculations

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Queues
2: Market St & Benton Dr

02/06/2023

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	148	145	5	65	612	2	5	847	370
v/c Ratio	0.36	0.35	0.01	0.19	0.34	0.00	0.02	0.61	0.44
Control Delay	22.7	20.0	0.0	29.0	14.4	0.0	30.8	22.3	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.7	20.0	0.0	29.0	14.4	0.0	30.8	22.3	5.0
Queue Length 50th (ft)	46	38	0	18	42	0	1	126	0
Queue Length 95th (ft)	120	108	0	81	248	0	14	#420	73
Internal Link Dist (ft)		1706	264		2041			339	
Turn Bay Length (ft)	150			350		50	100		330
Base Capacity (vph)	414	417	443	347	1800	861	316	1390	846
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.35	0.01	0.19	0.34	0.00	0.02	0.61	0.44

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
3: Benton Dr & Quartz Hill Rd

02/06/2023

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	46	157	326	75	59	9	109	268	476
v/c Ratio	0.30	0.46	0.53	0.49	0.15	0.02	0.34	0.79	0.87
Control Delay	33.9	24.2	7.2	42.4	18.2	0.1	27.0	43.6	41.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.9	24.2	7.2	42.4	18.2	0.1	27.0	43.6	41.5
Queue Length 50th (ft)	15	49	23	24	14	0	32	81	149
Queue Length 95th (ft)	#55	88	49	#96	40	0	89	#258	#417
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	153	390	626	153	438	528	338	358	591
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.30	0.40	0.52	0.49	0.13	0.02	0.32	0.75	0.81

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
4: Market St & Quartz Hill Rd
02/06/2023

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	54	54	184	41	122	733	26	819	94
v/c Ratio	0.15	0.15	0.36	0.10	0.49	0.53	0.10	0.76	0.17
Control Delay	28.5	28.5	7.2	21.3	43.5	26.6	37.9	35.5	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	28.5	7.2	21.3	43.5	26.6	37.9	35.5	2.9
Queue Length 50th (ft)	22	22	0	12	54	125	11	200	0
Queue Length 95th (ft)	64	64	47	39	#171	#431	44	#497	12
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	369	372	507	419	250	1377	250	1071	564
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.15	0.15	0.36	0.10	0.49	0.53	0.10	0.76	0.17

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
2: Market St & Benton Dr
02/06/2023

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	191	188	11	71	921	3	541	305
v/c Ratio	0.52	0.37	0.03	0.18	0.49	0.00	0.41	0.40
Control Delay	29.2	7.7	17.2	22.7	9.4	0.0	16.1	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.2	7.7	17.2	22.7	9.4	0.0	16.1	4.6
Queue Length 50th (ft)	60	2	1	20	72	0	72	0
Queue Length 95th (ft)	#181	56	15	62	187	0	153	54
Internal Link Dist (ft)		1706	264		2041		339	
Turn Bay Length (ft)	150			350		50		330
Base Capacity (vph)	367	502	336	386	1888	899	1334	772
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.52	0.37	0.03	0.18	0.49	0.00	0.41	0.40

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

3: Benton Dr & Quartz Hill Rd

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	42	80	171	56	159	21	282	360	272
v/c Ratio	0.28	0.27	0.22	0.31	0.43	0.04	0.51	0.62	0.77
Control Delay	37.8	25.0	1.5	36.5	25.1	0.2	22.3	23.9	42.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	37.8	25.0	1.5	36.5	25.1	0.2	22.3	23.9	42.0
Queue Length 50th (ft)	13	24	0	17	40	0	80	103	78
Queue Length 95th (ft)	#70	70	11	#84	123	0	196	246	#337
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	150	334	779	186	415	503	579	605	390
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.28	0.24	0.22	0.30	0.38	0.04	0.49	0.60	0.70

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

4: Market St & Quartz Hill Rd

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	21	22	140	46	252	883	29	593	59
v/c Ratio	0.05	0.05	0.27	0.10	0.73	0.50	0.10	0.63	0.12
Control Delay	30.4	30.4	6.4	19.8	49.4	25.2	39.9	33.4	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.4	30.4	6.4	19.8	49.4	25.2	39.9	33.4	0.5
Queue Length 50th (ft)	9	9	0	12	123	159	13	143	0
Queue Length 95th (ft)	34	36	42	42	#390	#563	50	#358	0
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	414	416	522	463	393	1771	285	1073	557
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.05	0.27	0.10	0.64	0.50	0.10	0.55	0.11

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
2: Market St & Benton Dr

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	151	148	5	65	612	2	5	847	372
v/c Ratio	0.36	0.35	0.01	0.19	0.34	0.00	0.02	0.61	0.44
Control Delay	22.8	20.1	0.0	29.0	14.4	0.0	30.8	22.3	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.8	20.1	0.0	29.0	14.4	0.0	30.8	22.3	5.0
Queue Length 50th (ft)	47	40	0	18	42	0	1	126	0
Queue Length 95th (ft)	122	110	0	81	248	0	14	#420	73
Internal Link Dist (ft)		1706	264		2041			339	
Turn Bay Length (ft)	150			350		50	100		330
Base Capacity (vph)	414	418	443	347	1800	861	316	1390	847
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.36	0.35	0.01	0.19	0.34	0.00	0.02	0.61	0.44

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
3: Benton Dr & Quartz Hill Rd

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	52	168	331	75	63	9	111	268	478
v/c Ratio	0.34	0.48	0.54	0.49	0.19	0.02	0.35	0.79	0.87
Control Delay	35.8	24.7	7.4	42.5	19.8	0.1	27.1	43.8	41.8
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	35.8	24.7	7.4	42.5	19.8	0.1	27.1	43.8	41.8
Queue Length 50th (ft)	17	52	24	24	18	0	33	81	150
Queue Length 95th (ft)	#63	93	50	#96	42	0	91	#258	#419
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	153	390	627	153	390	492	337	357	590
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.43	0.53	0.49	0.16	0.02	0.33	0.75	0.81

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
4: Market St & Quartz Hill Rd

02/06/2023

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	54	54	194	41	127	733	26	819	94
v/c Ratio	0.14	0.14	0.37	0.10	0.50	0.54	0.10	0.78	0.17
Control Delay	28.5	28.5	7.2	21.3	43.9	26.7	37.9	36.0	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	28.5	7.2	21.3	43.9	26.7	37.9	36.0	2.9
Queue Length 50th (ft)	22	22	0	12	56	125	11	200	0
Queue Length 95th (ft)	64	64	48	39	#180	#431	44	#497	12
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	373	376	518	423	253	1362	253	1056	558
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.14	0.37	0.10	0.50	0.54	0.10	0.78	0.17

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
2: Market St & Benton Dr

02/06/2023

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	194	190	11	71	921	3	541	311
v/c Ratio	0.53	0.38	0.03	0.18	0.50	0.00	0.41	0.40
Control Delay	29.5	7.9	17.2	22.7	9.4	0.0	16.2	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.5	7.9	17.2	22.7	9.4	0.0	16.2	4.6
Queue Length 50th (ft)	61	2	1	20	72	0	72	0
Queue Length 95th (ft)	#183	57	15	62	187	0	153	55
Internal Link Dist (ft)		1706	264		2041		339	
Turn Bay Length (ft)	150			350		50		330
Base Capacity (vph)	368	502	336	387	1891	900	1330	775
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.38	0.03	0.18	0.49	0.00	0.41	0.40

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
3: Benton Dr & Quartz Hill Rd
02/06/2023

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	47	87	174	56	169	21	287	360	277
v/c Ratio	0.31	0.29	0.23	0.31	0.45	0.04	0.53	0.63	0.78
Control Delay	38.8	25.2	1.6	36.4	25.3	0.2	22.8	24.3	42.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	38.8	25.2	1.6	36.4	25.3	0.2	22.8	24.3	42.0
Queue Length 50th (ft)	15	27	0	18	43	0	83	104	79
Queue Length 95th (ft)	#78	75	11	#84	131	0	200	246	#343
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	151	339	787	189	420	506	585	610	395
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.31	0.26	0.22	0.30	0.40	0.04	0.49	0.59	0.70

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
4: Market St & Quartz Hill Rd
02/06/2023

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	21	22	147	46	262	883	29	593	59
v/c Ratio	0.05	0.05	0.28	0.10	0.76	0.50	0.10	0.63	0.12
Control Delay	30.5	30.4	7.1	19.8	50.9	25.2	39.9	33.5	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.5	30.4	7.1	19.8	50.9	25.2	39.9	33.5	0.5
Queue Length 50th (ft)	9	9	0	12	129	159	13	143	0
Queue Length 95th (ft)	34	36	47	42	#409	#563	50	#358	0
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	413	414	521	462	391	1774	284	1069	555
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.05	0.28	0.10	0.67	0.50	0.10	0.55	0.11

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
2: Market St & Benton Dr

02/06/2023

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	152	149	5	66	774	2	5	963	375
v/c Ratio	0.37	0.36	0.01	0.19	0.43	0.00	0.02	0.69	0.44
Control Delay	22.9	20.3	0.0	29.0	15.5	0.0	30.8	23.7	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.9	20.3	0.0	29.0	15.5	0.0	30.8	23.7	5.0
Queue Length 50th (ft)	47	41	0	19	57	0	1	150	0
Queue Length 95th (ft)	123	111	0	82	#352	0	14	#505	74
Internal Link Dist (ft)		1706	264		2041			339	
Turn Bay Length (ft)	150			350		50	100		330
Base Capacity (vph)	410	414	441	344	1814	867	313	1404	854
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.36	0.01	0.19	0.43	0.00	0.02	0.69	0.44

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
3: Benton Dr & Quartz Hill Rd

02/06/2023

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	52	168	333	75	63	9	121	273	491
v/c Ratio	0.35	0.49	0.55	0.50	0.19	0.02	0.38	0.81	0.88
Control Delay	36.1	24.9	7.7	43.2	19.8	0.1	27.7	45.7	42.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.1	24.9	7.7	43.2	19.8	0.1	27.7	45.7	42.4
Queue Length 50th (ft)	17	52	26	24	18	0	36	83	155
Queue Length 95th (ft)	#63	93	52	#96	42	0	97	#263	#433
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	150	383	617	150	383	487	330	351	578
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.44	0.54	0.50	0.16	0.02	0.37	0.78	0.85

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

4: Market St & Quartz Hill Rd

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	54	55	194	43	130	916	31	914	100
v/c Ratio	0.14	0.15	0.37	0.10	0.51	0.67	0.12	0.87	0.18
Control Delay	28.5	28.5	7.2	20.6	44.2	29.6	37.9	41.5	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	28.5	7.2	20.6	44.2	29.6	37.9	41.5	3.5
Queue Length 50th (ft)	22	22	0	12	58	167	13	~258	0
Queue Length 95th (ft)	64	65	48	39	#186	#577	49	#571	16
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	374	377	518	423	253	1360	253	1053	557
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.15	0.37	0.10	0.51	0.67	0.12	0.87	0.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

2: Market St & Benton Dr

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	207	201	11	73	982	3	651	317
v/c Ratio	0.57	0.41	0.03	0.19	0.52	0.00	0.48	0.40
Control Delay	31.1	8.8	17.2	22.9	9.6	0.0	16.8	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.1	8.8	17.2	22.9	9.6	0.0	16.8	4.5
Queue Length 50th (ft)	67	6	1	21	78	0	90	0
Queue Length 95th (ft)	#200	64	15	63	203	0	186	55
Internal Link Dist (ft)		1706	264		2041		339	
Turn Bay Length (ft)	150			350		50		330
Base Capacity (vph)	361	495	330	380	1888	899	1349	785
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.57	0.41	0.03	0.19	0.52	0.00	0.48	0.40

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
3: Benton Dr & Quartz Hill Rd 02/06/2023

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	56	87	223	56	169	21	287	360	277
v/c Ratio	0.37	0.29	0.28	0.31	0.51	0.05	0.52	0.63	0.78
Control Delay	40.9	25.2	1.7	36.4	28.5	0.2	22.7	24.1	42.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.9	25.2	1.7	36.4	28.5	0.2	22.7	24.1	42.5
Queue Length 50th (ft)	18	27	0	18	53	0	83	104	80
Queue Length 95th (ft)	#96	75	13	#84	131	0	200	246	#343
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	150	337	811	187	371	472	582	607	393
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.26	0.27	0.30	0.46	0.04	0.49	0.59	0.70

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
4: Market St & Quartz Hill Rd 02/06/2023

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	21	22	147	52	264	982	33	712	59
v/c Ratio	0.05	0.05	0.29	0.12	0.78	0.55	0.12	0.73	0.11
Control Delay	30.4	30.4	7.2	20.7	52.9	26.1	39.9	35.6	0.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.4	30.4	7.2	20.7	52.9	26.1	39.9	35.6	0.4
Queue Length 50th (ft)	9	9	0	15	130	184	15	180	0
Queue Length 95th (ft)	34	36	47	47	#412	#648	56	#461	0
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	401	402	510	451	379	1780	275	1036	542
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.05	0.29	0.12	0.70	0.55	0.12	0.69	0.11

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	152	149	5	65	612	2	5	847	373
v/c Ratio	0.37	0.36	0.01	0.19	0.34	0.00	0.02	0.61	0.44
Control Delay	22.8	20.3	0.0	29.0	14.4	0.0	30.8	22.3	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.8	20.3	0.0	29.0	14.4	0.0	30.8	22.3	5.0
Queue Length 50th (ft)	47	41	0	18	42	0	1	126	0
Queue Length 95th (ft)	123	111	0	81	248	0	14	#420	73
Internal Link Dist (ft)		1706	264		2041			339	
Turn Bay Length (ft)	150			350		50	100		330
Base Capacity (vph)	414	417	443	347	1800	861	316	1390	848
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.36	0.01	0.19	0.34	0.00	0.02	0.61	0.44

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	54	172	333	75	63	9	111	268	479
v/c Ratio	0.35	0.49	0.54	0.49	0.19	0.02	0.35	0.79	0.87
Control Delay	36.3	24.9	7.4	42.6	19.8	0.1	27.1	44.0	42.1
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	36.3	24.9	7.4	42.6	19.8	0.1	27.1	44.0	42.1
Queue Length 50th (ft)	17	54	24	24	18	0	33	81	150
Queue Length 95th (ft)	#67	95	51	#96	42	0	91	#258	#421
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	153	389	627	153	389	492	336	357	589
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.44	0.53	0.49	0.16	0.02	0.33	0.75	0.81

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
4: Market St & Quartz Hill Rd
02/06/2023

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	54	54	199	41	127	733	26	819	94
v/c Ratio	0.14	0.14	0.38	0.10	0.50	0.54	0.10	0.78	0.17
Control Delay	28.5	28.5	7.1	21.3	43.8	26.7	37.9	36.2	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	28.5	7.1	21.3	43.8	26.7	37.9	36.2	2.9
Queue Length 50th (ft)	22	22	0	12	56	125	11	200	0
Queue Length 95th (ft)	64	64	49	39	#180	#431	44	#497	12
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	375	378	523	425	254	1356	254	1049	556
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.14	0.38	0.10	0.50	0.54	0.10	0.78	0.17

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
2: Market St & Benton Dr
02/06/2023

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	194	191	11	71	921	3	541	315
v/c Ratio	0.53	0.38	0.03	0.18	0.50	0.00	0.41	0.41
Control Delay	29.5	7.9	17.2	22.6	9.4	0.0	16.2	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.5	7.9	17.2	22.6	9.4	0.0	16.2	4.6
Queue Length 50th (ft)	61	3	1	20	72	0	72	0
Queue Length 95th (ft)	#183	57	15	62	187	0	153	55
Internal Link Dist (ft)		1706	264		2041		339	
Turn Bay Length (ft)	150			350		50		330
Base Capacity (vph)	368	502	337	387	1893	901	1329	776
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.38	0.03	0.18	0.49	0.00	0.41	0.41

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	48	89	176	56	176	21	290	360	282
v/c Ratio	0.32	0.29	0.23	0.31	0.46	0.04	0.54	0.64	0.78
Control Delay	39.0	25.2	1.6	36.4	25.4	0.2	23.0	24.5	41.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.0	25.2	1.6	36.4	25.4	0.2	23.0	24.5	41.9
Queue Length 50th (ft)	15	27	0	18	45	0	84	104	81
Queue Length 95th (ft)	#80	76	11	#84	135	0	202	246	#348
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	151	339	788	188	419	506	583	608	394
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.26	0.22	0.30	0.42	0.04	0.50	0.59	0.72

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	21	22	149	46	269	883	29	593	59
v/c Ratio	0.05	0.05	0.29	0.10	0.76	0.50	0.10	0.63	0.12
Control Delay	30.5	30.4	7.3	19.8	51.2	25.1	40.0	33.7	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.5	30.4	7.3	19.8	51.2	25.1	40.0	33.7	0.5
Queue Length 50th (ft)	9	9	0	12	133	159	13	143	0
Queue Length 95th (ft)	34	36	49	42	#421	#563	50	#358	0
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	410	411	518	458	388	1778	281	1061	552
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.05	0.29	0.10	0.69	0.50	0.10	0.56	0.11

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

2: Market St & Benton Dr

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	155	151	5	65	612	2	5	847	375
v/c Ratio	0.37	0.36	0.01	0.19	0.34	0.00	0.02	0.61	0.44
Control Delay	22.9	20.4	0.0	29.0	14.4	0.0	30.8	22.3	5.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	22.9	20.4	0.0	29.0	14.4	0.0	30.8	22.3	5.0
Queue Length 50th (ft)	48	41	0	18	42	0	1	126	0
Queue Length 95th (ft)	125	113	0	81	248	0	14	#420	74
Internal Link Dist (ft)		1706	264		2041			339	
Turn Bay Length (ft)	150			350		50	100		330
Base Capacity (vph)	414	417	443	347	1800	861	316	1390	849
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.36	0.01	0.19	0.34	0.00	0.02	0.61	0.44

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

3: Benton Dr & Quartz Hill Rd

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	60	183	338	75	68	9	114	268	482
v/c Ratio	0.44	0.54	0.53	0.55	0.20	0.02	0.39	0.85	0.93
Control Delay	40.5	26.4	7.3	46.6	20.0	0.1	28.0	51.4	50.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.5	26.4	7.3	46.6	20.0	0.1	28.0	51.4	50.7
Queue Length 50th (ft)	19	58	25	24	20	0	34	81	152
Queue Length 95th (ft)	#76	101	52	#96	44	0	93	#258	#423
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	137	357	639	137	357	468	301	321	528
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.51	0.53	0.55	0.19	0.02	0.38	0.83	0.91

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	54	54	209	41	131	733	26	819	94
v/c Ratio	0.14	0.14	0.39	0.10	0.51	0.55	0.10	0.79	0.17
Control Delay	28.5	28.5	7.1	21.3	44.1	26.8	37.9	36.6	2.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	28.5	7.1	21.3	44.1	26.8	37.9	36.6	2.9
Queue Length 50th (ft)	22	22	0	12	58	125	11	200	0
Queue Length 95th (ft)	64	64	50	39	#187	#431	44	#497	12
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	378	381	533	428	257	1343	257	1037	551
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.14	0.39	0.10	0.51	0.55	0.10	0.79	0.17

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	197	192	11	71	921	3	541	321
v/c Ratio	0.53	0.38	0.03	0.18	0.50	0.00	0.41	0.41
Control Delay	29.7	8.0	17.2	22.6	9.4	0.0	16.2	4.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	29.7	8.0	17.2	22.6	9.4	0.0	16.2	4.6
Queue Length 50th (ft)	62	3	1	20	72	0	72	0
Queue Length 95th (ft)	#188	58	15	62	187	0	153	55
Internal Link Dist (ft)		1706	264		2041		339	
Turn Bay Length (ft)	150			350		50		330
Base Capacity (vph)	369	503	338	388	1896	902	1328	780
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.53	0.38	0.03	0.18	0.49	0.00	0.41	0.41

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
3: Benton Dr & Quartz Hill Rd

02/06/2023

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	52	96	179	56	186	21	294	360	287
v/c Ratio	0.34	0.31	0.24	0.31	0.54	0.05	0.56	0.65	0.78
Control Delay	39.9	25.4	1.6	36.4	29.0	0.2	23.5	25.0	42.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	39.9	25.4	1.6	36.4	29.0	0.2	23.5	25.0	42.0
Queue Length 50th (ft)	17	29	0	18	59	0	86	104	83
Queue Length 95th (ft)	#87	81	11	#84	142	0	205	246	#354
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	152	345	796	189	375	474	588	613	398
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.34	0.28	0.22	0.30	0.50	0.04	0.50	0.59	0.72

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
4: Market St & Quartz Hill Rd

02/06/2023

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	21	22	156	46	279	883	29	593	59
v/c Ratio	0.05	0.05	0.30	0.10	0.78	0.50	0.10	0.64	0.12
Control Delay	30.5	30.4	7.6	19.8	51.8	25.1	40.0	33.8	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.5	30.4	7.6	19.8	51.8	25.1	40.0	33.8	0.5
Queue Length 50th (ft)	9	9	0	12	138	159	13	143	0
Queue Length 95th (ft)	34	36	53	42	#438	#563	50	#358	0
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	405	406	516	454	383	1779	278	1047	547
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.05	0.30	0.10	0.73	0.50	0.10	0.57	0.11

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

2: Market St & Benton Dr

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBL	SBT	SBR
Lane Group Flow (vph)	156	152	5	66	774	2	5	963	378
v/c Ratio	0.38	0.37	0.01	0.19	0.43	0.00	0.02	0.69	0.44
Control Delay	23.0	20.5	0.0	29.0	15.5	0.0	30.8	23.7	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	23.0	20.5	0.0	29.0	15.5	0.0	30.8	23.7	4.9
Queue Length 50th (ft)	48	42	0	19	57	0	1	150	0
Queue Length 95th (ft)	125	114	0	82	#352	0	14	#505	75
Internal Link Dist (ft)		1706	264		2041			339	
Turn Bay Length (ft)	150			350		50	100		330
Base Capacity (vph)	410	414	441	344	1814	867	313	1404	855
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.38	0.37	0.01	0.19	0.43	0.00	0.02	0.69	0.44

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

3: Benton Dr & Quartz Hill Rd

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	60	183	340	75	68	9	123	273	495
v/c Ratio	0.44	0.55	0.54	0.55	0.20	0.02	0.42	0.86	0.94
Control Delay	40.7	26.5	7.5	47.0	20.0	0.1	28.7	53.2	53.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	40.7	26.5	7.5	47.0	20.0	0.1	28.7	53.2	53.3
Queue Length 50th (ft)	19	58	27	24	20	0	37	83	157
Queue Length 95th (ft)	#76	101	54	#96	44	0	98	#263	#438
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	136	355	632	136	355	467	299	320	524
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.44	0.52	0.54	0.55	0.19	0.02	0.41	0.85	0.94

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
4: Market St & Quartz Hill Rd

02/06/2023

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	54	55	209	43	135	916	31	914	100
v/c Ratio	0.14	0.14	0.39	0.10	0.53	0.68	0.12	0.88	0.18
Control Delay	28.5	28.4	7.1	20.6	44.5	29.9	37.9	42.9	3.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	28.5	28.4	7.1	20.6	44.5	29.9	37.9	42.9	3.5
Queue Length 50th (ft)	22	22	0	12	60	167	13	~258	0
Queue Length 95th (ft)	64	65	50	39	#195	#577	49	#571	16
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	379	382	534	428	257	1340	257	1033	549
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.14	0.14	0.39	0.10	0.53	0.68	0.12	0.88	0.18

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues
2: Market St & Benton Dr

02/06/2023

Lane Group	EBL	EBT	WBT	NBL	NBT	NBR	SBT	SBR
Lane Group Flow (vph)	210	203	11	73	982	3	651	327
v/c Ratio	0.58	0.41	0.03	0.19	0.52	0.00	0.48	0.41
Control Delay	31.4	8.9	17.2	22.9	9.6	0.0	16.8	4.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	31.4	8.9	17.2	22.9	9.6	0.0	16.8	4.5
Queue Length 50th (ft)	68	6	1	21	78	0	90	0
Queue Length 95th (ft)	#204	65	15	63	203	0	186	56
Internal Link Dist (ft)		1706	264		2041		339	
Turn Bay Length (ft)	150			350		50		330
Base Capacity (vph)	361	496	331	380	1886	898	1347	790
Starvation Cap Reductn	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.58	0.41	0.03	0.19	0.52	0.00	0.48	0.41

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

3: Benton Dr & Quartz Hill Rd

02/06/2023

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	SBT
Lane Group Flow (vph)	61	96	228	56	186	21	294	360	287
v/c Ratio	0.40	0.31	0.29	0.31	0.54	0.05	0.55	0.65	0.78
Control Delay	41.9	25.5	1.7	36.4	29.1	0.2	23.3	24.7	42.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	41.9	25.5	1.7	36.4	29.1	0.2	23.3	24.7	42.4
Queue Length 50th (ft)	20	29	0	18	59	0	86	104	83
Queue Length 95th (ft)	#104	81	13	#84	142	0	205	246	#354
Internal Link Dist (ft)		474			765			602	772
Turn Bay Length (ft)	105			105		300	105		
Base Capacity (vph)	151	344	819	188	373	473	585	610	397
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.28	0.28	0.30	0.50	0.04	0.50	0.59	0.72

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Queues

4: Market St & Quartz Hill Rd

02/06/2023

Lane Group	EBL	EBT	EBR	WBT	NBL	NBT	SBL	SBT	SBR
Lane Group Flow (vph)	21	22	156	52	281	982	33	712	59
v/c Ratio	0.05	0.06	0.31	0.12	0.80	0.55	0.12	0.74	0.11
Control Delay	30.4	30.4	7.7	20.7	53.8	26.1	40.0	36.1	0.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.4	30.4	7.7	20.7	53.8	26.1	40.0	36.1	0.5
Queue Length 50th (ft)	9	9	0	15	140	184	15	180	0
Queue Length 95th (ft)	34	36	53	47	#443	#648	56	#461	0
Internal Link Dist (ft)		760		925		434		2041	
Turn Bay Length (ft)	130		160		150		150		
Base Capacity (vph)	393	394	505	443	371	1784	269	1013	533
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.05	0.06	0.31	0.12	0.76	0.55	0.12	0.70	0.11

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Appendix F

Intersection Level of Service Calculations

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Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	267	1	11	100	0	36
Future Vol, veh/h	267	1	11	100	0	36
Conflicting Peds, #/hr	0	1	2	0	1	2
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	314	1	13	118	0	42

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	317	0	461	318
Stage 1	-	-	-	-	316	-
Stage 2	-	-	-	-	145	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1243	-	432	662
Stage 1	-	-	-	-	620	-
Stage 2	-	-	-	-	814	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1241	-	426	659
Mov Cap-2 Maneuver	-	-	-	-	426	-
Stage 1	-	-	-	-	619	-
Stage 2	-	-	-	-	805	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	10.8
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	659	-	-	1241	-
HCM Lane V/C Ratio	-	0.064	-	-	0.01	-
HCM Control Delay (s)	0	10.8	-	-	7.9	-
HCM Lane LOS	A	B	-	-	A	-
HCM 95th %tile Q(veh)	-	0.2	-	-	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	241	1	31	1	0	4	60	569	2	5	788	344
Future Volume (veh/h)	241	1	31	1	0	4	60	569	2	5	788	344
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	280	0	0	1	0	1	65	612	2	5	847	294
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	709	372	0	5	0	5	225	1528	678	24	1126	502
Arrive On Green	0.20	0.00	0.00	0.01	0.00	0.01	0.13	0.43	0.43	0.01	0.32	0.32
Sat Flow, veh/h	3563	1870	0	837	0	837	1781	3554	1578	1781	3554	1585
Grp Volume(v), veh/h	280	0	0	2	0	0	65	612	2	5	847	294
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1675	0	0	1781	1777	1578	1781	1777	1585
Q Serve(g_s), s	3.7	0.0	0.0	0.1	0.0	0.0	1.8	6.5	0.0	0.2	11.7	8.5
Cycle Q Clear(g_c), s	3.7	0.0	0.0	0.1	0.0	0.0	1.8	6.5	0.0	0.2	11.7	8.5
Prop In Lane	1.00		0.00	0.50		0.50	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	709	372	0	9	0	0	225	1528	678	24	1126	502
V/C Ratio(X)	0.40	0.00	0.00	0.22	0.00	0.00	0.29	0.40	0.00	0.21	0.75	0.59
Avail Cap(c_a), veh/h	719	377	0	307	0	0	359	1528	678	327	1226	547
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.0	0.0	0.0	27.0	0.0	0.0	21.6	10.7	8.9	26.6	16.7	15.6
Incr Delay (d2), s/veh	0.4	0.0	0.0	4.3	0.0	0.0	0.5	0.2	0.0	3.2	2.9	2.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.0	0.1	4.2	2.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.4	0.0	0.0	31.3	0.0	0.0	22.1	10.9	8.9	29.8	19.6	17.7
LnGrp LOS	B	A	A	C	A	A	C	B	A	C	B	B
Approach Vol, veh/h		280			2			679			1146	
Approach Delay, s/veh		19.4			31.3			12.0			19.1	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.9	29.6		15.4	11.1	23.5		4.5
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	2.2	8.5		5.7	3.8	13.7		2.1
Green Ext Time (p_c), s	0.0	3.8		0.5	0.0	3.6		0.0

Intersection Summary			
HCM 6th Ctrl Delay			16.9
HCM 6th LOS			B

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	137	284	65	51	8	95	189	44	11	376	27
Future Volume (veh/h)	40	137	284	65	51	8	95	189	44	11	376	27
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	46	157	259	75	59	6	109	217	31	13	432	28
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	66	292	512	95	322	273	298	267	38	14	471	31
Arrive On Green	0.04	0.16	0.16	0.05	0.17	0.17	0.17	0.17	0.17	0.28	0.28	0.28
Sat Flow, veh/h	1781	1870	1580	1781	1870	1585	1781	1595	228	51	1688	109
Grp Volume(v), veh/h	46	157	259	75	59	6	109	0	248	473	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1580	1781	1870	1585	1781	0	1822	1848	0	0
Q Serve(g_s), s	1.4	4.2	7.1	2.2	1.4	0.2	2.9	0.0	7.0	13.3	0.0	0.0
Cycle Q Clear(g_c), s	1.4	4.2	7.1	2.2	1.4	0.2	2.9	0.0	7.0	13.3	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.13	0.03		0.06
Lane Grp Cap(c), veh/h	66	292	512	95	322	273	298	0	305	516	0	0
V/C Ratio(X)	0.70	0.54	0.51	0.79	0.18	0.02	0.37	0.00	0.81	0.92	0.00	0.00
Avail Cap(c_a), veh/h	136	292	512	136	322	273	298	0	305	516	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	25.6	20.9	14.7	25.2	19.0	18.5	19.8	0.0	21.6	18.8	0.0	0.0
Incr Delay (d2), s/veh	4.9	1.1	0.3	11.4	0.1	0.0	0.3	0.0	14.3	21.0	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	1.7	3.0	1.2	0.6	0.1	1.1	0.0	3.9	7.9	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.5	21.9	15.0	36.6	19.1	18.5	20.1	0.0	35.9	39.7	0.0	0.0
LnGrp LOS	C	C	B	D	B	B	C	A	D	D	A	A
Approach Vol, veh/h		462			140			357			473	
Approach Delay, s/veh		18.9			28.4			31.1			39.7	
Approach LOS		B			C			C			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	6.4	13.4		20.0	5.5	14.3		14.0
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	4.1	8.4		15.0	4.1	8.4		9.0
Max Q Clear Time (g_c+I1), s	4.2	9.1		15.3	3.4	3.4		9.0
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.0		0.0

Intersection Summary		
HCM 6th Ctrl Delay		29.8
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	87	6	158	25	2	9	105	613	17	22	704	81
Future Volume (veh/h)	87	6	158	25	2	9	105	613	17	22	704	81
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	106	0	58	29	2	1	122	713	15	26	819	50
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	781	0	341	154	11	5	244	1225	26	103	942	418
Arrive On Green	0.22	0.00	0.22	0.10	0.10	0.10	0.14	0.34	0.34	0.06	0.27	0.27
Sat Flow, veh/h	3563	0	1554	1612	111	56	1781	3557	75	1781	3554	1576
Grp Volume(v), veh/h	106	0	58	32	0	0	122	356	372	26	819	50
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1779	0	0	1781	1777	1855	1781	1777	1576
Q Serve(g_s), s	1.6	0.0	2.0	1.1	0.0	0.0	4.1	10.7	10.7	0.9	14.3	1.6
Cycle Q Clear(g_c), s	1.6	0.0	2.0	1.1	0.0	0.0	4.1	10.7	10.7	0.9	14.3	1.6
Prop In Lane	1.00		1.00	0.91		0.03	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	781	0	341	170	0	0	244	612	639	103	942	418
V/C Ratio(X)	0.14	0.00	0.17	0.19	0.00	0.00	0.50	0.58	0.58	0.25	0.87	0.12
Avail Cap(c_a), veh/h	822	0	359	383	0	0	274	612	639	274	962	427
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.4	0.0	20.6	27.1	0.0	0.0	26.0	17.5	17.5	29.3	22.8	18.1
Incr Delay (d2), s/veh	0.1	0.0	0.2	0.4	0.0	0.0	0.6	2.2	2.1	0.5	9.2	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.7	0.5	0.0	0.0	1.6	4.1	4.2	0.4	6.4	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	20.8	27.5	0.0	0.0	26.6	19.7	19.6	29.8	32.0	18.4
LnGrp LOS	C	A	C	C	A	A	C	B	B	C	C	B
Approach Vol, veh/h		164			32			850			895	
Approach Delay, s/veh		20.6			27.5			20.7			31.2	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.9	28.2		18.5	13.1	23.0		10.4
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	17.6		* 15	* 10	17.6		14.0
Max Q Clear Time (g_c+I1), s	2.9	12.7		4.0	6.1	16.3		3.1
Green Ext Time (p_c), s	0.0	2.7		0.4	0.0	0.9		0.0

Intersection Summary		
HCM 6th Ctrl Delay		25.6
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd 02/01/2023

Intersection						
Int Delay, s/veh	1.1					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	133	0	33	225	0	19
Future Vol, veh/h	133	0	33	225	0	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	140	0	35	237	0	20

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	140	0	447	140
Stage 1	-	-	-	-	140	-
Stage 2	-	-	-	-	307	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1443	-	444	873
Stage 1	-	-	-	-	820	-
Stage 2	-	-	-	-	629	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1443	-	433	873
Mov Cap-2 Maneuver	-	-	-	-	433	-
Stage 1	-	-	-	-	820	-
Stage 2	-	-	-	-	614	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	9.2
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	873	-	-	1443	-
HCM Lane V/C Ratio	-	0.023	-	-	0.024	-
HCM Control Delay (s)	0	9.2	-	-	7.6	-
HCM Lane LOS	A	A	-	-	A	-
HCM 95th %tile Q(veh)	-	0.1	-	-	0.1	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr 02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	314	0	35	3	1	6	65	847	3	0	498	281
Future Volume (veh/h)	314	0	35	3	1	6	65	847	3	0	498	281
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	364	0	0	3	1	2	71	921	3	0	541	233
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	761	400	0	14	5	9	243	1696	756	3	919	400
Arrive On Green	0.21	0.00	0.00	0.02	0.02	0.02	0.14	0.48	0.48	0.00	0.26	0.26
Sat Flow, veh/h	3563	1870	0	861	287	574	1781	3554	1583	1781	3554	1547
Grp Volume(v), veh/h	364	0	0	6	0	0	71	921	3	0	541	233
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1723	0	0	1781	1777	1583	1781	1777	1547
Q Serve(g_s), s	4.6	0.0	0.0	0.2	0.0	0.0	1.8	9.4	0.1	0.0	6.8	6.7
Cycle Q Clear(g_c), s	4.6	0.0	0.0	0.2	0.0	0.0	1.8	9.4	0.1	0.0	6.8	6.7
Prop In Lane	1.00		0.00	0.50		0.33	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	761	400	0	28	0	0	243	1696	756	3	919	400
V/C Ratio(X)	0.48	0.00	0.00	0.22	0.00	0.00	0.29	0.54	0.00	0.00	0.59	0.58
Avail Cap(c_a), veh/h	766	402	0	337	0	0	383	1696	756	348	1305	568
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	17.6	0.0	0.0	24.9	0.0	0.0	19.9	9.4	7.0	0.0	16.6	16.6
Incr Delay (d2), s/veh	0.6	0.0	0.0	1.5	0.0	0.0	0.5	0.5	0.0	0.0	1.0	2.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.7	0.0	0.0	0.1	0.0	0.0	0.7	2.5	0.0	0.0	2.4	2.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	18.2	0.0	0.0	26.3	0.0	0.0	20.4	9.9	7.0	0.0	17.6	18.9
LnGrp LOS	B	A	A	C	A	A	C	A	A	A	B	B
Approach Vol, veh/h		364			6			995			774	
Approach Delay, s/veh		18.2			26.3			10.6			18.0	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	30.6		15.5	11.2	19.4		5.0				
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2				
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0				
Max Q Clear Time (g_c+I1), s	0.0	11.4		6.6	3.8	8.8		2.2				
Green Ext Time (p_c), s	0.0	4.6		0.7	0.0	4.4		0.0				

Intersection Summary	
HCM 6th Ctrl Delay	14.6
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	72	154	50	143	19	254	282	42	11	182	52
Future Volume (veh/h)	38	72	154	50	143	19	254	282	42	11	182	52
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	42	80	129	56	159	11	282	313	40	12	202	39
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	65	226	578	80	242	204	436	396	51	15	254	49
Arrive On Green	0.04	0.12	0.12	0.04	0.13	0.13	0.24	0.24	0.24	0.18	0.18	0.18
Sat Flow, veh/h	1781	1870	1572	1781	1870	1573	1781	1619	207	86	1448	280
Grp Volume(v), veh/h	42	80	129	56	159	11	282	0	353	253	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1572	1781	1870	1573	1781	0	1826	1814	0	0
Q Serve(g_s), s	1.0	1.8	2.5	1.4	3.6	0.3	6.3	0.0	8.1	6.0	0.0	0.0
Cycle Q Clear(g_c), s	1.0	1.8	2.5	1.4	3.6	0.3	6.3	0.0	8.1	6.0	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	0.05		0.15
Lane Grp Cap(c), veh/h	65	226	578	80	242	204	436	0	447	318	0	0
V/C Ratio(X)	0.65	0.35	0.22	0.70	0.66	0.05	0.65	0.00	0.79	0.80	0.00	0.00
Avail Cap(c_a), veh/h	163	310	648	203	352	296	558	0	572	406	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	21.2	18.0	9.8	21.0	18.5	17.1	15.1	0.0	15.8	17.7	0.0	0.0
Incr Delay (d2), s/veh	4.0	0.3	0.1	4.1	1.1	0.0	0.7	0.0	4.3	6.3	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.7	1.1	0.6	1.4	0.1	2.2	0.0	3.3	2.7	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.3	18.4	9.9	25.2	19.6	17.1	15.8	0.0	20.1	24.0	0.0	0.0
LnGrp LOS	C	B	A	C	B	B	B	A	C	C	A	A
Approach Vol, veh/h		251			226			635			253	
Approach Delay, s/veh		15.2			20.9			18.2			24.0	
Approach LOS		B			C			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	5.5	10.4		12.8	5.1	10.8		15.9
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	5.1	7.4		10.0	4.1	8.4		14.0
Max Q Clear Time (g_c+I1), s	3.4	4.5		8.0	3.0	5.6		10.1
Green Ext Time (p_c), s	0.0	0.1		0.2	0.0	0.1		0.8

Intersection Summary		
HCM 6th Ctrl Delay		19.1
HCM 6th LOS		B

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	1	126	22	4	16	227	767	28	26	534	53
Future Volume (veh/h)	38	1	126	22	4	16	227	767	28	26	534	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	43	0	28	24	4	5	252	852	29	29	593	37
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	627	0	274	129	21	27	302	1233	42	114	875	379
Arrive On Green	0.18	0.00	0.18	0.10	0.10	0.10	0.17	0.35	0.35	0.06	0.25	0.25
Sat Flow, veh/h	3563	0	1554	1275	213	266	1781	3503	119	1781	3554	1538
Grp Volume(v), veh/h	43	0	28	33	0	0	252	432	449	29	593	37
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1753	0	0	1781	1777	1845	1781	1777	1538
Q Serve(g_s), s	0.6	0.0	0.9	1.0	0.0	0.0	8.2	12.5	12.5	0.9	9.0	1.1
Cycle Q Clear(g_c), s	0.6	0.0	0.9	1.0	0.0	0.0	8.2	12.5	12.5	0.9	9.0	1.1
Prop In Lane	1.00		1.00	0.73		0.15	1.00		0.06	1.00		1.00
Lane Grp Cap(c), veh/h	627	0	274	177	0	0	302	625	650	114	875	379
V/C Ratio(X)	0.07	0.00	0.10	0.19	0.00	0.00	0.83	0.69	0.69	0.25	0.68	0.10
Avail Cap(c_a), veh/h	892	0	389	410	0	0	410	670	696	297	1115	483
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.6	0.0	20.7	24.7	0.0	0.0	24.1	16.6	16.6	26.7	20.4	17.4
Incr Delay (d2), s/veh	0.0	0.0	0.2	0.4	0.0	0.0	7.8	3.9	3.7	0.4	2.1	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.3	0.4	0.0	0.0	3.7	4.8	4.9	0.4	3.4	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.6	0.0	20.9	25.1	0.0	0.0	31.9	20.5	20.4	27.1	22.6	17.7
LnGrp LOS	C	A	C	C	A	A	C	C	C	C	C	B
Approach Vol, veh/h		71			33			1133			659	
Approach Delay, s/veh		20.7			25.1			23.0			22.5	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.0	26.9		14.8	14.4	20.6		10.3
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	22.6		* 15	* 14	18.8		14.0
Max Q Clear Time (g_c+I1), s	2.9	14.5		2.9	10.2	11.0		3.0
Green Ext Time (p_c), s	0.0	4.9		0.1	0.1	3.6		0.0

Intersection Summary		
HCM 6th Ctrl Delay		22.8
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd

02/01/2023

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	285	1	11	108	0	36
Future Vol, veh/h	285	1	11	108	0	36
Conflicting Peds, #/hr	0	1	2	0	1	2
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	335	1	13	127	0	42

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	338	0	491	339
Stage 1	-	-	-	-	337	-
Stage 2	-	-	-	-	154	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1221	-	409	640
Stage 1	-	-	-	-	600	-
Stage 2	-	-	-	-	802	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1219	-	403	638
Mov Cap-2 Maneuver	-	-	-	-	403	-
Stage 1	-	-	-	-	599	-
Stage 2	-	-	-	-	792	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.7	11
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	638	-	-	1219	-
HCM Lane V/C Ratio	-	0.066	-	-	0.011	-
HCM Control Delay (s)	0	11	-	-	8	-
HCM Lane LOS	A	B	-	-	A	-
HCM 95th %tile Q(veh)	-	0.2	-	-	0	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	246	1	31	1	0	4	60	569	2	5	788	346
Future Volume (veh/h)	246	1	31	1	0	4	60	569	2	5	788	346
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	286	0	0	1	0	1	65	612	2	5	847	296
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	709	372	0	5	0	5	225	1528	678	24	1126	502
Arrive On Green	0.20	0.00	0.00	0.01	0.00	0.01	0.13	0.43	0.43	0.01	0.32	0.32
Sat Flow, veh/h	3563	1870	0	837	0	837	1781	3554	1578	1781	3554	1585
Grp Volume(v), veh/h	286	0	0	2	0	0	65	612	2	5	847	296
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1675	0	0	1781	1777	1578	1781	1777	1585
Q Serve(g_s), s	3.8	0.0	0.0	0.1	0.0	0.0	1.8	6.5	0.0	0.2	11.7	8.6
Cycle Q Clear(g_c), s	3.8	0.0	0.0	0.1	0.0	0.0	1.8	6.5	0.0	0.2	11.7	8.6
Prop In Lane	1.00		0.00	0.50		0.50	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	709	372	0	9	0	0	225	1528	678	24	1126	502
V/C Ratio(X)	0.40	0.00	0.00	0.22	0.00	0.00	0.29	0.40	0.00	0.21	0.75	0.59
Avail Cap(c_a), veh/h	719	377	0	307	0	0	359	1528	678	327	1225	546
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.0	0.0	0.0	27.0	0.0	0.0	21.6	10.7	8.9	26.6	16.7	15.6
Incr Delay (d2), s/veh	0.4	0.0	0.0	4.3	0.0	0.0	0.5	0.2	0.0	3.2	2.9	2.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.4	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.0	0.1	4.2	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.5	0.0	0.0	31.3	0.0	0.0	22.1	10.9	8.9	29.8	19.6	17.8
LnGrp LOS	B	A	A	C	A	A	C	B	A	C	B	B
Approach Vol, veh/h		286			2			679			1148	
Approach Delay, s/veh		19.5			31.3			12.0			19.2	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.9	29.6		15.5	11.1	23.5		4.5
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	2.2	8.5		5.8	3.8	13.7		2.1
Green Ext Time (p_c), s	0.0	3.8		0.6	0.0	3.6		0.0

Intersection Summary	
HCM 6th Ctrl Delay	16.9
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	146	288	65	55	8	97	189	44	11	376	29
Future Volume (veh/h)	45	146	288	65	55	8	97	189	44	11	376	29
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	52	168	264	75	63	6	111	217	31	13	432	30
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	72	292	512	95	316	268	298	267	38	14	469	33
Arrive On Green	0.04	0.16	0.16	0.05	0.17	0.17	0.17	0.17	0.17	0.28	0.28	0.28
Sat Flow, veh/h	1781	1870	1580	1781	1870	1585	1781	1595	228	51	1680	117
Grp Volume(v), veh/h	52	168	264	75	63	6	111	0	248	475	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1580	1781	1870	1585	1781	0	1822	1847	0	0
Q Serve(g_s), s	1.6	4.5	7.3	2.2	1.6	0.2	3.0	0.0	7.0	13.4	0.0	0.0
Cycle Q Clear(g_c), s	1.6	4.5	7.3	2.2	1.6	0.2	3.0	0.0	7.0	13.4	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.13	0.03		0.06
Lane Grp Cap(c), veh/h	72	292	512	95	316	268	298	0	305	515	0	0
V/C Ratio(X)	0.73	0.57	0.52	0.79	0.20	0.02	0.37	0.00	0.81	0.92	0.00	0.00
Avail Cap(c_a), veh/h	136	292	512	136	316	268	298	0	305	515	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	25.5	21.0	14.8	25.2	19.2	18.6	19.9	0.0	21.6	18.8	0.0	0.0
Incr Delay (d2), s/veh	5.1	1.8	0.4	11.4	0.1	0.0	0.3	0.0	14.3	21.8	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	1.9	3.1	1.2	0.6	0.1	1.1	0.0	3.9	8.0	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.7	22.8	15.2	36.6	19.3	18.6	20.2	0.0	35.9	40.6	0.0	0.0
LnGrp LOS	C	C	B	D	B	B	C	A	D	D	A	A
Approach Vol, veh/h		484			144			359			475	
Approach Delay, s/veh		19.5			28.3			31.0			40.6	
Approach LOS		B			C			C			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	6.4	13.4		20.0	5.7	14.1		14.0
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	4.1	8.4		15.0	4.1	8.4		9.0
Max Q Clear Time (g_c+I1), s	4.2	9.3		15.4	3.6	3.6		9.0
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.1		0.0

Intersection Summary	
HCM 6th Ctrl Delay	30.0
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	87	6	167	25	2	9	109	613	17	22	704	81
Future Volume (veh/h)	87	6	167	25	2	9	109	613	17	22	704	81
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	106	0	68	29	2	1	127	713	15	26	819	50
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	785	0	343	154	11	5	246	1226	26	103	939	417
Arrive On Green	0.22	0.00	0.22	0.10	0.10	0.10	0.14	0.34	0.34	0.06	0.26	0.26
Sat Flow, veh/h	3563	0	1554	1612	111	56	1781	3557	75	1781	3554	1576
Grp Volume(v), veh/h	106	0	68	32	0	0	127	356	372	26	819	50
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1779	0	0	1781	1777	1855	1781	1777	1576
Q Serve(g_s), s	1.6	0.0	2.3	1.1	0.0	0.0	4.3	10.7	10.7	0.9	14.4	1.6
Cycle Q Clear(g_c), s	1.6	0.0	2.3	1.1	0.0	0.0	4.3	10.7	10.7	0.9	14.4	1.6
Prop In Lane	1.00		1.00	0.91		0.03	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	785	0	343	170	0	0	246	612	639	103	939	417
V/C Ratio(X)	0.13	0.00	0.20	0.19	0.00	0.00	0.52	0.58	0.58	0.25	0.87	0.12
Avail Cap(c_a), veh/h	819	0	357	381	0	0	273	612	639	273	958	425
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.4	0.0	20.7	27.2	0.0	0.0	26.1	17.5	17.5	29.4	23.0	18.2
Incr Delay (d2), s/veh	0.1	0.0	0.3	0.4	0.0	0.0	0.6	2.2	2.1	0.5	9.4	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.8	0.5	0.0	0.0	1.7	4.1	4.3	0.4	6.4	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	21.0	27.6	0.0	0.0	26.8	19.8	19.7	29.9	32.4	18.5
LnGrp LOS	C	A	C	C	A	A	C	B	B	C	C	B
Approach Vol, veh/h		174			32			855			895	
Approach Delay, s/veh		20.7			27.6			20.8			31.6	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.0	28.3		18.6	13.2	23.1		10.4
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	17.6		* 15	* 10	17.6		14.0
Max Q Clear Time (g_c+I1), s	2.9	12.7		4.3	6.3	16.4		3.1
Green Ext Time (p_c), s	0.0	2.7		0.4	0.0	0.9		0.0

Intersection Summary	
HCM 6th Ctrl Delay	25.8
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd

02/01/2023

Intersection	
Int Delay, s/veh	1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	146	0	33	243	0	19
Future Vol, veh/h	146	0	33	243	0	19
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	154	0	35	256	0	20

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	154	0	480	154
Stage 1	-	-	-	-	154	-
Stage 2	-	-	-	-	326	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1426	-	417	855
Stage 1	-	-	-	-	802	-
Stage 2	-	-	-	-	610	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1426	-	407	855
Mov Cap-2 Maneuver	-	-	-	-	407	-
Stage 1	-	-	-	-	802	-
Stage 2	-	-	-	-	595	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	9.3
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	855	-	-	1426	-
HCM Lane V/C Ratio	-	0.023	-	-	0.024	-
HCM Control Delay (s)	0	9.3	-	-	7.6	-
HCM Lane LOS	A	A	-	-	A	-
HCM 95th %tile Q(veh)	-	0.1	-	-	0.1	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	318	0	35	3	1	6	65	847	3	0	498	286
Future Volume (veh/h)	318	0	35	3	1	6	65	847	3	0	498	286
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	369	0	0	3	1	2	71	921	3	0	541	239
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	760	399	0	14	5	9	243	1701	758	3	925	402
Arrive On Green	0.21	0.00	0.00	0.02	0.02	0.02	0.14	0.48	0.48	0.00	0.26	0.26
Sat Flow, veh/h	3563	1870	0	861	287	574	1781	3554	1583	1781	3554	1547
Grp Volume(v), veh/h	369	0	0	6	0	0	71	921	3	0	541	239
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1723	0	0	1781	1777	1583	1781	1777	1547
Q Serve(g_s), s	4.7	0.0	0.0	0.2	0.0	0.0	1.8	9.4	0.1	0.0	6.8	6.9
Cycle Q Clear(g_c), s	4.7	0.0	0.0	0.2	0.0	0.0	1.8	9.4	0.1	0.0	6.8	6.9
Prop In Lane	1.00		0.00	0.50		0.33	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	760	399	0	28	0	0	243	1701	758	3	925	402
V/C Ratio(X)	0.49	0.00	0.00	0.22	0.00	0.00	0.29	0.54	0.00	0.00	0.58	0.59
Avail Cap(c_a), veh/h	764	401	0	336	0	0	382	1701	758	347	1302	567
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	17.7	0.0	0.0	24.9	0.0	0.0	19.9	9.4	7.0	0.0	16.6	16.6
Incr Delay (d2), s/veh	0.6	0.0	0.0	1.5	0.0	0.0	0.5	0.5	0.0	0.0	1.0	2.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.7	0.0	0.0	0.1	0.0	0.0	0.7	2.5	0.0	0.0	2.4	2.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	18.3	0.0	0.0	26.4	0.0	0.0	20.4	9.9	7.0	0.0	17.6	19.0
LnGrp LOS	B	A	A	C	A	A	C	A	A	A	B	B
Approach Vol, veh/h		369			6			995			780	
Approach Delay, s/veh		18.3			26.4			10.6			18.0	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	0.0	30.8		15.5	11.2	19.6		5.0
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	0.0	11.4		6.7	3.8	8.9		2.2
Green Ext Time (p_c), s	0.0	4.6		0.7	0.0	4.4		0.0

Intersection Summary	
HCM 6th Ctrl Delay	14.7
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	42	78	157	50	152	19	258	282	42	11	182	57
Future Volume (veh/h)	42	78	157	50	152	19	258	282	42	11	182	57
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	47	87	132	56	169	11	287	313	40	12	202	44
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	70	240	588	79	250	210	434	394	50	15	252	55
Arrive On Green	0.04	0.13	0.13	0.04	0.13	0.13	0.24	0.24	0.24	0.18	0.18	0.18
Sat Flow, veh/h	1781	1870	1573	1781	1870	1573	1781	1619	207	84	1416	308
Grp Volume(v), veh/h	47	87	132	56	169	11	287	0	353	258	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1573	1781	1870	1573	1781	0	1826	1809	0	0
Q Serve(g_s), s	1.2	1.9	2.6	1.4	3.9	0.3	6.6	0.0	8.3	6.2	0.0	0.0
Cycle Q Clear(g_c), s	1.2	1.9	2.6	1.4	3.9	0.3	6.6	0.0	8.3	6.2	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	0.05		0.17
Lane Grp Cap(c), veh/h	70	240	588	79	250	210	434	0	444	322	0	0
V/C Ratio(X)	0.67	0.36	0.22	0.71	0.68	0.05	0.66	0.00	0.79	0.80	0.00	0.00
Avail Cap(c_a), veh/h	160	304	641	199	345	290	547	0	561	397	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	21.6	18.2	9.8	21.5	18.8	17.2	15.6	0.0	16.2	18.0	0.0	0.0
Incr Delay (d2), s/veh	4.1	0.3	0.1	4.2	1.2	0.0	1.0	0.0	4.7	7.5	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.7	1.2	0.6	1.5	0.1	2.3	0.0	3.4	2.9	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	25.7	18.5	9.9	25.7	20.0	17.3	16.6	0.0	20.9	25.4	0.0	0.0
LnGrp LOS	C	B	A	C	C	B	B	A	C	C	A	A
Approach Vol, veh/h		266			236			640			258	
Approach Delay, s/veh		15.5			21.2			19.0			25.4	
Approach LOS		B			C			B			C	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	5.5	10.9	13.1	5.3	11.1	16.1
Change Period (Y+Rc), s	3.5	5.0	5.0	3.5	5.0	5.0
Max Green Setting (Gmax), s	5.1	7.4	10.0	4.1	8.4	14.0
Max Q Clear Time (g_c+I1), s	3.4	4.6	8.2	3.2	5.9	10.3
Green Ext Time (p_c), s	0.0	0.1	0.2	0.0	0.1	0.8

Intersection Summary	
HCM 6th Ctrl Delay	19.9
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	1	132	22	4	16	236	767	28	26	534	53
Future Volume (veh/h)	38	1	132	22	4	16	236	767	28	26	534	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	43	0	35	24	4	5	262	852	29	29	593	37
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	648	0	283	128	21	27	311	1241	42	113	864	374
Arrive On Green	0.18	0.00	0.18	0.10	0.10	0.10	0.17	0.35	0.35	0.06	0.24	0.24
Sat Flow, veh/h	3563	0	1554	1275	213	266	1781	3503	119	1781	3554	1538
Grp Volume(v), veh/h	43	0	35	33	0	0	262	432	449	29	593	37
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1753	0	0	1781	1777	1845	1781	1777	1538
Q Serve(g_s), s	0.6	0.0	1.2	1.1	0.0	0.0	8.7	12.7	12.7	1.0	9.3	1.1
Cycle Q Clear(g_c), s	0.6	0.0	1.2	1.1	0.0	0.0	8.7	12.7	12.7	1.0	9.3	1.1
Prop In Lane	1.00		1.00	0.73		0.15	1.00		0.06	1.00		1.00
Lane Grp Cap(c), veh/h	648	0	283	176	0	0	311	630	654	113	864	374
V/C Ratio(X)	0.07	0.00	0.12	0.19	0.00	0.00	0.84	0.69	0.69	0.26	0.69	0.10
Avail Cap(c_a), veh/h	871	0	380	400	0	0	401	654	680	290	1089	471
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.8	0.0	21.0	25.3	0.0	0.0	24.5	16.9	16.9	27.4	21.1	18.0
Incr Delay (d2), s/veh	0.0	0.0	0.2	0.4	0.0	0.0	9.8	3.9	3.7	0.4	2.3	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	0.0	0.4	0.4	0.0	0.0	4.1	4.9	5.1	0.4	3.6	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.8	0.0	21.2	25.7	0.0	0.0	34.3	20.8	20.6	27.8	23.4	18.3
LnGrp LOS	C	A	C	C	A	A	C	C	C	C	C	B
Approach Vol, veh/h		78			33			1143			659	
Approach Delay, s/veh		21.0			25.7			23.8			23.3	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	8.1	27.5	15.4	14.9	20.7	10.4
Change Period (Y+Rc), s	* 4.2	5.8	* 4.2	* 4.2	5.8	4.2
Max Green Setting (Gmax), s	* 10	22.6	* 15	* 14	18.8	14.0
Max Q Clear Time (g_c+I1), s	3.0	14.7	3.2	10.7	11.3	3.1
Green Ext Time (p_c), s	0.0	4.7	0.1	0.1	3.5	0.0

Intersection Summary	
HCM 6th Ctrl Delay	23.6
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	294	1	12	110	0	40
Future Vol, veh/h	294	1	12	110	0	40
Conflicting Peds, #/hr	0	1	2	0	1	2
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	346	1	14	129	0	47

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	349	0	506	350
Stage 1	-	-	-	-	348	-
Stage 2	-	-	-	-	158	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1210	-	397	629
Stage 1	-	-	-	-	589	-
Stage 2	-	-	-	-	797	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1208	-	391	627
Mov Cap-2 Maneuver	-	-	-	-	391	-
Stage 1	-	-	-	-	588	-
Stage 2	-	-	-	-	787	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.8	11.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	627	-	-	1208	-
HCM Lane V/C Ratio	-	0.075	-	-	0.012	-
HCM Control Delay (s)	0	11.2	-	-	8	-
HCM Lane LOS	A	B	-	-	A	-
HCM 95th %tile Q(veh)	-	0.2	-	-	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	248	1	31	1	0	4	61	720	2	5	896	349
Future Volume (veh/h)	248	1	31	1	0	4	61	720	2	5	896	349
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	288	0	0	1	0	1	66	774	2	5	963	299
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	697	366	0	5	0	5	225	1564	695	24	1163	519
Arrive On Green	0.20	0.00	0.00	0.01	0.00	0.01	0.13	0.44	0.44	0.01	0.33	0.33
Sat Flow, veh/h	3563	1870	0	837	0	837	1781	3554	1578	1781	3554	1585
Grp Volume(v), veh/h	288	0	0	2	0	0	66	774	2	5	963	299
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1674	0	0	1781	1777	1578	1781	1777	1585
Q Serve(g_s), s	3.9	0.0	0.0	0.1	0.0	0.0	1.9	8.7	0.0	0.2	13.9	8.7
Cycle Q Clear(g_c), s	3.9	0.0	0.0	0.1	0.0	0.0	1.9	8.7	0.0	0.2	13.9	8.7
Prop In Lane	1.00		0.00	0.50		0.50	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	697	366	0	9	0	0	225	1564	695	24	1163	519
V/C Ratio(X)	0.41	0.00	0.00	0.22	0.00	0.00	0.29	0.49	0.00	0.21	0.83	0.58
Avail Cap(c_a), veh/h	705	370	0	301	0	0	352	1564	695	320	1202	536
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.6	0.0	0.0	27.5	0.0	0.0	22.0	11.1	8.7	27.1	17.3	15.5
Incr Delay (d2), s/veh	0.5	0.0	0.0	4.3	0.0	0.0	0.5	0.3	0.0	3.2	5.2	2.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	0.0	0.0	0.0	0.0	0.7	2.6	0.0	0.1	5.4	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.0	0.0	0.0	31.9	0.0	0.0	22.6	11.5	8.7	30.3	22.5	17.6
LnGrp LOS	C	A	A	C	A	A	C	B	A	C	C	B
Approach Vol, veh/h		288			2			842			1267	
Approach Delay, s/veh		20.0			31.9			12.3			21.4	
Approach LOS		C			C			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.9	30.7		15.5	11.2	24.4		4.5
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	2.2	10.7		5.9	3.9	15.9		2.1
Green Ext Time (p_c), s	0.0	4.2		0.5	0.0	2.3		0.0

Intersection Summary			
HCM 6th Ctrl Delay			18.1
HCM 6th LOS			B

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↑	↱	↰	↑	↱	↰	↱			✥	
Traffic Volume (veh/h)	45	146	290	65	55	8	105	193	44	11	386	30
Future Volume (veh/h)	45	146	290	65	55	8	105	193	44	11	386	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	52	168	266	75	63	6	121	222	31	13	444	31
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	72	292	512	95	316	268	298	268	37	14	469	33
Arrive On Green	0.04	0.16	0.16	0.05	0.17	0.17	0.17	0.17	0.17	0.28	0.28	0.28
Sat Flow, veh/h	1781	1870	1580	1781	1870	1585	1781	1600	223	49	1680	117
Grp Volume(v), veh/h	52	168	266	75	63	6	121	0	253	488	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1580	1781	1870	1585	1781	0	1823	1847	0	0
Q Serve(g_s), s	1.6	4.5	7.4	2.2	1.6	0.2	3.3	0.0	7.2	13.9	0.0	0.0
Cycle Q Clear(g_c), s	1.6	4.5	7.4	2.2	1.6	0.2	3.3	0.0	7.2	13.9	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.12	0.03		0.06
Lane Grp Cap(c), veh/h	72	292	512	95	316	268	298	0	305	515	0	0
V/C Ratio(X)	0.73	0.57	0.52	0.79	0.20	0.02	0.41	0.00	0.83	0.95	0.00	0.00
Avail Cap(c_a), veh/h	136	292	512	136	316	268	298	0	305	515	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	25.5	21.0	14.8	25.2	19.2	18.6	20.0	0.0	21.6	19.0	0.0	0.0
Incr Delay (d2), s/veh	5.1	1.8	0.4	11.4	0.1	0.0	0.3	0.0	16.2	26.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	1.9	3.1	1.2	0.6	0.1	1.2	0.0	4.1	8.9	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.7	22.8	15.2	36.6	19.3	18.6	20.3	0.0	37.8	45.6	0.0	0.0
LnGrp LOS	C	C	B	D	B	B	C	A	D	D	A	A
Approach Vol, veh/h		486			144			374			488	
Approach Delay, s/veh		19.5			28.3			32.1			45.6	
Approach LOS		B			C			C			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	6.4	13.4		20.0	5.7	14.1		14.0
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	4.1	8.4		15.0	4.1	8.4		9.0
Max Q Clear Time (g_c+I1), s	4.2	9.4		15.9	3.6	3.6		9.2
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.1		0.0

Intersection Summary	
HCM 6th Ctrl Delay	32.0
HCM 6th LOS	C

Notes
User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	↰↑	↱		✥		↰	↑↱		↰	↑↑	↱
Traffic Volume (veh/h)	88	6	167	25	2	10	112	768	20	27	786	86
Future Volume (veh/h)	88	6	167	25	2	10	112	768	20	27	786	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	107	0	68	29	2	3	130	893	18	31	914	56
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	778	0	339	150	10	15	245	1204	24	117	947	420
Arrive On Green	0.22	0.00	0.22	0.10	0.10	0.10	0.14	0.34	0.34	0.07	0.27	0.27
Sat Flow, veh/h	3563	0	1554	1505	104	156	1781	3560	72	1781	3554	1576
Grp Volume(v), veh/h	107	0	68	34	0	0	130	446	465	31	914	56
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1764	0	0	1781	1777	1855	1781	1777	1576
Q Serve(g_s), s	1.6	0.0	2.4	1.2	0.0	0.0	4.5	14.6	14.6	1.1	16.8	1.8
Cycle Q Clear(g_c), s	1.6	0.0	2.4	1.2	0.0	0.0	4.5	14.6	14.6	1.1	16.8	1.8
Prop In Lane	1.00		1.00	0.85		0.09	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	778	0	339	175	0	0	245	601	627	117	947	420
V/C Ratio(X)	0.14	0.00	0.20	0.19	0.00	0.00	0.53	0.74	0.74	0.27	0.97	0.13
Avail Cap(c_a), veh/h	809	0	353	374	0	0	270	601	627	270	947	420
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.8	0.0	21.1	27.3	0.0	0.0	26.5	19.3	19.3	29.4	23.9	18.4
Incr Delay (d2), s/veh	0.1	0.0	0.3	0.4	0.0	0.0	0.7	5.9	5.7	0.4	21.5	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.9	0.5	0.0	0.0	1.8	6.1	6.3	0.4	8.9	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.9	0.0	21.4	27.7	0.0	0.0	27.2	25.2	25.0	29.8	45.4	18.7
LnGrp LOS	C	A	C	C	A	A	C	C	C	C	D	B
Approach Vol, veh/h		175			34			1041			1001	
Approach Delay, s/veh		21.1			27.7			25.4			43.5	
Approach LOS		C			C			C			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.5	28.1		18.6	13.3	23.4		10.8
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	17.6		* 15	* 10	17.6		14.0
Max Q Clear Time (g_c+I1), s	3.1	16.6		4.4	6.5	18.8		3.2
Green Ext Time (p_c), s	0.0	0.7		0.4	0.0	0.0		0.1

Intersection Summary	
HCM 6th Ctrl Delay	33.1
HCM 6th LOS	C

Notes
User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd

02/01/2023

Intersection	
Int Delay, s/veh	1.1

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	146	0	36	245	0	21
Future Vol, veh/h	146	0	36	245	0	21
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	154	0	38	258	0	22

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	154	0	488	154
Stage 1	-	-	-	-	154	-
Stage 2	-	-	-	-	334	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1426	-	411	855
Stage 1	-	-	-	-	802	-
Stage 2	-	-	-	-	603	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1426	-	400	855
Mov Cap-2 Maneuver	-	-	-	-	400	-
Stage 1	-	-	-	-	802	-
Stage 2	-	-	-	-	587	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1	9.3
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	-	855	-	-	1426	-
HCM Lane V/C Ratio	-	0.026	-	-	0.027	-
HCM Control Delay (s)	0	9.3	-	-	7.6	-
HCM Lane LOS	A	A	-	-	A	-
HCM 95th %tile Q(veh)	-	0.1	-	-	0.1	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	334	0	41	3	1	6	67	903	3	0	599	292
Future Volume (veh/h)	334	0	41	3	1	6	67	903	3	0	599	292
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	393	0	0	3	1	2	73	982	3	0	651	245
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	733	385	0	14	5	9	243	1765	787	3	1001	436
Arrive On Green	0.21	0.00	0.00	0.02	0.02	0.02	0.14	0.50	0.50	0.00	0.28	0.28
Sat Flow, veh/h	3563	1870	0	861	287	574	1781	3554	1583	1781	3554	1547
Grp Volume(v), veh/h	393	0	0	6	0	0	73	982	3	0	651	245
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1723	0	0	1781	1777	1583	1781	1777	1547
Q Serve(g_s), s	5.2	0.0	0.0	0.2	0.0	0.0	2.0	10.2	0.1	0.0	8.6	7.2
Cycle Q Clear(g_c), s	5.2	0.0	0.0	0.2	0.0	0.0	2.0	10.2	0.1	0.0	8.6	7.2
Prop In Lane	1.00		0.00	0.50		0.33	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	733	385	0	27	0	0	243	1765	787	3	1001	436
V/C Ratio(X)	0.54	0.00	0.00	0.22	0.00	0.00	0.30	0.56	0.00	0.00	0.65	0.56
Avail Cap(c_a), veh/h	735	386	0	323	0	0	368	1765	787	334	1254	546
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	18.9	0.0	0.0	25.9	0.0	0.0	20.7	9.3	6.8	0.0	16.8	16.3
Incr Delay (d2), s/veh	0.9	0.0	0.0	1.5	0.0	0.0	0.5	0.5	0.0	0.0	1.3	1.9
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.0	0.0	0.0	0.1	0.0	0.0	0.7	2.8	0.0	0.0	3.0	2.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.8	0.0	0.0	27.4	0.0	0.0	21.2	9.8	6.8	0.0	18.1	18.3
LnGrp LOS	B	A	A	C	A	A	C	A	A	A	B	B
Approach Vol, veh/h		393			6			1058			896	
Approach Delay, s/veh		19.8			27.4			10.6			18.2	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	0.0	32.7		15.6	11.5	21.2		5.0
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	0.0	12.2		7.2	4.0	10.6		2.2
Green Ext Time (p_c), s	0.0	4.5		0.6	0.0	4.4		0.0

Intersection Summary	
HCM 6th Ctrl Delay	15.1
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd
02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	78	201	50	152	19	258	282	42	11	182	57
Future Volume (veh/h)	50	78	201	50	152	19	258	282	42	11	182	57
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	56	87	181	56	169	11	287	313	40	12	202	44
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	79	249	594	79	249	210	432	393	50	15	251	55
Arrive On Green	0.04	0.13	0.13	0.04	0.13	0.13	0.24	0.24	0.24	0.18	0.18	0.18
Sat Flow, veh/h	1781	1870	1573	1781	1870	1573	1781	1619	207	84	1416	308
Grp Volume(v), veh/h	56	87	181	56	169	11	287	0	353	258	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1573	1781	1870	1573	1781	0	1826	1809	0	0
Q Serve(g_s), s	1.4	1.9	3.7	1.4	4.0	0.3	6.7	0.0	8.4	6.3	0.0	0.0
Cycle Q Clear(g_c), s	1.4	1.9	3.7	1.4	4.0	0.3	6.7	0.0	8.4	6.3	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	0.05		0.17
Lane Grp Cap(c), veh/h	79	249	594	79	249	210	432	0	443	321	0	0
V/C Ratio(X)	0.71	0.35	0.30	0.71	0.68	0.05	0.66	0.00	0.80	0.80	0.00	0.00
Avail Cap(c_a), veh/h	159	301	638	197	341	287	542	0	555	393	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	21.7	18.1	10.1	21.7	19.0	17.4	15.7	0.0	16.4	18.2	0.0	0.0
Incr Delay (d2), s/veh	4.3	0.3	0.1	4.3	1.2	0.0	1.1	0.0	5.0	7.8	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.7	1.6	0.6	1.6	0.1	2.4	0.0	3.5	2.9	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.0	18.4	10.2	26.0	20.2	17.4	16.8	0.0	21.3	25.9	0.0	0.0
LnGrp LOS	C	B	B	C	C	B	B	A	C	C	A	A
Approach Vol, veh/h		324			236			640			258	
Approach Delay, s/veh		15.2			21.4			19.3			25.9	
Approach LOS		B			C			B			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.5	11.1		13.2	5.5	11.1		16.2				
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0				
Max Green Setting (Gmax), s	5.1	7.4		10.0	4.1	8.4		14.0				
Max Q Clear Time (g_c+I1), s	3.4	5.7		8.3	3.4	6.0		10.4				
Green Ext Time (p_c), s	0.0	0.1		0.2	0.0	0.1		0.7				
Intersection Summary												
HCM 6th Ctrl Delay			19.9									
HCM 6th LOS			B									

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd
02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	1	132	27	4	16	238	844	40	30	641	53
Future Volume (veh/h)	38	1	132	27	4	16	238	844	40	30	641	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	43	0	35	30	4	5	264	938	42	33	712	37
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	626	0	273	149	20	25	310	1260	56	123	920	398
Arrive On Green	0.18	0.00	0.18	0.11	0.11	0.11	0.17	0.36	0.36	0.07	0.26	0.26
Sat Flow, veh/h	3563	0	1553	1352	180	225	1781	3460	155	1781	3554	1539
Grp Volume(v), veh/h	43	0	35	39	0	0	264	482	498	33	712	37
Grp Sat Flow(s),veh/h/ln	1781	0	1553	1757	0	0	1781	1777	1838	1781	1777	1539
Q Serve(g_s), s	0.7	0.0	1.2	1.3	0.0	0.0	9.4	15.5	15.5	1.2	12.2	1.2
Cycle Q Clear(g_c), s	0.7	0.0	1.2	1.3	0.0	0.0	9.4	15.5	15.5	1.2	12.2	1.2
Prop In Lane	1.00		1.00	0.77		0.13	1.00		0.08	1.00		1.00
Lane Grp Cap(c), veh/h	626	0	273	194	0	0	310	647	669	123	920	398
V/C Ratio(X)	0.07	0.00	0.13	0.20	0.00	0.00	0.85	0.74	0.74	0.27	0.77	0.09
Avail Cap(c_a), veh/h	816	0	356	376	0	0	375	647	669	272	1020	442
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.5	0.0	22.8	26.5	0.0	0.0	26.2	18.2	18.2	28.9	22.5	18.4
Incr Delay (d2), s/veh	0.0	0.0	0.2	0.4	0.0	0.0	12.6	5.6	5.4	0.4	4.4	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.5	0.6	0.0	0.0	4.6	6.3	6.5	0.5	5.0	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	22.6	0.0	23.0	26.9	0.0	0.0	38.9	23.8	23.6	29.4	26.9	18.7
LnGrp LOS	C	A	C	C	A	A	D	C	C	C	C	B
Approach Vol, veh/h		78			39			1244			782	
Approach Delay, s/veh		22.8			26.9			26.9			26.6	
Approach LOS		C			C			C			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.7	29.7		15.7	15.6	22.8		11.4				
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2				
Max Green Setting (Gmax), s	* 10	22.6		* 15	* 14	18.8		14.0				
Max Q Clear Time (g_c+I1), s	3.2	17.5		3.2	11.4	14.2		3.3				
Green Ext Time (p_c), s	0.0	3.6		0.1	0.1	2.7		0.1				
Intersection Summary												
HCM 6th Ctrl Delay			26.6									
HCM 6th LOS			C									

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd
02/01/2023

Intersection	
Int Delay, s/veh	1.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↱	↰	↑	↰	↱
Traffic Vol, veh/h	285	1	14	106	1	44
Future Vol, veh/h	285	1	14	106	1	44
Conflicting Peds, #/hr	0	1	2	0	1	2
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	335	1	16	125	1	52

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	338	0	495	339
Stage 1	-	-	-	-	337	-
Stage 2	-	-	-	-	158	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1221	-	406	640
Stage 1	-	-	-	-	600	-
Stage 2	-	-	-	-	797	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1219	-	400	638
Mov Cap-2 Maneuver	-	-	-	-	400	-
Stage 1	-	-	-	-	599	-
Stage 2	-	-	-	-	786	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	11.2
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	400	638	-	-	1219	-
HCM Lane V/C Ratio	0.003	0.081	-	-	0.014	-
HCM Control Delay (s)	14	11.1	-	-	8	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0	0.3	-	-	0	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr
02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰	✥			✥		↰	↑↑	↱	↰	↑↑	↱
Traffic Volume (veh/h)	248	1	31	1	0	4	60	569	2	5	788	347
Future Volume (veh/h)	248	1	31	1	0	4	60	569	2	5	788	347
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	288	0	0	1	0	1	65	612	2	5	847	297
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	710	373	0	5	0	5	225	1528	678	24	1126	502
Arrive On Green	0.20	0.00	0.00	0.01	0.00	0.01	0.13	0.43	0.43	0.01	0.32	0.32
Sat Flow, veh/h	3563	1870	0	837	0	837	1781	3554	1578	1781	3554	1585
Grp Volume(v), veh/h	288	0	0	2	0	0	65	612	2	5	847	297
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1675	0	0	1781	1777	1578	1781	1777	1585
Q Serve(g_s), s	3.8	0.0	0.0	0.1	0.0	0.0	1.8	6.5	0.0	0.2	11.7	8.6
Cycle Q Clear(g_c), s	3.8	0.0	0.0	0.1	0.0	0.0	1.8	6.5	0.0	0.2	11.7	8.6
Prop In Lane	1.00		0.00	0.50		0.50	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	710	373	0	9	0	0	225	1528	678	24	1126	502
V/C Ratio(X)	0.41	0.00	0.00	0.22	0.00	0.00	0.29	0.40	0.00	0.21	0.75	0.59
Avail Cap(c_a), veh/h	719	377	0	307	0	0	359	1528	678	327	1225	546
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.0	0.0	0.0	27.0	0.0	0.0	21.6	10.7	8.9	26.6	16.7	15.7
Incr Delay (d2), s/veh	0.5	0.0	0.0	4.3	0.0	0.0	0.5	0.2	0.0	3.2	2.9	2.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.0	0.1	4.2	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.5	0.0	0.0	31.3	0.0	0.0	22.1	10.9	8.9	29.8	19.6	17.8
LnGrp LOS	B	A	A	C	A	A	C	B	A	C	B	B
Approach Vol, veh/h		288			2			679			1149	
Approach Delay, s/veh		19.5			31.3			12.0			19.2	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.9	29.6		15.5	11.1	23.5		4.5
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	2.2	8.5		5.8	3.8	13.7		2.1
Green Ext Time (p_c), s	0.0	3.8		0.6	0.0	3.6		0.0

Intersection Summary	
HCM 6th Ctrl Delay	16.9
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	47	150	290	65	55	8	97	189	44	11	376	30
Future Volume (veh/h)	47	150	290	65	55	8	97	189	44	11	376	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	54	172	266	75	63	6	111	217	31	13	432	31
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	73	292	512	95	315	267	298	267	38	14	468	34
Arrive On Green	0.04	0.16	0.16	0.05	0.17	0.17	0.17	0.17	0.17	0.28	0.28	0.28
Sat Flow, veh/h	1781	1870	1580	1781	1870	1585	1781	1595	228	50	1676	120
Grp Volume(v), veh/h	54	172	266	75	63	6	111	0	248	476	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1580	1781	1870	1585	1781	0	1822	1846	0	0
Q Serve(g_s), s	1.6	4.6	7.4	2.2	1.6	0.2	3.0	0.0	7.0	13.5	0.0	0.0
Cycle Q Clear(g_c), s	1.6	4.6	7.4	2.2	1.6	0.2	3.0	0.0	7.0	13.5	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.13	0.03		0.07
Lane Grp Cap(c), veh/h	73	292	512	95	315	267	298	0	305	515	0	0
V/C Ratio(X)	0.74	0.59	0.52	0.79	0.20	0.02	0.37	0.00	0.81	0.92	0.00	0.00
Avail Cap(c_a), veh/h	136	292	512	136	315	267	298	0	305	515	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	25.5	21.1	14.8	25.2	19.2	18.7	19.9	0.0	21.6	18.8	0.0	0.0
Incr Delay (d2), s/veh	5.3	2.1	0.4	11.4	0.1	0.0	0.3	0.0	14.3	22.2	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	2.0	3.1	1.2	0.6	0.1	1.1	0.0	3.9	8.1	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.7	23.2	15.2	36.6	19.4	18.7	20.2	0.0	35.9	41.0	0.0	0.0
LnGrp LOS	C	C	B	D	B	B	C	A	D	D	A	A
Approach Vol, veh/h		492			144			359			476	
Approach Delay, s/veh		19.7			28.3			31.0			41.0	
Approach LOS		B			C			C			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	6.4	13.4		20.0	5.7	14.0		14.0
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	4.1	8.4		15.0	4.1	8.4		9.0
Max Q Clear Time (g_c+I1), s	4.2	9.4		15.5	3.6	3.6		9.0
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.1		0.0

Intersection Summary		
HCM 6th Ctrl Delay		30.2
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	87	6	171	25	2	9	109	613	17	22	704	81
Future Volume (veh/h)	87	6	171	25	2	9	109	613	17	22	704	81
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	106	0	73	29	2	1	127	713	15	26	819	50
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	787	0	344	154	11	5	245	1225	26	103	939	416
Arrive On Green	0.22	0.00	0.22	0.10	0.10	0.10	0.14	0.34	0.34	0.06	0.26	0.26
Sat Flow, veh/h	3563	0	1554	1612	111	56	1781	3557	75	1781	3554	1576
Grp Volume(v), veh/h	106	0	73	32	0	0	127	356	372	26	819	50
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1779	0	0	1781	1777	1855	1781	1777	1576
Q Serve(g_s), s	1.6	0.0	2.5	1.1	0.0	0.0	4.3	10.7	10.7	0.9	14.4	1.6
Cycle Q Clear(g_c), s	1.6	0.0	2.5	1.1	0.0	0.0	4.3	10.7	10.7	0.9	14.4	1.6
Prop In Lane	1.00		1.00	0.91		0.03	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	787	0	344	170	0	0	245	612	639	103	939	416
V/C Ratio(X)	0.13	0.00	0.21	0.19	0.00	0.00	0.52	0.58	0.58	0.25	0.87	0.12
Avail Cap(c_a), veh/h	818	0	357	381	0	0	273	612	639	273	957	424
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.4	0.0	20.8	27.2	0.0	0.0	26.2	17.6	17.6	29.5	23.0	18.3
Incr Delay (d2), s/veh	0.1	0.0	0.3	0.4	0.0	0.0	0.6	2.2	2.1	0.5	9.5	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	0.9	0.5	0.0	0.0	1.7	4.1	4.3	0.4	6.4	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	21.1	27.6	0.0	0.0	26.8	19.8	19.7	29.9	32.5	18.5
LnGrp LOS	C	A	C	C	A	A	C	B	B	C	C	B
Approach Vol, veh/h		179			32			855			895	
Approach Delay, s/veh		20.8			27.6			20.8			31.6	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.0	28.3		18.6	13.2	23.1		10.4
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	17.6		* 15	* 10	17.6		14.0
Max Q Clear Time (g_c+I1), s	2.9	12.7		4.5	6.3	16.4		3.1
Green Ext Time (p_c), s	0.0	2.7		0.4	0.0	0.9		0.0

Intersection Summary		
HCM 6th Ctrl Delay		25.9
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd

02/01/2023

Intersection						
Int Delay, s/veh	1.2					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	145	1	43	246	1	24
Future Vol, veh/h	145	1	43	246	1	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	153	1	45	259	1	25

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	154	0	502	153
Stage 1	-	-	-	-	153	-
Stage 2	-	-	-	-	349	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1426	-	400	856
Stage 1	-	-	-	-	804	-
Stage 2	-	-	-	-	588	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1426	-	387	856
Mov Cap-2 Maneuver	-	-	-	-	387	-
Stage 1	-	-	-	-	804	-
Stage 2	-	-	-	-	569	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	9.5
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	387	856	-	-	1426	-
HCM Lane V/C Ratio	0.003	0.03	-	-	0.032	-
HCM Control Delay (s)	14.3	9.3	-	-	7.6	-
HCM Lane LOS	B	A	-	-	A	-
HCM 95th %tile Q(veh)	0	0.1	-	-	0.1	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	319	0	35	3	1	6	65	847	3	0	498	290
Future Volume (veh/h)	319	0	35	3	1	6	65	847	3	0	498	290
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	370	0	0	3	1	2	71	921	3	0	541	243
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	758	398	0	14	5	9	243	1705	760	3	930	405
Arrive On Green	0.21	0.00	0.00	0.02	0.02	0.02	0.14	0.48	0.48	0.00	0.26	0.26
Sat Flow, veh/h	3563	1870	0	861	287	574	1781	3554	1583	1781	3554	1547
Grp Volume(v), veh/h	370	0	0	6	0	0	71	921	3	0	541	243
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1723	0	0	1781	1777	1583	1781	1777	1547
Q Serve(g_s), s	4.7	0.0	0.0	0.2	0.0	0.0	1.8	9.4	0.1	0.0	6.8	7.1
Cycle Q Clear(g_c), s	4.7	0.0	0.0	0.2	0.0	0.0	1.8	9.4	0.1	0.0	6.8	7.1
Prop In Lane	1.00		0.00	0.50		0.33	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	758	398	0	28	0	0	243	1705	760	3	930	405
V/C Ratio(X)	0.49	0.00	0.00	0.22	0.00	0.00	0.29	0.54	0.00	0.00	0.58	0.60
Avail Cap(c_a), veh/h	762	400	0	335	0	0	381	1705	760	346	1299	565
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	17.8	0.0	0.0	25.0	0.0	0.0	20.0	9.4	7.0	0.0	16.5	16.6
Incr Delay (d2), s/veh	0.6	0.0	0.0	1.5	0.0	0.0	0.5	0.5	0.0	0.0	1.0	2.4
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.7	0.0	0.0	0.1	0.0	0.0	0.7	2.5	0.0	0.0	2.4	2.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	18.4	0.0	0.0	26.5	0.0	0.0	20.5	9.8	7.0	0.0	17.5	19.1
LnGrp LOS	B	A	A	C	A	A	C	A	A	A	B	B
Approach Vol, veh/h		370			6			995			784	
Approach Delay, s/veh		18.4			26.5			10.6			18.0	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	0.0	30.9		15.5	11.2	19.7		5.0
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	0.0	11.4		6.7	3.8	9.1		2.2
Green Ext Time (p_c), s	0.0	4.6		0.7	0.0	4.4		0.0

Intersection Summary		
HCM 6th Ctrl Delay		14.7
HCM 6th LOS		B

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	43	80	158	50	158	19	261	282	42	11	182	61
Future Volume (veh/h)	43	80	158	50	158	19	261	282	42	11	182	61
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	48	89	134	56	176	11	290	313	40	12	202	49
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	71	247	592	79	255	215	432	393	50	15	250	61
Arrive On Green	0.04	0.13	0.13	0.04	0.14	0.14	0.24	0.24	0.24	0.18	0.18	0.18
Sat Flow, veh/h	1781	1870	1573	1781	1870	1573	1781	1619	207	82	1385	336
Grp Volume(v), veh/h	48	89	134	56	176	11	290	0	353	263	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1573	1781	1870	1573	1781	0	1826	1804	0	0
Q Serve(g_s), s	1.2	2.0	2.7	1.4	4.1	0.3	6.8	0.0	8.4	6.5	0.0	0.0
Cycle Q Clear(g_c), s	1.2	2.0	2.7	1.4	4.1	0.3	6.8	0.0	8.4	6.5	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	0.05		0.19
Lane Grp Cap(c), veh/h	71	247	592	79	255	215	432	0	443	326	0	0
V/C Ratio(X)	0.68	0.36	0.23	0.71	0.69	0.05	0.67	0.00	0.80	0.81	0.00	0.00
Avail Cap(c_a), veh/h	158	300	636	197	340	286	540	0	553	391	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	21.9	18.3	9.9	21.8	19.0	17.3	15.8	0.0	16.4	18.2	0.0	0.0
Incr Delay (d2), s/veh	4.1	0.3	0.1	4.3	1.7	0.0	1.3	0.0	5.1	8.4	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.8	1.2	0.6	1.7	0.1	2.4	0.0	3.5	3.0	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.0	18.6	9.9	26.1	20.7	17.4	17.1	0.0	21.5	26.6	0.0	0.0
LnGrp LOS	C	B	A	C	C	B	B	A	C	C	A	A
Approach Vol, veh/h		271			243			643			263	
Approach Delay, s/veh		15.6			21.8			19.5			26.6	
Approach LOS		B			C			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	5.5	11.1		13.3	5.3	11.3		16.2
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	5.5	7.4		10.0	4.1	8.4		14.0
Max Q Clear Time (g_c+I1), s	3.4	4.7		8.5	3.2	6.1		10.4
Green Ext Time (p_c), s	0.0	0.1		0.2	0.0	0.1		0.7

Intersection Summary	
HCM 6th Ctrl Delay	20.5
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	1	134	22	4	16	242	767	28	26	534	53
Future Volume (veh/h)	38	1	134	22	4	16	242	767	28	26	534	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	43	0	37	24	4	5	269	852	29	29	593	37
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	652	0	284	128	21	27	318	1250	43	113	859	372
Arrive On Green	0.18	0.00	0.18	0.10	0.10	0.10	0.18	0.36	0.36	0.06	0.24	0.24
Sat Flow, veh/h	3563	0	1554	1275	213	266	1781	3503	119	1781	3554	1538
Grp Volume(v), veh/h	43	0	37	33	0	0	269	432	449	29	593	37
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1753	0	0	1781	1777	1845	1781	1777	1538
Q Serve(g_s), s	0.6	0.0	1.2	1.1	0.0	0.0	9.1	12.8	12.8	1.0	9.4	1.2
Cycle Q Clear(g_c), s	0.6	0.0	1.2	1.1	0.0	0.0	9.1	12.8	12.8	1.0	9.4	1.2
Prop In Lane	1.00		1.00	0.73		0.15	1.00		0.06	1.00		1.00
Lane Grp Cap(c), veh/h	652	0	284	176	0	0	318	634	658	113	859	372
V/C Ratio(X)	0.07	0.00	0.13	0.19	0.00	0.00	0.85	0.68	0.68	0.26	0.69	0.10
Avail Cap(c_a), veh/h	862	0	376	396	0	0	396	648	673	287	1077	466
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.9	0.0	21.2	25.6	0.0	0.0	24.6	17.0	17.0	27.6	21.4	18.3
Incr Delay (d2), s/veh	0.0	0.0	0.2	0.4	0.0	0.0	11.0	3.8	3.7	0.4	2.4	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.4	0.5	0.0	0.0	4.3	5.0	5.1	0.4	3.7	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.0	0.0	21.4	26.0	0.0	0.0	35.6	20.8	20.6	28.1	23.8	18.5
LnGrp LOS	C	A	C	C	A	A	D	C	C	C	C	B
Approach Vol, veh/h		80			33			1150			659	
Approach Delay, s/veh		21.2			26.0			24.2			23.7	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.1	27.9		15.5	15.3	20.8		10.4
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	22.6		* 15	* 14	18.8		14.0
Max Q Clear Time (g_c+I1), s	3.0	14.8		3.2	11.1	11.4		3.1
Green Ext Time (p_c), s	0.0	4.7		0.1	0.1	3.4		0.0

Intersection Summary	
HCM 6th Ctrl Delay	23.9
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection						
Int Delay, s/veh	1.3					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	303	1	14	114	1	44
Future Vol, veh/h	303	1	14	114	1	44
Conflicting Peds, #/hr	0	1	2	0	1	2
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	356	1	16	134	1	52

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	359	0	525	360
Stage 1	-	-	-	-	358	-
Stage 2	-	-	-	-	167	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1200	-	383	619
Stage 1	-	-	-	-	580	-
Stage 2	-	-	-	-	786	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1198	-	377	617
Mov Cap-2 Maneuver	-	-	-	-	377	-
Stage 1	-	-	-	-	579	-
Stage 2	-	-	-	-	775	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	11.5
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	377	617	-	-	1198	-
HCM Lane V/C Ratio	0.003	0.084	-	-	0.014	-
HCM Control Delay (s)	14.6	11.4	-	-	8	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0	0.3	-	-	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	253	1	31	1	0	4	60	569	2	5	788	349
Future Volume (veh/h)	253	1	31	1	0	4	60	569	2	5	788	349
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	293	0	0	1	0	1	65	612	2	5	847	299
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	710	373	0	5	0	5	225	1528	678	24	1126	502
Arrive On Green	0.20	0.00	0.00	0.01	0.00	0.01	0.13	0.43	0.43	0.01	0.32	0.32
Sat Flow, veh/h	3563	1870	0	837	0	837	1781	3554	1578	1781	3554	1585
Grp Volume(v), veh/h	293	0	0	2	0	0	65	612	2	5	847	299
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1675	0	0	1781	1777	1578	1781	1777	1585
Q Serve(g_s), s	3.9	0.0	0.0	0.1	0.0	0.0	1.8	6.5	0.0	0.2	11.7	8.7
Cycle Q Clear(g_c), s	3.9	0.0	0.0	0.1	0.0	0.0	1.8	6.5	0.0	0.2	11.7	8.7
Prop In Lane	1.00		0.00	0.50		0.50	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	710	373	0	9	0	0	225	1528	678	24	1126	502
V/C Ratio(X)	0.41	0.00	0.00	0.22	0.00	0.00	0.29	0.40	0.00	0.21	0.75	0.60
Avail Cap(c_a), veh/h	718	377	0	307	0	0	359	1528	678	327	1225	546
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.1	0.0	0.0	27.0	0.0	0.0	21.6	10.7	8.9	26.6	16.7	15.7
Incr Delay (d2), s/veh	0.5	0.0	0.0	4.3	0.0	0.0	0.5	0.2	0.0	3.2	2.9	2.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	0.0	0.0	0.0	0.0	0.7	1.9	0.0	0.1	4.2	2.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.5	0.0	0.0	31.4	0.0	0.0	22.1	11.0	8.9	29.8	19.6	17.9
LnGrp LOS	B	A	A	C	A	A	C	B	A	C	B	B
Approach Vol, veh/h		293			2			679			1151	
Approach Delay, s/veh		19.5			31.4			12.0			19.2	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.9	29.7		15.5	11.1	23.5		4.5
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	2.2	8.5		5.9	3.8	13.7		2.1
Green Ext Time (p_c), s	0.0	3.8		0.6	0.0	3.6		0.0

Intersection Summary	
HCM 6th Ctrl Delay	17.0
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	52	159	294	65	59	8	99	189	44	11	376	32
Future Volume (veh/h)	52	159	294	65	59	8	99	189	44	11	376	32
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	60	183	271	75	68	6	114	217	31	13	432	34
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	78	292	512	95	309	262	298	267	38	14	464	37
Arrive On Green	0.04	0.16	0.16	0.05	0.17	0.17	0.17	0.17	0.17	0.28	0.28	0.28
Sat Flow, veh/h	1781	1870	1580	1781	1870	1585	1781	1595	228	50	1663	131
Grp Volume(v), veh/h	60	183	271	75	68	6	114	0	248	479	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1580	1781	1870	1585	1781	0	1822	1844	0	0
Q Serve(g_s), s	1.8	4.9	7.5	2.2	1.7	0.2	3.1	0.0	7.0	13.6	0.0	0.0
Cycle Q Clear(g_c), s	1.8	4.9	7.5	2.2	1.7	0.2	3.1	0.0	7.0	13.6	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.13	0.03		0.07
Lane Grp Cap(c), veh/h	78	292	512	95	309	262	298	0	305	515	0	0
V/C Ratio(X)	0.76	0.63	0.53	0.79	0.22	0.02	0.38	0.00	0.81	0.93	0.00	0.00
Avail Cap(c_a), veh/h	136	292	512	136	309	262	298	0	305	515	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	25.4	21.2	14.8	25.2	19.4	18.8	19.9	0.0	21.6	18.9	0.0	0.0
Incr Delay (d2), s/veh	5.7	3.2	0.5	11.4	0.1	0.0	0.3	0.0	14.3	23.4	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	2.2	3.2	1.2	0.7	0.1	1.2	0.0	3.9	8.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.1	24.4	15.4	36.6	19.6	18.8	20.2	0.0	35.9	42.3	0.0	0.0
LnGrp LOS	C	C	B	D	B	B	C	A	D	D	A	A
Approach Vol, veh/h		514			149			362			479	
Approach Delay, s/veh		20.4			28.1			31.0			42.3	
Approach LOS		C			C			C			D	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.4	13.4		20.0	5.9	13.9		14.0				
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0				
Max Green Setting (Gmax), s	4.1	8.4		15.0	4.1	8.4		9.0				
Max Q Clear Time (g_c+I1), s	4.2	9.5		15.6	3.8	3.7		9.0				
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.1		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			30.7									
HCM 6th LOS			C									
Notes												

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	87	6	180	25	2	9	113	613	17	22	704	81
Future Volume (veh/h)	87	6	180	25	2	9	113	613	17	22	704	81
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	106	0	83	29	2	1	131	713	15	26	819	50
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	790	0	345	154	11	5	247	1225	26	102	937	415
Arrive On Green	0.22	0.00	0.22	0.10	0.10	0.10	0.14	0.34	0.34	0.06	0.26	0.26
Sat Flow, veh/h	3563	0	1554	1612	111	56	1781	3557	75	1781	3554	1576
Grp Volume(v), veh/h	106	0	83	32	0	0	131	356	372	26	819	50
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1779	0	0	1781	1777	1855	1781	1777	1576
Q Serve(g_s), s	1.6	0.0	2.9	1.1	0.0	0.0	4.5	10.8	10.8	0.9	14.5	1.6
Cycle Q Clear(g_c), s	1.6	0.0	2.9	1.1	0.0	0.0	4.5	10.8	10.8	0.9	14.5	1.6
Prop In Lane	1.00		1.00	0.91		0.03	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	790	0	345	170	0	0	247	612	639	102	937	415
V/C Ratio(X)	0.13	0.00	0.24	0.19	0.00	0.00	0.53	0.58	0.58	0.25	0.87	0.12
Avail Cap(c_a), veh/h	815	0	356	380	0	0	272	612	639	272	954	423
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.5	0.0	21.0	27.3	0.0	0.0	26.3	17.6	17.6	29.5	23.1	18.4
Incr Delay (d2), s/veh	0.1	0.0	0.4	0.4	0.0	0.0	0.7	2.2	2.1	0.5	9.7	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.0	1.0	0.5	0.0	0.0	1.8	4.1	4.3	0.4	6.5	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.5	0.0	21.3	27.7	0.0	0.0	26.9	19.8	19.7	30.0	32.8	18.6
LnGrp LOS	C	A	C	C	A	A	C	B	B	C	C	B
Approach Vol, veh/h		189			32			859			895	
Approach Delay, s/veh		20.9			27.7			20.9			31.9	
Approach LOS		C			C			C			C	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	8.0	28.4		18.7	13.3	23.1		10.5				
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2				
Max Green Setting (Gmax), s	* 10	17.6		* 15	* 10	17.6		14.0				
Max Q Clear Time (g_c+I1), s	2.9	12.8		4.9	6.5	16.5		3.1				
Green Ext Time (p_c), s	0.0	2.7		0.4	0.0	0.8		0.0				
Intersection Summary												
HCM 6th Ctrl Delay			26.0									
HCM 6th LOS			C									
Notes												

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	158	1	43	264	1	24
Future Vol, veh/h	158	1	43	264	1	24
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	166	1	45	278	1	25

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	167	0	534	166
Stage 1	-	-	-	-	166	-
Stage 2	-	-	-	-	368	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1411	-	377	839
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	571	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1411	-	365	839
Mov Cap-2 Maneuver	-	-	-	-	365	-
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	553	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	9.6
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	365	839	-	-	1411	-
HCM Lane V/C Ratio	0.003	0.03	-	-	0.032	-
HCM Control Delay (s)	14.9	9.4	-	-	7.6	-
HCM Lane LOS	B	A	-	-	A	-
HCM 95th %tile Q(veh)	0	0.1	-	-	0.1	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	323	0	35	3	1	6	65	847	3	0	498	295
Future Volume (veh/h)	323	0	35	3	1	6	65	847	3	0	498	295
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	374	0	0	3	1	2	71	921	3	0	541	249
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	755	397	0	14	5	9	242	1711	762	3	939	409
Arrive On Green	0.21	0.00	0.00	0.02	0.02	0.02	0.14	0.48	0.48	0.00	0.26	0.26
Sat Flow, veh/h	3563	1870	0	861	287	574	1781	3554	1583	1781	3554	1547
Grp Volume(v), veh/h	374	0	0	6	0	0	71	921	3	0	541	249
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1723	0	0	1781	1777	1583	1781	1777	1547
Q Serve(g_s), s	4.8	0.0	0.0	0.2	0.0	0.0	1.9	9.4	0.1	0.0	6.8	7.3
Cycle Q Clear(g_c), s	4.8	0.0	0.0	0.2	0.0	0.0	1.9	9.4	0.1	0.0	6.8	7.3
Prop In Lane	1.00		0.00	0.50		0.33	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	755	397	0	28	0	0	242	1711	762	3	939	409
V/C Ratio(X)	0.50	0.00	0.00	0.22	0.00	0.00	0.29	0.54	0.00	0.00	0.58	0.61
Avail Cap(c_a), veh/h	759	398	0	334	0	0	379	1711	762	345	1294	563
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	17.9	0.0	0.0	25.1	0.0	0.0	20.1	9.4	7.0	0.0	16.5	16.7
Incr Delay (d2), s/veh	0.6	0.0	0.0	1.5	0.0	0.0	0.5	0.4	0.0	0.0	1.0	2.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.8	0.0	0.0	0.1	0.0	0.0	0.7	2.5	0.0	0.0	2.4	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	18.5	0.0	0.0	26.5	0.0	0.0	20.6	9.8	7.0	0.0	17.5	19.2
LnGrp LOS	B	A	A	C	A	A	C	A	A	A	B	B
Approach Vol, veh/h		374			6			995			790	
Approach Delay, s/veh		18.5			26.5			10.6			18.0	
Approach LOS		B			C			B			B	

Timer - Assigned Phs	1	2	4	5	6	8
Phs Duration (G+Y+Rc), s	0.0	31.1	15.5	11.2	19.8	5.0
Change Period (Y+Rc), s	* 4.2	6.2	4.6	* 4.2	6.2	4.2
Max Green Setting (Gmax), s	* 10	19.8	11.0	* 11	18.8	10.0
Max Q Clear Time (g_c+I1), s	0.0	11.4	6.8	3.9	9.3	2.2
Green Ext Time (p_c), s	0.0	4.6	0.7	0.0	4.3	0.0

Intersection Summary	
HCM 6th Ctrl Delay	14.7
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	47	86	161	50	167	19	265	282	42	11	182	66
Future Volume (veh/h)	47	86	161	50	167	19	265	282	42	11	182	66
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	52	96	137	56	186	11	294	313	40	12	202	54
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	75	259	600	79	263	221	430	390	50	15	248	66
Arrive On Green	0.04	0.14	0.14	0.04	0.14	0.14	0.24	0.24	0.24	0.18	0.18	0.18
Sat Flow, veh/h	1781	1870	1574	1781	1870	1574	1781	1619	207	81	1356	362
Grp Volume(v), veh/h	52	96	137	56	186	11	294	0	353	268	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1574	1781	1870	1574	1781	0	1826	1799	0	0
Q Serve(g_s), s	1.4	2.2	2.8	1.5	4.5	0.3	7.1	0.0	8.6	6.7	0.0	0.0
Cycle Q Clear(g_c), s	1.4	2.2	2.8	1.5	4.5	0.3	7.1	0.0	8.6	6.7	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	0.04		0.20
Lane Grp Cap(c), veh/h	75	259	600	79	263	221	430	0	440	329	0	0
V/C Ratio(X)	0.70	0.37	0.23	0.71	0.71	0.05	0.68	0.00	0.80	0.81	0.00	0.00
Avail Cap(c_a), veh/h	155	294	630	193	334	281	530	0	543	382	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	22.2	18.4	9.9	22.2	19.3	17.5	16.2	0.0	16.8	18.4	0.0	0.0
Incr Delay (d2), s/veh	4.3	0.3	0.1	4.4	3.0	0.0	1.6	0.0	5.5	9.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	0.8	1.2	0.6	1.9	0.1	2.6	0.0	3.7	3.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	26.5	18.7	10.0	26.6	22.3	17.5	17.8	0.0	22.3	28.1	0.0	0.0
LnGrp LOS	C	B	A	C	C	B	B	A	C	C	A	A
Approach Vol, veh/h		285			253			647			268	
Approach Delay, s/veh		16.0			23.0			20.3			28.1	
Approach LOS		B			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	5.6	11.5		13.6	5.5	11.6		16.3
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	5.1	7.4		10.0	4.1	8.4		14.0
Max Q Clear Time (g_c+I1), s	3.5	4.8		8.7	3.4	6.5		10.6
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	0.1		0.7

Intersection Summary		
HCM 6th Ctrl Delay		21.4
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd

02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	1	140	22	4	16	251	767	28	26	534	53
Future Volume (veh/h)	38	1	140	22	4	16	251	767	28	26	534	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	43	0	44	24	4	5	279	852	29	29	593	37
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	668	0	291	127	21	26	327	1259	43	112	849	368
Arrive On Green	0.19	0.00	0.19	0.10	0.10	0.10	0.18	0.36	0.36	0.06	0.24	0.24
Sat Flow, veh/h	3563	0	1554	1275	213	266	1781	3503	119	1781	3554	1538
Grp Volume(v), veh/h	43	0	44	33	0	0	279	432	449	29	593	37
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1753	0	0	1781	1777	1845	1781	1777	1538
Q Serve(g_s), s	0.6	0.0	1.5	1.1	0.0	0.0	9.6	13.0	13.0	1.0	9.7	1.2
Cycle Q Clear(g_c), s	0.6	0.0	1.5	1.1	0.0	0.0	9.6	13.0	13.0	1.0	9.7	1.2
Prop In Lane	1.00		1.00	0.73		0.15	1.00		0.06	1.00		1.00
Lane Grp Cap(c), veh/h	668	0	291	175	0	0	327	638	663	112	849	368
V/C Ratio(X)	0.06	0.00	0.15	0.19	0.00	0.00	0.85	0.68	0.68	0.26	0.70	0.10
Avail Cap(c_a), veh/h	844	0	368	388	0	0	388	638	663	281	1055	457
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	21.2	0.0	21.5	26.2	0.0	0.0	25.0	17.2	17.2	28.3	22.0	18.8
Incr Delay (d2), s/veh	0.0	0.0	0.2	0.4	0.0	0.0	13.0	3.8	3.6	0.4	2.5	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.5	0.5	0.0	0.0	4.7	5.1	5.2	0.4	3.8	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	21.2	0.0	21.8	26.5	0.0	0.0	38.0	20.9	20.8	28.7	24.6	19.0
LnGrp LOS	C	A	C	C	A	A	D	C	C	C	C	B
Approach Vol, veh/h		87			33			1160			659	
Approach Delay, s/veh		21.5			26.5			25.0			24.4	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.2	28.6		16.1	15.8	20.9		10.5
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	22.6		* 15	* 14	18.8		14.0
Max Q Clear Time (g_c+I1), s	3.0	15.0		3.5	11.6	11.7		3.1
Green Ext Time (p_c), s	0.0	4.6		0.2	0.1	3.3		0.0

Intersection Summary		
HCM 6th Ctrl Delay		24.7
HCM 6th LOS		C

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd 02/01/2023

Intersection	
Int Delay, s/veh	1.4

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	312	1	15	116	1	48
Future Vol, veh/h	312	1	15	116	1	48
Conflicting Peds, #/hr	0	1	2	0	1	2
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	85	85	85	85	85	85
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	367	1	18	136	1	56

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	370	0	542	371
Stage 1	-	-	-	-	369	-
Stage 2	-	-	-	-	173	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1189	-	371	609
Stage 1	-	-	-	-	570	-
Stage 2	-	-	-	-	779	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1187	-	364	607
Mov Cap-2 Maneuver	-	-	-	-	364	-
Stage 1	-	-	-	-	569	-
Stage 2	-	-	-	-	767	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.9	11.6
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	364	607	-	-	1187	-
HCM Lane V/C Ratio	0.003	0.093	-	-	0.015	-
HCM Control Delay (s)	14.9	11.5	-	-	8.1	-
HCM Lane LOS	B	B	-	-	A	-
HCM 95th %tile Q(veh)	0	0.3	-	-	0	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr 02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	255	1	31	1	0	4	61	720	2	5	896	352
Future Volume (veh/h)	255	1	31	1	0	4	61	720	2	5	896	352
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	295	0	0	1	0	1	66	774	2	5	963	302
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	697	366	0	5	0	5	225	1564	695	24	1162	518
Arrive On Green	0.20	0.00	0.00	0.01	0.00	0.01	0.13	0.44	0.44	0.01	0.33	0.33
Sat Flow, veh/h	3563	1870	0	837	0	837	1781	3554	1578	1781	3554	1585
Grp Volume(v), veh/h	295	0	0	2	0	0	66	774	2	5	963	302
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1674	0	0	1781	1777	1578	1781	1777	1585
Q Serve(g_s), s	4.0	0.0	0.0	0.1	0.0	0.0	1.9	8.7	0.0	0.2	13.9	8.8
Cycle Q Clear(g_c), s	4.0	0.0	0.0	0.1	0.0	0.0	1.9	8.7	0.0	0.2	13.9	8.8
Prop In Lane	1.00		0.00	0.50		0.50	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	697	366	0	9	0	0	225	1564	695	24	1162	518
V/C Ratio(X)	0.42	0.00	0.00	0.22	0.00	0.00	0.29	0.49	0.00	0.21	0.83	0.58
Avail Cap(c_a), veh/h	705	370	0	301	0	0	352	1564	695	320	1201	536
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	19.6	0.0	0.0	27.5	0.0	0.0	22.0	11.1	8.7	27.1	17.3	15.6
Incr Delay (d2), s/veh	0.5	0.0	0.0	4.3	0.0	0.0	0.5	0.3	0.0	3.2	5.3	2.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	1.5	0.0	0.0	0.0	0.0	0.0	0.7	2.6	0.0	0.1	5.4	2.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.1	0.0	0.0	31.9	0.0	0.0	22.6	11.5	8.7	30.3	22.5	17.7
LnGrp LOS	C	A	A	C	A	A	C	B	A	C	C	B
Approach Vol, veh/h		295			2			842			1270	
Approach Delay, s/veh		20.1			31.9			12.3			21.4	
Approach LOS		C			C			B			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	4.9	30.7		15.5	11.2	24.4		4.5
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0
Max Q Clear Time (g_c+I1), s	2.2	10.7		6.0	3.9	15.9		2.1
Green Ext Time (p_c), s	0.0	4.2		0.6	0.0	2.3		0.0

Intersection Summary	
HCM 6th Ctrl Delay	18.1
HCM 6th LOS	B

Notes

User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th Signalized Intersection Summary
3: Benton Dr & Quartz Hill Rd
02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	52	159	296	65	59	8	107	193	44	11	386	33
Future Volume (veh/h)	52	159	296	65	59	8	107	193	44	11	386	33
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.97	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	60	183	273	75	68	6	123	222	31	13	444	35
Peak Hour Factor	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	78	292	512	95	309	262	298	268	37	14	464	37
Arrive On Green	0.04	0.16	0.16	0.05	0.17	0.17	0.17	0.17	0.17	0.28	0.28	0.28
Sat Flow, veh/h	1781	1870	1580	1781	1870	1585	1781	1600	223	49	1664	131
Grp Volume(v), veh/h	60	183	273	75	68	6	123	0	253	492	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1580	1781	1870	1585	1781	0	1823	1844	0	0
Q Serve(g_s), s	1.8	4.9	7.6	2.2	1.7	0.2	3.3	0.0	7.2	14.1	0.0	0.0
Cycle Q Clear(g_c), s	1.8	4.9	7.6	2.2	1.7	0.2	3.3	0.0	7.2	14.1	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.12	0.03		0.07
Lane Grp Cap(c), veh/h	78	292	512	95	309	262	298	0	305	515	0	0
V/C Ratio(X)	0.76	0.63	0.53	0.79	0.22	0.02	0.41	0.00	0.83	0.96	0.00	0.00
Avail Cap(c_a), veh/h	136	292	512	136	309	262	298	0	305	515	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	25.4	21.2	14.9	25.2	19.4	18.8	20.0	0.0	21.6	19.1	0.0	0.0
Incr Delay (d2), s/veh	5.7	3.2	0.6	11.4	0.1	0.0	0.3	0.0	16.2	28.6	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.8	2.2	3.2	1.2	0.7	0.1	1.3	0.0	4.1	9.2	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.1	24.4	15.4	36.6	19.6	18.8	20.4	0.0	37.8	47.6	0.0	0.0
LnGrp LOS	C	C	B	D	B	B	C	A	D	D	A	A
Approach Vol, veh/h		516			149			376			492	
Approach Delay, s/veh		20.4			28.1			32.1			47.6	
Approach LOS		C			C			C			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	6.4	13.4		20.0	5.9	13.9		14.0
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	4.1	8.4		15.0	4.1	8.4		9.0
Max Q Clear Time (g_c+I1), s	4.2	9.6		16.1	3.8	3.7		9.2
Green Ext Time (p_c), s	0.0	0.0		0.0	0.0	0.1		0.0

Intersection Summary		
HCM 6th Ctrl Delay		32.8
HCM 6th LOS		C

Notes
User approved pedestrian interval to be less than phase max green.

HCM 6th Signalized Intersection Summary
4: Market St & Quartz Hill Rd
02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	88	6	180	25	2	10	116	768	20	27	786	86
Future Volume (veh/h)	88	6	180	25	2	10	116	768	20	27	786	86
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	107	0	83	29	2	3	135	893	18	31	914	56
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	783	0	341	149	10	15	246	1203	24	117	943	418
Arrive On Green	0.22	0.00	0.22	0.10	0.10	0.10	0.14	0.34	0.34	0.07	0.27	0.27
Sat Flow, veh/h	3563	0	1554	1505	104	156	1781	3560	72	1781	3554	1576
Grp Volume(v), veh/h	107	0	83	34	0	0	135	446	465	31	914	56
Grp Sat Flow(s),veh/h/ln	1781	0	1554	1764	0	0	1781	1777	1855	1781	1777	1576
Q Serve(g_s), s	1.6	0.0	2.9	1.2	0.0	0.0	4.7	14.7	14.7	1.1	16.9	1.8
Cycle Q Clear(g_c), s	1.6	0.0	2.9	1.2	0.0	0.0	4.7	14.7	14.7	1.1	16.9	1.8
Prop In Lane	1.00		1.00	0.85		0.09	1.00		0.04	1.00		1.00
Lane Grp Cap(c), veh/h	783	0	341	175	0	0	246	601	627	117	943	418
V/C Ratio(X)	0.14	0.00	0.24	0.19	0.00	0.00	0.55	0.74	0.74	0.27	0.97	0.13
Avail Cap(c_a), veh/h	806	0	352	372	0	0	269	601	627	269	943	418
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	20.8	0.0	21.3	27.4	0.0	0.0	26.6	19.4	19.4	29.5	24.1	18.6
Incr Delay (d2), s/veh	0.1	0.0	0.4	0.4	0.0	0.0	0.8	5.9	5.7	0.4	22.3	0.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	1.1	0.5	0.0	0.0	1.8	6.1	6.4	0.4	9.0	0.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	20.9	0.0	21.7	27.8	0.0	0.0	27.4	25.3	25.1	29.9	46.4	18.9
LnGrp LOS	C	A	C	C	A	A	C	C	C	C	D	B
Approach Vol, veh/h		190			34			1046			1001	
Approach Delay, s/veh		21.2			27.8			25.5			44.3	
Approach LOS		C			C			C			D	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.6	28.2		18.8	13.4	23.4		10.8
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	17.6		* 15	* 10	17.6		14.0
Max Q Clear Time (g_c+I1), s	3.1	16.7		4.9	6.7	18.9		3.2
Green Ext Time (p_c), s	0.0	0.7		0.4	0.0	0.0		0.1

Intersection Summary		
HCM 6th Ctrl Delay		33.5
HCM 6th LOS		C

Notes
User approved pedestrian interval to be less than phase max green.
User approved volume balancing among the lanes for turning movement.
* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

HCM 6th TWSC
1: Stone Canyon Dr & Quartz Hill Rd 02/01/2023

Intersection	
Int Delay, s/veh	1.2

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	158	1	46	266	1	26
Future Vol, veh/h	158	1	46	266	1	26
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	130	260	-	0	25
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	10	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	166	1	48	280	1	27

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	167	0	542	166
Stage 1	-	-	-	-	166	-
Stage 2	-	-	-	-	376	-
Critical Hdwy	-	-	4.12	-	8.42	7.22
Critical Hdwy Stg 1	-	-	-	-	7.42	-
Critical Hdwy Stg 2	-	-	-	-	7.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1411	-	371	839
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	563	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1411	-	358	839
Mov Cap-2 Maneuver	-	-	-	-	358	-
Stage 1	-	-	-	-	787	-
Stage 2	-	-	-	-	544	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.1	9.6
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	358	839	-	-	1411	-
HCM Lane V/C Ratio	0.003	0.033	-	-	0.034	-
HCM Control Delay (s)	15.1	9.4	-	-	7.6	-
HCM Lane LOS	C	A	-	-	A	-
HCM 95th %tile Q(veh)	0	0.1	-	-	0.1	-

HCM 6th Signalized Intersection Summary
2: Market St & Benton Dr 02/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	339	0	41	3	1	6	67	903	3	0	599	301
Future Volume (veh/h)	339	0	41	3	1	6	67	903	3	0	599	301
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	398	0	0	3	1	2	73	982	3	0	651	255
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	733	385	0	14	5	9	243	1767	787	3	1002	436
Arrive On Green	0.21	0.00	0.00	0.02	0.02	0.02	0.14	0.50	0.50	0.00	0.28	0.28
Sat Flow, veh/h	3563	1870	0	861	287	574	1781	3554	1583	1781	3554	1547
Grp Volume(v), veh/h	398	0	0	6	0	0	73	982	3	0	651	255
Grp Sat Flow(s),veh/h/ln	1781	1870	0	1723	0	0	1781	1777	1583	1781	1777	1547
Q Serve(g_s), s	5.3	0.0	0.0	0.2	0.0	0.0	2.0	10.2	0.1	0.0	8.6	7.6
Cycle Q Clear(g_c), s	5.3	0.0	0.0	0.2	0.0	0.0	2.0	10.2	0.1	0.0	8.6	7.6
Prop In Lane	1.00		0.00	0.50		0.33	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	733	385	0	27	0	0	243	1767	787	3	1002	436
V/C Ratio(X)	0.54	0.00	0.00	0.22	0.00	0.00	0.30	0.56	0.00	0.00	0.65	0.58
Avail Cap(c_a), veh/h	735	386	0	323	0	0	367	1767	787	334	1253	545
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh	18.9	0.0	0.0	25.9	0.0	0.0	20.7	9.3	6.8	0.0	16.8	16.5
Incr Delay (d2), s/veh	0.9	0.0	0.0	1.5	0.0	0.0	0.5	0.5	0.0	0.0	1.3	2.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.0	0.0	0.0	0.1	0.0	0.0	0.7	2.8	0.0	0.0	3.0	2.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	19.9	0.0	0.0	27.4	0.0	0.0	21.3	9.8	6.8	0.0	18.1	18.6
LnGrp LOS	B	A	A	C	A	A	C	A	A	A	B	B
Approach Vol, veh/h		398			6			1058			906	
Approach Delay, s/veh		19.9			27.4			10.6			18.3	
Approach LOS		B			C			B			B	
Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	0.0	32.7		15.6	11.5	21.2		5.1				
Change Period (Y+Rc), s	* 4.2	6.2		4.6	* 4.2	6.2		4.2				
Max Green Setting (Gmax), s	* 10	19.8		11.0	* 11	18.8		10.0				
Max Q Clear Time (g_c+I1), s	0.0	12.2		7.3	4.0	10.6		2.2				
Green Ext Time (p_c), s	0.0	4.5		0.6	0.0	4.5		0.0				

Intersection Summary			
HCM 6th Ctrl Delay			15.1
HCM 6th LOS			B

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	55	86	205	50	167	19	265	282	42	11	182	66
Future Volume (veh/h)	55	86	205	50	167	19	265	282	42	11	182	66
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.99	1.00		0.99	1.00		0.97	1.00		0.99
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	61	96	186	56	186	11	294	313	40	12	202	54
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	83	267	606	78	262	221	428	389	50	15	248	66
Arrive On Green	0.05	0.14	0.14	0.04	0.14	0.14	0.24	0.24	0.24	0.18	0.18	0.18
Sat Flow, veh/h	1781	1870	1574	1781	1870	1574	1781	1619	207	81	1356	362
Grp Volume(v), veh/h	61	96	186	56	186	11	294	0	353	268	0	0
Grp Sat Flow(s),veh/h/ln	1781	1870	1574	1781	1870	1574	1781	0	1826	1799	0	0
Q Serve(g_s), s	1.6	2.2	3.9	1.5	4.5	0.3	7.1	0.0	8.6	6.8	0.0	0.0
Cycle Q Clear(g_c), s	1.6	2.2	3.9	1.5	4.5	0.3	7.1	0.0	8.6	6.8	0.0	0.0
Prop In Lane	1.00		1.00	1.00		1.00	1.00		0.11	0.04		0.20
Lane Grp Cap(c), veh/h	83	267	606	78	262	221	428	0	439	329	0	0
V/C Ratio(X)	0.74	0.36	0.31	0.71	0.71	0.05	0.69	0.00	0.80	0.82	0.00	0.00
Avail Cap(c_a), veh/h	154	292	627	191	331	279	526	0	539	379	0	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	0.00
Uniform Delay (d), s/veh	22.3	18.4	10.2	22.4	19.5	17.7	16.4	0.0	17.0	18.6	0.0	0.0
Incr Delay (d2), s/veh	4.7	0.3	0.1	4.5	3.2	0.0	1.7	0.0	5.8	10.0	0.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.8	1.7	0.6	1.9	0.1	2.6	0.0	3.7	3.3	0.0	0.0
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	27.0	18.7	10.3	26.8	22.6	17.7	18.1	0.0	22.7	28.6	0.0	0.0
LnGrp LOS	C	B	B	C	C	B	B	A	C	C	A	A
Approach Vol, veh/h		343			253			647			268	
Approach Delay, s/veh		15.6			23.3			20.6			28.6	
Approach LOS		B			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	5.6	11.8		13.7	5.7	11.7		16.4
Change Period (Y+Rc), s	3.5	5.0		5.0	3.5	5.0		5.0
Max Green Setting (Gmax), s	5.1	7.4		10.0	4.1	8.4		14.0
Max Q Clear Time (g_c+I1), s	3.5	5.9		8.8	3.6	6.5		10.6
Green Ext Time (p_c), s	0.0	0.1		0.1	0.0	0.1		0.7

Intersection Summary	
HCM 6th Ctrl Delay	21.4
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	38	1	140	27	4	16	253	844	40	30	641	53
Future Volume (veh/h)	38	1	140	27	4	16	253	844	40	30	641	53
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		0.98	1.00		0.97
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870	1870
Adj Flow Rate, veh/h	43	0	44	30	4	5	281	938	42	33	712	37
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	643	0	280	148	20	25	326	1276	57	122	904	391
Arrive On Green	0.18	0.00	0.18	0.11	0.11	0.11	0.18	0.37	0.37	0.07	0.25	0.25
Sat Flow, veh/h	3563	0	1553	1352	180	225	1781	3460	155	1781	3554	1539
Grp Volume(v), veh/h	43	0	44	39	0	0	281	482	498	33	712	37
Grp Sat Flow(s),veh/h/ln	1781	0	1553	1757	0	0	1781	1777	1838	1781	1777	1539
Q Serve(g_s), s	0.7	0.0	1.6	1.4	0.0	0.0	10.3	15.8	15.8	1.2	12.6	1.2
Cycle Q Clear(g_c), s	0.7	0.0	1.6	1.4	0.0	0.0	10.3	15.8	15.8	1.2	12.6	1.2
Prop In Lane	1.00		1.00	0.77		0.13	1.00		0.08	1.00		1.00
Lane Grp Cap(c), veh/h	643	0	280	192	0	0	326	655	678	122	904	391
V/C Ratio(X)	0.07	0.00	0.16	0.20	0.00	0.00	0.86	0.74	0.74	0.27	0.79	0.09
Avail Cap(c_a), veh/h	792	0	345	365	0	0	365	655	678	264	991	429
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.9	0.0	23.3	27.3	0.0	0.0	26.7	18.4	18.4	29.8	23.4	19.2
Incr Delay (d2), s/veh	0.0	0.0	0.3	0.4	0.0	0.0	16.0	5.2	5.1	0.4	4.9	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.3	0.0	0.6	0.6	0.0	0.0	5.4	6.4	6.6	0.5	5.2	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	23.0	0.0	23.6	27.7	0.0	0.0	42.7	23.7	23.5	30.3	28.3	19.4
LnGrp LOS	C	A	C	C	A	A	D	C	C	C	C	B
Approach Vol, veh/h		87			39			1261			782	
Approach Delay, s/veh		23.3			27.7			27.8			28.0	
Approach LOS		C			C			C			C	

Timer - Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.8	30.7		16.4	16.5	23.0		11.6
Change Period (Y+Rc), s	* 4.2	5.8		* 4.2	* 4.2	5.8		4.2
Max Green Setting (Gmax), s	* 10	22.6		* 15	* 14	18.8		14.0
Max Q Clear Time (g_c+I1), s	3.2	17.8		3.6	12.3	14.6		3.4
Green Ext Time (p_c), s	0.0	3.3		0.2	0.1	2.5		0.1

Intersection Summary	
HCM 6th Ctrl Delay	27.7
HCM 6th LOS	C

Notes

User approved pedestrian interval to be less than phase max green.

User approved volume balancing among the lanes for turning movement.

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Attachment G

Cultural Resources Inventory Survey, prepared by Gallaway Enterprises, December 6, 2022

Attachment F

Cultural Resources Inventory Survey

<u>NOTE TO REVIEWER</u>: Information contained in the *Cultural Resources Inventory Survey* for the Cottages at Bel Air Subdivision related to the specific location of prehistoric and historic sites is confidential and exempt from the Freedom of Information Act (FOIA) and the California Public Records Act (CPRA); therefore, site specific cultural resource investigations are not appended to this Initial Study. Professionally qualified individuals, as determined by the California Office of Historic Preservation, may contact the City of Redding Development Services Department, Planning Division directly in order to inquire about its availability.

Attachment H

Tree Inventory Canopy Assessment, prepared by Gallaway Enterprises, December 9, 2022

117 Meyers Street • Suite 120 • Chico CA 95928 • 530-332-9909

December 9, 2022

Zovest Capital, LLC
1309 Coffeen Avenue
Suite 1200
Sheridan, Wyoming 82801

Re: Tree Canopy Assessment for the Cottages at Bel Air Property – City of Redding, California.

As requested, Gallaway Enterprises conducted an assessment of tree resources within the Cottages at Bel Air Property in November 2022. The following is a summary of the methodology and results of the assessment.

Location

The approximately 28-acre Property is located within the US Geological Survey (USGS) Redding Quadrangle, Section 23 of Township 32 North, Range 05 West. The Property is situated south of Quartz Hill Road, and west of Interstate 5.

Approach

The assessment was conducted with the intent of addressing survey requirements for the City of Redding Tree Preservation Ordinance (Chapter 18.45 of the Municipal Code) and oak tree preservation guide.[1]

The Property is large (approximately 28 acres) and contains a high density of oak woodland/tree resources. Therefore, a tree-by-tree inventory methodology is not well suited to assessing tree resources within the Property for several reasons:

1) The lengthy timeframe in which developments are implemented means that trees grow, age and die, therefore the tree-by-tree inventory approach has a limited lifespan; and
2) The cost to conduct a tree-by-tree inventory on a site of this size with the amount of resources present would be inefficient, especially in light of reason 1) above.

Therefore, the approach for this survey included determining the canopy coverage of trees through remote sensing and then ground truthing sample areas to determine the accuracy of the remote sensing and collect data to estimate the number of individual trees, tree species, and diameter at breast height (DBH) per acre of canopy. This approach is appropriate for this survey based on the size of the site, number of trees involved, and uniformity of tree conditions (e.g., species, size, health, etc.). To verify the acceptability of using this approach to address all applicable oak conservation and preservation

[1] City of Redding. Trees & Construction, A Guide to Preservation. Document can be found at: http://www.cityofredding.org/home/showdocument?id=3720

regulations, the City of Redding Planning Manager, Lily Toy, was contacted prior to initiating this survey approach.

Survey Methods

The canopy area of the oak woodland was analyzed through a combination of remote sensing in Geographic Information Systems (GIS) and ground truthing of sample plots. To determine canopy coverage via remote sensing, an aerial image was selected that captures "leaf on" conditions of the trees and the color signature of trees and tree canopy was identified and turned into a separate layer in GIS. Three, 1-acre sample plots were then established and Gallaway Enterprises staff conducted a field assessment to identify the number of individual trees, tree species, DBH, and map actual canopy dripline in each sample plot. The ground truthing was performed to verify the accuracy of the remote sensing canopy evaluation as well as to gain insight on the species composition, average DBH, and average number of trees present in a given acre of canopy area.

Results

The field survey identified the dominant tree type as being Oak trees (95.2% of the trees identified within the plots), with a minor amount of foothill pine trees (4.8% of the trees). The following is a summary of information obtained from the field survey evaluation:

- Average number of oak trees per acre of oak canopy = 51 trees
- Average number of pine trees per acre of pine canopy = 2.3 trees
- Average DBH of oak trees = 10 inches
- Average DBH of pine trees = 4 inches

The remote sensing canopy analysis identified 5.87 acres of oak canopy (**Figure 1**) totaling 21% of the total Property's acreage and 0.11 acres of pine canopy totaling 0.03% of the total Property's acreage. When comparing the remote sensing effort to the field verification of oak canopy within the sample plots, the average oak canopy cover identified by remote sensing was 29.4% (range of 22.9% to 40%) whereas the field verification identified an average oak canopy of 27.2% (range of 20.4% to 37.9%). Based on this comparison, it was determined that the remote sensing canopy analysis on average overestimated the oak canopy cover by 2.2%. When comparing the remote sensing effort to the field verification of pine canopy within the sample plots, the average pine canopy cover identified by remote sensing was 1.8% (range of 0% to 5.4%) whereas the field verification identified an average pine canopy of 2.3% (range of 0% to 6.9%). Based on this comparison, it was determined that the remote sensing canopy analysis on average underestimated the pine canopy by 0.5%.

Conclusions/Recommendations

As specified above, there is justification why a standard tree-by-tree inventory of the Property is not feasible and not warranted due to the nature of the review necessary to determine the project's potential impacts on trees. Further, the inventory methods described within this report have been deemed acceptable by the City Planning Manager for this Property as an alternative to conducting a more intensive tree-by-tree inventory. However, if during the course of the project planning and design it is proposed to preserve any existing trees or grouping of trees within the Property, an individual tree survey of these preserved trees may be warranted and a map depicting all preserved trees will need to be provided to the City per their Tree Preservation Ordinance.

The comparison between the results of the remote sensing effort and the field verification within the sample plots demonstrated that the slight differences between the remote sensing and field verification of canopy cover is negligible. Therefore, there is a high confidence level in the accuracy of the remote sensing effort.

A total of 5.87 acres of oak canopy and 0.11 acres of pine canopy have been determined to occur within the Property (**Figure 1**). By conducting a simple extrapolation of the number of trees identified within the survey plots across the entire Property, there is an estimated 1098 oak trees within the Property and an estimated 11 pine trees within the Property.

Should you have any questions, please do not hesitate to contact me at (530) 332-9909 or kevin@gallawayenterprises.com.

Sincerely,

Kevin Sevier, Vice President
Gallaway Enterprises

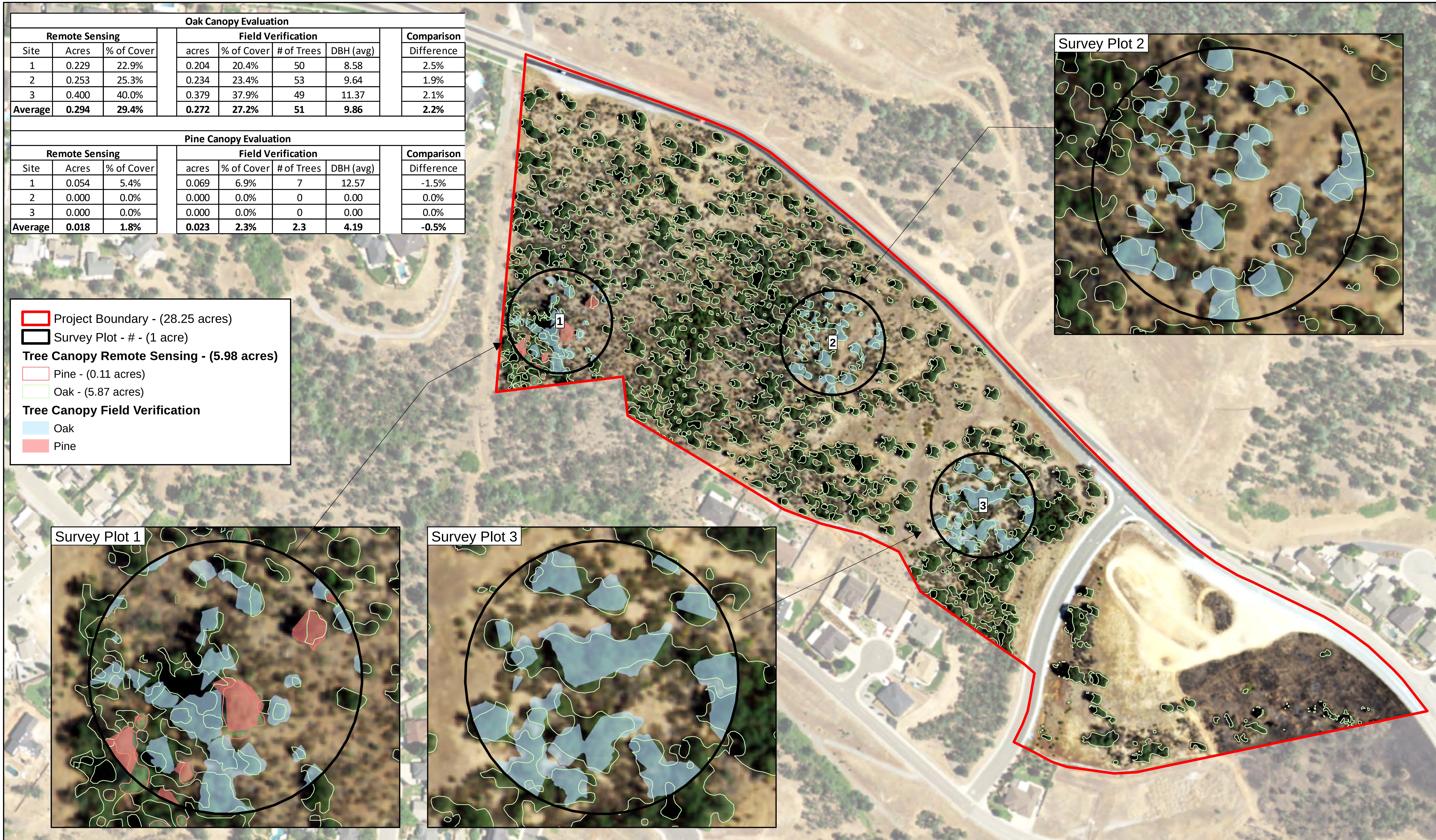
Encl: Figure 1 – Tree Canopy Assessment Map

Oak Canopy Evaluation

Remote Sensing				Field Verification					Comparison
Site	Acres	% of Cover		acres	% of Cover	# of Trees	DBH (avg)		Difference
1	0.229	22.9%		0.204	20.4%	50	8.58		2.5%
2	0.253	25.3%		0.234	23.4%	53	9.64		1.9%
3	0.400	40.0%		0.379	37.9%	49	11.37		2.1%
Average	**0.294**	**29.4%**		**0.272**	**27.2%**	**51**	**9.86**		**2.2%**

Pine Canopy Evaluation

Remote Sensing				Field Verification					Comparison
Site	Acres	% of Cover		acres	% of Cover	# of Trees	DBH (avg)		Difference
1	0.054	5.4%		0.069	6.9%	7	12.57		-1.5%
2	0.000	0.0%		0.000	0.0%	0	0.00		0.0%
3	0.000	0.0%		0.000	0.0%	0	0.00		0.0%
Average	**0.018**	**1.8%**		**0.023**	**2.3%**	**2.3**	**4.19**		**-0.5%**



NORTH 1:2,400 1 inch = 200 feet

0 250 500 Feet

Data Sources: ESRI, Shasta County, NAIP 2020

Cottages at Bel Air
Tree Canopy Assessment
Figure 1

gallaway ENTERPRISES

GE: #22-130 Map Date: 11/28/2022

Attachment I

Tree Health Assessment, prepared by Gallaway Enterprises, April 9, 2024

gallaway
ENTERPRISES

117 Meyers Street • Suite 120 • Chico CA 95928 • 530-332-9909

April 9, 2024

Nicole Dues
Sharrah Dunlap Sawyer, Inc.
320 Hartnell Ave, Redding, CA 96002
ndues@sdsengineering.com
(530) 221-1792

Re: Tree Resources Health Assessment for The Cottages at Bel Air, Redding, California

Ms. Dues,

As requested, Gallaway Enterprises conducted a Tree Resources Health Assessment for The Cottages at Bel Air, Redding, California on April 2, 2024. Please find enclosed a summary of the results of the assessment conducted.

Site Location

The survey area is located on the southwest side of Quartz Hill Road in Redding, California from 40.612894 latitude, -122.411635 longitude to 40.608861 latitude, -122.404315 longitude.

Environmental Setting

The Project area is a 28.25-acre parcel on the southwest side of Quartz Hill Road. The survey area was limited to the area within the grading limits within the Project area. The survey area is composed of primarily blue oak-foothill pine habitat dominated by manzanita (*Arctostaphylos sp.*), as well as an area composed of annual grassland, barren, and palustrine habitats void of any trees. The surrounding area is comprised of residential sub-division development to the south, west, and east of the Project area, and rural development to the north. The majority of the trees that occur within the survey area are blue oak (*Quercus douglasii*), gray pine (*Pinus sabiniana*), and interior live oak (*Quercus wislizeni*).

Survey Method

Gallaway Enterprises' biologist Nick Perazzo conducted a Tree Health Assessment on April 2, 2024, within the Project area. The assessment was conducted on foot within the survey area. Stands of trees with similar characteristics of size and/or health were grouped into zones and given a general health assessment. Tree health scores were assigned to all tree stands within the survey area following a health rating scale of 0 to 5, with 0 being dead and 5 being excellent. The health ratings were based on the following standards:

0 - These trees are standing dead trees.

1 - These trees have major defects that could result in the tree or portions of the tree (e.g. branches) to be unstable or to fail. The defect is typically extensive decay or cavity located within the trunk or numerous dead/decayed branches, and/or in severe decline.

2 - These are generally sound trees but often have prominent leans, trunk elongation, or general crown and branching defects. Other potential health detractors include over-competition with other trees, extensive epicormic sprouting, excessive deadwood and/or dieback. These trees are of low vigor, weak, slow growing, and/or stressed.

3 - These are average trees; generally, in good health and without prominent defects in their branching pattern and overall structure. These trees typically have adequate growing room and are not overgrown with mistletoe, poison oak or ivy. These trees are of average vigor for its species and site conditions.

4 - These trees are above average, with good branch form. The trees are not overcrowded or light-starved and have typically have plenty of room to grow. These trees often look much like a “3” except they are larger, older, and better established in the tree stand. They are of normal to high vigor, are growing well and appear to be free of significant health stress factors.

5 - These trees are considered excellent in all aspects: form, branching, and structure.

Tree health scores identified by Mr. Perazzo are portrayed in **Attachment A,** and the general health of the trees and species names within each tree stand are depicted in **Attachment B**.

Results of the Tree Health Assessment

A total of 9 tree stands were identified and surveyed based on similar health ratings of the trees within each specific zone.

No tree stands were assigned a rating greater than 3. The average health of the tree stands was a 2.

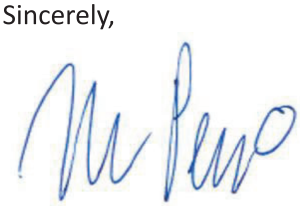
No individual trees were identified to be exceptionally healthy and mature within the survey area.

Recommendations

Gallaway Enterprises has no recommendations at this time.

Should you have any questions or need any additional information on managing trees during construction, please do not hesitate to contact Kevin Sevier at (530) 332-9909 or kevin@gallawayenterprises.com.

Sincerely,



Nick Perazzo, Biologist
Gallaway Enterprises

Attachment A: Tree Health Map
Attachment B: Tree Table
Attachment C: Project Site Photos

NORTH

1:4,250

0 250 500 Feet

Data Sources: ESRI, SDS Engineering, Maxar 06/23/2023 & 09/08/2023

Cottages at Bel Air
Tree Health Map
Attachment A

gallaway ENTERPRISES

GE: #22-130 Map Date: 04/08/2024

Attachment B

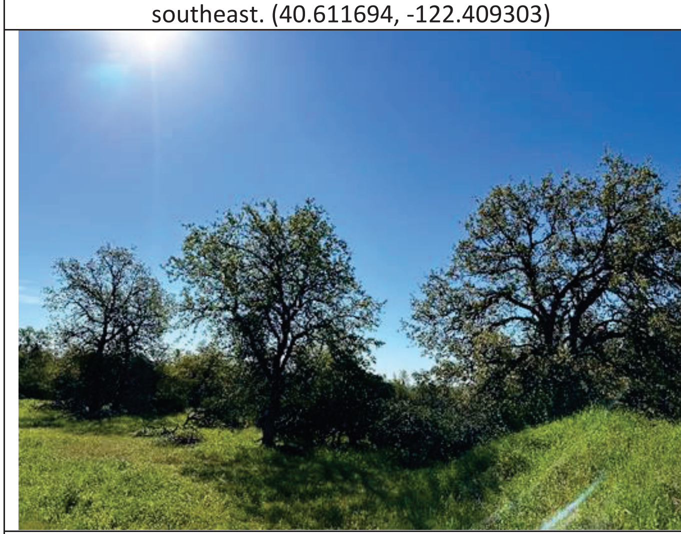
Tree Table

Tree Resources Health Assessment for The Cottages at Bel Air, Redding, California		
TS - Tree Stand #	Species	Rating
TS 1	Blue Oak	3
TS 2	Blue Oak & Gray Pine	2
TS 3	Blue Oak & Gray Pine	3
TS 4	Blue Oak	1
TS 5	Blue Oak & Gray Pine	3
TS 6	Blue Oak	1
TS 7	Blue Oak & Interior Live Oak	2
TS 8	Blue Oak	1
TS 9	Blue Oak	3

Attachment C

Project Site Photos

Photos Taken: April 2, 2024

	
Manzanita dominates much of the survey area, facing southeast. (40.611694, -122.409303)	Tree stand (TS) 1 comprised of blue oak, facing west. (40.612183, -122.411322)
	
Northwest portion of TS 2 comprised of blue oak, facing southeast. (40.612761, -122.411614)	Northeast portion of TS 2 comprised of blue oak, facing east. (40.612328, -122.410575)

TS 3 comprised of blue oak and a gray pine, facing north. (40.611989, -122.411147)

TS 5 comprised of blue oak and gray pine, facing northwest. (40.611664, -122.409356)

TS 6 with dead blue oak mixed within live blue oak, facing north. (40.611028, -122.409036)

TS 7 comprised of blue oak and an interior live oak, facing southeast. (40.610569, -122.408219)

Middle portion of TS 7 comprised of blue oak, facing north. (40.610583, -122.408492)

Northwest portion of TS 7 comprised of blue oak, facing west. (40.610772, -122.407639)

	
Dead blue oaks within the survey area at TS 8, facing west. (40.610828, -122.409028)	TS 9 comprised of blue oak, facing south. (40.610656, -122.407447)

The Cottages at Bel Air Subdivision
TENTATIVE SUBDIVISION MAP S-2023-00803

MITIGATION MONITORING PROGRAM CONTENTS

This document is the Mitigation Monitoring Program (MMP) for the Cottages at Bel Air Subdivision. The MMP includes a brief discussion of the legal basis for and purpose of the program, discussion and direction regarding complaints about noncompliance, a key to understanding the monitoring matrix, and the monitoring matrix itself.

LEGAL BASIS OF AND PURPOSE FOR THE MITIGATION MONITORING PROGRAM

California Public Resources Code Section 21081.6 requires public agencies to adopt mitigation monitoring or reporting programs whenever certifying an Environmental Impact Report (EIR) or a Mitigated Negative Declaration. This requirement facilitates implementation of all mitigation measures adopted through the California Environmental Quality Act (CEQA) process.

The MMP contained herein is intended to satisfy the requirements of CEQA as they relate to the Initial Study/Mitigated Negative Declaration prepared for the Cottages at Bel Air Subdivision. It is intended to be used by City of Redding (City) staff, participating agencies, project contractors, and mitigation monitoring personnel during implementation of the project.

Mitigation is defined by CEQA Guidelines Section 15370 as a measure that does any of the following:

- Avoids impacts altogether by not taking a certain action or parts of an action.
- Minimizes impacts by limiting the degree or magnitude of the action and its implementation.
- Rectifies impacts by repairing, rehabilitating or restoring the impacted environment.
- Reduces or eliminates impacts over time by preservation and maintenance operations during the life of the project.
- Compensates for impacts by replacing or providing substitute resources or environments.

The intent of the MMP is to ensure the effective implementation and enforcement of adopted mitigation measures and permit conditions. The MMP will provide for monitoring of construction activities as necessary, on-site identification and resolution of environmental problems, and proper reporting to City staff

Mitigation Monitoring Table

The Mitigation Monitoring Table identifies the mitigation measures proposed for the Cottages at Bel Air Subdivision. These mitigation measures are reproduced from the Initial Study and conditions of approval for the project. The tables have the following columns:

Mitigation Measure: Lists the mitigation measures identified within the Initial Study for a specific impact, along with the number for each measure as enumerated in the Initial Study.

Timing: Identifies at what point in time, review process, or phase the mitigation measure will be completed.

Agency/Department Consultation: References the City department or any other public agency with which coordination is required to satisfy the identified mitigation measure.

Verification: Spaces to be initialed and dated by the individual designated to verify adherence to a specific mitigation measure.

Noncompliance Complaints

Any person or agency may file a complaint asserting noncompliance with the mitigation measures associated with the project. The complaint shall be directed to the City in written form, providing specific information on the asserted violation. The City shall conduct an investigation and determine the validity of the complaint. If noncompliance with a mitigation measure has occurred, the City shall take appropriate action to remedy any violation. The complainant shall receive written confirmation indicating the results of the investigation or the final action corresponding to the particular noncompliance issue.

Mitigation Monitoring Table
For the Cottages at Bel Air Subdivision MMP

Mitigation Measure	Timing/ Implementation	Enforcemen/ Monitoring	Verification (Date and Initials)
Biological Resources			
MM-Bio-1 To the extent practicable, removal of large trees with cavities shall occur before bat maternity colonies form (i.e., prior to March 1) or after young are volant (i.e., after August 15). If construction (including the removal of large trees) occurs during the bat non-volant season (March 1 through August 15), a qualified professional shall conduct a pre-construction survey of the study area to locate maternity colonies and identify measures to protect colonies from disturbance. The preconstruction survey will be performed no more than seven (7) days prior to the implementation of construction activities. If a maternity colony is located within the study area, or adjacent to the study area, a disturbance free buffer shall be established by a qualified professional, in consultation with the California Department of Fish and Wildlife to ensure the colony is protected from project activities.	At time of development	Public Works, Planning	
MM-Bio-2 If vegetation removal or construction activities will occur during the nesting season for migratory birds and raptors (February 1 through August 31), a qualified biologist shall conduct a pre-construction survey seven (7) days before construction activities begin. If any candidate, sensitive, or special-status nesting birds are found, the California Department of Fish and Wildlife (CDFW) will be notified and consulted. An appropriate buffer, as determined by the CDFW and the qualified biologist, will be placed around the nest until the young have fledged. If construction activities cease for a period greater than 7 days, additional preconstruction surveys will be required.	At time of development	Public Works, Planning	

Mitigation Measure	Timing/ Implementation	Enforcement/ Monitoring	Verification (Date and Initials)
Biological Resources			
MM-Bio-3. Any impacts to the detention basin identified in the biological report or drainages on the project site shall have a pre-construction rare plant survey for the Red Bluff dwarf rush conducted by a qualified botanist during the appropriate survey window (blooming period) for rare plants that have the potential to occur within the project site, as deemed appropriate by the California Department of Fish and Wildlife. Any required survey shall be in accordance with California Native Plant Society *Botanical Survey Guidelines* (CNPS 2001), California Department of Fish and Wildlife *Protocols for Surveying and Evaluating Impacts to Special Status Plant Species Native Plant Populations and Natural Communities* (CDFW 2009), and U.S. Fish and Wildlife's *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 2000). If present, special status plant species plant populations will be flagged and if possible avoided during construction. If the population cannot be avoided during construction a mitigation plan will be developed for approval by the California Department of Fish and Wildlife which could include transplanting the plant population or compensation.	At time of development	Public Works, Planning	