UPDATED MASTER PLAN FLOOD RISK ANALYSIS AND PHASE I MASTER PLAN PULGAS CREEK FLOODING ANALYSIS

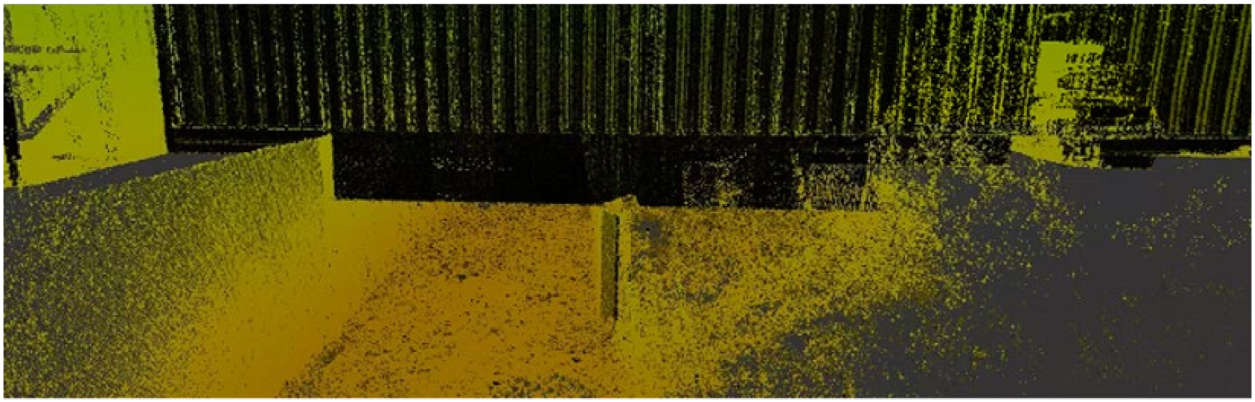
APPENDIX K

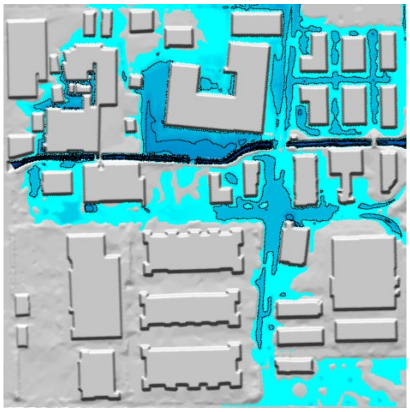
to the
Alexandria Center for Life Science Project Final EIR

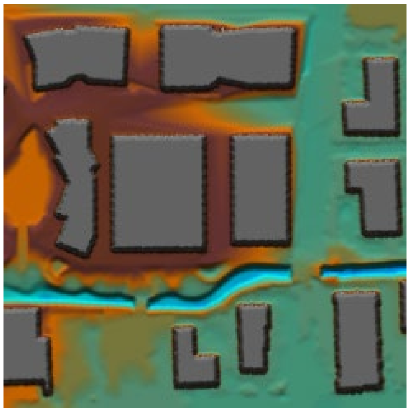
Alexandria Center for Life Sciences at San Carlos (ACLS)

Updated Master Plan Pulgas Creek Flooding Analysis

San Carlos, California







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List of Acronyms

1D	One-dimensional
2D	Two-dimensional
ACST	Alexandria Center for Science & Technology at San Carlos
AF	acre-feet
cfs	Cubic Feet per Second
CLOMR	Conditional Letter of Map Revision
F&L	Freyer & Laureta, Inc.
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
ft	Feet
HEC-RAS	Hydrologic Engineering Center – River Analysis System
LiDAR	Light Detection and Ranging
MHHW	Mean Higher High Water
lb/sf	Pounds per Square Foot
n	Manning's roughness coefficient
NOAA	National Oceanic and Atmospheric Administration
PLS	Professional Land Surveyor
Q	Discharge or Streamflow
Q10	Discharge or Streamflow of a 10-year flood event
Q100	Discharge or Streamflow of a 100-year flood event
RS	River Station
TOB	Top of Bank
WSEL	Water Surface Elevation

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1.0 EXECUTIVE SUMMARY

WRA, Inc. has conducted hydraulic studies for the revised Alexandria Center for Life Sciences (ACLS) 2024 Master Plan (Project) in the City of San Carlos, San Mateo County (City Planning submission #PLN2020-00032). The Project site is adjacent to the north side of Pulgas Creek, south of Commercial Street between Old County Road and Industrial Road. WRA completed flood modeling for the original Project design in a report dated November 2020 (WRA, Inc., 2020a). This report provides flood modeling results for the revised 2024 Master Plan dated August 9, 2024. Modeling indicates that the flood management strategies that are incorporated into the 2024 design can successfully address potential flood issues associated with the Project.

The hydraulic modeling for the current Project design was performed using the same modeling software, but updated version (HEC-RAS version 6.6) and combination of creek and study area model types (one-dimensional [1D] model of the Pulgas Creek channel and two-dimensional [2D] model of surrounding areas) as the November 2020 modeling study. No changes to any off-site areas were made in the model set-up, and the model's boundary conditions and hydrologic inputs were held constant.

The current Project design incorporates flood management strategies that were developed as part of the November 2020 study with the intent of successfully meeting key performance targets:

- Offsite flooding would be equivalent to existing conditions.
- The Project building layout would be preserved.
- Project operations and flood cleanup needs within the Project site would be minimized.

The individual key design features utilized to achieve these goals are:

1. Allowing inflow of flood waters to a lowered landscape depression on the site in a predictable, controlled fashion via a surface swale or culvert on the north bank of Pulgas Creek downstream of the dual container crossing. The model represented this as a surface swale with an invert elevation (at the creek bank) of 11.5 feet[1] and a slope ranging from 0.5% to 2% up to the landscape depression.
2. Facilitating the outflow of water to return from the landscape depression to the creek via the same swale or culvert described in the note above as the flood hydrograph peak passes.
3. Creating a floodplain flow path within a landscaped area along the northern bank of Pulgas Creek within the site, modeled to have an upstream finished grade sloping from an elevation of 12 feet (west end) to an elevation of 10.5 feet at the east end connection with Industrial Road, and widening of Pulgas Creek within the site. This would allow flood waters to roughly mimic existing conditions by permitting flow to overbank, slow down, then flow into Industrial Road.

Each of these design features will be further optimized for the Project construction drawings to fully realize their functionality and verify their performance relative to the flood impact requirements of the City, the project layout and project operations targets.

[1] *Elevations presented in North American Vertical Datum of 1988 (NAVD88)*

2.0 INTRODUCTION

2.1 Site Overview

The proposed *Alexandria Center for Life Sciences at San Carlos* (ACLS) (Project) is adjacent to the north side of Pulgas Creek in the City of San Carlos, San Mateo County, south of Commercial Street between Old County Road and Industrial Road (City Planning submission #PLN2020-00032).

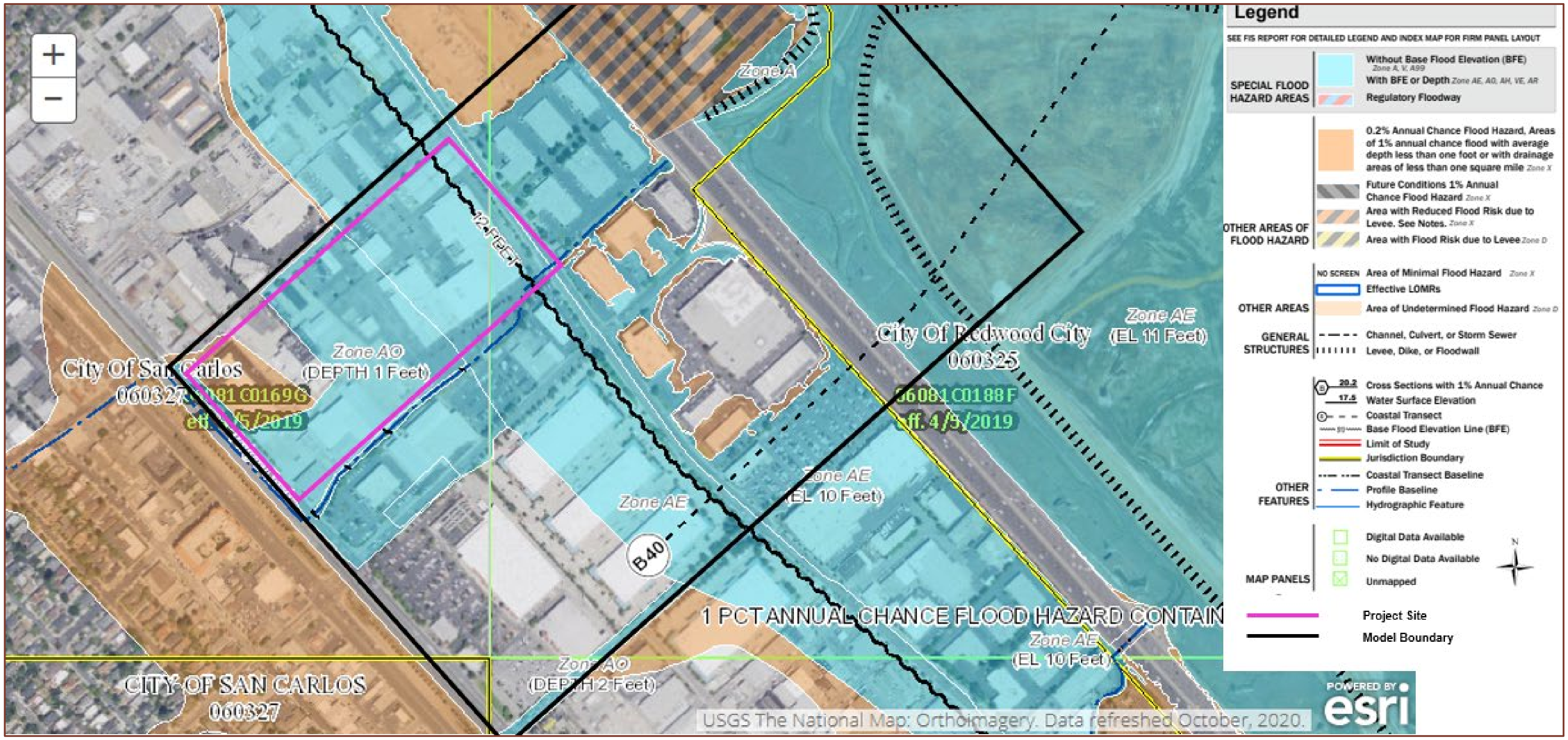
2.2 Purpose, Scope and Limitation

WRA, Inc. has conducted hydraulic studies for the Project to describe the existing flood conditions of the Project site and vicinity from watershed runoff, assess the potential for the Project to modify flooding, and determine design features to avoid and minimize changes to post-project flood patterns. WRA produced a memo in November 2020 showing modeling results for a proposed Project design that reduced the potential adverse flooding impacts of the Project during both the 10-year flood and 100-year flood (WRA, Inc., 2020a). The Project design has since been updated and this memo re-evaluates the flood modeling for the proposed design updates.

3.0 VICINITY FLOODING CONTEXT

The Project vicinity is the low-lying, nearly level Bayshore portion of the City of San Carlos adjacent to the City of Redwood City which has Special Flood Hazard Areas designated by the Federal Emergency Management Agency (FEMA) (FEMA Flood Map Service Center, n.d.)(Figure 1) extending generally parallel to the Bayshore. Much of the Project site (shown with magenta outline) is in the FEMA flood zone overlay (Figure 1). The model boundary (i.e., study area) for the Project specific flood analysis is shown with a black outline (Figure 1).

The City of San Carlos's (City) Storm Drain Master Plan (GHD, 2018) includes a hydrologic model of the watershed and urban system of open channels, pipe networks, and pump stations for a range of storm events including the 100-year and 10-year base conditions. Pulgas Creek is one of the four primary creeks in the GHD hydrologic model. The lower Pulgas Creek segment in our study is the low gradient (0.5 percent slope) portion downstream of underground culvert systems that daylight near Old County Road. The GHD model results for the Base Condition (i.e., existing conditions) of Project site and vicinity indicate overbank inundation on the Project site and across Pulgas Creek to the south within the Project reach between Old County and Industrial Roads under both of these storms (Figure 2 and Figure 3). The area and extent of inundation estimated by the GHD model is similar for the 10-year and 100-year events.



Reference: FEMA Flood Map Service Center (https://msc.fema.gov/portal/home)

Figure 1. Effective FEMA Flood Information Rate Map (FIRM) for the Project Vicinity

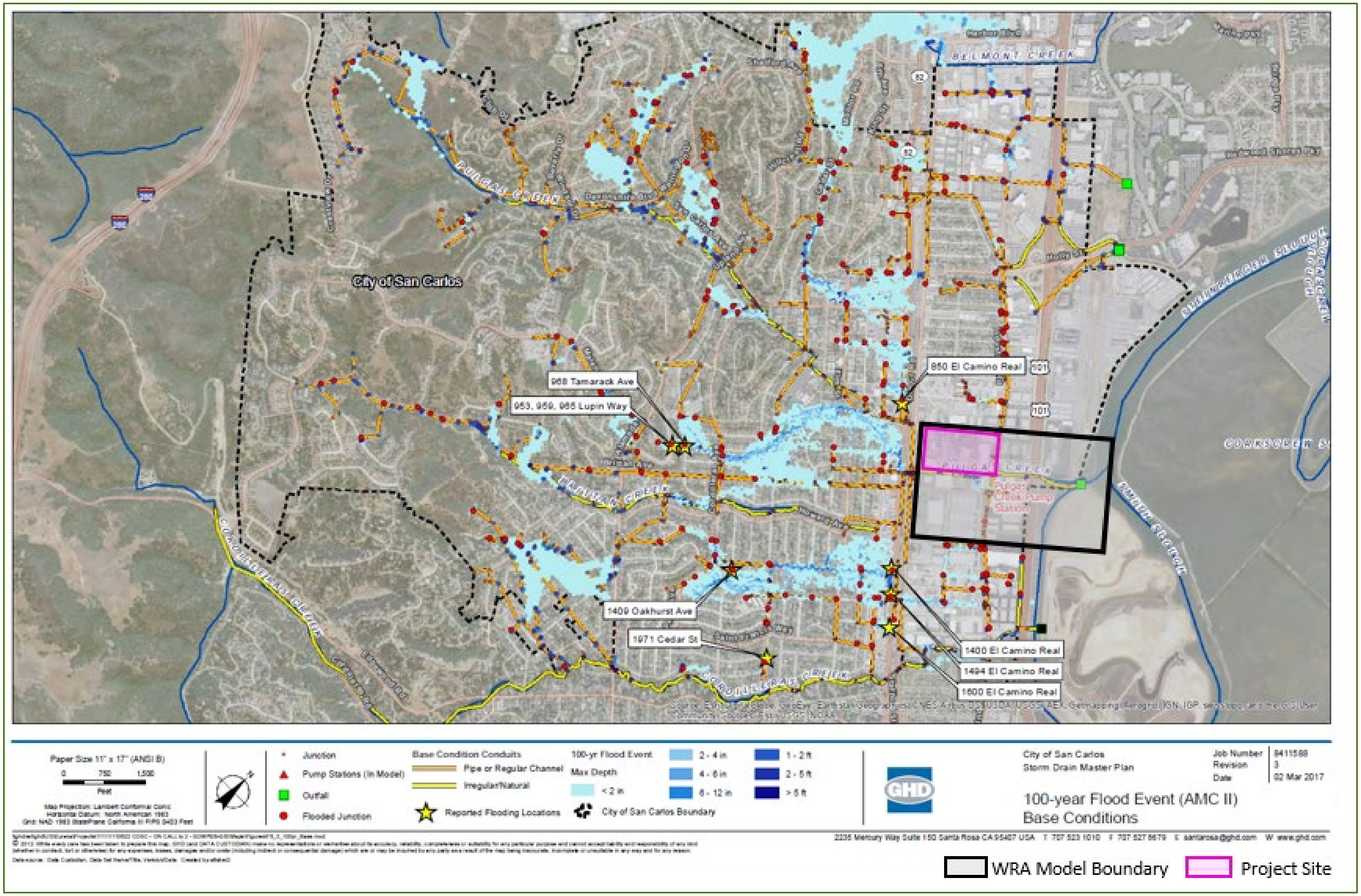


Figure 2. Storm Drain Master Plan 100-year Flood Event Base Conditions

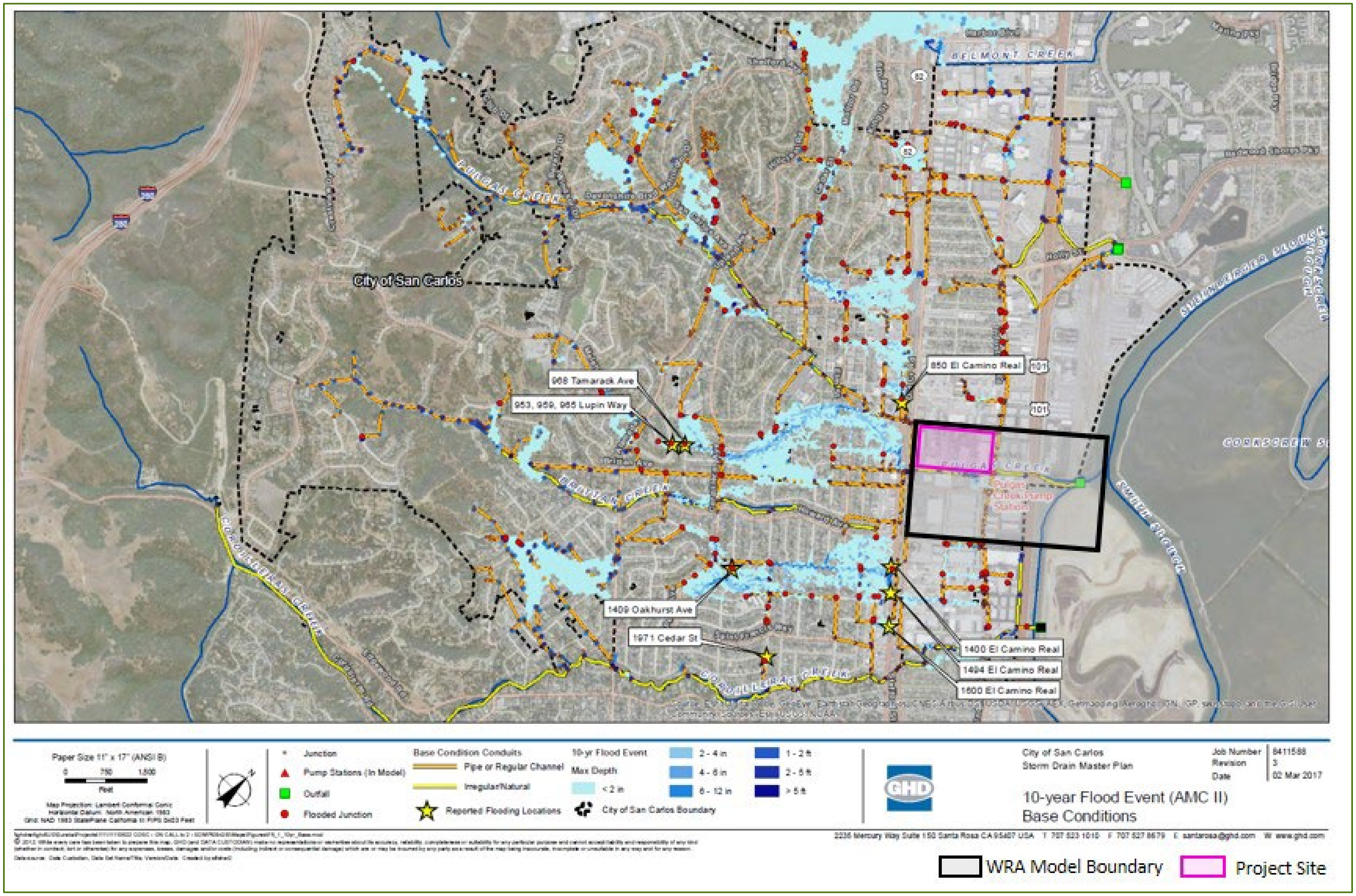


Figure 3. Storm Drain Master Plan 10-year Flood Event Base Conditions

4.0 HYDRAULIC MODEL DEVELOPMENT

WRA developed a baseline model for the Project Site in 2020 using HEC-RAS based on a one-dimensional [1D] model of the Pulgas Creek channel and two-dimensional [2D] model of surrounding areas (WRA 2020b).

The baseline model was calibrated by comparison of the WRA HEC-RAS model results and the GHD PCSWMM model results. The WRA model was reasonably consistent with the GHD results in pattern and relative flood extent. The GHD model was at a lower level of resolution than the WRA Project-specific model, since the GHD model was addressing the entire City storm drain system and all contributing watersheds.

4.1 Model Extent

The 0.275 square mile (169 acre) model boundary (i.e., study area), 0.04 square mile (25 acre) Project site, and stream channel cross section locations used for the 100-year event modeling were applied for both the baseline condition and the evaluation of the Project design.

4.2 Topographic and Bathymetric Data

The site and Pulgas Creek (including the onsite parking lot bridge) were surveyed in July 2020 by a professional land surveyor (PLS) under contract to Freyer & Laureta, Inc. (F&L). The survey effort included a 3D scan of the container crossing and the downstream side of Industrial Road. A field survey of the remaining bridges (the upstream side of Industrial Road, the off-site parking lot bridge and Highway 101) was performed by F&L. Topographic data from a National Oceanic Atmospheric Administration (NOAA) Light Detection and Ranging (LiDAR) scan from 2010 was used to complete the topographic information for the entire model boundary area. F&L compiled the topographic and bathymetric information from all the different sources to create a continuous ground surface which was used as the basis for topography within the Study Area.

4.3 Existing Buildings

The existing building footprints and heights for the existing conditions modeling for this current updated modeling effort were kept consistent with the modeling completed in 2020.

4.4 Channel Crossings

The channel crossings (i.e., bridges) for the existing conditions modeling are represented in the same manner as for the previous modeling completed in 2020.

4.5 Channel Profile

The existing channel bed and streambank elevation profiles for the existing conditions modeling are the same as for the previous modeling efforts completed in 2020).

4.6 Downstream Boundary Conditions

The downstream boundary conditions for the current modeling are kept the same as for the previous modeling effort in 2020.

4.7 Upstream and Project Reach Inflows

4.7.1 Upstream Inflow Hydrograph

The same 100-year peak flow magnitude and unsteady hydrograph applied in the existing conditions and Project modeling completed in 2020 is used for the current modeling effort. The 10-year peak flow magnitude and unsteady hydrograph from the GHD study was used for the 10-year flood event in both the 2020 analysis and this current update. The same data (GHD model node J24) is the source to represent the upstream watershed runoff inputs to the project reach for the 100-year and 10-year storms (Figure 4). Both hydrographs rise fairly steeply to a peak discharge around the six-hour mark of the storm, then decrease over the next couple of hours, but remain elevated (i.e., flows remain over 200 cfs for the 100-year event and over 100 cfs for the 10-year event) from hour 10 through 24.

4.7.2 Project Reach Inflows

The existing input flows in the Project reach and further downstream are simulated consistent with the City's storm drain master plan model base condition for each storm (Figure 5 and Figure 6). The pump station along Pulgas Creek downstream of Industrial Road is assumed to be operating at capacity (~75 cfs total) as a worst-case/conservative status, and is the largest of the lateral inputs. Other inflows to the Project reach are small, with peaks less than 30 cfs for the 100-year event (Figure 5) and less than 20 cfs for the 10-year event (Figure 6).

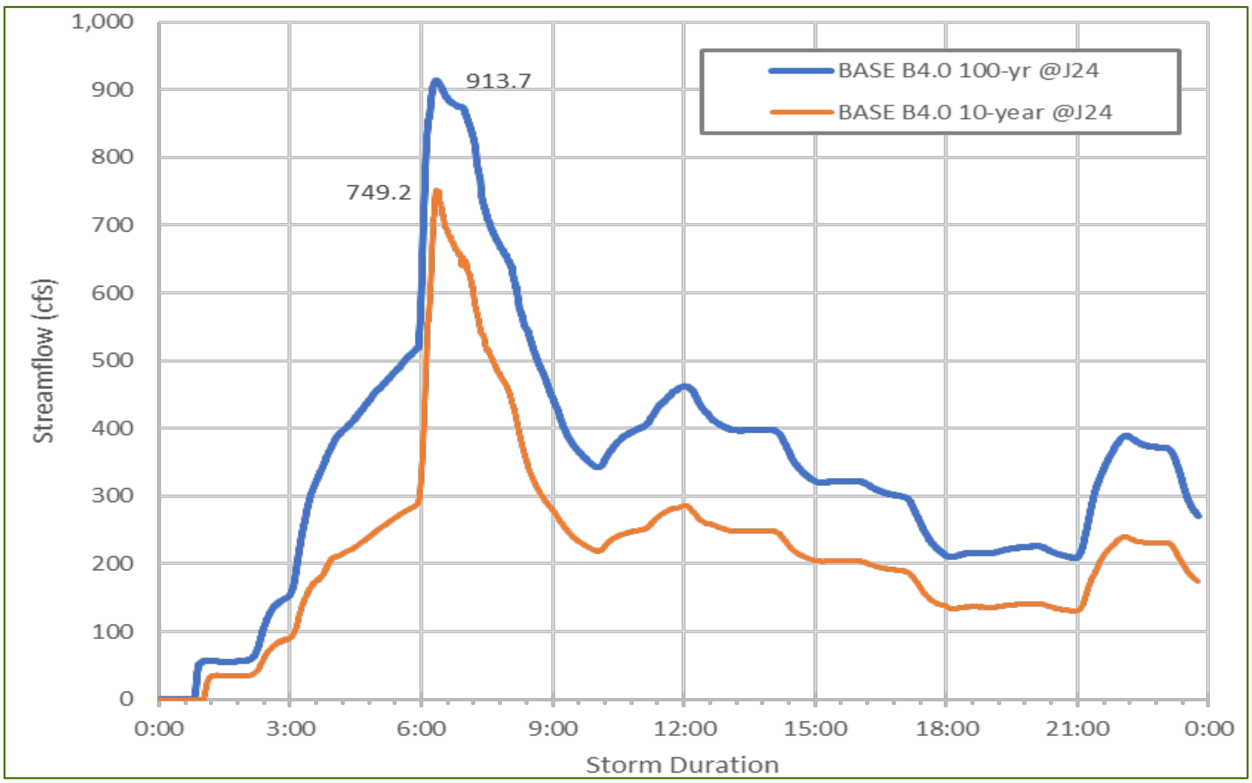


Figure 4. Upstream Input Hydrograph - 100-year and 10-year Base Conditions

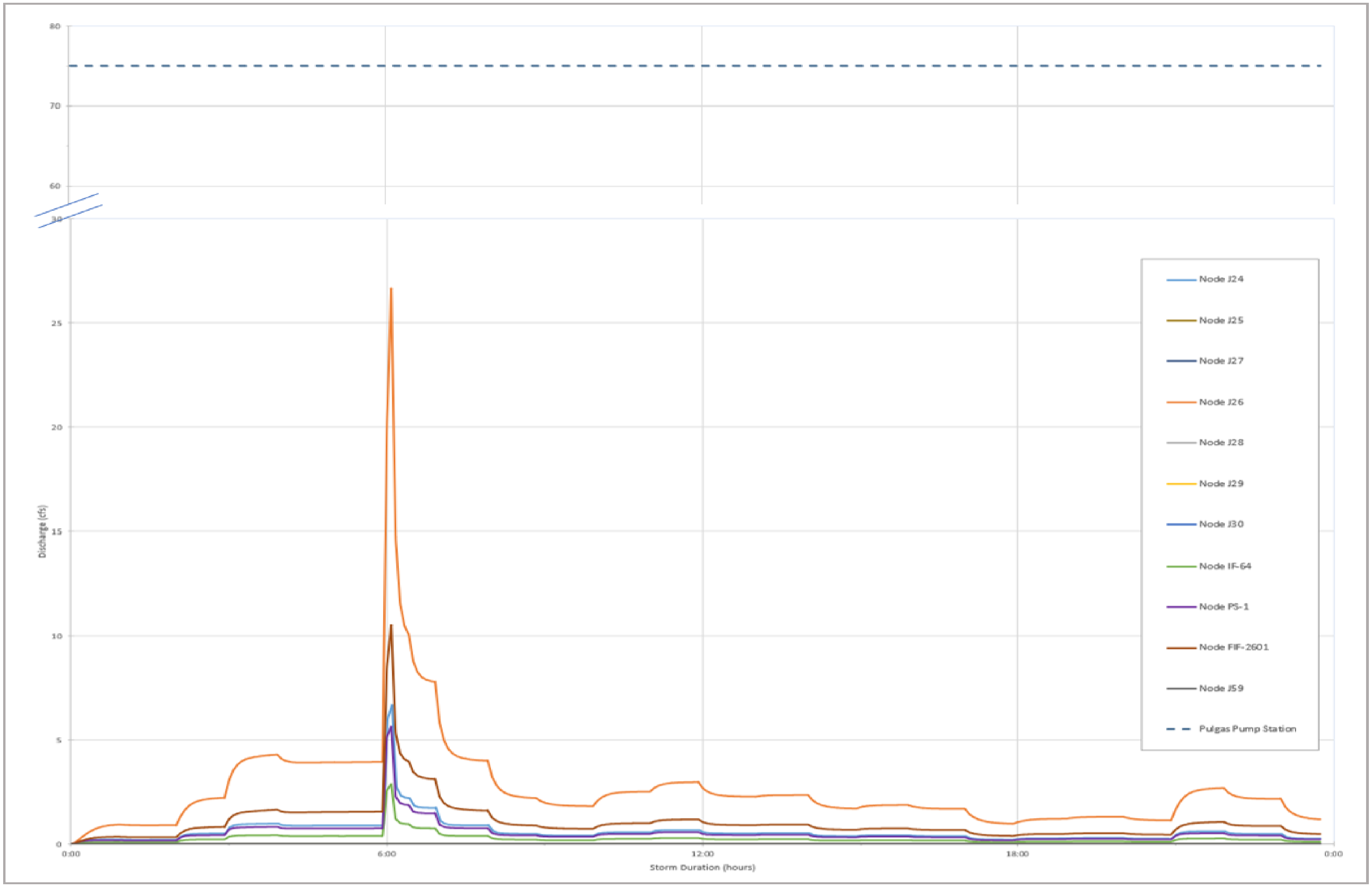


Figure 5. Lateral Inflow Hydrographs - 100-year Base Condition

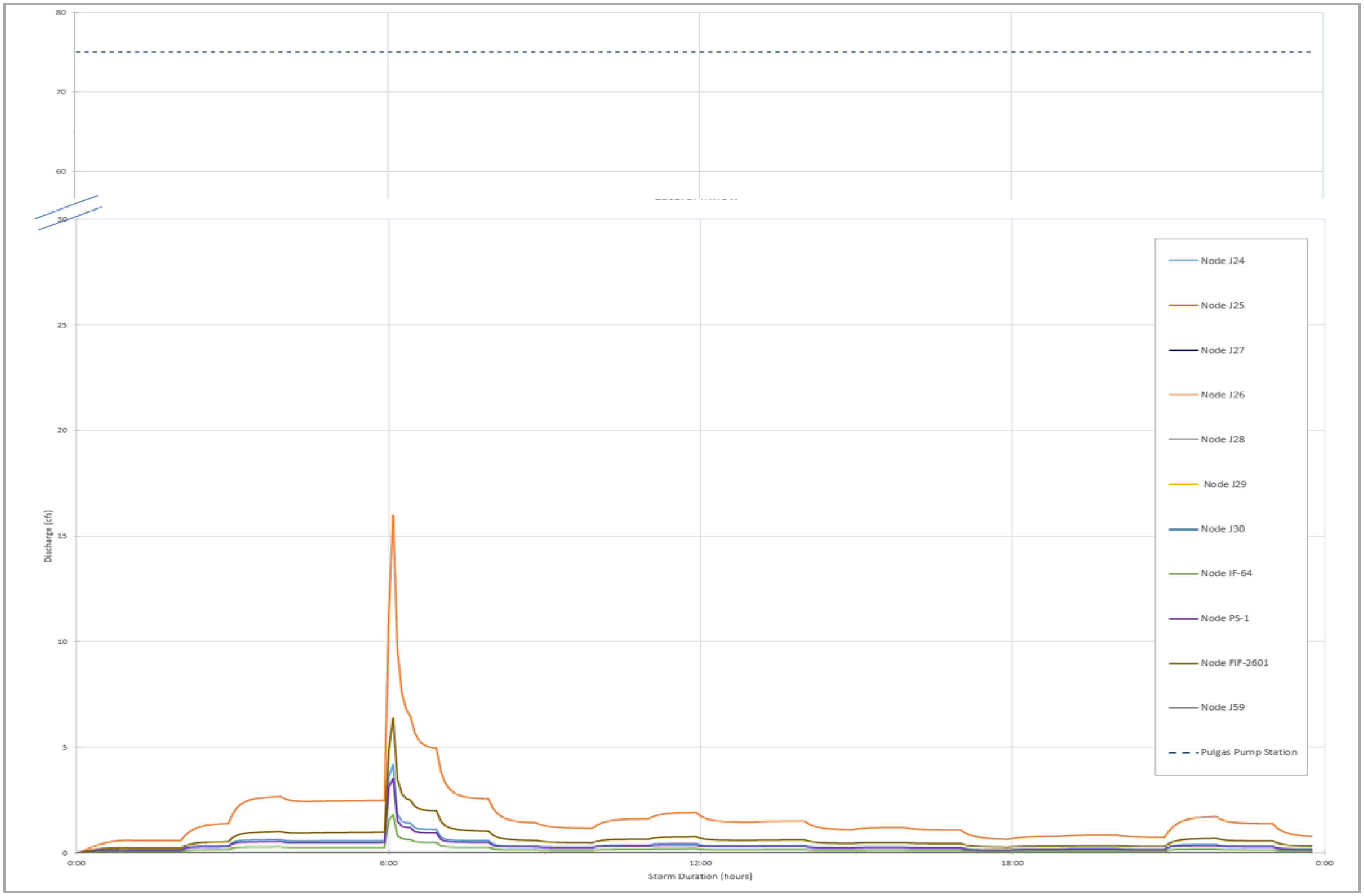


Figure 6. Lateral Inflow Hydrographs – 10-year Base Condition

4.8 Land Cover and Roughness

The hydraulic roughness parameters for the existing conditions modeling were the same as those used for the 2020 modeling studies. The floodplain is represented with a Manning's roughness (n) value of 0.013 and the channel is assigned a composite value of 0.05 (Chow, 1959). These roughness values are appropriate for the land cover/surface types in the drawings and aerials and for the average channel conditions under high flows. They are within the roughness value ranges in the FIS (FEMA, 2012).

4.9 Model Sensitivity

Model sensitivity was evaluated as described in the October 2020 memo (WRA 2020b).

5.0 HYDRAULIC ANALYSIS OF EXISTING CONDITIONS

Below is a summary of the existing conditions modeling of the maximum water surface elevation (WSEL) and areal extent. Both the 100-year and 10-year results are included. The maximum WSEL and inundation area occurs after the peak flow, roughly six hours into the simulation.

5.1 Flood Water Surface Elevations and Depths

The existing 100-year flood extent covers 57.5 acres (roughly 34 percent) of the overall 169 acre model study area. The inundated areas include most of the Project site, the northeast side of Industrial Road, the Brittan Avenue corridor and along Industrial Road (Figure 7). The 100-year maximum WSEL at the downstream end of the model domain (east) of Highway 101 is around 7.7 feet NAVD88. The 100-year maximum WSEL rises from 8.3 to 9.6 feet NAVD88 between Highway 101 and Industrial Road. The 100-year maximum WSEL upstream of Industrial Road is 11.4 feet NAVD88 and increases to about 12.1 feet NAVD88 at the parking lot bridge. The 100-year WSEL upstream of the parking lot bridge is 12.5 feet NAVD88 and rises to 12.8 feet NAVD88 downstream of the dual containers. The 100-year WSEL upstream of the dual container crossings is 14.1 feet NAVD88, and increase to 16.0 feet NAVD88 near Old County Road. The existing maximum water depths for the 100-year event across the floodplains (outside of the channel) on both sides of the channel have areas between 0.5 and 1.0 feet deep, some areas between 1.0 and 2.0 feet deep, and a few deeper isolated areas. Onsite, the existing maximum flood depth for the 100-year event is just over 2.5 feet deep (Figure 7).

The existing 10-year flood extent is 44.6 acres (roughly 26 percent) of the overall 169 acre model study area. It is a subset of the 100-year flood extent, including much of the Project site, sections northeast of Industrial Road, and the vicinity of the Brittan Avenue and Industrial Road intersection (Figure 8). The 10-year maximum WSEL at the downstream end of the model domain (east) of Highway 101 is around 7.7 feet NAVD88. The 10-year maximum WSEL rises from 8.3 to 9.5 feet NAVD88 between Highway 101 and Industrial Road. The 10-year maximum WSEL upstream of Industrial Road is 11.2 feet NAVD88 and increase about 11.9 feet NAVD88 at the parking lot bridge. The 10-year maximum WSEL upstream of the parking lot bridge is 12.3 feet NAVD88 and rises to 12.6 feet NAVD88 downstream of the dual containers. The 10-year maximum WSEL upstream of the dual container crossings is 13.7 feet NAVD88, and increases to 15.6 feet NAVD88 near Old County Road. The water surface is generally similar on both sides of the creek as you move upstream from the bay, with slightly higher on the north (Project) side of the creek. The maximum water depths offsite for the 10-year event are generally shallower than for the 100-year and within a smaller footprint. Onsite, the maximum flood depth for the 10-year event is just under 2.5 feet, but much of the 10-year flood area has maximum depths close to that for the 100-year event (Figure 8).

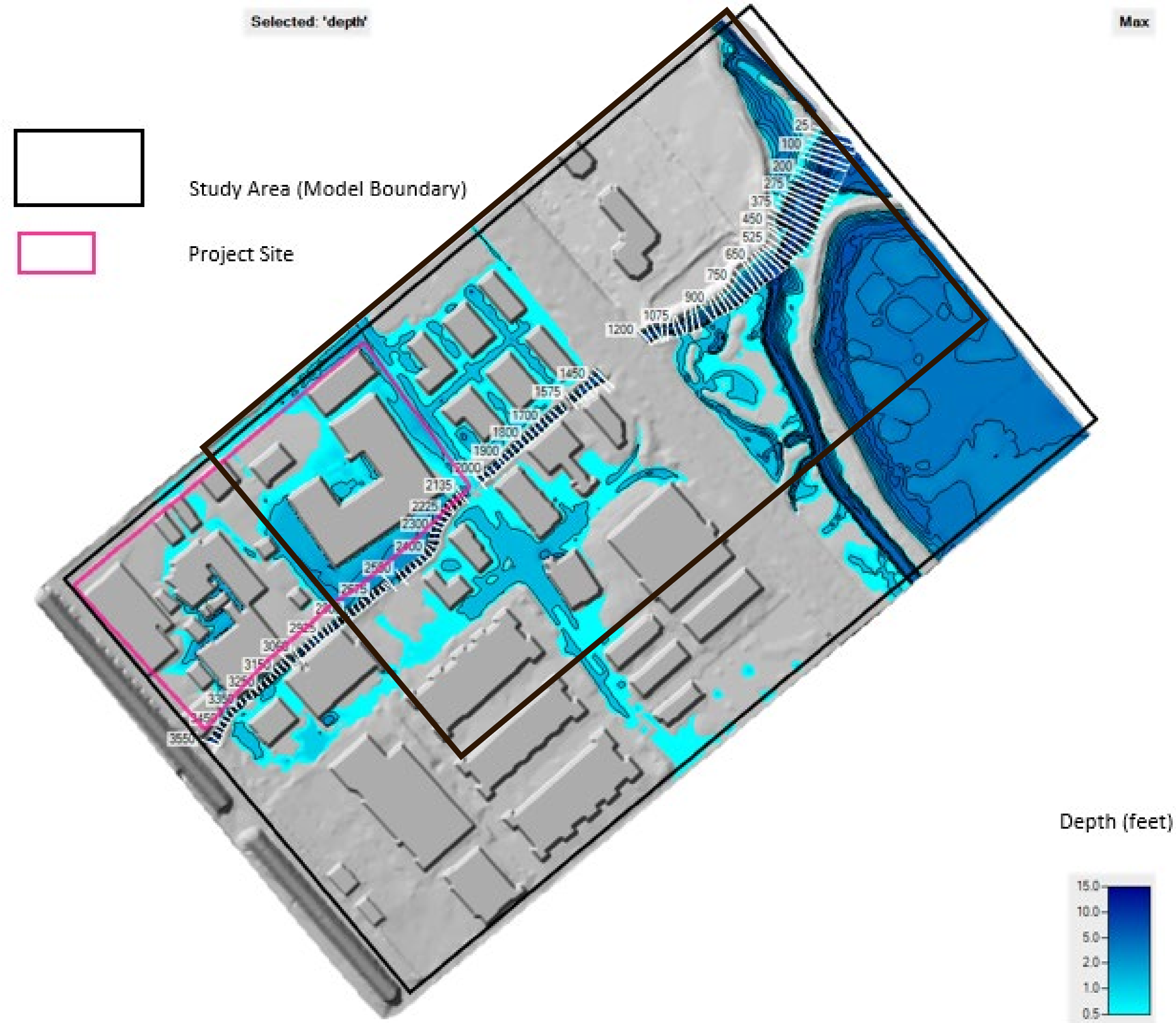


Figure 7. Project Site and Vicinity 100-year Flood Maximum Extent and Depths – Existing Conditions

Figure 8. Project Site and Vicinity 10-year Flood Maximum Extent and Depth – Existing Conditions

5.2 Pulgas Creek Flood Profile and Cross Sections

The existing condition flood profiles of Pulgas Creek show how the modeled maximum WSELs for the 100-year and 10-year events relate to the channel bank heights and shapes (which are a mixture of irregular natural soils and human-constructed materials), as well as the effects of the bridge locations, cross-section areas, and underside elevations (i.e., bridge soffits) (Figure 9).

The maximum WSEL profiles for both the 100-year and 10-year events have the same general shape. The potential for overbank flow is evident in some areas between Industrial Road and Old County Road where the maximum WSELs are higher than portions of the streambanks. The maximum WSEL for the 100-year and 10-year event is consistent at the downstream boundary in the bay, gently rising to about 8 feet NAVD88 at Highway 101 and up to 10 feet NAVD88 on the downstream side of Industrial Road. The WSELs are about one foot higher than the underside (soffit) of the Industrial Road bridge, indicating flow constriction (Figure 9). As a result, the maximum WSEL for both the 100-year and 10-year events steps up to around 11.5 feet NAVD88 on the upstream side of Industrial Road and slopes up over the parking lot bridge, with WSELs about 3.5 feet higher than its soffit (Figure 9). The maximum WSEL for both the 100-year and 10-year events also step up from constrictions at the dual container crossings. The maximum 10-year and 100-year WSELs are nearly identical downstream of Industrial Road, and the 10-year WSEL is slightly lower than the 100-year WSEL between Industrial Road and Old County Road (Figure 9).

5.3 FEMA Discussion

As presented in the October 2020 Memorandum, a qualitative comparison of the existing condition model results for the 100-year event profile and map views (Figure 9 and Figure 10) shows consistency with the FEMA Flood Insurance Study (FIS) (revised April 5, 2019) (FEMA, 2012) and effective Flood Insurance Rate Map (FIRM) (FEMA Flood Map Service Center, n.d.). The FEMA profile (Figure 9) is slightly lower in portions of the creek where our modeling is more detailed and expectedly higher in the bay, since the FEMA analysis considers coastal flooding sources. The FEMA map shows a larger flood zone along the Bayshore beyond the Project site and study area (Figure 10), since the FEMA mapping addresses the broader vicinity and the coastal flooding sources in addition to the local watershed-driven sources.

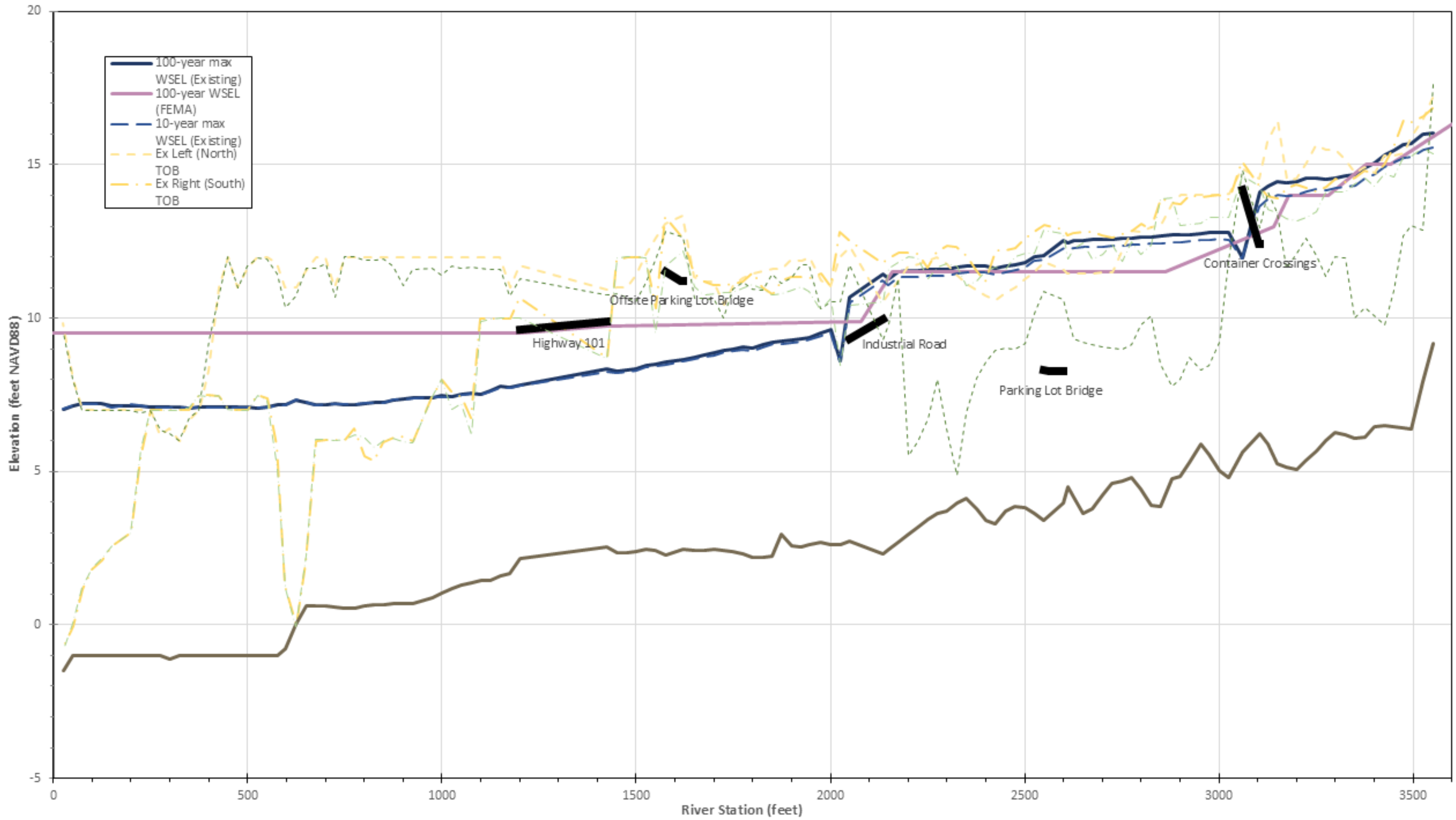


Figure 9. Pulgas Creek Channel Flood Profiles – Existing Conditions and FEMA

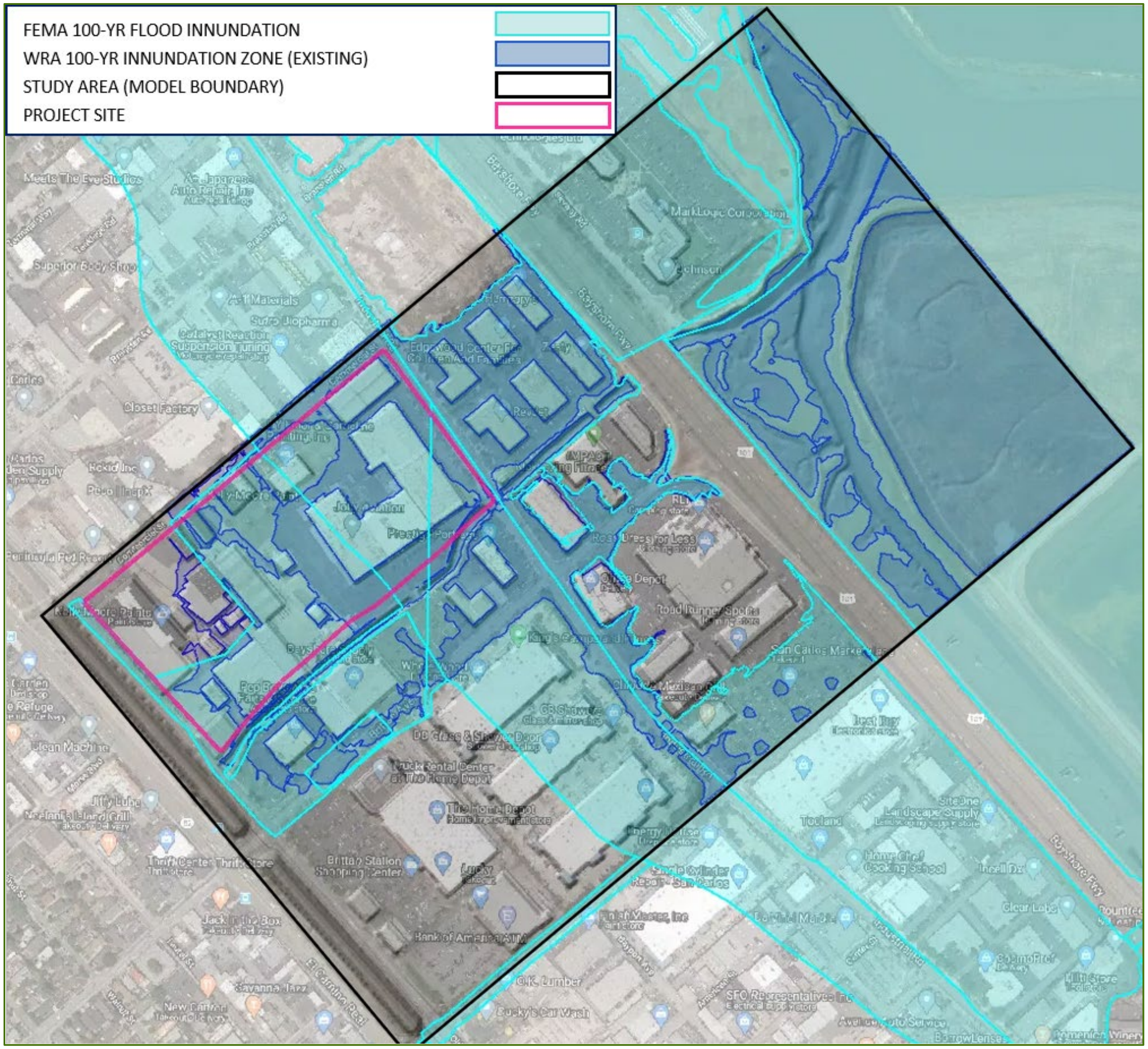


Figure 10. Project Site and Vicinity 100-year Flood Areas - Existing Conditions and FEMA

6.0 HYDRAULIC ANALYSIS OF THE REVISED PROJECT

6.1 Project Conditions Modeling

The hydraulic analysis of Project features and scenarios was performed by modifying specific characteristics such as the topographic surface, building layouts, surface swales, lateral structures, and cross sections, that would reflect the proposed design features for the Project.

No changes to any off-site areas were made in the model set-up (since the Project would not have the authority or responsibility to directly change off-site properties), and the model's boundary conditions and hydrologic inputs were held constant.

6.2 Project Features and Scenarios

The current Project design incorporates flood management strategies that were developed as part of the November 2020 study with the intent of successfully meeting key performance targets:

- Offsite flooding would be equivalent to existing conditions.
- The Project building layout would be preserved.
- Project operations and flood cleanup needs within the Project site would be minimized.

The individual Project design features utilized to achieve these goals are:

- Widening of Pulgas Creek adjacent to the Project
- Allowing inflow of flood waters to the site in a predictable, controlled fashion via a surface swale or culvert off the north bank of Pulgas Creek upstream of the parking lot bridge.
- Facilitating the outflow of water to return from the landscape depression to the creek via swale or culvert as the flood hydrograph peak passes.
- Directing flood water into an enlarged lowered landscape depression for temporary storage.
- Maintaining a floodplain flow path on the creek side portion of the property at a finished grade elevation that allows water to flow overbank, be slowed down and detained, but follow their existing route across Industrial Road.

The hydraulic modeling demonstrated that a Project design to keep offsite flooding to no worse than present is feasible, even though the surrounding offsite areas are sensitive low elevation surfaces where minor topographic changes can result in large differences in how much, where, or how far flood waters flow. Hydraulic modeling of the current Project design, with flood management strategies incorporated, indicates that the potential extent and depth of offsite flooding can match existing conditions with only minor local deviations in pattern and depth. Additional modeling during final design will be used to optimize Project features and validate that offsite flooding would be no worse than for existing conditions.

In summary the modeling to-date demonstrates that the proposed Project flood management strategies can be successful in achieving their goals.

6.3 The Project

6.3.1 Project Terrain

The Project incorporates several flood management features that will be accommodated and optimized in final grading and operational plans for the Project (Figure 11).

The individual flood management strategies incorporated into the current design are:

1. Allowing inflow of flood waters to a lowered landscape depression on the site in a predictable, controlled fashion via a surface swale or culvert on the north bank of Pulgas Creek downstream of the dual container crossing. The model represented this as a surface swale with an invert elevation (at the creek bank) of 11.5 feet and a slope ranging from 0.5% to 2% up to the landscape depression.
2. Facilitating the outflow of water to return from the landscape depression to the creek via the same swale or culvert described in the note above as the flood hydrograph peak passes.
3. Creating a floodplain flow path within a landscaped area along the northern bank of Pulgas Creek within the site, modeled to have an upstream finished grade sloping from an elevation of 12 feet (west end) to an elevation of 10.5 feet at the east end connection with Industrial Road, and widening of Pulgas Creek within the site. This would allow flood waters to roughly mimic existing conditions by permitting flow to overbank, slow down, then flow into Industrial Road.

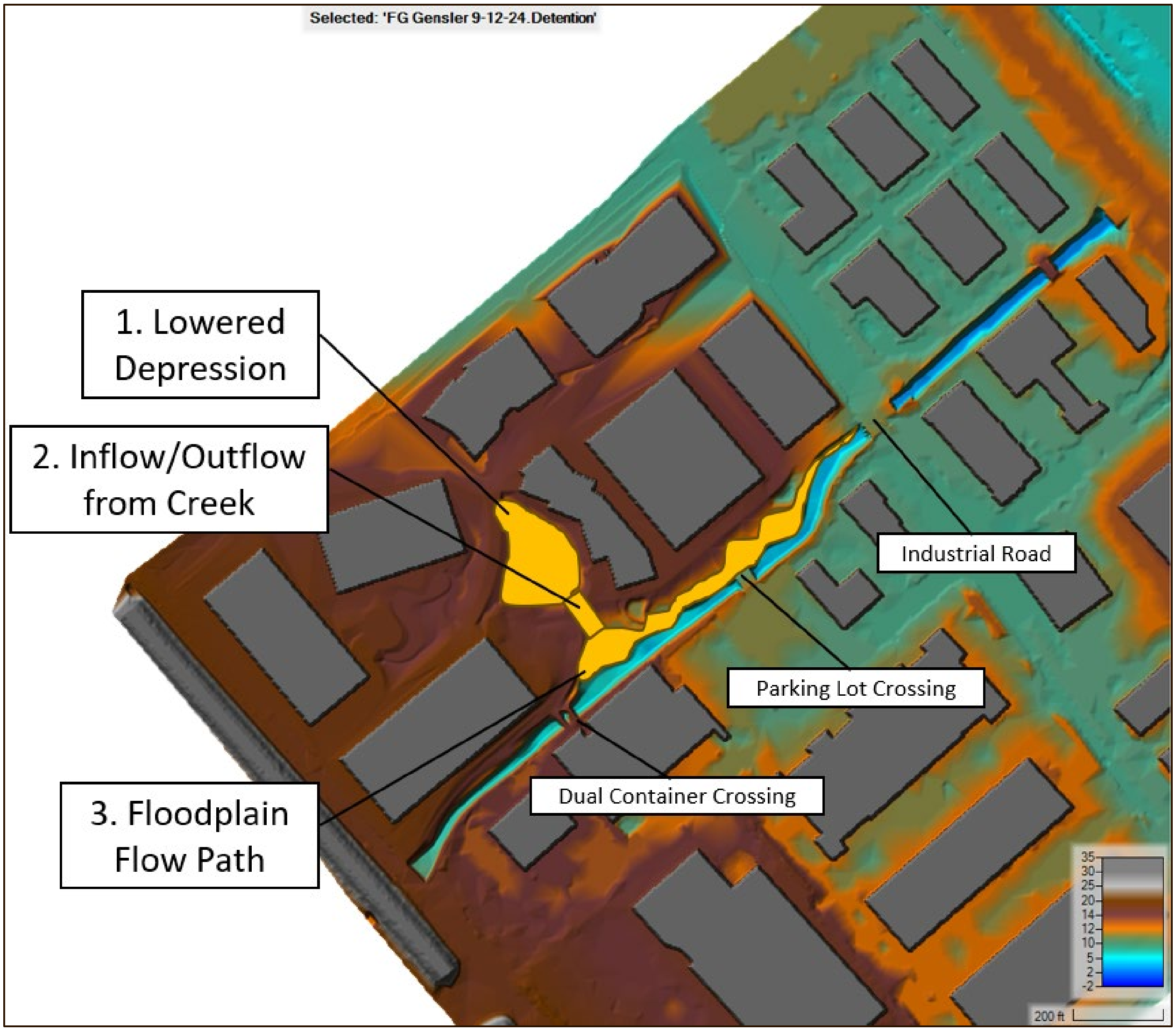


Figure 11. Optimized Project Terrain

6.3.2 Project Flood Extent and Depths

The Project model results for the 100-year flood indicate the 100-year flooding is eliminated from the building footprint onsite while engaging the Project features of the landscape depression and floodplain (Figure 12).

The Project model results for the 10-year flood indicate that the 10-year flooding is eliminated from the building footprint onsite, while engaging the landscape depression and floodplain (Figure 13).

The 100-year flood extent off site for the Project is nearly identical to the existing condition (Figure 14). Areas of Figure 14 that display using only bright blue tones have existing 100-year flooding that is reduced or eliminated under Project conditions. The fringe areas in lime green are the minor areas with modeled extent beyond the existing conditions (primarily the onsite Project feature flooding). Darker green areas are overlap that have 100-year flooding under both conditions (i.e., no change).

The 10-year flood extent off site for the Project is modeled to nearly eliminate flooding south along Brittan Avenue or Industrial Road (Figure 15). Areas of Figure 15 Figure 14 that display using only bright blue tones have existing 10-year flooding that is reduced or eliminated under Project conditions. The fringe areas in lime green are areas with modeled extent beyond the existing conditions (the onsite Project feature area and some areas northeast of Industrial Road. Darker green areas are overlap that have 10-year flooding under both conditions (i.e., no change).

Figure 12: Project 100-year Flood Extent and Depth

Figure 13. Project 10-year Flood Extent and Depth

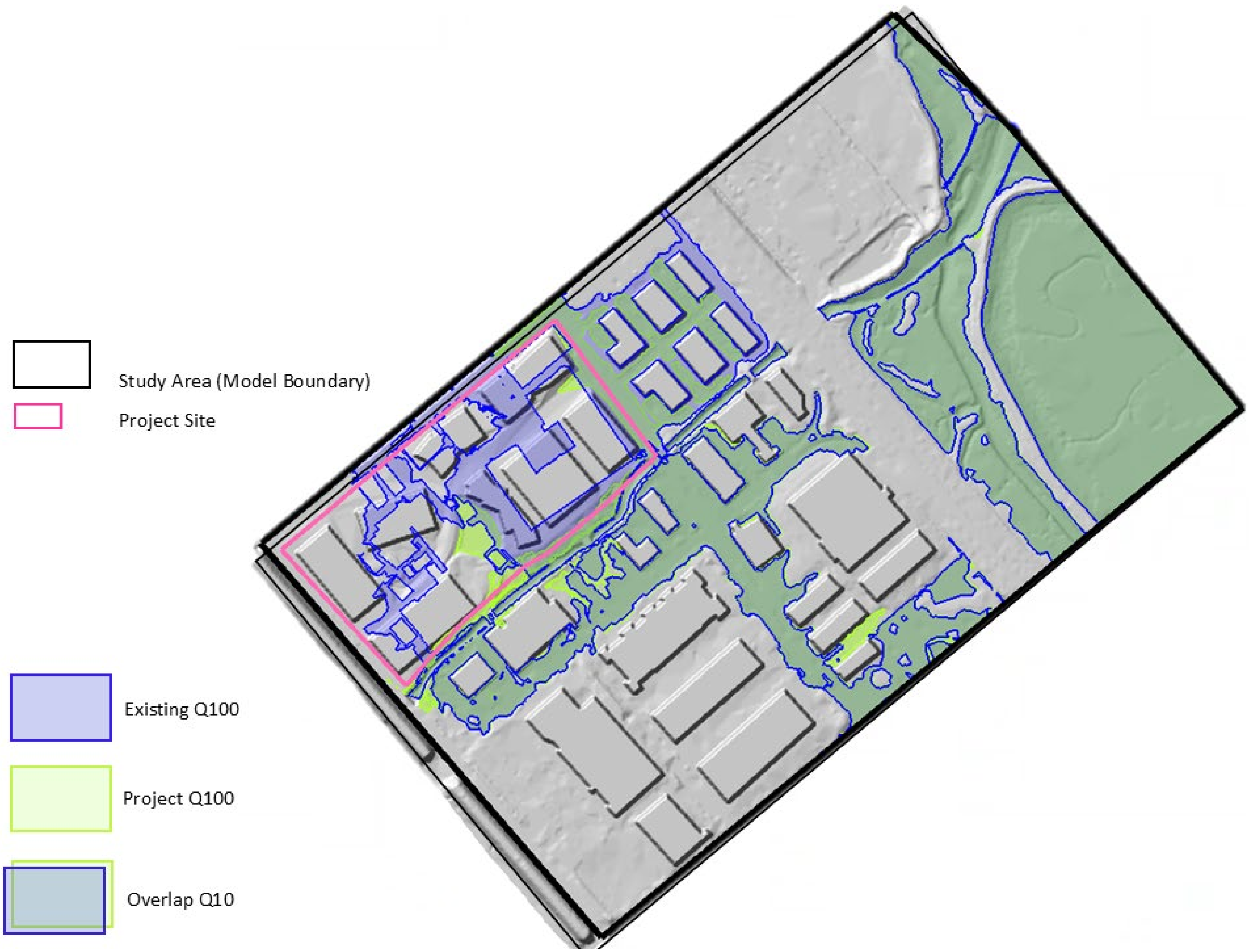


Figure 14. Existing Conditions and Project 100-year Flood Extents

Figure 15. Existing Conditions and Project 10-year Flood Extents

6.3.3 Project Flood Profiles

The Project 100-year maximum WSEL along Pulgas Creek would not be higher than existing conditions downstream between Industrial Road and the Bay, but would be higher than existing conditions upstream of the dual container crossing (Figure 16). The Project 100-year maximum WSEL would be higher than existing between Industrial Road and the dual container crossing. While WSELs generally increase around the project, the flood behavior is altered to overbank earlier onto the site with inundation extent similar to existing conditions with some regions slightly decreasing in inundation extent and other regions slightly increasing.

6.3.4 Project Channel Shear Stress

The Project will decrease channel bed shear stress under the 100-year event compared with the existing conditions through the project reach (Figure 17). The features allow overbank flow to commence slightly earlier in the hydrograph, which reduces shear and is supportive of channel bed and bank stability.

The changes can be compared to known resistance/stability of channel materials (Fischenich, 2001) as context to assess whether an appreciable change in the channel condition or stability would occur. Materials along the existing channel bed and banks of Pulgas Creek are quite varied and include sections with concrete bed or banks, sakrete banks, rooted woody and herbaceous vegetation, unvegetated soils, as well as fine sediment, sand, gravel, small cobble, and occasional larger rock or concrete slabs.

The 100-year channel bed shear stress with the Project would provide more consistent shear stress throughout the study reach as compared to existing conditions. Shear stress for the Project condition is generally under or around 0.2 to 0.3 pounds per square foot (lb/sq ft) aside from local areas downstream of the Industrial Road crossing of up to 0.8 lb/sq ft (Figure 17). The bed material expected to remain stable would be more consistently in alluvium and small gravels.

6.3.5 Project Flood Water Surface Elevations

Comparison of water surface elevations along key profiles in the study area supplement the map views to indicate the ability of the Project (with flood management strategies incorporated) to roughly match existing conditions for the 100-year (Figure 18) and 10-year (Figure 19) floods. They demonstrate the ability of the proposed flood management strategies to not only limit the areal extent of flooding (as shown in the above maps), but also manage water elevations. The existing conditions are shown in blue lines, and the Project in green. In general, changes between water surface elevations slightly increase by up to half a foot southeast of the site and decrease by up to half a foot north of the site. Full size versions of these graphs are provided as Appendix A for closer inspection.

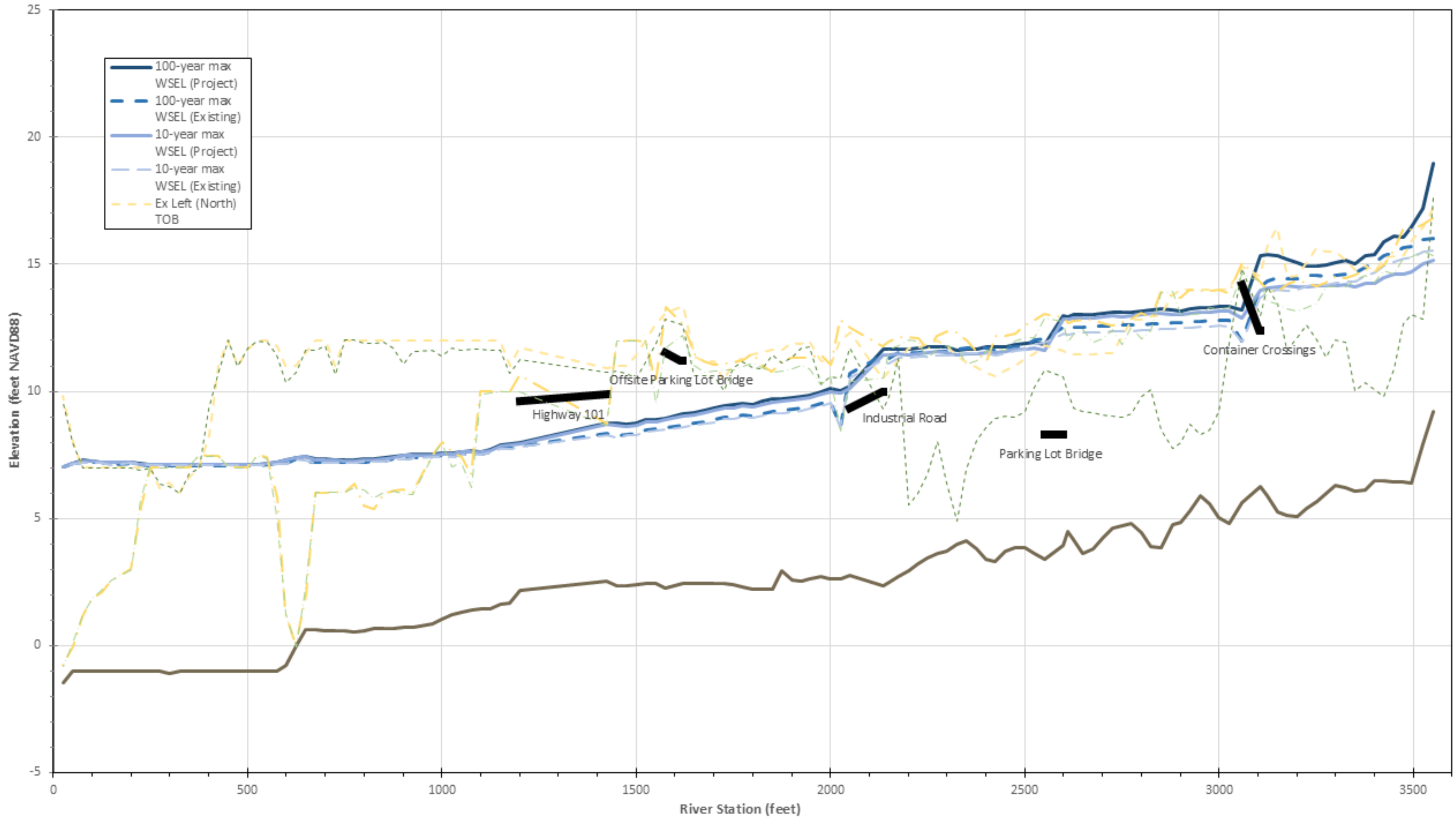


Figure 16. Pulgas Creek Maximum Water Surface Elevation Profiles for the 100-year Flood

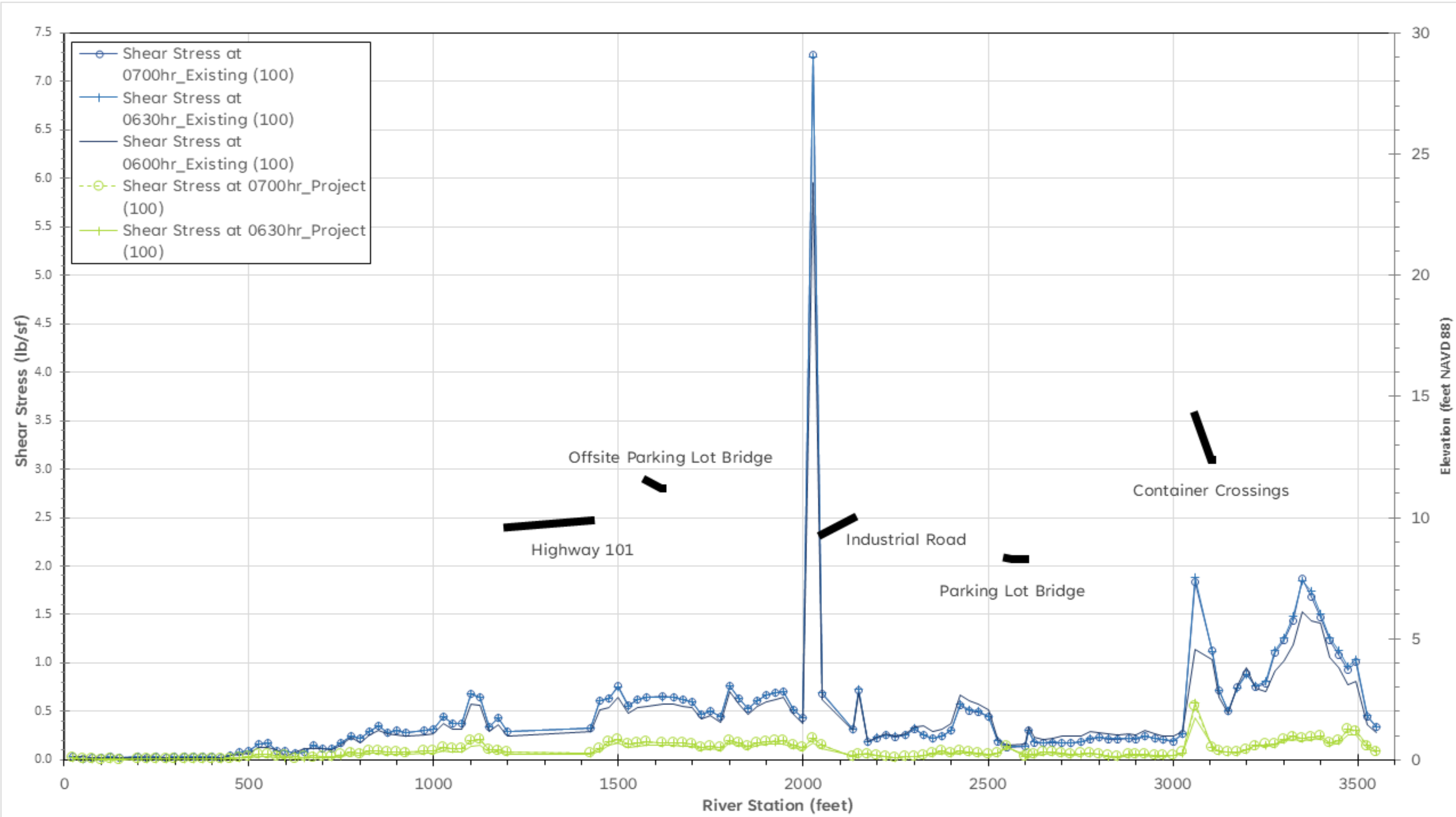


Figure 17: Pulgas Creek Shear Stress Profiles for the 100-year Flood

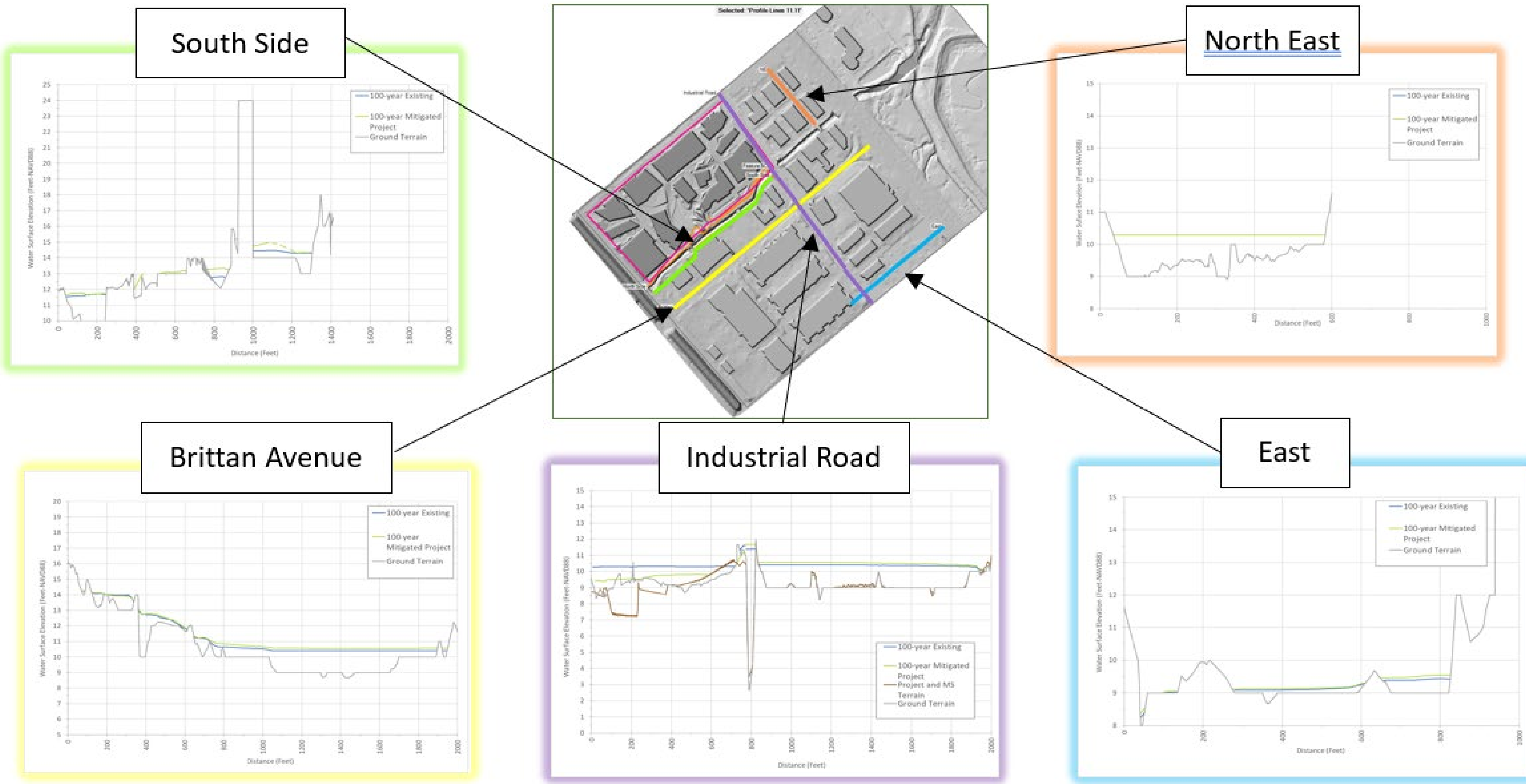


Figure 18. Maximum Water Surface Elevations and Ground Surfaces: 100-year Flood

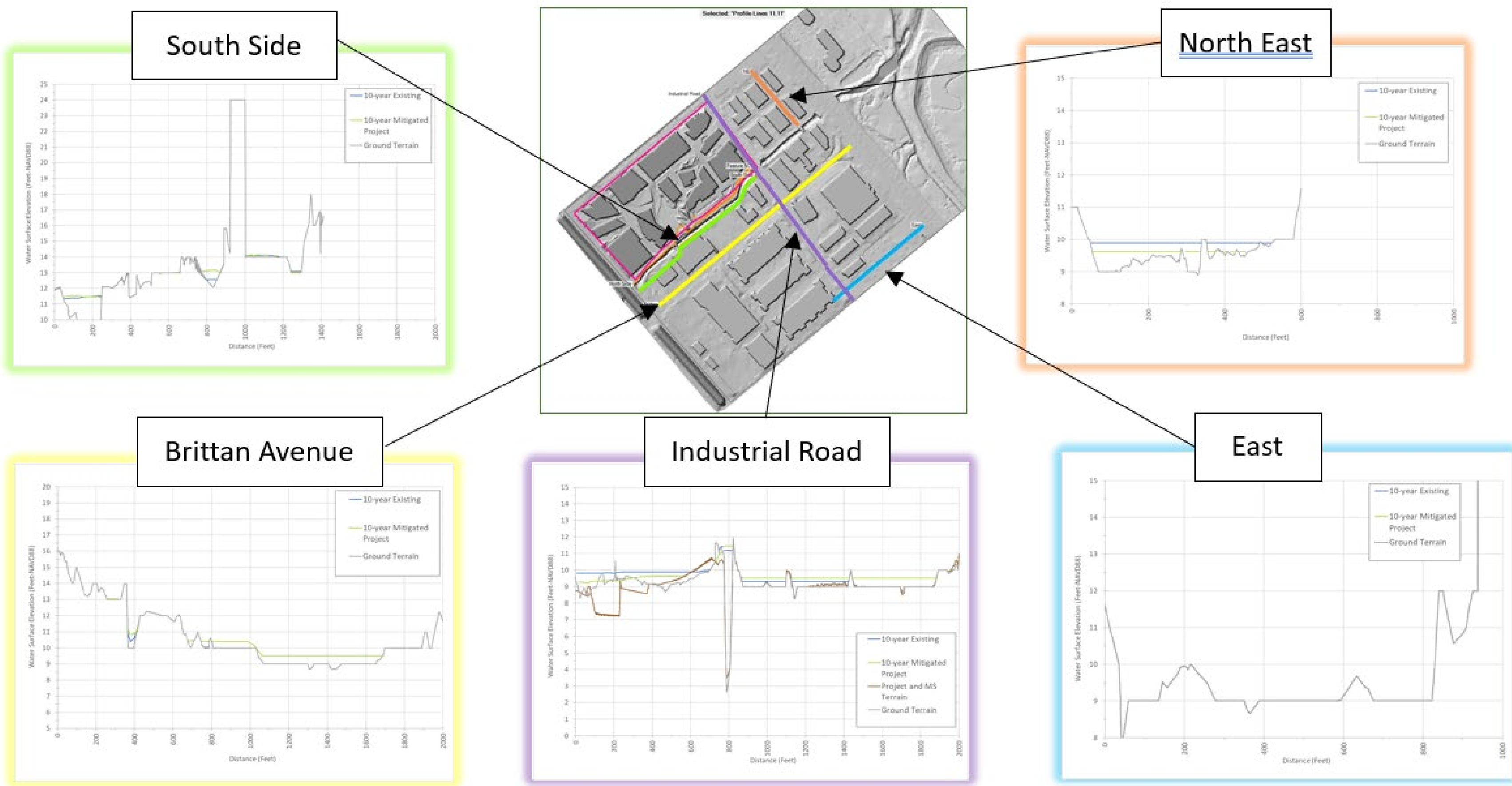


Figure 19. Maximum Water Surface Elevations and Ground Surfaces: 10-year Flood

7.0 CONCLUSION

WRA performed hydraulic modeling of the revised Project design to determine off-site flooding extent and depth and local shear stresses in Pulgas Creek. *Based on our understanding of the site hydraulics from modeling of the proposed Project, the Project would minimize the potential for change in offsite flooding behavior for the 100-year and 10-year floods compared to existing conditions.* Modeling indicates that the Project will reduce the 100-year flood conditions on site and be protective of the proposed buildings.

As previously presented the individual key design features within the identified Project are:

1. Allowing inflow of flood waters to a lowered landscape depression on the site in a predictable, controlled fashion via a surface swale or culvert on the north bank of Pulgas Creek downstream of the dual container crossing. The model represented this as a surface swale with an invert elevation (at the creek bank) of 11.5 feet and a slope ranging from 0.5% to 2% up to the landscape depression.
2. Facilitating the outflow of water to return from the landscape depression to the creek via the same swale or culvert described in the note above as the flood hydrograph peak passes.
3. Creating a floodplain flow path within a landscaped area along the northern bank of Pulgas Creek within the site, modeled to have an upstream finished grade sloping from an elevation of 12 feet (west end) to an elevation of 10.5 feet at the east end connection with Industrial Road, and widening of Pulgas Creek within the site. This would allow flood waters to roughly mimic existing conditions by permitting flow to overbank, slow down, then flow into Industrial Road.

Each of these design features will be further optimized for the Project during final design and fully realize their functionality and verify their performance relative to the flood impact requirements of the City and the project layout and project operations targets.

Project modeling assumes that preservation of channel conveyance capacity will be maintained by the City for long-term flood management to address potential in-channel sedimentation associated with sea level rise or from upstream sources, or vegetation and debris restrictions.

8.0 LIMITATIONS

The models developed for this study have focused particular recurrence interval events (i.e. 100 - year and 10-year) rather than a full range of recurrence interval peak flows or hydrographs. The scope and emphasis of model optimization was on comparing and evaluating the relationship between the existing conditions and the proposed and/or Project within the study area.

It is important to acknowledge that as for any numerical model, is there is uncertainty or a margin of error in the hydraulic model. The model sensitivity analysis shows the water surface elevation may be within +/- 0.3 ft of the model results. The volume of water quantified may be within 10 acre-ft of the model results. These are reasonable and typical for the resolution of modeling herein.

Additionally, we note that the scope of this flood analysis is limited to the physical hydraulics and does not address options for flood safety hazard measures such as signage, trash management, monitoring or maintenance.

9.0 REFERENCES

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APPENDIX A. PROJECT WATER SURFACE ELEVATION PROFILES

Appendix A

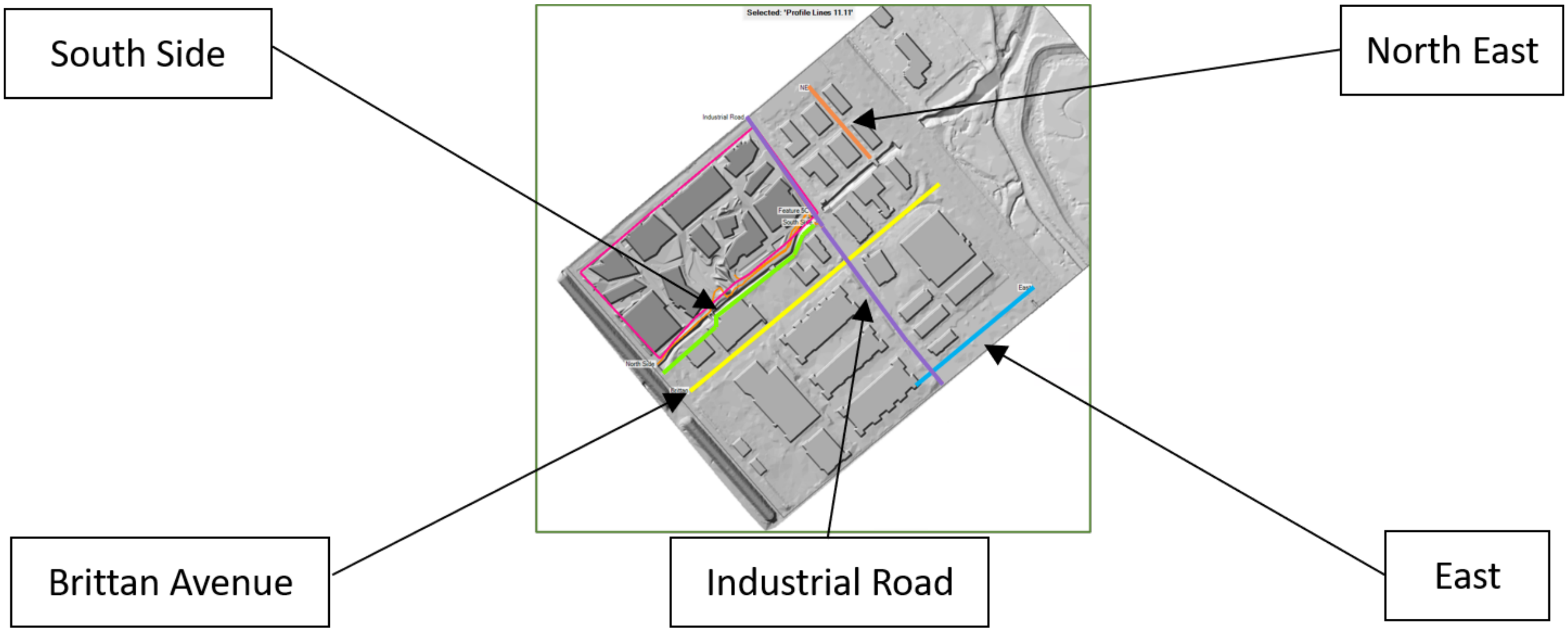


Figure B-1: Water Surface Elevation (WSEL) Comparison Q100 Key

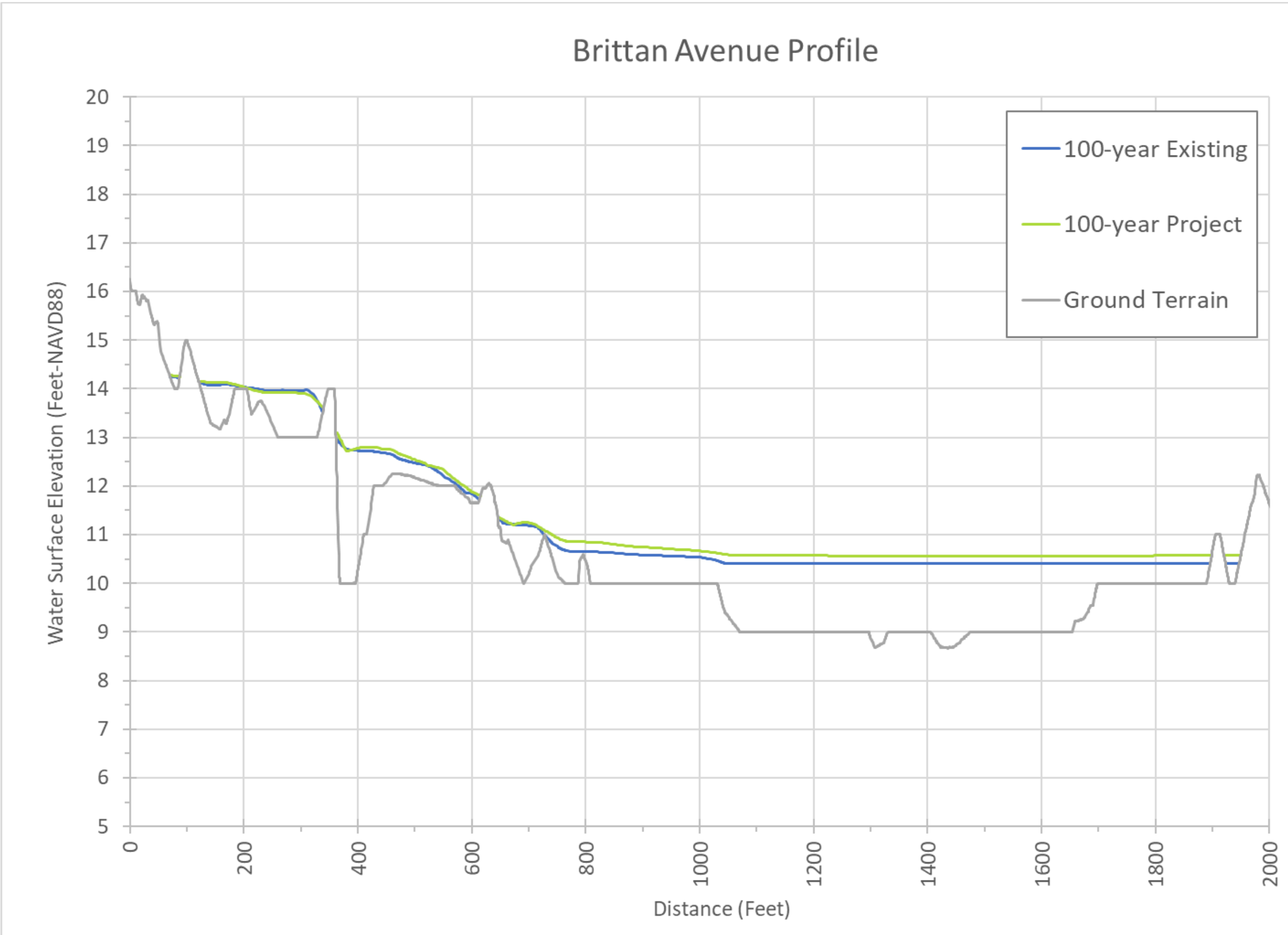


Figure B-1: Brittan Avenue WSEL Profile Q100

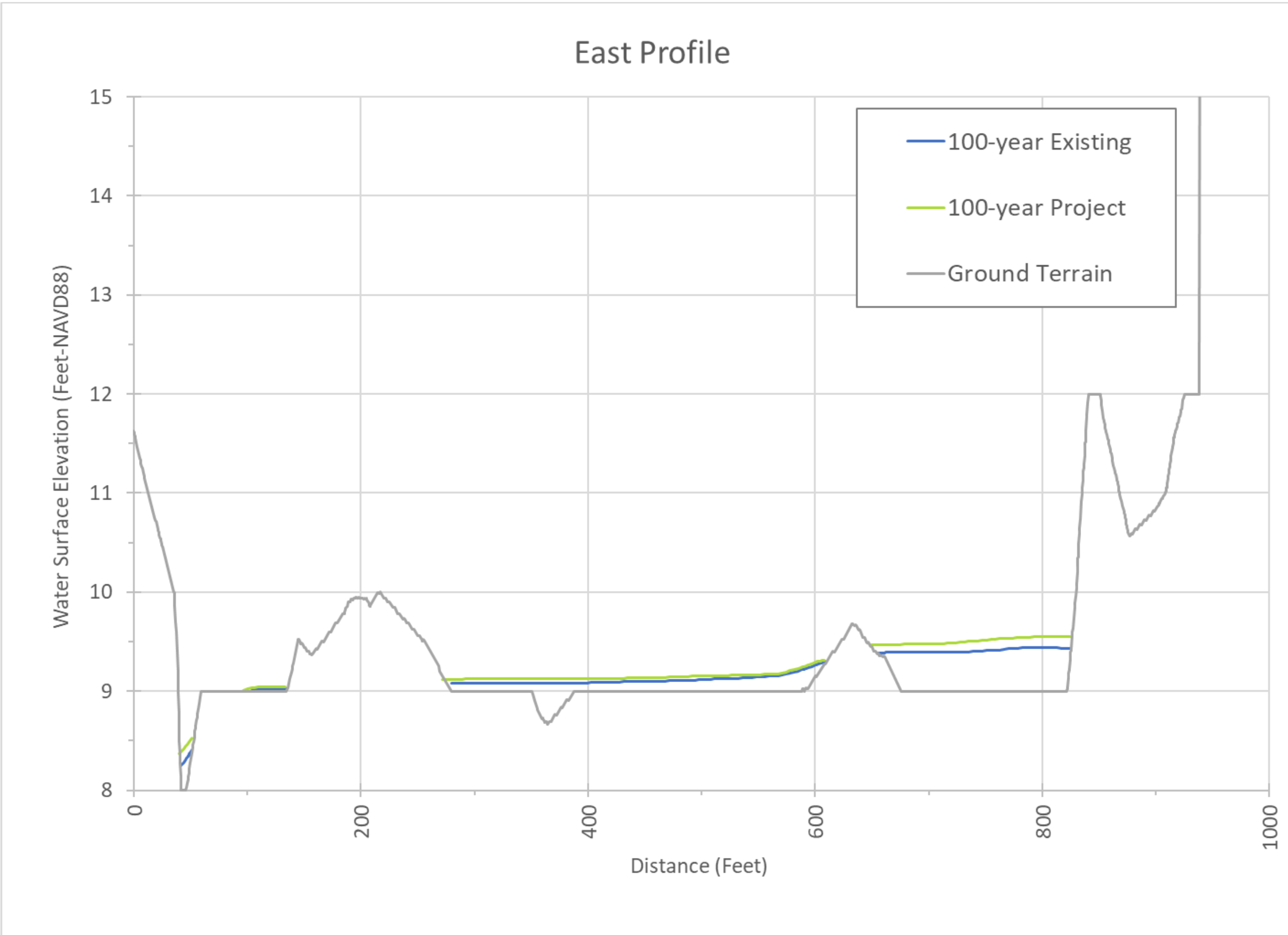


Figure B-1: East WSEL Profile Q100

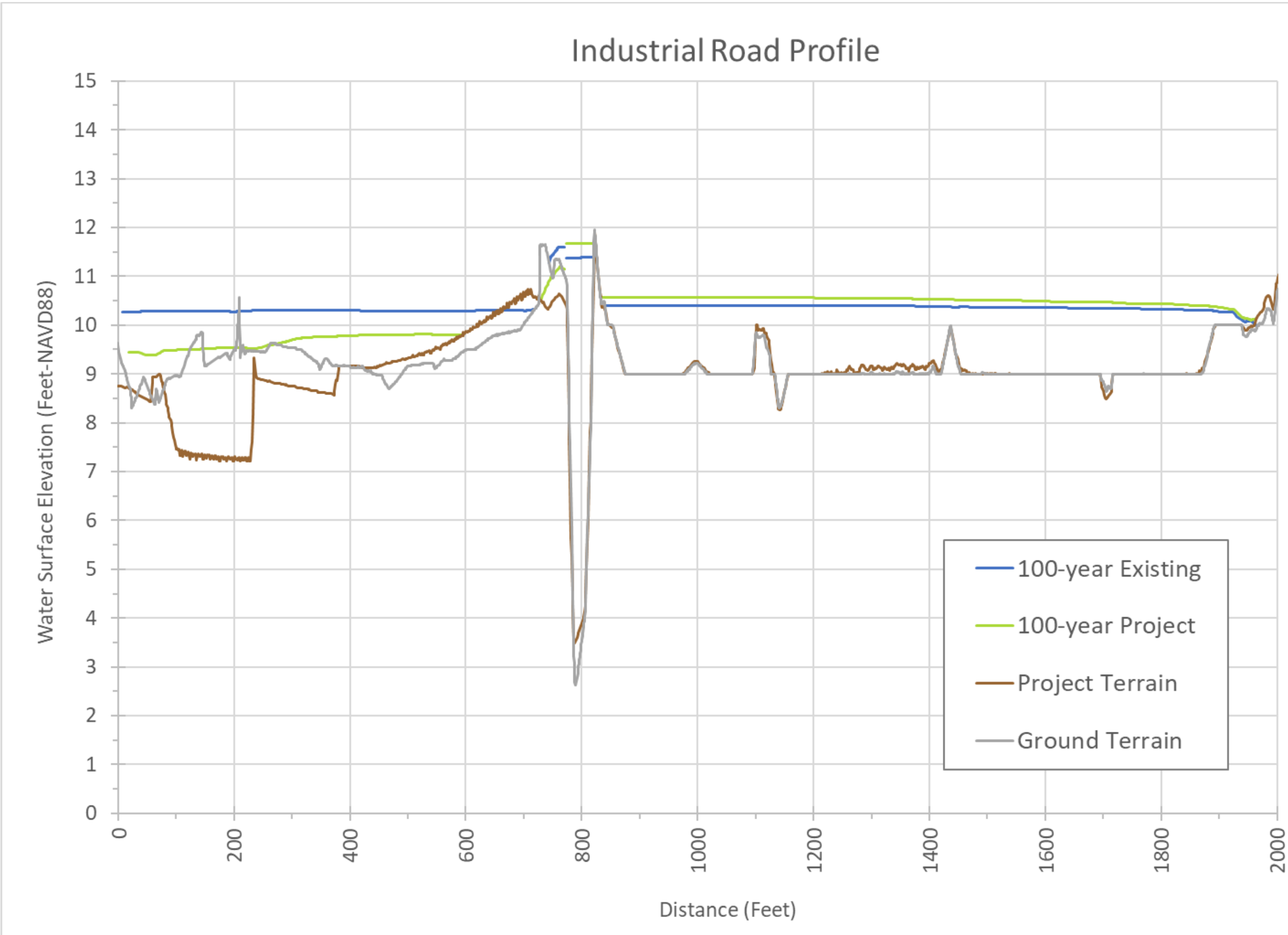


Figure B-1: Industrial Road WSEL Profile Q100

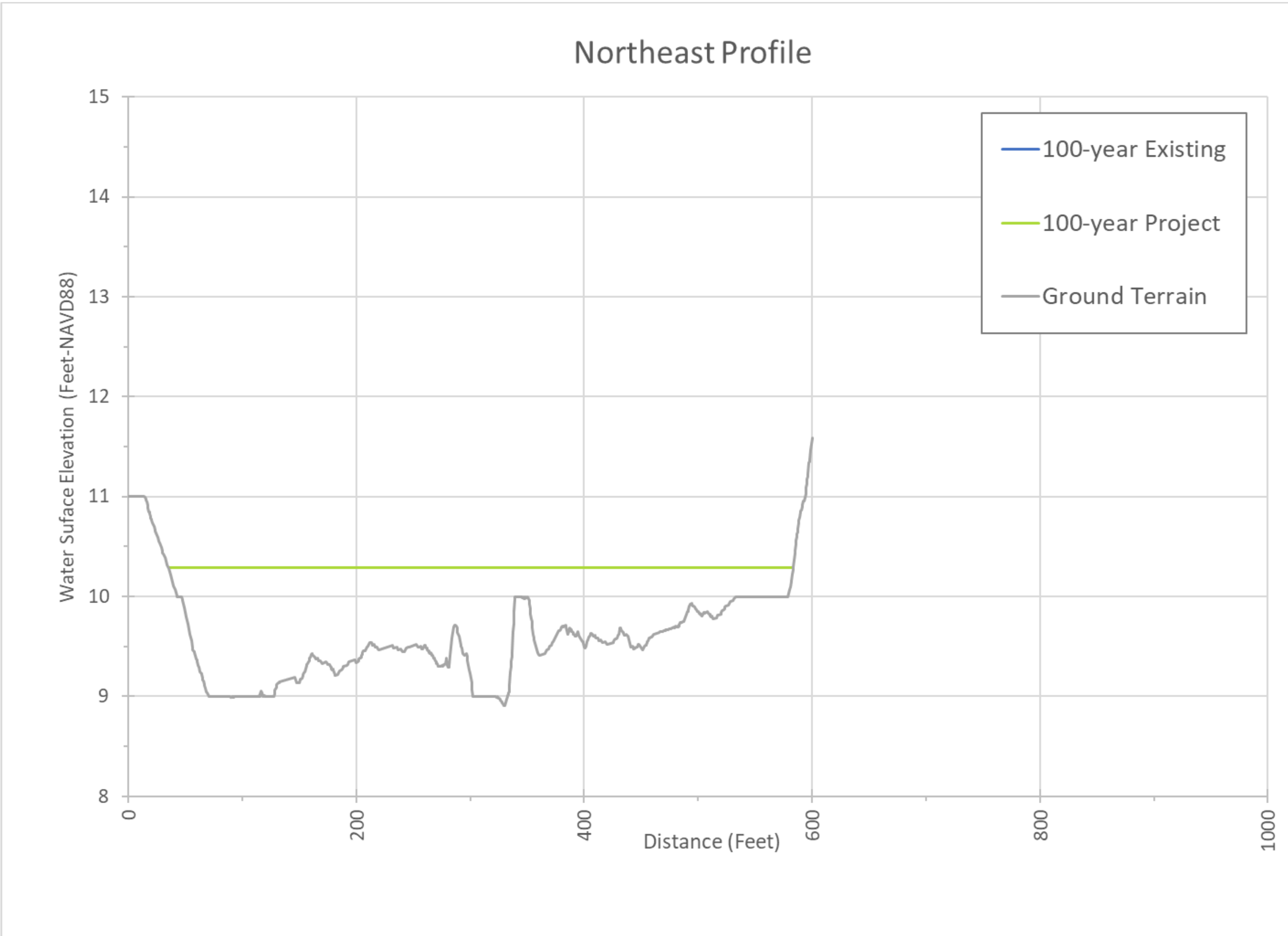


Figure B-1: Northeast WSEL Profile Q100

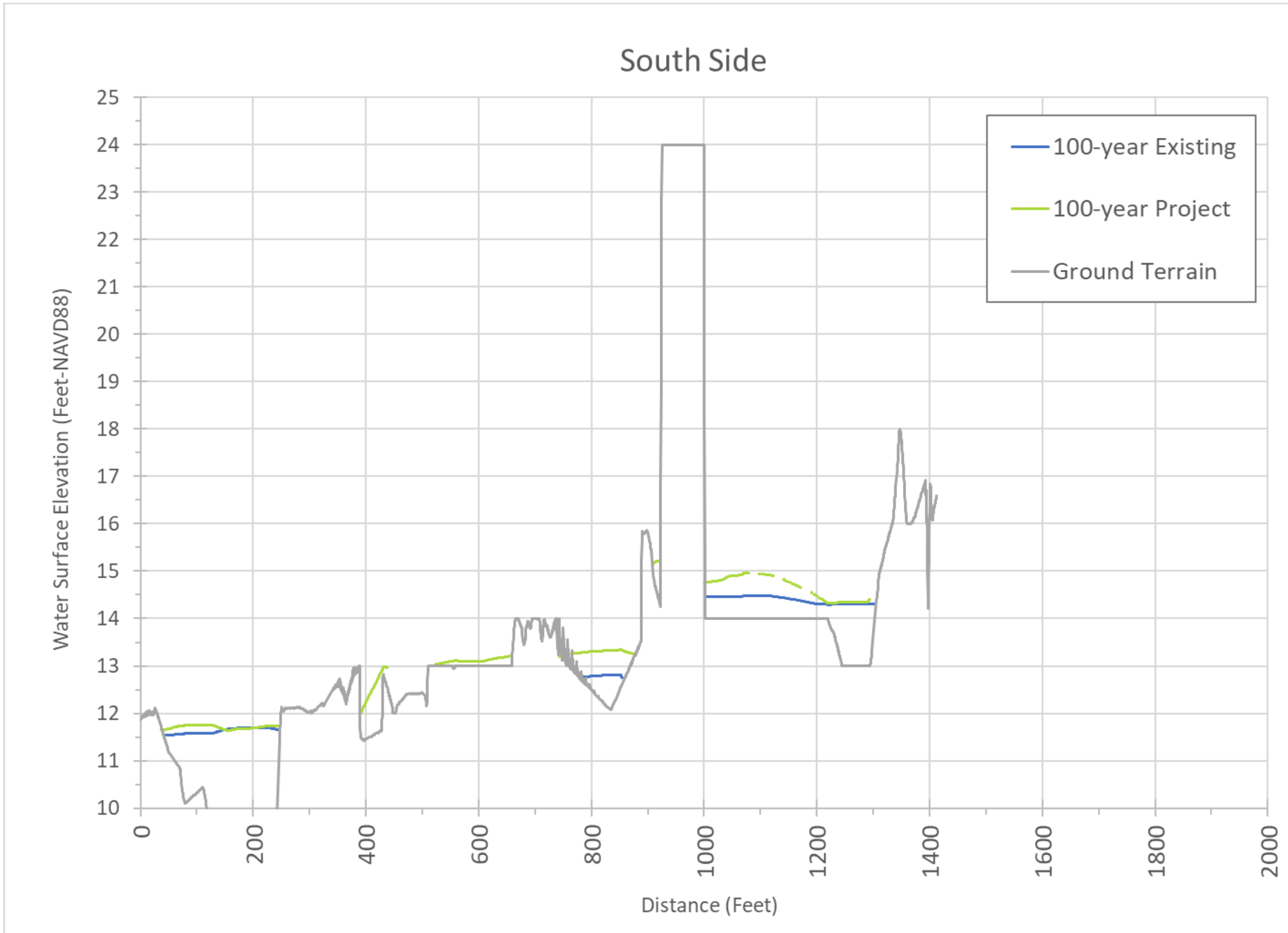


Figure B-1: South Side WSEL Profile Q100

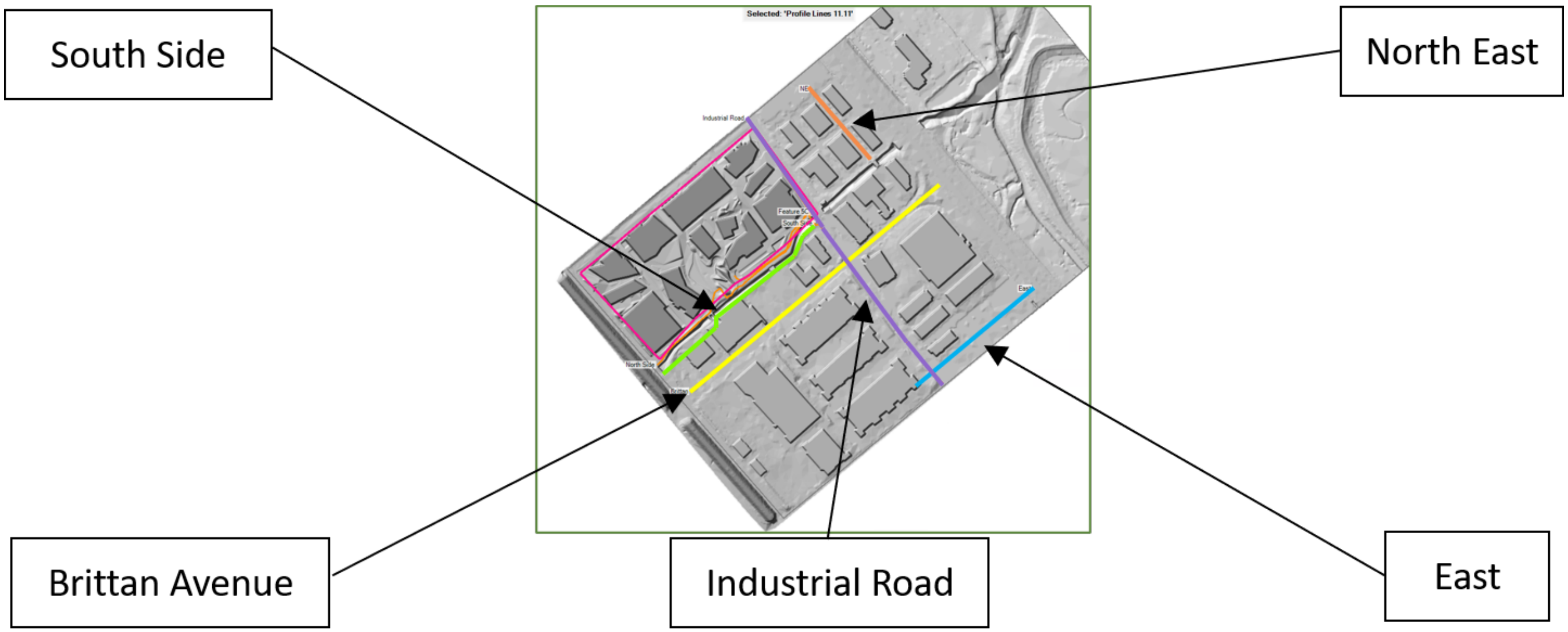


Figure B-1: Water Surface Elevation (WSEL) Comparison Q10 Key

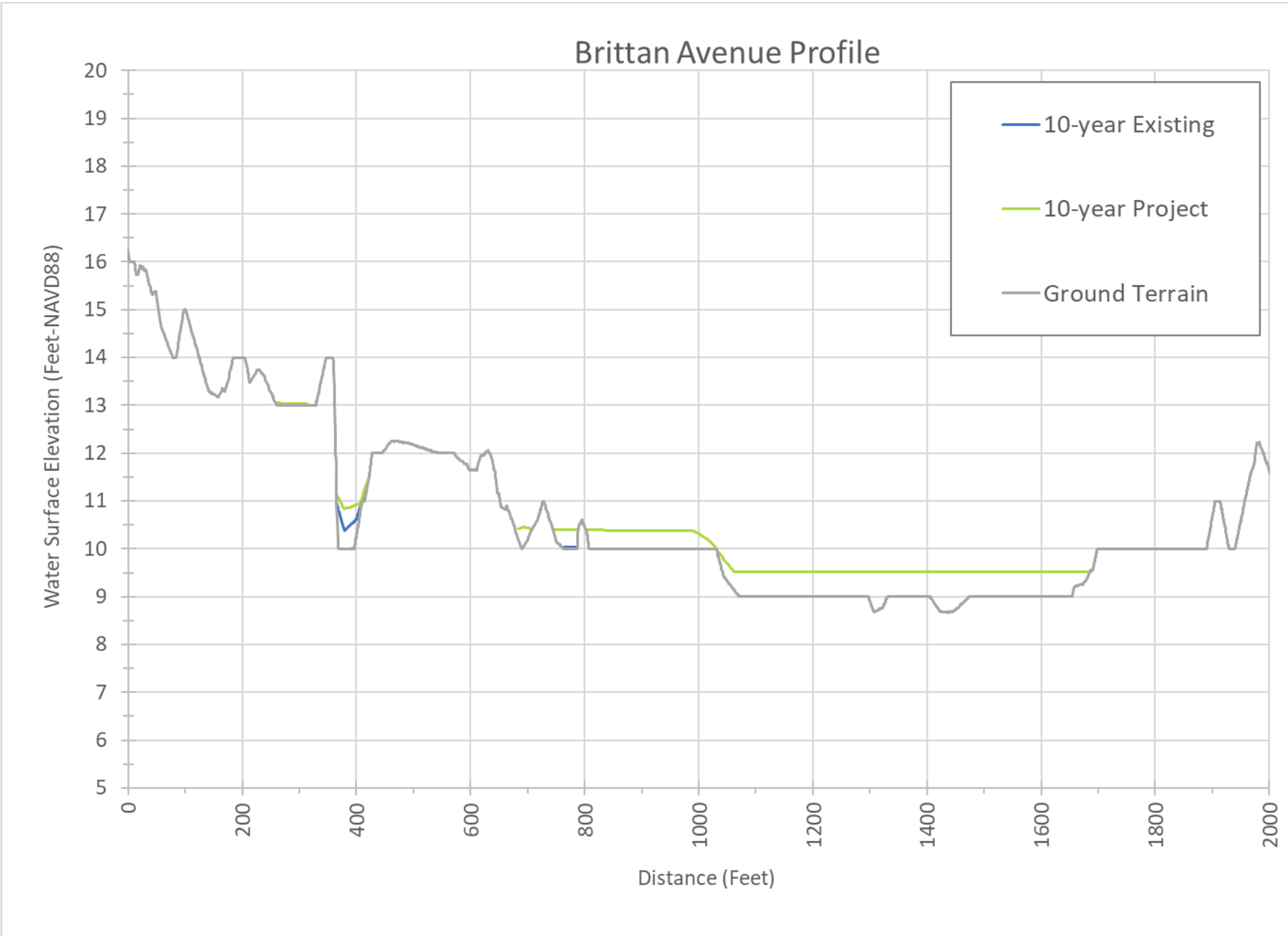


Figure B-2: Brittan Avenue WSEL Profile Q10

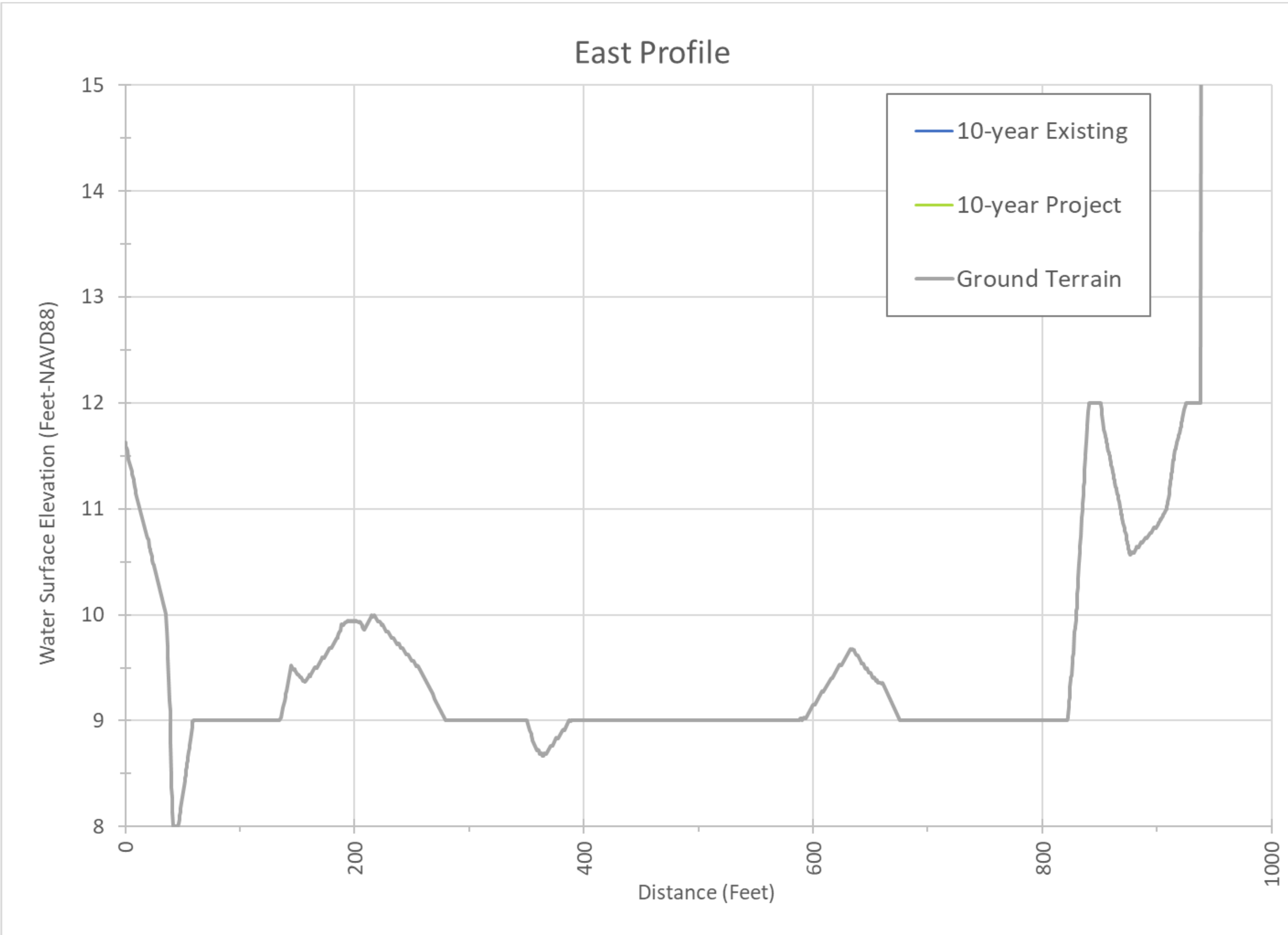


Figure B-3: East WSEL Profile Q10

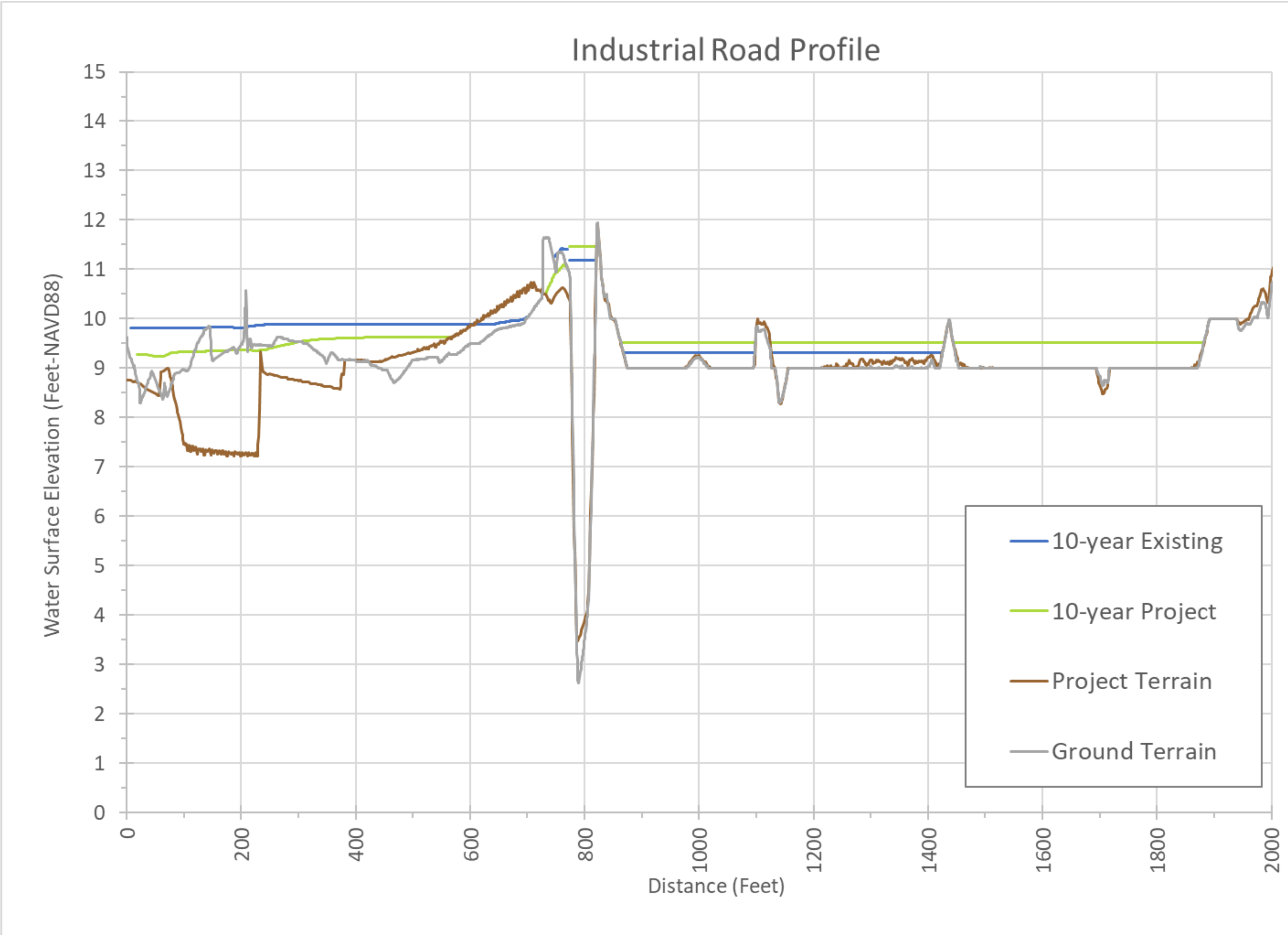


Figure B-4: Industrial Road WSEL Profile Q10

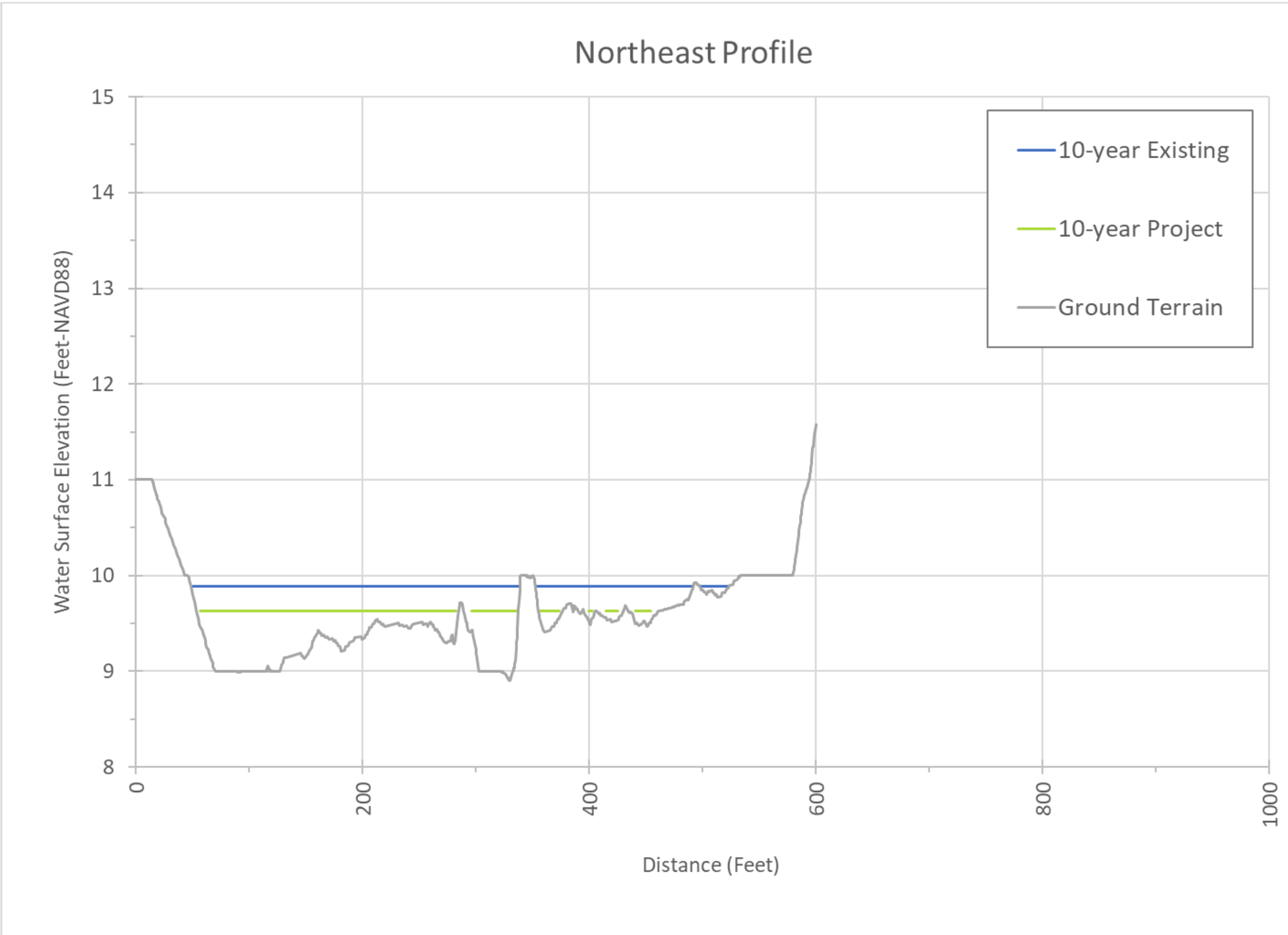


Figure B-5: Northeast WSEL Profile Q10

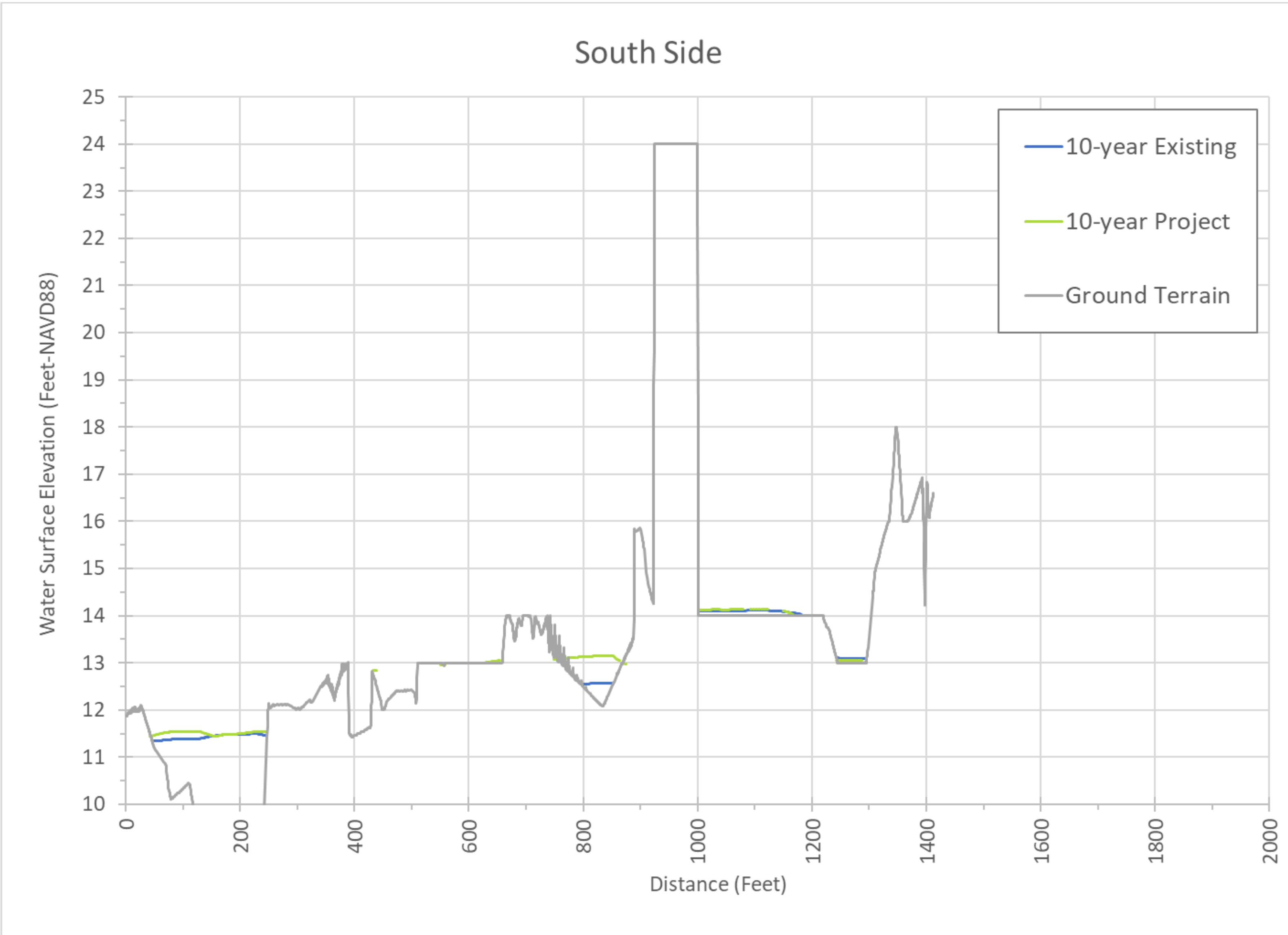


Figure B-6: South Side WSEL Profile Q10

MEMORANDUM

TO:	Jeff Tarantino, Fryer & Lauretta	**FROM:**	Chris Feng, WRA Andrew Smith, WRA
CC:	Mark Quito, Fryer & Lauretta	Justin Semion, WRA Bianca Clarke, WRA	
DATE:	November 8, 2024		
SUBJECT:	Alexandria Center for Life Science at San Carlos (ACLS) Phase 1 Flood Mitigation Technical Memorandum		

INTRODUCTION

The proposed *Alexandria Center for Life Sciences at San Carlos* (ACLS) (Project) is adjacent to the north side of Pulgas Creek in the City of San Carlos, San Mateo County, south of Commercial Street between Old County Road and Industrial Road (City Planning submission #PLN2020-00032). WRA, Inc. has conducted hydraulic studies for the Project to describe the existing flood conditions of the Project site and vicinity from watershed runoff, assess the potential for the Project to modify flooding, and determine design features to avoid and minimize changes to post-project flood patterns. WRA produced a report in November 2024 describing the comparison of existing and proposed flood conditions for the 10-year and 100-year flood for the completed Master Plan implementation of the ACLS site (WRA, Inc., 2024). This memorandum describes existing and proposed flood conditions for Phase 1 of the Master Plan, with the Phase 1 design plan produced by Surfacedesign Inc. presented in Attachment A. Construction of Phase 1 will involve developing approximately three quarters of the site with the northeastern quarter of the site abutting Pulgas Creek left as existing conditions.

HYDRAULIC MODEL DEVELOPMENT

Existing Conditions

WRA developed an existing conditions baseline model for the Project Site in 2020 using HEC-RAS based on a one-dimensional [1D] model of the Pulgas Creek channel and two-dimensional [2D] model of surrounding areas (WRA, Inc., 2020). Existing conditions model set-up details including hydrology assessment, model geometry descriptions, assigned roughness values, etc. are available in the October 2020 memo and the November 2024 report. Existing conditions 100 and 10-year flood maps (Figure 1 and Figure 2 respectively) are reproduced from the November 2024 report below for reference.

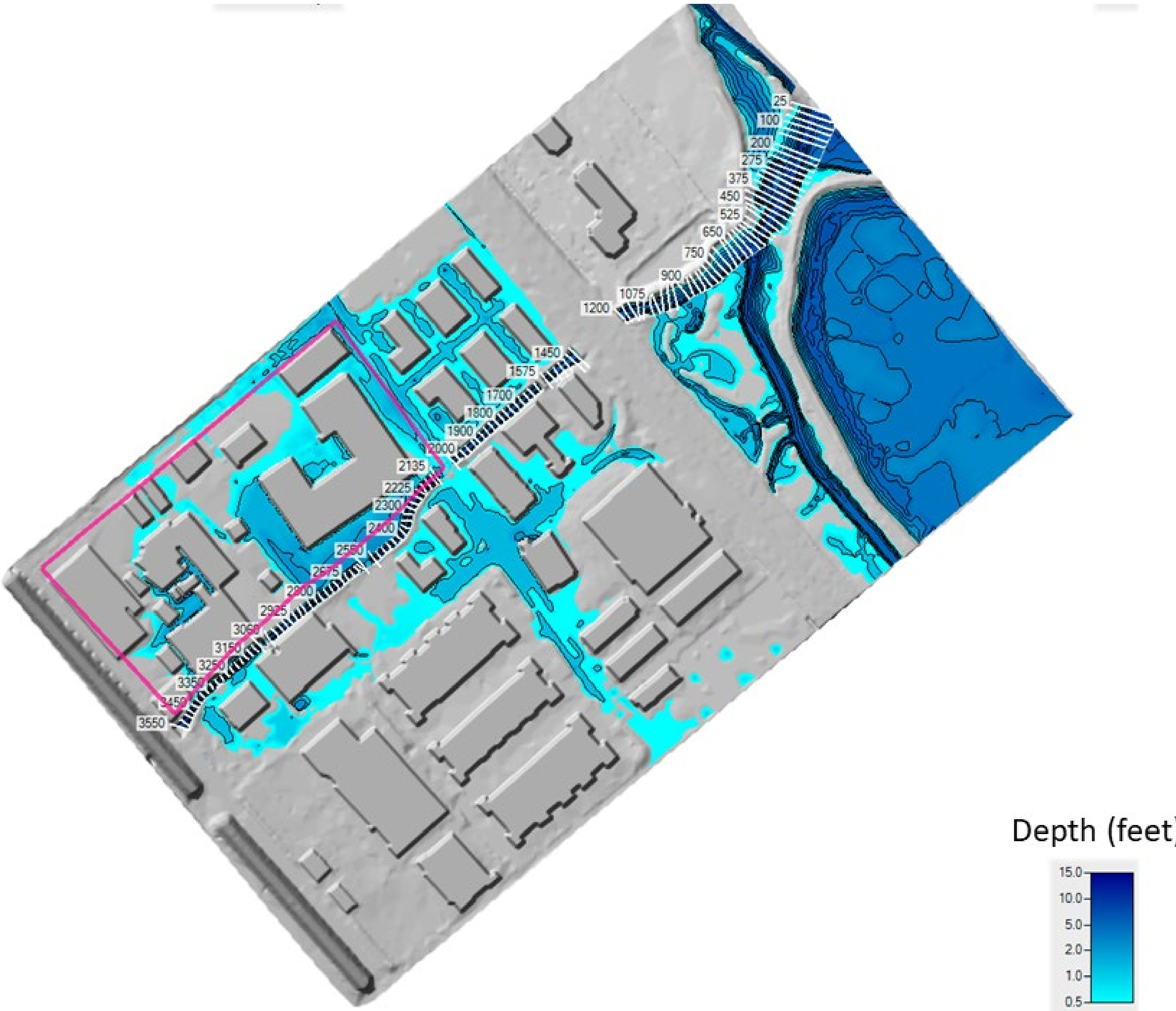


Figure 1. Project Site and Vicinity 100-year Flood Maximum Extent and Depths – Existing Conditions

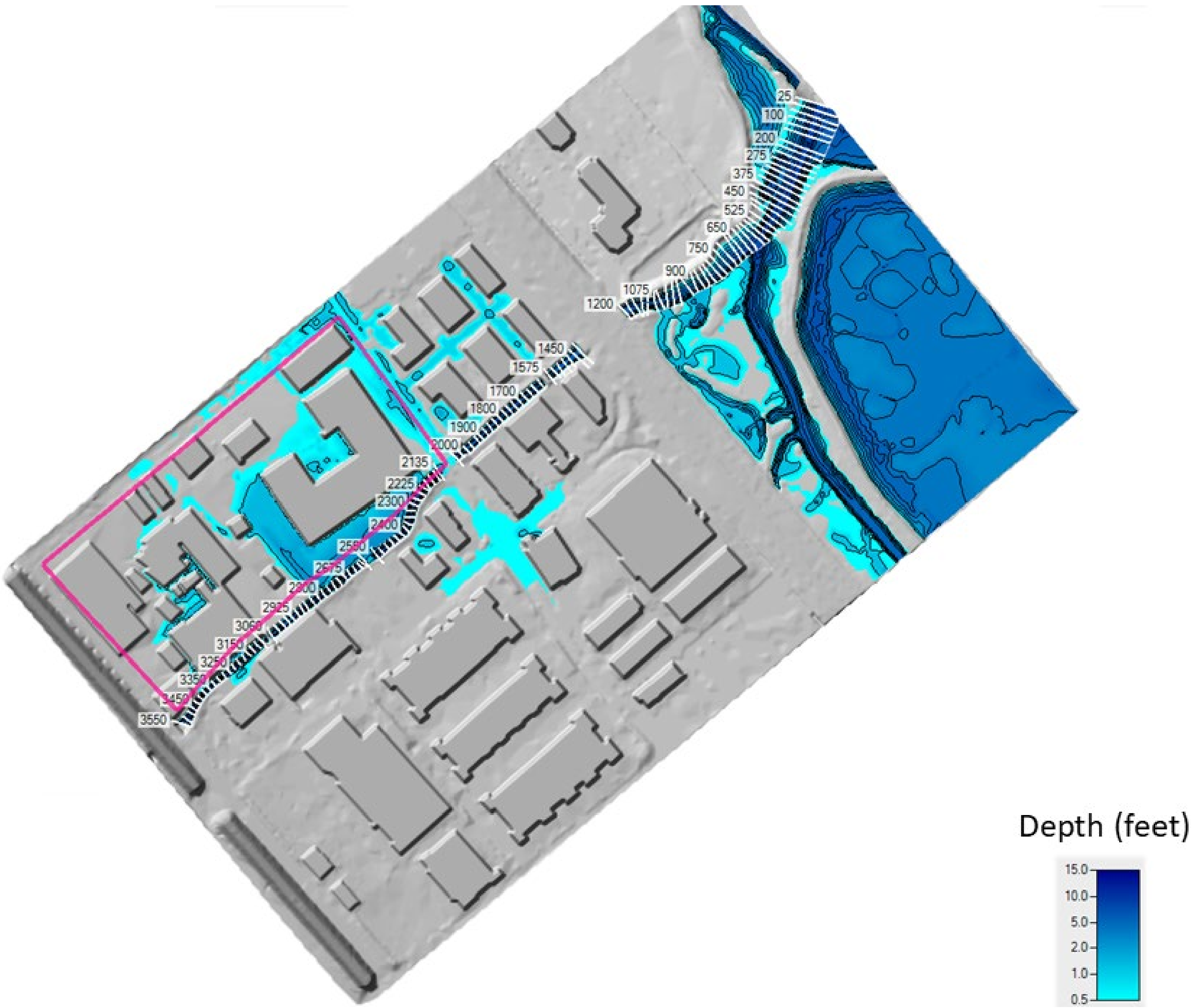


Figure 2. Project Site and Vicinity 10-year Flood Maximum Extent and Depth – Existing Conditions

Phase 1 Proposed Conditions

The hydraulic analysis of Project features and scenarios was performed by modifying the topographic surface and building layouts, that would reflect the proposed design features for the Phase 1 Project. A comparison of existing and Phase 1 Project topography is shown in Figure 3.

No changes to any off-site areas were made in the model set-up (since the Project would not have the authority or responsibility to directly change off-site properties), and the same boundary conditions and hydrologic inputs were used as for the existing conditions model. The Phase 1 Project design is intended to have negligible change in existing flood dynamics by minimizing changes to the existing flood flow path.

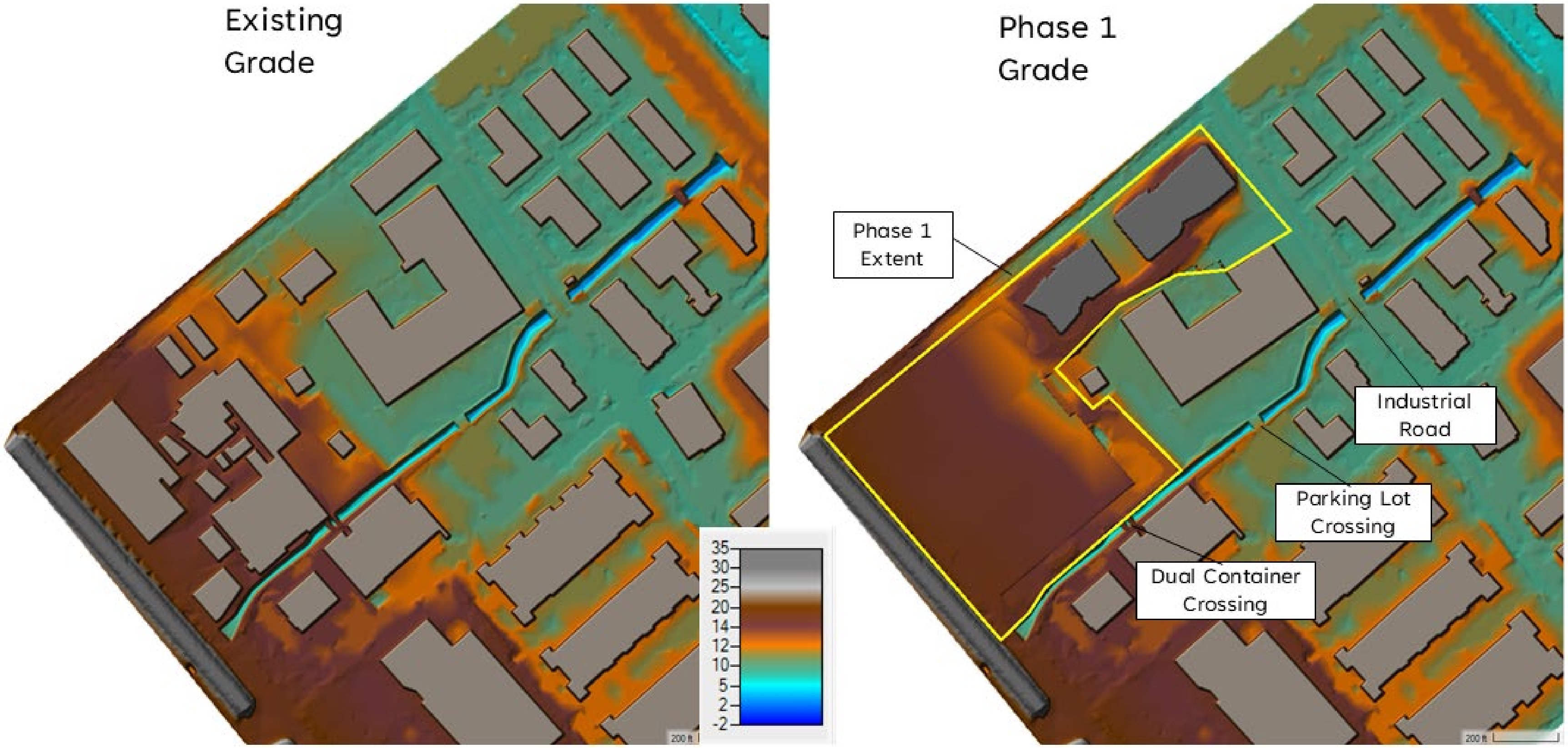


Figure 3. Existing (Left) and Phase 1 Project (Right) Model Terrains

Phase 1 Flood Extent

The Phase 1 Project model results for the 100-year and 10-year flood indicate that both 100-year and 10-year flooding have negligible change in flood depth from existing conditions (Figure 4 and Figure 5 respectively). Under the 10-year, flood depths increase along roads by less than 6-inches northeast of the site and decrease by less than 3-inches southeast of the site under Phase 1 Project conditions compared to existing. Under the 100-year, flood depths increase along roads by less than 3-inches northeast of the site and decrease by less than 3-inches southeast and less than 12-inches south of the site under Phase 1 Project conditions compared to existing.

The 100-year and 10-year flood extents off site for the Project are nearly identical to the existing condition (Figure 6 and Figure 7 respectively). Areas of Figure 6 and Figure 7 that display using only bright blue tones show existing flooding that is reduced or eliminated under Phase 1 Project conditions. The fringe areas in lime green are the minor areas with modeled extent beyond the existing conditions (primarily the onsite Phase 1 Project feature flooding). Darker green areas are overlap that have flooding under both conditions (i.e., no change).

Figure 4: Project 100-year Flood Extent and Depth

Figure 5. Project 10-year Flood Extent and Depth

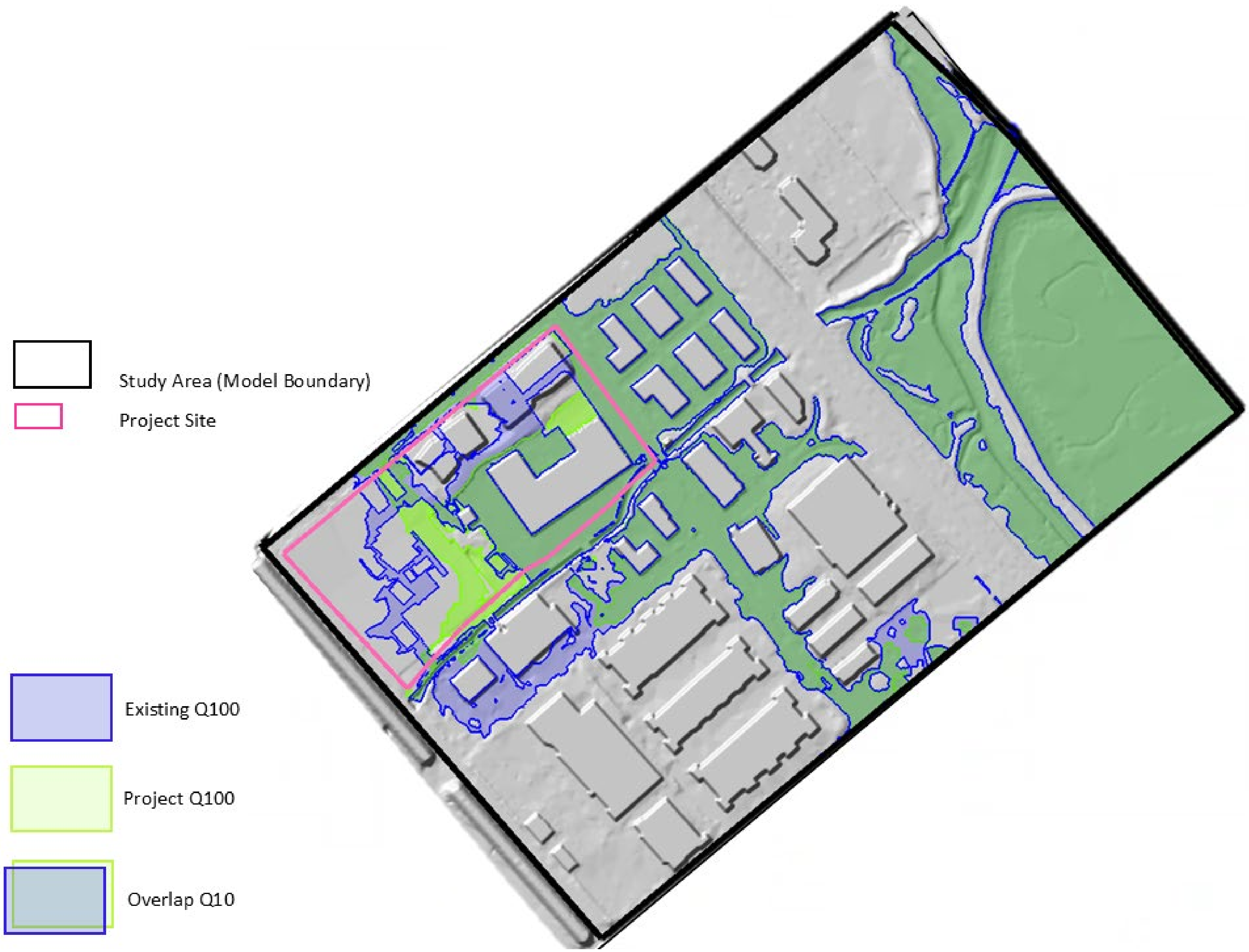


Figure 6. Existing Conditions and Project 100-year Flood Extents

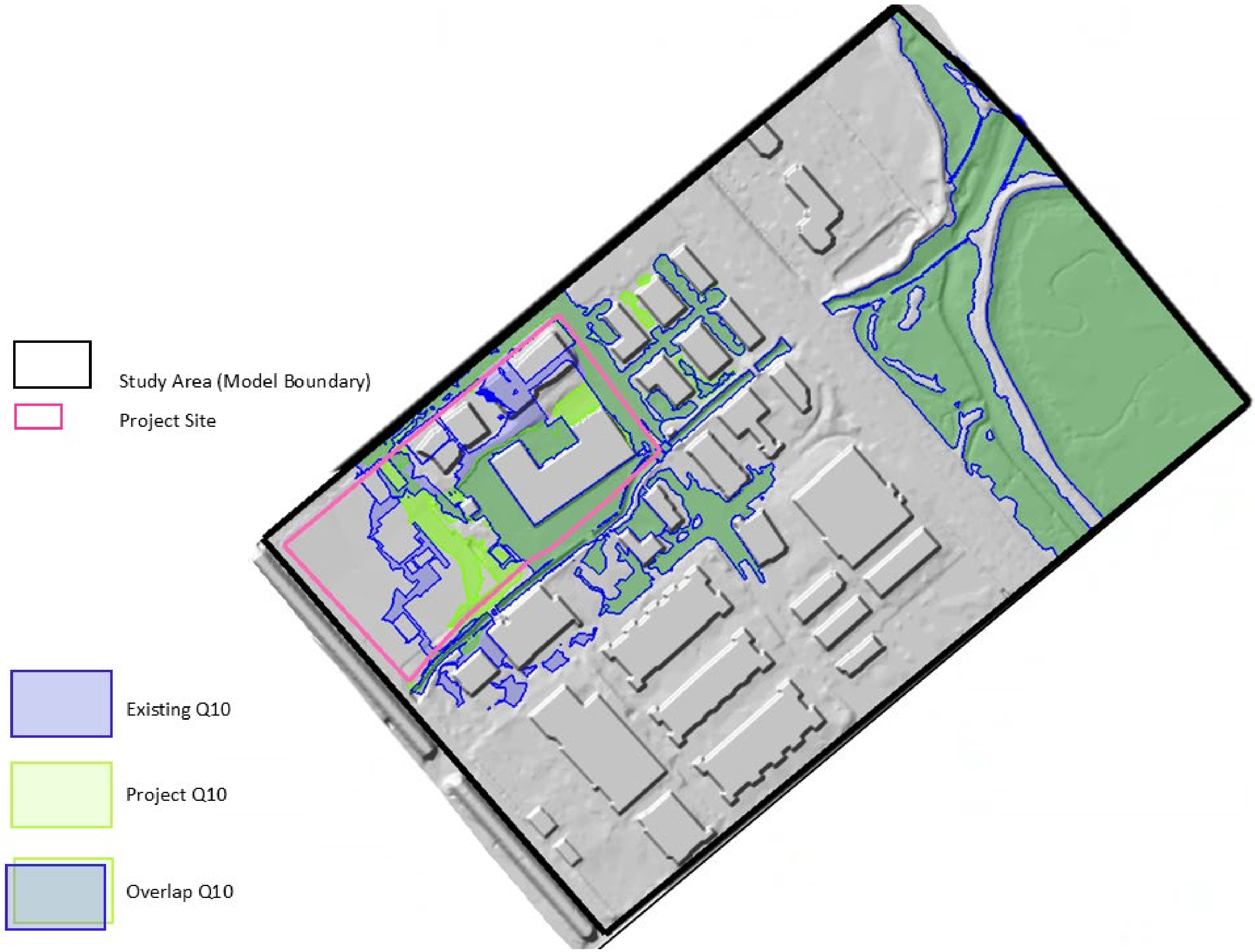


Figure 7. Existing Conditions and Project 10-year Flood Extents

Phase 1 Profiles and Cross Sections

The Project 100-year and 10-year maximum WSEL along Pulgas Creek would be slightly higher than existing conditions downstream of the container crossings down to the downstream end of the Highway 101 crossing (Figure 8). Upstream of the container crossing, the 100-year WSEL increases with the 10-year WSEL decreasing compared to existing conditions. In general, the Phase 1 Project tends to direct flood waters more towards the north-east off-site and less towards the south for the 100-year and 10-year events (Figure 9 and Figure 10 respectively). In-depth view of the WSEL cross sections can be found in Attachment B. However, the difference in WSELs between existing and Phase 1 Project is less than a quarter foot increase and decrease between the off-site locations. All flooding remains concentrated towards the roadways and are not expected to change level of impact to off-site buildings.

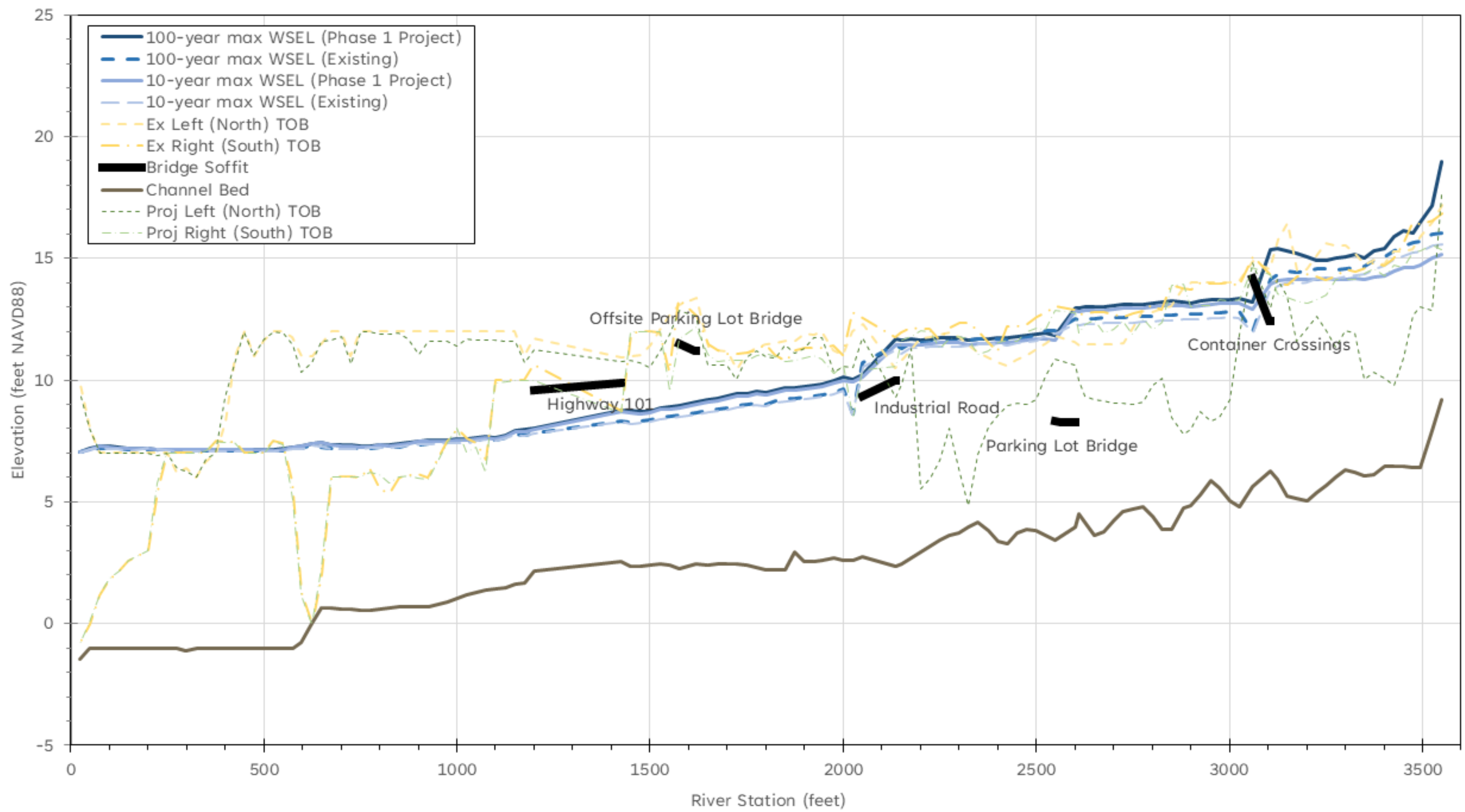


Figure 8. Pulgas Creek Maximum Water Surface Elevation Profiles for the 100-year Flood

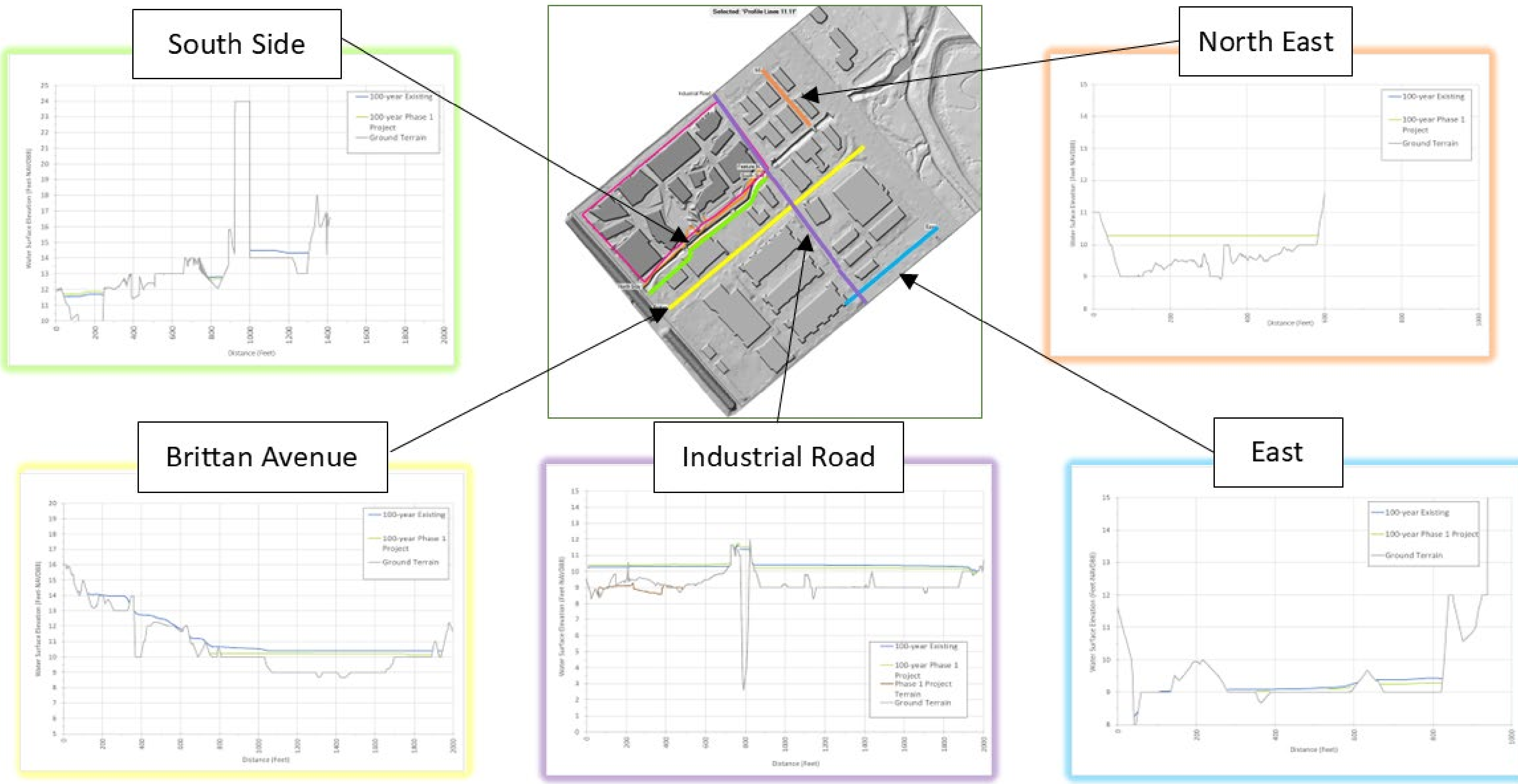


Figure 9. Maximum Water Surface Elevations and Ground Surfaces: 100-year Flood

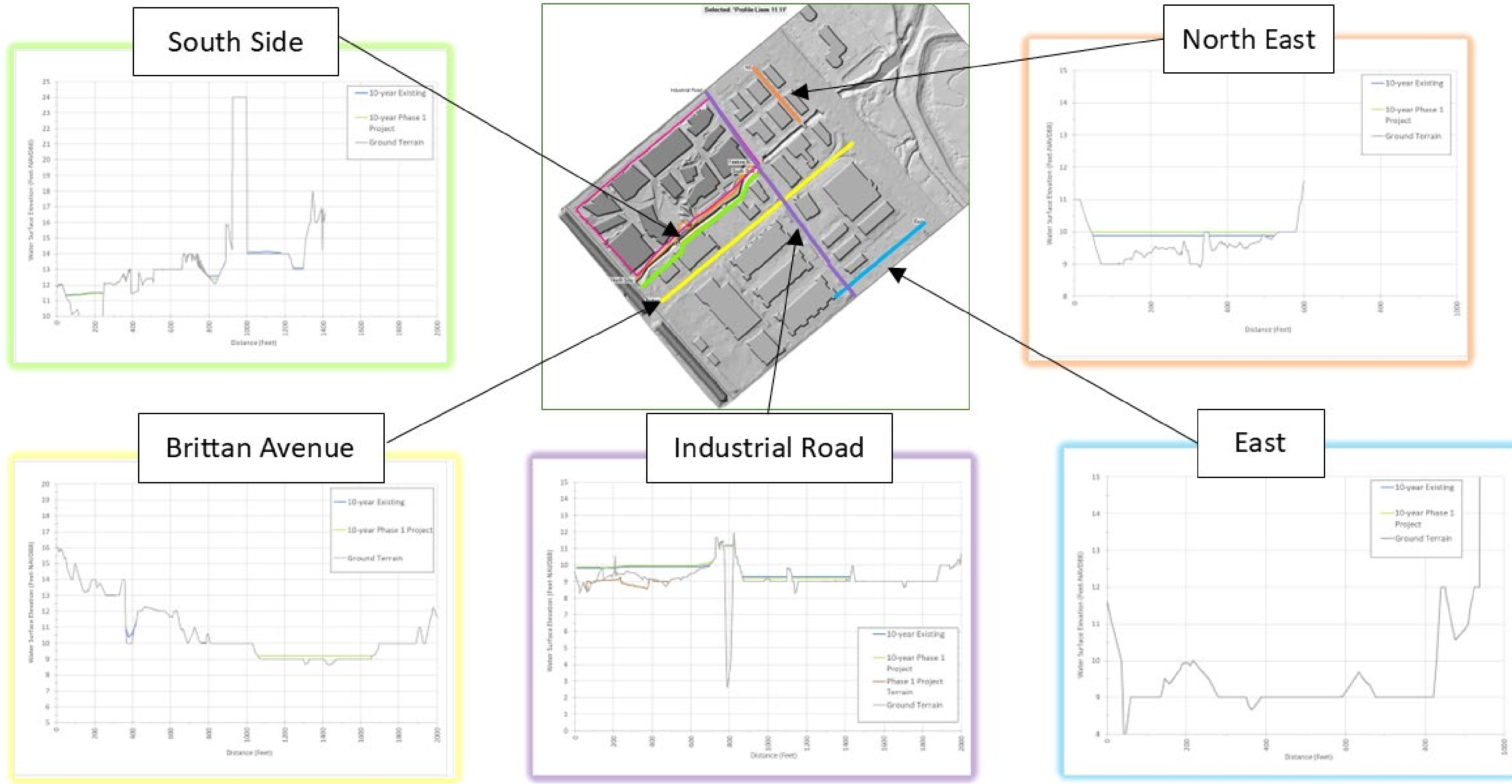


Figure 10. Maximum Water Surface Elevations and Ground Surfaces: 10-year Flood

CONCLUSION

WRA performed hydraulic modeling of the Phase 1 Project design to determine off-site flooding extent and depth and local shear stresses in Pulgas Creek. *Based on the modeled site hydraulics for the proposed Phase 1 Project, potential for change in offsite flooding behavior for the 100-year and 10-year floods is negligible compared to existing conditions with a flood neutral effect offsite.* Modeling indicates that the Phase 1 Project will alter the 100-year flood conditions on site and be protective of the proposed buildings.

LIMITATIONS

The models developed for this study have focused particular recurrence interval events (i.e. 100 -year and 10-year) rather than a full range of recurrence interval peak flows or hydrographs. The scope and emphasis of model optimization was on comparing and evaluating the relationship between the existing conditions and the proposed and/or Project within the study area.

It is important to acknowledge that as for any numerical model, there is uncertainty or a margin of error in the hydraulic model. The model sensitivity analysis shows the water surface elevation may be within +/- 0.3 ft of the model results. The volume of water quantified may be within 10 acre-ft of the model results. These are reasonable and typical for the resolution of modeling herein.

Additionally, we note that the scope of this flood analysis is limited to the physical hydraulics and does not address options for flood safety hazard measures such as signage, trash management, monitoring or maintenance.

REFERENCES

WRA, Inc. (2020, October). Alexandria Phase 2 Project Pulgas Creek 100-year Flooding Analysis. Prepared for Freyer & Lauretta.

WRA, Inc. (2024, November). Alexandria Center for Life Sciences at San Carlos (ACLS) Updated Master Plan Pulgs Creek Flooding Analysis. Prepared for Freyer & Lauretta Inc.

APPENDIX A. ACLS SAN CARLOS CAMPUS – PHASE 1 DEVELOPMENT – ENTITLEMENTS BY SURFACEDESIGN INC.

ACLS San Carlos Campus - Phase 1 Development - Entitlements

Surfacedesign Inc.

31. October, 2024

APPENDIX B. PHASE 1 PROJECT WATER SURFACE ELEVATION PROFILES

Attachment B

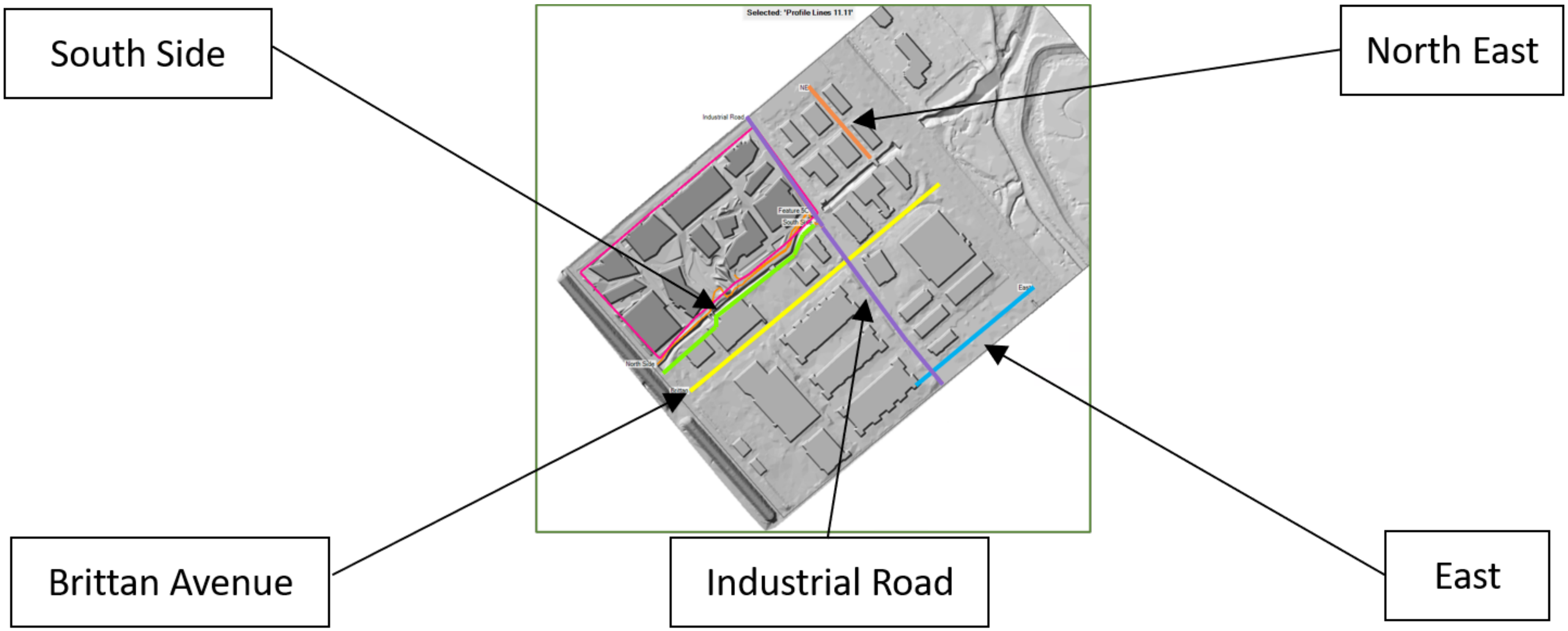


Figure B-1: Water Surface Elevation (WSEL) Comparison Q100 Key

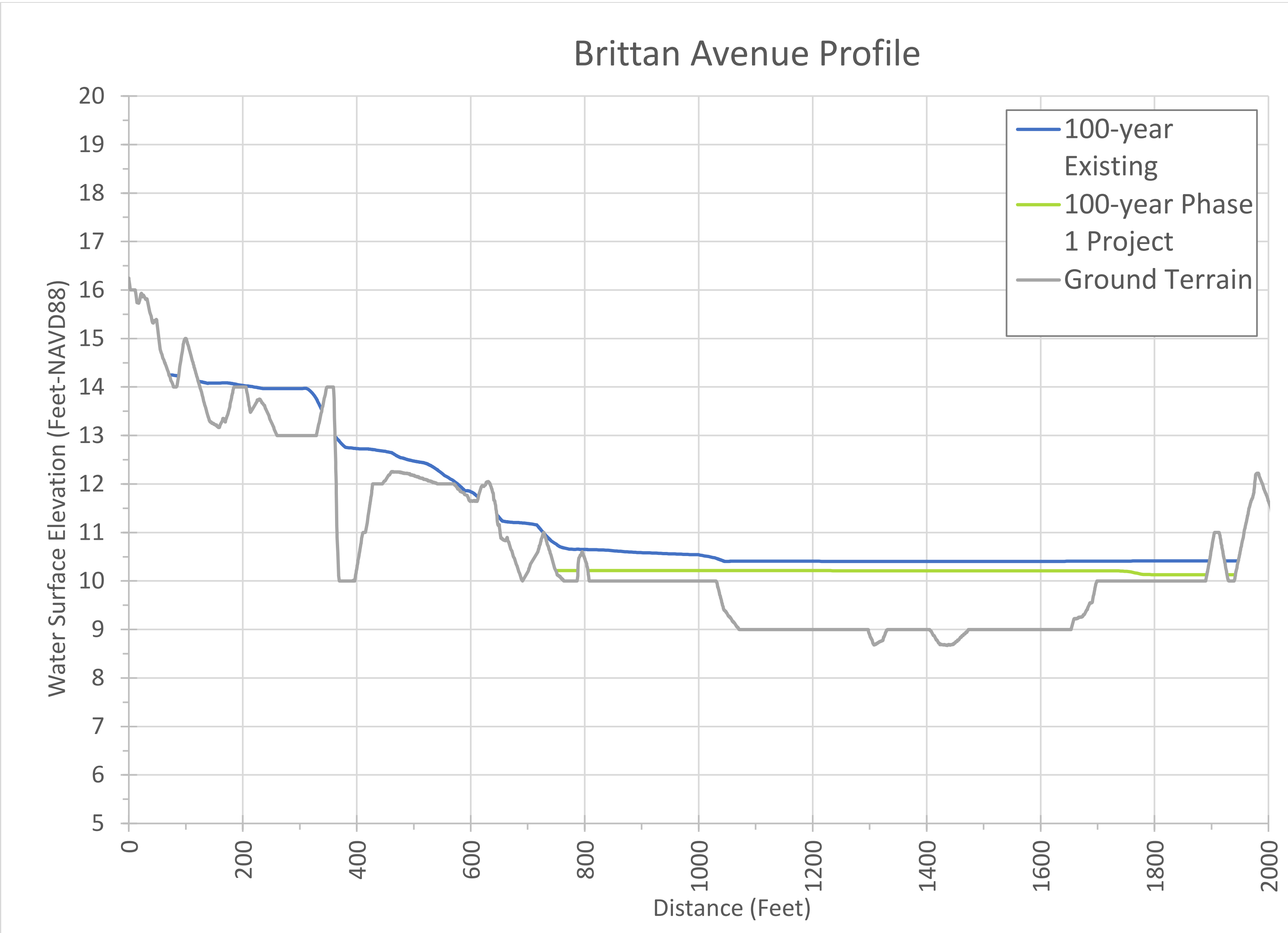


Figure B-1: Brittan Avenue WSEL Profile Q100

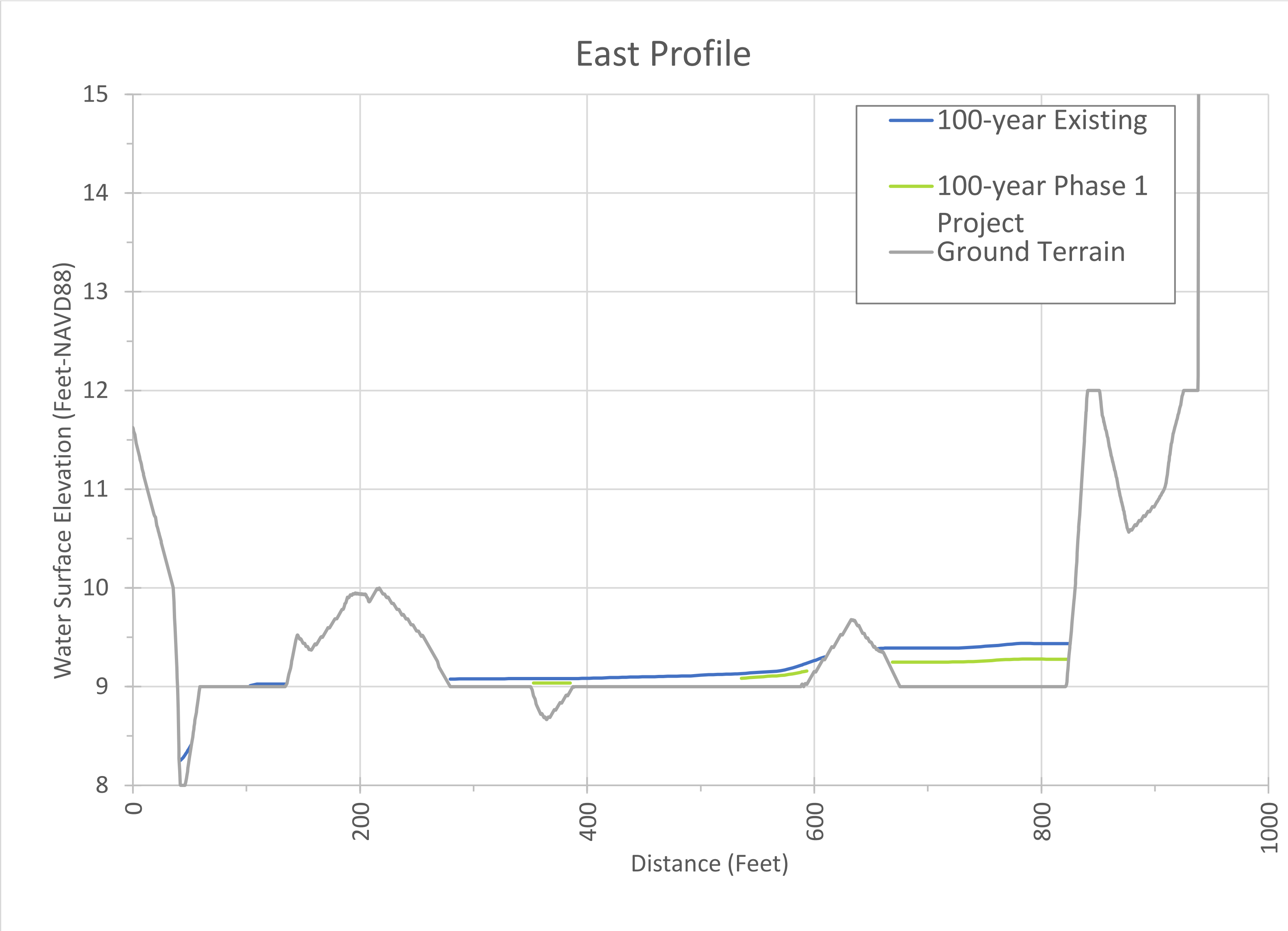


Figure B-1: East WSEL Profile Q100

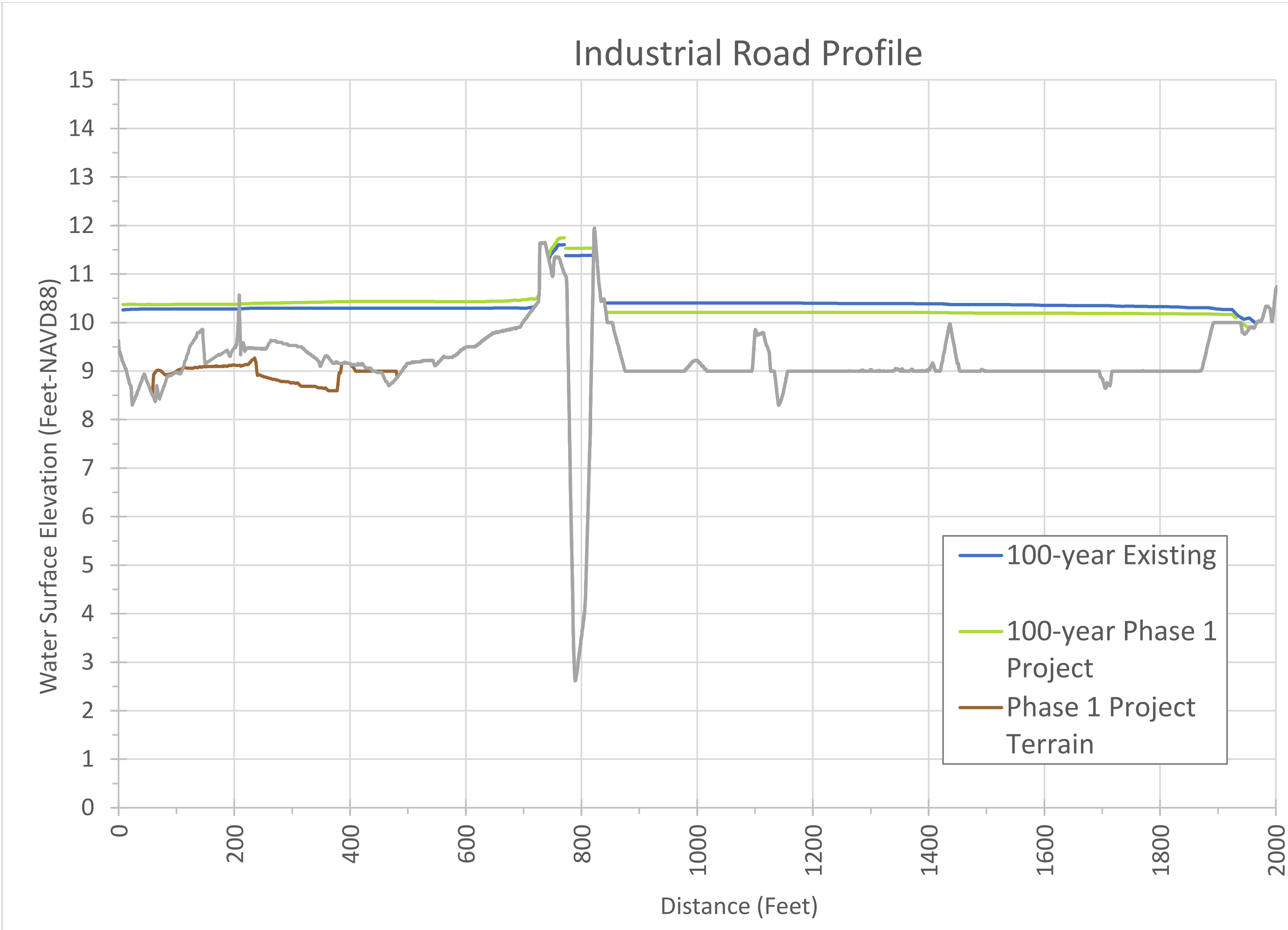
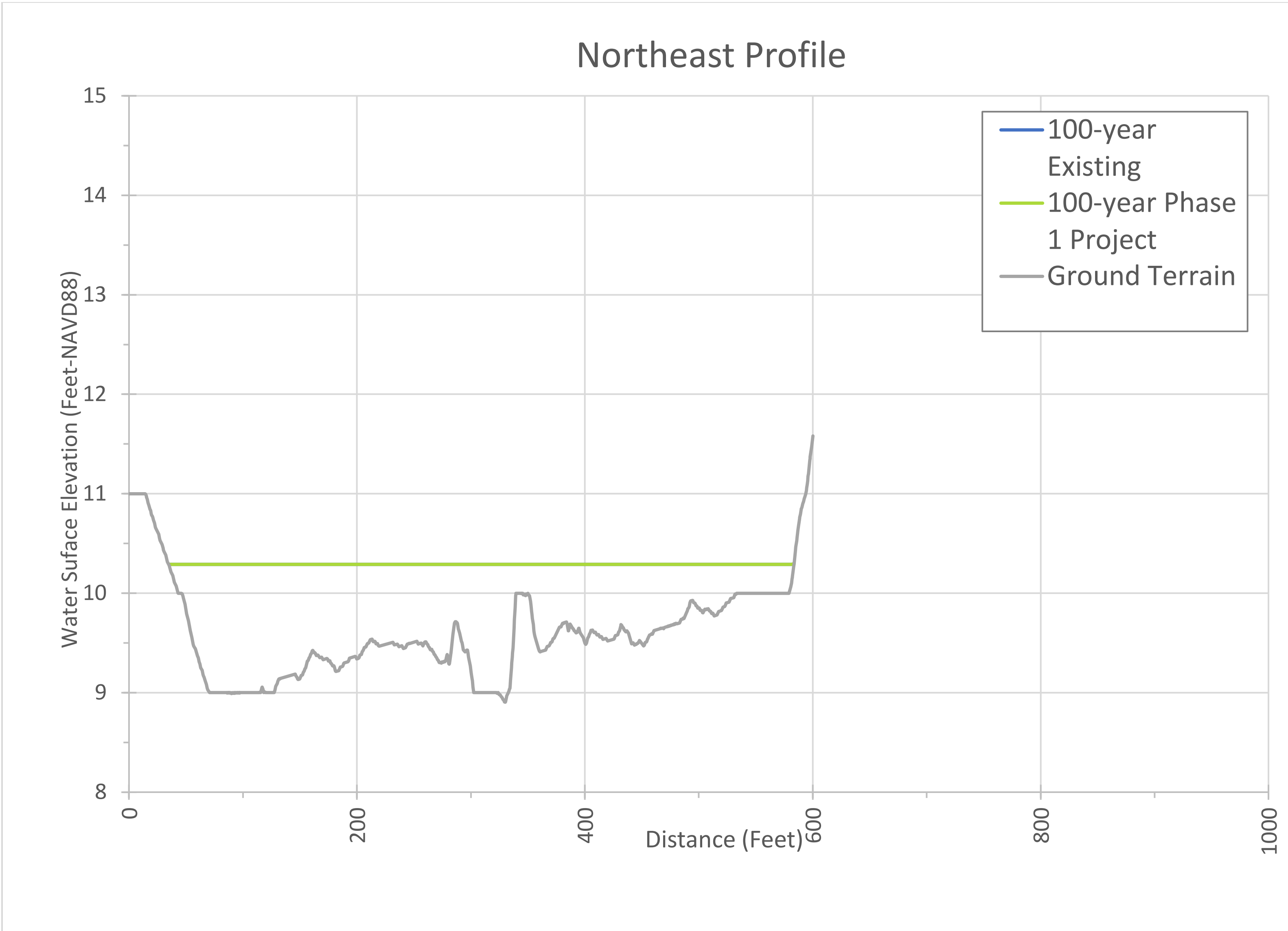


Figure B-1: Industrial Road WSEL Profile Q100



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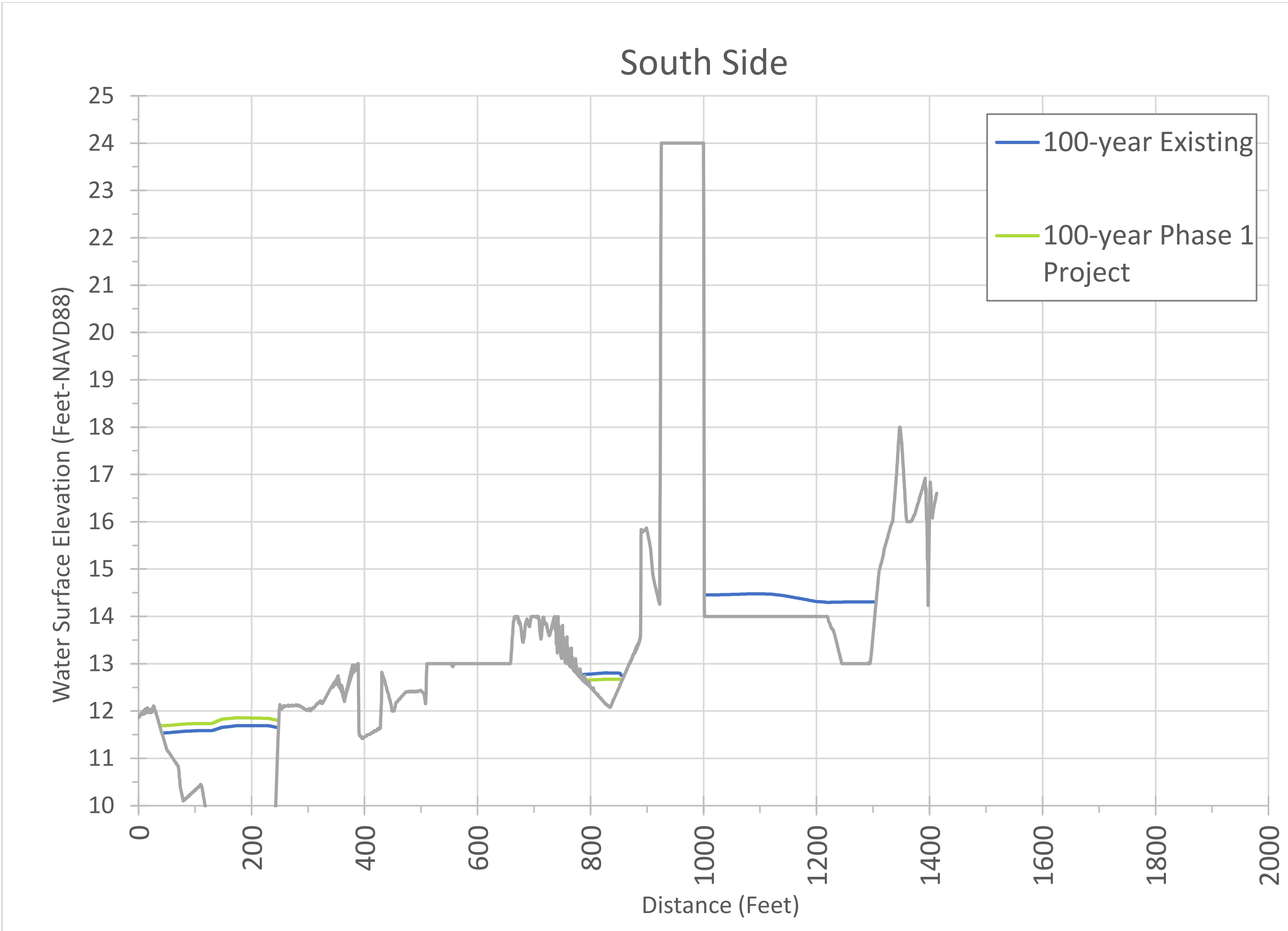

Figure B-1: South Side WSEL Profile Q100

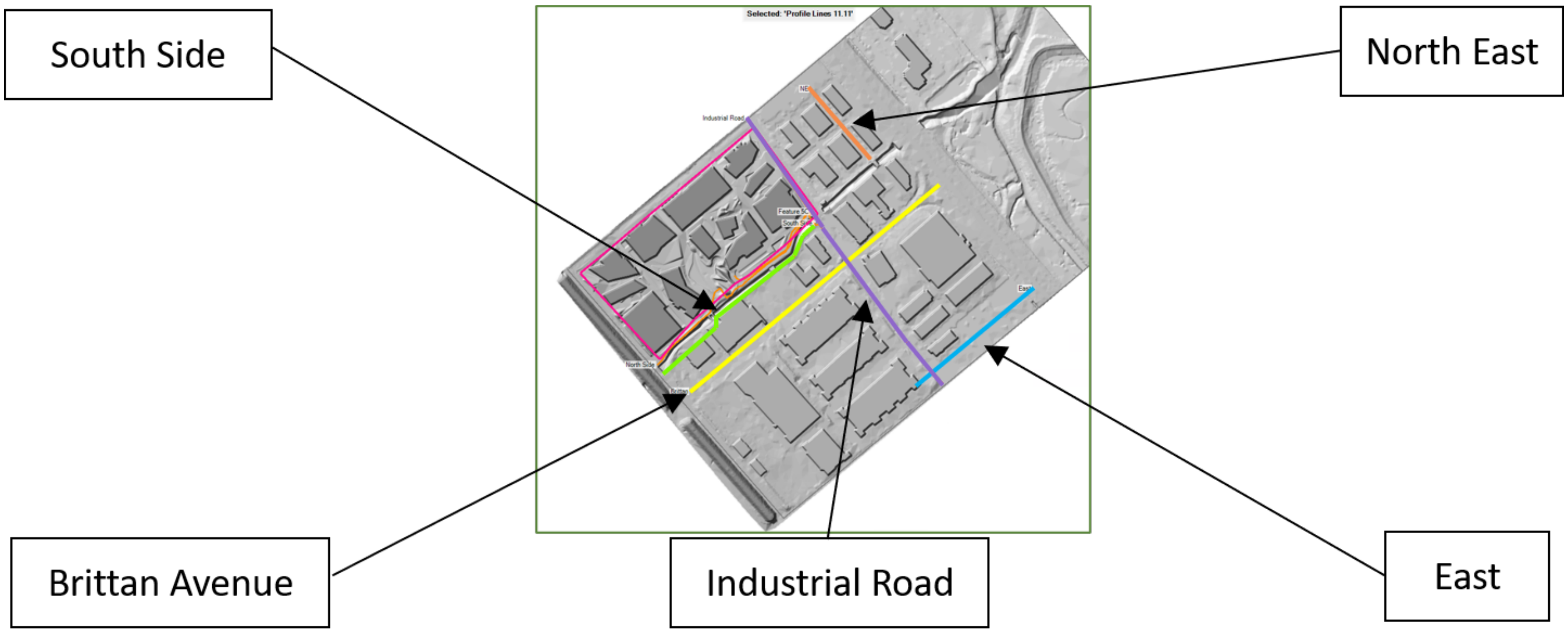

Figure B-1: Water Surface Elevation (WSEL) Comparison Q10 Key

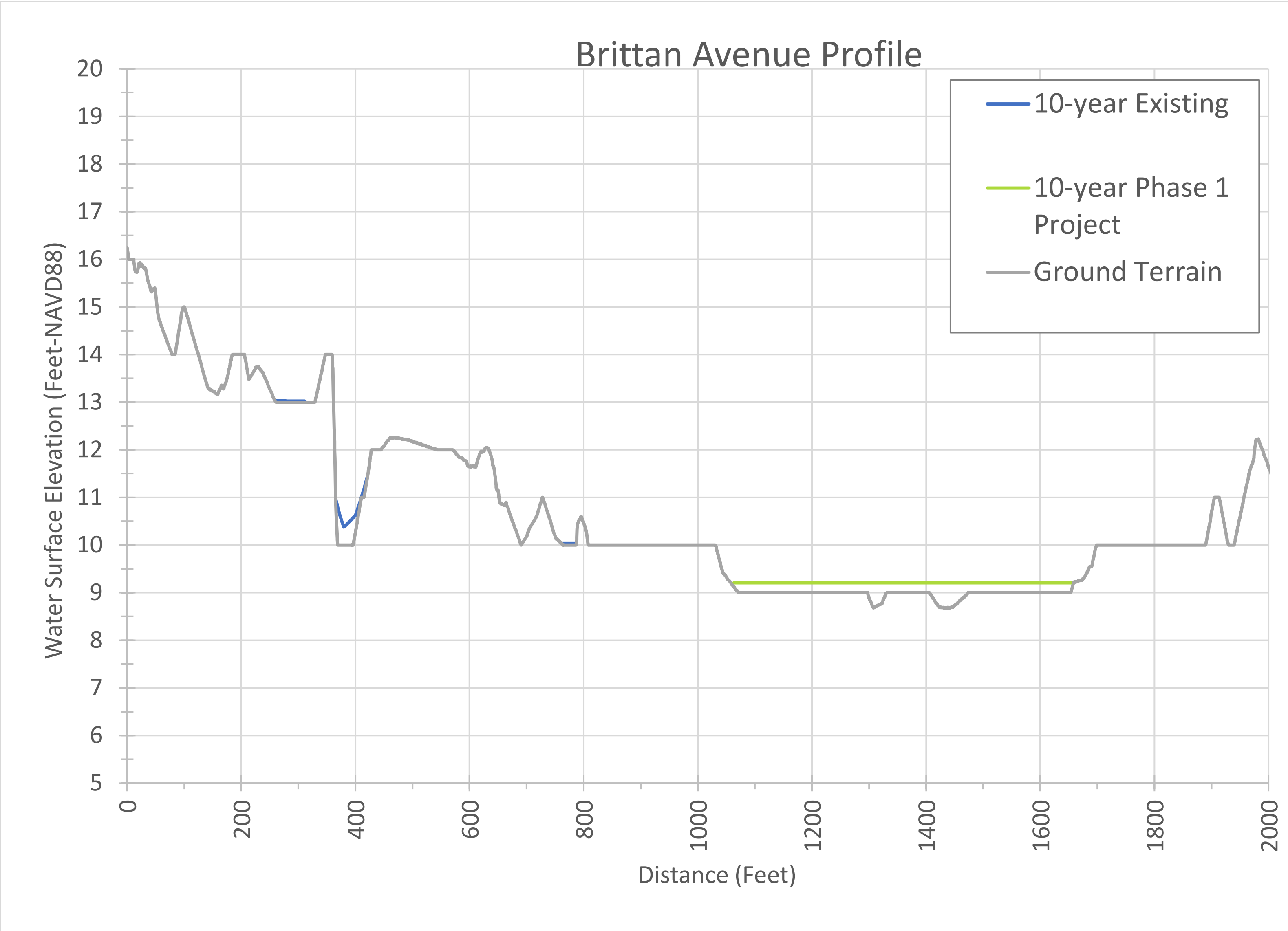

Figure B-2: Brittan Avenue WSEL Profile Q10

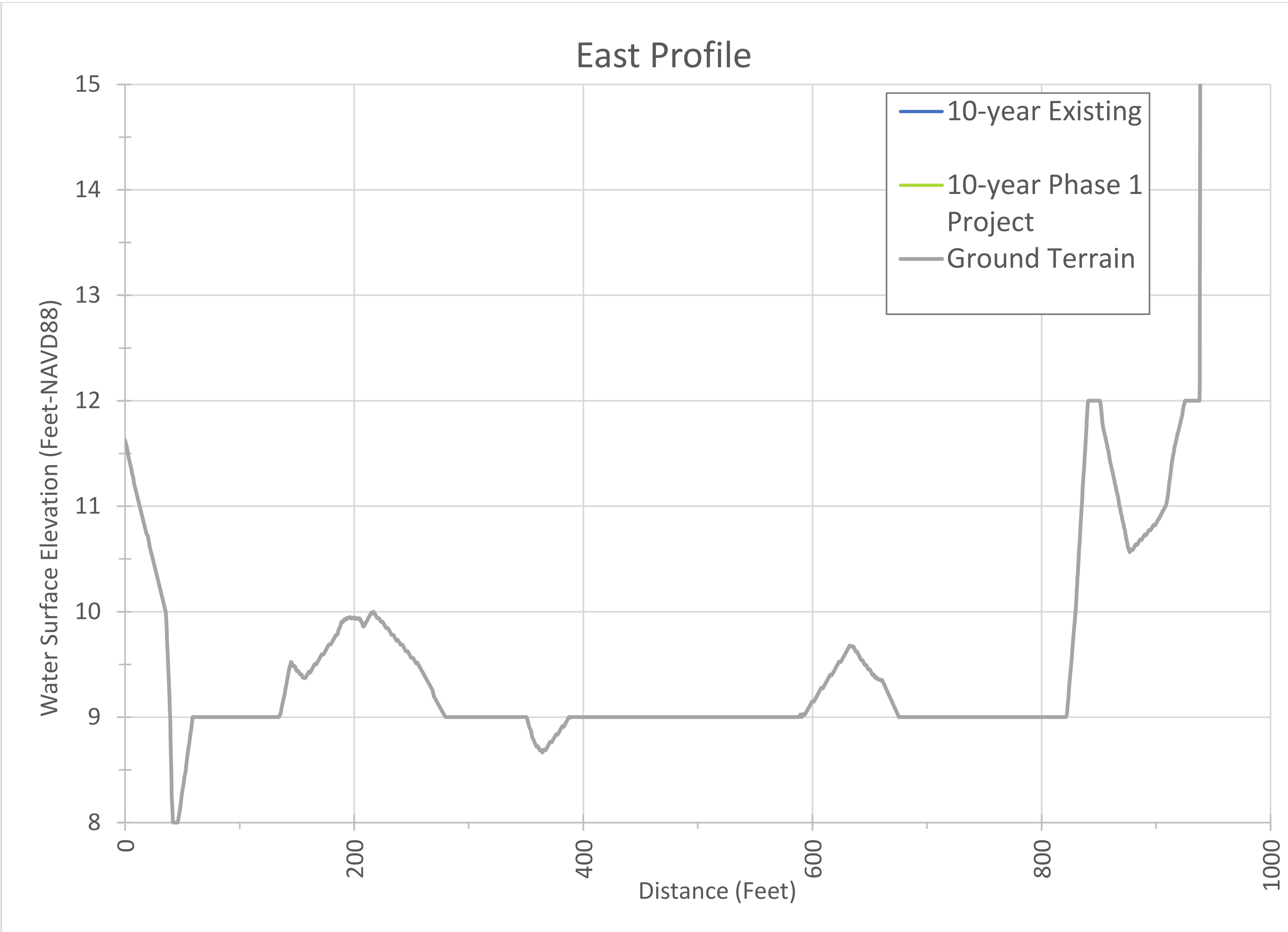

Figure B-3: East WSEL Profile Q10

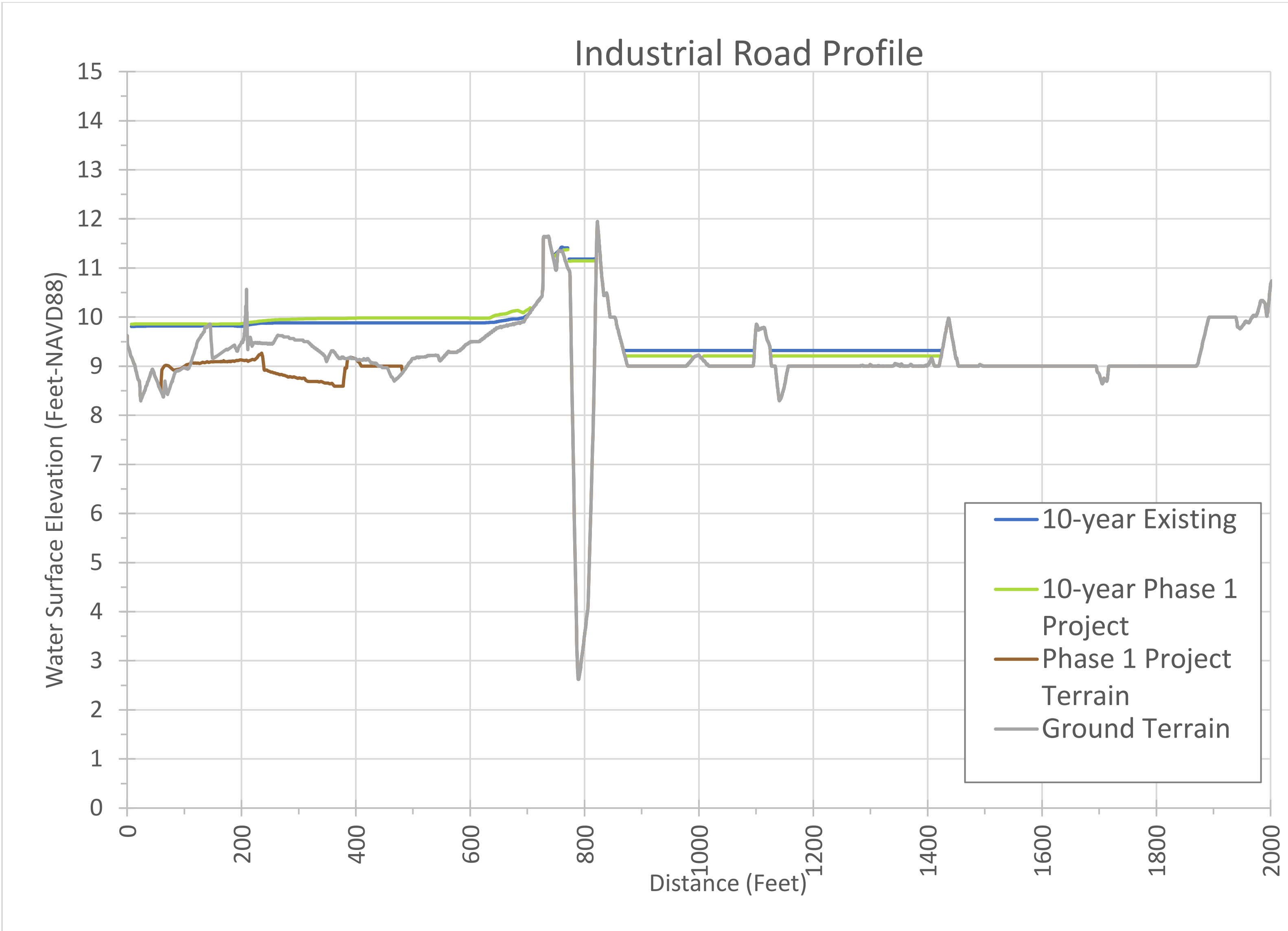

Figure B-4: Industrial Road WSEL Profile Q10

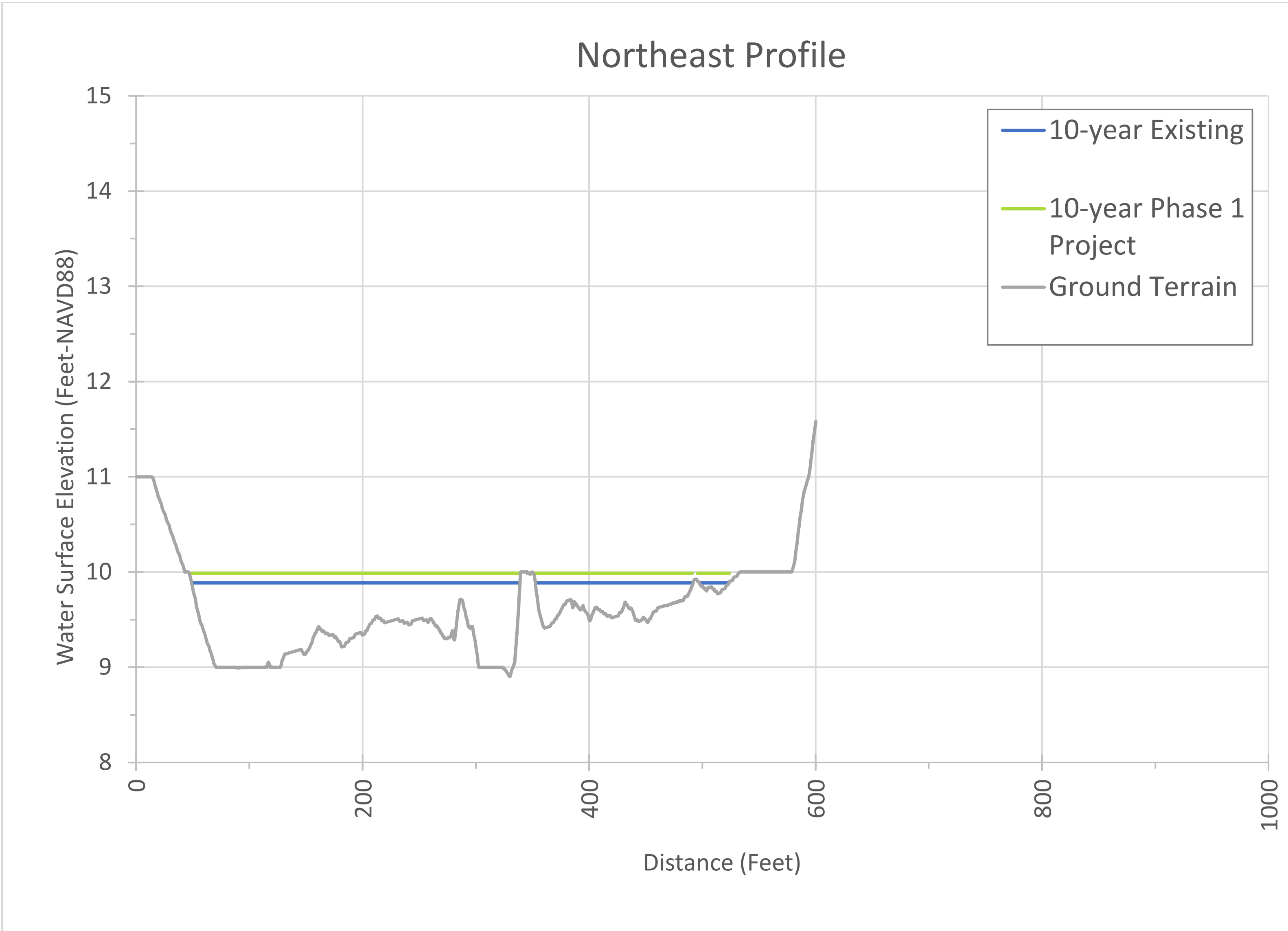

Figure B-5: Northeast WSEL Profile Q10

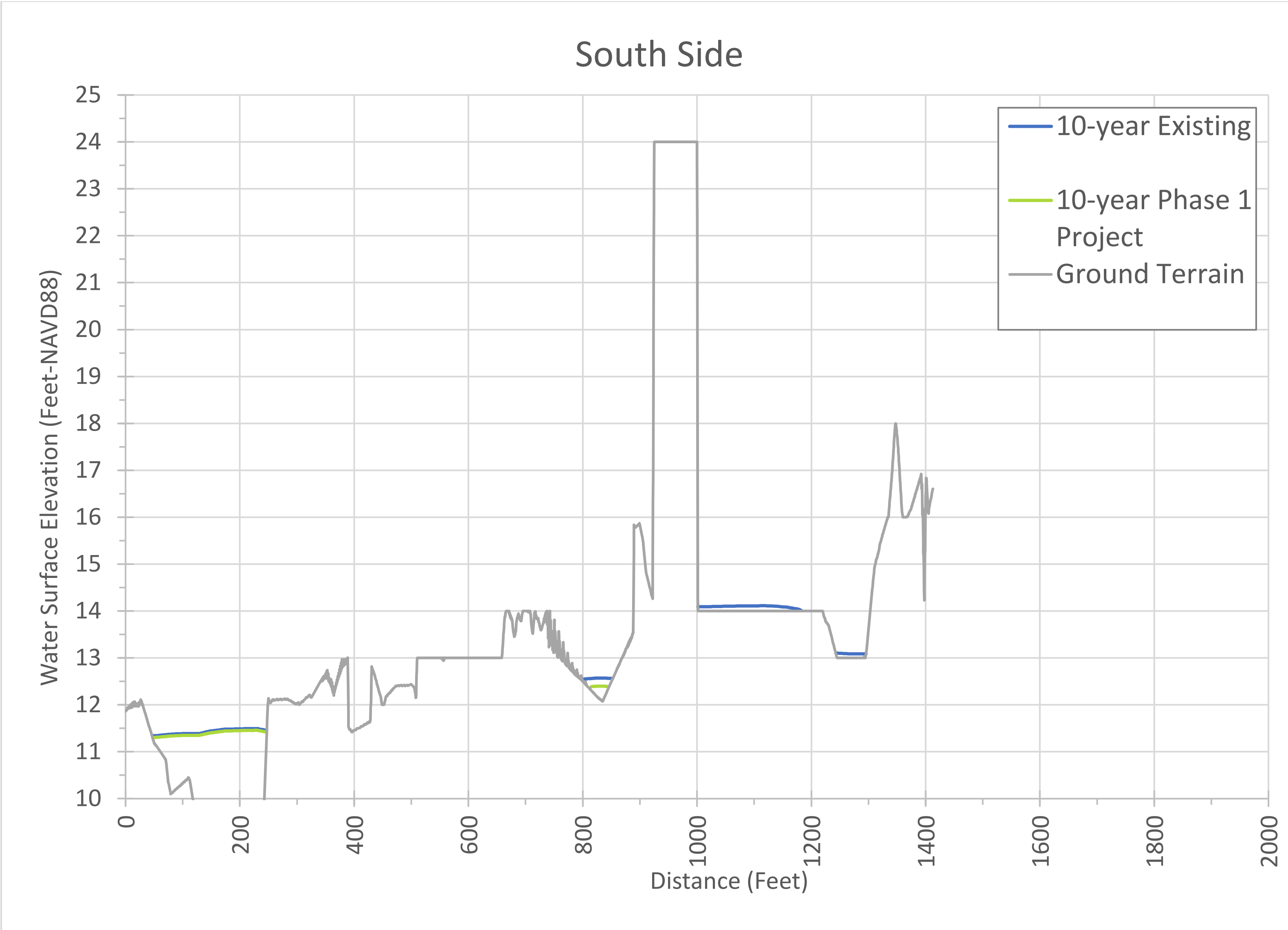

Figure B-6: South Side WSEL Profile Q10