Bolinas Lagoon Wye Wetlands Project

Basis of Design Report – 60% Design

Prepared for:

MARIN COUNTY PARKS
PRESERVATION · RECREATION

Prepared By:

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ENVIRONMENTAL CONSULTANTS

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LIST OF PREPARERS

Jenn Hyman, PE – Principal Engineer
Brian Bartell, RLA – Project Manager
Andrew Smith, PE – Project Engineer

LIST OF ACRONYMS

Acronym	Full Name
2D	Two Dimensional
AF	Acre-Feet
CAD	Computer Assisted Drafting
CEQA	California Environmental Quality Act
cfs	Cubic Feet per Second
FEMA	Federal Emergency Management Agency
ft	Feet
GIS	Geographic Information System
HEC-RAS	Hydrologic Engineering Center – River Analysis System
PLS	Professional Land Surveyor
SLR	Sea Level Rise
USACE	United States Army Corps of Engineers
USGS	United State Geological Survey
WSEL	Water Surface Elevation

Glossary

Term	*Definition*
Bankfull Discharge or Bankfull Streamflow	A simplified understanding of bankfull flow is that it is the streamflow at which water begins to overtop the streambanks and start to spread out beyond the active channel. It can also be expressed relative to the return period for a peak flow (e.g., the 2-year event).
Bioengineering	Measures for stream restoration that include living willow or other species that root readily from cuttings.
Discharge	Discharge (also called 'streamflow') is the quantity of water flow passing through channel at a location and expressed as a rate in terms of volume per unit time (i.e., cubic feet per second).
Flood Conveyance	Flood conveyance refers to the maximum magnitude of streamflow (discharge) that a channel can hold without overtopping its banks.
Freeboard	"Freeboard" is a means to express a factor of safety relative to flood water elevations by compensating for the unknowns and uncertainties with predicting flood heights. The freeboard is a vertical distance (e.g., 1 to 3 feet) between the flood water elevation and natural or built features like channel banks, levee crests or bridge soffits.
Geomorphic Bankfull	Geomorphic bankfull refers to either the physical field indicators of the bankfull discharge, or the streamflow when those indicators are just inundated. It may differ from the discharge reaching the top of bank or the effective discharge.
Hydric Soils	soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part.
Pilot Channels	Channels constructed using simplified plan and cross-sectional form that are expected to naturalize.

Planform Geometry	The planform geometry of a stream refers to the overall layout and shape of the channel as viewed from overhead (i.e., map view); It may have one or more active channels and each of the channels may have a range of curvature (sinuosity) and width.
Recurrence Interval or Return Period	The recurrence interval or return period is the estimated average number of years between events (e.g., floods, fires, earthquakes) of a certain magnitude.
Roughness	Roughness is a measure of the amount of frictional resistance water experiences when flowing over land surfaces (i.e., soil, rocks, vegetation or built features) and in channels (e.g., stream bed and bank materials). It is expressed in engineering calculations using the Manning's n value.
Sediment Conveyance	The ability for a stream, creek, or river to erode, deposit, or transport sediment with a natural equilibrium where human intervention and maintenance is not required.
Soffit	The soffit is the lower surface of an arch and/or the underside (bottom) surface of a bridge.

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1. Introduction

The Marin County Open Space District (District) is leading a consortium of stakeholders working on a long-term vision to improve aquatic habitat, transportation safety and climate resilience at the North End of Bolinas Lagoon near Bolinas, CA. The Bolinas Lagoon Wye Project (Project) is the first step in implementation of the larger Bolinas Lagoon North End Vision, which aims to re-establish and rehabilitate hydrologic, geomorphic, and ecologic processes; improve habitat connectivity; increase wetland sea level rise (SLR) resiliency; improve special-status species' habitat; and protect community safety by moving roads out of flood inundation areas. The 60% design drawings have been submitted concurrently and are referenced throughout this document.

Existing conditions are presented in Sheet V-1.0. As shown in that sheet, the Wye Wetland (the Wye) is framed by California Department of Transportation (Caltrans) State Route 1 (SR-1) to the east and Olema-Bolinas Road to the west. The Wye is bisected by Fairfax-Bolinas Road (also known as Crossover Road), which breaks the Wye into a northern triangle and southern area that transitions into Bolinas Lagoon. Lewis Gulch Creek flows from the north, crosses under SR-1 approximately 400 yards northwest of the Wye, and eventually flows along the western edge of Olema-Bolinas Road before crossing through an undersized box culvert and through a ditch to the lagoon. Lewis Gulch Creek is known to have a population of Federally threatened Central California Coast Steelhead (steelhead, *Oncorhynchus mykiss*), CDFW species of special concern California Giant Salamander (*dicamptodon ensatus)*, California state threatened California Black Rail (*Laterallus jamaicensis coturniculus*) and federally threatened and CDFW species of special concern California red-legged frog (*Rana draytonii*).

This Project's key design elements include:

- The removal of Fairfax-Bolinas Road and restoration into tidal wetlands,
- The replacement of the Lewis Gulch Creek culvert with a bridge
- Rerouting Lewis Gulch Creek to enter the wetlands at the top of the Wye, expanding and enhancing the wetlands
- Improving Lewis Gulch Creek habitat for steelhead though the addition of large wood structures
- Reduce flooding on Olema-Bolinas Road by raising the roadway
- Repairing a bank failure on Lewis Gulch Creek close to SR-1

WRA, Inc. (WRA) is working in collaboration with the District with assistance from Mark Thomas Civil Engineering, Crawford Geotechnical Engineering, and Resource Environmental Solutions

(RES) to provide technical support for efforts related to the Project. This analysis builds on conceptual designs, projects plans, and previous studies related to existing fisheries habitat, hydraulics, hydrology, and geomorphology. The scope of this analysis includes:

- Evaluation of existing and historical conditions of the Bolinas Wye
- Development of conceptual designs for Lewis Gulch Creek and Olema-Bolinas Road
- Analysis of alternatives for channel and roadway design
- Development of geomorphic channel design
- Development of grading plans
- Development of two-dimensional hydrodynamic modeling of the proposed bridge and creek designs
- Analysis of Lewis Gulch Creek fish passage and design
- Estimation of probable costs
- Development and analysis of construction and constructability and an implementation phasing plan
- Recommendations for avoidance and impact minimization measures

1.1. Project Goals and Objectives

Goals and objectives for the Project were developed by Marin County Parks, One Tam, and the consortium of stakeholders, through a series of meetings and outreach efforts. The Project goals and objectives are summarized in Table 1.

Table 1. Bolinas Lagoon - Wye Wetlands Project Goals and Objectives

Goals	Objectives
Restore hydrological, geomorphic, and ecological processes in the Wye	Allow for an unimpeded flow of surface and groundwater in the Wye
	Restore natural sediment transport processes in Lewis Gulch Creek.
	Direct Lewis Gulch Creek into the wetland and design channel system to promote natural geomorphic processes.
Enhance freshwater and estuarine wetland communities	Increase the extent and quality of estuarine palustrine and riverine wetland vegetation.
Reconnect Lewis Gulch Creek with its historic floodplain	Design Lewis Gulch Creek to encourage frequent overbank flows.
Prevent further stream bank erosion and incision, to protect habitat and SR-1	Use bioengineering methods along Lewis Gulch Creek to protect areas experiencing accelerated erosion that impacts infrastructure.
Protect and restore native riparian and wetland species	Remove non-native invasive species, prevent colonization by re-vegetating with native riparian and wetland species.
Accommodate Sea Level Rise and climate change by providing areas for the lagoon's habitats to migrate, and by restoring natural geomorphic and floodplain processes	Remove Crossover Road
	Raise roadway
	Reconnect Lewis Gulch Creek to its alluvial fan and allow for future reconnection with Wilkins Gulch Creek.
Improve anadromous fish and amphibian habitat; Improve habitat connectivity and habitat for special-status species	Raise roadways to provide opportunity for upslope habitat migration and lagoon expansion, thus providing an unimpeded transition zone for areas subject to backwater flooding and delta development.
	Design a creek/floodplain/wetland mosaic with resiliency to withstand climate variability, including extended drought and excessive rainfall.
	Remove anadromous fish and amphibian migration barriers including the Crossover Road and install bridge on Olema Bolinas Road for Lewis Gulch Creek.
Improve road safety	Install crossings to allow for volitional fish passage and migration corridors for non-fish species.
	Realign roads and State Route 1/Olema Bolinas Road intersection to improve safety.
	Reduce roadway flooding during winter storms and high tide events.
Create a sustainable and self-maintaining system	Reduce or eliminate flooding of roadways.
	Decrease need for vegetation management.
	Reduce or eliminate dredging of road side channel.

2. Existing Site Conditions

A comprehensive analysis of site conditions was reported in the *Bolinas Lagoon North End Restoration Project-Site Conditions Report* (AECOM 2016) and in other previous studies provided by the District, with input from renowned experts in riverine and coastal restoration. Relevant information from a review of those documents is summarized briefly in the following sections.

2.1. Land Ownership

The Project is located on several parcels in Marin County at the North end of the Bolinas Lagoon between Olema-Bolinas Road and State Highway 1. The County of Marin and Marin County Open Space District owns the parcels within the Wye wetland, and one parcel west of Olema-Bolinas Road, where the bulk of the work will be performed (Drawing V-1.0). State Highway 1 is owned and maintained by Caltrans. Olema-Bolinas Road and Fairfax-Bolinas Road are both within County-maintained rights-of-way.

2.2. Geology and Faults

The Project is located within the San Andreas Fault zone comprised of three main faults: San Gregorio Fault, the San Andreas Fault (1906 rupture) and the Golden Gate Fault. The San Andreas Fault traverses the Project area and is responsible for the formation of the lagoon. A 2006 study prepared by PWA and WRA (Philip Williams & Associates, Ltd (PWA) 2006) concluded that seismic activity in the region has resulted in significant changes in ground surface elevations in the region, including a drop in the lagoon of approximately two feet and lateral movement of the fault by 12 feet during the great 1906 San Francisco earthquake.

Geology of the entire north end of Bolinas Lagoon is also discussed and faults are mapped in the Bolinas Lagoon North End Restoration Project – Site Conditions Report (AECOM, Bolinas Lagoon North End Restoration Project-Site Conditions Report. 2016). The site is in a mapped liquefaction zone, which, along with the close proximity to the active faults described above impacts the bridge design substantially. A fault rupture study is being completed to determine the design parameters for the bridge. A preliminary geotechnical report is included in Appendix E. The final geotechnical report, which will include soil borings performed in 2021 and the results of the fault rupture study, will be included with the 90 percent design submittal.

2.1. Existing Hydrology

Four creeks enter the Lagoon in the vicinity of the Project. Lewis Gulch Creek enters the Wye from the southwest as it combines with Wharf Creek in a roadside ditch before crossing Olema-Bolinas Road through a box culvert. Wilkins Gulch Creek enters the Wye from the Northeast through a box culvert crossing the intersection of Olema-Fairfax Road and State Route 1. Annual high flows from Wilkins Gulch Creek typically overwhelm the Wilkins Gulch Creek culvert and spill across Olema-Fairfax Road along a cattle grate and merge with Salt Creek before entering the Wye from a culvert near the northeastern corner approximately 250 feet southeast of the primary culvert for Wilkins Gulch Creek. The drainage area for each creek is listed in Table 2 for a total drainage area of 1.6 square miles. The Project is focused on rerouting and restoring Lewis Gulch Creek to a more natural alignment.

Table 2. Bolinas Lagoon Wye Wetlands Contributing Drainage Areas

Watershed	Drainage Area (sq mi)
Wharf Creek	0.1
Lewis Gulch Creek	0.7
Wilkins Gulch Creek	0.7
Salt Creek	0.1

Surface water hydrology in Lewis Gulch Creek is influenced by precipitation, with “flashy” hydrographs showing rapid flow and stage increases shortly after the onset of precipitation events, followed by rapid initial decreases after precipitation ends. Flow response to individual precipitation events is generally not detectable within a week of the end of precipitation (ESA 2020). During the period of drought during the summer of 2021, WRA staff observed that the Lewis Gulch Creek channel downstream of the State Route 1 culvert was dry. Groundwater elevations also show a direct correlation to precipitation within and adjacent to the proposed project area. Groundwater elevations fluctuate between greater than eight feet and a few inches below the ground surface, with depth increasing from south to north. Tidal elevations influence groundwater in the southern portion of the site (ESA 2020).

2.2. Soils

The dominant soil type in the Project Area, as mapped in the USDA NRCS Web Soil Survey mapping of the site and verified by soil borings (AECOM and Watershed Sciences 2016), are Blucher-Cole complex, Cronkhite-Barnabe complex. These soils are classified as hydric and are somewhat poorly drained and are made up largely of clay silt and loam alluvium derived from sedimentary and granitic parent materials. Blucher and Cole soils are typically found in basin floors and alluvial fans.

2.3. Fish Habitat

An evaluation of salmonid habitat in Wilkins Gulch Creek and Lewis Gulch Creek was completed in 2017 by WRA, Inc. and the National Park Service to document existing conditions and available habitat for steelhead and Coho salmon (Chase, 2017). Neither creek supported Coho salmon habitat, however steelhead were observed in both creeks during the surveys. Both creeks contained sufficient year-round rearing and spawning habitat for steelhead (or resident rainbow trout), although suitable habitat on Wilkins Gulch Creek was less frequent than on Lewis Gulch Creek. Both the Lewis Gulch Creek Highway 1 Culvert and the Olema-Bolinas Road Culvert were identified as partial barriers to fish passage, preventing some fish passage during low flows.

A fish passage analysis was completed to assess the potential for the Project to create suitable passage and habitat conditions for salmonids, attached in Appendix C. As detailed in the analysis, the Project is designed to meet the Stream Simulation Design Criteria as presented in the California Salmonid Stream Passage Restoration Manual (Flosi, et al. 2010)) through inclusion of design features that mimic natural stream characteristics, including wood and boulder placement, and suitable water velocities and flows to facilitate successful fish passage.

The lower portion of the Project Area where the existing tidally influenced Lewis Gulch Creek channel will t into the proposed creek channel may provide valuable refugia habitat for juvenile salmonids. This area, which encompasses a portion of the existing Lewis Gulch Creek, may provide refugia for salmonids during high flow events that push flows out of the main channel to vegetated floodplain areas with low velocities preferred by juveniles to hide from predators and feed on biota

2.4. Vegetation

The vegetation communities with the most acreage cover within the Project area are Arroyo Willow thicket, Red Alder Forests and Salt Marsh. Two rare plant species known to be in or near the Project site are *Castilleja ambigua ssp. Ambigua* (salt marsh owl's clover) and *Elymus californicus* (California bottlebrush grass) (Benson, Addendum to Bolinas Lagoon North End Restoration Project: Rare Plant Survey. 2018, Benson, Technical Memorandum Bolinas Lagoon North End Restoration:Rare Plant Survey 2017). Several invasive species of concern are present, including Himalayan blackberry (*Rubus armeniacus*) and cape ivy (*Delairea odorata*). A full list of plant species and vegetative communities are found in Chapter 4, Table 7 of the *Site Conditions Report* (AECOM, Bolinas Lagoon North End Restoration Project-Site Conditions Report. 2016).

2.5. Regional Context

The site is located at the northern end of Bolinas Lagoon, one of 37 internationally designated Ramsar sites in the United States and one of four along the west coast (U.S. Fish and Wildlife Service 2015). The lagoon, connected to the Pacific Ocean at the south end, contains 1000 acres of marsh, subtidal and intertidal lagoon habitat of importance for migratory birds, critical habitat for steelhead, and special status species including California black rail (*Laterallus jamaicensis coturniculus*) and California red-legged frog (*Rana draytonii*). The lands to the east of the site are protected as part of the golden Gate National Recreation Area, including the historic Wilkins Ranch.

The Wye wetland is bounded on the east by California State Route 1, on the west by Olema-Bolinas Road and by Bolinas Lagoon to the south. It is bisected by the western extent of Fairfax-Bolinas Road. Lewis Gulch Creek flows from the north, and along Olema-Bolinas Road before crossing under the road and entering the lagoon at the northern tip. The lower section of the creek flows through numerous vegetative communities that include red alder forest, pickleweed mats, arroyo willow thicket, and salt marsh bulrush. The watershed is mostly undeveloped, lying almost entirely in public lands and contains several pastures maintained by Wilkins Ranch. Historically, the watershed was heavily used for logging. Wharf Creek was the location for loading logging shipments in the Upper Bolinas Lagoon.

Lewis Gulch Creek has been documented to support steelhead (Brinton 2019), and while watershed size and observed number of fish makes it unlikely that there is a large run, these smaller populations are nonetheless important because they contribute to diversity in habitat and life history to the overall regional steelhead population.

Olema-Bolinas Road provides the main access to the town of Bolinas. Due to the low elevation of the roads and the convergence of several stream systems on the site experiences flooding on an almost yearly basis (K. Kull, personal communication, January 15, 2020). In addition, per data provided by the County of Marin C-SMART (C-SMART and Marin County Community Development Agency. 2015), and the AECOM Site Conditions Report (AECOM, Bolinas Lagoon North End Restoration Project-Site Conditions Report. 2016) portions of both roads and State Route 1 will be impacted by sea level rise by the end of the century, resulting in potential disruptions to transportation in the region.

3. Assessment of Historical Conditions

3.1. Pre-settlement Hydrology and Geomorphology

The confluence of Lewis Gulch Creek, Wilkins Gulch Creek and Salt Creek formed a large alluvial fan at the north end of Bolinas Lagoon prior to European settlement. Additionally, San Andreas Fault and other associated faults merge at the head of the Lagoon. This alluvial fan was fed by large amounts of sediment from the watershed due to seismic uplift and subsequent down-cutting of headwater stream channels. The Lewis Gulch Creek flows parallel to the active trace of the San Andreas Fault and may flow within a depression formed along former fault traces.

Review of the earliest maps from 1854 and aerial photos show that the Wye appears to have formed a dynamic marsh plain with dense growths of trees (willows and/or oaks) and a network of distributary channels. The distributary channels would work their way across the fan, sometimes connecting with Wilkins Gulch Creek on the north side of the fan, sometimes following the south side of the fan and flowing directly to the lagoon. An excellent, in-depth analysis of historic conditions may be found in *Bolinas Lagoon North End Restoration Project Technical Memorandum Current and Historic Geomorphology and Hydrology* (AECOM and Watershed Sciences 2016).

3.2. Post-Settlement Evolution of the Site

In the early 19th century, logging, mining, agriculture, and infrastructure changes altered the Bolinas Lagoon shoreline and watersheds of most of the north end tributaries. The deforestation and land use changes increased sediment delivery to the Lagoon and altered the flow paths of many of the streams in the region. Improvement of Olema-Bolinas Road resulted in the relocation of Lewis Gulch Creek to a roadside ditch running along the west side of the road. Over the last 50 to 100 years, logging and mining ceased in the region, and agriculture focused on ranching activities. In that period, the Wye has become a densely vegetated wetland.

4. Design Elements

The project consists of numerous design elements. In some cases, alternative design concepts were assessed to gauge the ability to attain the intended function and achieve the goals of the project. In other cases, the intended function drove the design process, and alternatives were not explored. A summary of each is provided below.

4.1. Lewis Gulch Creek Morphology

The morphology and alignment of Lewis Gulch Creek is one of the most important aspects of the project. Lewis Gulch Creek currently skirts the upper portion of the Wye to the west where it flows through a roadside ditch. One of the main project goals is to return Lewis Gulch Creek to the east side of State Route 1 where it previously flowed, found in maps from 1910 (AECOM and Watershed Sciences 2016). Moving the Creek will involve re-aligning Olema-Bolinas Road and installing a bridge crossing for Lewis Gulch Creek. The creek morphology design element works in conjunction with all of the other elements listed below, and several alternatives were analyzed. Lewis Gulch Creek has documented occurrences of steelhead, and considerations of channel morphology relied heavily on providing suitable habitat and passage for a range of life stages. In addition, the ultimate design will ensure that the creek remains resilient during a range of peak flows (1, 2, 10, 50, 100 and 200 year), account for the end of century sea level rise, and promote overbank flow and floodplain connection.

4.2. Olema-Bolinas Road Alignment and Creek Crossing

The new intersection of Olema-Bolinas Road and State Route 1, elevation of Olema-Bolinas Road and the alignment of Olema-Bolinas Road and the proposed bridge creek crossing of the re-aligned Lewis Gulch Creek are the main civil engineering aspects of the project. The road design will focus on creating a safer intersection with Highway 1 and providing the ability to safely pass the 100-year flood event in Lewis Gulch Creek with projected end-of-century sea level rise. Two intersection alignments and three creek crossing alternatives were assessed.

4.3. Olema-Bolinas Roadside Slopes

The side slopes of the re-aligned section of Olema-Bolinas Road were also a major project consideration, mainly in relation to minimizing impacts to existing resources within the Wye wetland. Because the road is being realigned through the Wye and elevated to reduce flooding, the impact from side slopes on existing wetlands and the remaining Lewis Gulch Creek channel must be considered. Constructability of the slopes must also be considered because of the potentially unstable substrate upon which the road is built.

4.4. Removal of Fairfax-Bolinas (Crossover) Road

Another main element of the project that has been identified is the removal of Fairfax-Bolinas Road (Crossover Road) between Highway 1 and Olema-Bolinas Road. The road currently bisects the Wye wetland, creating a physical barrier to the movement of water and wildlife. In addition, sea level predictions for the area show that portions of the road will be inundated by Bolinas Lagoon by the end of century. The proposed design will remove Crossover Road to reconnect and restore the wetland habitats and allow for incremental landward migration of tidally-influenced habitat types. This area will provide much of the mitigation for unavoidable impacts to other resources associated with the improvements to Olema-Bolinas Road. No alternatives were assessed for this project element.

4.5. Lewis Gulch Creek Bank Stabilization

Lewis Gulch Creek has eroded into State Route 1 just north of the intersection with Olema-Bolinas Road. Caltrans has implemented an emergency repair that consists of riprap and live willow stakes. To ensure that the creek does not impact Highway 1 in the future, stabilization, and improved channel conditions of the creek in that area are design elements of the project. Alternatives were not formally analyzed, and the design team is proposing an approach that includes realigning the channel and installing bioengineering on the outside bank to provide long term stability.

5. Alternative Analysis

Alternatives analyses (Appendix E: Preliminary Geotechnical Report and Appendix F: Alternative Analysis) were completed for three main design elements of the project - Lewis Gulch Creek morphology, the Olema-Bolinas Road intersection alignment and creek crossing type, and the Olema-Bolinas Road fill side slopes. The project elements are interconnected in meeting project goals, but largely function independently and thus were evaluated independently. Three alternatives were analyzed for each distinct design consideration, with the exception of the Olema-Bolinas Road realignment and crossing analyses that included six ultimate configurations due to the fact that two alignments were considered, each with three crossing types. A no action alternative was also assessed for each main design element.

For each category of assessment, a percentage weight was assigned. Weights of each category varied based on the design element being assessed. For example, cost was assigned a higher weight for the Olema-Bolinas Road assessment than the Lewis Gulch Creek morphology assessment because the scale of costs for roadway work is considerably higher than that of stream channel restoration. Each category was given a score, and the sum of the scores times the weight of each category was tallied to determine the most advantageous alternative for the project. The alternatives analysis in Table 3 below shows the approach for the alternatives analysis.

Table 3. Alternatives Analysis Summary

Category	**Subcategories**	**Assessment Considerations**	**Available Data for Assessment**
Cost	Planning/Design	Estimate of engineering/design/permitting costs	Cost estimate
	Construction	Estimate of construction costs	Cost estimate
	Mitigation	Estimate of cost for mitigation, considering whether all mitigation can be performed on-site	Estimate of mitigation area (from road removal), estimate of potential impacts, and required mitigation, cost estimate for mitigation, including monitoring
Schedule/Feasibility (short-term impacts)	Permitting/CEQA	Estimate of permitting complexity, especially as it relates to using innovative approaches or those opposed by agencies	Cost estimate
	Construction Period Impacts	Ability of residents and emergency responders to access Bolinas and area during construction	Preliminary traffic management plan
	Environmental Impacts during construction	Preliminary assessment of general habitat (wetland, riparian, upland) disturbance during construction; mitigation needs.	Preliminary GIS impact assessment
Climate Change/ Resilience/ Maintenance	Lagoon Expansion and Wetland Transition Zone	Prediction of alternative's ability to accommodate rising sea level	Sea level rise assessment
	Need for re-entry	Degree of ongoing maintenance required by alternative (sediment removal, adaptive management, etc.)	Assessment of design feasibility, draw from past experience (somewhat subjective); assessment of lifecycle of structures

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Category	Subcategories	Assessment Considerations	Available Data for Assessment
	Resilience for Extreme Weather Events	Ability of design to withstand extreme weather, including prolonged drought and excessive storm events	Modelling of large storm event, Sea level rise assessment, past experience
Improve Hydrologic Connectivity	Natural Channel Processes and Dynamism	Does alternative allow for natural processes, i.e., sediment movement	Design assessment
	Baseflow Conditions	Will alternative allow for groundwater expression in the channel and/or convey base flows effectively	Groundwater elevation assessment, draw on past experience
	High Flow Connection to Floodplain	Assess relative frequency and duration of floodplain or overbank inundation	Channel capacity evaluation, flood frequency curve; total area of connected floodplain
	Channel Migration	Ability of crossing to allow for natural variability in cross-section, pattern, and profile of channel	Assessment of crossing opening size, skew related to road and channel
	Transition to Channel	Changes in slope, curvature in upstream and downstream transition zones, maintaining self-maintaining low flow channel	Slope and channel form assessment, hydraulic modelling of a range of flows to evaluate shear stress, velocities, and stream power
Environmental Benefits/ Impacts	Wetlands/Riparian	Preliminary assessment of wetland and riparian habitat improvements/ impacts or net increase/decrease in wetland and riparian habitat function or acreage.	Quantify impacts and potential area of mitigation
	Sensitive Habitats	Assessment of net gain/loss or net improvements/ impacts to sensitive habitats regulated by CDFW (bay forest, alkali bulrush, coastal brambles, pickleweed plains).	habitat assessment, impact, and mitigation assessment

Category	Subcategories	Assessment Considerations	Available Data for Assessment
	Special Status Species	Preliminary assessment of improvements/ impacts to CRLF, California black rails breeding, refuge, and migration habitat. Assessment of net gain/loss of upland dispersal and breeding habitat.	Biologist consultation
	Cultural Resources	Preliminary assessment of disturbance with respect to sensitive cultural resources	Cultural resources mapping (may not be possible unless County has previous cultural report for site)
Salmonids	Adult In-migration	Depth and velocity swim capable for steelhead focused on December - February	Hydraulic modelling and assessment of fish passage data
	Juvenile Out-migration	Depth, period of connectedness focused on February - May optimal timeframe	Hydraulic modelling and assessment of fish passage data
	In-channel Habitat (Rearing and Refugia)	Pool frequency and depth, amount of wood and channel complexity/dynamism, net change in stream length with medium to high quality habitat	Assessment of design, prediction of evolution
	In-channel Habitat (Dry Season/Oversummering)	Interaction of surface/groundwater, pool depth and frequency, riparian Canopy cover/thermal considerations, cover, and food access within channel	Prediction of groundwater influence, channel design assessment
	Floodplain Access and Habitat (Rearing and Refugia)	Duration of floodplain activation, aerial extent of flow on floodplain	Hydraulic modeling

Category	Subcategories	Assessment Considerations	Available Data for Assessment
Roadway Safety/ Community Benefits	Accessibility by Multiple User Groups	Ability of roadways/crossings to facilitate travel by multiple users (automobiles, trucks, bicycles, pedestrians)	Road and bridge design assessment
	Flooding	Does project reduce likelihood of flooding of Olema -Bolinas Road or SR-1	Hydraulic modeling
	Flood Flow Capacity	Ability of crossing to pass the 100-year event, considering debris in flows and potential for jams	Hydraulic modeling
	Traffic and Visibility	Does alternative positively or negatively affect transportation to and from Bolinas. Effect of roadway design on vertical and horizontal site lines	Road and bridge design assessment

5.1. Lewis Gulch Creek Morphology Alternatives

The most ecologically essential element of the project is the realignment of Lewis Gulch Creek through the Wye Wetland. Based on historical assessment (AECOM and Watershed Sciences 2016), the Wye was once an alluvial fan formed where Lewis Gulch Creek and Wilkins Gulch Creek (which flows to the east of the site) met Bolinas Lagoon. It is thought that historically Lewis Gulch Creek ran through the Wye in a network of diffuse interconnected channels that drained to Bolinas Lagoon. Appendix F contains the summary of the alternatives analysis performed during the conceptual design phase of the project.

Three design alternatives were considered for the realignment of Lewis Gulch Creek. All three alternatives assumed that the creek would cross under Olema-Bolinas Road near the north end of the Wye, as determined in the alternatives analysis for that design element. Each alternative assumed that Fairfax-Bolinas Road would be removed.

Alternative 1 was a diffuse network of channels that would restore an alluvial fan condition. In this alternative, the channel would decrease in size and capacity as it flowed under the new Olema-Bolinas Road crossing, and branch into smaller “pilot” channels that act as “starter” channels that would encourage the development of a network of diffused and interconnected flow paths. Large woody debris would be used to restore habitat for steelhead and other species, promote natural scour and deposition patterns, and create general geomorphic and hydraulic heterogeneity.

Alternative 2 was to restore a single thread channel through the Wye that would be sized to carry the annual peak flow of the creek. Flows greater than the annual peak flow would then inundate the Wye. The formation of side channels would be encouraged by removing vegetation in select areas and installing large woody debris as described in Alternative 1 above.

Alternative 3 involved creating a traditional bankfull (1.5-year recurrence interval) channel through the Wye. This alternative would also use large woody debris to create habitat and system complexity.

Alternative 2 was selected as the preferred alternative because it provided valuable floodplain habitat, minimized impacts, and maintained volitional passage for all life stages of steelhead. Alternative 1 was not selected mainly because it was viewed as potentially creating a barrier to fish passage during most times of the year. Although this scenario is seen as more "natural," assessing a design of this type using current guidelines for salmonid passage would show that the approach would be insufficient because flows would be too diffuse and not deep enough for volitional passage. Alternative 3 also ranked low because it would have minimized connection between the creek and the Wye floodplain and would have resulted in the most impacts to existing wetlands of all three alternatives.

5.2. Olema-Bolinas Road Alignment and Crossing Alternatives

It was necessary to decide on both the alignment of the new roadway and the type of crossing used to convey Lewis Gulch Creek (culvert, bridge, or causeway) when redesigning Olema-Bolinas Road. Because the type and size of the crossing was dependent on the road alignment, each potential combination of alignment and crossing was evaluated. This resulted in assessment of six possible alternative configurations.

Two potential alignments were evaluated, a western alignment that intersected SR-1 just southeast of the existing intersection, and an eastern alignment that intersects SR-1 approximately 200 feet southeast of the existing intersection. The western alignment resulted in less replacement of Olema-Bolinas Road but created a sharp angle with the creek alignment that would have resulted in a need for larger crossing span or longer culvert crossing of the channel. The skew of the creek to the road was also seen as creating the potential for scour and channel avulsion upstream of the crossing. The eastern alignment alleviates the skew issue allowing for a more natural plan morphology that reduces the risk of bank scour and the need for channel bank reinforcement and a shorter span or culvert length. The eastern alignment was selected as the preferred alternative.

Three crossing types were evaluated: a bottomless arch culvert, a free span bridge and a causeway. The roadway elevation at the proposed crossing is dictated by the maximum allowable road slope of two percent extending from the existing SR-1 elevation at the proposed intersection. The existing slopes and the elevation of Lewis Gulch Creek upstream of the crossing, and the desire to maintain a similar slope and channel morphology through the bridge section to allow for sediment transport continuity, made the use of a bottomless arch culvert undesirable and would have necessitated the use of multiple culverts to pass the 100-year flood event. This is due to the fact that an arch culvert constricts flows as stage increases, resulting in diminished flow capacity and increased constriction scour with increase in stage. The bridge option allowed for passage of the 100-year event while allowing for some degree of natural channel migration under the road. In addition, the bridge design will allow for passage of large debris, minimization of scour or deposition and associated reduced ongoing maintenance needs. The bridge design also allows for more unimpeded movement of terrestrial animal species. The causeway option allowed for maximum channel migration, floodwater passage and would also have allowed for unimpeded movement of reptiles, amphibians, and mammals. Because the maximum size of the culvert is dictated by the channel and roadway elevations, a culvert would not be expected to pass large flow events without creating an upstream backwater effect and substantially increased velocities within the culvert. The increased velocities, coupled with the potential for creating a scour pool at the downstream end that would disconnect low flows, would result in the least amount of volitional fish passage. The causeway would have provided the maximum amount of floodplain habitat for steelhead and other fish. Ultimately, the cost of the causeway made it infeasible, and the bridge was selected as the preferred crossing alternative.

5.3. Olema-Bolinas Roadside Slopes Fill Alternatives

The side slopes of the improved and relocated areas of Olema-Bolinas Road were also assessed as part of the alternatives analysis. Alternative 1 called for installing vertical retaining walls at the edge of the road. Alternative 2 called for using a 2:1 outboard slope, involving the use of engineered fill. Alternative 3 called for using a 3:1 slope with engineered fill.

Two to one side slopes were selected as the preferred alternative. Alternative 1 was not selected mainly because of cost and the need for substantial footings able to support the road. Alternative 3 was rejected because it would have resulted in excessive impacts to existing wetlands, riparian habitat and the remaining channel of Lewis Gulch Creek. Alternative 2 was selected as the best approach.

6. Restoration Design

With the selection of the primary alternative options, the restoration design approach integrates elements of process-based and form-based restoration. The channel cross section geometry, alignment, and vertical profile aspects of the design were developed using field data, GIS, empirical relationships, CAD, and US Army Corps of Engineers HEC-RAS two-dimensional (2D) hydrodynamic modeling to develop and refine the design. Each aspect of the channel design is related to the others, so iterative changes were made to the section geometry, alignment, and profile to arrive at the 60% design. For the purposes of the design, Lewis Gulch Creek has been divided into five distinct reaches as described below:

- Bank Stabilization Reach (Station 24+10 – 24+75) – the area of Lewis Gulch Creek where bioengineering bank stabilization will occur adjacent to State Route 1.
- Upstream Reach (Station 21+00 – 24+10) – The stream reach between the bioengineering bank stabilization area and the new bridge, where floodplain grading and channel log structure installation will occur to enhance refugia habitat.
- Bridge Reach (Station 19+50 – 21+00) – The reach between the existing Lewis Gulch Creek channel upstream of the proposed bridge and the Transitional Reach below the bridge, where channel and floodplain grading will focus on effectively routing flows and sediment around a bend, through the bridge and into the Wye.
- Transition Reach (Station 18+00 – 19+50) – The short section of Lewis Gulch Creek where the Bridge Reach channel width and depth decrease to meet the dimensions of the Wye Reach.
- Wye Reach (Station 11+00 – 18+00) – The channel reach with enhanced floodplain connectivity through the Wye wetland that ties into the existing Lewis Gulch Creek at the downstream end of the project.

Figure 1 depicts the location of the areas described above on the site. Appendix B includes the Hydrology and Hydraulics Memo that forms the hydrologic basis for the restoration design. The design development process is described in the following sections.

Figure 1. Lewis Gulch Creek Project Reach Areas

6.1. Cross Section Geometry

The primary considerations in defining the cross-section geometry are: 1) flood conveyance, 2) sediment conveyance, 3) floodplain connectivity, and 4) fish passage. Two methods were used to design the channel for the proposed re-aligned Lewis Gulch Creek with unique performance requirements. Both methods consider the 1.5-year recurrence interval flow rate of 25 cfs which is considered to be the primary scenario for addressing scour and deposition processes. The first method is to contain the 25 cfs flow in an 8- to 10-foot-wide channel to prevent scour at key locations. The Bank Stabilization Reach, Upstream Reach, and Bridge Reach are designed to prevent scour along infrastructure such as State Route 1 and the bridge abutments but allow for natural stream processes where acceptable such as the new floodplain grading upstream of Olema-Bolinas Road. The second method is to unleash the 25 cfs flow outside of a channel allowing floodplain inundation as often as possible. The Transition Reach uses the first method to prevent scour and deposition near the proposed bridge and transition to the Wye Reach to begin the second method. The Wye Reach is designed to disperse flows as much as possible and initiate alluvial fan processes while maintaining fish passage characteristics.

The Bank Stabilization Reach and Upstream Reach use a traditional bankfull channel design based on conditions upstream of the bridge and the calculated 1.5-year recurrence flow of 25 cfs. The 1.5-year recurrence interval flow approximates the flow that is most effective at routing sediment through the system, preventing the risk of aggradation or degradation upslope of the proposed bridge.

The Bridge Reach uses a geometry to convey a 35 cfs flow, slightly higher than the 1.5-year recurrence interval, to support sediment transport functions and 100-year recurrence interval event to alleviate flood risk. A compound channel cross section design was chosen for the bridge area, with the lower inset channel conveying the 35 cfs flow, and the 100-yr event (271 cfs) being conveyed in the floodplain area. The Marin County Department of Public Works requires at least 2 ft of freeboard between the 100-yr water surface elevation and the bridge soffit (low point) (C-SMART and Marin County Community Development Agency. 2015) therefore the 100-year water surface elevation at the bridge with this channel design was a constraint in the bridge design.

The inset channel cross section was designed to convey a 1.5-year recurrence interval event, 25 cfs, (as derived using the HEC RAS model cited above) through the bridge and for a distance of approximately 150 feet downstream of the bridge, to provide sufficient sediment transport capacity to carry sediment downstream away from the roadway. It is expected that this will minimize the need for sediment removal maintenance, as opposed to having a smaller channel similar to the Wye Reach through the bridge. The expectation is that sediment will be successfully transported a sufficient distance downstream of the bridge before being deposited in the Wye wetland, where it can eventually be eroded and reworked by natural geomorphic processes.

The channel cross section decreases in size through the Transition Reach and is sized to convey the approximate annual peak flow of 15 cfs through the upper stretch of the Wye Reach to meet the enhanced floodplain connection goals. In lower areas of the Wye Reach, the channel decreases in size to convey a flow of approximately 9 cfs. The decrease in size is expected to encourage overbank flow and associated deposition of sediment to enhance alluvial fan processes and wetland resilience.

The section geometries were designed to meet the target flows of 35, 25, cfs15 and 9cfscfs using the Manning formula:

$$Q = \frac{1.49AR^{2/3}S^{1/2}}{n}$$

Where:

Q = discharge, cfs
A = flow area, ft^2
R = hydraulic radius, ft
S = energy gradient, ft/ft
n = roughness coefficient

Throughout the iterative design process, the width and depth of the channel were adjusted until the flow depth was equal to the channel depth. The final section geometry is trapezoidal, with 3 to 1 (horizontal to vertical) side slopes. The energy gradient is assumed to be equal to the bed slope, which is 0.025 ft/ft through the bridge, and an average of 0.0075 ft/ft in the downstream reach. Manning's roughness coefficients were determined using USGS guidance and further refined during the calibration process discussed in Appendix B (Arcement, Jr. and Verne 1989). These values were used to approximate the appropriate size of the channel section. For further discussion on the project's Manning's coefficient, see Appendix B, section Model Development.

This channel sizing process was based largely on the model results coupled with observations of channel reaches between Olema-Bolinas Road and the SR-1 culvert. The Collins and Leventhal regional curve data (Collins and Leventhal 2013) was also consulted to provide a reference to the 1.5-year recurrence interval channel width, average depth, and maximum depth. The design calls for a bankfull channel through the bridge reach to effectively route flows and sediment to minimize the potential for incision or aggradation. The proposed inset channel has a 4-foot bottom width, a bankfull width of 10 ft and 1.5-foot maximum depth (0.8 ft average bankfull depth) through the bridge sub reach. Regional relationships suggest the same dimensions, the Collins and Leventhal data shows that a creek in this region with the same drainage area as Lewis Gulch Creek would have an average bankfull width of approximately 10 ft and a bankfull depth of 0.8 ft. The proposed bankfull channel cross-section area through the bridge is approximately 8 square ft, with the regional curve average value at approximately 9 square ft. The 100-yr floodplain width through the bridge will range from 50 to 60 ft due to the acute angles of the bridge abutments.

Approximately 150 ft downstream of the bridge, the channel size decreases to allow for more overbank flows and floodplain connection. In this reach, the maximum depth is 1 ft (average depth of 0.7 ft) with an average channel top width of 7 ft, with a similar channel configuration continuing through the Wye wetland to the confluence with the existing Lewis Gulch Creek channel. For comparison, the regional curve regression lines (Figures 5, 6 and 7) show an appropriate bankfull depth of 0.8 ft and width of 10 ft. These results support the design intent of providing more frequent and longer duration overbank flows in the Wye wetland. Section views are presented on Sheet C-3.1 of the 60% design plans. A detailed explanation of the hydraulic modeling approach and results is included in the hydraulic modeling memo in Appendix B.

Figures 5, 6, and 7 below show the channel width, flow area and depth compared to the regional bankfull channel design geometries (Collins and Leventhal 2013) developed through analysis of field sites and regional regression equations. Green and red dots were added to the plots representing the sections designed to the 15 cfs (1-yr) and 25 cfs (1.5-yr) flows, respectively. Note that bankfull width is the top width, and bankfull depth is the average depth (not maximum depth).

The plots show that the 15 cfs design is within the scatter of the data, and consistently lower than the regression line based on field sites, while the 25 cfs geometry is very close to, but never greater than, the field site regression line. This is consistent with our expectation that the 25 cfs is an appropriate estimate for bankfull flow, while the 15 and 9cfs design will experience overbank flows more frequently. This is representative of the balance the design team is intending to strike with Concept 2, conveying a significant amount of flow, while allowing for frequent overtopping, floodplain inundation, erosion, and sedimentation, and creating dynamic conditions within the Wye.

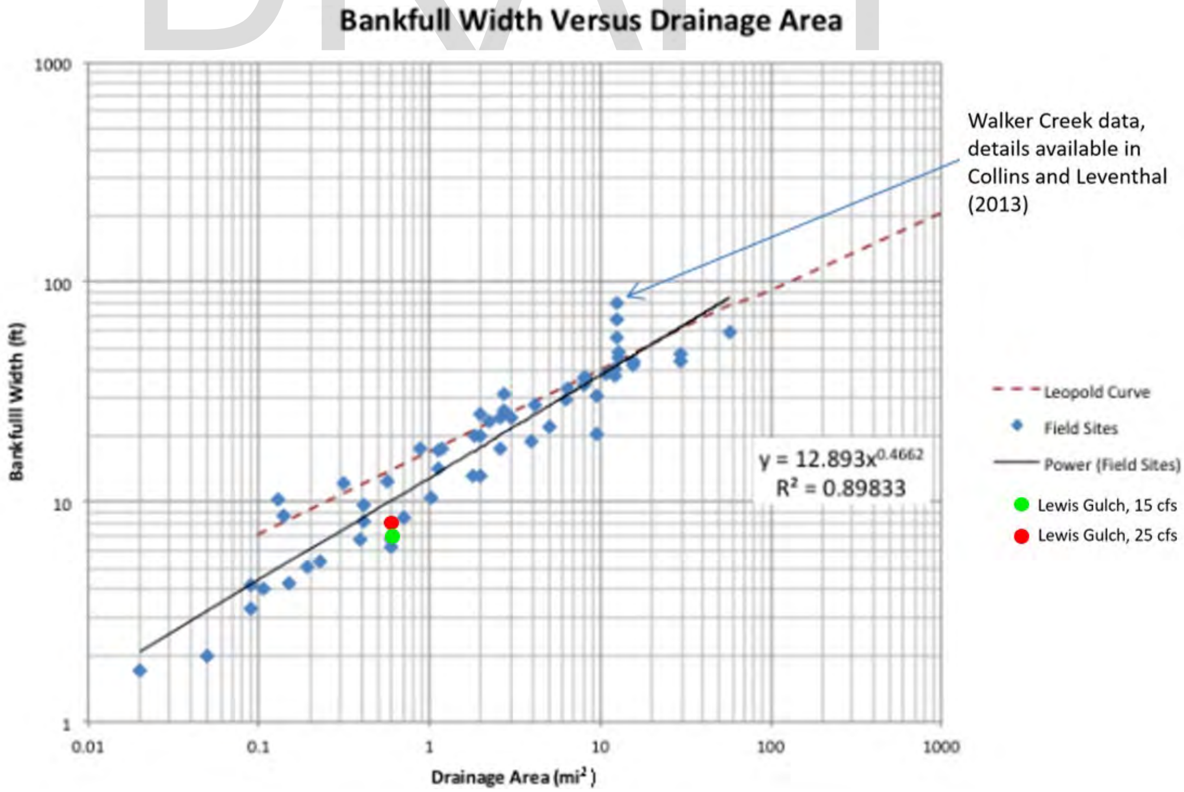

Figure 2. Bankfull Width Versus Drainage Area, From (Collins and Leventhal 2013)

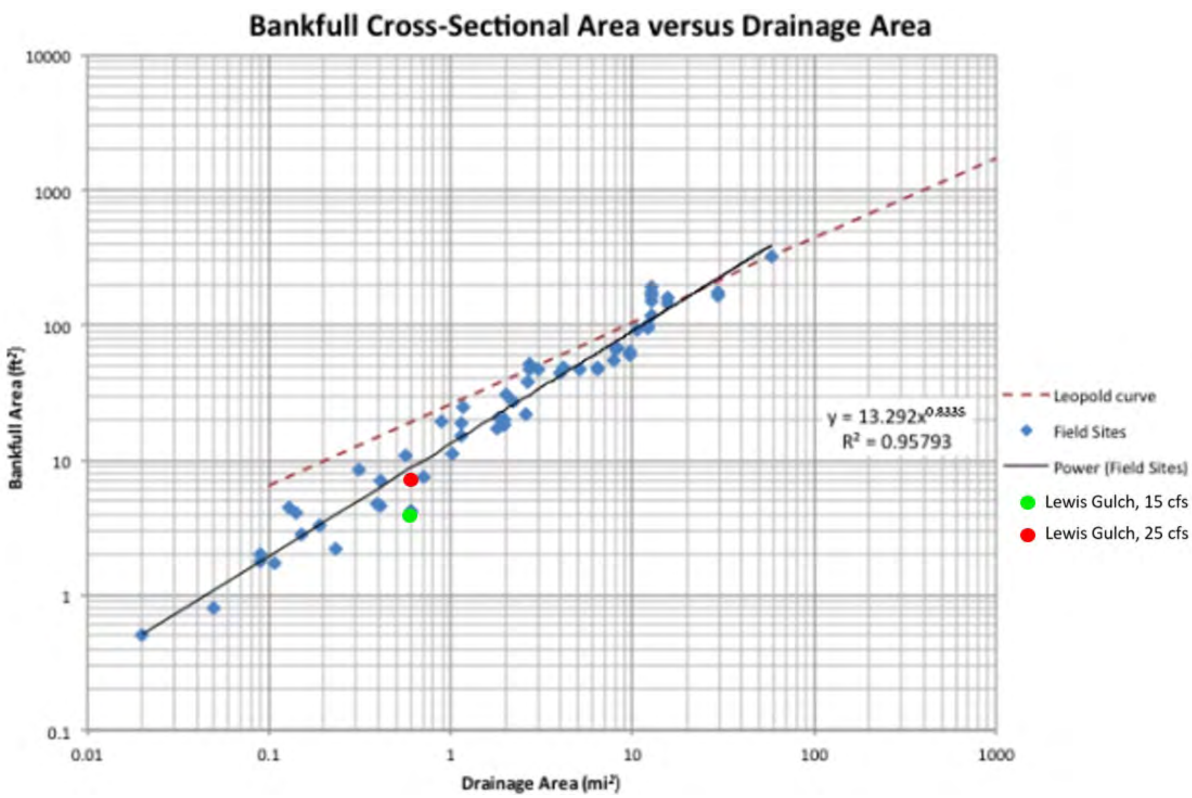

Figure 3. Bankfull Cross-Sectional Area Versus Drainage Area, From (Collins and Leventhal 2013)

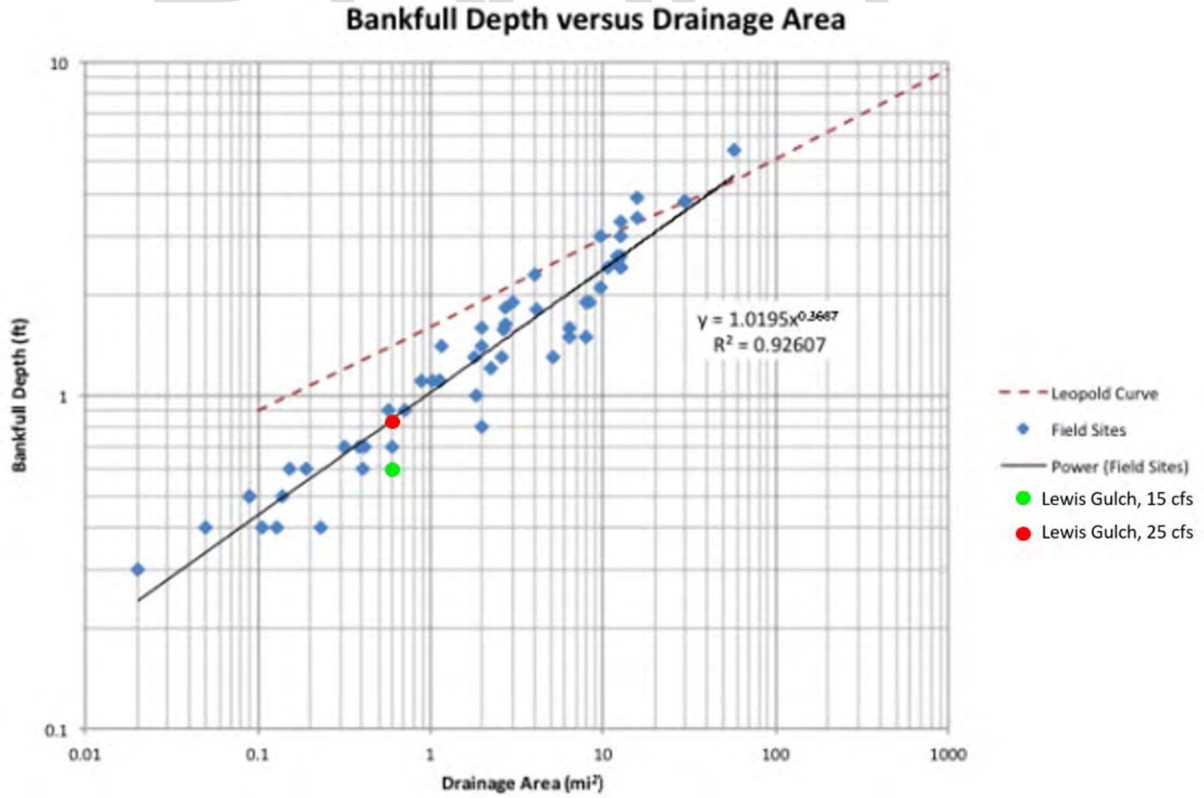

Figure 4. Bankfull Depth Versus Drainage Area, From (Collins and Leventhal 2013)

6.2. Channel Alignment

The primary factors considered in the channel alignment were the skew of the bridge opening to the creek and the planform geometry of the new channel through the Wye. Skew is the angle of the bridge compared to the centerline of the channel. A bridge with zero skew is aligned exactly perpendicular to the flow. As this angle increases, the conveyance of the bridge decreases, and ineffective flow areas (eddies, backwaters, and areas with no velocity) may begin to form within the bridge section, resulting in sediment deposition. The safe alignment of the roadway on the bridge would not allow for zero skew, however the bridge opening was located so as to minimize skew, minimize impacts to existing habitat, and achieve the project goals presented in Section 1. Downstream of the bridge, the channel is largely aligned to follow the existing lowest elevation areas of the Wye and connect to the existing creek just above the mouth in the lagoon.

The planform geometry downstream of the bridge was based on empirical relationships relating channel width to meander wavelength, amplitude, and radius of curvature (Leopold and Wolman 1960). A schematic showing the definition of each of these terms is presented in Figure 5. Following Leopold and Wolman (1960), meander wavelength for Lewis Gulch Creek below the proposed bridge was estimated as 11 times the channel top width, or roughly 80 ft. Amplitude ranges between 0.5 and 1.5 times the meander wavelength, providing a range of 40 to 120 ft. The radius of curvature ranges from 2 to 3 times the channel width, or roughly the meander wavelength divided by 5, resulting in a range of 14 to 21 feet, or close to 18 feet. As designed, the creek has an average meander belt width of 35 feet, with wavelength ranging between 60 feet and 80 feet and meander radii between 15 feet and 20 feet. The creek design dimensions are summarized in Table 4.

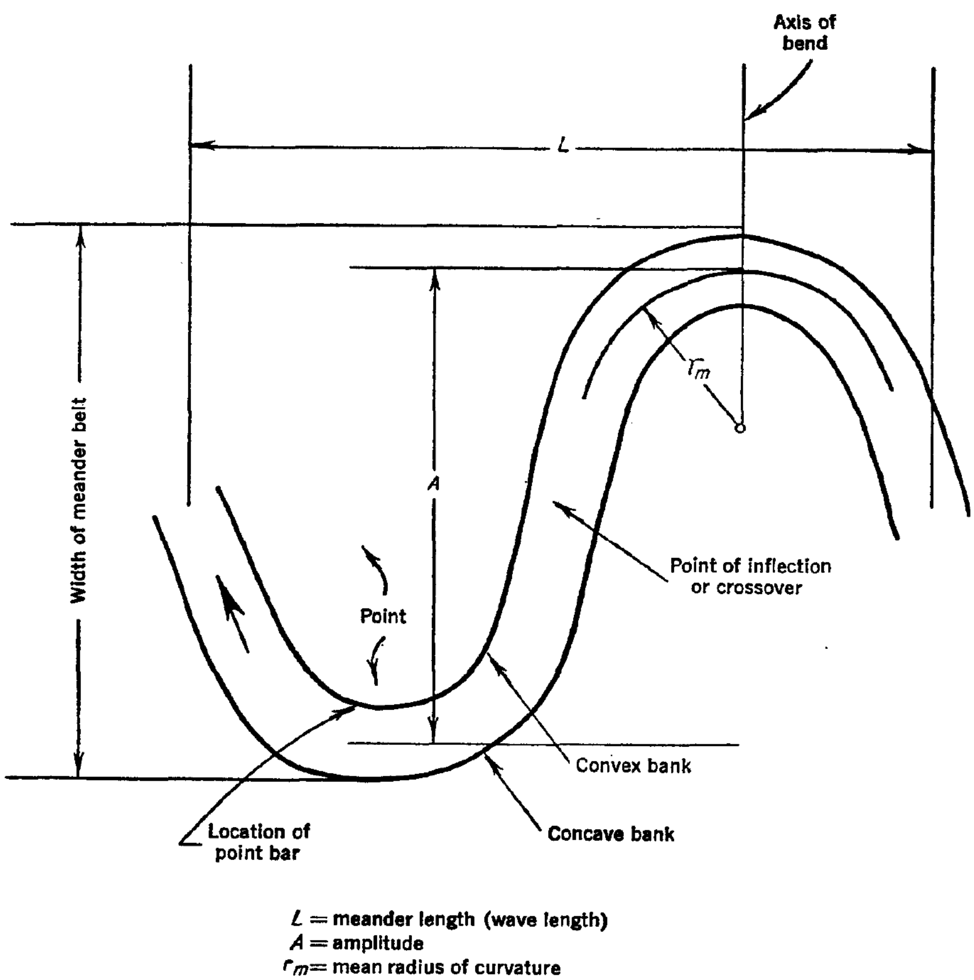

Figure 5. Schematic to define terms of planform geometry

Table 4. Planform Geometry Summary

Planform Geometry	Recommended Range*	Design Values
Meander Wavelength	60 – 80 ft	60 – 80 ft
Belt Width	40 – 120 ft	35 – 45 ft
Radius of Curvature	14 – 21 ft	15 – 20 ft

* (Leopold and Wolman 1960)

6.3. Channel Bed Profile

The channel profile was designed to limit the occurrence of sharp grade breaks that could cause rapid changes in flow shear stress, which may then increase likelihood of erosion, headcutting, or sediment deposition without the use of channel armoring. Artificially reinforcing the channel is not consistent with the primary goal of restoring natural geomorphic processes to Lewis Gulch Creek. Appendix A: 60% Design (Not Attached), Sheet C-4.0 displays the channel bed profile design.

The design profile for the Bridge Reach of Lewis Gulch Creek diverges from the existing profile just upstream of the proposed Olema-Bolinas Road Bridge, where the existing channel will be plugged with an earthen berm to direct flow into the new channel.

The average bed slope of the Upstream Reach is roughly 2.5%. The profile design process for the Bridge Reach sought to maintain a bed slope no higher than that of the Upstream Reach, so that sediment transport capacity would not exceed sediment transport supply. This is notable because alternative bridge locations explored in the alternatives analysis have required lowering the channel bed to pass the 100-yr flow event with sufficient freeboard. Lowering the channel bed in the vicinity of the bridge would have required increasing bed slope, leading to increased shear stress and velocity that would have resulted in the need for channel armoring.

Through the Transition and Wye Reaches, the bed profile largely follows the existing grade, with no grading of pool or riffle features. The process-based design approach will allow for pools and riffles to develop in the natural substrate during high flow events. To aid in creating deeper pools, channel facing rootwad structures will be placed on outsides of channel meanders in areas with higher velocities and shear stress to scour and maintain pool habitat. The higher velocity and shear stress areas were identified in the hydraulic modeling (Appendix B). The installation of log structures is described in more detail in Section 7.

6.4. Expected Channel Evolution

The channel profile and planform geometry are expected to remain largely stable through the Upstream Reach, where it is constrained by existing trees, bank vegetation, the State Route 1 embankment, and the proposed Olema-Bolinas Road bridge abutments. The left bank (eastern) floodplain of the Upstream reach will be graded to restore floodplain connection for flows greater than the 1.5-year return interval storm event (approximately 25 cfs). Rootwads will be placed along the left bank of the reach to enhance scour in existing pools to improve summer habitat for juvenile and resident fish. Some localized lateral bank migration may be expected to occur in response to normal rainfall-runoff events.

The profile and cross-sectional area of the Bridge Reach is expected to be maintained over time, although some meandering of the channel is expected. It is expected that the channel planform geometry will change over time, through natural geomorphic processes. The bankfull channel may migrate laterally under the bridge, but will be constrained by the concrete bridge abutments, which will be set deep enough to allow for scour caused by a 100-yr flow event. Through the footprint of the bridge and extending a short distance upstream and downstream, the design will include the placement of a layer of large cobble material at the elevation of the channel thalweg prior to grading the channel and floodplain under the bridge. This will allow for channel migration while limiting the opportunity for channel incision or headcutting.

Sediment is expected to be deposited downstream of the bridge, in the Transitional and Wye Reaches where the cross-sectional area of the channel and the bed slope decrease. the Wye Reach and surrounding floodplain areas are expected to function much like the historic Lewis Gulch Creek alluvial fan. This will likely be an area of frequent channel adjustment, as sediment is both actively deposited and eroded by Lewis Gulch Creek in response to storm events. Although the channel alignment follows the lowest points of the existing topography further downstream in the lower Wye, sedimentation could rapidly fill portions of the project area, causing the channel to change course and potentially cut a new alignment. The use of channel cross section geometry that is considerably smaller than the bankfull flow estimate will increase the likelihood of dynamic channel adjustments. The presence of existing vegetation and proposed installations of large woody material will contribute to the formation of a hydraulically complex system, with considerable cover, forage, and velocity refugia for all life stages of steelhead and other species of interest.

The hydraulic modeling of the site shows that the 1.5-year flow event and all higher events will spread out through the Wye wetlands, with variable velocities and shear stress values. The results of the model were used to target log structure locations in areas with higher velocities to maximize channel scour to improve summer refugia habitat, as well as to locate floodplain log structures in areas with lower velocities and shear stress to encourage sediment deposition and enhance refugia habitat for juvenile salmonids.

It's expected that a defined channel, sized to convey the amount of water and sediment delivered to it through natural geomorphic processes, will generally be present in the Wye. However, there may be times when the channel in the Wye fills in completely or is so wide, shallow, and densely vegetated that it is difficult to identify in the field. This would be consistent with conditions that were likely present before European settlement and would represent successful restoration of the alluvial fan and Wye wetland. It is anticipated under these conditions that any channels formed on the floodplain will be suitable to convey passage of upstream migrating steelhead seasonally, as steelhead are thought to generally migrate during turbid, high flow conditions.

7. Large Wood

Large wood pieces with rootwads will be used in the new channel to enhance habitat conditions. The logs will all be harvested on-site, staged on-site, and placed in the channel using heavy equipment. Channel log structures will be installed into the channel banks, with a portion of the stem and rootwad exposed in the channel, providing velocity refugia, forage, cover and hydraulic complexity for steelhead rearing habitat. They will be positioned not to completely block the flow, which could potentially impede volitional fish passage. Force-balance calculations performed (see Appendix B) have determined that the proposed design, with channel log structures covered with soil, will be properly secured. Despite this fact, the 90 percent design plans may include revised channel log structure details that include “pinning logs” driven at angles into the ground on either side to limit the potential for floating and movement that could result in diminished function of the design.

Floodplain log structures are proposed for areas within the Wye Reach. These structures are slightly different from the channel log structures, oriented with the rootwad facing downstream and the upper portion of the log buried beneath the ground surface. This will create partial blockages of overbank flows that will result in backwater refugia for fish as well as deposition of both coarse and fine sediment. As with the channel log structures, the design of the floodplain structures may be refined to include pinning and/or the use of small woody debris or slash.

It is expected that no imported rock, cabling, or mechanical anchors will be used for any wood pieces, relying solely on embedment or natural materials as ballast to stabilize the wood pieces during high flow events. Risk to property due to log mobilization and entrainment due to a high flow event is very low at this site due to the absence of downstream infrastructure, although mobilization of log structures could result in loss of their intended function.

8. Bank Stabilization

The Project includes one area with a restoration design focused on bank stabilization area along the outboard curve in the creek, on the west side of State Route 1, north of Olema-Bolinas Road State Route 1 intersection, as described in section 6 above. Stabilization of this area is desirable to prevent the potential for future damage to Highway 1, and it must also take into consideration the fact that this reach of stream contains high quality aquatic habitat for steelhead as well as California red-legged frog. For that reason, an approach that relies heavily on bioengineering methods has been selected.

The stabilization concept uses a mix of channel re-alignment, large wood and soil bioengineering as shown in sheet C-5.0 of the drawings. The channel will be shifted to the west slightly, to reduce the near bank stress associated with the small radius of curvature and accommodate space to install rootwads. A small floodplain bench will be graded on the inside of the meander to allow for flow relief during high flow events. The toe will be protected by a series of rootwads buried into the bank and bed of the channel on the outside meander bend. The rootwads will sit on a footer log, with the trunks extending into the bank. Above the rootwads along the bank will be two layers of coir fabric-encapsulated soil lifts between 6 and 8 inches in height. A row of live willow branches or rooted cuttings will be placed between the two lifts. The elevation of the top soil lift will be set to a height approximately 0.5 feet higher than the floodplain graded on the inside meander bend, and the slope above will be graded at a maximum slope of 3:1 up to the elevation of State Route 1.

9. Bridge Design

The bridge design is under review as of the writing of this report. The 30 percent design used abutments at each end and was completed without the benefit of a full geotechnical evaluation. Preliminary geotechnical assessments show that significant fault rupture could occur in the vicinity of the bridge, resulting in consideration of a pier-supported structure to improve public safety. The final geotechnical report will be included in the Basis of Design Report submitted with the 90 percent design plans. A fault rupture study is being completed to determine the potential ground movement generated by an earthquake event that would have a five percent chance of occurring in 50 years, per the direction of the Marin County Department of Public Works.

The Department of Public Works has also requested that a tsunami scour analysis be performed because the site lies within a mapped tsunami hazard zone. As with the fault rupture study, the tsunami analysis will assess a wave that has a five percent chance of occurring in 50 years. The results of the tsunami scour assessment and fault rupture study will be used to determine the type of structure to use (abutment or pier supported), as well as the depth of the supporting structures. Full design details will be included in the 90 percent design plans and updated Basis of Design Report.

10. Intersection Control Evaluation (ICE)

Caltrans requires an Intersection Control Evaluation (ICE) Study at the proposed intersection of State Route 1 and Olema-Bolinas Road. Mark Thomas, Inc. engaged Fehr and Peers, Inc. to prepare the study and prepare the summarized results in an ICE memorandum. In completing the report, detailed accident data for the existing intersections on the site were analyzed, and traffic studies were completed. The results of the study show that an intersection with stop control on Olema-Bolinas Road is suitable. The memorandum is under review by Caltrans and is included as Appendix H to this report.

11. Environmental Contaminant Screening

Environmental contaminant screening has been performed by Crawford & Associates, Inc. The scope of work included shallow soil sampling in October 2021 along the Crossover Road and on Olema-Bolinas Road. The preliminary results of the study show that no metals, petroleum hydrocarbons or other volatile organic compounds are present in the soils above regulatory thresholds on the site. In addition, pH levels do not exceed hazardous waste thresholds. The draft preliminary report is included as Appendix I to this report.

12. Constructability

Constructability of the project has been a major consideration throughout the design process. The project is complex, involving large scale roadway and bridge construction, and small-scale nuances of channel construction in a heavily wooded area. The site is in a liquefaction zone and soils are poorly suited for providing stability, resulting in the need for over excavation, pilings or other stabilizing measures for roads and bridges. A complete geotechnical investigation, including the results of the fault hazard and tsunami scour analyses will be included at the 90 percent design stage, and will be used to determine appropriate stabilization techniques. Access to the site for heavy equipment or structures is another consideration, due to the winding nature of West Marin roads and notably the distance that needs to be traveled along a curvy, narrow road.

Olema-Bolinas Road is the only access route in and out of Bolinas, therefore the roadwork in this project needs to be planned to provide through access at all times. The design is therefore being prepared to require construction over two construction seasons, generally between May 1 and October 31, although considerations for special status species may influence the work window dates. Work completed during the first construction season (Phase 1) will include:

- Realigning Olema-Bolinas Road,

- Constructing the proposed bridge,
- Building the proposed Olema-Bolinas Road/State Route 1 intersection,
- Floodplain grading in the Upstream Reach,
- Removal of decommissioned areas of Olema-Bolinas Road,
- Installation of the improvements to the Bank Stabilization Area, and
- Construction of the Lewis Gulch Creek channel through the Bridge Reach.

After the first construction season, or phase one, flows in Lewis Gulch Creek will follow the existing path along the west side of Olema-Bolinas Road. The newly graded Bridge Reach channel will be isolated from flow using large volume sandbags placed just upstream of the newly constructed bridge through the winter between the first and second phases, and up until the end of the second phase of work (described below).

Phase 2 construction will include:

- Removal of the crossover road,
- Excavating the Transitional and Wye Reaches of Lewis Gulch Creek,
- Installation of log structures in the Transitional and Wye Reaches,
- removal of invasive stands of Himalayan blackberry (*Rubus armeniancus*), and
- notching the existing berm on the southern side of Lewis Gulch Creek just downstream of the existing Olema-Bolinas Road culvert.

At the end of Phase 2, the temporary sandbag diversion dam upstream of the bridge will be removed, and the earthen berm will be installed in the former Lewis Gulch Creek channel to divert all flow into the newly constructed channel. Phasing of the project is illustrated on sheets C-1.0 and C-1.1 of the drawings.

Construction activities related to realigning the Lewis Gulch Creek channel will involve the use of small excavators, dozers, track trucks and skip loaders to minimize the disturbance footprint. Dozers, scrapers, excavators, cranes, pile driving equipment, rollers, compacters, and paving equipment will be used to construct improvements to Olema-Bolinas Road and the bridge. Topsoil excavated from the channel will be reused in the area where Fairfax-Bolinas Road (Crossover Road) is removed and in the restored floodplain above Olema-Bolinas Road. Wetland sod and topsoil removed from the channel areas will be stored and re-used in the former footprint of Fairfax-Bolinas Road. Trees removed from the channel and road realignment areas will be cut to size and stored temporarily on site for re-use as channel and floodplain log structures. All remaining removed trees and brush will be removed from the site and disposed of at appropriate disposal facilities.

Road fill soil will be prepared at approved facilities and imported to the site in tandem dump trucks. Soil specifications will be prepared by Mark Thomas using the recommendations from the geotechnical report. Because of the existing subsurface soil conditions, road grade areas will need extended time to settle and reach the necessary compaction. Soil amendments and/or extra soil compaction efforts may be required to reach the required compaction for new and improved areas of Olema-Bolinas Road.

During Phase 1 work, traffic will use Fairfax-Bolinas Road (Crossover Road) to access the town of Bolinas from State Route 1. Temporary single lane traffic controls will be required during Phase 1 to complete road grading activities on Olema-Bolinas Road south of the intersection with Fairfax-Bolinas Road. A temporary paved ramp will also be required for the transition from Olema-Bolinas Road to Fairfax-Bolinas Road. Temporary paving will also be added to the intersection of Fairfax-Bolinas Road and State Route 1 to allow for large vehicles to turn onto Fairfax-Bolinas Road from southbound State Route 1.

Staging of construction activities and stockpiling of materials will use decommissioned areas of Olema-Bolinas Road during Phase 1 and Fairfax-Bolinas Road during Phase 2. A temporary signal on Olema-Bolinas Road or intermittent single lane closures may be required for portions of the work.

13. Self-Mitigation

Regulatory agencies with jurisdiction over wetlands and non-wetland waters within the Project Area include the U.S. Army Corps of Engineers (Corps), Regional Water Quality Control Board (RWQCB), California Department of Fish and Wildlife (CDFW), and the California Coastal Commission (CCC). The last three agencies will collectively be referred to herein as “State.” The impact and mitigation information presented herein is preliminary and based on the wetland assessment conducted by WRA in 2021.

The proposed Project will result in a net increase of approximately 0.55 acres of aquatic resource areas, as well as an increase of function and services of existing aquatic resource areas. Approximately 0.73 acres of jurisdictional habitats will be re-established from existing uplands habitats through removal of the existing Crossover Road and re-alignment of the Olema-Bolinas Road. Permanent impacts to approximately 0.12 acres of wetland and 0.07 acres of stream habitats will result from grading and re-alignment of the Olema-Bolinas Road. Approximately 0.23 acre of Corps and State features will be converted; the majority of these changes are related to the creation of the new channel alignment. All acreages are preliminary, and final impact, enhancement, and restoration acreages will be included in the regulatory permit applications. Table 5 below summarizes the preliminary changes in stream and wetland habitats as a result of the Project.

Table 5. Summary of Preliminary Proposed Impacts and Mitigation for Jurisdictional Habitats (in Acres)

	Impact Habitat and Type	Grading & Road	New Channel	New Floodplain	New Wetland	Grand Total
Corps / RWQCB / CDFW / CCC Jurisdictional	**Waters of the U.S.**	**0.34**	**0.13**	**0.41**	**0.25**	**1.14**
	Conversion	-	-	0.00	0.01	0.02
	Re-establishment	-	0.09	0.41	0.24	0.73
	Permanent Impact	0.07	-	-	-	0.07
	Temporary Impact	0.27	0.05	-	-	0.32
	Wetland Waters	**0.70**	**0.18**	**-**	**0.06**	**0.94**
	Conversion	-	0.18	-	-	0.18
	Permanent Impact	0.12	-	-	-	0.12
	Temporary Impact	0.58	-	-	0.06	0.64
RWQCB / CDFW / CCC Jurisdictional	**State Wetland**	**0.08**	**0.02**	**0.02**	**0.00**	**0.12**
	Conversion	-	0.02	0.02	-	0.04
	Temporary Impact	0.08	-	-	-	0.08
	Total	**1.13**	**0.33**	**0.44**	**0.31**	**2.20**

14. Revegetation

The majority of the proposed work areas outside of the roadways are currently heavily vegetated wetlands, riparian, and upland communities. The main objectives of the revegetation efforts will be to restore wetland, floodplain, and riparian habitats to all disturbed areas to improve both habitat and the character of the area. To the extent possible, revegetation will involve using native material from the site, including seed collection, taking cuttings for nursery development, or bioengineering and transplanting of individuals or clumps of wetland sod.

The Golden Gate National Parks Conservancy, working in conjunction with Marin County Parks and the WRA design team, has created a draft Vegetation Management Plan for the site (Appendix J) that has detailed information on invasive species removal and revegetation efforts. Areas identified on the site for replanting are based on the limits of disturbance. There are nine vegetative communities mapped on the site as described below. Nine distinct planting palettes have been developed for the disturbed areas of the site as described below. In addition to the planting areas described below, willows will be used to provide channel stability through live stake planting and branch layering (in the Bank Stabilization Area). The revegetation efforts are anticipated to be implemented over the course of several years. The design plans show only the planting that will occur immediately following construction. Sheets L-2.0 through L-2.5 show the planting areas, schedules, and details for the first year of planting on the site. More details on revegetation efforts are in Appendix J.

14.1. Arroyo Willow Thicket

An arroyo willow (*Salix laseolepis*) -dominated plant community will be planted predominantly in the channel restoration areas of the site, except for the farthest downstream reached of the restored channel. Other species included in the planting palette include red alder (*Alnus rubra*), California blackberry (*Rubus ursinus*), western chain fern (*Woodwardii fimbriata*), small-fruiting bulrush (*Scirpus microcarpus*) and slough sedge (*Carex obnupta*).

14.2. Upland Red Alder Forest

Upland red alder forest areas will be planted along the eastern edge of the improved areas of Olema-Bolinas Road. Species include red alder, boxelder (*Acer negundo*), red elderberry (*Sambucus racemosa*), coast redwood (*Sequoia sempervirens*), small-fruiting bulrush and bee plant ((*Scrophularia californica*).

14.3. Lowland Red Alder Forest

Lowland red alder forest will be planted in areas where the Fairfax-Bolinas Road has been removed. Species composition is similar to that of the arroyo willow thicket palette, with a higher percentage of red alder and lower percentage of arroyo willow. Other species found in the plant mix include silver cinquefoil (*Potentilla anserina*) and dune rush (*Juncus lescurii*).

14.4. Salt Marsh Bulrush Marsh

The extreme lower end of the channel relocation area runs through areas dominated by herbaceous wetland vegetation. The planting community targeted for revegetation in this area is saltmarsh bulrush marsh. The two dominant species to be planted are alkali bulrush (*Bolboschoenus maritimus*) and marsh jaumea (*Jaumea carnosa*). Other species include saltgrass (*Distichlis spicata*) and pickleweed (*Salicornia pacifica*). Plantings will start in the mid bank region of the channel and extend to the limits of disturbance. The active channel will remain unvegetated, as is typical of tidally -influenced channels.

14.5. Saltgrass Flats

The extreme downstream end of the restored creek channel, near the tie in point with the existing tidally-influenced channel will be planted with a saltgrass dominated plant mix. Other main species include beach saltbush (*Atroplex lucophylla*) and silver cinquefoil. Planting will be similar to the saltmarsh bulrush areas, with planting starting midway up the creek bank and extending to the limits of disturbance.

14.6. Coastal Brambles

A California blackberry-dominated coastal brambles planting mix will be planted in areas where Himalayan blackberry is removed near the corner of Olema-Bolinas and Fairfax-Bolinas Roads, as well as adjacent to State Route 1 in the area where Fairfax-Bolinas Road has been removed. Other species include red alder, mugwort (*Artemesia douglasiana*), coyote brush (*Baccharis pilularis*), and rushes.

14.7. Coyote Brush Scrub

Coyote brush scrub will be planted in areas along State Route 1 and on the east side of the re-aligned portion of Olema-Bolinas Road north of the proposed bridge. The plant mix is dominated by coyote brush and also includes coastal sagebrush (*Artemesia californica*), California blackberry and purple needlegrass (*Stipa pulchra*).

14.8. Coast Live Oak Woodland

Coast live oak woodland will be planted in the area east of the re-aligned Olema-Bolinas Road north of the proposed bridge. The woodland planting mix contains coast live oak (*Quercus agrifolia*), California buckeye (*Aesculus californica*), and California bay (*Umbellularia californica*) as canopy tree species. Understory plantings are dominated by coastal sage brush, California oatgrass (Danthonia californica), manroot (Marah oregana), soap root (*Chlorogalium pomeridianum*), woodland strawberry (*Fragaria vesga*) and purple needlegrass.

14.9. Roadside Grassland

Roadside slopes will be planted with a mix of native grasses and forbs. The mix will also include Regreen, a sterile wheatgrass that will provide short term stability as the native species become established.

15. Sea Level Rise Scenarios and Future Climate Conditions

The site is vulnerable to sea level rise, as well as other climate change-related effects including prolonged drought and storms with high magnitudes and intensities. A goal of the project is to reduce the impacts of sea level rise. Many projections of sea level rise exist, and the guidance provided in Marin County's C-SMART is used in planning for this project. The guidance projects sea level rise of approximately 2.0 feet by 2050 (to a mean high-water elevation of 7.6 feet NAVD88) and 5.5 feet by 2100 (to a mean high-water elevation of 11.1 feet NAVD88).

To determine the maximum expected extent of mean high water, WRA modeled the 100-year flood event with 2.0 and 5.5 feet of sea level rise. The results, shown below in Figure 7 and Figure 8, show the extent of inundation during the 100-year flow event with 2050 and 2100 sea level rise scenarios and demonstrate that those flows will not impact the proposed bridge or raised portion of Olema-Bolinas Road. As a comparison, the 100-year flow was modeled with no sea level rise, and results show that there is no measurable impact to the water surface elevation under the proposed bridge or in adjacent downstream locations. Figure 3 shows the channel profile with the water surface elevation of the three modeled 100-year flow scenarios, along with a modeling scenario showing the maximum recorded tide in Bolinas Lagoon of 8.02 feet NAVD88 recorded on March 20, 2011, (NOAA 2022) with 5.5 feet of sea level rise. The projected end of century sea level rise is not expected to reach the proposed bridge or upgraded portions of Olema-Bolinas Road under these tidal scenarios, a correction of current conditions in which flooding occasionally inundates Olema-Bolinas Road. This analysis does not account for storm surge, wave runup, or groundwater.

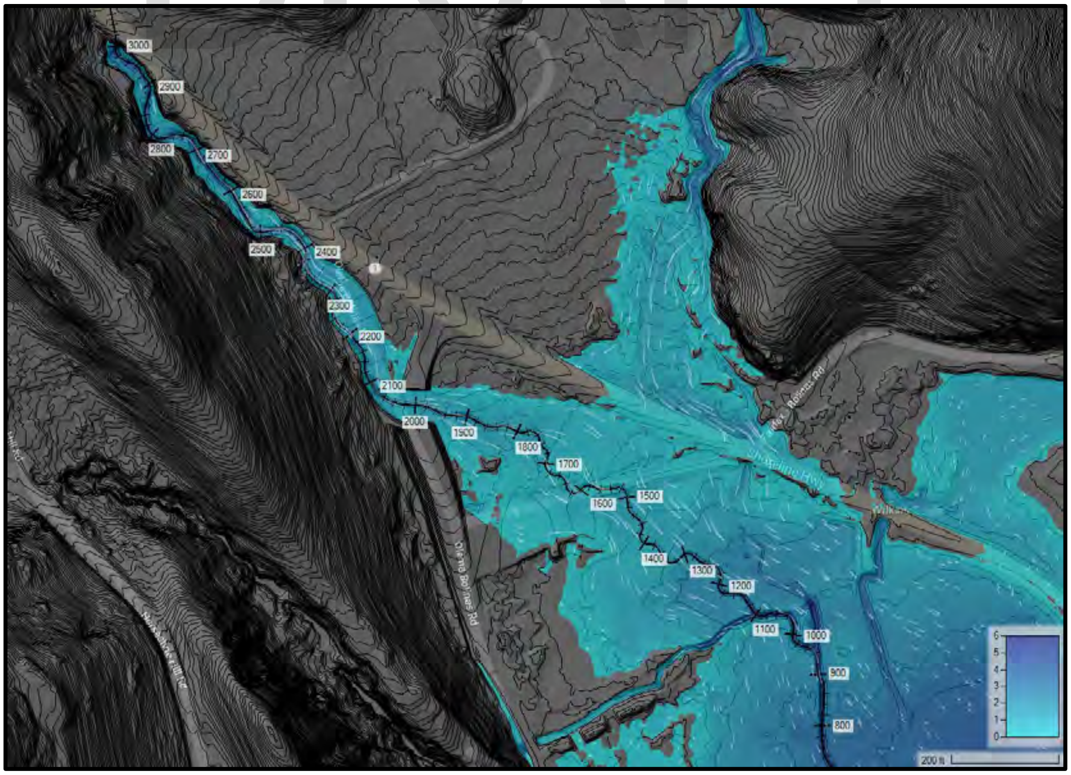

Figure 6. Model Results Showing Depth of Water During The 100-Year Flow Event with Projected 2050 Sea Level Rise.

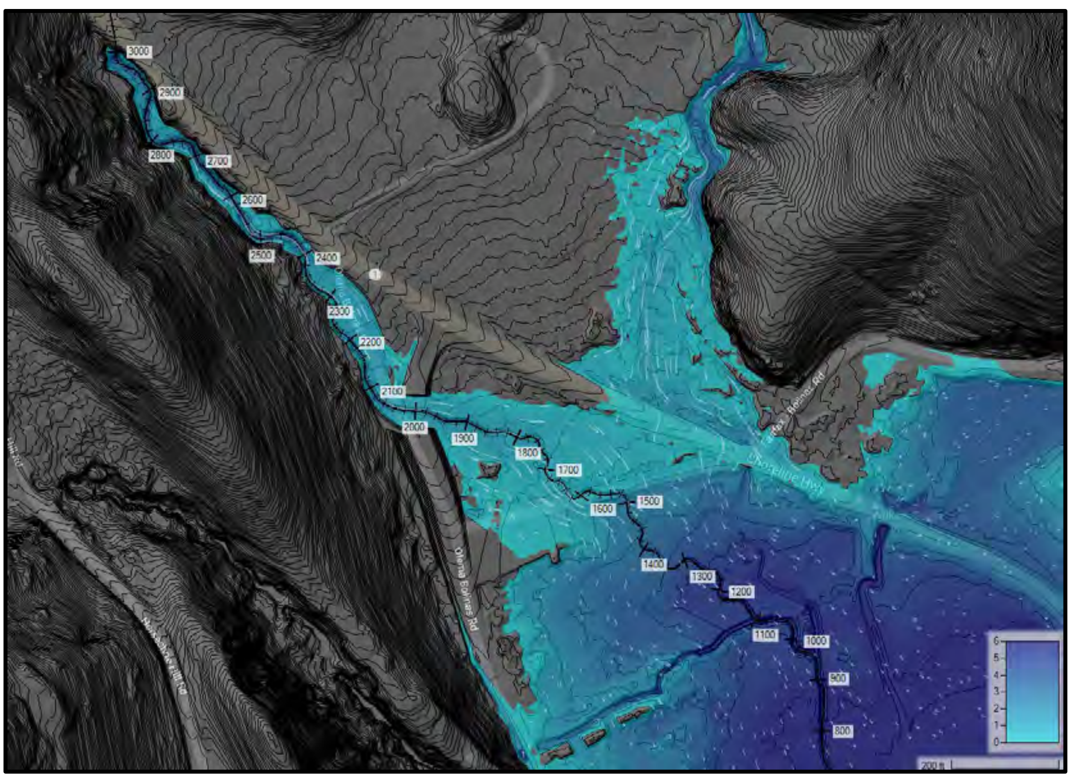

Figure 7. Model Results Showing Depth of Water During The 100-Year Flow Event with Projected 2100 Sea Level Rise.

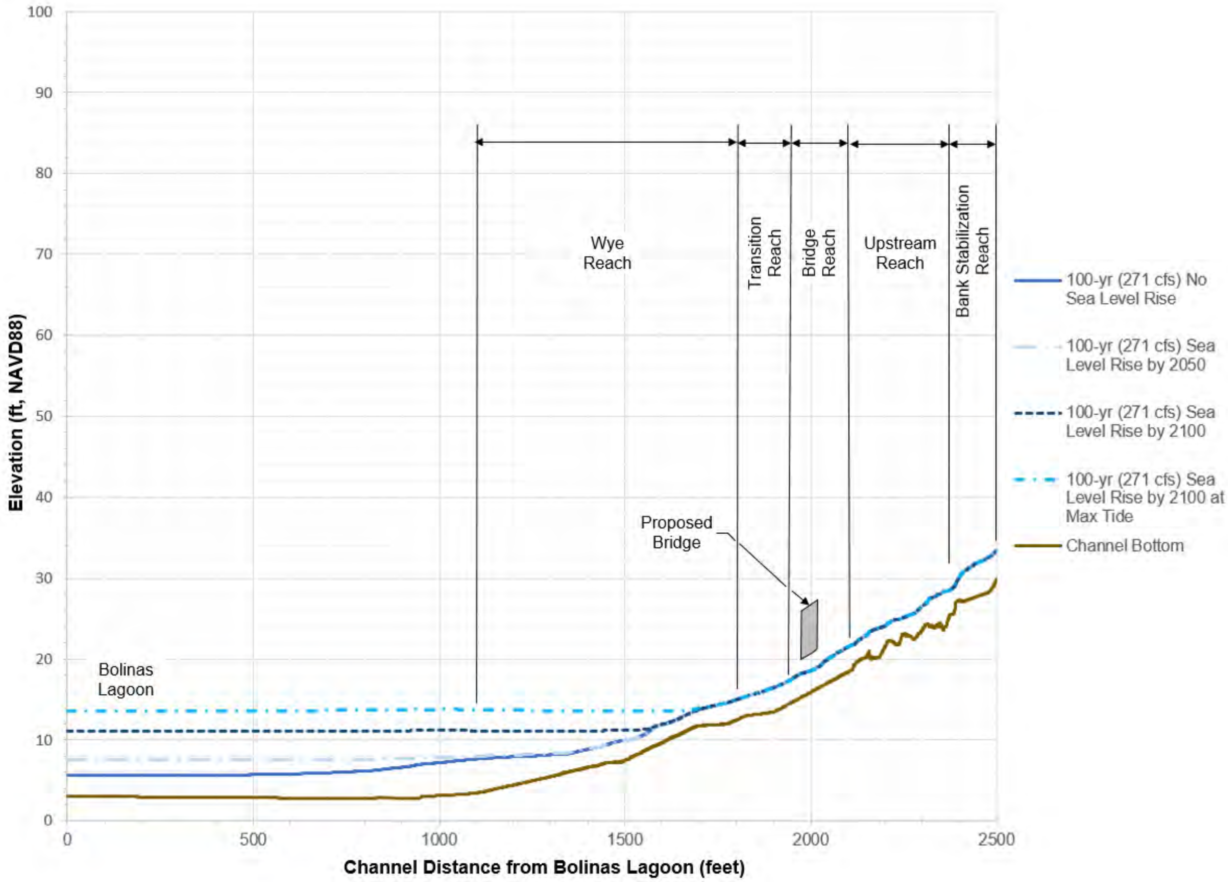

Figure 8. Profile View Through Lewis Gulch Creek Showing Model Results of 100-Year Flood Event With and Without Sea Level Rise and Channel Bottom

The modeled scenarios do not account for sediment deposition within the project area. Sediment loads from Lewis Gulch Creek are relatively high, including both bedload, or coarse sediment, and suspended, or fine sediment. Because the restoration area is a historic alluvial fan, it is anticipated that the majority of the coarse and a small amount of the fine sediment will be deposited in random patterns across the site. Methods to predict deposition rates and locations are imprecise at best, although it is anticipated that backwater effects of the lagoon water surface elevation will result in the majority of the coarse sediment being deposited on the alluvial fan before progressing to the lagoon. Sediment deposition is expected to be random in both location and volume.

Deposition of sediment within the project area may result in a decrease of the projected encroachment of tidal influence with sea level rise. Sediment deposition volume and location is also expected to be highly variable on a temporal scale, determined by the magnitude and number of high flow events rather than evenly over time. This may result in migration of the mean high-water line from year to year or throughout the year, as sea levels rise in a relatively uniform rate and deposition occurs episodically.

Bolinas Lagoon is also known to accrue fine sediment from tidal inputs from the ocean and this sediment should also accrue in the wye wetlands as sea levels rise. The combination of sediment inputs from the creek and the tides should raise the elevation of the wetlands and allow it to be more resilient to impacts from sea level rise.

16. Schedule

The construction schedule is projected to occur for two summer construction seasons (May through October) – for Phases 1 and 2 described in Section 12 totaling approximately 12 months of construction (excluding replanting). The first season will include constructing the proposed Olema-Bolinas roadway, the bridge, and the proposed channel underneath the bridge. The second season will conclude construction by removing the Bolinas-Fairfax Road and installing the remaining portion of the channel and restoration activities. Planting is expected to occur over the course of three years, with the majority of the planting and seeding occurring the first year after construction. Long-term monitoring if the site restoration and planting is expected to be a permitting requirement and may last 5 or 10 years following completion of construction.

17. Cost

The Engineer's Opinion of Probable Costs for the 60 percent design can be found in Appendix D. The total estimated cost of construction is approximately $7 million dollars in 2024 dollars, the assumed midpoint of construction. This includes a 30% contingency to account for the preliminary design stage of this project. Resources used to develop unit costs include similar past project experience, RS Means data (a commercial database of construction costs) and material inquiries. Inflation of 4% a year for 3 years is assumed. AutoCAD was used to estimate quantities. This estimate does not include soft costs (engineering design, environmental documentation, construction management) or maintenance and monitoring.

18. Conclusion

The 60 percent design for the Bolinas Wye Wetland Project has been completed with input from MCP, DPW and GGNPC. The design meets the goals and objectives of the project by realigning Lewis Gulch Creek into the Wye, constructing a low flow channel connected to the floodplain and adjacent wetlands, restoring, and enhancing habitat for aquatic and terrestrial species, providing climate change resilience, and improving road safety. It is anticipated that this 60 percent design submittal will be suitable for California Environmental Quality Act (CEQA) review.

The next step for the project is to review the design with the Technical Advisory Committee. Comments from the review, and from Marin County Parks will then be incorporated into the 60 percent design. In addition, information from the updated wetland delineation, tree survey, geotechnical and fault rupture investigation, and other studies necessary for permit submittal will be used to further refine the design.

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Appendix A: 60% Design (Not Attached)

Appendix B: Hydrology and Hydraulic Modeling Technical Report

Hydrologic and Hydraulic Modeling Technical Report Bolinas Lagoon Wye Wetlands Project

60% Design

Prepared for:
Veronica Pearson
Marin County Open Space District

MARIN COUNTY PARKS
PRESERVATION • RECREATION

Prepared by
WRA, INC

wra
ENVIRONMENTAL CONSULTANTS

February 2022

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Table of Contents

Figures

TABLES

LIST OF ACRONYMS

Acronym	Full Name
1D	One-dimensional
2D	Two -Dimensional
AF	acre-feet
Caltrans	California Department of Transportation
cfs	Cubic Feet per Second
CMP	Corrugated Metal Pipe
D50	Median diameter particle
EG	Existing Grade
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
n	Manning's roughness coefficient
NOAA	National Oceanic and Atmospheric Administration
RS	River Station
RCB	Reinforced Concrete Box
TOB	Top of Bank
WSE	Water Surface Elevation

1. INTRODUCTION

This technical memorandum is an addendum to the Bolinas Lagoon Wye Wetlands Project Basis of Design Report. It documents the hydrology and hydraulic analyses performed to evaluate the realignment of Olema-Bolinas Road and restoration of Lewis Gulch Creek.

The primary goals of the project include: 1) restoring the hydrological and ecological processes and reducing the need for human intervention and maintenance, 2) realigning roads to improve safety and reduce road flooding during winter storm and high tide events, and 3) raising the roadways and removing infrastructure to provide opportunities for upslope habitat migration and lagoon expansion, thus providing an unimpeded transition zone for areas subject to backwater flooding and delta development.

Hydraulic modeling was used to predict water surface elevations, velocities, depths, and shear stresses for the proposed design. Model output was used to validate appropriate techniques for channel restoration and biotechnical engineering, as well as evaluate fish passage, ecological value, and flood conveyance.

The following studies were reviewed as part of this effort prior to model setup:

- Mineart, P., S. McNeely, and M. Collins. 2017. Hydraulic Model Report: Bolinas Lagoon North End Project, Topographic Survey & Hydraulic Modeling.
- AECOM and Watershed Sciences. 2016. Bolinas Lagoon North End Restoration Project Technical Memorandum Current and Historic Geomorphology and Hydrology.
- Brennan, M., D. Kunz, and D. Behrens. 2019. North End Monitoring Project: Task 3 Data Analysis & Reporting; Memorandum 1.

2. PROPOSED PROJECT

The existing Lewis Gulch Creek alignment runs southeast along the west side of State Route 1 then turns south in a roadside ditch along Olema-Bolinas Road then turns northeast to cross Olema-Bolinas Road through a box culvert which feeds into a drainage before reaching a tidal slough on the Bolinas Lagoon. The roadside ditch and drainage ditch are straightened channels without meanders. The drainage ditch reportedly requires periodic maintenance because sediment sometimes accumulates during the rainy season, plugging the drainage ditch and preventing Lewis Gulch Creek from draining into Bolinas Lagoon. An overview of the existing conditions model domain including the existing Lewis Gulch Creek alignment, boundary condition lines, culvert locations, and topography is presented in Figure 1.

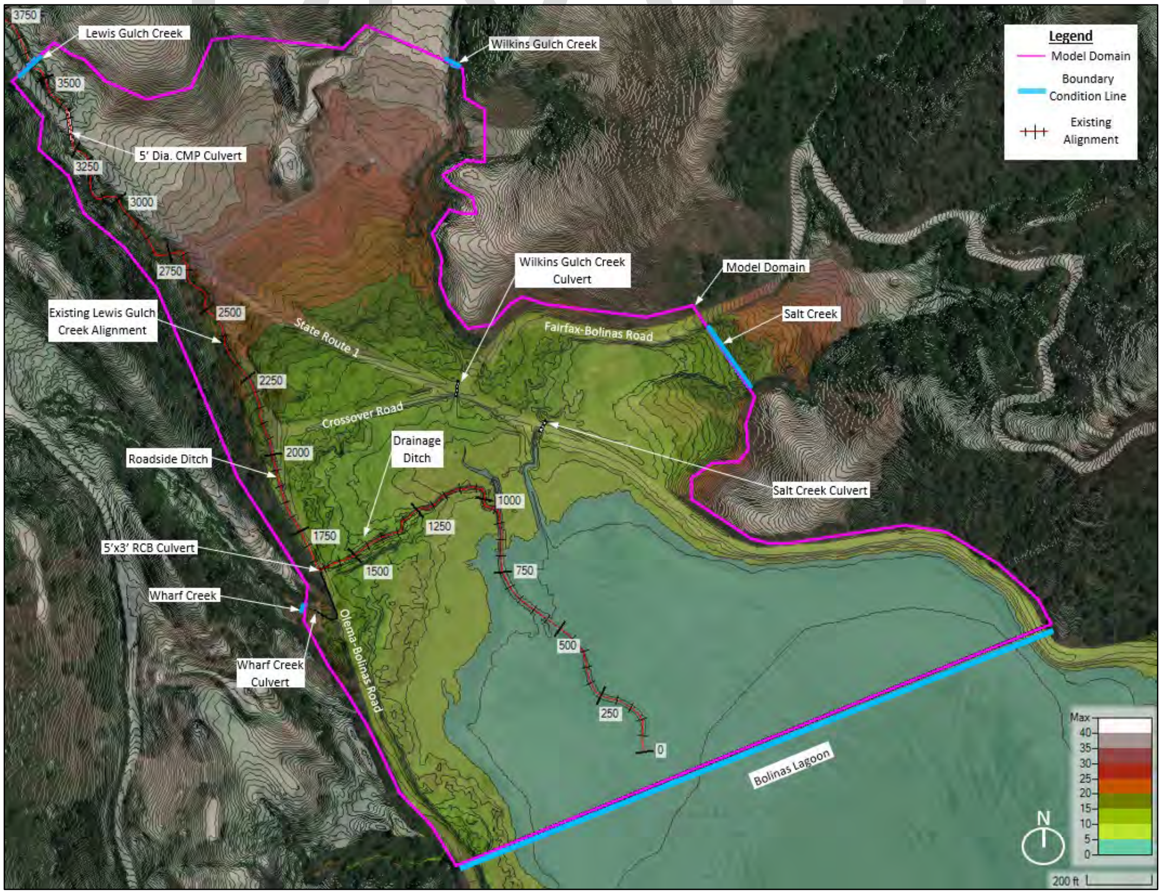

Figure 1. Existing Conditions Model Domain and Existing Lewis Gulch Creek Alignment

The proposed project would replace the roadside ditch and drainage ditch with a new creek alignment. The new alignment would run southeast along the west side of State Route 1 like the existing alignment but before turning south in the roadside ditch, the new alignment would cross Olema-Bolinas Road through a new bridge and meander through the Bolinas Lagoon Wye Wetlands and tie into the existing creek alignment where the creek becomes a tidal slough of the Bolinas Lagoon. Key features of the project include the following:

- Bank Stabilization where Lewis Gulch Creek is eroding the bank near State Route 1
- Excavation to create floodplain habitat where Olema-Bolinas Road is being abandoned just south of State Route 1
- Installation of a new bridge and road alignment for Olema-Bolinas Road
- Installation of a berm to direct flow under the new bridge
- Installation of a new channel for Lewis Gulch Creek to flow under the new bridge and into the Bolinas Wye Wetland for ecologic uplift and fish passage

An overview of the proposed conditions model domain including the proposed Lewis Gulch Creek alignment, boundary condition lines, culvert locations, and topography is presented in Figure 2.

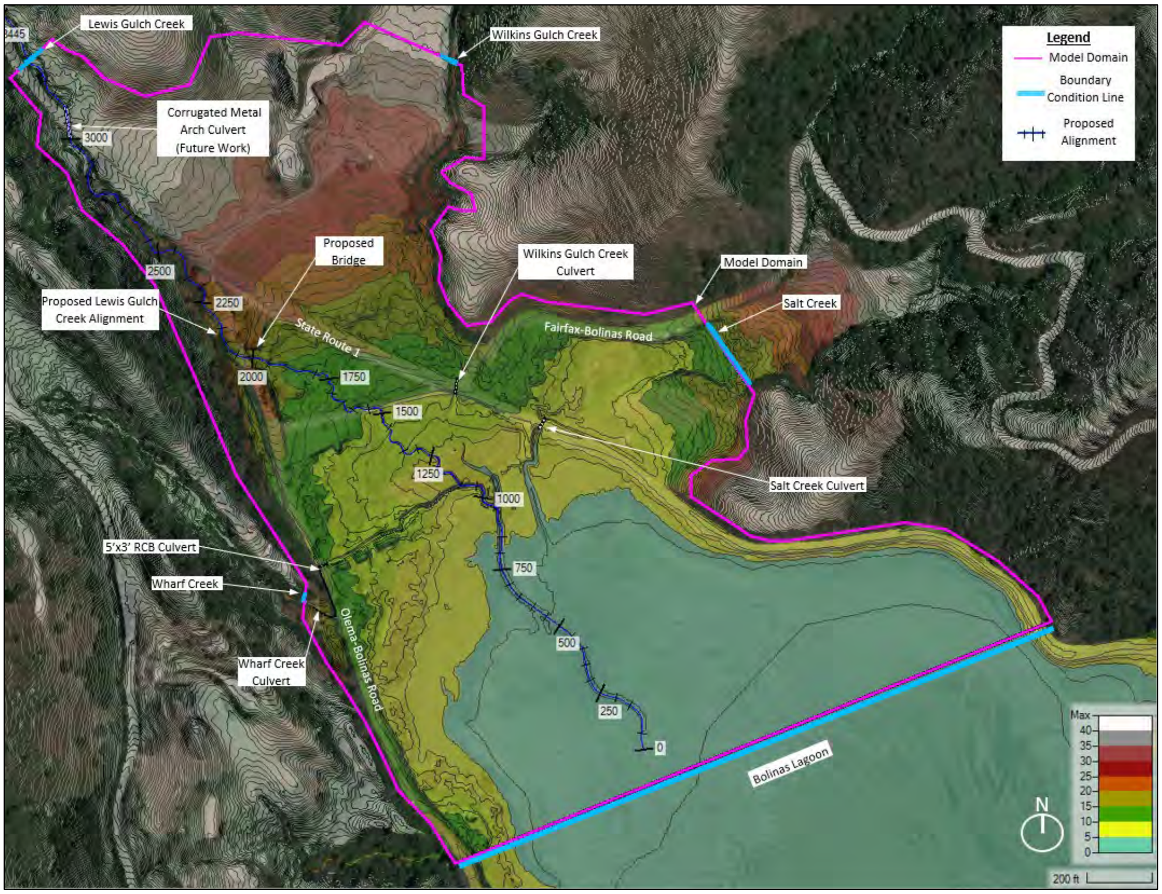

Figure 2. Project Conditions Model Domain and Project Lewis Gulch Creek Alignment

3. HYDROLOGIC ANALYSIS

Bolinas Lagoon Wye is located along the California coast, 15 miles northwest of San Francisco. The Bolinas Lagoon Wye has four primary watersheds: Lewis Gulch Creek, Wilkins Gulches Creek, Wharf Creek, and Salt Creek. The Project is located at the north end of the Bolinas Lagoon Open Space Preserve. Each watershed is primarily forested with vegetated tidal transition zones. The upper portions of each watershed are steep (15-20%) while the lower portions near the Lagoon within the Project maintain a 2% to 3% slope. Each creek is connected to the Lagoon Wye by a culvert crossing a road. The Project is prone to annual flooding, causing traffic issues on Olema-Bolinas Road. Other areas outside of the project footprint flood along State Route 1. Flooding is projected to increase in severity and frequency due to sea level rise. Caltrans and the County of Marin are working to avoid potential damage to the roads and preventing recurring traffic issues.

Flows

A range of peak flows for various return intervals (RI) were determined in order to evaluate flood risk along the roads of the project area and the proposed bridge, and to size the proposed channel to accommodate fish passage, sediment transport, and ecological functions. USGS regional runoff regression equations, based on drainage area and mean annual precipitation, were used to estimate peak creek flows at return intervals ranging from 2 to 500 years (Gotvald, et al. 2012). The drainage area and mean annual precipitation for each watershed for the Lagoon Wye are presented in Table 1 (USGS 2020).

Table 1. Bolinas Lagoon Wye Watershed Parameters

Parameter	Lewis Gulch Creek	Wilkins Gulch Creek	Wharf Creek	Salt Creek
Drainage Area (sq mi)	0.7	0.7	0.1	0.1
Mean Annual Precipitation (inches)	38.5	39.4	30.3	34.3

Peak flow return intervals and nomenclature for each modeled flow scenario for the primary watersheds draining in the Bolinas Lagoon Wye are presented in Table 2. The Lewis Gulch Creek channel design flows have been nominally referred to as the 1-Year RI and 1.5 year RI flows, or Q1 and Q1.5, respectively. The Q1.5 flow refers to the bankfull discharge identified using field indicators. The so-called Q1 design flow, which is used to represent a flow that has a greater likelihood of occurrence than the Q1.5, though it is not known with any precision what the actual annual chance of exceedance of 15 cfs is due to the lack of long-term creek gage data at the site. The Q1 designation has been used as shorthand in this analysis to indicate an annual peak flow that is less than bankfull. This analysis does not account for changes in precipitation or runoff characteristics due to climate change. The modeling performed in this analysis represents the current hydrology for the assigned return interval storms. The sea level rise analysis, discussed below, uses the same return interval storms.

Table 2. Peak Flow Return Intervals

Return Interval (years)	Model Scenario Nomenclature	Lewis Gulch Creek Flow Rate (cfs)	Wilkins Gulch Creek Flow Rate (cfs)	Wharf Creek Flow Rate (cfs)	Salt Creek Flow Rate (cfs)
~1	Q1	15	15	3	6
1.5	Q1.5	25	25	6	7
2	Q2	48	48.8	6.5	7.3
5	Q5	99	101	14.6	16.1
10	Q10	137	139	21	22.8
25	Q25	188	191	29.6	32
50	Q50	229	232	36.5	39.3
100	Q100	271	275	44	47.1
200	Q200	312	315	51.2	54.6
500	Q500	366	370	60.9	64.8

Tides

A range of tide elevations were determined for the Bolinas Lagoon as the downstream boundary condition to the model. This study primarily relies on Mean Higher High Water (MHHW) for analysis as recorded by the NOAA Bolinas Lagoon tide gage 9414958 using the current epoch of 1983 to 2001 (AECOM and Watershed Sciences 2016). Additional model scenarios consider sea level rise for mid-century (2050) and end-of-century (2100). Sea level rise predictions used for this study were determined from published guidance from the Collaboration Sea-Level Marin Adaptation Response Team (C-SMART) online library (Armstrong 2018). The model also considers the maximum tide recorded by the NOAA tide gage which occurred on March 20th, 2011. Elevations for the downstream boundary condition for various tide scenarios are determined by the sum of the associated tide elevation and sea level rise prediction, presented in Table 3.

Table 3. Tide Elevations

Tide Scenario	Tide Elevation 1983 – 2001 Epoch (ft NAVD88)	Sea Level Rise Prediction (ft)	Elevation for Downstream Boundary Condition (ft NAVD88)
MHHW	5.6	0	5.6
Mid-Century (2050) MHHW	5.6	2.0	7.6
Mid-Century (2050) Maximum Tide	8.0	2.0	10.0
End-of-Century (2100) MHHW	5.6	5.5	11.1
End-of-Century (2100) Maximum Tide	8.0	5.5	13.5

4. MODEL DEVELOPMENT

WRA developed a two-dimensional (2D) hydraulic model using US Army Corps of Engineers software HEC-RAS v. 6.1 to estimate existing and proposed conditions water surface elevations, velocities, depths, and shear stresses.

Topographic and Bathymetric Data

The topography used for the hydraulic model included Marin County LIDAR from 2019 that captures topography and bathymetry for the Bolinas Lagoon and the surrounding area. The topography also included total station survey data from AECOM's involvement in 2017 on the Bolinas North End-Phase 1 Topographic Survey conducted by CLE Engineering. The 2017 total station survey collected elevation values in July 2017 along representative cross sections and a longitudinal profile along Lewis Gulch Creek. Cross sections identified channel features such as the toe of the hillslope, top of riverbank, and channel thalweg. Elevations of reference features such as road centerlines and edges of pavement were also collected. AECOM performed the survey using approximate 100-foot intervals along the thalweg profile. Refer to CLE's Field Data Collection Report for additional details (Mineart, McNeely and Collins 2017).

In 2020, two additional topographic surveys were conducted. First, Mark Thomas collected topographic data along the roads to support the design of the re-alignment of Olema-Bolinas Road. Second, WRA collected topographic data from the edge of the lagoon to Fairfax-Bolinas Road to address inconsistent high ground from the LIDAR and look for possible pilot channels to tie in with the proposed Lewis Gulch Creek alignment.

The LIDAR was processed via ArcGIS then imported into AutoCAD Civil 3D as 1-foot contours. The topography data sets from CLE, WRA, and Mark Thomas were used to supplement the LIDAR with key terrain features for design and hydraulic modeling. Finally, the terrain was exported as a Geotiff with elevation samples on a 1 ft by 1ft spacing.

The project vertical datum is NAVD88 and the Horizontal Coordinate System is NSRS11 California State Plane Zone 3, US Ft.

Crossings

The Lagoon Wye is bordered by roads on the north and southwest sides. Under existing conditions, surface water crosses these roads by culverts. There are two crossings for Lewis Gulch Creek. The first crossing is far upstream where the creek crosses State Route 1 via a corrugated metal pipe (CMP). The culvert parameters are determined from the CLE Topographic Survey. This existing crossing is included in the existing conditions model. Initial results of the existing conditions model show that the 100-year event and higher flows overtop the existing culvert under State Route 1 and flood along the northeast side of State Route 1. The study assumes all flows up to the 200-year event would pass through the culvert without overtopping State Route 1. To be conservative and properly evaluate the higher flows throughout the project, the project conditions model use a corrugated metal arch with an open bottom, a maximum opening height of 6 ft and a bottom width of 12 ft. This feature is not being modified in the project but was modeled to inform the concept design planning. Both the existing and proposed conditions modeling use an SA/2D Area Connection to evaluate the hydraulic function at the crossing.

The second crossing for Lewis Gulch Creek is at Olema-Bolinas Road. The existing condition modeling portrays it as a reinforced concrete box culvert with parameters determined from the CLE Topographic Survey. The project condition modeling uses a much larger opening for the proposed bridge; the 30% design of the proposed bridge was used in the model. The existing condition modeling uses a SA/2D Area Connection to evaluate the hydraulic function at the crossing. The existing condition roughness value for the Olema-Bolinas Road box culvert is used to represent the deposition of sediment found at this location. The proposed condition modeling assumes open channel flow with topography matching the vertical abutments of the bridge. This method for hydraulic analysis for the bridge only works where there is sufficient freeboard between the highest possible water surface elevation and the soffit of the bridge. The proposed condition roughness value for the proposed bridge opening is used to conservatively represent miscellaneous vegetation and intermittent boulders under the bridge span. The remaining crossings in the model are used to convey flows from Wilkins Gulch Creek, Salt Creek, and Wharf Creek into the Bolinas Lagoon Wye. These culvert parameters are approximate and ancillary to the Lewis Gulch Creek crossings. See Table 4 for existing condition and project condition creek crossing parameters.

Table 4. Crossing Parameters

Condition	Creek	Road	Type	Upstream Invert Elevation (ft NAVD88)	Downstream Invert Elevation (ft NAVD88)	Length (ft)	Width (ft)	Height (ft)	Manning's "n"
Existing	Lewis Gulch	SR-1	CMP	43.8	41	103	N/A	5	0.024
Existing	Lewis Gulch	Olema-Bolinas Road	RCB	5.9	7.6	30	5	3[1]	0.03
Existing	Wilkins Gulch	SR-1	RCB	11.0	7.0	51	6.8	2.25	0.013
Existing	Salt	SR-1	RCB	7.5[2]	5[2]	38[2]	9[2]	1[2]	0.013
Existing	Wharf	Olema-Bolinas Road	RCP	19.1[2]	5.7[2]	228[2]	N/A	1[2]	0.013
Project[3]	Lewis Gulch	SR-1	Arch	43.8	41	103	12	6	0.024
Project	Lewis Gulch	Olema-Bolinas Road	Bridge	16.6	15.4	46	60	4	0.079

1 – Actual culvert height is 1.5 feet due to sediment blocking bottom half of culvert opening

2 – Parameters were not field verified and are assumed based on photographs and topography

3 – Feature is not included in the project but was used based on concept design planning

Mesh Generation Conditions

The upstream limit of the mesh is upstream of the State Route 1 (SR-1) crossing to evaluate flows in the upper reach of the creek for the restoration design near the proposed Olema-Bolinas Road crossing and for the bank stabilization design near State Route 1. The downstream limit of the mesh is the Bolinas Lagoon so that the distribution of flow from Lewis Gulch Creek can be evaluated throughout the entire Bolinas Lagoon Wye. The mesh also extends northeast if future evaluations need to consider the flows of the Wilkins Gulch Creek or other tributaries.

The mesh uses over 30,000 cells to evaluate 55.1 acres of possible flood inundation. The typical grid cell size is 10 ft by 10 ft, however, break lines are used within the mesh to reduce the grid cells to 2 ft by 2 ft and increase resolution of data at key locations such as the creek invert and bridge abutments. The existing condition geometry only uses one break line along the creek thalweg. The proposed condition geometry uses additional break lines near the proposed Olema-Bolinas Road Crossing for increased resolution.

Boundary Conditions

There are four boundary conditions allowing creek surface water to enter the model domain for each primary watershed of the Lagoon Wye: Lewis Gulch Creek, Wilkins Gulch Creek, Wharf Creek, and Salt Creek. Each of the four creeks' boundary conditions are assigned a steady-state flow rate based on the return intervals in Table 2. There is one downstream boundary which is in the Bolinas lagoon roughly 1,000 ft away from the downstream end of the proposed grading. The downstream boundary condition is assigned a water surface elevation based on tide conditions in Table 3.

Roughness Assignments

Roughness values related to Manning's Coefficient (n) are assigned to the channel bed, channel banks and floodplain based on USGS guidance, then refined through calibration. Roughness assignments are focused on Lewis Gulch Creek and should not be considered accurate for other nearby creeks. The channel bed is the area of natural ground between the left toe of bank and right toe of bank. The channel bank is the area from the toe of bank to the top of bank with a vertical height difference ranging from 1 to 3 feet for Lewis Gulch Creek. The floodplain is any ground outside of the channel top of bank. The channel banks and floodplain are considered to be the same roughness, so they are combined into one land cover type.

Initial model results were evaluated using observed flow and depth measurements on February 13, 2019 as reported in the North End Bolinas Lagoon Water Monitoring Report developed by Environmental Science Associates (ESA 2020). The return interval for their observed flow is unknown but is assumed to be approximately 1 year since the precipitation records on the same day correlate with a 1 year return interval. Multiple model simulations were run with varying manning's roughness values to match or calibrate to the observed values in Lewis Gulch Creek. Simulation #1 used values based on field observations and USGS Guidance (Arcement, Jr. and Verne 1989). Simulation #2 used adjusted roughness values in response to the results of simulation #1. Simulation #3 used adjusted values from the USGS guidance in response to the results of simulation #2. Roughness assignments and observed flow and depth compared to simulated flow and depth are presented in Table 5. The results of the different calibration simulations have led to higher roughness value for the channel bed and the channel banks and floodplain. The channel bed has a higher influence on the model output for depth then the channel banks and floodplain.

Table 5. Observed and Simulated Values of 18.07 cfs Flow

Parameter	Observed Values (ESA 2020)	Simulation #1	Simulation #2	Simulation #3
Channel Bed Roughness	N/A	0.063	0.080	0.079
Channel Bank and Floodplain Roughness	N/A	0.113	0.100	0.132
Precipitation (PRISM 2022)	2.04 in	N/A	N/A	N/A
Return Interval[1] (NOAA 2017)	1	N/A	N/A	N/A
Flow	18.07 cfs	18.07 cfs	18.07 cfs	18.07 cfs
Depth	1.52 ft	1.33 ft	1.46 ft	1.47 ft
Depth Variance from Observed Value	N/A	0.19 ft	0.06 ft	0.05 ft

1 – Return Interval is based on precipitation, not flow

The land cover types used in this analysis are focused on Lewis Gulch Creek only. Roughness assignments for all other areas including creeks, roads, and ditches use the same roughness value as the Channel Bank and Floodplain. Roughness assignments for creek crossings are based on published for similar infrastructure (Chow 1959). Final roughness value assignments are presented in Table 6.

Table 6. Roughness Value Assignments

Land Cover Type	Manning's n Roughness Value
Channel Bed	0.079
Channel Bank and Floodplain	0.132
Crossings (Culverts & Bridges)	See Table 4

5. HYDRAULIC THRESHOLDS

Fish Passage Thresholds

Fish passage analysis considers depth and velocity limitations for salmonids at multiple life stages and resident trout. Each life stage has a unique limitation in depth, prolonged swim speed and burst swim speed that is evaluated for fish passage. Swim speeds correlate to permissible velocities, above which fish are not able to migrate upstream. This study relies on published data related to adult anadromous salmonids, resident trout and juvenile steelhead, and juvenile salmonids (CDFW 2004). Minimum water depth, prolonged swimming speed, and burst swimming speed is presented below in Table 7.

Table 7. Depth and Velocity Requirements Adapted from the California Salmonid Stream Habitat Restoration Manual (CDFW 2004)

Species or Life Stage	Minimum Water Depth	Prolonged Swimming Mode		Burst Swimming Mode		
		Maximum Swim Speed	Time to Exhaustion	Maximum Swim Speed	Time to Exhaustion	Maximum Leap Speed
Adult Anadromous Salmonids	0.8 feet	6.0 fps	30 Minutes	10.0 fps	5.0 Seconds	15.0 fps
Resident Trout and Juvenile Steelhead >6”	0.5 feet	4.0 fps	30 Minutes	5.0 fps	5.0 Seconds	6.0 fps
Juvenile Salmonids <6”	0.3 feet	1.5 fps	30 Minutes	3.0 fps	5.0 Seconds	4.0 fps

Stability Thresholds

There are various thresholds for permissible shear stress and velocity used in hydraulic analysis to determine areas at risk for erosion or deposition. This study relies on published stability thresholds provided by the U.S. Army Corps of Engineers (Fischenich 2001). This study does not include sediment transport modeling but provides context for expected aggradation and degradation based on permissible velocity and shear stress values for a range of lining materials existing on site and proposed in the design. The stability of sediments for the Project can be determined by comparing model outputs to the published permissible velocity and shear stress values. Table 8 presents permissible shear stress and velocity for different surface types expected in the project. Model outputs are compared to the values listed in Table 8, where modeled results exceed these thresholds, degradation is assumed to occur for that surface type. When model outputs show values lower than the values listed in Table 8, aggradation is assumed to occur for the associated surface type. The results of this analysis are discussed in Section 6 and Section 7 below.

Table 8. Permissible Shear Stress and Velocity for Selected Lining Materials Adapted from USACE Stability Thresholds (Fischenich 2001)

Boundary Type	Permissible Shear Stress (psf)	Permissible Velocity (fps)
18" Riprap	7.6	12
6" Cobble	2	4
2" Gravel	0.67	3
1" Gravel	0.33	2.5
Stiff Clay	0.26	3
Silty Loam	0.045	1.75

6. HYDRAULIC ANALYSIS RESULTS FOR EXISTING CONDITIONS

Below is a summary of the existing conditions model outputs organized by water surface elevations, velocity, depth, and shear stress. The analysis for water surface elevations is primarily focused on the 100-year event to evaluate flood risk and comply with local and state regulations for the proposed bridge design. The analysis for velocity is focused on lower return intervals ranging from the 1-year to 5-year events to primarily understand fish passage characteristics but also provide context for sediment transport. The analysis for shear stress is focused on the lower return intervals from the 1-year to 5-year for a more refined understanding of sediment transport but also considers the 10-year and 100-year events for stability related to the bank stabilization and proposed bridge.

The existing conditions analysis divides Lewis Gulch Creek into three segments:

- The upstream section is the creek along State Route 1.
- The middle section is the creek in the roadside ditch along Olema-Bolinas Road.
- The downstream section is the channel in the Wye downstream of the Olema-Bolinas culvert which is referred to as the drainage ditch.

The reach designations and topography for the existing conditions are presented in Figure 3.

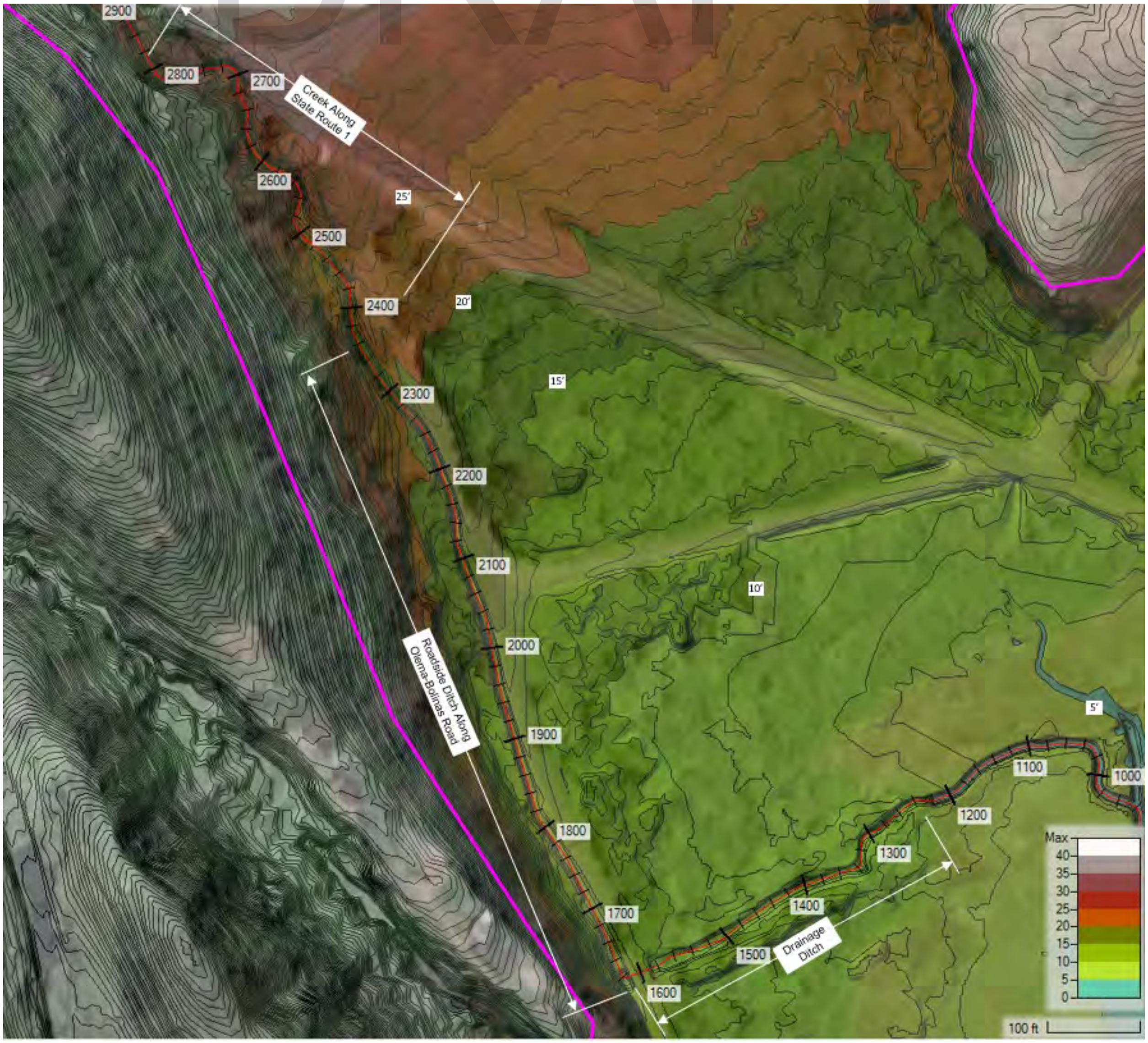

Figure 3. Existing Conditions Reach Areas and Topography

Water Surface Elevations

The existing conditions model was run for Q1 – Q100 with a downstream boundary condition of Mean Higher High Water. The water surface elevations for the existing conditions show backwater effects from the Olema-Bolinas Road crossing for all simulations suggesting the existing 5 ft by 3 ft RCB culvert is undersized. The water surface profiles increase in stage with each increase in flow from Q1 to Q100 upstream of station 18+50. In the roadside ditch, between station 18+50 and 16+00, the water surface profiles converge together due to flooding across Olema-Bolinas Road. In the drainage ditch, between stations 12+00 and 16+00, the water surface profiles converge due to surface water overtopping the north bank and flowing north for approximately 100 feet then flowing northwest parallel with the creek alignment. A profile view of existing conditions water surface elevations and the Olema-Bolinas RCB culvert is presented in Figure 4. A plan view of the existing condition Q100 simulation with water surface contours labeled is presented in Figure 5.

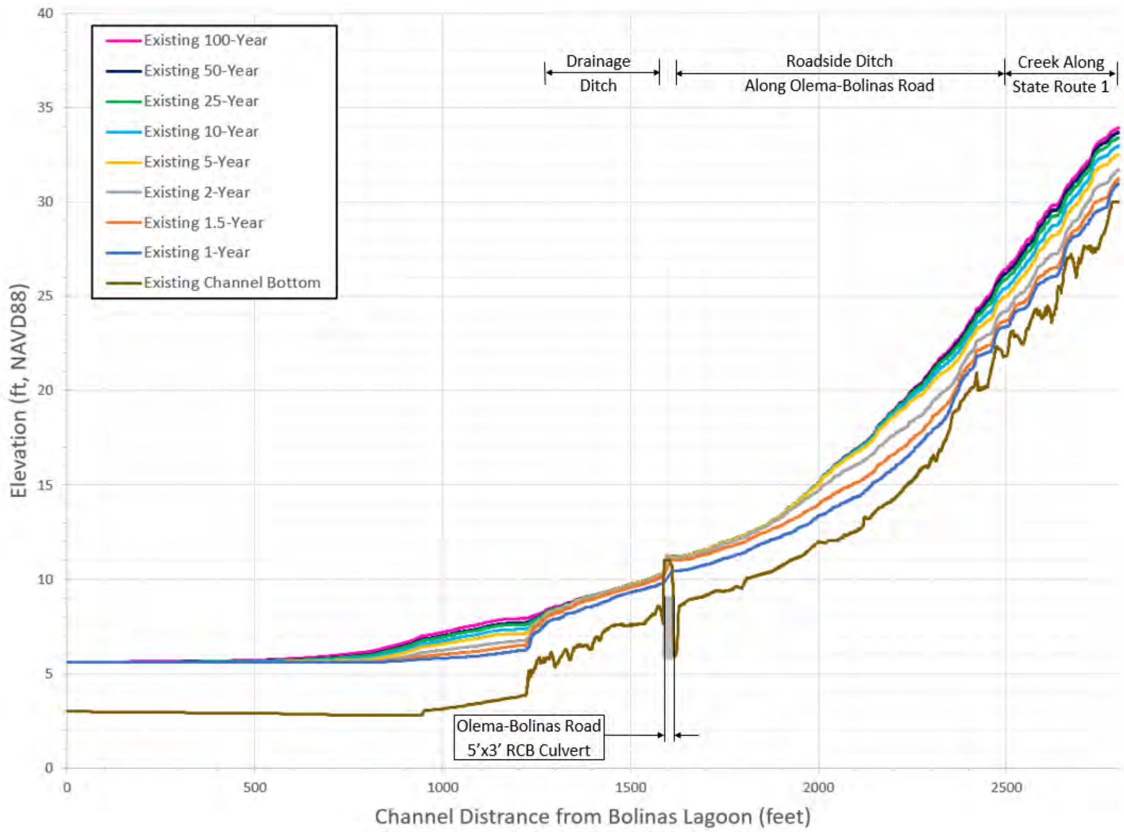

Figure 4. Existing Conditions Profile WSEs

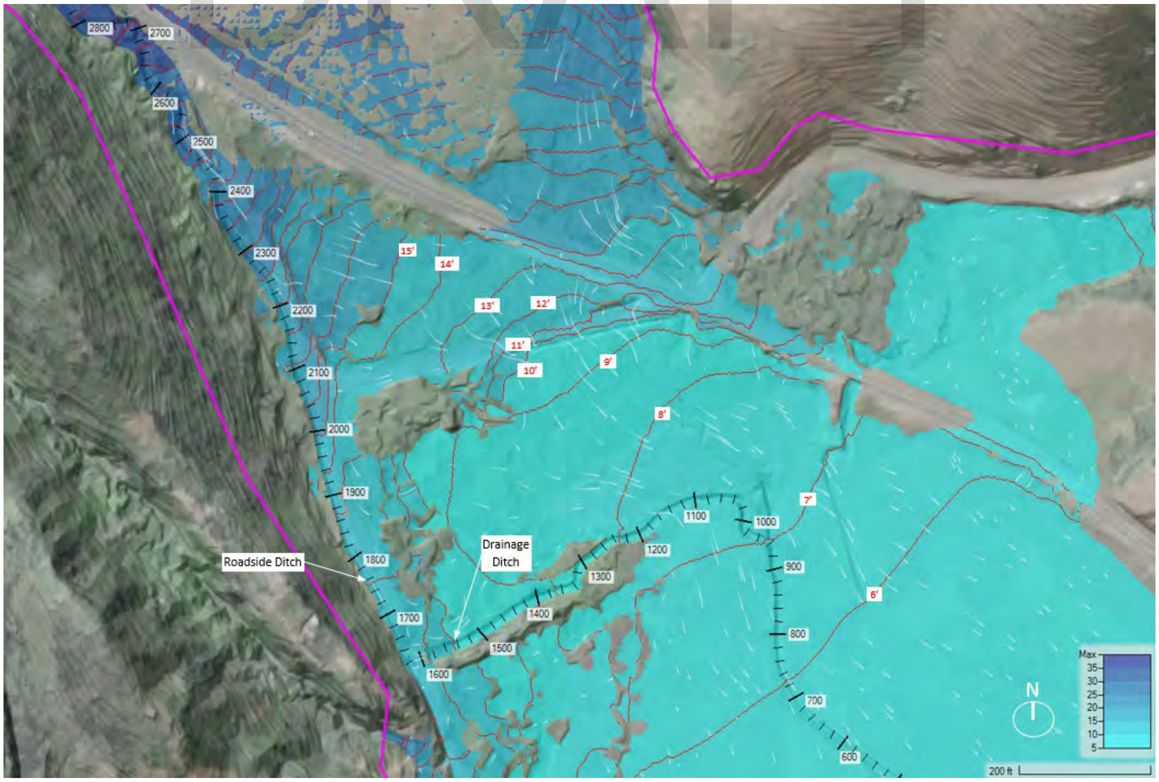

Figure 5. Existing Conditions Plan View Q100 Simulation WSEs Represented with Contours

Velocity

Figure 6 below shows the creek velocity along its profile for Q1, Q1.5, Q2, and Q5 along with threshold levels for velocity for different surface types and fish passage criteria. Comparing the model results to fish passage thresholds, the velocity values along State Route 1 in the existing creek exceed the maximum prolonged swim speed for resident trout and juvenile steelhead <6" but there are areas of low velocity where fish can rest. The velocity values in the roadside ditch along Olema-Bolinas Road are below the maximum burst speed for juvenile salmonids <6" but there are not likely any areas for fish to rest during these peak flow events. Winter base flow and summer base flow were not modeled in this analysis but are expected to be below the maximum prolonged swim speed for Juvenile Salmonids <6".

The range of velocity values along State Route 1 suggest that gravels and cobbles will be mobilized in the upper part of the system. The velocity values are reduced in the roadside ditch along Olema-Bolinas Road where deposition of 1" gravel is expected to occur. A plan view of the existing conditions Q1.5 simulation showing velocities across the site is provided in Figure 7. Areas colored red from station 2400 to 2800 with velocities around 5-15 fps are likely to be riffles and areas colored blue with velocities up to 2.5 fps are likely to be pools. Areas in the roadside ditch have limited floodplain extent for velocity refugia during the Q1.5 simulation.

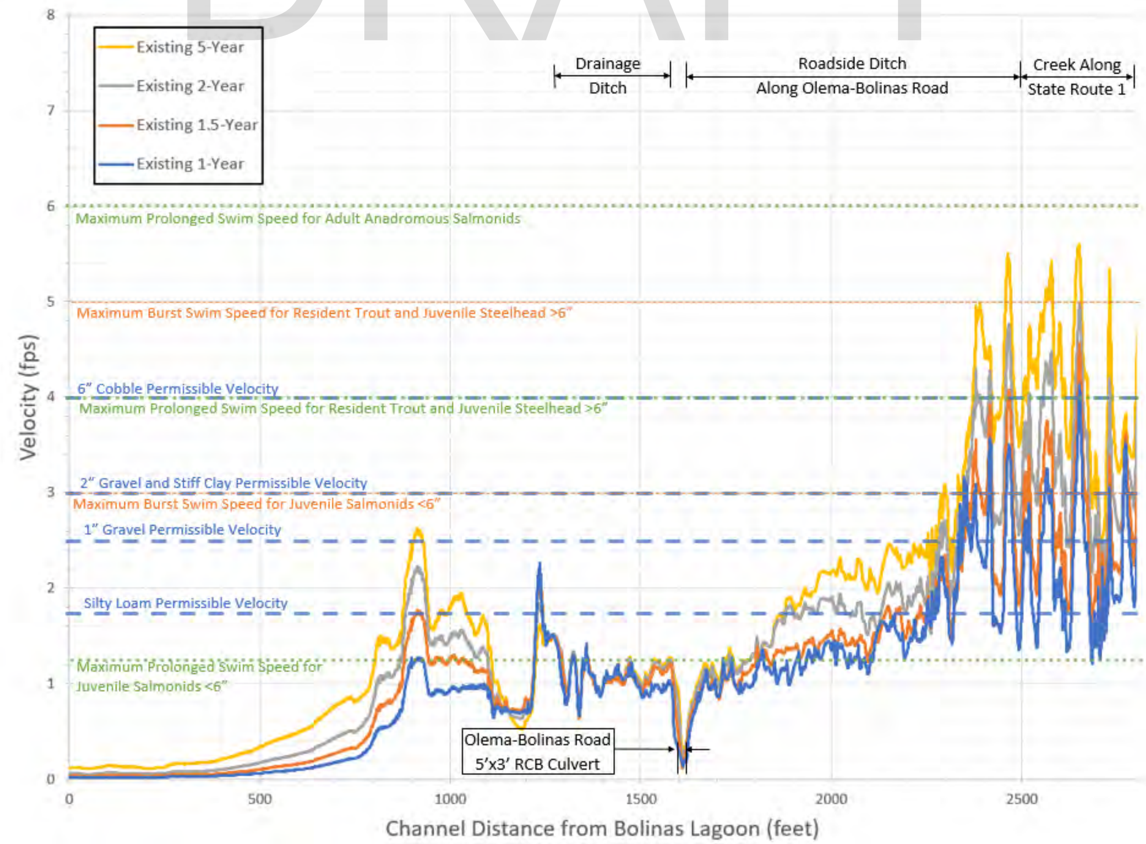

Figure 6. Existing Conditions Profile Velocity (fps) for Q1, 1.5, Q2, and Q5

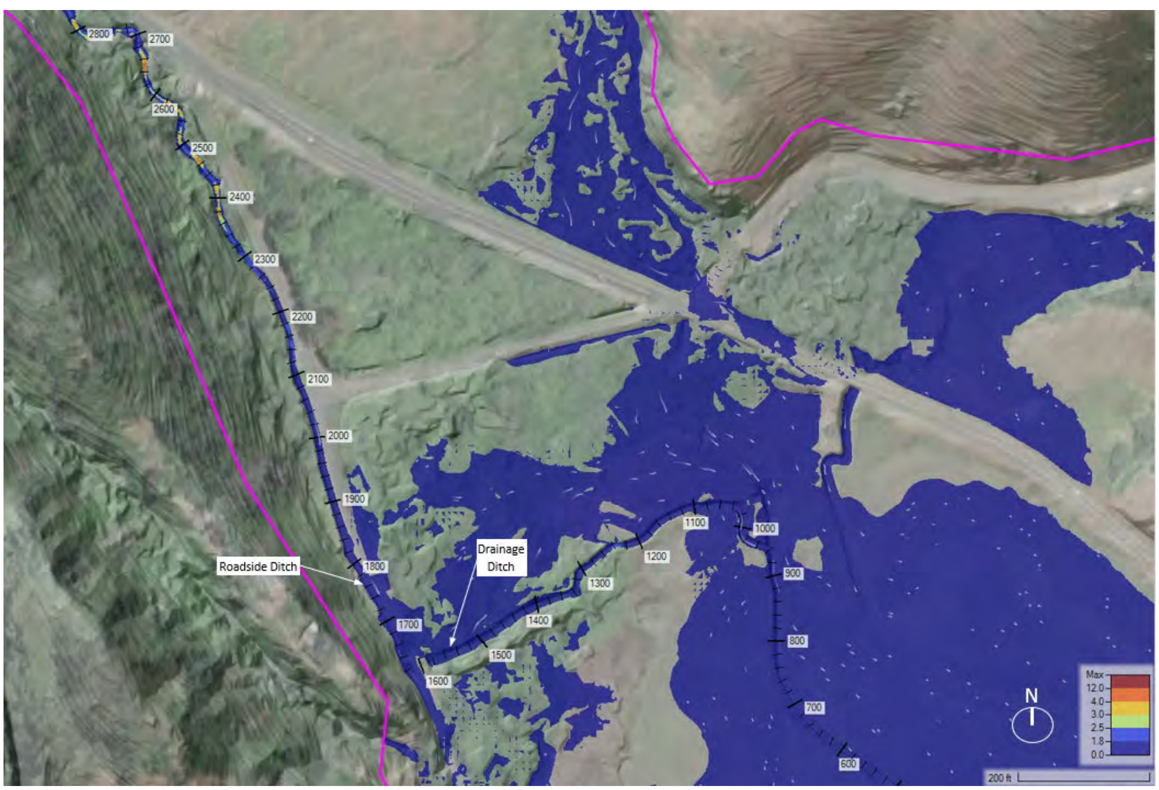

Figure 7. Existing Conditions Plan View Q1.5 Simulation Velocity (fps) Magnitude and Distribution

Depth

Model results for depth values along the existing creek are provided in Figure 8 for Q1, Q1.5, Q2 and Q5 peak flows. These results show water depths upstream of the Olema-Bolinas Road RCB culvert vary between 1 – 4 ft, suggesting there is sufficient water depth for fish migration. The creek along State Route 1 has much different oscillation of depth values than the roadside ditch along Olema-Bolinas Road (Figure 8). The plan view of the depth values for the Q1.5 simulation is provided in Figure 9 and shows limited access to an inundated floodplain in the roadside ditch along Olema-Bolinas Road due to the confined geometry of the roadside ditch.

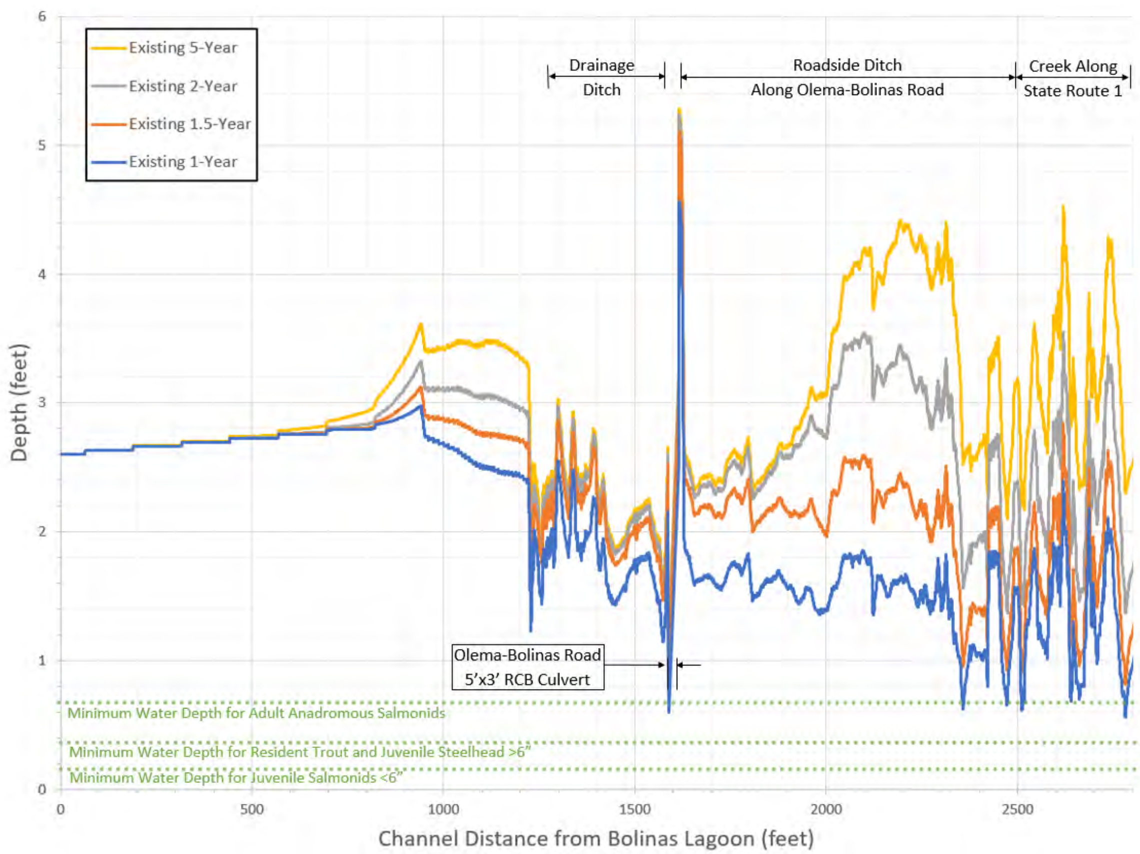

Figure 8. Existing Conditions Profile Depth (ft) for Q1, 1.5, Q2, and Q5

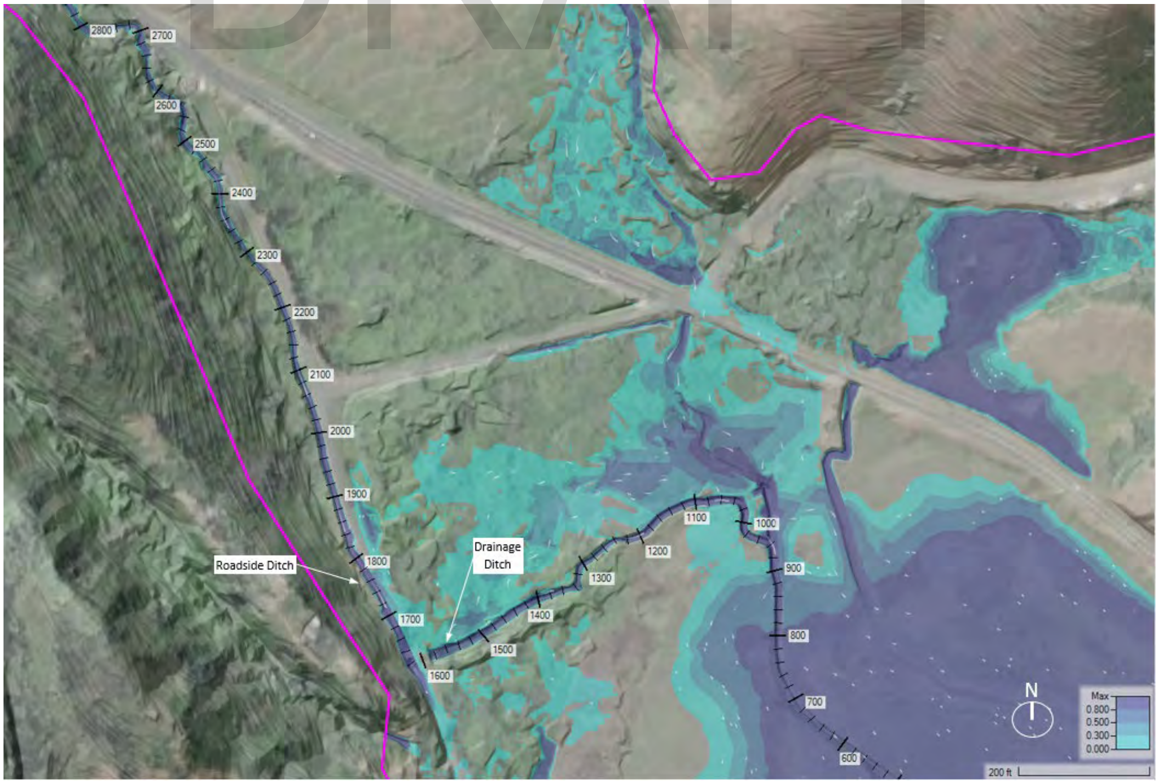

Figure 9. Existing Conditions Plan View Q1.5 Simulation Depth (ft) Magnitude and Distribution

Shear Stress

Existing condition shear stress values for the Q1 to Q5 simulations along the existing creek alignment are presented in Figure 10 along with threshold criteria for substrate mobilization. The range of shear stress values along State Route 1 suggest that gravels and cobbles will be mobilized in the system. The shear stress values are reduced in the roadside ditch along Olema-Bolinas Road where deposition of 1" gravel is expected to occur. The location of the low shear stress coincides with the location of the maintenance dredging previously reported (AECOM and Watershed Sciences 2016). The shear stress, similar to the velocity results, show a somewhat steady decline through the Roadside Ditch Reach toward the box culvert for the Olema-Bolinas road crossing.

A plan view of the existing condition Q1.5 simulation with shear stress values corresponding to permissible shear stress values in Table 8 is provided in Figure 11 and shows a pool-riffle regime from station 2400 to 2800 where areas colored red-orange are likely to be riffles and areas in blue are likely to be pools . Sediment is not deposited on the upper to mid fan surface, instead it is transported further downstream in the roadside ditch. The Q10 and Q100 simulations presented in plan view in Figure 12 and Figure 13 show substantially higher shear stress values upstream of Olema-Bolinas Road than downstream. These model outputs suggest large particle size sediment, such as 6" cobbles, would not likely descend into the Lagoon Wye.

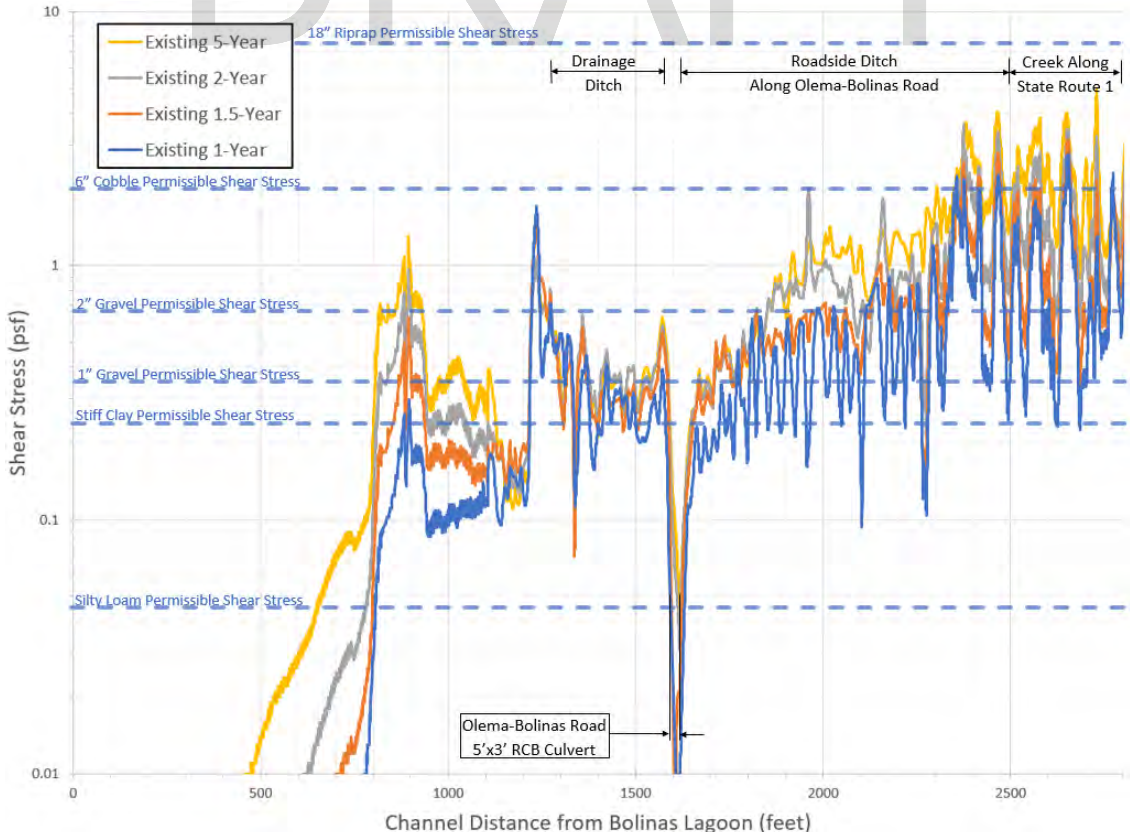

Figure 10. Existing Conditions Profile Shear Stress (psf) for Q1, 1.5, Q2, and Q5

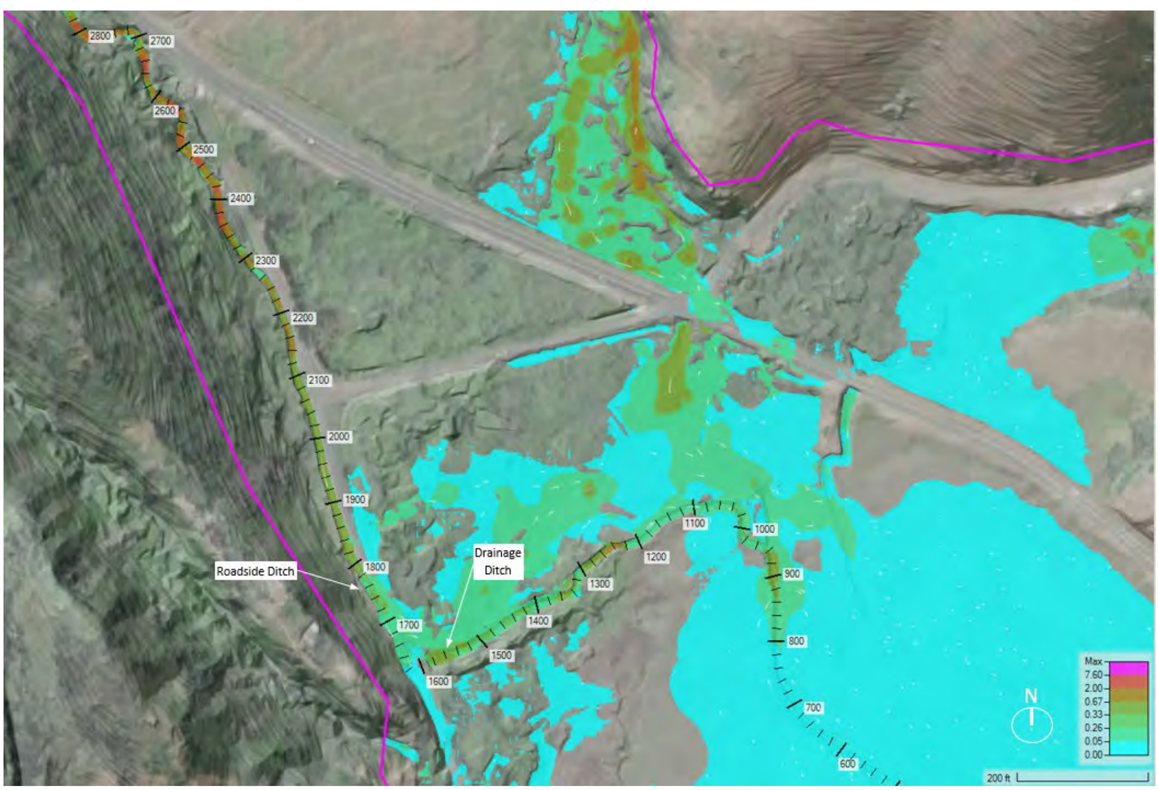

Figure 11. Existing Conditions Plan View Q1.5 Simulation Shear Stress (psf) Magnitude and Distribution

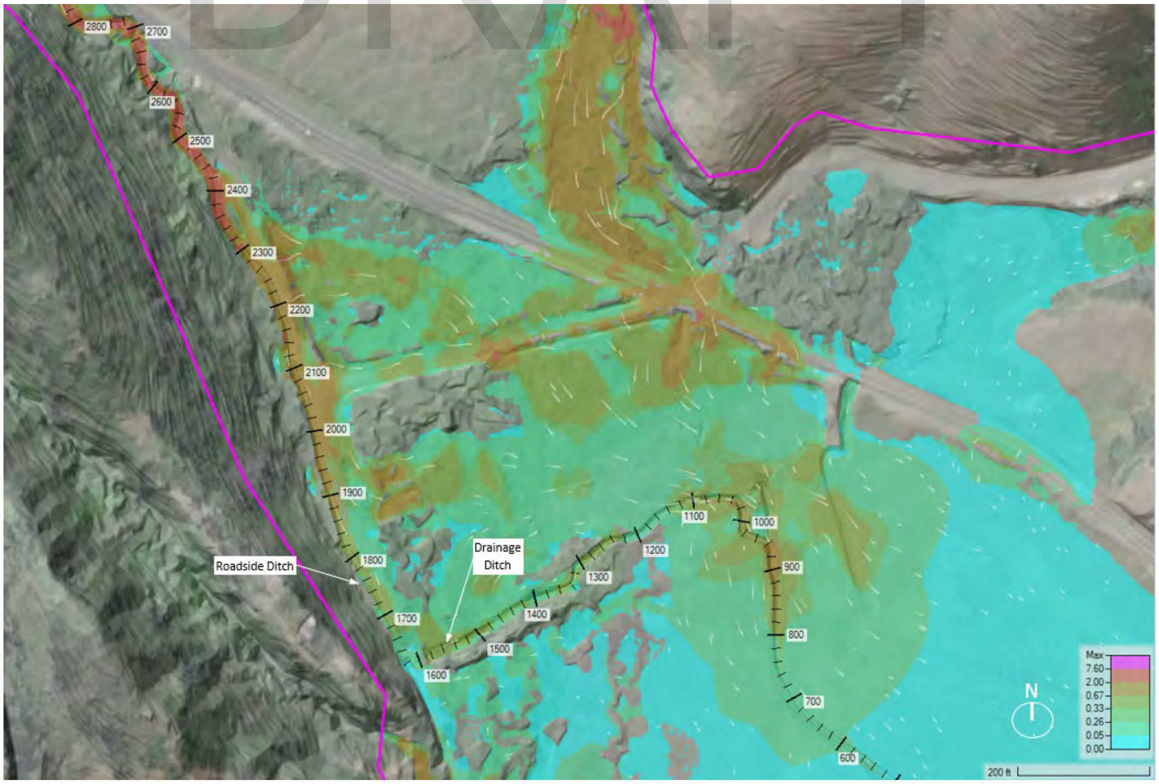

Figure 12. Existing Conditions Plan View Q10 Simulation Shear Stress (psf) Magnitude and Distribution

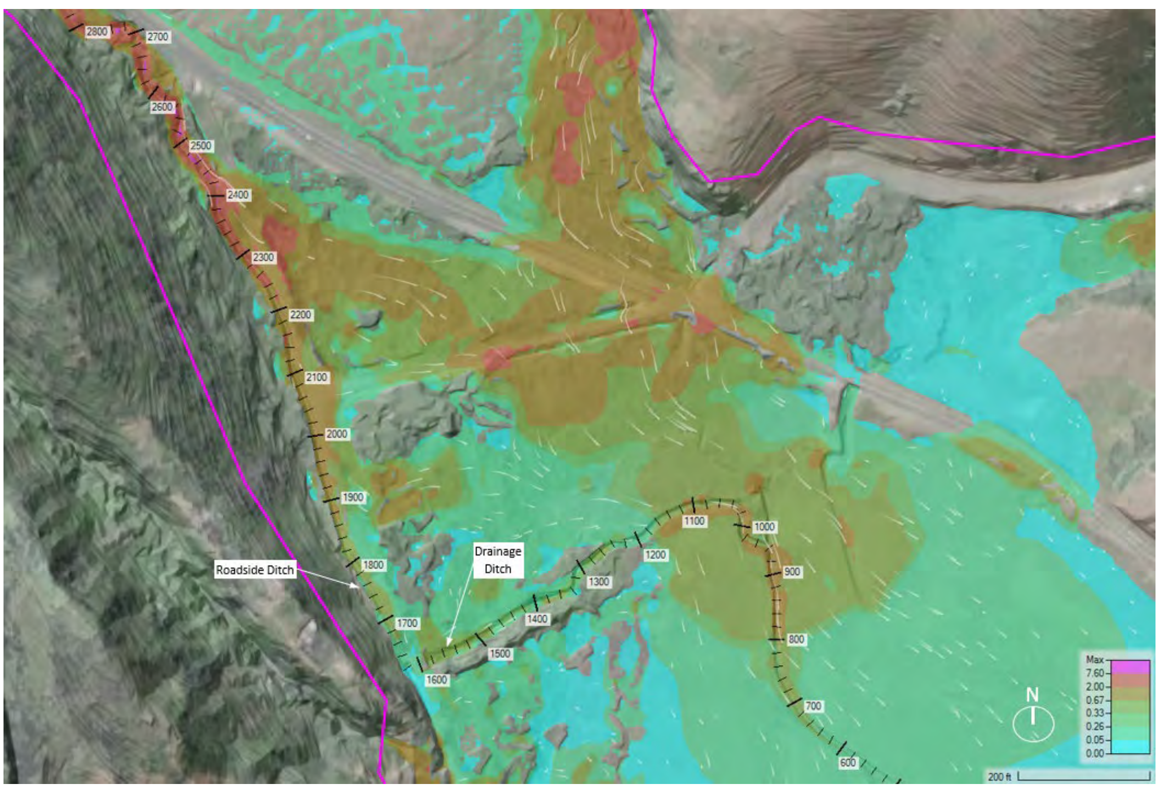

Figure 13. Existing Conditions Plan View Q100 Simulation Shear Stress (psf) Magnitude and Distribution

7. HYDRAULIC ANALYSIS RESULTS FOR PROPOSED CONDITIONS

This section describes the results of the project condition modeling, organized by water surface elevations, velocity, depth, and shear stress. The analysis focuses on the same return intervals as the existing condition analysis. This analysis divides Lewis Gulch Creek into five reaches:

- Bank Stabilization Reach, just downstream from State Route 1 where the design approach includes stabilizing the bank with a log system;
- Upstream Reach, upstream of the proposed bridge which has a new floodplain adjacent to the creek where the Olema-Bolinas Road used to be;
- Bridge Reach, where the new bridge will be constructed;
- Transition Reach, a newly designed reach of the creek just downstream of the bridge; and
- Wye Reach, a newly designed reach of the creek within the Wye wetlands that connects up with an existing tidal slough at the edge of the lagoon.

The reach designations and topography for the proposed conditions are presented in Figure 14 .

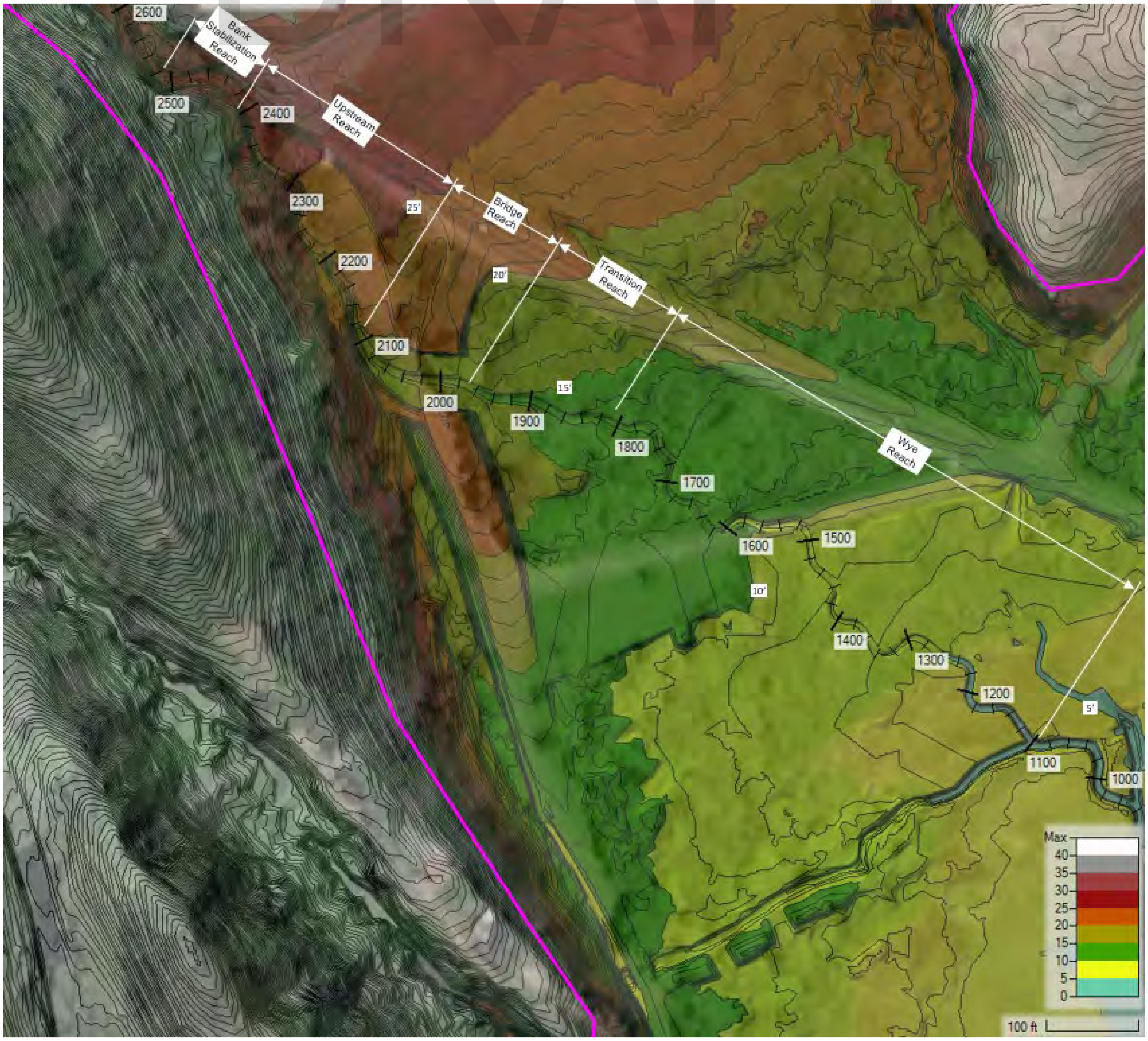

Figure 14. Project Conditions Reach Areas and Topography

Water Surface Elevations

A profile view of proposed conditions water surface elevations and the Olema-Bolinas proposed bridge is presented in Figure 15. A plan view of the project conditions Q100 simulation with water surface contours labeled is presented in Figure 16.The water surface elevations for the proposed conditions do not show backwater effects from the proposed Olema-Bolinas Road crossing (bridge). The water surface profiles have a steep decline at the transition from the Bank Stabilization Reach to the Upstream Reach due to a steep channel bed slope and the proposed floodplain receiving flows from the channel. This area will be refined during the 90% design phase.

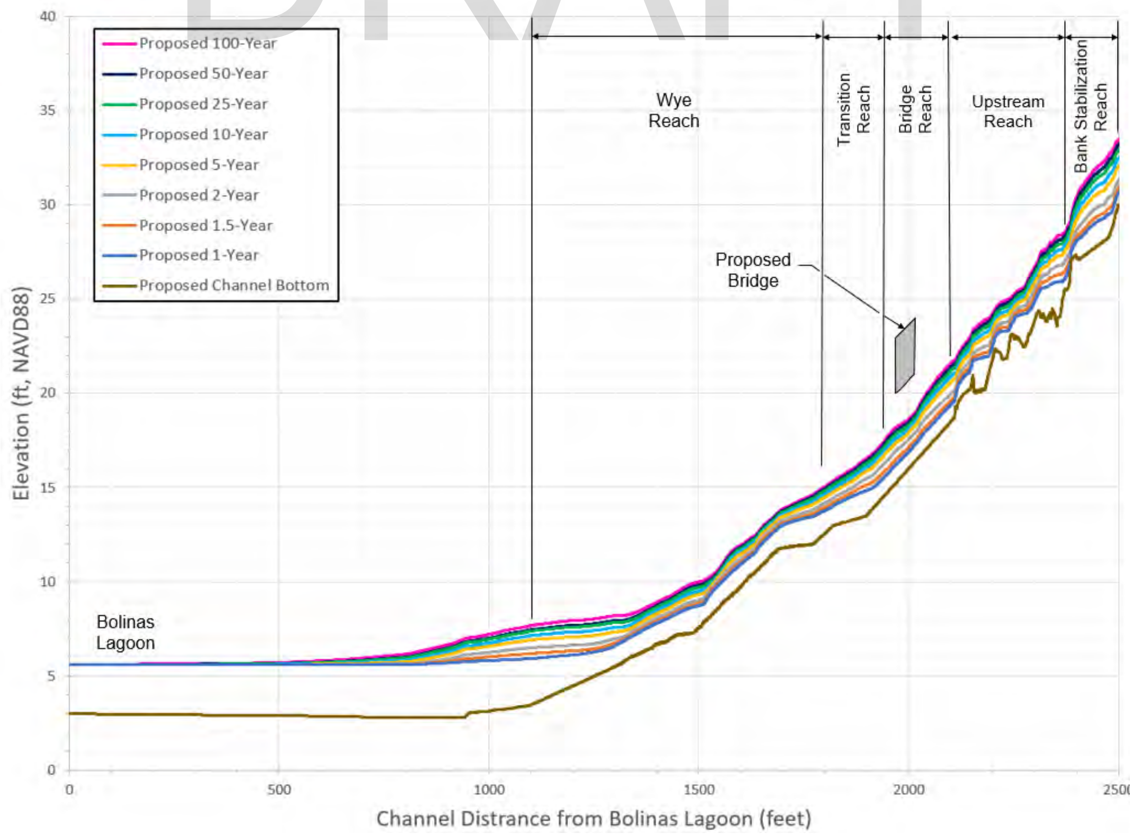

Figure 15. Project Conditions Profile WSEs

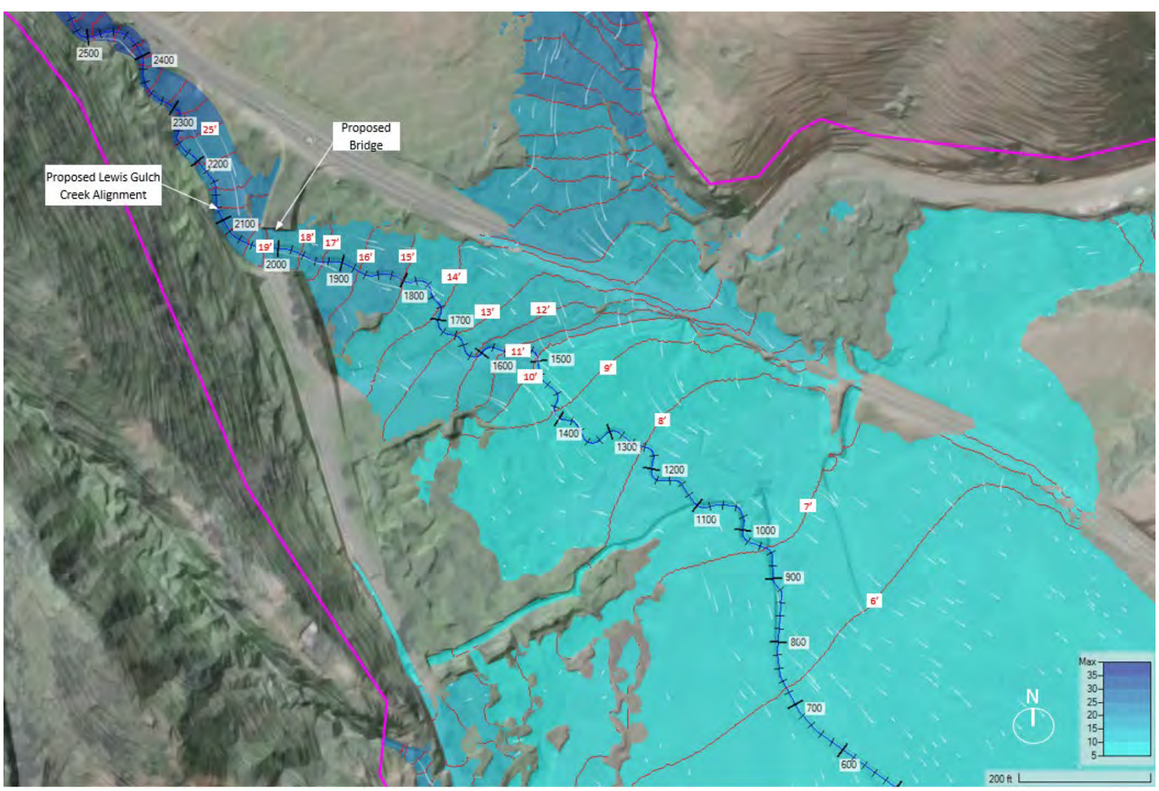

Figure 16. Proposed Conditions Plan View Q100 Simulation WSEs Represented with Contours

Velocity

Proposed condition velocity values for the Q1 to Q5 simulations along the proposed creek alignment are presented in Figure 17 along with substrate and fish passage velocity thresholds. Comparing the model results to fish passage thresholds, the velocity in the Upstream Reach and Bank Stabilization Reach exceed the maximum prolonged swim speed for resident trout and juvenile steelhead <6" but there are areas of low velocity where fish can rest. The velocity values in the Bridge Reach and Transition Reach are below the maximum burst speed for juvenile salmonids >6" and there are areas outside the main channel to rest during these peak flow events. Winter base flow and summer base flow were not modeled in this analysis but are expected to be below the maximum prolonged swim speed for Juvenile Salmonids <6".

The range of velocity values in the Upstream Reach and Bank Stabilization Reach suggest that gravels and cobbles will be mobilized in the system and continue to the Bridge Reach and deposit in the Transition Reach within the Bolinas Lagoon Wye. The velocity values are reduced in the Wye Reach where deposition of 1" gravel is expected to occur. A plan view of the proposed condition Q1.5 simulation with velocity values corresponding to permissible velocity values in Table 8, provided in Figure 18, show a pool-riffle regime from station 2100 to 2500 where areas colored red are likely to be riffles and areas colored blue are likely to be pools. There is a continuous area colored yellow from station 1925 to 2100 that represents velocity values suitable for mobilizing 2" gravel through the Bridge Reach. This area is expected to maintain a stable sediment transport regime under the proposed bridge. Areas outside the main channel provide velocity refugia during the Q1.5 simulation.

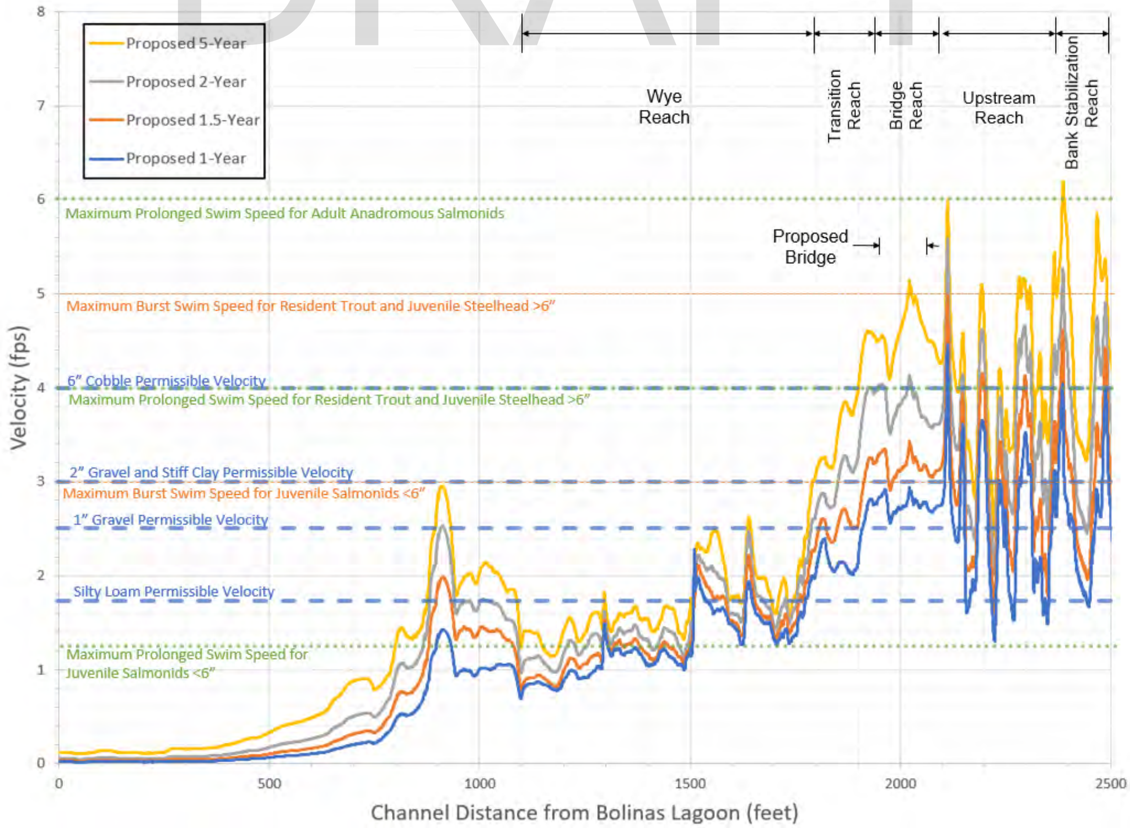

Figure 17. Proposed Conditions Profile Velocity (fps) for Q1, 1.5, Q2, and Q5

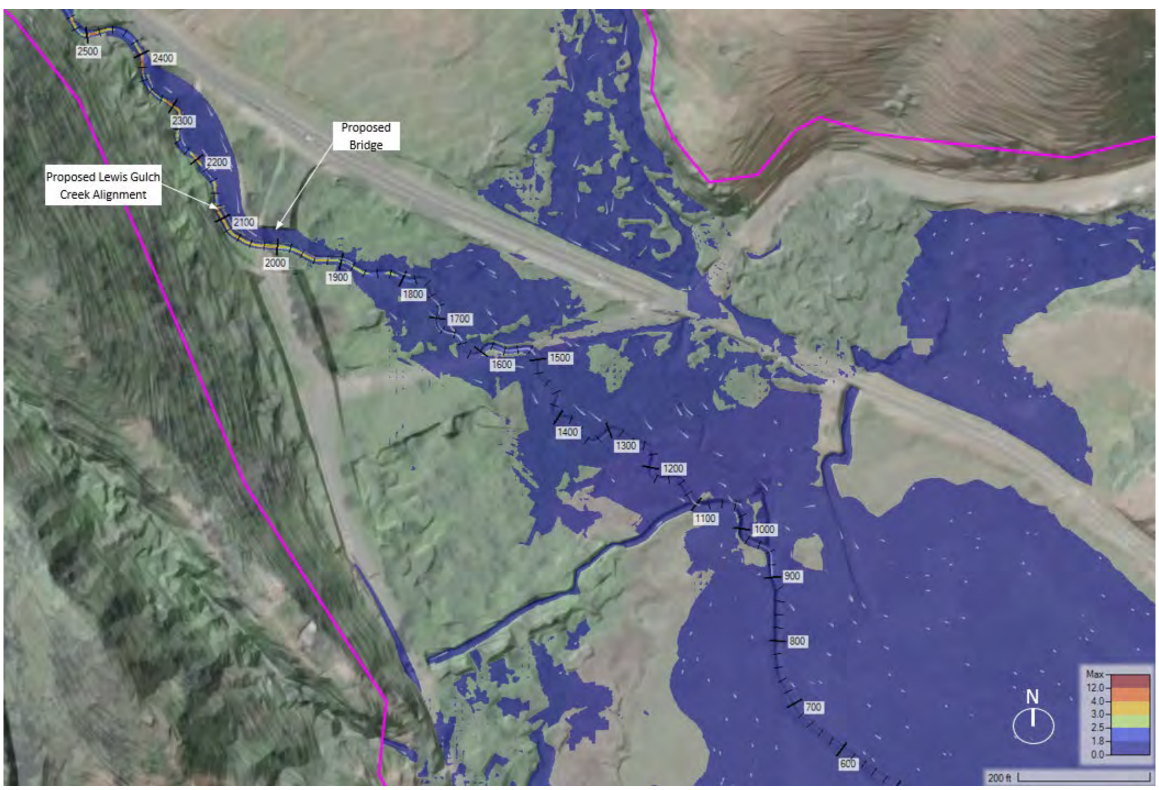

Figure 18. Proposed Conditions Plan View Q1.5 Simulation Velocity (fps) Magnitude and Distribution

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Depth

Model results for depth values along the proposed creek alignment, provided in Figure 19, show water depths ranging from 1 – 3 ft for all five reaches, suggesting there is sufficient water depth for fish migration. A plan view of the depth values for the Q1.5 simulation, provided in Figure 20, shows inundation in the top part of the wye, which was not the case in the existing conditions.

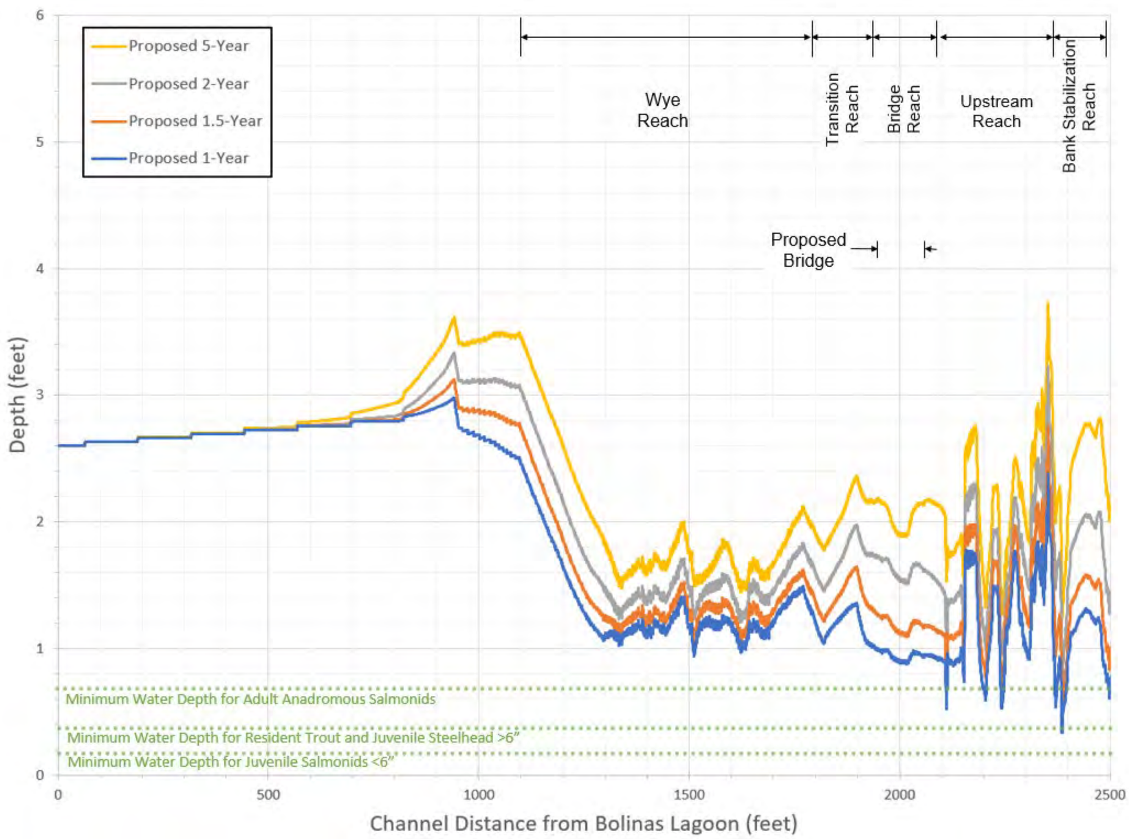

Figure 19. Proposed Conditions Profile Depth (ft) for Q1, 1.5, Q2, and Q5

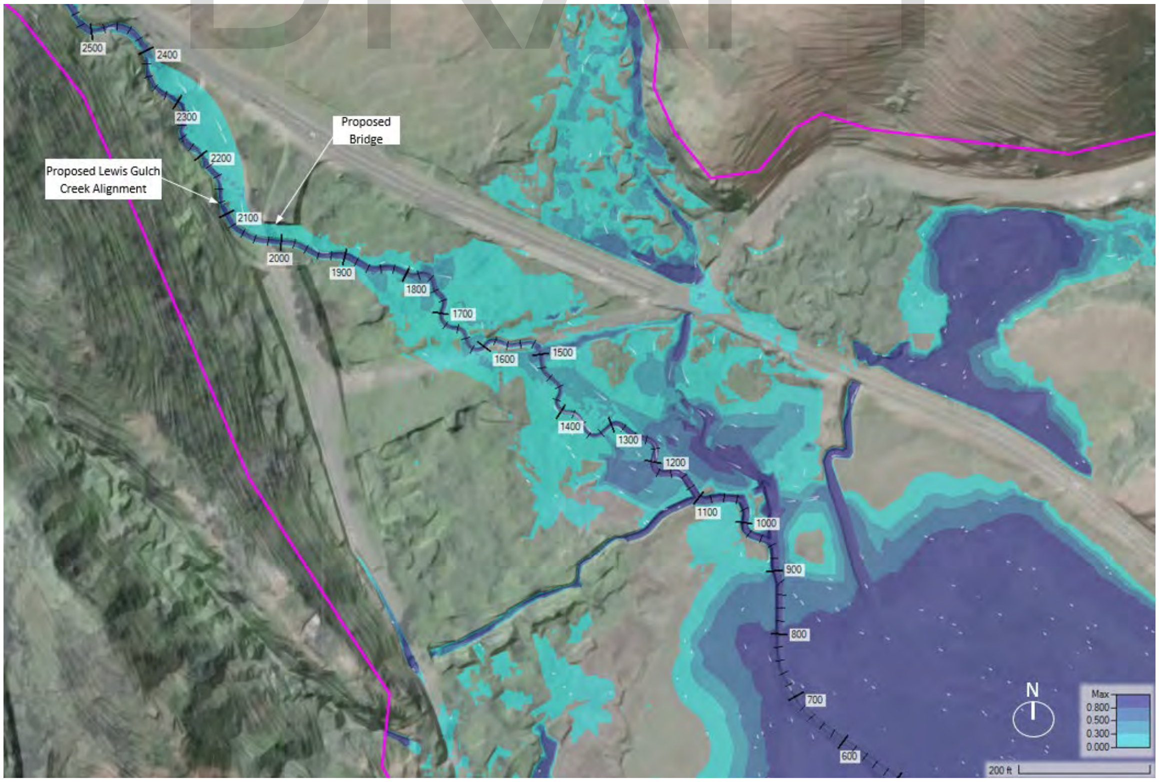

Figure 20. Proposed Conditions Plan View Q1.5 Simulation Depth (ft) Magnitude and Distribution

Shear Stress

Proposed conditions shear stress values for the Q1 to Q5 simulations along the proposed creek alignment as compared to substrate thresholds are presented in Figure 21. The range of shear stress values in the Upstream Reach and Bank Stabilization Reach suggest that gravels and cobbles will be mobilized in the system and continue to the Bridge Reach and deposit in the Transition Reach within the Bolinas Lagoon Wye. The shear stress values are reduced in the Wye Reach where deposition of 1" gravel is expected to occur. A plan view of the proposed condition Q1.5 simulation with shear stress values corresponding to permissible shear stress values in Table 8 is presented in Figure 22. There is a continuous area colored light brown from station 1925 to 2100 that represents shear stress values suitable for mobilizing 2" gravel. This area is expected to maintain a stable sediment transport regime under the proposed bridge. A plan view of the project condition Q10 and Q100 simulations with shear stress values are presented in Figure 23 and Figure 24. Model outputs indicate shear stress values high enough to mobilize 6" cobble but do not exceed the permissible shear stress value for 18" riprap.

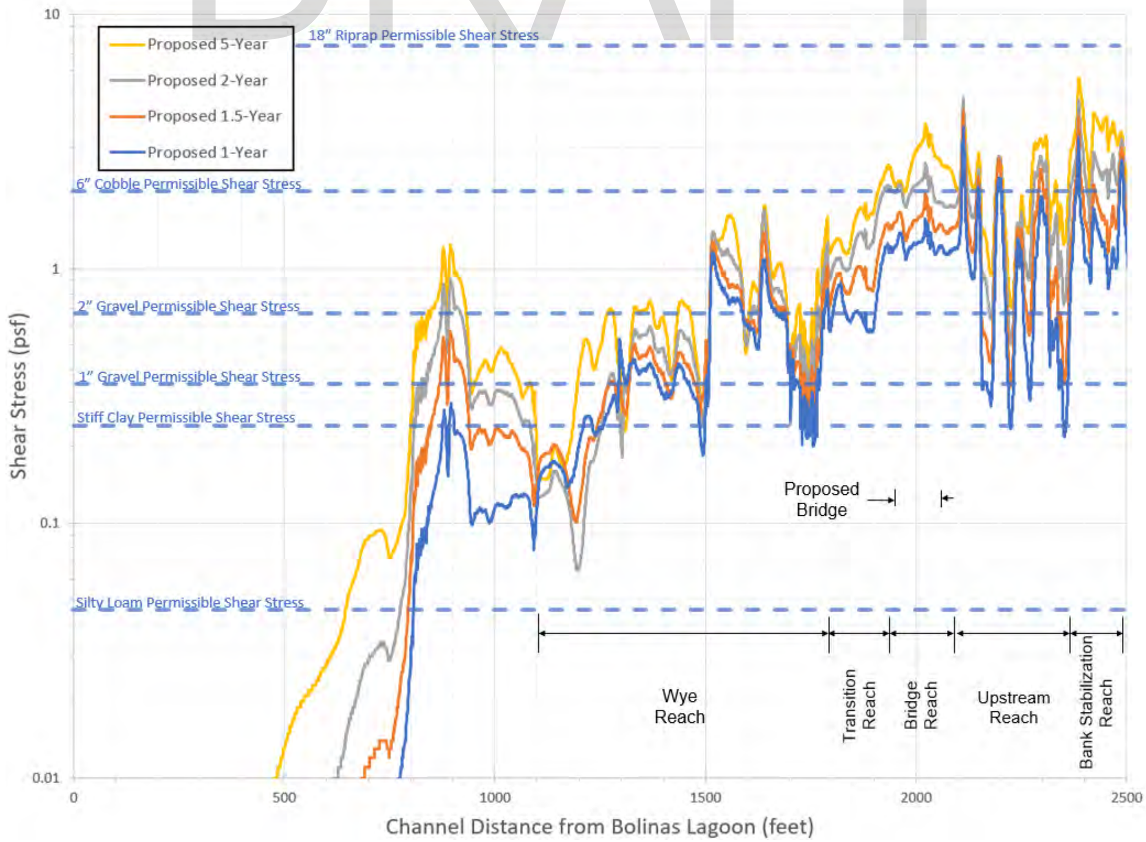

Figure 21. Proposed Conditions Profile Shear Stress (psf) for Q1, 1.5, Q2, and Q5

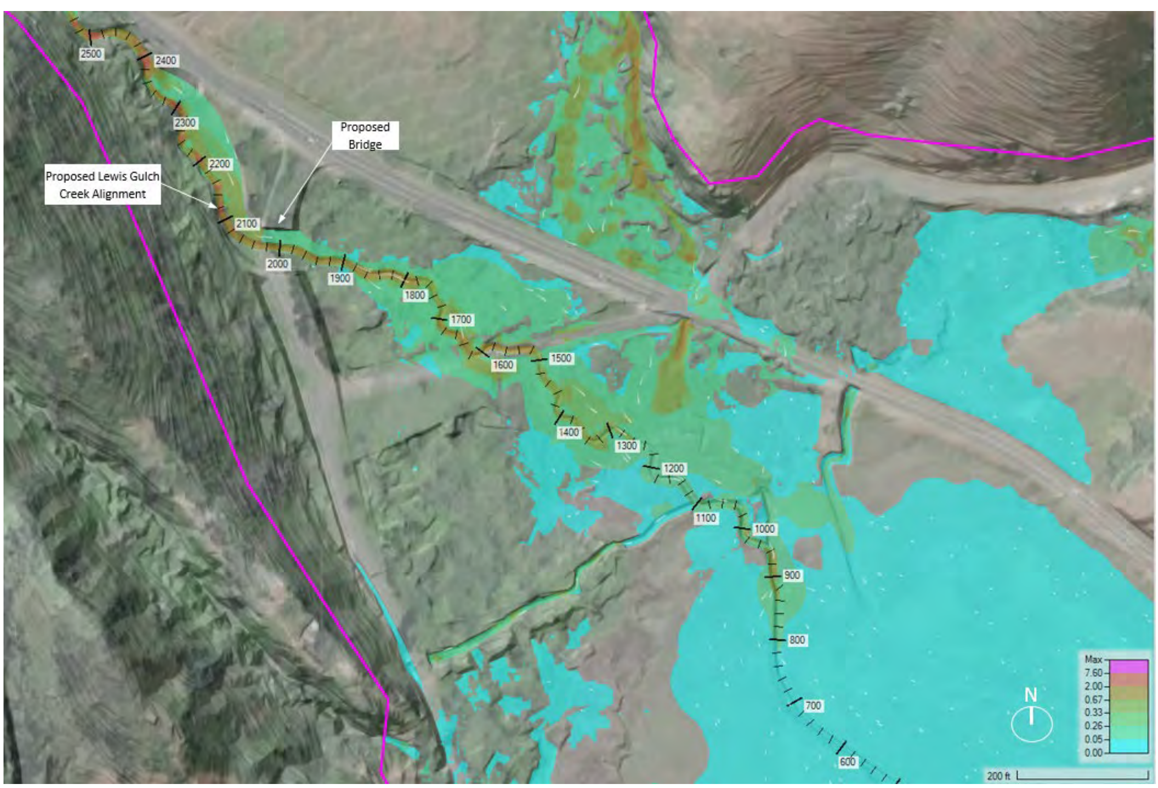

Figure 22. Proposed Conditions Plan View Q1.5 Simulation Shear Stress (psf) Magnitude and Distribution

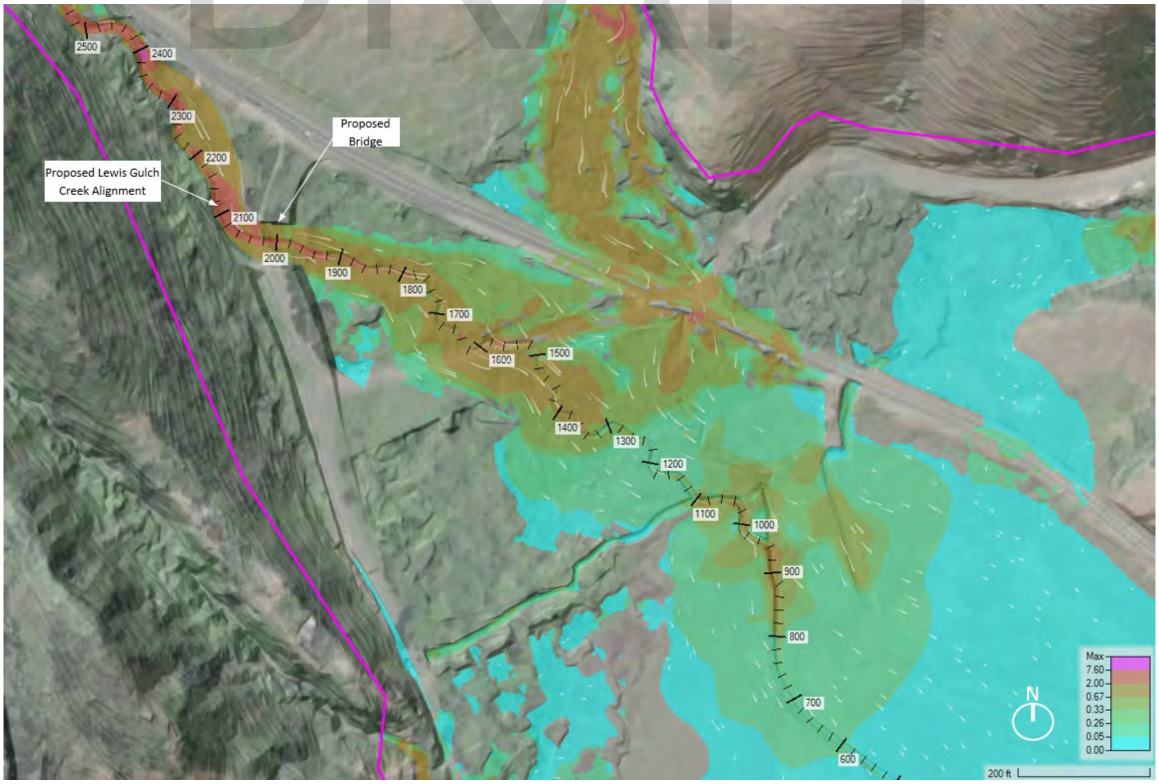

Figure 23. Proposed Conditions Plan View Q10 Simulation Shear Stress (psf) Magnitude and Distribution

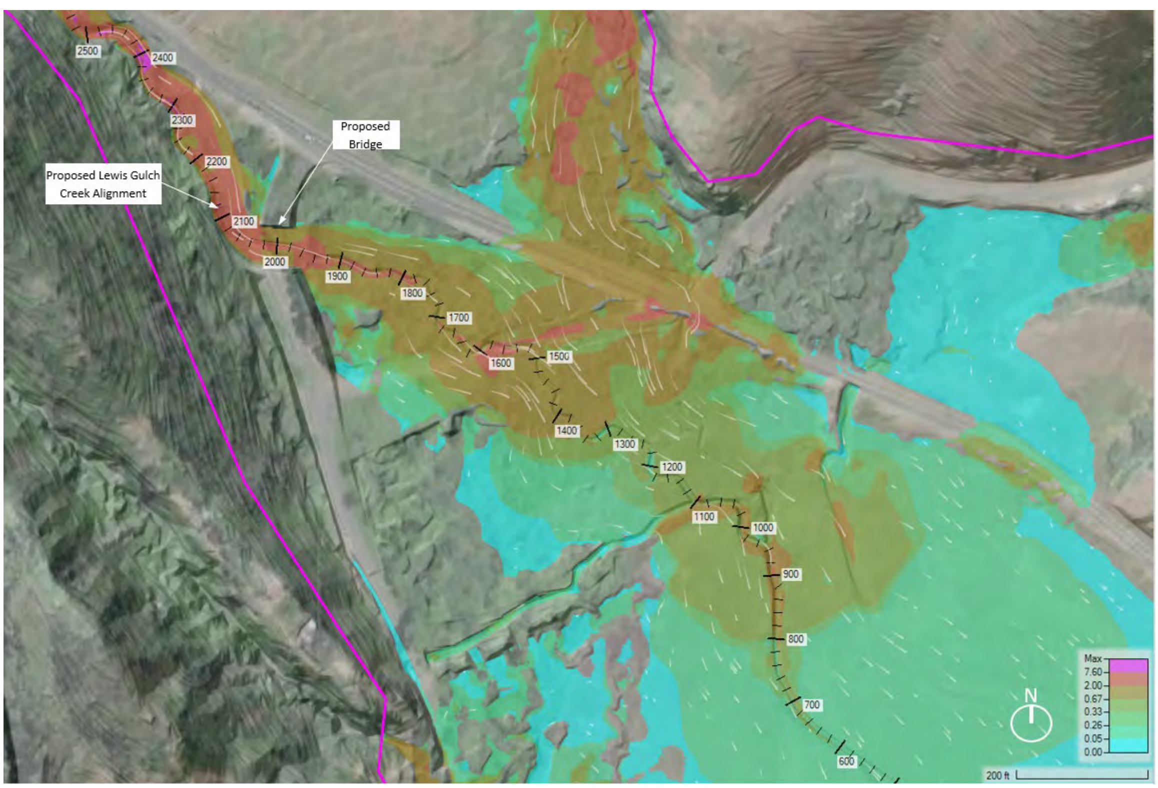

Figure 24. Proposed Conditions Plan View Q100 Simulation Shear Stress (psf) Magnitude and Distribution

8. HYDRAULIC DESIGN CONSIDERATIONS

Large Wood Structure Stability Analysis

Force-balance calculations were performed for several typical arrangements of the log structures to determine what types of anchoring is to be required to stabilize the logs during high flow storm events. Force-balance calculations consider the bed material, bank material, channel cross-section geometry, 100-year flow depth and velocity, log geometries, log density and log positioning relative to the flow. Factors of safety were calculated for vertical forces (buoyancy, weight, and anchor tension), horizontal forces (fluid pressure, soil friction, drag, and anchor tension), and torque acting to rotate the log out of position for several typical log positions during a 100-year flow event using a spreadsheet model (Rafferty 2016).

These calculations provide confidence that the log structures in the Bolinas Lagoon Wye will be long-lasting structural features and promote restoration of natural geomorphic function, without creating a nuisance of floating logs in the Lagoon. The input data, assumptions, and underlying calculations of the log structure stability calculations are provided in Attachment 1.

Bank Stabilization

Along the existing channel alignment in the Bank Stabilization Reach at roughly station 2700, erosion is occurring that is threating the integrity of State Route 1. In 2019, Caltrans implemented an emergency repair, consisting of placed riprap with live willow poles planted in voids. The proposed condition grading in this area reduces the radius of curvature of the meander and lowers the floodplain so that flows similar to the Q1 simulation would activate the floodplain. This feature will be revised in the 90% design phase to have a high floodplain elevation. A comparison of the existing and proposed WSEs and terrain in this reach are presented in Figure 25. In addition to the proposed grading improvements, a log-based bank stabilization treatment is proposed to protect the outboard bank in this area to alleviate the effects of elevated near bank shear stress on the outside of the meander bend.

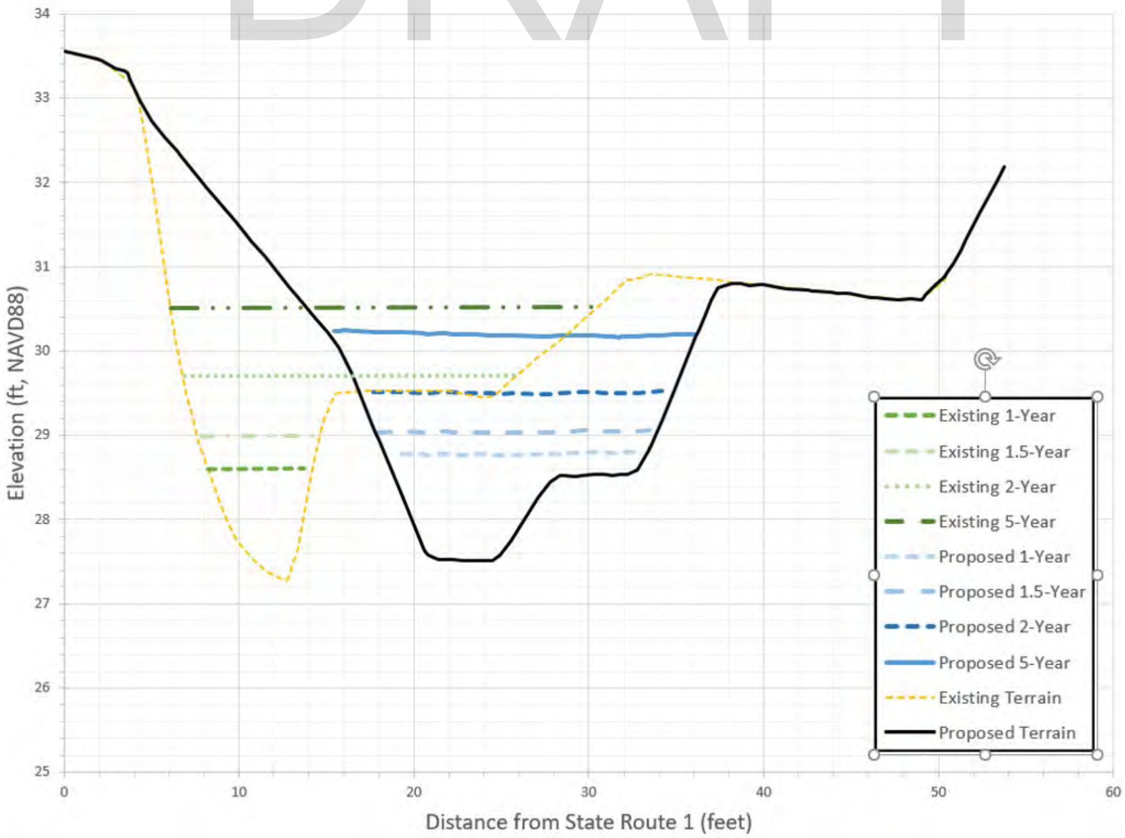

Figure 25. Section View of Bank Stabilization Existing and Proposed WSEs and Terrain

Typical Sections

A typical section of the existing conditions roughly 200 ft downstream of the Olema-Bolinas Road box culvert is used to evaluate and compare the water surface elevations. All simulated scenarios except the Q1 and Q1.5 show overbank flow on the left bank (facing downstream). The right bank is 3 feet higher. A section view of station 1400 of the existing creek alignment with existing water surface elevations ranging from the Q1 to Q100 is presented in Figure 26.

A typical section of the proposed condition roughly 200 ft downstream of the proposed bridge is used to evaluate and compare the water surface elevations. The model outputs show that as flow rate increases, inundation onto the Lagoon Wye increases. A section view of station 1825 of the proposed creek alignment with proposed water surface elevations ranging from the Q1 to Q100 is presented in Figure 27.

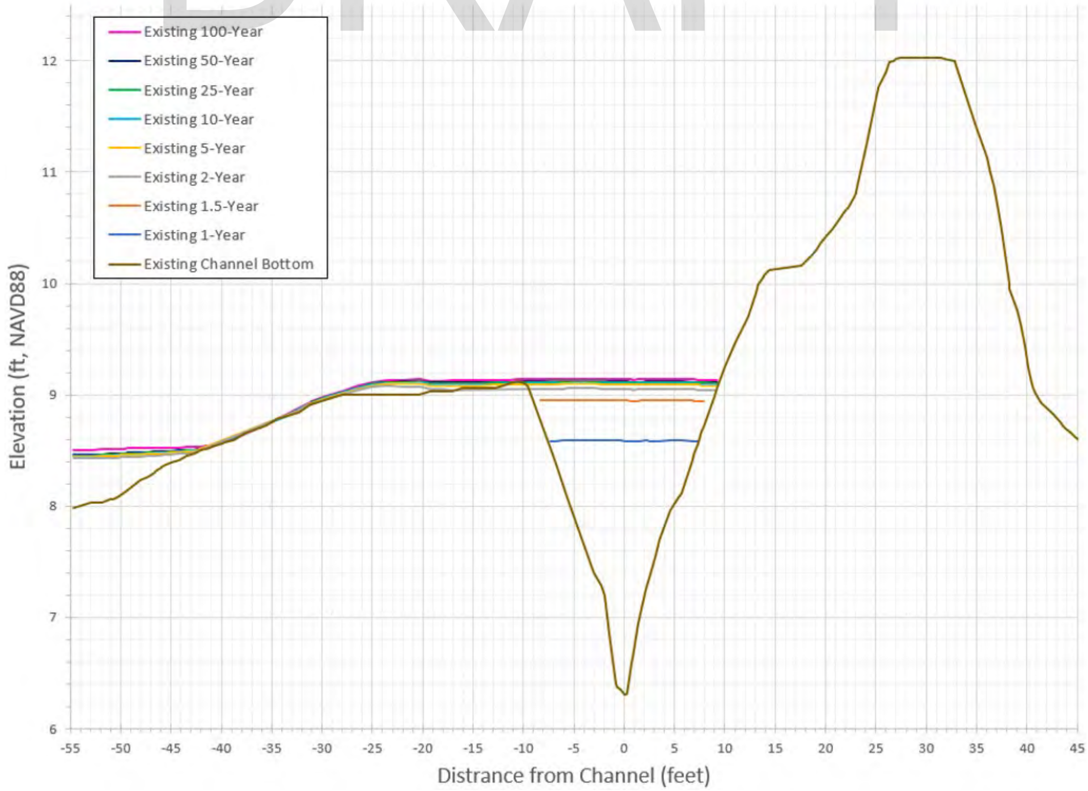

Figure 26. Existing Conditions Section WSEs at Station 1400 on the Existing Creek Alignment

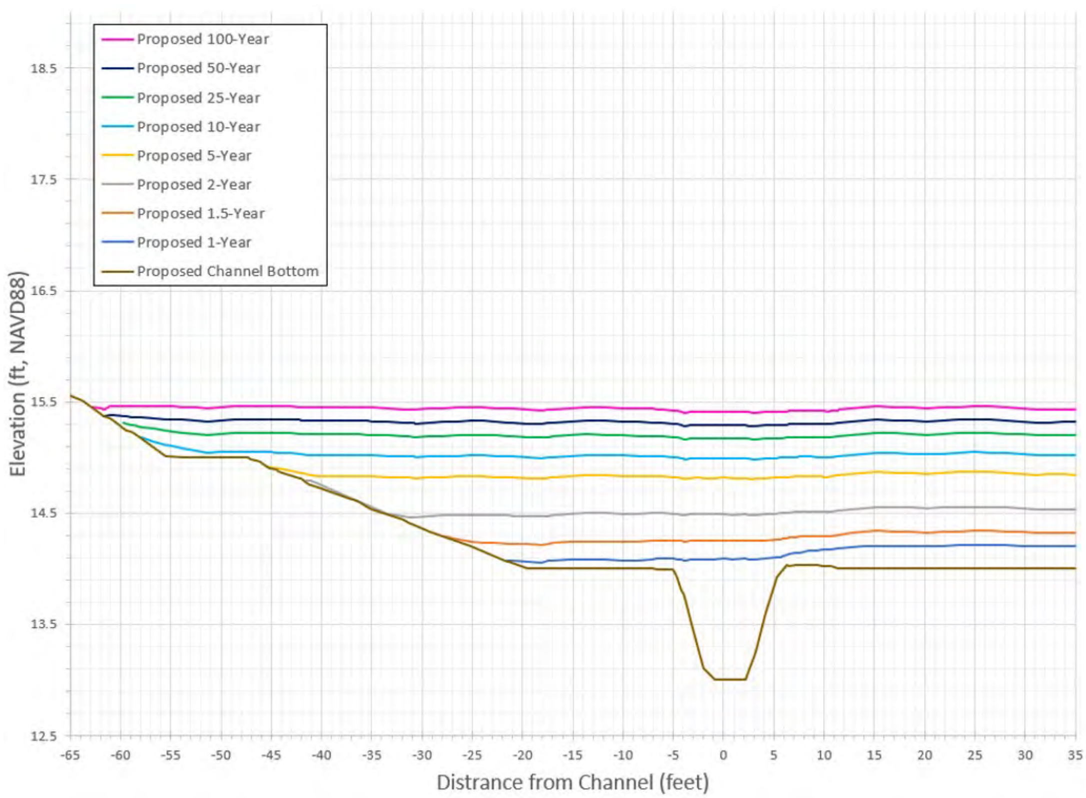

Figure 27. Proposed Conditions Section WSEs at Station 1825 on the Proposed Creek Alignment

Typical sections of existing and proposed conditions in the same location in the Bank Stabilization Reach along State Route 1 (at station 2575) and in the Upstream Reach (at station 2300) are used for a comparison of the terrain and water surface elevations. A section view of station 2575 of the existing creek alignment with proposed water surface elevations ranging from the Q1 to Q100 is presented in Figure 28. A section view of station 2300 of the proposed creek alignment with proposed water surface elevations ranging from the Q1 to Q100 is presented in Figure 29. At station 2575 the existing condition Q1.5 simulation shows a water surface inundation width of roughly 14 ft while the proposed condition Q1.5 shows an inundation width of roughly 38 ft. At station 2300 at Q100 the proposed floodplain is inundated with a water surface inundation width of about 53 ft.

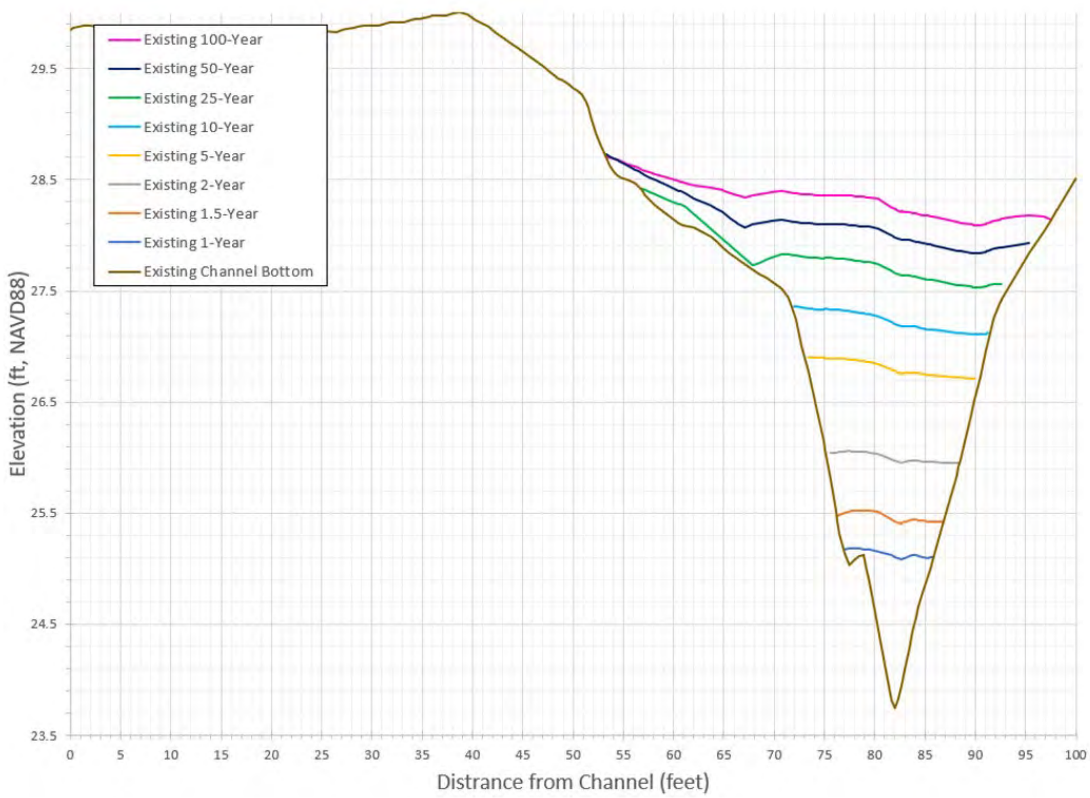

Figure 28. Existing Conditions Section WSEs at Station 2575 on the Existing Creek Alignment

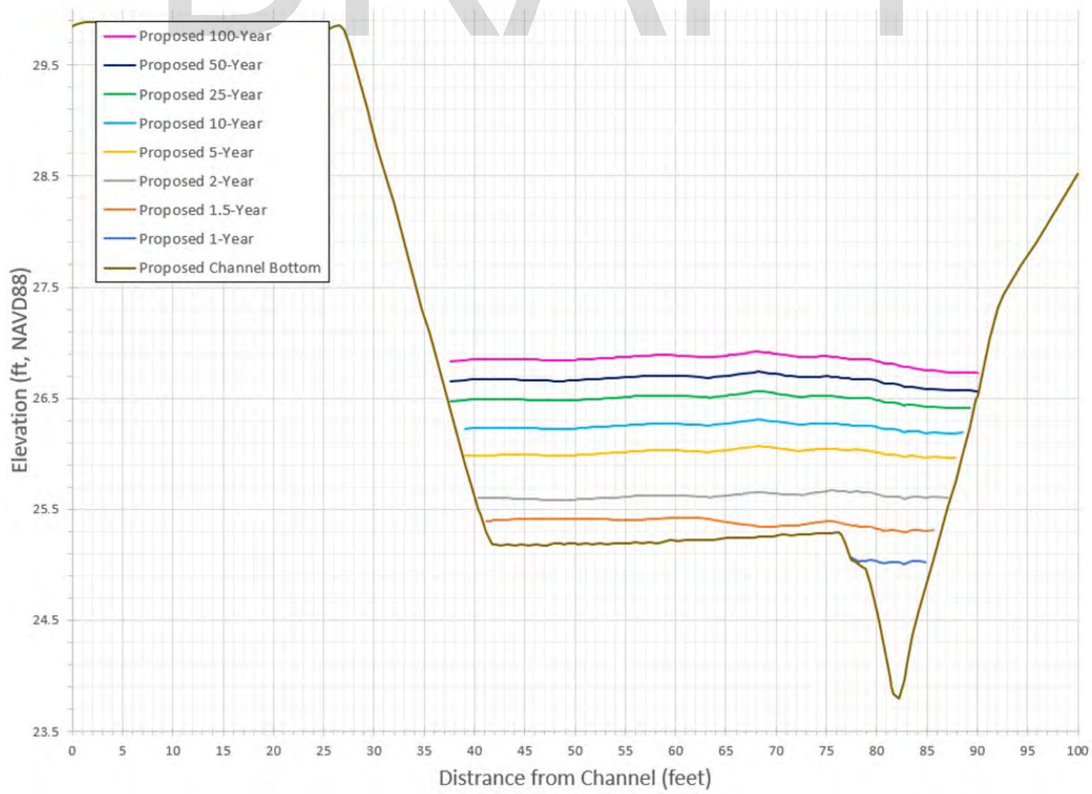

Figure 29. Proposed Conditions Section WSEs at Station 2300 on the Proposed Creek Alignment

Flooding

Flooding of the roadways in and adjacent to the project area occurs on a regular basis during years with average to above average rainfall. The existing conditions simulations show flood inundation overtopping Olema-Bolinas Road due to Lewis Gulch Creek flooding and overtopping State Route 1 due to Wilkins Gulch Creek flooding for the Q1.5 to Q500 simulations. The existing conditions simulations show flood inundation overtopping Olema-Bolinas Road from Wharf Creek and overtopping State Route 1 from Salt Creek for the Q5 to Q500 simulations. The proposed condition Q100 simulation does not show flood inundation on Olema-Bolinas Road. Flooding due to Wilkins Gulch Creek, Salt Creek, and Wharf Creek requires additional modeling and could be overestimated or underestimated in this analysis.

Sea Level Rise and Groundwater

A sea level rise analysis for mid-century (2050) and end-of-century (2100) was performed by applying the present-day 100-year return interval flows into the model and using a downstream boundary condition with future predictions of water surface elevations for Bolinas Lagoon. Sea level rise of 2 ft at 2050 and 5.5 ft at 2100 (over current tide levels at MHHW) were assumed, consistent with C-SMART. A profile view of proposed conditions water surface elevations with and without sea level rise and the Olema-Bolinas proposed bridge is presented in Figure 30. The effects of sea level rise show no change to the hydraulic performance of the proposed Olema-Bolinas bridge, since the higher tides do not reach the bridge. Model outputs at the proposed bridge for water surface elevation, velocity, and shear stress under various return intervals and sea level rise scenarios are presented in Table 9.

Groundwater elevations are being monitored in a number of monitoring wells in the Wye area by ESA with the latest annual report of groundwater levels reported for 2020 (ESA 2020). This report also describes measurements of creek level, precipitation, and groundwater conductivity (salinity). The data for wells just upstream of the Bank Stabilization Reach, indicate that for several months in the winter of 2020, groundwater elevations were higher than creek levels in the creek, causing groundwater to contribute to creek flow. Outside the winter period, groundwater level dropped 4-6 feet from winter levels with some influence from a pumping well at Wilkins Ranch on the north side of State Route 1. Groundwater elevations within the Wye wetlands near the Crossover Road are at elevations of 10-12 ft NAV88, very close to the ground surface, and show small responses to tides and rainfall.

Table 3 shows tidal datums (for NOAA tide gage #9414958 in Bolinas Lagoon) with predicted sea level rise. Ground elevations in the Wye wetlands range from about 12 ft NAVD88 by the Crossover Road up to about 25 ft NAVD88 at the top of the Wye wetlands. At 2050, tides in the Wye wetlands will be raised from sea level rise and along with a contribution from higher groundwater levels, more of the wetlands will be submerged. It is not known to what extent groundwater will be pushed up from sea level rise, however it appears that by 2100, the Wye wetlands will be submerged up past the Crossover Road due to a combination of both groundwater and sea level rise.

The effects of sea level rise can be exacerbated by land subsidence and ground level changes due to fault activity. Those factors were not examined in this analysis.

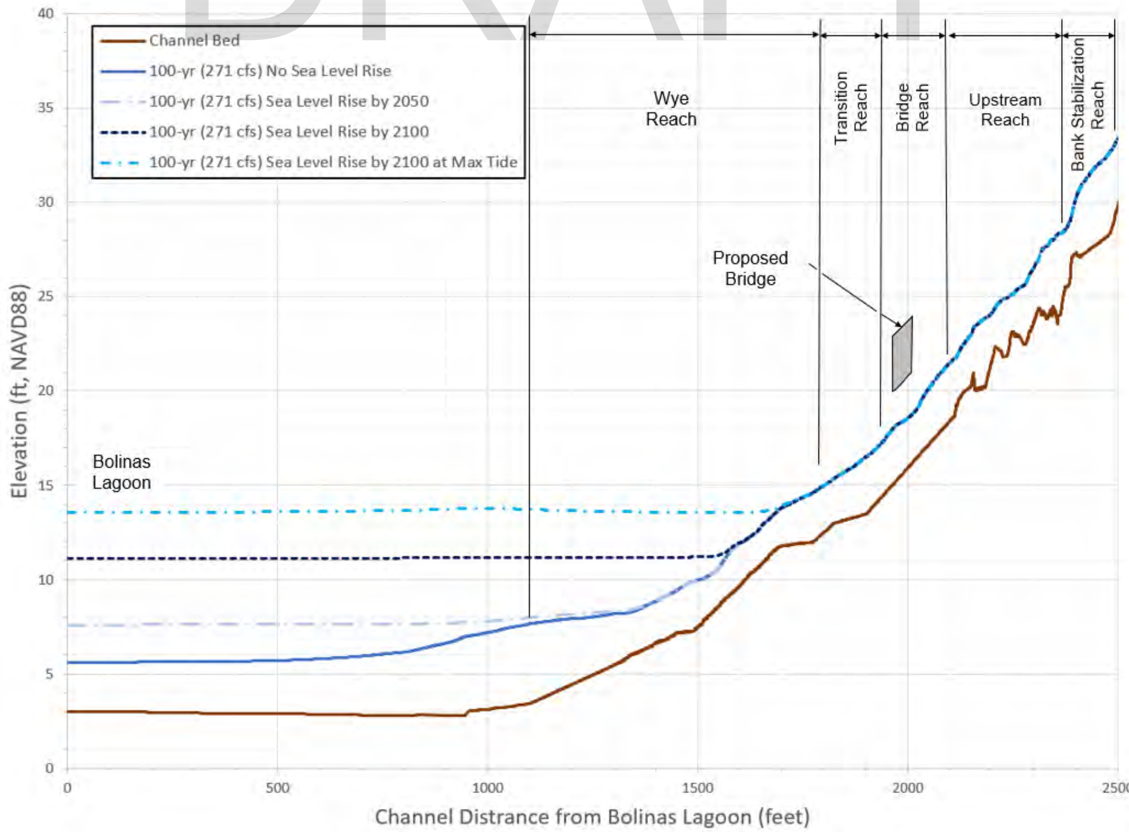

Figure 30. Project Conditions Profile WSEs of 100-Year Event With and Without Sea Level Rise

Table 9. Model Outputs at Proposed Bridge (STA 20+00) with Bolinas Lagoon Sea Level Rise Scenarios

Sea Level Rise Scenario	2 YR RI WSE (feet, NAVD88)	10 YR RI WSE (feet, NAVD88)	100 YR RI WSE (feet, NAVD88)	100 YR RI Velocity (fps)	100 YR RI Shear Stress (psf)
Present-Day	17.6	18.1	18.6	5.7	3.7
2050	17.6	18.1	18.6	5.7	3.7
2050 Max Tide	17.6	18.1	18.6	5.7	3.7
2100	17.6	18.1	18.6	5.7	3.7
2100 Max Tide	17.6	18.1	18.6	5.7	3.7

Bridge Hydraulics

The hydraulic analysis related to the proposed bridge is primarily concerned with freeboard requirements enforced by the Marin County municipal code and bridge scour depth to be used in the structural design of the bridge. This evaluation is based on the bridge geometry for the 30% design with bridge abutments only and does not account for the revised bridge design with piers to accommodate earthquake and tsunami design implications.

Freeboard

Freeboard is the vertical distance above a design stage that is allowed for waves, surges, drift, and other contingencies. Marin County Code 24.04.520(d) states the following:

> "Open channel systems shall be designed to carry the one hundred-year flow with a minimum freeboard equal to the velocity head. Bridges and utility crossings which span open channel waterways shall have a minimum clearance of two feet between soffit and the one hundred-year flow elevation."

The highest water surface elevation near the proposed bridge for the Q100 simulation is 19.14 ft NAVD88 (see design drawings). The highest velocity head is 19.52 ft NAVD88. The lowest surface of the bridge soffit is 21.07 ft NAVD88. This analysis finds that the design complies with the first sentence of the Marin County Code, but not the second sentence. Additional coordination with Marin County is required on this freeboard requirement as the design evaluates earthquake and tsunami implications.

Bridge Scour

In a focused effort to estimate bridge scour depths, WRA developed a one-dimensional (1D) hydraulic model using US Army Corps of Engineers software HEC-RAS v. 5.0.7. Specific locations for cross sections were determined using the HEC-RAS 5.0 User Manual for bridge scour analysis. Model outputs determined by HEC-RAS were used to calculate bridge scour depth using the FHWA Hydraulic Toolbox 5.0. Geomorphic characteristics of the bridge site were evaluated in accordance with Federal Highway Administration HEC-18. A cross section of the FHWA Hydraulic Toolbox 5.0 calculations is presented in Figure 31**Error! Reference source not found.**.

The scour calculations for this analysis use the 200-year event in accordance with Caltrans Memo to Designers 16-1 dated December 2017. The scour calculations use a grain size D50 of 17 mm based on a pebble count (MCP 2018).

The sum of long-term degradation, contraction scour, and local scour determines the total scour depths. Long term degradation of the Project is unknown, but the flood history and maintenance activities show the Bridge Reach is within an aggradation zone. To be conservative, it is assumed that 1 foot of long-term degradation could occur. Contraction scour is determined from the change in width as the creek approaches the bridge. Typically, a 200-year flood channel width is substantially greater than the width of the bridge opening, however, this is not the case for the Project design. The wetted top width upstream of the bridge is 46.5 feet and the wetted top width at the bridge is 60 feet. The FHWA Hydraulic Toolbox calculates zero feet of contraction scour for the channel and overbanks.

The primary source of scour is local scour occurring from the abutments. Abutment scour was determined using the NCHRP 24-20 Abutment Scour Approach (NCHRP 2010). The calculations use a K1 factor of 0.82 to account for vertical abutments with wing walls. The degree of skew for the left abutment is 89 degrees where zero degrees is downstream, 90 degrees is perpendicular to flow, and 180 degrees is upstream. The degree of skew for the right abutment is 109 degrees. Lateral shifts in the channel alignment are expected. Long term degradation is not likely but possible.

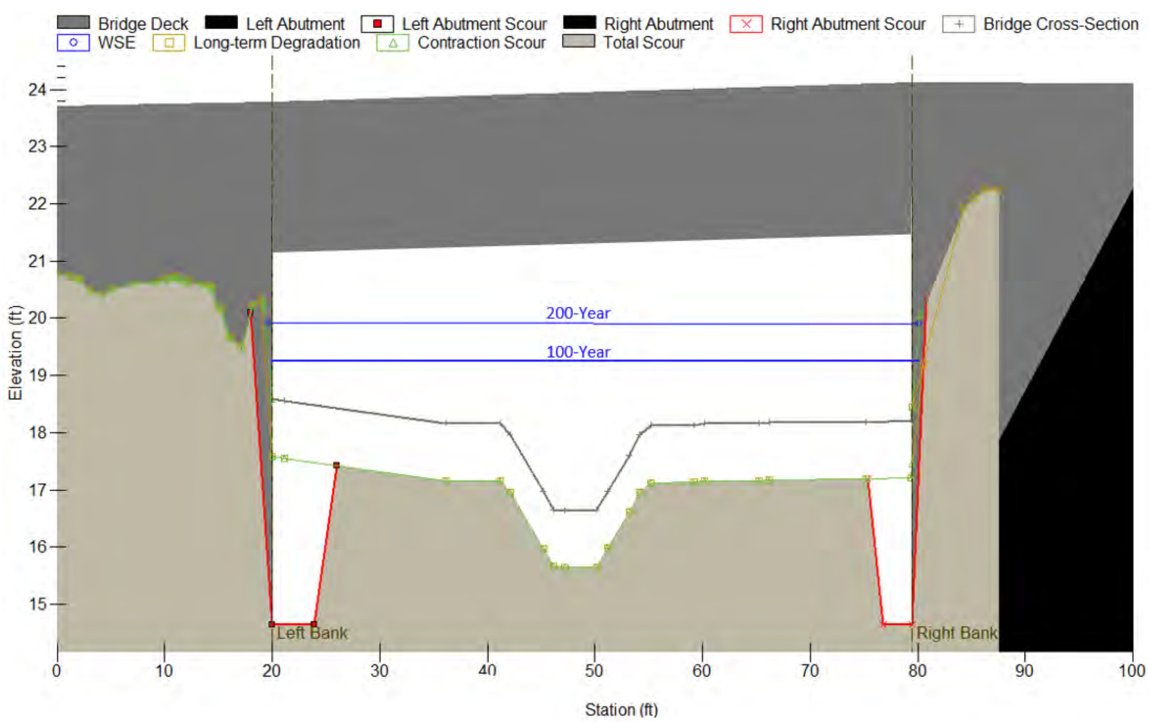

Figure 31. Bridge Scour FHWA Toolbox Model Output

WRA recommends that rock slope protection (RSP) should be placed under the bridge extending 25 feet upstream and downstream of the bridge, as shown in the drawings. This will prevent scour at the abutments and will act as a safeguard for long term degradation while allowing the channel to shift laterally during natural processes.

The data provided in the tables below is based on runoff from Lewis Gulch Creek only and does not account for scour due to a tsunami. The Hydraulic Summary Table, Scour Summary Table, and Scour Data Table are presented below**Error! Reference source not found.**.

Table 10. Hydraulic Summary Table

Hydrologic Summary for Bridge No. XX-XXX			
Drainage Area: 0.7 mi^2			
Frequency	Design Flood	Base Flood	Flood of Record
	100-year	200-year	Not Applicable
Discharge	271 cfs	312 cfs	Not Applicable
Water Surface Elevation at Bridge (NAVD88)	19.14 ft	19.91 ft	Not Applicable
Floodplain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigations			

Table 11. Scour Summary Table

Long Term & Short Term Scour Depths Bridge Name, Br. No. XX-XXX			
Support No.	Degradation Scour Depth (ft)	Contraction Scour Depth (ft)	Short Term (Local) Scour Depth (ft)
North Abutment	1	0	-2.0
South Abutment	1	0	-1.5

Table 12. Scour Data Table

Support No.	Long Term (Degradation and Contraction) Scour Elevation (ft, NAVD88)	Short Term (Local) Scour Depth (ft, NAVD88)
North Abutment	15.6	14.6
South Abutment	15.6	14.6

9. SUMMARY

The existing conditions and proposed models were successfully developed to accurately predict and assess water surface elevations, velocities, depths, and shear stress. By utilizing the model outputs, it was possible to create a 60% design to alleviate flooding and traffic safety concerns as well as to develop an improved habitat at the Project site. The next steps in the design process are addressing high shear stress values shown in the modeling near the bank stabilization reach, improving transitions between each reach, and refining the design drawings, specifications, and cost estimate for bid documents.

10. LIMITATIONS

The models developed herein were focused only on evaluating the potential for re-aligning Lewis Gulch Creek through the Bolinas Lagoon Wye and understanding the channel and bridge hydraulics for the features in the proposed design. The scope of this analysis is limited to the physical hydraulics and does not address potential safety hazards to property or persons. The model was created from data available at the time using historical data to predict future conditions, and the scope reflects the budget and timeline provided. Due to these limitations, there is uncertainty or a margin of error in the hydraulic model inputs and results.

11.REFERENCES

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Attachment 1 – Large Wood Structure Stability Analysis

Bolinas Wye Wetland Project

Large Wood Structure Stability Analysis

TABLE OF CONTENTS

Date of Last Revision: February 15, 2022

Designer:
Bridgette Medeghini, E.I.T

Reviewed by:
Andrew Smith, P.E.

Large Wood Structure Stability Analysis Spreadsheet was developed by Michael Rafferty, P.E.
Version 1.1

Reference for Companion Paper:

Rafferty, M. 2016. *Computational Design Tool for Evaluating the Stability of Large Wood Structures.* Technical Note TN-103.1. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, National Stream & Aquatic Ecology Center. 27 p.

Bolinas Wye Wetland Project
Factors of Safety and Design Constants

Spreadsheet developed by
Michael Rafferty, P.E.

Symbol	Description	Value
FS_V	Factor of Safety for Vertical Force Balance	**1.50**
FS_H	Factor of Safety for Horizontal Force Balance	**1.50**
FS_M	Factor of Safety for Moment Force Balance	**1.50**

Symbol	Description	Units	Value
C_{Lrock}	Coefficient of lift for submerged boulder (D'Aoust, 2000)	-	0.17
C_{Drock}	Coefficient of drag for submerged boulder (Schultz, 1954)	-	0.85
g	Gravitational acceleration constant	ft/s^2	32.174
DF_{RW}	Diameter factor for rootwad ($DF_{RW} = D_{RW}/D_{TS}$)	-	1.50
LF_{RW}	Length factor for rootwad ($LF_{RW} = L_{RW}/D_{TS}$)	-	1.50
SG_{rock}	Specific gravity of quartz particles	-	2.65
γ_{rock}	Dry unit weight of boulders	lb/ft^3	165.0
γ_w	Specific weight of water at 50ºF	lb/ft^3	62.40
η	Rootwad porosity from NRCS Tech Note 15 (2001)	-	0.20
ν	Kinematic viscosity of water at 50ºF	ft/s^2	1.41E-05

Bolinas Wye Wetland Project
Hydrologic and Hydraulic Inputs

Spreadsheet developed by
Michael Rafferty, P.E.

Average Return Interval (ARI) of Design Discharge: 100 yr

Site ID	Proposed Station	Design Discharge, Q_{des} (cfs)	Maximum Depth, d_w (ft)	Average Velocity, u_{avg} (ft/s)	Bankfull Width, W_{BF} (ft)	Wetted Area, A_W (ft^2)	Radius of Curvature, R_c (ft)
Site A	13+00	271	2.73	1.74	9.0	25	15
Site B	19+50	271	2.94	2.87	11.0	32	30
Site C	21+00	271	5.00	2.45	14.0	70	70
Site D	24+00	271	4.10	3.32	15.0	62	40

Bolinas Wye Wetland Project
Stream Bed Substrate Properties

Spreadsheet developed by
Michael Rafferty, P.E.

Site ID	Proposed Station	Stream bed D_{50} (mm)	Stream Bed Substrate Grain Size Class	Bed Soil Class	Dry Unit Weight[1], γ_{bed} (lb/ft^3)	Buoyant Unit Weight, γ'_{bed} (lb/ft^3)	Friction Angle, ϕ_{bed} (deg)
Site A	13+00	17.00	Coarse gravel	5	122.9	76.5	38
Site B	19+50	17.00	Coarse gravel	5	122.9	76.5	38
Site C	21+00	17.00	Coarse gravel	5	122.9	76.5	38
Site D	24+00	17.00	Coarse gravel	5	122.9	76.5	38

Source: Compiled from Julien (2010) and Shen and Julien (1993); soil classes from NRCS Table TS14E–2 Soil classification

[1] γ_{bed} (kg/m^3) = 1,600 + 300 log D_{50} (mm) (from Julien 2010)

1 kg/m^3 = 0.062 1 lb/ft^3

Bolinas Wye Wetland Project
Bank Soil Properties

Spreadsheet developed by
Michael Rafferty, P.E.

Site ID	Proposed Station	Bank Soils (from field observations)	Bank Soil Class	Dry Unit Weight, γ_{bank} (lb/ft^3)	Buoyant Unit Weight, γ'_{bank} (lb/ft^3)	Friction Angle, ϕ_{bank} (deg)
Site A	13+00	Clayey silt	6	84.0	52.3	27
Site B	19+50	Clayey silt	6	84.0	52.3	27
Site C	21+00	Clayey silt	6	84.0	52.3	27
Site D	24+00	Clayey silt	6	84.0	52.3	27

Bolinas Wye Wetland Project
Large Wood Properties

Spreadsheet developed by
Michael Rafferty, P.E.

Project Location: West Coast

Timber Unit Weights			Air-dried[1] γ_{Td} (lb/ft^3)	Green[2] γ_{Tgr} (lb/ft^3)
Selected Species	**Common Name**	**Scientific Name**		
Tree Type #1:	Alder, Red	Alnus rubra	28.7	46.0
Tree Type #2:				
Tree Type #3:				
Tree Type #4:				
Tree Type #5:				
Tree Type #6:				
Tree Type #7:				
Tree Type #8:				
Tree Type #9:				
Tree Type #10:				

[1] **Air-dried unit weight,** γ_{Td} = Average unit weight of wood after exposure to air on a 12% moisture content volume basis. Air-dried unit weight is used in the force balance calculations for the portion of wood that is above the proposed thalweg elevation (assuming unsaturated conditions).

[2] **Green unit weight,** γ_{Tgr} = Average unit weight of freshly sawn wood when the cell walls are completely saturated with water. Green unit weight is used in the force balance calculations as a conservative estimate of the unit weight for the portion of wood that is below the proposed thalweg elevation (assuming saturated conditions). For comparison, Thevenet, Citterio, & Piegay (1998) determined wood unit weight typically increases by more than 100% after less than 24 hours exposure to water.

Source for timber unit weights:

U.S. Department of Agriculture, U.S. Forest Service. (2009) Specific Gravity and Other Properties of Wood and Bark for 156 Tree Species Found in North America. Research Note NRS-38. Table 1A.

Bolinas Wye Wetland Project

Spreadsheet developed by
Michael Rafferty, P.E.

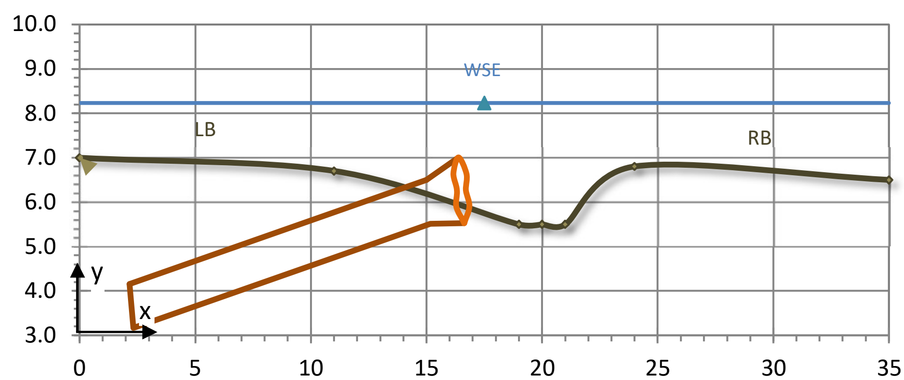
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
Site A	Rootwad	Left bank	Outside	13+00	2.73	1.67	2.83

Multi-Log Structures	Layer	Log ID
	N/A	A

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	0.00	7.00
Top LB	11.00	6.70
Toe LB	19.00	5.50
Thalweg	20.00	5.50
Toe RB	21.00	5.50
Top RB	24.00	6.80
Fldpln RB	35.00	6.50

Proposed Cross-Section and Structure Geometry (Looking D/S)

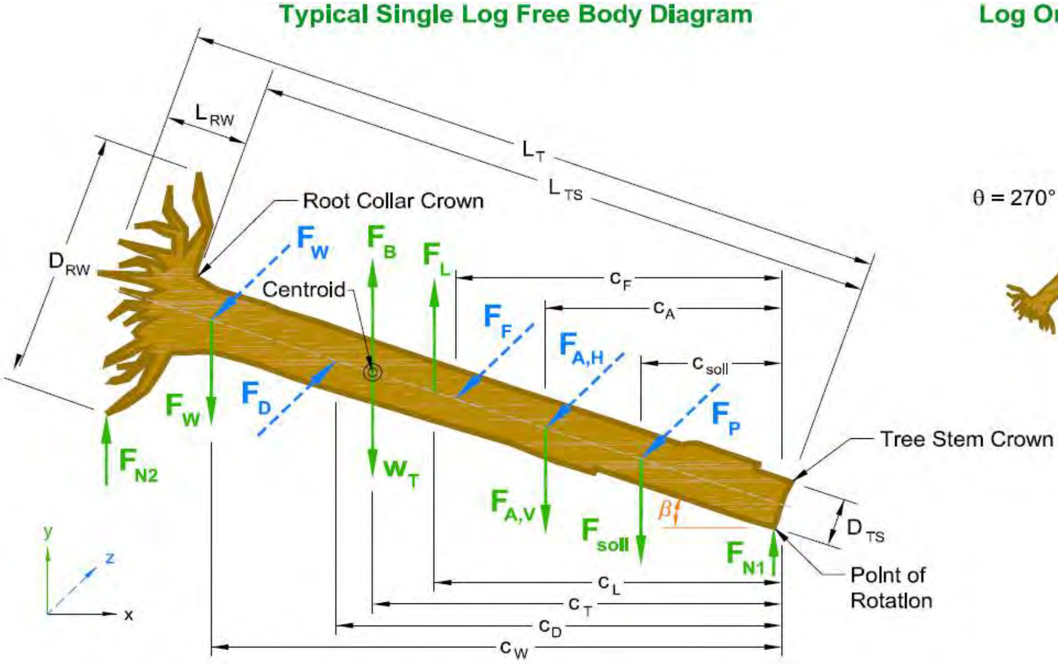


Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Alder, Red	Yes	15.0	1.00	1.50	1.50	28.7	46.0

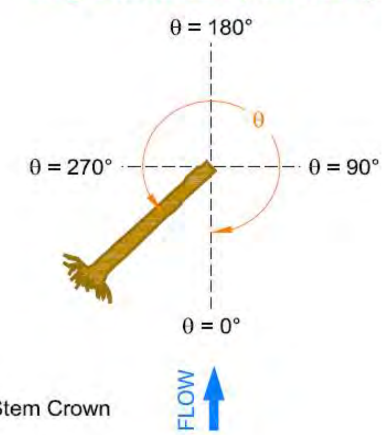
Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	75.0	-10.0	Root collar: Crown	15.00	6.50	3.17	7.01	1.81

Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	122.9	76.5	38.0	5	0.00	0.00	0.00
Bank	Clayey silt	84.0	52.3	27.0	6	12.24	2.79	1.52

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft^3)	V_{RW} (ft^3)	V_T (ft^3)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.0	0.0	0	0
↓WS↑Thw	2.3	1.5	3.8	109	236
↓Thalweg	8.3	0.0	8.3	382	518
Total	10.6	1.5	12.1	491	755

Lift Force

C_{LT}	0.00
F_L (lbf)	0

Vertical Force Balance

F_B (lbf)	755
F_L (lbf)	0
W_T (lbf)	491
F_{soil} (lbf)	975
$F_{W,V}$ (lbf)	0
$F_{A,V}$ (lbf)	0
ΣF_V (lbf)	711
FS_V	1.94

Soil Ballast Force

Soil	V_{dry} (ft^3)	V_{sat} (ft^3)	V_{soil} (ft^3)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	18.6	18.6	975
Total	0.0	18.6	18.6	975

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.07	0.50	1.14	0.24	1.61	23

Horizontal Force Balance

F_D (lbf)	23
F_P (lbf)	1,298
F_F (lbf)	385
$F_{W,H}$ (lbf)	0
$F_{A,H}$ (lbf)	0
ΣF_H (lbf)	1,660
FS_H	74.66

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	65
Bank	2.66	1,298	15.00	0.51	319
Total	-	1,298	17.00	-	385

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
7.4	0.0	13.7	7.4	6.1	7.5	8.2

*Distances are from the stem tip

Point of Rotation: Stem Tip

Moment Force Balance

M_d (lbf)	5,812
M_r (lbf)	27,956
FS_M	4.81

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft^3)	V_{Awet} (ft^3)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft^3)	$V_{r,wet}$ (ft^3)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Bolinas Wye Wetland Project

Spreadsheet developed by
Michael Rafferty, P.E.

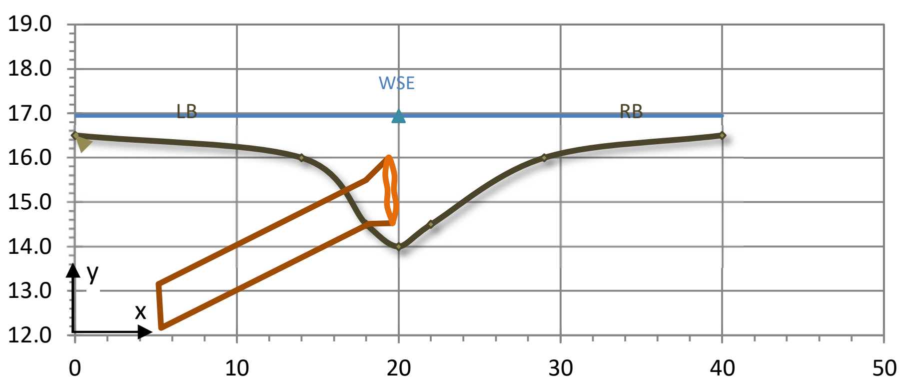
Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
Site B	Rootwad	Left bank	Outside	19+50	2.94	2.73	4.34

Multi-Log Structures	Layer	Log ID
	N/A	B

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	0.00	16.50
Top LB	14.00	16.00
Toe LB	18.00	14.50
Thalweg	20.00	14.00
Toe RB	22.00	14.50
Top RB	29.00	16.00
Fldpln RB	40.00	16.50

Proposed Cross-Section and Structure Geometry (Looking D/S)

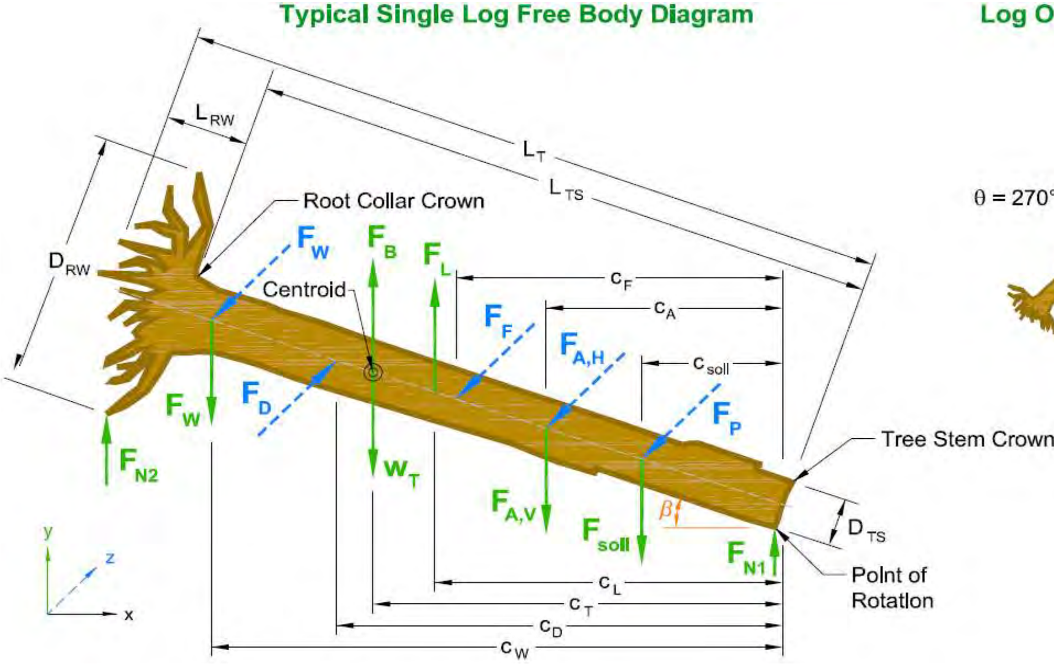


Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Alder, Red	Yes	15.0	1.00	1.50	1.50	28.7	46.0

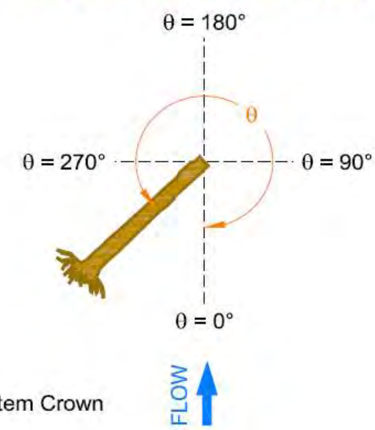
Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	75.0	-10.0	Root collar: Crown	18.00	15.50	12.17	16.01	2.98

Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	122.9	76.5	38.0	5	0.00	0.00	0.00
Bank	Clayey silt	84.0	52.3	27.0	6	11.61	3.16	1.89

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft³)	V_{RW} (ft³)	V_T (ft³)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.0	0.0	0	0
↓WS↑Thw	4.6	1.5	6.0	173	377
↓Thalweg	6.0	0.0	6.0	278	377
Total	10.6	1.5	12.1	451	755

Lift Force

C_{LT}	0.08
F_L (lbf)	4

Vertical Force Balance

F_B (lbf)	755	↑
F_L (lbf)	4	↑
W_T (lbf)	451	↓
F_{soil} (lbf)	1,142	↓
$F_{W,V}$ (lbf)	0	
$F_{A,V}$ (lbf)	0	
ΣF_V (lbf)	834	↓
FS_V	2.10	✓

Soil Ballast Force

Soil	V_{dry} (ft³)	V_{sat} (ft³)	V_{soil} (ft³)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	21.8	21.8	1,142
Total	0.0	21.8	21.8	1,142

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.09	0.77	1.14	0.29	1.73	94

Horizontal Force Balance

F_D (lbf)	94	→
F_P (lbf)	1,520	←
F_F (lbf)	454	←
$F_{W,H}$ (lbf)	0	
$F_{A,H}$ (lbf)	0	
ΣF_H (lbf)	1,880	←
FS_H	20.94	✓

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	84
Bank	2.66	1,520	13.46	0.51	370
Total	-	1,520	15.46	-	454

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
7.5	14.1	13.3	7.5	5.8	6.7	7.7

*Distances are from the stem tip

Point of Rotation: Stem Tip

Moment Force Balance

M_d (lbf)	6,848
M_r (lbf)	29,860
FS_M	4.36 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft³)	V_{Awet} (ft³)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft³)	$V_{r,wet}$ (ft³)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

DRAFT

Bolinas Wye Wetland Project

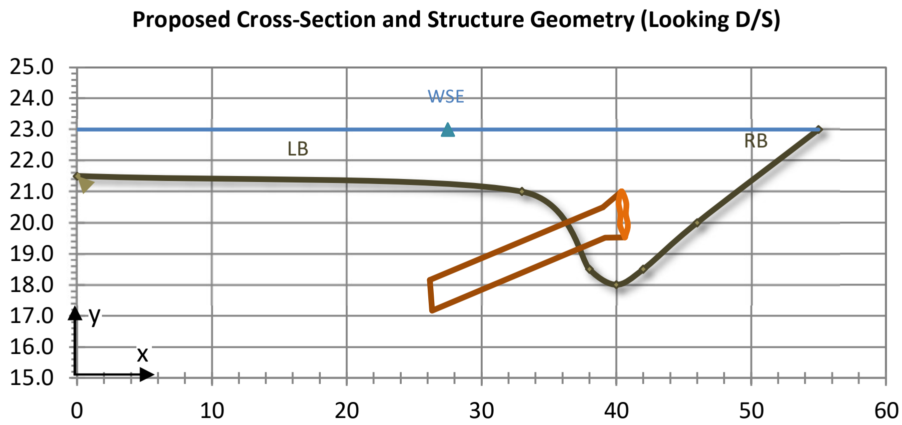
Spreadsheet developed by Michael Rafferty, P.E.

Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
Site C	Rootwad	Left bank	Outside	21+00	5.00	5.00	3.37

Multi-Log Structures	Layer	Log ID
	N/A	C

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	0.00	21.50
Top LB	33.00	21.00
Toe LB	38.00	18.50
Thalweg	40.00	18.00
Toe RB	42.00	18.50
Top RB	46.00	20.00
Fldpln RB	55.00	23.00



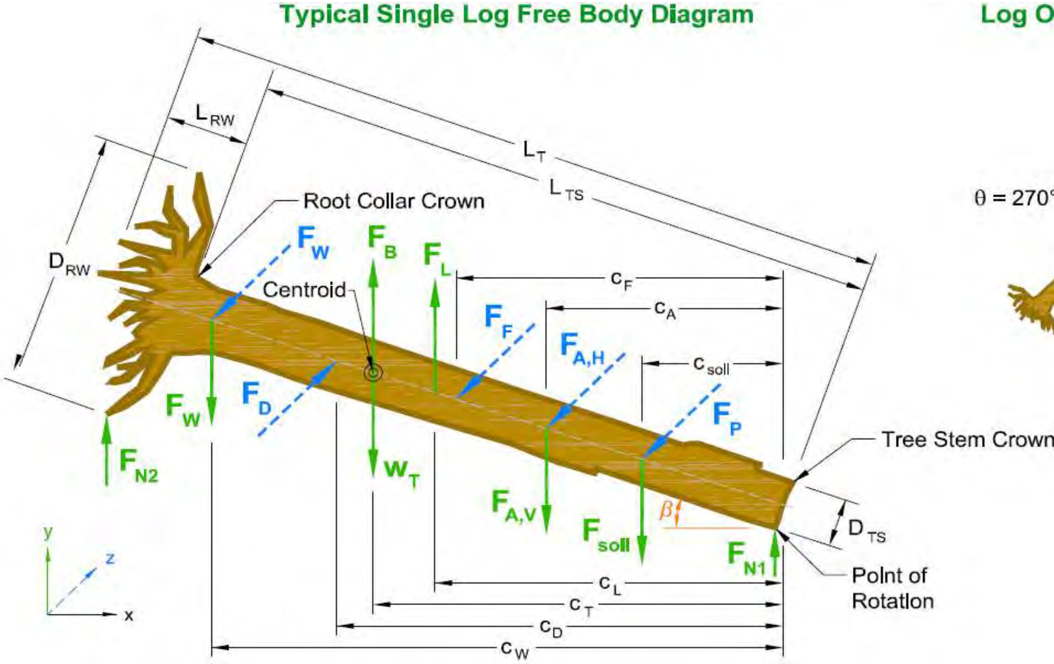
Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft³)	γ_{Tgr} (lb/ft³)
Alder, Red	Yes	15.0	1.00	1.50	1.50	28.7	46.0

Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft²)
	75.0	-10.0	Root collar: Crown	39.00	20.50	17.17	21.01	5.01

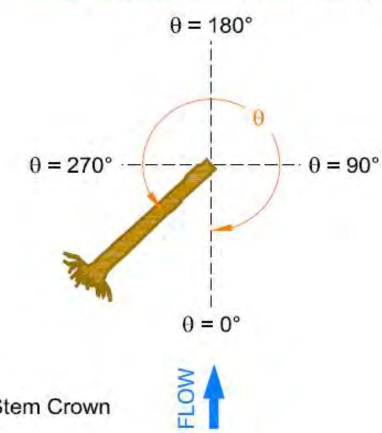
40

Soils	Material	γ_s (lb/ft³)	γ'_s (lb/ft³)	φ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	122.9	76.5	38.0	5	0.00	0.00	0.00
Bank	Clayey silt	84.0	52.3	27.0	6	9.65	2.95	1.90

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft³)	V_{RW} (ft³)	V_T (ft³)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.0	0.0	0	0
↓WS↑Thw	9.1	1.5	10.5	302	658
↓Thalweg	1.6	0.0	1.6	71	97
Total	10.6	1.5	12.1	373	755

Lift Force

C_{LT}	0.03
F_L (lbf)	2

Vertical Force Balance

F_B (lbf)	755	↑
F_L (lbf)	2	↑
W_T (lbf)	373	↓
F_{soil} (lbf)	957	↓
$F_{W,V}$ (lbf)	0	
$F_{A,V}$ (lbf)	0	
ΣF_V (lbf)	574	↓
FS_V	1.76	✓

Soil Ballast Force

Soil	V_{dry} (ft³)	V_{sat} (ft³)	V_{soil} (ft³)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	18.3	18.3	957
Total	0.0	18.3	18.3	957

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.07	0.59	1.14	0.08	1.41	78

Horizontal Force Balance

F_D (lbf)	78	→
F_P (lbf)	1,274	←
F_F (lbf)	316	←
$F_{W,H}$ (lbf)	0	
$F_{A,H}$ (lbf)	0	
ΣF_H (lbf)	1,512	←
FS_H	20.36	✓

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	68
Bank	2.66	1,274	11.14	0.51	248
Total	-	1,274	13.14	-	316

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
7.6	11.6	12.3	7.6	4.8	5.6	6.4

*Distances are from the stem tip

Point of Rotation: Stem Tip

Moment Force Balance

M_d (lbf)	6,635
M_r (lbf)	20,223
FS_M	3.05 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft³)	V_{Awet} (ft³)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft³)	$V_{r,wet}$ (ft³)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Bolinas Wye Wetland Project

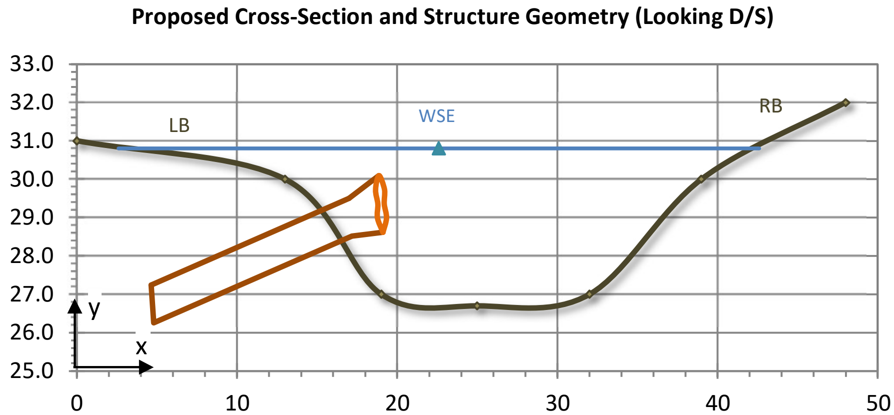
Spreadsheet developed by
Michael Rafferty, P.E.

Single Log Stability Analysis Model Inputs

Site ID	Structure Type	Structure Position	Meander	Station	d_w (ft)	R_c/W_{BF}	u_{des} (ft/s)
Site D	Rootwad	Left bank	Outside	24+00	4.10	2.67	5.04

Multi-Log Structures	Layer	Log ID
	N/A	D

Channel Geometry Coordinates		
Proposed	x (ft)	y (ft)
Fldpln LB	0.00	31.00
Top LB	13.00	30.00
Toe LB	19.00	27.00
Thalweg	25.00	26.70
Toe RB	32.00	27.00
Top RB	39.00	30.00
Fldpln RB	48.00	32.00

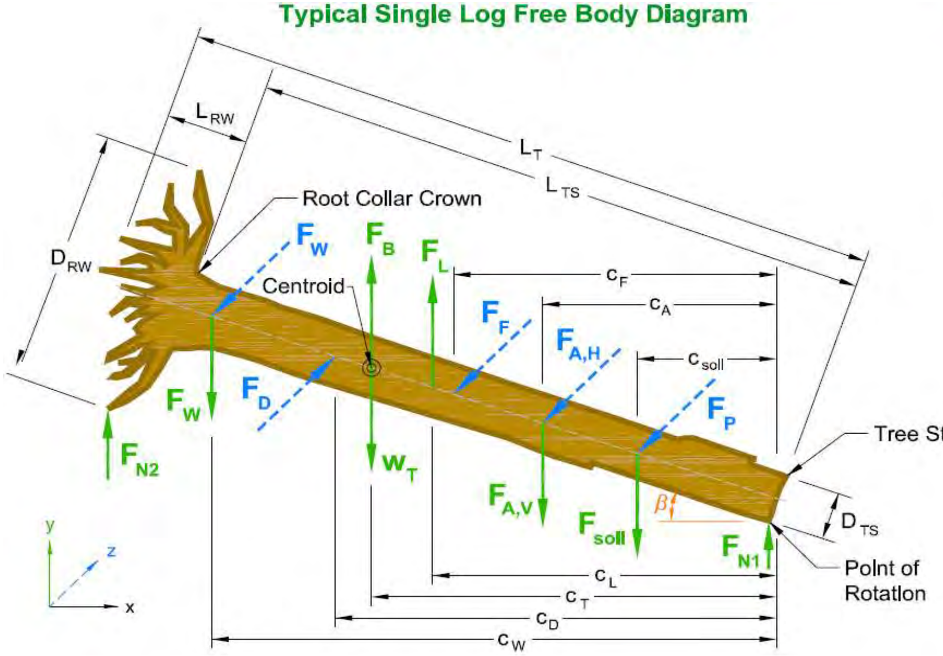


Wood Species	Rootwad	L_T (ft)	D_{TS} (ft)	L_{RW} (ft)	D_{RW} (ft)	γ_{Td} (lb/ft^3)	γ_{Tgr} (lb/ft^3)
Alder, Red	Yes	15.0	1.00	2.00	1.50	28.7	46.0

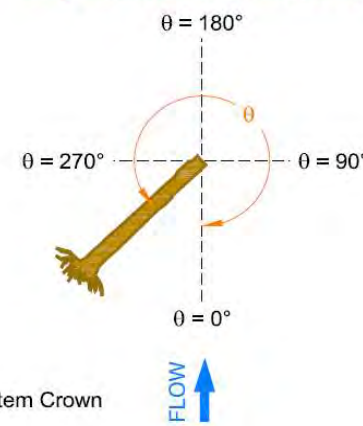
Structure Geometry	θ (deg)	β (deg)	Define Fixed Point	x_T (ft)	y_T (ft)	$y_{T,min}$ (ft)	$y_{T,max}$ (ft)	A_{Tp} (ft^2)
	75.0	-10.0	Root collar: Crown	17.00	29.50	26.26	30.09	4.02

Soils	Material	γ_s (lb/ft^3)	γ'_s (lb/ft^3)	ϕ (deg)	Soil Class	$L_{T,em}$ (ft)	$d_{b,max}$ (ft)	$d_{b,avg}$ (ft)
Stream Bed	Coarse gravel	122.9	76.5	38.0	5	0.00	0.00	0.00
Bank	Clayey silt	84.0	52.3	27.0	6	10.69	3.40	2.02

Typical Single Log Free Body Diagram



Log Orientation (Plan View)



Vertical Force Analysis

Net Buoyancy Force

Wood	V_{TS} (ft³)	V_{RW} (ft³)	V_T (ft³)	W_T (lbf)	F_B (lbf)
↑WSE	0.0	0.0	0.0	0	0
↓WS↑Thw	9.8	2.0	11.8	339	738
↓Thalweg	0.4	0.0	0.4	17	23
Total	10.2	2.0	12.2	356	761

Lift Force

C_{LT}	0.04
F_L (lbf)	4

Vertical Force Balance

F_B (lbf)	761	↑
F_L (lbf)	4	↑
W_T (lbf)	356	↓
F_{soil} (lbf)	1,126	↓
$F_{W,V}$ (lbf)	0	
$F_{A,V}$ (lbf)	0	
ΣF_V (lbf)	717	↓
FS_V	1.94	✓

Soil Ballast Force

Soil	V_{dry} (ft³)	V_{sat} (ft³)	V_{soil} (ft³)	F_{soil} (lbf)
Bed	0.0	0.0	0.0	0
Bank	0.0	21.5	21.5	1,126
Total	0.0	21.5	21.5	1,126

Horizontal Force Analysis

Drag Force

A_{Tp} / A_W	Fr_L	C_{Di}	C_w	C_D*	F_D (lbf)
0.07	0.89	1.14	0.20	1.53	152

Horizontal Force Balance

F_D (lbf)	152	→
F_P (lbf)	1,499	←
F_F (lbf)	393	←
$F_{W,H}$ (lbf)	0	
$F_{A,H}$ (lbf)	0	
ΣF_H (lbf)	1,740	←
FS_H	12.48	✓

Passive Soil Pressure / Friction Force

Soil	K_P	F_P (lbf)	L_{Tf} (ft)	μ	F_F (lbf)
Bed	4.20	0	2.00	0.78	79
Bank	2.66	1,499	12.19	0.51	314
Total	-	1,499	14.19	-	393

Moment Force Balance

Driving Moment Centroids / Resisting Moment Centroids

$c_{T,B}$ (ft)	c_L (ft)	c_D (ft)	$c_{T,W}$ (ft)	c_{soil} (ft)	$c_{F\&N}$ (ft)	c_P (ft)
7.7	12.6	12.9	7.7	5.3	6.1	7.1

*Distances are from the stem tip

Point of Rotation: Stem Tip

Moment Force Balance

M_d (lbf)	7,761
M_r (lbf)	25,733
FS_M	3.32 ✓

Anchor Forces

Additional Soil Ballast

V_{Adry} (ft³)	V_{Awet} (ft³)	c_{Asoil} (ft)	$F_{A,Vsoil}$ (lbf)	$F_{A,HP}$ (lbf)
			0	0

Mechanical Anchors

Type	c_{Am} (ft)	Soils	F_{Am} (lbf)
			0
			0

Boulder Ballast

Position	D_r (ft)	c_{Ar} (ft)	$V_{r,dry}$ (ft³)	$V_{r,wet}$ (ft³)	W_r (lbf)	$F_{L,r}$ (lbf)	$F_{D,r}$ (lbf)	$F_{A,Vr}$ (lbf)	$F_{A,Hr}$ (lbf)
								0	0
								0	0
								0	0

Bolinas Wye Wetland Project
Notation, Units, and List of Symbols

Notation

Symbol	Description	Unit
A_W	Wetted area of channel at design discharge	ft^2
A_{Tp}	Projected area of wood in plane perpendicular to flow	ft^2
c_D	Centroid of the drag force along log axis	ft
c_{Am}	Centroid of a mechanical anchor along log axis	ft
c_{Ar}	Centroid of a ballast boulder along log axis	ft
c_{Asoil}	Centroid of the added ballast soil along log axis	ft
$c_{F\&N}$	Centroid of friction and normal forces along log axis	ft
c_L	Centroid of the lift force along log axis	ft
c_P	Centroid of the passive soil force along log axis	ft
c_{soil}	Centroid of the vertical soil forces along log axis	ft
$c_{T,B}$	Centroid of the buoyancy force along log axis	ft
$c_{T,W}$	Centroid of the log volume along log axis	ft
c_{WI}	Centroid of a wood interaction force along log axis	ft
C_{Lrock}	Coefficient of lift for submerged boulder	-
C_{LT}	Effective coefficient of lift for submerged tree	-
C_{Di}	Base coefficient of drag for tree, before adjustments	-
C_D*	Effective coefficient of drag for submerged tree	-
C_{Di}	Base coefficient of drag for tree, before adjustments	-
C_W	Wave drag coefficient of submerged tree	-
$d_{b,avg}$	Average buried depth of log	ft
$d_{b,max}$	Maximum buried depth of log	ft
d_w	Maximum flow depth at design discharge in reach	ft
D_{50}	Median grain size in millimeters (SI units)	mm
D_r	Equivalent diameter of boulder	ft
D_{RW}	Assumed diameter of rootwad	ft
D_{TS}	Nominal diameter of tree stem (DBH)	ft
DF_{RW}	Diameter factor for rootwad ($DF_{RW} = D_{RW}/D_{TS}$)	-
e	Void ratio of soils	-
$F_{A,H}$	Total horizontal load capacity of anchor techniques	lbf
$F_{A,HP}$	Passive soil pressure applied to log from soil ballast	lbf
$F_{A,Hr}$	Horizontal resisting force on log from boulder	lbf
F_{Am}	Load capacity of mechanical anchor	lbf
$F_{A,V}$	Total vertical load capacity of anchor techniques	lbf
$F_{A,Vr}$	Vertical resisting force on log from boulder	lbf
$F_{A,Vsoil}$	Vertical soil loading on log from added ballast soil	lbf
F_B	Buoyant force applied to log	lbf
F_D	Drag forces applied to log	lbf
$F_{D,r}$	Drag forces applied to boulder	lbf
F_F	Friction force applied to log	lbf
F_H	Resultant horizontal force applied to log	lbf
F_L	Lift force applied to log	lbf
$F_{L,r}$	Lift force applied to boulder	lbf
F_P	Passive soil pressure force applied to log	lbf
F_{soil}	Vertical soil loading on log	lbf
$F_{W,H}$	Horizontal forces from interactions with other logs	lbf
$F_{W,V}$	Vertical forces from interactions with other logs	lbf

Notation (continued)

Symbol	Description	Unit
F_V	Resultant vertical force applied to log	lbf
Fr_L	Log Froude number	-
FS_V	Factor of Safety for Vertical Force Balance	-
FS_H	Factor of Safety for Horizontal Force Balance	-
FS_M	Factor of Safety for Moment Force Balance	-
g	Gravitational acceleration constant	ft/s^2
K_P	Coefficient of Passive Earth Pressure	-
$L_{T,em}$	Total embedded length of log	ft
L_{RW}	Assumed length of rootwad	ft
L_T	Total length of tree (including rootwad)	ft
L_{Tf}	Length of log in contact with bed or banks	ft
L_{TS}	Length of tree stem (not including rootwad)	ft
$L_{TS,ex}$	Exposed length of tree stem	ft
LF_{RW}	Length factor for rootwad ($LF_{RW} = L_{RW}/D_{TS}$)	-
M_d	Driving moment about embedded tip	lbf
M_r	Driving moment about embedded tip	lbf
N	Blow count of standard penetration test	-
p_o	Porosity of soil volume	-
Q_{des}	Design discharge	cfs
R	Radius	ft
R_c	Radius of curvature at channel centerline	ft
SG_r	Specific gravity of quartz particles	-
SG_T	Specific gravity of tree	-
u_{avg}	Average velocity of cross section in reach	ft/s
u_{des}	Design velocity	ft/s
u_m	Adjusted velocity at outer meander bend	ft/s
V_{dry}	Volume of soils above stage level of design flow	ft^3
V_{sat}	Volume of soils below stage level of design flow	ft^3
V_{soil}	Total volume of soils over log	ft^3
V_{RW}	Volume of rootwad	ft^3
V_S	Volume of solids in soil (void ratio calculation)	ft^3
V_T	Total volume of log	ft^3
V_{TS}	Total volume of tree	ft^3
V_V	Volume of voids in soil	ft^3
V_{Adry}	Volume of ballast above stage of design flow	ft^3
V_{Awet}	Volume of ballast below stage of design flow	ft^3
$V_{r,dry}$	Volume of boulder above stage of design flow	ft^3
$V_{r,wet}$	Volume of boulder below stage of design flow	ft^3
W_{BF}	Bankfull width at structure site	ft
W_r	Effective weight of boulder	lbf
W_T	Total log weight	lbf
x	Horizontal coordinate (distance)	ft
y	Vertical coordinate (elevation)	ft
$y_{T,max}$	Minimum elevation of log	ft
$y_{T,min}$	Maximum elevation of log	ft

Greek Symbols

Symbol	Description	Unit
β	Tilt angle from stem tip to vertical	deg
γ_{bank}	Dry specific weight of bank soils	lb/ft^3
$\gamma_{bank,sat}$	Saturated unit weight of bank soils	lb/ft^3
γ'_{bank}	Effective buoyant unit weight of bank soils	lb/ft^3
γ_{bed}	Dry specific weight of stream bed substrate	lb/ft^3
γ'_{bed}	Effective buoyant unit weight of stream bed substrate	lb/ft^3
γ_{rock}	Dry unit weight of boulders	lb/ft^3
γ_s	Dry specific weight of soil	lb/ft^3
γ'_s	Effective buoyant unit weight of soil	lb/ft^3
γ_{Td}	Air-dried unit weight of tree (12% MC basis)	lb/ft^3
γ_{Tgr}	Green unit weight of tree	lb/ft^3
γ_w	Specific weight of water at 50ºF	lb/ft^3
η	Rootwad porosity	-
θ	Rootwad (or large end of log) orientation to flow	deg
μ	Coefficient of friction	-
ν	Kinematic viscosity of water at 50ºF	ft/s^2
Σ	Sum of forces	-
ϕ_{bank}	Internal friction angle of bank soils	deg
ϕ_{bed}	Internal friction angle of stream bed substrate	deg

Units

Notation	Description
cfs	Cubic feet per second
ft	Feet
lb	Pound
lbf	Pounds force
kg	Kilograms
m	Meters
mm	Millimeters
s	Seconds
yr	Year

Abbreviations

Notation	Description
ARI	Average return interval
Avg	Average
DBH	Diameter at breast height
deg	Degrees
Dia	Diameter
Dist	Distance
D/S	Downstream
ELJ	Engineered log jam
Ex	Example
Fldpln	Floodplain
H&H	Hydrologic and hydraulic
ID	Identification
i.e.	That is
LB	Left bank
LW	Large wood
Max	Maximum
MC	Moisture content
Min	Minimum
ML	Multi-log
SL	Single log
N/A	Not applicable
no	Number
Pt	Point
rad	Radians
RB	Right bank
RW	Rootwad
SL	Single log
Thw	Thalweg (lowest elevation in channel bed)
Typ	Typical
U.S.	United States
WS	Water surface
WSE	Water surface elevation
↑	Above
↓	Below

Appendix C: Fish Passage Design Criteria and Guidance Report

Fish Passage Design Criteria and Guidance Report

Bolinas Lagoon Wye Wetland Restoration Project

Prepared for:

Veronica Pearson

Marin County Open Space District

Prepared by

Stewart DesMeules, Fisheries Biologist

WRA, Inc.

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(Updated February 22, 2022)

Introduction

The following design criteria and guidance discusses the suitability of the Bolinas Lagoon Wye Wetlands Project (Project) and accompanying 60% Hydraulic Design (Design) to create suitable passage conditions for salmonid species, primarily for Central California steelhead, (steelhead, *Oncorhynchus mykiss*), a federally threatened species. A more detailed fish passage analysis will be completed once 100% design is reached, analyzing the final design (including anticipated hydrologic conditions) to ensure the Project creates suitable passage conditions for salmonids.

In addition to reducing flooding of roadways and addressing sea-level rise and traffic safety, the Project and Design aims to improve volitional fish passage, primarily for salmonid species, as well as to improve and restore the ecological functions of adjacent and contained stream habitat, riparian corridors, tidal marshes, and associated upland habitats. The associated bridge area at the Olema-Bolinas Road crossing is currently made up of a 5ft wide by 1.5ft tall concrete box culvert.

This design criteria and guidance takes into account unique site specific conditions, National Marine Fisheries Service (NMFS) Guidelines for Salmonid Passage at Stream Crossings (NMFS 2019)[1] and the California Salmonid Stream Passage Restoration Manual (CDFW, 2004)[2]. This technical memorandum is an addendum to the working Basis of Design Report (Report), which describes the Project and Design in more detail.

Design Criteria

The Project is designed to meet the Stream Simulation Design criteria as presented in the California Salmonid Stream Passage Restoration Manual (CDFW, 2004). The goals of the Stream Simulation Design option are to provide natural stream processes, mimicking typical fish passage, sediment transport, and other characteristics of a naturally occurring stream channel. The Design for the Project matches upstream and downstream slopes, thus will not impede annual high flow through the area. The Upper West portion of the watershed contains steep slopes of between 15 and 20%, while the lower portions, and those within the Project Area fluctuate between 2% and 3%, slopes that are maintained in the Design.

In addition to maintaining slopes, the Design incorporates a natural bottom, increasing the ability of the Project post-completion to provide natural processes that will benefit fish species. The proposed Design incorporates a new 60ft wide clear span bridge with an effective opening width of 55 feet and providing a natural substrate and channel. The crossing is sized at wider than bankfull channel width, where the effective 100-year floodplain width through the bridge will be approximately 55 feet. Note that the effective width is smaller than the bridge span length due to the skew of the bridge angle to the flow path of Lewis Gulch Creek. The width of the bridge,

[1] NMFS 2019. Guidelines for salmonid passage at stream crossings, NMFS, Southwest Region.
[2] Flosi et al. 2010. California Salmonid Stream Restoration Manual, Fourth Edition. California Department of Fish and Game.

or the length of the flow through the bridge section with slightly higher velocities is approximately 45 feet. The slope within the crossing is at a gradient similar to that of the upstream and downstream reaches.

Modeled flows through the Design at the Olema-Bolinas Road crossing at a Q2 (48 CFS) event show flow rates suitable for salmonid passage. Flows across the entire Project at a Q2 event range from approximately zero feet per second (fps) to 5 fps. The Olema-Bolinas Road crossing exhibits some of the more constricted flows in the Project Area, however at Q2 event, flows at the crossing range from approximately 0.10 fps to 5 fps, allowing for successful volitional passage of salmonids. Additionally, the Design incorporates large boulders under the bridge for hydraulic cover and refugia, and a natural substrate gravel, cobble, and boulder bottom. Table 1 shows water velocities and associated distances that adult salmonids are able to successfully move through.

Table 1. Water Velocity for culvert length (adapted from CDFW 2004)

Culvert Length (ft)	**Velocity (fps) – Adult Salmonids**
<60	6
60-100	5
100-200	4
200-300	3
>300	2

In addition to the above criteria, the design avoids any significant hydraulic drops, further facilitating passage of both juvenile and adult salmonids. Per NMFS guidance, hydraulic drops should be avoided in all cases (NMFS, 2019); however, maximum hydraulic drops, as well as minimum/maximum criteria for fish passage are presented below in Table 2.

Table 2. Adapted from the California Salmonid Stream Habitat Restoration Manual (CDFW, 2004)

Species or Lifestage	Minimum Water Depth	Maximum Hydraulic Drop	Prolonged Swimming Mode		Burst Swimming Mode		
			Maximum Swim Speed	Time to Exhaustion	Maximum Swim Speed	Time to Exhaustion	Maximum Leap Speed
Adult anadromous salmonids	9.6 inches	12 inches	6.0 ft/sec	30 minutes	10.0 ft/sec	5.0 sec	15.0 ft/sec
Resident trout and juvenile steelhead trout >6"	6 inches	12 inches	4.0 ft/sec	30 minutes	5.0 ft/sec	5.0 sec	6.0 ft/sec
Juvenile salmonids <6"	3.6 inches	6 inches	1.5 ft/sec	30 minutes	3.0 ft/sec	5.0 sec	4.0 ft/sec

Realigned Lewis Gulch Creek Channel

The design incorporates a realignment of Lewis Gulch Creek, which will run through the approximate center of the Project, and is designed to convey flows up to two times the average base flow (8 CFS) and to increase connectivity through the existing Wye wetlands. In periods of low flow, this channel will maintain water flow when adjacent floodplain areas have dried, allowing for fish passage for a longer period of time than if this channel was not incorporated. Modeled velocities within the channel at a Q2 event show volitional fish passage, with an average of approximately 0.5 to 2 fps within the channel.

Side Channel

The area where the proposed channel will tie into the existing channel will intersect and cut off a portion of Lewis Gulch Creek. This cut off channel will dead end, with the main proposed channel serving to convey nearly 100 percent of flows. At a modeled Q2 event with the proposed Design, flows from this to-be-remnant channel will not exceed 1 fps, and will thus not serve as an adequate attracting flow for migrating salmonids. It is unlikely that fish will dead end and strand in this location due to the lack of attracting flow, and with water velocities in the main channel at a Q2 event between 1 and 3 fps, fish will likely migrate upstream using this area.

Wood and Boulder Placement

The Design incorporates the placement of large woody debris (LWD) and boulders along the proposed channel. Boulders will be placed primarily underneath the bridge, and will provide resting spots for migrating fish as they transit higher velocity sections. The LWD/boulder combinations placed in the steeper areas further upstream of the bridge will provide both high velocity refugia and more permanent habitat. Only trees removed for the Project will be used as LWD, and will be placed to provide high velocity refugia, as well as nutrient and sediment storage, increasing habitat complexity to drive increased food production. The LWD and associated root wads are intended to promote pool formation to serve as habitat for rearing and migrating salmonids. The high velocity refugia provided by these pools is anticipated to facilitate successful fish passage, giving migrating salmonids a place to rest during upstream migration. Willow plantings are also incorporated into the design to mitigate bank erosion, as well as to improve habitat for fish species within the creek. The incorporation of willow plantings into the design will benefit fish by providing increased shaded areas for fish to escape high temperatures, as well as by driving an increase in general productivity by increasing habitat complexity, providing an important invertebrate foraging base for fish.

Summary

In conclusion, the Design follows the Stream Simulation Design parameters presented in CDFW 2004, and complies with NMFS Guidelines for Salmonid Passage at Stream Crossings. The Design mimics a natural stream channel, providing large boulders for high velocity refugia, LWD for high velocity refugia. The Design eliminates an inadequate culvert, replacing it with a single natural bottom and significantly increasing its width, thus reducing velocity at high flows, allowing for improved and increased volitional fish passage.

Please contact me with any questions.

Sincerely,

Stewart DesMeules

Fisheries Biologist

Appendix D: Cost Estimate

Bolinas Lagoon Wye Wetland Project Engineer's Opinion of Probable Costs
60% Design
February 22, 2022
SUMMARY

Prepared by:
WRA, Inc.
2169-G East Francisco Blvd.
San Rafael, CA 94901
(415) 454-8868

1. Mobilization / Demobilization	$ 775,000
2. Site Preparation	$ 219,460
3. Channel and Floodplain Grading	$ 456,683
4. Bank Stabilization	$ 36,625
5. Large Wood Structures	$ 95,040
6. Erosion Contol	$ 59,025
7. Planting and Seeding	$ 161,784
8. Roadway and Bridge	$ 2,323,435
9. Miscellaneous Items	$ 652,800
30% Contingency	$ 1,433,956

GRAND TOTAL (2021)	$ 6,213,808
GRAND TOTAL (2024)	$ 6,990,000

Bolinas Lagoon Wye Wetland Project Engineer's Opinion of Probable Costs
60% Design
February 22, 2022
DETAIL

Prepared by:
WRA, Inc.
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San Rafael, CA 94901
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1. Mobilization / Demobilization — **Subtotal $ 775,000**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
1.01	Mobilization and Demobilization (Roadway included)	1	LS	575,000.00	$ 575,000
1.02	Performance Bond	1	LS	200,000.00	$ 200,000

2. Site Preparation — **Subtotal $ 219,460**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
2.01	Clear and Grub	4	AC	9,000.00	$ 32,400
2.02	Tree Removal and Disposal	90	EA	448.00	$ 40,320
2.03	Tree Removal and Salvage	33	EA	180.00	$ 5,940
2.04	SWPPP Preparation and Implementation	1	LS	30,000.00	$ 30,000
2.05	Tree Protection Fencing	3200	LF	5.75	$ 18,400
2.06	Diversion and Dewatering (Submersible Pump 4")	12	MO	7,700.00	$ 92,400

3. Channel and Floodplain Grading — **Subtotal $ 456,683**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
3.01	Topsoil Stripping and Stockpile	910	CY	55.00	$ 50,050
3.02	Floodplain Excavation (includes area under bridge)	1570	CY	30.00	$ 47,100
3.03	Channel Excavation (Wye)	280	CY	25.00	$ 7,000
3.04	Berm Notch Excavation	130	CY	55.00	$ 7,150
3.05	Fill Placement Fairfax Bolinas Road Footprint	1200	CY	31.00	$ 37,200
3.06	Offhaul Soil	780	CY	120.00	$ 93,600
3.07	Topsoil Placement (9")	910	CY	65.00	$ 59,150
3.08	Boulder Purchase and Install	30	TON	195.00	$ 5,850
3.09	18" Riprap Purchase and Install	1071	TON	125.00	$ 133,875
3.10	Bedding Purchase and Install	357	TON	44.00	$ 15,708
3.11	Sandbag Diversion - Year 1	1	LS	20,200.00	$ 20,200

4. Bank Stabilization — **Subtotal $ 36,625**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
4.01	Place Footer Log (salvaged on site)	5	EA	800.00	$ 4,000
4.03	Place Rootwad (salvaged on site)	11	EA	1,600.00	$ 17,600
4.05	Excavation and Fill	47	CY	125.00	$ 5,875
4.05	Soil Lifts	100	LF	85.00	$ 8,500
4.06	Willow Cuttings	100	EA	6.50	$ 650

5. Large Wood Structures — **Subtotal $ 95,040**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
5.01	Log Structure Installation	33	EA	2,880.00	$ 95,040

6. Erosion Contol — **Subtotal $ 59,025**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
6.01	Straw Wattles (Purchase, Deliver, and Install)	5,100	LF	8.00	$ 40,800
6.02	Erosion Control Blanket	2,600	SY	3.00	$ 7,800
6.03	Temporary Hydroseeding Stabilization	34,750	SF	0.30	$ 10,425

7. Planting and Seeding — **Subtotal $ 161,784**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
7.01	Salt Marsh Bulrush Marsh	1.00	LS	3,202.75	$ 3,203
7.02	Arroyo Willow Thicket	1.00	LS	21,196.25	$ 21,196
7.03	Red Alder Forest (Upland)	1.00	LS	12,528.50	$ 12,529
7.04	Red Alder Forest (Lowland)	1.00	LS	41,425.50	$ 41,426
7.05	Coastal Brambles	1.00	LS	43,938.00	$ 43,938
7.06	Coastal Live Oak Woodlands	1.00	LS	22,842.75	$ 22,843
7.07	Coyote Brush Scrub	1.00	LS	7,663.50	$ 7,664
7.08	Salt Grass Flats	1.00	LS	2,586.75	$ 2,587
7.09	Seeding - Red Alder Forest (Lowland)	0.18	AC	8,000.00	$ 1,440
7.10	Seeding - Roadside grassland	0.62	AC	8,000.00	$ 4,960
7.11	Plant Protection Cages	1,742	EA	26.00	$ 45,283

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8. Roadway and Bridge **Subtotal** **$ 2,323,435**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
8.01	Roadway	1	LS	663,045.00	$ 663,045
8.02	Structures	1	LS	1,660,390.00	$1,660,390

9. Miscellaneous Items **Subtotal** **$ 652,800**

Item Number	Description	Quantity	Unit	Unit Cost	Cost
9.01	Submittal Prep	120	HR	200.00	$ 24,000
9.02	Kick-Off Meeting	1	EA	4,800.00	$ 4,800
9.03	Environmental Coordination	1	LS	12,000.00	$ 12,000
9.04	Weekly Meetings	144	HR	200.00	$ 28,800
9.05	Construction Oversight	520	HR	220.00	$ 114,400
9.06	Project Engineer/Manager	1040	HR	220.00	$ 228,800
9.07	Environmental Compliance	1	LS	240,000.00	$ 240,000

Line Item Tot	**$ 4,779,852**
30% Contingency	**$ 1,433,956**
Grand Total (2021 dollars)	**$ 6,213,808**
Grand Total, rounded and escalated to 2024	**$ 6,990,000**

Annual inflation
0.04

Bolinas Wye Engineer's Estimate - Roadway and Bridge Detail

ITEM No.	BEES	ITEM DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	TOTAL
ROADWAY						
1	070030	LEAD COMPLIANCE PLAN	LS	1	3000.00	$ 3,000
2	080050	PROGRESS SCHEDULE (CRITICAL PATH METHOD)	LS	1	5000.00	$ 5,000
3	100100	DEVELOP WATER SUPPLY	LS	1	10000.00	$ 10,000
4	120090	CONSTRUCTION AREA SIGNS	LS	1	5000.00	$ 5,000
5	120100	TRAFFIC CONTROL SYSTEM	LS	1	50000.00	$ 50,000
6	120120	TYPE III BARRICADE	EA	6	200.00	$ 1,200
7	120165	CHANNELIZER (SURFACE MOUNTED)	EA	5	60.00	$ 300
8	128652	PORTABLE CHANGEABLE MESSAGE SIGN (LS)	LS	1	30000.00	$ 30,000
9	129000	TEMPORARY RAILING (TYPE K)	LF	660	60.00	$ 39,600
10	129152	TEMPORARY RADAR SPEED FEEDBACK SIGN SYSTEM	EA	2	10000.00	$ 20,000
11	130100	JOB SITE MANAGEMENT	LS	1	28000.00	$ 28,000
12	130300	PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	0	3000.00	$ -
13	130300A	TEMPORARY WATER POLLUTION CONTROL	LS	0	25000.00	$ -
14	130330	STORM WATER ANNUAL REPORT	EA	0	2000.00	$ -
15	130900	TEMPORARY CONCRETE WASHOUT	LS	1	4725.00	$ 4,725
16	170103	CLEARING AND GRUBBING (LS)	LS	1	50000.00	$ 50,000
17	170103A	REMOVE TREE	EA	0	2000.00	$ -
18	190101	ROADWAY EXCAVATION	CY	1,040	60.00	$ 62,400
19	198010	IMPORTED BORROW (CY)	CY	330	60.00	$ 19,800
20	198215	SUBGRADE ENHANCEMENT GEOGRID	SQYD	1,650	10.00	$ 16,500
21	210430	HYDROSEED	SQFT	0	1.00	$ -
22	260203	CLASS 2 AGGREGATE BASE (CY)	CY	700	60.00	$ 42,000
23	390132	HOT MIX ASPHALT (TYPE A)	TON	900	130.00	$ 117,000
24	398200	COLD PLANE ASPHALT CONCRETE PAVEMENT	SQYD	720	10.00	$ 7,200
25	398300	REMOVE BASE AND SURFACING	SY	2,370	20.00	$ 47,400
26	650014	18" REINFORCED CONCRETE PIPE	LF	56	300.00	$ 16,800
27	705204	18" CONCRETE FLARED END SECTION	EA	2	1500.00	$ 3,000
28	810170	DELINEATOR (CLASS 1)	EA	6	50.00	$ 300
29	810230	PAVEMENT MARKER (RETROREFLECTIVE)	EA	80	8.00	$ 640
30	820250	REMOVE ROADSIDE SIGN	EA	5	200.00	$ 1,000
31	820610	RELOCATE ROADSIDE SIGN	EA	1	250.00	$ 250
32	820840	ROADSIDE SIGN - ONE POST	EA	3	400.00	$ 1,200
33	832006	MIDWEST GUARDRAIL SYSTEM (STEEL POST)	LF	50	50.00	$ 2,500
34	832070	VEGETATION CONTROL (MINOR CONCRETE)	SQYD	176	85.00	$ 14,960
35	839543	TRANSITION RAILING (TYPE WB-31)	EA	4	4500.00	$ 18,000
36	839584	ALTERNATIVE IN-LINE TERMINAL SYSTEM	EA	4	5000.00	$ 20,000
37	839576	END CAP (TYPE A)	EA	4	500.00	$ 2,000
38	840501	THERMOPLASTIC TRAFFIC STRIPE	LF	3,610	2.00	$ 7,220
39	840516	THERMOPLASTIC PAVEMENT MARKING (ENHANCED WET NIGHT VISIBILITY)	SQFT	105	10.00	$ 1,050
40	129110A	ALTERNATIVE TEMPORARY CRASH CUSHION	EA	2	7500.00	$ 15,000
					ROADWAY SUBTOTAL	**$ 663,045**

STRUCTURES							
41	192020	STRUCTURE EXCAVATION (TYPE D)	CY	42	265.00	$	11,130
42	193003	STRUCTURE BACKFILL (BRIDGE)	CY	26	200.00	$	5,200
43	490592	72" PERMANENT STEEL CASING	LF	48	1400.00	$	67,200
44	490609	60" CAST-IN-DRILLED-HOLE CONCRETE PILING	LF	152	1750.00	$	266,000
45	490685	60" CAST-IN-DRILLED-HOLE CONCRETE PILING (ROCK SOCKET)	LF	40	2000.00	$	80,000
46	500001	PRESTRESSING CAST-IN-PLACE CONCRETE	LS	1	41000.00	$	41,000
47	510053	STRUCTURAL CONCRETE, BRIDGE	CY	74	2000.00	$	148,000
48	510054	STRUCTURAL CONCRETE, BRIDGE (POLYMER FIBER)	CY	364	1700.00	$	618,800
49	510085	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE EQ)	CY	26	1200.00	$	31,200
50	520102	BAR REINFORCING STEEL (BRIDGE)	LB	111,130	2.00	$	222,260
51	600162	MISCELLANEOUS METAL (RESTRAINER - PIPE TYPE)	LB	1,392	50.00	$	69,600
52	839740	CALIFORNIA ST-10 BRIDGE RAIL	LF	200	500.00	$	100,000
					STRUCTURE SUBTOTAL	**$**	**1,660,390**
53	999990	MOBILIZATION	LS	1	0.00	$	-
					CONSTRUCTION TOTAL=	$	2,323,435
					CONTINGENCIES (20%)=	$	464,687
					GRAND TOTAL=	$	2,789,000

SALT GRASS FLATS PLANTING AREAS - 0.03 AC

Subtotal $ 2,587

BOTANICAL NAME	CONTAINER SIZE	QUANTITY	FENCE TYPE	Unit Cost	Cost
DISTICHLIS SPICATA	DP 16	132	N/A	$17.75	$ 2,343
JAUMEA CARNOSA	4" POT	18	N/A	$9.75	$ 176
SALICORNIA PACIFICA	4" POT	7	N/A	$9.75	$ 68

SALT MARSH BULRUSH MARSH PLANTING AREAS - 0.09 AC

Subtotal $ 3,203

BOTANICAL NAME	CONTAINER SIZE	QUANTITY	FENCE TYPE	Unit Cost	Cost
BOLBOSCHOENUS MARITIMUS	DP 16	87	N/A	$17.75	$ 1,544
DISTICHLIS SPICATA	DP 16	30	N/A	$17.75	$ 533
FRANKENIA SALINA	DP 16	7	N/A	$17.75	$ 124
GRINDELIA STRICTA	DP 16	7	N/A	$17.75	$ 124
JAUMEA CARNOSA	4" POT	60	N/A	$9.75	$ 585
SALICORNIA PACIFICA	4" POT	30	N/A	$9.75	$ 293

ARROYO WILLOW THICKET PLANTING AREAS - 1.51 AC

Subtotal $ 21,196

BOTANICAL NAME	CONTAINER SIZE	QUANTITY	FENCE TYPE	Unit Cost	Cost
ALNUS RUBRA	DP 40	44		$25.50	$ 1,122
CAREX OBNUPTA	DP 16	142	N/A	$17.75	$ 2,521
OENANTHE SARMENTOSA	DP 16	18	N/A	$17.75	$ 320
PERSICARIA PUNCTATA	DP 16	36	N/A	$17.75	$ 639
RUBUS URSINUS	DP 16	266	GROUP	$17.75	$ 4,722
SALIX LASIOLEPIS	STAKE	133	GROUP	$9.75	$ 1,297
SCIRPUS MICROCARPUS	DP 16	533	N/A	$17.75	$ 9,461
STACHYS CHAMISSONIS	DP 16	53	N/A	$17.75	$ 941
WOODWARDIA FIMBRIATA	4" POT	18	N/A	$9.75	$ 176

RED ALDER FOREST - LOWLAND PLANTING AREAS - 0.42 AC

Subtotal $ 41,426

BOTANICAL NAME	CONTAINER SIZE	QUANTITY	FENCE TYPE	Unit Cost	Cost
ALNUS RUBRA	DP 40	251	INDIVID	$25.50	$ 6,401
CAREX OBNUPTA	DP 16	168	N/A	$17.75	$ 2,982
JUNCUS LESCURII	DP 16	168	N/A	$17.75	$ 2,982
PERSICARIA PUNCTATA	DP 16	101	N/A	$17.75	$ 1,793
POTENTILLA ANSERINA	DP 16	67	N/A	$17.75	$ 1,189
SALIX LASIOLEPIS	STAKE	126	GROUP	$9.75	$ 1,229
SAMBUCUS RACEMOSA	DP 40	168	INDIVID	$25.50	$ 4,284
SCIRPUS MICROCARPUS	DP 16	1005	N/A	$17.75	$ 17,839
SCROPHULARIA CALIFORNICA	DP 16	101	N/A	$17.75	$ 1,793
STACHYS CHAMISSONIS	DP 16	34	N/A	$17.75	$ 604
WOODWARDIA FIMBRIATA	4" POT	34	N/A	$9.75	$ 332

RED ALDER FOREST - UPLAND PLANTING AREAS - 0.09 AC

Subtotal $ 12,529

BOTANICAL NAME	CONTAINER SIZE	QUANTITY	FENCE TYPE	Unit Cost	Cost
ACER NEGUNDO	DP 16	6	INDIVID	$17.75	$ 107
ALNUS RUBRA	DP 16	100	INDIVID	$17.75	$ 1,775
JUNCUS LESCURII	DP 16	57	N/A	$17.75	$ 1,012
SALIX LASIOLEPIS	STAKE	29	GROUP	$9.00	$ 261
SAMBUCUS RACEMOSA	DP 40	34	INDIVID	$25.50	$ 867
SCIRPUS MICROCARPUS	DP 16	182	N/A	$9.75	$ 1,775
SCROPHULARIA CALIFORNICA	DP 16	251	N/A	$25.50	$ 6,401
SEQUOIA SEMPERVIRENS	1G TREEBAND	6	INDIVID	$37.50	$ 225
WOODWARDIA FIMBRIATA	4" POT	11	N/A	$9.75	$ 107

COASTAL BRAMBLES PLANTING AREAS - 0.59 AC

Subtotal $ 43,938

BOTANICAL NAME	CONTAINER SIZE	QUANTITY	FENCE TYPE	Unit Cost	Cost
ALNUS RUBRA	DP 16	102	INDIVID	$17.75	$ 1,811
ARTEMISA DOUGLASIANA	DP 16	136	GROUP	$17.75	$ 2,414
BACCHARIS PILULARIS	DP 16	82	GROUP	$17.75	$ 1,456
JUNCUS HESPERIUS	DP 16	136	N/A	$17.75	$ 2,414
JUNCUS LESCURII	DP 16	191	N/A	$17.75	$ 3,390
RUBUS URSINUS	DP 16	1361	GROUP	$17.75	$ 24,158
SAMBUCUS RACEMOSA	DP 40	136	INDIVID	$25.50	$ 3,468
SCIRPUS MICROCARPUS	DP 16	272	N/A	$17.75	$ 4,828

COAST LIVE OAK WOODLAND PLANTING AREAS - 0.12 AC

Subtotal $ 22,843

BOTANICAL NAME	CONTAINER SIZE	QUANTITY	FENCE TYPE	Unit Cost	Cost
AESCULUS CALIFORNICA	DP 16	11	INDIVID	$17.75	$ 195
ARTEMISA CALIFORNICA	DP 16	43	GROUP	$17.75	$ 763
CHLOROGALUM POMERIDIANUM	DP 16	43	N/A	$17.75	$ 763
DANTHONIA CALIFORNICA	DP 16	384	N/A	$17.75	$ 6,816
FRAGARIA VESCA	DP 16	96	N/A	$17.75	$ 1,704
HETEROMELES ARBUTIFOLIA	DP 40	21	INDIVID	$25.50	$ 536
MARAH OREGANA	DP 16	43	N/A	$17.75	$ 763
QUERCUS AGRIFOLIA	1G TREEBAND	85	INDIVID	$37.50	$ 3,188
SCROPHULARIA CALIFORNICA	DP 16	43	N/A	$17.75	$ 763
STIPA PULCHRA	DP 16	384	N/A	$17.75	$ 6,816
UMBELLULARIA CALIFORNICA	DP 40	21	INDIVID	$25.50	$ 536

COYOTE BRUSH SCRUB PLANTING AREAS - 0.06 AC

Subtotal $ 7,664

BOTANICAL NAME	CONTAINER SIZE	QUANTITY	FENCE TYPE	Unit Cost	Cost
ARTEMISA CALIFORNICA	DP 16	66	GROUP	$17.75	$ 1,172
BACCHARIS PILULARIS	DP 16	93	GROUP	$17.75	$ 1,651
FRANGULA CALIFORNICA	DP 40	4	INDIVID	$25.50	$ 102
LONICERA HISPIDULA	DP 16	3	INDIVID	$17.75	$ 53
MIMULUS AURANTIACUS	DP 16	10	N/A	$17.75	$ 178
RUBUS URSINUS	DP 16	46	GROUP	$17.75	$ 817
STIPA PULCHRA	DP 16	208	N/A	$17.75	$ 3,692

Appendix E: Preliminary Geotechnical Report

PRELIMINARY FOUNDATION REPORT

Marin County Open Space District Bolinas Lagoon Wye Wetlands Project

Marin County, California

Prepared by:

Sacramento | Modesto | Pleasanton | Rocklin | Ukiah

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

June 17, 2020

Prepared for:

WRA
2168-G East Francisco Blvd
San Rafael, CA 94901

June 17, 2020
CAInc File No. 19-570.1

Mr. Brian Bartell
WRA, Inc.
2168-G East Francisco Blvd
San Rafael, CA 94901

Subject: **PRELIMINARY FOUNDATION REPORT**
Marin County Open Space District Bolinas Lagoon Wye Wetlands Project
Marin County, California

Dear Mr. Bartell,

Crawford & Associates, Inc. (CAInc) prepared this Preliminary Foundation Report for the Marin County Open Space District Bolinas Lagoon Wye Wetlands Project in Marin County, California. CAInc prepared this report in accordance with our December 18, 2019 agreement. Further geotechnical study including test borings, laboratory testing, and analysis will be completed to prepare design level recommendations for the project.

The preliminary recommendations presented in this report are based on discussions with WRA, Marin County, and Mark Thomas personnel, review of the geometric plan, and nearby subsurface exploration.

Thank you for the opportunity to be part of your design team. Please call if you have questions or require additional information.

Crawford & Associates, Inc.,

Ellen Tiedemann, EIT
Project Engineer

Benjamin D. Crawford, PE, GE
Principal Geotechnical Engineer

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1 SCOPE OF WORK

1.1 PURPOSE

Crawford & Associates, Inc. (CAInc) prepared this Preliminary Foundation Report for the Marin County Open Space District Bolinas Lagoon Wye Wetlands Project in Marin County, California. The purpose of this report is to provide preliminary geologic, seismic, and foundation data for use in preliminary bridge design.

Following preliminary design, CAInc will complete test borings, laboratory tests, Log of Test Borings (LOTB), geotechnical evaluation/analysis, and prepare a draft/final foundation report.

1.2 GEOTECHNICAL SERVICES

To prepare this report, CAInc:

- Discussed with WRA, Mark Thomas, and Marin County;
- Attended kick off meeting on December 11, 2019;
- Reviewed the Conceptual Design Report dated December 2017 prepared by AECOM;
- Reviewed the Geometrics Drawing dated June 1, 2020 prepared by Mark Thomas; and
- Reviewed available published geologic and seismic mapping of the site.

2 PROJECT DESCRIPTION

The project site is in Bolinas Lagoon in Marin County, California; located at the intersection of Olema-Bolinas Road and State Route (SR) 1. The site coordinates are approximately latitude 37.9350°N and longitude 122.6997°W. See the Figure 1 for the site vicinity map.

The Marin County Open Space District Bolinas Lagoon Wye Wetlands Project is aimed at providing roadway improvements to restore wetlands/streams, protect wildlife, improve safety, reduce flooding, and create climate change resiliency. The intersection of Olema-Bolinas Road and SR 1 will be realigned approximately 250 ft east for the proposed realignment/restoration of Lewis Gulch Creek. A single-span bridge approximately 24 ft wide and 60 ft long is proposed for the new Lewis Gulch Creek crossing. Olema-Bolias Road will be raised 2 to 5 ft and widened 8 ft to the east with side slopes of 2:1 (H:V). The project also includes the removal of the existing Olema-Bolinas Road and SR 1 intersection and approximately 525 ft of Fairfax-Bolinas Road to restore natural wetlands.

We show the proposed alignment in Appendix II.

3 EXCEPTIONS TO POLICIES AND PROCEDURES

There are no geotechnical design exceptions to departmental policies and procedures for this project.

4 FIELD INVESTIGATION

CAInc will complete a field investigation including borings at select support locations for the Draft Foundation Report.

5 SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 REGIONAL GEOLOGY

The site is located within the Coast Ranges portion of the Central Valley Province[1] characterized by a series of northwest trending mountain ranges subparallel to the San Andreas Fault. This geomorphic province is bounded by the Klamath Mountains to the north, the Great Valley on the east and the Transverse Ranges to the south. To the west is the Pacific Ocean and strata dip beneath alluvium of the Great Valley on the east. The coastline is uplifted, terraced and wave-cut. The Coast Ranges are composed of thick Mesozoic and Cenozoic sedimentary strata. The northern and southern ranges are separated by a depression containing the San Francisco Bay.

5.2 SITE GEOLOGY

Published geologic mapping[2] shows the proposed bridge crossing underlain by undivided Holocene aged Alluvial deposits (Qa), comprised of gravel, sand, silt and clay. The mapping shows existing Fairfax-Bolinas Road is underlain by Holocene aged Estuarine-delta deposits (Qed) characterized by a mixture of coarse/fine estuarine sediment deposited in delta at mouths of tidally influenced coastal streams where fresh water mixes with seawater. At the project location, Olema-Bolinas Road is mapped within both Qa and Qed deposits.

The proposed bridge is mapped approximately 300 ft east of the San Andreas Fault Zone. In the vicinity of the project, the San Andreas Fault zone is comprised of San Gregorio Fault, San Andreas Fault, Golden Gate Fault, and multiple splays.

We note that 1977 geologic mapping in AECOM's Conceptual Design Report shows slightly different fault trace locations than the 2015 mapping we used. Based on the 2015 quadrangle mapping, six of the seven borings completed by AECOM were located east of the Golden Gate Fault.

A Geologic Map is included as Figure 2.

5.3 PREVIOUS FIELD EXPLORATIONS

AECOM completed seven borings in March through April 2017 to a maximum depth of 66.5 ft below ground surface (bgs). Borings 1 and 6 are located closest to the proposed bridge. In general, the upper 20 ft bgs within borings 1 and 6 consisted of very soft to soft clay/silty clay. Medium to very stiff clay was encountered below the very soft/soft clay to a depth of 30 ft bgs. These clay layers were underlain by medium dense to dense clayey sand, clayey sand with gravel, and silty sand. Sandy claystone was encountered at 46 ft bgs and shale was encountered at 55 ft bgs in borings 1 and 6 respectively.

The AECOM boring logs and locations are attached in Appendix I.

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[1] California Geologic Survey (2002), *California Geomorphic Province*, Note 36.

[2] Cochrane, G.R., Dartnell, Peter, Johnson, S.Y., Greene, H.G., Erdey, M.D., Golden, N.E., Hartwell, S.R., Manson, M.W., Sliter, R.W., Endris, C.A., Watt, J.T., Ross, S.L., Kvitek, R.G., Phillips, E.L., Bruns, T.R., and Chin, J.L., 2015, California State Waters Map Series: offshore of Bolinas, California: U.S. Geological Survey, Open-File Report OF-2015-1135, scale 1:24,000

5.4 GROUNDWATER

AECOM encountered shallow groundwater ranging from 1.5 to 10 ft bgs during their subsurface exploration. AECOM installed four groundwater monitoring wells and measured groundwater depths ranging from 0.3 to 2.8 ft bgs between March and April of 2017.

Based on the above information, CAInc expects design groundwater to be relatively shallow.

6 AS-BUILT FOUNDATION DATA

The proposed crossing is a new bridge with no as-built information.

7 SCOUR EVALUATION

We consider the alluvial soils susceptible to scour and this will be a design consideration for new structure foundations.

8 CORROSION EVALUATION

A corrosion evaluation will be completed for the Draft Foundation Report. Based on United States Department of Agriculture mapping[3], the site corrosivity is low for concrete elements and high for steel elements.

9 PRELIMINARY SEISMIC DATA

9.1 GROUND MOTION

CAInc used the Caltrans ARS Online (V3.0.2)[4] web-based tool to calculate probabilistic acceleration response spectra for the site based on criteria outlined in Appendix B of the April 2019 Caltrans Seismic Design Criteria (SDC) Version 2.0.

For our preliminary evaluation, we used latitude 37.9350°N and longitude 122.6997°W for the site coordinates and an estimated shear wave velocity (V_{S30}) of 200 meters per second (about 690 feet per second) that corresponds to a "stiff soil" with 180 m/s < Vs < 360 m/s (Soil Profile Type D) for the upper 100 feet of the soil profile.

The V_{S30} value was estimated for this site based on the soil data from AECOM.

Caltrans structure design practice also requires an increase in design strength due to fault proximity (near-fault factor) and a deep sedimentary basin (basin factor). The near-fault adjustment factor is applied for locations with a site-to-rupture plane distance (R_{rup}) of 25 km (15.5 miles) or less. The basin adjustment factor is applied for locations over a deep sedimentary basin to compensate for the increased ground response caused by soft sediments. The near fault factor applies to the site and the basin factor does not.

[3] https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
[4] https://arsonline.dot.ca.gov

9.2 RECOMMENDED SEISMIC DATA

For probabilistic analysis, Caltrans ARS Online (v3.0.2) uses 2014 USGS hazard deaggregation results. The site-source distance (mean distance used to calculate near-fault factor) is calculated at the deaggregation performed at 1-second spectral period. The mean magnitude is included for simplified liquefaction analysis and is determined from a hazard deaggregation performed at the PGA.

The Preliminary Seismic Design Response Spectrums will be re-evaluated following subsurface exploration by CAInc. Based on the above information, we recommend that structure design be based on the following Caltrans SDC parameters:

- Shear Wave Velocity, V_{S30}: 200 meters per second (656 fps);
- Soil Profile Type D;
- Magnitude (M): 7.62;
- Peak Ground Acceleration (PGA): 0.73g;
- Site-to-Fault Distance (r): 0.68 mi / 1.1 km; and,
- Controlling Spectra: Caltrans ARS Online USGS Probabilistic Spectrum

We include the recommended Preliminary ARS Curve as Figure 4, attached.

9.3 FAULT RUPTURE

The site does lie within an Alquist–Priolo Earthquake Fault Zone (EFZ) mapping by the California Geologic Survey. An Earthquake Fault Zone is defined as a regulatory zone around a fault that shows evidence of surface rupture within the past 11,000 years.

Since the site is within an EFZ, the fault rupture hazard (defined as the probability of occurrence) cannot be precluded. The bridge does not cross the mapped fault traces. The nearest fault trace is estimated to be about 250 ft west of the proposed bridge based on Alquist-Priolo EFZ mapping.

Based on Caltrans Memo to Designers 2013 (MTD) 20-10, a fault rupture hazard analysis is required. Measurements of site specific fault displacements are not available for this site. Trenching to evaluate traces of the San Andreas Fault at the bridge site would be difficult due to vegetation, environmental constraints, and shallow groundwater. Additional field work to estimate site specific fault displacements would most likely not significantly reduce the expected displacement at the bridge site, therefore is not recommended.

We will estimate fault displacements per Caltrans MTD 20-10 in the Foundation Report during final design.

We show the Fault Map on Figure 3.

9.4 LIQUEFACTION AND SEISMIC SETTLEMENT POTENTIAL

Soil liquefaction can occur when saturated, relatively loose sand and specific soft, fine-grained saturated soils are subject to ground shaking strong enough to create soil particle separation that results from increased pore pressure. This separation and subsequent pore pressure dissipation can lead to decreased soil shear strength and settlement. Liquefaction is known to occur in soils ranging from low plasticity silts to gravels (generally within 50 feet of the surface). However, soils most susceptible to liquefaction are clean sands to silty sands and non-plastic silts.

Based on our analysis/review of AECOM nearby borings (B1 and B6), liquefaction settlement is possible but probably low due to the cohesive nature of the soils. The potential for liquefaction will be further evaluated in the Draft Foundation Report after completion of test borings and laboratory testing.

10 PRELIMINARY RECOMMENDATIONS

The site is considered adequately stable with support available for new bridge foundations established within the underlying rock. Key geotechnical considerations associated with the project include liquefaction settlement, possible differential settlement between the bridge and structure embankment approaches due to the presence of thick clay layers, and potential for long-term static (consolidation) settlement.

10.1 BRIDGE FOUDATIONS

We do not expect spread footing foundations to be appropriate at this site due to the relatively weak bearing materials and potential settlement. It is expected that the new bridge will be supported on either driven or drilled pile foundations. Driven or drilled pipe foundations can be designed to accommodate downdrag from settlement (consolidation and/or liquefaction). H-piles were considered, but are not preferred due to the tendency to drive further than displacement-type piles for similar bearing.

Use of CIDH piles at this site is expected to require special installation measures, including temporary casing, slurry drilling methods (with inspection tubes) and the use of minimum 24-inch diameter CIDH piles for tremie concrete placement due to the anticipated presence of groundwater observed at the site. Cast-in-drilled-hole (CIDH) piles may be preferable due to the noise/vibration associated with driven piles.

For preliminary design 24-inch CIDH piles and Class 200 14-inch square concrete displacement piles (Alt “X”) are expected to extend to about 60 to 80 ft below existing road elevation to develop capacity for 400-kip nominal capacity loads.

10.2 APPROACH ROADWAY SECTION

Some earthwork is anticipated at the approaches for a higher profile grade and alignment shift to the east. We expect that new approach fills will be stable at slopes of 2H:1V, or flatter, when constructed in accordance with typical earthwork specifications and with approved borrow material and geotextiles. Due to the near surface soft/compressible soils, geotextiles will be needed to stabilize subgrade and embankments and reduce the potential for differential settlement. The Olema-Bolinas Road shoulder roadway widening on virgin wetland will cause differential settlement and a settlement waiting period will be necessary. For preliminary planning, we expect a settlement waiting period of 6 to 12 months. The use of surcharge loads, wick drains, and/or lightweight fill will reduce the settlement waiting period.

11 ADDITIONAL STUDY

CAInc will provide a Foundation Report for final bridge design as needed, including specific foundation recommendations based on our completed field explorations and testing.

12 LIMITATIONS

This report is preliminary and not to be used for final design. CAInc will complete geotechnical engineering analysis for selected foundation elements based on defined foundation data and loads provided by Mark Thomas. CAInc prepared this report for preliminary design purposes only. CAInc will provide a Foundation Report for final bridge design, including specific foundation recommendations based on design criteria developed for this project.

CAInc performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. This report applies only to the Marin County Open Space District Bolinas Lagoon Wye Wetlands Project. Do not use or rely on this report for different locations or improvements without the written consent of CAInc.

FIGURES

Map Source:
-USGS 7.5' Topographic Maps, Bolinas, Marin County, California, 2018, Scale 1:24,000

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services
1100 Corporate Way
Suite 230
Sacramento, CA 95831
(916) 455-4225

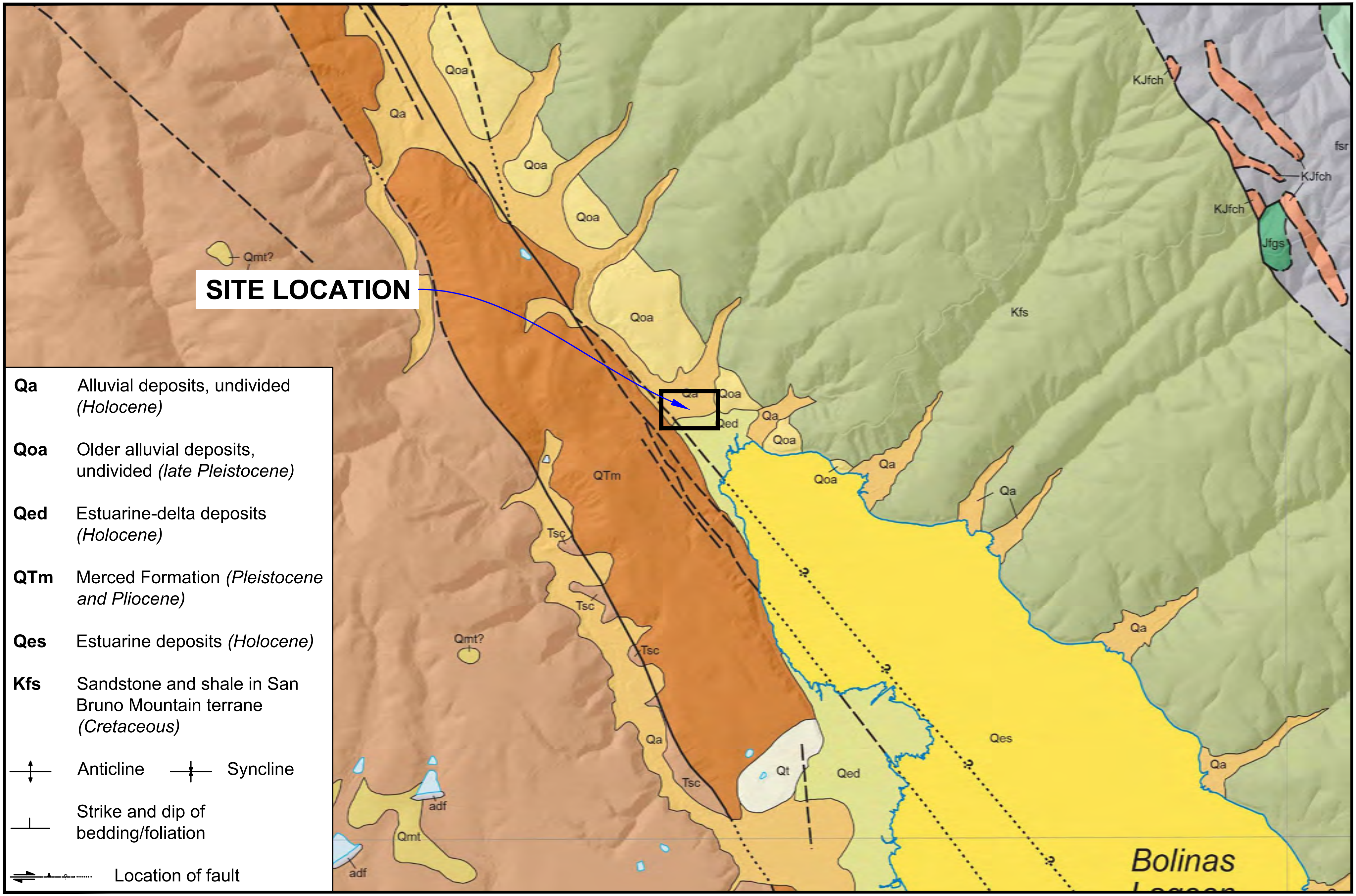
Taber
Since 1954

MARIN COUNTY OPEN SPACE DISTRICT BOLINAS LAGOON WYE WETLANDS PROJECT

MARIN COUNTY, CA

Figure 1
Vicinity Map

Proj. No:	19-570.1
Scale:	1" = 2,000'
Date:	6/16/2020



Map Source:

-Cochrane, G.R., et al. *California State Waters Map Series: offshore of Bolinas, California*. 1:24,000. Denver, CO: U.S. Geological Survey, 2015.

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Suite 230
Sacramento, CA 95831
(916) 455-4225

MARIN COUNTY OPEN SPACE DISTRICT
BOLINAS LAGOON WYE WETLANDS PROJECT

MARIN COUNTY, CA

Figure 2
Geologic Map

Proj. No:	19-570.1
Scale:	1"=2,000'
Date:	6/16/2020

LEGEND

Quaternary Fault (Age)	Quaternary Fault (Age)	Location	
<150 years (red)	<750,000 years (blue)	———	Well Constrained
<15,000 years (orange)	<1.6 million years (cyan)	– – – –	Moderately Constrained
<130,000 years (yellow)		--------	Inferred

North

Map and Data Sources:

-Basemap via AutoCAD Civil 3D geolocation tool

-Fault data via CGS Fault Activity Map of California 2010 GIS data

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1100 Corporate Way
Suite 230
Sacramento, CA 95831
(916) 455-4225

MARIN COUNTY OPEN SPACE DISTRICT
BOLINAS LAGOON WYE WETLANDS PROJECT

MARIN COUNTY, CA

Figure 3
Fault Map

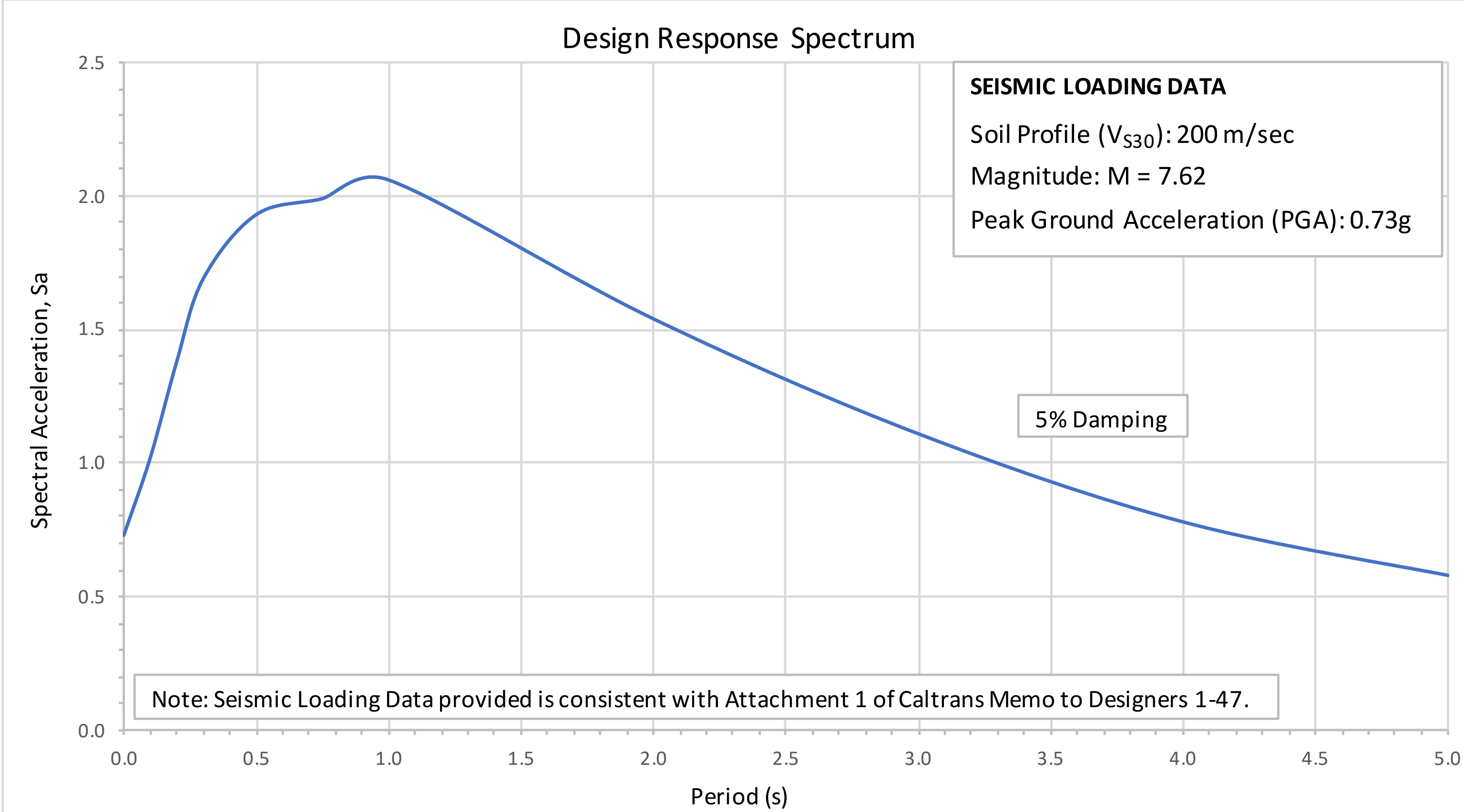
Proj. No:	19-570.1
Scale:	1"=5,000'
Date:	6/16/2020

SEISMIC DESIGN DATA

Marin County Open Space District Bolinas Lagoon Wye Project
Marin County, California

CAInc Project Number: 19-570.1
Caltrans ARS Online Version: V3.0.2
Date Accessed: 6/16/2020

Period (s)	Spectral Acceleration, Sa (g)
0.000	0.73
0.100	1.02
0.200	1.38
0.300	1.69
0.500	1.93
0.750	1.99
1.000	2.06
2.000	1.54
3.000	1.11
4.000	0.78
5.000	0.58



The Design Response Spectrum for the Safety Evaluation Earthquake is based on the 2014 USGS Seismic Hazard Map for the 5% in 50 years probability of exceedance (975-year return period) with adjustment factors for near-fault and basin amplification effects.

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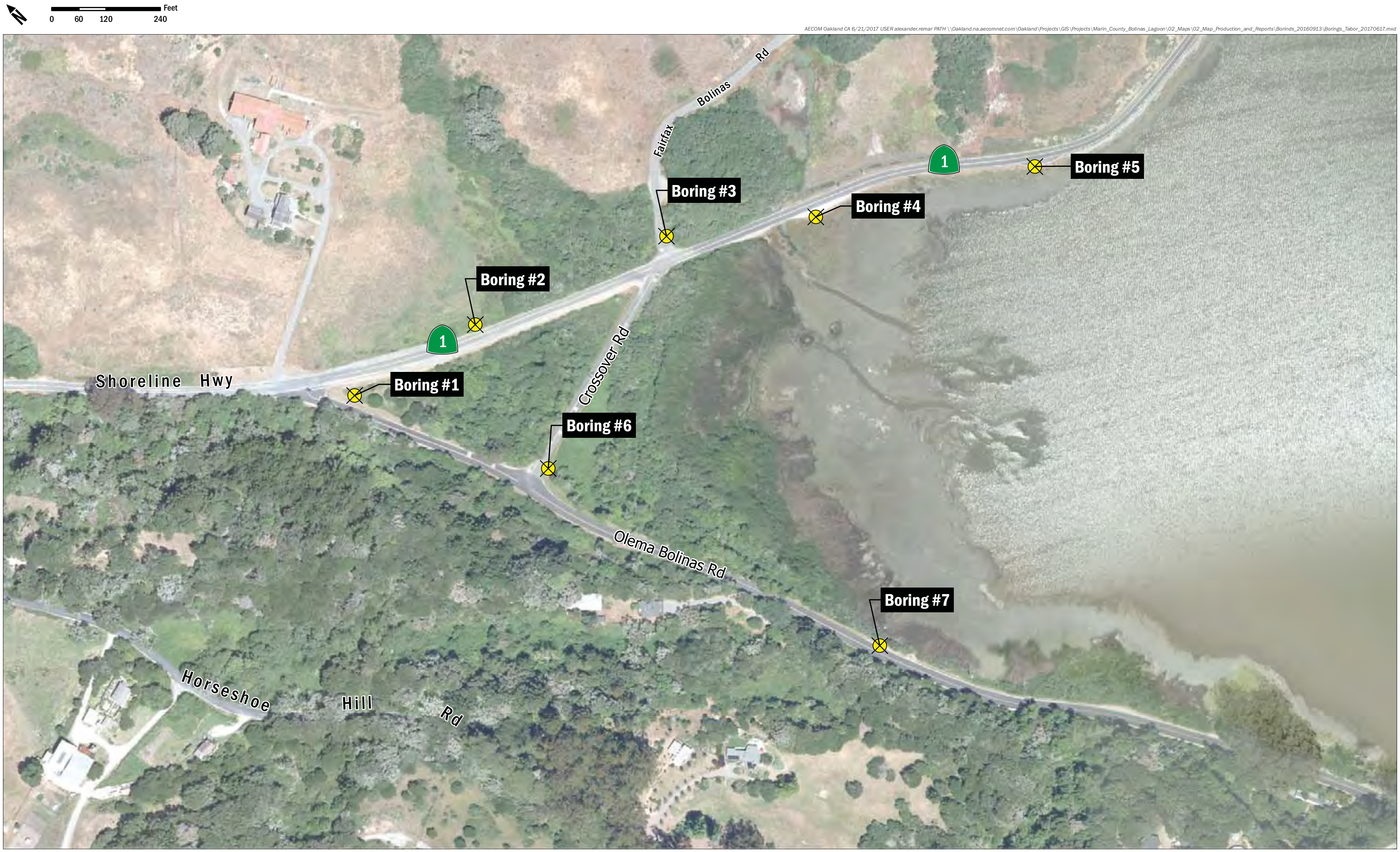
Site Latitude: 37.935
Site Longitude: -122.6997

Figure 4

APPENDIX I

AECOM Boring Location Plan
AECOM Boring Logs



AECOM
Marin County
Bolinas Lagoon Restoration

EXPLANATION

Geotechnical Boring (AECOM, March - April 2017)

FIGURE 1

Project Site and Geotechnical Boring Location Plan, June 2017

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! H' 1+-; $Ā%<) Ā ! "#$%Ā&' "$%($)Ā+Ā-. ,- +!%' Ā !(' $!0 '* %)-* (' ' &Ā2"$%Ā2/.)0, Ā' Ā3 "0!$*'& Ā'0) 4 5

> J 1,#';1:Ā# 3$';+,;%4) 6' ,%$"($)*Ā+Ā !(' $!0Ā*%)- *(' '& Ā$* !&&$($)Ā) Ā%0!,$-$%!($)Ā*& Ā7898: Ā! 2Ā$*%0-&Ā' 0!($;'Ā&'* ,$(2) Ā%* ,$, ('*%2:Ā%)0) Ā)$,(- ': Ā*& Ā- ! $*Ā$='5

8 G# ::Ā; 1<'10) Ā ! "#$%Ā&' "$%($)Ā+Ā4 '00Ā "$'=)/'(' Ā$*,(!00!($)*Ā !(' $!0Ā' Ā0$;'& Ā$*Ā#'!& Ā0)%T1 < !" #$%Ā2/.)0, Ā' Ā3 "0!$*'&Ā'0)4 5

Ā. G1,#' Ā0%4,#4,) L! (' Ā)*(* (Ā+Ā)$0Ā!/ "0' Ā '! ,-' &Ā$* 0!.) ! () 2:Ā3 " ',,'& Ā, Ā' %'* (!<' Ā+Ā& 2Ā4 '$<#(Ā+Ā"'%$/ '* 5

ĀĀ C:4#3Ā0%4,#4,ĀF O' %'* (Ā+$*' Ā#!* ĀSAEĀ$;' :Ā, Ā '! ,-' &Ā$* (#' Ā0!.) ! () 2

Ā "# 01 '23Ā145Ā, - #' Ā#3,3) M.,' ;! ($)*, Ā'<! &$*<Ā& 00Ā< ,!/ "0$*<Ā! &' Ā2 Ā& $00Ā Ā+$'0Ā' ,)** '05Ā(#' Ā$'0Ā* & 0!.) ! () 2 Ā,(Ā' ,-0(, :Ā,$*< Ā# Ā+)00)4$*<Ā. ' ;$! ($)*,N

7PNMQI ĀQ 7L" MQI ĀH"Q NRMĀPJ S6I9

JGQ>Ā9J QVĀH9JK	JGQ>Ā9J QVĀ4$(#Ā8Q>6 H9JK	8Q>6V ĀJGQ>Ā9J QVĀH9JK	8Q>6V ĀJGQ>Ā9J QVĀ4$(# ĀWQXGJĀH9JK
8UJRVĀ9J QVĀH9JC JK	JGQ>Ā) ĀYQRĀ9J QV H9JC9Z K	JGQ>Ā) ĀYQRĀ9J QVĀ4$(# ĀWQXGJĀH9JC9Z K	YQRĀ9JQV ĀH9ZK
YQRĀ8UJRVĀ9JQV H9ZC ZK	YQRĀ8UJRVĀ9JQV Ā4$(# ĀWQXGJĀH9ZC ZK	8Q>68RM> G	8Q>6V Ā8UJR8RM>G
8UJR8RM>G	9 JQV8RM>G	8ZQJG	I GJQ>ĀGĀ8ZQJG

7PNMQI ĀGLII ĀH"Q NRMĀPJ S6I9

AFĀOX9 Ā8)0$&Ā! ,$*<Ā$* >' !(Ā'/'*(ĀĀ)- (	AFĀOX9 Ā8)0$&Ā! ,$*<Ā$* ['*()* $('Ā'00'(,
AFĀOX9 Ā8)0$&Ā! ,$*<Ā$*ĀSF 8!*&	AFĀOX9 ĀE5EĀC$*Ā80)(('& 9! ,$*<Ā$*ĀSFĀ8!*&
SFĀ8!*& Ā$*Ā#) 0'	

W") (N ĀGM@ĀL\MQ] '] GVĀĀ0'ĀMJU>Q8 ĀQG3MI ĀWM9] ĀMWGĀO^ĀĀ@DE@ĀĀC@

AECOM

8,0 ^(7'" ĀĀ=ĀĀ-23&Ā3:002 ĀG0,' +Ā24 ĀM(&'0,3'-02
8,0 ^(7' Ā073' -02"ĀĀĀ, -2Ā 052'. YĀ
8,0 ^(7' ĀG5; / (,"ĀĀĀF?] ?#] X

!0: Ā6Ā0 -)Ā=0 , -2: Ā=C#
/)KK* ĀĀ-JĀ

4? *K8=9 4@&MMK	?[$\[$F#\ C[$B[$F#\	1<LLK>ĀSO	I EZ320T &A-	7) K(+K>ĀSO	ZEL3/0,
4@&MM&' RK*) <>	R324Ā5:(,Ā0 ĀDSBC-2Ā-0))0T Ā'(; Ā5:(, UR J VĀ+(,(36'(,	4@&Ā&M /&dKE ,ONK	X'Ā-324Ā5:(,SB'ĀPOĀRI J	,< *?M4KN*) <JS<@)<MK	HHBĀ(('
4@&ĀM1 ,ONK	*K ĀDĀ,57AC;052'(4 Ā-: ĀJLKMV	4@&MM&' 7<' *@(?<@	8-'7+(,ĀO,-))-2: Ā0 ; @32.	32 H4 ĀXĀG@U'> /U@?(KĀ6 MK?*&<	J@@01-; 3'(ĀBC6'
G@U'>B ?*K@ 1KTKM8=9	#FĀT+-)(Ā4,-))-2:	/ ?;N M&' RK*)<>8=9	I8L YĀK04-6(4Ā 3)-60,2-3	c? ;;K @ 4? *?	J5'0; 3'-7Ā-3;;(,S #XFĀ/ &YĀFC27+Ā4,0@
S<@)<MK 7<;N MK&'<	$%Ā9* Ā@(W0; ('(, Ā2&'3))(4			7 <<@&?* K 1<(?*&'	GĀ$#\ FDXĀĀĀ] $\ $\]

6MKT&<' JKK*	4KN*)a JKK*	IJ K8!I ,ONK	3U;A K@	/?;N M&'L DK=&?'(K	DK(<TK@Āa	G@?%(Ā<L	KJL MNJ!ĀĀI*MN 8LNPG	_KMĀ&?L@?;	? *K@ 7<'*K'a Ā	P&'K-Ā<'*K'* 8Fb^! CĀ&KTK9	M K JMQIĀGO PLR M Ā ILI
	F						%&'() Ā) &(+Ā - ./-0 1				Ā !!" Ā$%Ā(() *+ ,-&'. Ā0 1Ā2&'3))(4 3'Ā5,637(
							/ 2345 Ā1623Ā7125Ā719Ā< &=Ā?@ĀĀ@B' ĀĀC5D" E'9Ā$F GD2H61 Ā<ĀE#I:Ā#" F ĀJ&'KL@&'K>Ā 234: Ā$! F ĀMBĀNM?*&(&*O P036 / :Ā@<*MK= 21 1QH0QR				Ā !!" Ā$%Ā9 * Ā0)-4 73&-2: Ā24Ā2(3' 7(; (2'Ā, 05'Ā0 &5,637(
$D											
	D	Ā! Ā"	Ā ! !	ĀCC			ĀĀSK(<;K =ĀTK@Ā<J		!!V "	$!	NNZĀVĀ=JĀ [QQ\ R?]VĀ-KT&?<@ =*@K=ZYXX N=J:(< J&&L N@==U@Z#$CĀN=J
$F											
	#F	!	Ā ! "	$%			ĀĀSK(<;K =ĀBK*:Ā _<*MKĀ-?@ĀĀ@B' ĀĀC5D" E'9Ā'> Ā-?@ĀL@O 8#E39ĀB&) ĀĀ$F ĀJ&'KGD2H61: Ā$%FĀP036/		!!V "	$%	NNZĀVI$Ā=JĀ ?;N MK ^! ĀĀ?LLK>
#D											
	#D	"	Ā " $	C			/ 2345 Ā1623Ā7125Ā719ĀK >&U Ā<ĀTK@Ā=*&UĀBK*:Ā-?@ĀL@O&=) A@B' Ā!V$#E!9ĀWFĀ=UA?'LUM@GD2H61 Ā<ĀE#I:Ā#ĀF ĀJ&'KĀ< (<?@=K@&'K>Ā 234: Ā$! F ĀMBĀNM?*&(&ĀP036/ -1 46 DĀ211QH0QR				3<Ā@K TK@Ā=?;N MK@ @MM(K>Ā&Ā< MĀ' > @K TK@KĀ ?;N MĀ" >&=U@K>Ā' >ĀĀ?LLK> Ā !!" Ā$<Ā (2'02-'(8())(' Ā(3) _? *K@MTKKMĀK ?=U@K ?*ĀĀ%ĀVĀJ*K@ ?;N MK ^" Ā !!" Ā-?Ā&324Ā6)'(, @3ĀĀ#BC$DE< Ā !!" Ā$%Ā9 * ĀE$F &0' ' (4Ā7, ((2
#F											
	$F	# ! # "	" Ā" Ā%	XY					!"V!	$!	
D											
	$D	$	Ā# Ā% Ā#	%W			ĀĀSK(<;K =Ā-K'= K:Ā-?@ĀL@K &=)ĀL@OĀ$G#EĀ				Ā !!" ĀG(3' Ā(; (2' :,05' Ā$DEĀ0 ĀHEĀ<
F							712565Ā2 34Ā/79:ĀK >&U Ā-K'= K:Ā< &=ĀĀM(+ĀW$5D!V$EĀ9 %CFĀJ&'KL@&'K>Ā 234: Ā#CF ĀMBĀNM?*&(&ĀP036/ R 6D76 4ĀPRĀ; (				
?F											

DKN<@G6-eĀI_e-2 f: ĀĀ&MĀ1032/ Ā67-R Ā-7f Ā-D6 VG.g:ĀĀEĀ$EĀWĀ Ā

AECOM

8,0 ^(7'" ĀĀ=ĀĀ-23&Ā3:002 ĀG0,' +Ā24 ĀM(&'0,3'-02
8,0 ^(7' Ā073' -02"ĀĀĀ, -2Ā 052'. YĀ
8,0 ^(7' ĀG5; / (,"ĀĀĀF?] ?#] X

!0: Ā6Ā0 -)Ā=0 , -2: Ā=C#

/)KK* Ā Ā<JĀ'

6MKT*&<' JKK*	4KN*)a JKK*	,ONK	3U;A K@	/?;N M&'L DK=&*?'(K	DK(<TK@Āa	G@?%(Ā<L	KJ L MNJ ! ĀĀ I*MN 8LNPG	_KMĀĀ?L@?;	? *K@ 7<'*K'*a Ā	P&'K=Ā<'*K'* 8Fb^! CĀ&KTK9	M K JMQI ĀGO PLR M Ā ILI
	?F		%	$ % W	ÄCC		712565Ā2 34Ā8/79:ĀK >&U Ā=K'=K:Ā< &=ĀM(+ĀW$5D!V$Ā9 %CFĀJ&'KL@&'K>Ā 234: Ā#CF ĀMBĀM?*&(&ĀP36/V ĀSK(<;K =Ā?@ L@K'&=) Ā@O8ĀCG5#EĀĀ*ĀĀ` R6D76 4ĀPRĀ; (Ā!"#$"%&(				3<Ā@(<Ā?A@&(<A=K@T=&'Ā?;N MK
CD							/01, 5Ā2 34Ā8/ R9Ā=K'=KĀ<ĀK>&U; Ā*&JĀ< &=Ā@K'&=) Ā@O 8ĀCG5$EĀĀ%CFĀJ&'KL@&'K>Ā 234: Ā#CF Ā< ĀM?*&(&ĀP36/				
	?D		W! W"	X Ä% !$	ÄCC				ÄYY		,[QQVĀR?]VĀ=KT&?<@ =*@K=Z! $XĀ N=J:(<' J&&L N@==U@Z" !CCĀN=J
C#F											
	XF		X	Ä% ÄX !!	C		ĀSK(<;K =ĀM&LĀ@OĀ' >Ā@B' &=ĀKMBĀ8ĀC5DWE!h%%9ĀCF =UĀ@U'>K>ĀGD2H61Ā<ĀE#I				3<Ā@(<TK@Ā?;N MK @(<TK@KĀJ@<; =MJL) Ā<MM(K@<' =?;N M@?'> Ā?LLK>
C#D											
	XD		Y! Y"	Ä! Ä# Ä%	ÄCC		/ 2345 Ā7125 /, -3 6:ĀTK@Ā*&JĀ< &=Ā?@Ā@K &=ĀĀ@O 8ĀCSG#EĀĀCF ĀJ&'KL@&'K>Ā 234: ĀCF ĀK>&U; Ā<Ā&L) ĀM?*&(&' P36/ :Ā<;N MKMĀMK@>:ĀTK@ĀĀK]*@; KMĀBK?+				NNZ" V!$Ā=J c? @Ā=@&MM&'L
C$F											
	DF		ÄC! ÄC"	Ä! !! #C	ÄCC		ĀSK(<;K =Ā?@:Ā=?@Ā@K &=ĀĀ@OĀĀC5#EĀ9Ā%CFĀP36/		ÄYV	%C	c? @Ā=@&MM&'L
C$D											
	DD										
C%F											
	HF		ÄÄ	ÄW !# !Y	XY						NNZ #\$Ā=J
C%D											
	HD										

DKN<@G6-eĀ!_e-2 f: ĀĀMĀ1032/ Ā67-R ĀD-7f Ā-D6 VG.g:ĀĀEĀ$EĀĀĀ Ā

AECOM

8,0 ^(7'" ĀĀ=ĀĀ-23&Ā3:002 ĀG0,' +Ā24 ĀM(&'0,3'-02
8,0 ^(7' Ā073' -02"ĀĀKĀ, -2Ā 052'. YĀI
8,0 ^(7' ĀG5; / (,"ĀĀĀĀF?] ?#] X

!0: Ā06Ā0 -)Ā=0 , -2: Ā=C#

/)KK* Ā' Ā<JĀ'

6MKT*&<' JKK*	4KN*)a JKK*	IJ K8!I ,ONK 3U;A K@	/?;N M&'L DK=&*?'(K	DK(<TK@ĀĀa	G@?'%(Ā<L	KJ L MNJ! ĀCĀ I*MN 8LNPG	KMM 4&?L@?;	? *K@ 7<'*K'*a Ā=	P&'K=Ā<'*K'* 8Fb^! CĀ&KTK9	M K JMQI ĀGO PLR M Ā ILI
	HD	Ā!	ĀW ĀY !W	ĀCC		/ 2345 Ā7125 /, -3 6:Ā?@:Ā< &=Ā>?@ĀL@K &=ĀL@OĀĀC5#ĀĀ9: !CF ĀJ&'KL@&?K>Ā 234: ĀKCF ĀK>&U; Ā<Ā&L) ĀM?*&(&ĀP36/: (<;N MKKMĀMK@>:ĀK@Ā<Ā]*@; KMĀBK?+ R 6D76 4 ĀPRĀ; (ĀĀ !"# $"%&(				NNZ #\$Ā=J

LPLJ! ĀO 8LRĀ ĀHĀDĀ` L
a ,05' Ā 0"0 ; Ā06Ā0)(Ā[$\[$F#'YĀĀ( ))Ā2&'3))Ā[$B[$F#\

CX, \F, CX0, \D, CB, BF, CD, BD, CH,]F, CB,]D, CF, #FF

DKN<@Ā6-eĀ!_e-2 f: ĀĀMĀ1032/ Ā67-R ĀD-7f Ā-D6 VG.g:ĀĀĀ$ĀWĀĀ Ā

AECOM

8,0](7'" ĀÃ@ĀÕ-23&Ā3:002 ĀP0,' +Ā24 ĀL(&'0,3'-02
8,0](7' Ā073' -02"ĀĀĀ, -2Ā 052'.V ĀI
8,0](7' ĀP5> / (,"ĀĀĀ,?Z?#ZS

!0: Ā06ĀH0-)Ā324Ā0 , (Ā@0,-2: Ā@$
3/<<0ĀĀĀLFĀ

F: 0<G$I F=%9J9<	?X$BX;#Y=?XZX$;#Y	6LQQ<ĀM;	H0W320[&E-	N/ <.1<J ĀM;	W&3/0,
F=%9Q%- H<0' LJ	R324Ā35:(,Ā0 ĀĀ-Ā,0'3,. Ā 3&+Ā+ (,(36'(,	F=%ĀD9% 3%<V7; #<	S°Ā-324,Ā35:(,TĀ^ĀUĀS°Ā4, 3: Ā324 ',-702(Ā- '&	7L0:9F<#0' LFĀL=</L9<	A#GĀ5(('
F=%Ā9%Q 7; #<	*J ĀAĀK,57E=>052'(4 Ā-: Ā^KJ L_	F=%9Q%- NL- 0=:.0L=	8-'7+(,ĀI,-))-2: Ā0 > D32.	E2 BF Ā* Ā@±Y-J 3Y=R <ĀC9<S: 0%L	I DD,01-> 3'(Ā$#=6'
@±Y-J D:0<= 6<S<9G$I	AG$Ā+-)(Ā4,-))-2:	3: T# 9%Q H<0/LJG$I	H8KVĀ$%Ā0 4-6(4Ā 3)-60,2-3ĀH+( )/ . '5/(	5: TT< = F: 0:	I 5'0,> 3'-7Ā-3>>(,T #S; Ā/ &VĀ;=-27+Ā4, 0D
ML=</L9< NLT# 9<0%L	$%Ā39* ĀD-(\ 0> ('(, Ā2&'3))(4Ā2Ā32Ā34]37(2 'ĀRHI Ā-0)(			NLL=J%0 < 6L. : 0%-	PĀ$#Y;SB?ĀĀĀZ$YSBS

C9<S0%L- R<<0	F<#0/e R<<0	HI J 8! H: 7; #< EYTK<=	3:T# 9%-Q A<$%$.-.<	A<.LS<= ĀW	@=:#% Ā6LQ	JI K LM! ĀĀH*LM 8KMOP	d<99F%:Q=:T	d: 0<= NL-0<-0ĀW	X%-<ĀL-0<-0 GWc\ !! Ā%S<I	LJ I LQHĀP N OKR L ĀK HKH
	;					Ā +%/- Ā0 %.Ā23 452 678Ā,Ā0:; <=$				Ā !!" Ā#$%Ā&'(() *+ , -&'. Ā0 1Ā2&'3))(4 3'Ā5,637(Ā !!" Ā$%Ā39 * Ā&0)-4 73&-2: Ā<=#; <Ā324Ā2(3' 7(> (2'Ā, 05'Ā0 &5,637(##^ U'Ā0$R
$;						3>67?Ā@A2BC6ĀD%Ā32E FĀG@0I8Ā0=; 8Ā0:- +K±LD- ++M32CNOPA3 C++				
						32EF? Ā6C2EĀN62?ĀD%ĀL=Q-%.ĀGN6Ā$LRĀ0LĀS<=Ā$0%ĀTL %$0 K9. 1ĀG'? U'VĀ8Ā ! WĀR%+G:%<JĀ32EF8Ā&WĀ9LDĀ#9:$0%.ĀX=EC38 =LL0$ ++26PB>PH++ ĀĀĀM<.L T< $ĀD<0 ĀĀĀM<.L T< $Ā$0%ĀTL 09<JĀJ: =1Ā<99D%$ĀK±LD- ĀGĀ?A) V,I				
#A	A	Ā+ Ā+)	Ā	*&				*U	'&	##^ ĀUĀ+ĀU'Ā0$8 7_ +PP'ĀH: [UĀ<S%0L= $0=<$$^Ā! (* #$R8.LR%Q_ #=<$$Y=<. " !Ā#$R Ā !!" ĀP<Ā@ 2'02-'(8())(' Ā(3)Ā<=B 3D%0ĀĀ0LĀ=L0:=ĀD:$ / 8 : JS:-.<ĀZĀ: $%Q0L)U'a Ā !!" ĀC2Ā&324Ā6)'(, D37EĀB<#F<
						32EF? Ā>67ĀGH5I8Ā$LRĀ83<0ĀS<=ĀJ: =1ĀQ=<-%$ĀQ=;ĀGĀ?) VĀI8))W ĀR%+G:%<JĀ32EF8Ā(WĀ<9$ 0%ĀX=EC38Ā$LT< ĀL=Q:-%ĀJ<0%%Y$				
#;	#;	+ +)	! ! !	Ā!!				*UĀ	'(	##^! U'Ā0$R 7^ĀU0" Ā1Q$bU.T8ĀPN` &', Ā#$R Ā !!" Ā$%Ā39 * ĀG$; &0'' (4Ā&7, ((2 Ā#;<=#A< ##^c! U" Ā0$R
		)	"! #$%	Ā!!						
						N62?C?Ā@A2BC6ĀD%Ā32E FĀG@0I8ĀD<0ĀS<=ĀJ: =1ĀQ=<-%$ĀQ=; GĀ?) VĀI8Ā$YK±Y-J<JĀ@A2BC6Ā0LĀVZĀ0ĀKL0LTĀLRĀ$: T# 9<Ā0YK<				
A	#A	,	! !	Ā!!		N62?C?Ā32EF ĀG3NI8Ā$0%ĀRLĀS<=Ā9L$<ĀD<0ĀS<=ĀJ: =1ĀQ=<-%$/ Q=;ĀGĀ?) VĀI8Ā! WĀ$YK±Y-J<JĀ@A2BC6Ā0LĀVZ8Ā"W ĀR%+G:%<J 32EF8Ā" WĀT<J%YTĀ#9:$0%.ĀX=EC38ĀS<=0%Ā=LL0$				##^ĀUĀ0$R
						@A2BC6ĀLFĀT%[<JĀ9%L0L9L0%$Ā$<<-Ā%ĀY00%Q$Ā-J Ā%Ā3: T# 9<Ā" $9LYQ'				@=S<9Ā%ĀY00%Q$
;	$;	"	& ĀĀ '	'Ā		32EF3 7OECĀKLY9<=8ĀT LJ<=0<Ā<99D%$ĀK±LD- ĀGĀ?A" V IĀ-J Q=<-%$/ ĀQ=;ĀG'@ VĀ8Ā%Q/9ĀD<:0/ <=<J8ĀS<=ĀD<:1 8ĀR%-%ĀD%0/ J<#0' ++7<=:<ĀF <#L$%$ĀG]0I++				OKS%I$Ā=L1 ĀR:K=%.
						32EF? Ā>67ĀGH6I8ĀT< J%YĀ<-$ <8ĀTL %$0TL J<=:0<Ā<99D%$/ K±LD- ĀGĀ?A" V IĀ-J ĀQ=<-%$ĀQ=;ĀG'@ VĀ8Ā"WĀ@A2BC6Ā0LĀZ8)"W ĀR%+Ā0LĀL: =$<G:%<JĀ32EF8Ā! WĀ9LDĀ#9:$0%.ĀX=EC3				A%Ā:0 0<= 3T LL0' ĀJ=%99%-Q
=A	$A	'+Ā '+	Ā(Ā)	(				Ā*U	"!	##^ U'Ā0$R2 JS:-.< "ZĀ: $%Q0LĀ" 8 =<TL S<ĀZĀ: $%Q8 C-J ĀLFĀ: ;Ā)V* V! Ā(M<Q%Ā: ;Ā)V& V! Ā(2H ĀD0<=Ā0<S<9^ĀU a KQ$ 3D%0ĀĀ0LĀZĀ0=%.L<ĀK%
						6C2EĀ0LĀX27ĀN62?ĀGN6N5I8Ā: =J8ĀTL %$0%ĀK±LD- ĀG"?A" V IĀ-J T LJ<=0<Ā<99D%$ĀK±LD- ĀGĀ?A" V I8Ā0=:<ĀR%+G:%<JĀ32EF8 T< J%YĀ0LĀ%Q' Ā#9:$0%.ĀX=EC38Ā0/%Ā9:T%: 0%L$				
	?;									

A<#L=0Ā@COgĀ dg02 h%ĀĀ%%MO6>E232CNOHĀONh ĀNOACU@i8ĀĀĀ,V! Ā(ĀĀM+

AECOM

8,0](7"' ĀÃ@ĀÂ)23&Ā3:002 ĀP0,' +Ā24 ĀL(&'0,3'-02
8,0](7' Ā073' -02"ĀĀ3Ā, -2Ā 052'.V ĀI
8,0](7' ĀP5> / (,"ĀĀĀ,?Z?#ZS

!0: Ā06Ā0-)Ā324 Ā0 ,(Ā@0,-2: Ā@$
3/<<0Ā ĀLFĀ

C9<S0%L- R<<0	F<#0/e R<<0	7; #<	EYTK<=	3:T# 9%-Q A<$%$-.<	A<.LS<=;eW	@=:#%ĀLQ	JI K LM!ĀĀH*LM 8KMP	d<99%:Q=:T	d: 0<= NL-0<-0eW	X%-<ĀL-0<-0 GWc\ !! Ā%S<I	LJ ILQHĀP N OKR L ĀK HKH
	?;		(	" (Ā!	'		6C2EĀ0LĀX27ĀN62?ĀGN6N5I8Ā: =J8ĀTL%$80%0ĀK+LD-ĀG"?A" VIĀ-J T LJ<=0<Ā<99D%$ĀK+LD-ĀGĀ?A" VI8Ā0=:<Ā%+Q:%<JĀ32 EF8 T<J%Y Ā0LĀ%Q' Ā#9:$0%.%ĀX=EC38Ā/%Ā0:T%: 0%L$ ++7<=:<ĀF<#L$%$ĀG]0I+ĀĀ!"#$"%&(				O-9;ĀQ=S<9Ā-J Ā9: ; $9LYQ' Ā=<L S<=<J
=#;							3>67?Ā32 EF ĀG3HI8ĀJ<-$ <8ĀTL%$8Q=; %$ĀK9Y<ĀQ=<-ĀG"M@" VI8 9%0QĀL-$ L9%:0<J8ĀJ%$0<K-JĀR=LĀS: T# 9%Q				
	?A		*	& !	*)						
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	S;		Ā		Ā!!						3D%0Ā0LĀ5] :JS: -. <T<-08Ā* J%T L-J ĀK%8 A] F^!W A] F^!W
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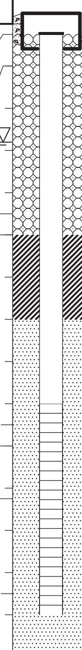
;							%#0 1Ā2#03Ā4567Ā15897:4Ā< -=>?				
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RJ											
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									35.6		44?* .5 tsf; T=2.7 k˘, &@cm Switc t˝ rota$%w˙ & # ˙. ˘˙ nce 5" c˙ sin˘ t˝ 4'; TX-UU: M˙ E .˘˘ ˙ tor stre&&=6>> 4sf;con' nin˘ 4$˘&&3$˘=45* p&'# LL=47 PL=22 °˝ n&˝)
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	R7		4-2 4-3	* 2 3	83		N˝ d˘ co24 ˝&˘. G+˜ 86L in v & ()˘ p˝rtion of sa24)˘		23.5	50	44?* .75 tsf; T=1:* k˘, &@c2# TB-UU: ! ˙ E .˘˘ ˙ to$ st$˘&&=1732 4sf;con' nin˘ 4$˘&&3$?1350 4&'
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Report: GEO_12W_OAK; File: BOLINAS AECOM ROCK CORE.GPJ; 6/15/2017 B-6

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APPENDIX II

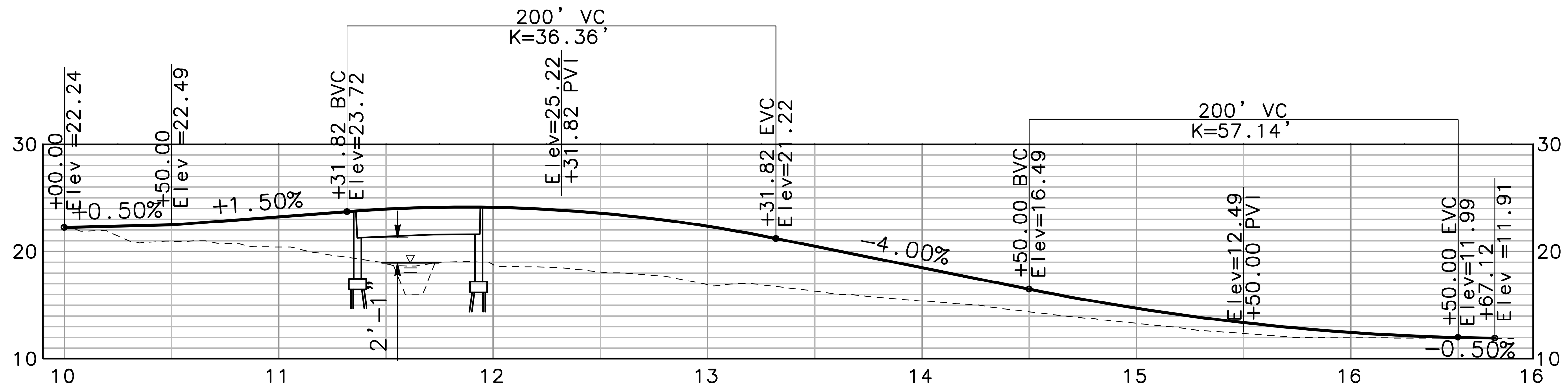
Bolinas Lagoon Wye Project Geometrics Drawing

GEOMETRICS
BOLINAS LAGOON WYE PROJECT

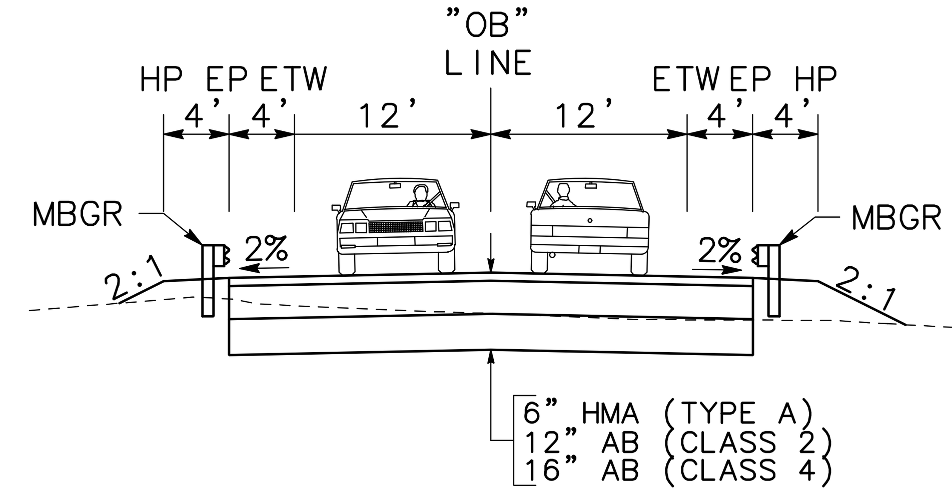
1-JUN-2020 PM 17.196/17.058 EA ______

MARK THOMAS 701 UNIVERSITY AVE, SUITE 200, SACRAMENTO, CALIFORNIA 95825

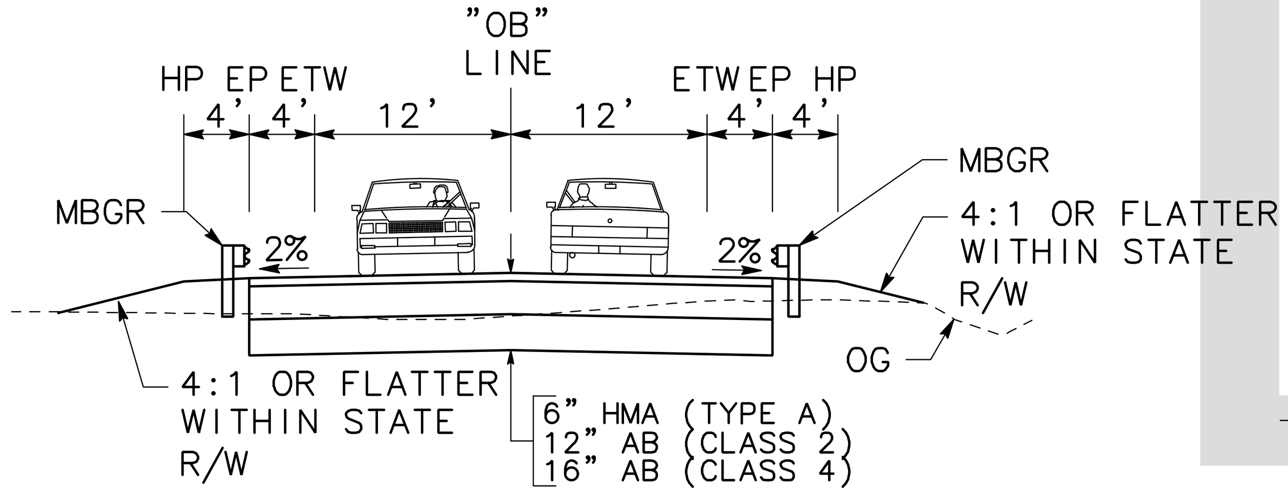
DRAWN BY KD	RECOMMENDED ______ DATE ______	JOB NO. SA-19184	SHEET NO. 1 OF 1
CKD. BY DB	CONCUR ______ DATE ______	FILE NO.	
DATE 6/1/2020	CONCUR ______ DATE ______		
SCALE 1"=50'	APPROVED ______ DATE ______		



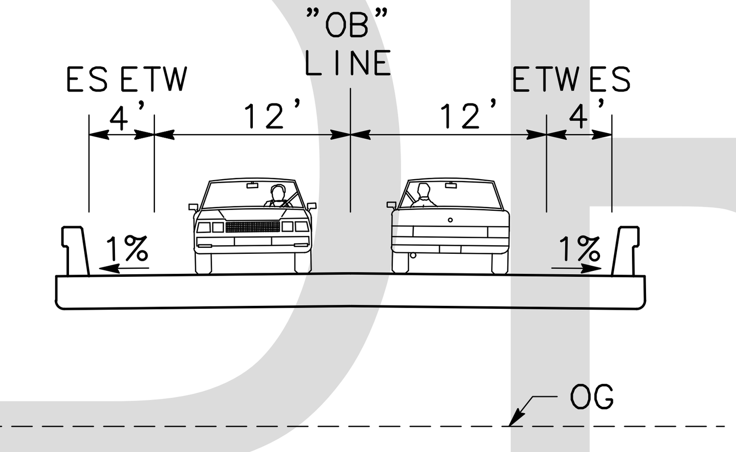
PROFILE
SCALE Hor: 1"=50'
Vert: 1"=5'



SECTION C-C
NO SCALE



SECTION A-A
NO SCALE



SECTION B-B
NO SCALE

CURVE TABLE

CURVE #	RADIUS	DELTA	TANGENT	LENGTH
C1	71.00'	70°25'42"	50.11'	87.27'
C2	40.00'	87°13'36"	38.11'	60.90'
C3	200.00'	53°34'50"	100.98'	187.03'
C4	800.00'	10°49'25"	75.79'	151.13'
C5	900.00'	11°43'05"	92.36'	184.07'

LINE TABLE

LINE #	LENGTH	DIRECTION
L1	45.09'	N29°52'10"E
L2	7.47'	N23°42'40"W
L3	101.23'	N12°53'16"W

LEGEND

- ROADWAY TO BE REMOVED
- EMBANKMENT STABILIZATION

Appendix F: Alternative Analysis Table

Bolinas Wye Wetlands Revised Alternative Evaluation Matrix

Score between 1 and 5

Category	Weight	Score Alt 1	Score Alt 2	Score Alt 3	No Action Alternative	Subcategories	Assessment Considerations	Available Data for Assessment
Cost	15%			0.75		Planning/Design	Estimate of engineering/design/permitting costs	Cost estimate
						Construction	Estimate of construction costs	Cost estimate
						Mitigation	Estimate of cost for mitigation, considering whether all mitigation can be performed on-site	Estimate of mitigation area (from road removal), estimate of potential impacts and required mitigation, cost estimate for mitigation, including monitoring
Schedule/Feasibility (short-term impacts)	10%			0.50		Permitting/CEQA	Estimate of permitting complexity, especially as it relates to using cutting edge approaches or those opposed by agencies	Cost estimate
						Construction Period Impacts	Ability of residents and emergency responders to access Bolinas and area during construction	Preliminary traffic management plan
						Environmental Impacts during construction	Preliminary assessment of general habitat (wetland, riparian, upland) disturbance during construction; mitigation needs.	Preliminary GIS impact assessment
Climate Change/ Resilience/ Maintenance	20%			1.00		Allow for Lagoon Expansion and Wetland Transition Zone	Prediction of alternative's ability to accommodate rising sea level	Sea level rise assessment
						Minimizes need for re-entry	Degree of ongoing maintenance required by alternative (sediment removal, adaptive management, etc.)	Assessment of design feasibility, draw from past experience (somewhat subjective); assessment of lifecycle of structures
						Provide Resilience for Extreme Weather Events	Ability of design to withstand extreme weather, including prolonged drought and excessive storm events (500-yr)	Modelling of large storm event, Sea level rise assessment, past experience
Improve Hydrologic Connectivity	15%			0.75		Allow for Natural Channel Processes and Dynamism	Does alternative allow for natural processes, ie sediment movement	Design assessment
						Restore and Enhance Baseflow Conditions	Will alternative allow for groundwater expression in the channel and/or convey base flows effectively	Groundwater elevation assessment, draw on past experience
						Restore High Flow Connection to Floodplain	Assess relative frequency and duration of floodplain or overbank inundation	Channel capacity evaluation, flood frequency curve; total area of connected floodplain
						Channel Migration	Ability of crossing to allow for natural variability in cross-section, pattern and profile of channel	Assessment of crossing opening size, skew related to road and channel
						Transition to Channel	Changes in slope, curvature in upstream and downstream transition zones, maintaining self-maintaining low flow channel	Slope and channel form assessment, hydraulic modelling of a range of flows to evaluate shear stress, velocities and stream power
Environmental Benefits/ Impacts	20%			1.00		Wetlands/Riparian	Preliminary assessment of wetland and riparian habitat improvements/ impacts or net increase/decrease in wetland and riparian habitat function or acreage.	Quantify impacts and potential area of mitigation
						Sensitive Habitats	Assessment of net gain/loss or net improvements/ impacts to sensitive habitats regulated by CDFW (bay forest, alkali bulrush, coastal brambles, pickleweed plains).	habitat assessment (from WRA/PWA study?), impact and mitigation assessment
						Special Status Species	Preliminary assessment of improvements/ impacts to CRLF, California black rails breeding, refuge and migration habitat. Assessment of net gain/loss of upland dispersal and breeding habitat.	Biologist consultation
						Cultural Resources	Preliminary assessment of disturbance with respect to sensitive cultural resources	Cultural resources mapping (may not be possible unless County has previous cultural report for site)
Salmonids	10%			0.50		Adult In-migration	Depth and velocity swim capable for steelhead focused on December - February	Hydraulic modelling and assessment of fish passage data
						Juvenile Out-migration	Depth, period of connectedness focused on February - May optimal timeframe	Hydraulic modelling and assessment of fish passage data
						In-channel Habitat (Rearing and Refugia)	Pool frequency and depth, amount of wood and channel complexity/dynamism, net change in stream length with medium to high quality habitat	Assessment of design , prediction of evolution
						In-channel Habitat (Dry Season/Oversummering)	Interaction of surface/groundwater, pool depth and frequency, riparian Canopy cover/thermal considerations, cover and food access within channel	Prediction of groundwater influence, channel design assessment
						Floodplain Access and Habitat (Rearing and Refugia)	Duration of floodplain activation, aerial extent of flow on floodplain	Hydraulic modeling
Roadway Safety/ Community Benefits	10%			0.50		Accessibility by Multiple User Groups	Ability of roadways/crossings to facilitate travel by multiple users (automobiles, trucks, bicycles, pedestrians)	Road and bridge design assessment
						Flooding	Does project reduce likelihood of flooding of Olema -Bolinas Road or SR-1	Hydraulic modeling
						Floodflow Capacity	Ability of crossing to pass the 100-year event, considering debris in flows and potential for jams	Hydraulic modeling
						Traffic and Visibility	Does alternative positively or negatively affect transportation to and from Bolinas. Affect of roadway design on vertical and horizontal site lines	Road and bridge design assessment
Weighted Score	**100%**			**5.00**				

Total Possible is 5 Points

Bolinas Wye Wetlands Alternative Evaluation Matrix: Lewis Gulch Creek

Score between 1 and 5

Category	Weight	Score Alt 1: Pilot Channels	Score Alt 2: Q1	Score Alt 3: Q 1.5	No Action Alternative	Subcategories	Assessment Considerations	Available Data for Assessment	Notes
Cost	15%	0.60	0.60	0.45	0.75	Planning/Design	Estimate of engineering/design/permitting costs	Cost estimate	similar for all 3
						Construction	Estimate of construction costs	Cost estimate	Alt 1 is least expensive- 1, Alt 2 middle- 1.5, Alt 3 highest -1.75, based on excavation and managing excess soil; assume LWD for each
						Mitigation	Estimate of cost for mitigation, considering whether all mitigation can be performed on-site	Estimate of mitigation area (from road removal), estimate of potential impacts and required mitigation, cost estimate for mitigation, including monitoring	in Alt 3; lower disturbance with Alt 1, higher with Alt 2, and highest with Alt 3. Explain function of new alluvial fan area with wetted area, fish passage, other processes. Mitigation more challenging to explain for Alt 1.
Schedule/Feasibility (short-term impacts)	10%	0.40	0.40	0.30	0.50	Permitting/CEQA	Estimate of permitting complexity, especially as it relates to using cutting edge approaches or those opposed by agencies	Cost estimate	Alt 2 easiest; Alt 3 has greater disturbance and wetland conversion to channel; Alt 1 fish passage challenge and more unusual restoration project
						Construction Period Impacts	Ability of residents and emergency responders to access Bolinas and area during construction	Preliminary traffic management plan	similar for all 3
						Environmental Impacts during construction	Preliminary assessment of general habitat (wetland, riparian, upland) disturbance during construction; mitigation needs.	Preliminary GIS impact assessment	Alt 1 least impact, Alt 2 greater, Alt 3 greatest
Climate Change/ Resilience/ Maintenance	20%	0.80	0.80	0.60	1.00	Allow for Lagoon Expansion and Wetland Transition Zone	Prediction of alternative's ability to accommodate rising sea level	Sea level rise assessment	All 3 pretty similar
						Minimizes need for re-entry	Degree of ongoing maintenance required by alternative (sediment removal, adaptive management, etc.)	Assessment of design feasibility, draw from past experience (somewhat subjective); assessment of lifecycle of structures	Alt 3 has higher sed transport capacity; design to focus on not depositing sediment at road crossing; all alts question of maintaining for fish passage?
						Provide Resilience for Extreme Weather Events	Ability of design to withstand extreme weather, including prolonged drought and excessive storm events (500-yr)	Modelling of large storm event, Sea level rise assessment, past experience	Alt 3 most impacted, Alt 1 and 2 less so
Improve Hydrologic Connectivity	15%	0.60	0.60	0.45	0.15	Allow for Natural Channel Processes and Dynamism	Does alternative allow for natural processes, ie sediment movement	Design assessment	sediment more readily at least in beginning, creates channel that would be naturally created over time. Alt 3 has greatest sed transport capacity
						Restore and Enhance Baseflow Conditions	Will alternative allow for groundwater expression in the channel and/or convey base flows effectively	Groundwater elevation assessment, draw on past experience	Groundwater expressed in all, Alt 3 influenced most by groundwater as deeper channel- but not much difference. Deep pools created with LWD in any alt. Groundwater could be lowered if future incision- most likely with Alt 3.
						Restore High Flow Connection to Floodplain	Assess relative frequency and duration of floodplain or overbank inundation	Channel capacity evaluation, flood frequency curve; total area of connected floodplain	Alt 1 highest, then Alt 2, then Alt 3
						Channel Migration	Ability of crossing to allow for natural variability in cross-section, pattern and profile of channel	Assessment of crossing opening size, skew related to road and channel	NA
						Transition to Channel	Changes in slope, curvature in upstream and downstream transition zones, maintaining self-maintaining low flow channel	Slope and channel form assessment, hydraulic modelling of a range of flows to evaluate shear stress, velocities and stream power	More for the road crossing, NA
Environmental Benefits/ Impacts	20%	0.80	0.90	0.60	0.40	Wetlands/Riparian	Preliminary assessment of wetland and riparian habitat improvements/ impacts or net increase/decrease in wetland and riparian habitat function or acreage.	Quantify impacts and potential area of mitigation	Impacts: Alt 1 least; Alt 3 has greater disturbance and wetland conversion to channel. Improvements: Alt 1 most, Alt 2, then Alt 3 lowest
						Sensitive Habitats	Assessment of net gain/loss or net improvements/ impacts to sensitive habitats regulated by CDFW (bay forest, alkali bulrush, coastal brambles, pickleweed plains).	habitat assessment (from WRA/PWA study?), impact and mitigation assessment	Impacts: Alt 1 least; Alt 3 has greater disturbance and wetland conversion to channel. Improvements: Alt 1 most, Alt 2, then Alt 3 lowest
						Special Status Species	Preliminary assessment of improvements/ impacts to CRLF, California black rails breeding, refuge and migration habitat. Assessment of net gain/loss of upland dispersal and breeding habitat.	Biologist consultation	Impacts: Alt 1 least; Alt 3 has greater disturbance and wetland conversion to channel. Improvements: Alt 2 greatest, then Alt 1, then Alt 3 lowest
						Cultural Resources	Preliminary assessment of disturbance with respect to sensitive cultural resources	Cultural resources mapping (may not be possible unless County has previous cultural report for site)	old wharf site; Sonoma Sate did assessment; NA
Salmonids	10%	0.30	0.45	0.40	0.20	Adult In-migration	Depth and velocity swim capable for steelhead focused on December - February	Hydraulic modelling and assessment of fish passage data	Alt 1 lower, Alt 2 higher, Alt 3 highest- persistence of depth and velocity in future conditions (Alt 3 avg 6" deeper) Still looking at base flows.
						Juvenile Out-migration	Depth, period of connectedness to Lagoon focused on February - May optimal timeframe	Hydraulic modelling and assessment of fish passage data	Alt 1 lower, Alt 2 higher, Alt 3 highest- persistence of depth and velocity in future conditions (Alt 3 avg 6" deeper) Still looking at base flows.
						In-channel Habitat (Rearing and Refugia)	Pool frequency and depth, amount of wood and channel complexity/dynamism, net change in stream length with medium to high quality habitat	Assessment of design , prediction of evolution	Alt 2 highest, greatest dynamism with stream length; then Alt 1, then Alt 3. Side channels very valuable for salmonids. Dan doesn't expect spawning in the Wye.
						In-channel Habitat (Dry Season/Oversummering)	Interaction of surface/groundwater, pool depth and frequency, riparian Canopy cover/thermal considerations, cover and food access within channel	Prediction of groundwater influence, channel design assessment	Alt 2 highest, greatest dynamism with stream length; then Alt 3, then Alt 1
						Floodplain Access and Habitat (Rearing and Refugia)	Duration of floodplain activation, aerial extent of flow on floodplain	Hydraulic modeling	Alt 1, Alt 2, Alt 3
Roadway Safety/ Community Benefits	10%	0.40	0.45	0.50	0.00	Accessibility by Multiple User Groups	Ability of roadways/crossings to facilitate travel by multiple users (automobiles, trucks, bicycles, pedestrians)	Road and bridge design assessment	NA
						Flooding	Does project reduce likelihood of flooding of Olema - Bolinas Road or SR-1	Hydraulic modeling	Alt 1 scores lowest, then Alt 2, then Alt 3
						Floodflow Capacity	Ability of crossing to pass the 100-year event, considering debris in flows and potential for jams	Hydraulic modeling	NA
						Traffic and Visibility	Does alternative positively or negatively affect transportation to and from Bolinas. Affect of roadway design on vertical and horizontal site lines	Road and bridge design assessment	NA
Weighted Score	100%	3.90	4.20	3.30	3.00				

Bolinas Wye Wetlands Alternative Evaluation Matrix: Lewis Gulch Creek

Score between 1 and 5

Category	Weight	Score Alt 1: East Alignment, Culvert	Score Alt 2: East Alignment, Bridge	Score Alt 3: East Alignment, Causeway	Score Alt 4: West Alignment, Culvert	Score Alt 5: West Alignment, Bridge	Score Alt 6: West Alignment, Causeway	No Action Alternative	Subcategories	Assessment Considerations	Available Data for Assessment	Notes
Cost	30%	4.00	3.25	0.40	4.50	3.75	0.40	4.75	Planning/Design	Estimate of engineering/design/permitting costs	Cost estimate	same cost for east and west alignment; design cost slightly lower for precast culvert
									Construction	Estimate of construction costs	Cost estimate	east alignment $100K more; estimate causeway is about double bridge cost; estimate culvert is 2/3 cost of the bridge.
									Mitigation	Estimate of cost for mitigation, considering whether all mitigation can be performed on-site	Estimate of mitigation area (from road removal), estimate of potential impacts and required mitigation, cost estimate for mitigation, including monitoring	higher cost for east alignment
Schedule/Feasibility (short-term impacts)	10%	3.00	3.75	3.50	3.25	4.50	4.25	4.75	Permitting/CEQA	Estimate of permitting complexity, especially as it relates to using cutting edge approaches or those opposed by agencies	Cost estimate	Bridges easier to permit than culverts
									Construction Period Impacts	Ability of residents and emergency responders to access Bolinas and area during construction	Preliminary traffic management plan	causeway longest construction; but roadwork/fill is driver on construction period
									Environmental Impacts during construction	Preliminary assessment of general habitat (wetland, riparian, upland) disturbance during construction; mitigation needs.	Preliminary GIS impact assessment	East alignment is more disturbance; minimal difference btwn culvet, bridge, causeway
Climate Change/ Resilience/ Maintenance	15%	3.50	4.25	5.00	3.00	4.00	4.75	0.50	Allow for Lagoon Expansion and Wetland Transition Zone	Prediction of alternative's ability to accommodate rising sea level	Sea level rise assessment	causewway scores highest; west alignment elevation is higher, scores a bit higher; bridges more space for water movement, score higher than culverts
									Minimizes need for re-entry	Degree of ongoing maintenance required by alternative (sediment removal, adaptive management, etc.)	Assessment of design feasibility, draw from past experience (somewhat subjective); assessment of lifecycle of structures	causeway score highest, then bridge, then culvert considering sediment dep; west alignment impacts Wye less, but east alignment avoids creek skew
									Provide Resilience for Extreme Weather Events	Ability of design to withstand extreme weather, including prolonged drought and excessive storm events (500-yr)	Modelling of large storm event, Sea level rise assessment, past experience	causeway score highest, then bridge, then culvert considering sediment dep; west alignment impacts Wye less, but east alignment avoids creek skew
Improve Hydrologic Connectivity	10%	3.00	4.00	5.00	2.50	3.50	4.50	0.50	Allow for Natural Channel Processes and Dynamism	Does alternative allow for natural processes, ie sediment movement	Design assessment	causeway, then bridge, then culvert; east alignment scores higher b/c of creek skew
									Restore and Enhance Baseflow Conditions	Will alternative allow for groundwater expression in the channel and/or convey base flows effectively	Groundwater elevation assessment, draw on past experience	causeway a bit higher score, then bridge, then culvert
									Restore High Flow Connection to Floodplain	Assess relative frequency and duration of floodplain or overbank inundation	Channel capacity evaluation, flood frequency curve; total area of connected floodplain	causeway highest, then bridge, then culvert
									Channel Migration	Ability of crossing to allow for natural variability in cross-section, pattern and profile of channel	Assessment of crossing opening size, skew related to road and channel	causeway highest, then bridge, then culvert; but causeway has 40ft btwn piers, bridge has 60ft free span; causeway allows alluvial fan to being further upstream
									Transition to Channel	Changes in slope, curvature in upstream and downstream transition zones, maintaining self-maintaining low flow channel	Slope and channel form assessment, hydraulic modelling of a range of flows to evaluate shear stress, velocities and stream power	east alignment scores higher, west alignment would require armoring to avoid headcutting; east alignment avoids creek skew
Environmental Benefits/ Impacts	15%	3.25	3.75	4.50	3.50	4.00	4.75	2.00	Wetlands/Riparian	Preliminary assessment of wetland and riparian habitat improvements/ impacts or net increase/decrease in wetland and riparian habitat function or acreage.	Quantify impacts and potential area of mitigation	Causeway highest score, then bridge, then culvert; west alignment has less disturbance- higher score
									Sensitive Habitats	Assessment of net gain/loss or net improvements/ impacts to sensitive habitats regulated by CDFW (bay forest, alkali bulrush, coastal brambles, pickleweed plains).	habitat assessment (from WRA/PWA study?), impact and mitigation assessment	Causeway highest score, then bridge, then culvert; west alignment has less disturbance- higher score
									Special Status Species	Preliminary assessment of improvements/ impacts to CRLF, California black rails breeding, refuge and migration habitat. Assessment of net gain/loss of upland dispersal and breeding habitat.	Biologist consultation	Causeway highest score, then bridge, then culvert;
									Cultural Resources	Preliminary assessment of disturbance with respect to sensitive cultural resources	Cultural resources mapping (may not be possible unless County has previous cultural report for site)	Causeway most likely to impact cultural resources when drilling; east alignment in currently undisturbed location-scores lower
Salmonids	10%	3.00	4.00	5.00	2.50	3.50	4.50	0.50	Adult In-migration	Depth and velocity swim capable for steelhead focused on December - February	Hydraulic modelling and assessment of fish passage data	east alignment reduced creek skew -slighlty higher score for east;
									Juvenile Out-migration	Depth, period of connectedness focused on February - May optimal timeframe	Hydraulic modelling and assessment of fish passage data	causeway, then bridge, then culvert; east alignment scores higher b/c of creek skew
									In-channel Habitat (Rearing and Refugia)	Pool frequency and depth, amount of wood and channel complexity/dynamism, net change in stream length with medium to high quality habitat	Assessment of design , prediction of evolution	causeway, then bridge, then culvert; east alignment scores higher b/c of creek skew avoids armoring
									In-channel Habitat (Dry Season/Oversummering)	Interaction of surface/groundwater, pool depth and frequency, riparian Canopy cover/thermal considerations, cover and food access within channel	Prediction of groundwater influence, channel design assessment	causeway, then bridge, then culvert; east alignment reduced skew, better able to pass wood
									Floodplain Access and Habitat (Rearing and Refugia)	Duration of floodplain activation, aerial extent of flow on floodplain	Hydraulic modeling	causeway, then bridge, then culvert; east alignment scores higher as channel is less steep
Roadway Safety/ Community Benefits	10%	3.00	4.00	5.00	2.50	3.50	4.50	1.00	Accessibility by Multiple User Groups	Ability of roadways/crossings to facilitate travel by multiple users (automobiles, trucks, bicycles, pedestrians)	Road and bridge design assessment	no difference btwn alts
									Flooding	Does project reduce likelihood of flooding of Olema - Bolinas Road or SR-1	Hydraulic modeling	east alignment reduced creek skew - higher score
									Floodflow Capacity	Ability of crossing to pass the 100-year event, considering debris in flows and potential for jams	Hydraulic modeling	east alignment reduced creek skew - higher score; causeway score highest, then bridge, then culvert

									Traffic and Visibility	Does alternative positively or negatively affect transportation to and from Bolinas. Affect of roadway design on vertical and horizontal site lines	Road and bridge design assessment	no difference btwn alts
Weighted Score	**100%**											

Bolinas Wye Wetlands Alternative Evaluation Matrix: Lewis Gulch Creek

Score between 1 and 5

Category	Weight	Score Alt 1: East Alignment, Culvert	Score Alt 2: East Alignment, Bridge	Score Alt 3: East Alignment, Causeway	Score Alt 4: West Alignment, Culvert	Score Alt 5: West Alignment, Bridge	Score Alt 6: West Alignment, Causeway	No Action Alternative	Subcategories	Assessment Considerations	Available Data for Assessment	Notes
Cost	30%	1.20	0.98	0.12	1.35	1.13	0.12	1.43	Planning/Design	Estimate of engineering/design/permitting costs	Cost estimate	same cost for east and west alignment; design cost slightly lower for precast culvert
									Construction	Estimate of construction costs	Cost estimate	east alignment $100K more; estimate causeway is about double bridge cost; estimate culvert is 2/3 cost of the bridge.
									Mitigation	Estimate of cost for mitigation, considering whether all mitigation can be performed on-site	Estimate of mitigation area (from road removal), estimate of potential impacts and required mitigation, cost estimate for mitigation, including monitoring	higher cost for east alignment
Schedule/Feasibility (short-term impacts)	10%	0.30	0.38	0.35	0.33	0.45	0.43	0.48	Permitting/CEQA	Estimate of permitting complexity, especially as it relates to using cutting edge approaches or those opposed by agencies	Cost estimate	Bridges easier to permit than culverts
									Construction Period Impacts	Ability of residents and emergency responders to access Bolinas and area during construction	Preliminary traffic management plan	causeway longest construction; but roadwork/fill is driver on construction period
									Environmental Impacts during construction	Preliminary assessment of general habitat (wetland, riparian, upland) disturbance during construction; mitigation needs.	Preliminary GIS impact assessment	East alignment is more disturbance; minimal difference btwn culvet, bridge, causeway
Climate Change/ Resilience/ Maintenance	15%	0.53	0.64	0.75	0.45	0.60	0.71	0.08	Allow for Lagoon Expansion and Wetland Transition Zone	Prediction of alternative's ability to accommodate rising sea level	Sea level rise assessment	causewway scores highest; west alignment elevation is higher, scores a bit higher; bridges more space for water movement, score higher than culverts
									Minimizes need for re-entry	Degree of ongoing maintenance required by alternative (sediment removal, adaptive management, etc.)	Assessment of design feasibility, draw from past experience (somewhat subjective); assessment of lifecycle of structures	causeway score highest, then bridge, then culvert considering sediment dep; west alignment impacts Wye less, but east alignment avoids creek skew
									Provide Resilience for Extreme Weather Events	Ability of design to withstand extreme weather, including prolonged drought and excessive storm events (500-yr)	Modelling of large storm event, Sea level rise assessment, past experience	causeway score highest, then bridge, then culvert considering sediment dep; west alignment impacts Wye less, but east alignment avoids creek skew
Improve Hydrologic Connectivity	10%	0.30	0.40	0.50	0.25	0.35	0.45	0.05	Allow for Natural Channel Processes and Dynamism	Does alternative allow for natural processes, ie sediment movement	Design assessment	causeway, then bridge, then culvert; east alignment scores higher b/c of creek skew
									Restore and Enhance Baseflow Conditions	Will alternative allow for groundwater expression in the channel and/or convey base flows effectively	Groundwater elevation assessment, draw on past experience	causeway a bit higher score, then bridge, then culvert
									Restore High Flow Connection to Floodplain	Assess relative frequency and duration of floodplain or overbank inundation	Channel capacity evaluation, flood frequency curve; total area of connected floodplain	causeway highest, then bridge, then culvert
									Channel Migration	Ability of crossing to allow for natural variability in cross-section, pattern and profile of channel	Assessment of crossing opening size, skew related to road and channel	causeway highest, then bridge, then culvert; but causeway has 40ft btwn piers, bridge has 60ft free span; causeway allows alluvial fan to being further upstream
									Transition to Channel	Changes in slope, curvature in upstream and downstream transition zones, maintaining self-maintaining low flow channel	Slope and channel form assessment, hydraulic modelling of a range of flows to evaluate shear stress, velocities and stream power	east alignment scores higher, west alignment would require armoring to avoid headcutting; east alignment avoids creek skew
Environmental Benefits/ Impacts	15%	0.49	0.56	0.68	0.53	0.60	0.71	0.30	Wetlands/Riparian	Preliminary assessment of wetland and riparian habitat improvements/ impacts or net increase/decrease in wetland and riparian habitat function or acreage.	Quantify impacts and potential area of mitigation	Causeway highest score, then bridge, then culvert; west alignment has less disturbance- higher score
									Sensitive Habitats	Assessment of net gain/loss or net improvements/ impacts to sensitive habitats regulated by CDFW (bay forest, alkali bulrush, coastal brambles, pickleweed plains).	habitat assessment (from WRA/PWA study?), impact and mitigation assessment	Causeway highest score, then bridge, then culvert; west alignment has less disturbance- higher score
									Special Status Species	Preliminary assessment of improvements/ impacts to CRLF, California black rails breeding, refuge and migration habitat. Assessment of net gain/loss of upland dispersal and breeding habitat.	Biologist consultation	Causeway highest score, then bridge, then culvert;
									Cultural Resources	Preliminary assessment of disturbance with respect to sensitive cultural resources	Cultural resources mapping (may not be possible unless County has previous cultural report for site)	Causeway most likely to impact cultural resources when drilling; east alignment in currently undisturbed location-scores lower
Salmonids	10%	0.30	0.40	0.50	0.25	0.35	0.45	0.05	Adult In-migration	Depth and velocity swim capable for steelhead focused on December - February	Hydraulic modelling and assessment of fish passage data	east alignment reduced creek skew -slighlty higher score for east;
									Juvenile Out-migration	Depth, period of connectedness focused on February - May optimal timeframe	Hydraulic modelling and assessment of fish passage data	causeway, then bridge, then culvert; east alignment scores higher b/c of creek skew
									In-channel Habitat (Rearing and Refugia)	Pool frequency and depth, amount of wood and channel complexity/dynamism, net change in stream length with medium to high quality habitat	Assessment of design , prediction of evolution	causeway, then bridge, then culvert; east alignment scores higher b/c of creek skew avoids armoring
									In-channel Habitat (Dry Season/Oversummering)	Interaction of surface/groundwater, pool depth and frequency, riparian Canopy cover/thermal considerations, cover and food access within channel	Prediction of groundwater influence, channel design assessment	causeway, then bridge, then culvert; east alignment reduced skew, better able to pass wood
									Floodplain Access and Habitat (Rearing and Refugia)	Duration of floodplain activation, aerial extent of flow on floodplain	Hydraulic modeling	causeway, then bridge, then culvert; east alignment scores higher as channel is less steep
Roadway Safety/ Community Benefits	10%	0.30	0.40	0.50	0.25	0.35	0.45	0.10	Accessibility by Multiple User Groups	Ability of roadways/crossings to facilitate travel by multiple users (automobiles, trucks, bicycles, pedestrians)	Road and bridge design assessment	no difference btwn alts
									Flooding	Does project reduce likelihood of flooding of Olema - Bolinas Road or SR-1	Hydraulic modeling	east alignment reduced creek skew - higher score
									Floodflow Capacity	Ability of crossing to pass the 100-year event, considering debris in flows and potential for jams	Hydraulic modeling	east alignment reduced creek skew - higher score; causeway score highest, then bridge, then culvert
									Traffic and Visibility	Does alternative positively or negatively affect transportation to and from Bolinas. Affect of roadway design on vertical and horizontal site lines	Road and bridge design assessment	no difference btwn alts
Weighted Score	**100%**	**3.41**	**3.75**	**3.40**	**3.40**	**3.83**	**3.32**	**2.48**				

Bolinas Wye Wetlands Alternative Evaluation Matrix: Lewis Gulch Creek

Score between 1 and 5

Category	Weight	Score Alt 1: Retaining Walls	Score Alt 2: 2:1 Side Slope	Score Alt 3:1 Side Slope	No Action Alternative	Subcategories	Assessment Considerations	Available Data for Assessment	Notes
Cost	15%	0.45	0.60	0.45	0.75	Planning/Design	Estimate of engineering/design/permitting costs	Cost estimate	Alt 1 highest, Alt 2, then Alt 3 lowest
						Construction	Estimate of construction costs	Cost estimate	Alt 1 much higher, Alt 2, then Alt 3 lowest (Walls add $1 mil). Alt 3 has longer culvert.
						Mitigation	Estimate of cost for mitigation, considering whether all mitigation can be performed on-site	Estimate of mitigation area (from road removal), estimate of potential impacts and required mitigation, cost estimate for mitigation, including monitoring	Alt 3 lowest score, then Alt 2, then Alt 1 (all are permanent impacts)
Schedule/Feasibility (short-term impacts)	10%	0.30	0.40	0.30	0.50	Permitting/CEQA	Estimate of permitting complexity, especially as it relates to using cutting edge approaches or those opposed by agencies	Cost estimate	Alt 3 lowest score, then Alt 2, then Alt 1 (all are permanent impacts)
						Construction Period Impacts	Ability of residents and emergency responders to access Bolinas and area during construction	Preliminary traffic management plan	Alt 2 requires settling period, longest construction period, lowest score; Alt 1 curing -lower score; then Alt 3
						Environmental Impacts during construction	Preliminary assessment of general habitat (wetland, riparian, upland) disturbance during construction; mitigation needs.	Preliminary GIS impact assessment	Alt 3 lowest score, then Alt 2, then Alt 1; disturbance, hauling,
Climate Change/ Resilience/ Maintenance	20%	0.60	0.80	0.60	1.00	Allow for Lagoon Expansion and Wetland Transition Zone	Prediction of alternative's ability to accommodate rising sea level	Sea level rise assessment	Alt 3 takes up most space- issue with saturation as no engineered fill; how will concrete walls adjust to SLR? Water movement through walls. Alt 1 scores highest, then Alt 2, then Alt 3
						Minimizes need for re-entry	Degree of ongoing maintenance required by alternative (sediment removal, adaptive management, etc.)	Assessment of design feasibility, draw from past experience (somewhat subjective); assessment of lifecycle of structures	Alt 1 scores highest, then Alt 2, then Alt 3
						Provide Resilience for Extreme Weather Events	Ability of design to withstand extreme weather, including prolonged drought and excessive storm events (500-yr)	Modelling of large storm event, Sea level rise assessment, past experience	Alt 1 scores highest, then Alt 2, then Alt 4
Improve Hydrologic Connectivity	15%					Allow for Natural Channel Processes and Dynamism	Does alternative allow for natural processes, ie sediment movement	Design assessment	NA
						Restore and Enhance Baseflow Conditions	Will alternative allow for groundwater expression in the channel and/or convey base flows effectively	Groundwater elevation assessment, draw on past experience	Ensure subsurface water is able to pass, same for all; for retaining walls- post-tension piers, not solid wall below ground
						Restore High Flow Connection to Floodplain	Assess relative frequency and duration of floodplain or overbank inundation	Channel capacity evaluation, flood frequency curve; total area of connected floodplain	NA
						Channel Migration	Ability of crossing to allow for natural variability in cross-section, pattern and profile of channel	Assessment of crossing opening size, skew related to road and channel	NA
						Transition to Channel	Changes in slope, curvature in upstream and downstream transition zones, maintaining self-maintaining low flow channel	Slope and channel form assessment, hydraulic modelling of a range of flows to evaluate shear stress, velocities and stream power	NA
Environmental Benefits/ Impacts	20%	0.60	0.80	0.60	0.40	Wetlands/Riparian	Preliminary assessment of wetland and riparian habitat improvements/ impacts or net increase/decrease in wetland and riparian habitat function or acreage.	Quantify impacts and potential area of mitigation	Alt 3 takes up most space. Alt 1 scores highest, then Alt 2, then Alt 3
						Sensitive Habitats	Assessment of net gain/loss or net improvements/ impacts to sensitive habitats regulated by CDFW (bay forest, alkali bulrush, coastal brambles, pickleweed plains).	habitat assessment (from WRA/PWA study?), impact and mitigation assessment	Alt 3 takes up most space. Alt 1 scores highest, then Alt 2, then Alt 4
						Special Status Species	Preliminary assessment of improvements/ impacts to CRLF, California black rails breeding, refuge and migration habitat. Assessment of net gain/loss of upland dispersal and breeding habitat.	Biologist consultation	Wall impact to CRLF migration- CRLF forced through crossing; impacts to other species; if Causeway, more area for migration. Alt 1 scores lowest, Alt 2 and Alt 3 the same
						Cultural Resources	Preliminary assessment of disturbance with respect to sensitive cultural resources	Cultural resources mapping (may not be possible unless County has previous cultural report for site)	Drilling for walls could impact cultural resources
Salmonids	10%					Adult In-migration	Depth and velocity swim capable for steelhead focused on December - February	Hydraulic modelling and assessment of fish passage data	NA
						Juvenile Out-migration	Depth, period of connectedness focused on February - May optimal timeframe	Hydraulic modelling and assessment of fish passage data	NA
						In-channel Habitat (Rearing and Refugia)	Pool frequency and depth, amount of wood and channel complexity/dynamism, net change in stream length with medium to high quality habitat	Assessment of design , prediction of evolution	NA
						In-channel Habitat (Dry Season/Oversummering)	Interaction of surface/groundwater, pool depth and frequency, riparian Canopy cover/thermal considerations, cover and food access within channel	Prediction of groundwater influence, channel design assessment	NA
						Floodplain Access and Habitat (Rearing and Refugia)	Duration of floodplain activation, aerial extent of flow on floodplain	Hydraulic modeling	NA
Roadway Safety/ Community Benefits	10%	0.40	0.40	0.40	0.10	Accessibility by Multiple User Groups	Ability of roadways/crossings to facilitate travel by multiple users (automobiles, trucks, bicycles, pedestrians)	Road and bridge design assessment	All Alts the same
						Flooding	Does project reduce likelihood of flooding of Olema - Bolinas Road or SR-1	Hydraulic modeling	All reduce flooding by raising road to same elevation
						Floodflow Capacity	Ability of crossing to pass the 100-year event, considering debris in flows and potential for jams	Hydraulic modeling	NA
						Traffic and Visibility	Does alternative positively or negatively affect transportation to and from Bolinas. Affect of roadway design on vertical and horizontal site lines	Road and bridge design assessment	All Alts require guardrails
Weighted Score	100%	2.35	3.00	2.35	2.75				

Appendix G: Meeting Minutes

Meeting Name: **Bolinas - Wye Wetland Project Kick-off**
Date: 11/20/2019
Attendees: Kallie Kull, Caroline Christman, Veronica Pearson, Eric Miller, Julie Passalacqua, Ben Crawford
Notes:

- Intros
- SLR – Look for models, but probably go with Baywave or C-Smart (5.5' in concept)
- FishPAC – Votes on Caltrans culvert replacements for the fish passage
- County now owns parcel (Salvani parcel), but it ends just above the crossroads. County is considering a C.E. on parcel to the north (Phase 3), but might be better to just do a temporary access easement (right to enter)
- County likes preferred alternative from AECOM
- Consultation on attraction flows in alluvial fan situation per Kallie
- Review of scope
- MT – Will send out 'A' letters
    - Crawford – Geotech – Borings
    - May have to hotpatch – Encroachment permit MT pulling parent permit
    - Materials sampling and geotech after 30%
    - Ahead of game because AECOM has data
- Look into studies of sedimentation in lagoons
- Julie would like to settle on 3 alternatives early on.
- Add decision matrix to schedule before crossing analysis
- County would like alternative analysis before first TAC (schedule for February)
    - TAC meeting – Split field/office meeting in Bolinas or Audubon Canyon Ranch
- Ben asked about past issues/ maintenance of Olema/ Bolinas Road. Expects settlement & will quantify & provide specs & alternatives for mitigating effects.
- Highway 1 culvert design is part of design and analysis. Caltrans will build it.
- Regular meetings – start with bi-weekly until March. Start 12/18 – RBB to send out meeting invite every other Wednesday at 10:00 AM.
- 1st Site Visit – 12/11 @8:30 AM
  8:30-10:00 AM – RBB Setup (High vis vests, boots)
- 1st TAC Meeting. Date TBD in February. Invite all NMFS Folks (Brian, Dan, David)
- Communication
    - Brian/ Julie
    - Veronica/Caroline

Action Items:

- County to Provide:
    - Ross Taylor study (per Kallie)
    - CAD Files for boundary
    - CAD files for topo
    - AECOM HECRAS model
    - Bolinas Lagoon bathymetry study follow up memo
    - Tech memo example for decision matrix for crossing analysis (Kallie)

<u>Meeting Name</u>: **Bolinas – Wye Field Meeting**
<u>Date</u>: 12/11/2019
<u>Attendees</u>: Robert Young (CalTrans), Veronica Pearon (MCOSD), Caroline Christman (GGNPC), Eric Miller (MCDPW), Ben Crawford (Crawford & Associates), Ellie (Crawford & Associates), Julie Passalacqua (Mark Thomas), Andrew Smith (WRA), Brian Bartell (WRA), Ben Snyder (WRA), Kari Dupler (WRA)
<u>Notes</u>:

- Safety brief
- Single thread channel vs pilot channel alluvial fan
- Remove existing barriers
- Talk to Callie about dredging along Bolinas Road
- Wind waves + storm flow
- Cross over road
  - Borings -> 5' footers, 2 each
  - WRA needs soil sample
- Existing culvert on Bolinas Road
  - Conveys 2 drainage areas
  - Now bridge will separate drainage areas
- Crawford's Concepts
  - MSE – Mechanically Stabilized Earth
  - Reinforced Embankment – Geo Fabric
  - Causeway
  - Open bottom culverts – Does not address raising roadway
- Sulvany Property Lines
  - CalTrans offers to move Hwy 1 over 10 feet away from Creek
  - One boring at emergency repair
  - Encroachment Permit
  - DWG
- 0-B Road – Considering:
  - Walls (traditional)
  - MSE – Mecanically Stabilized Embankment
  - Viaduct/Causeway
  - Reinforced Embankment – Uses Fabric
- E-mail and mail hard copy of all invoices
- Eucalyptus removal in area so have access to logs
- Consider concrete area for Rt. 1 culvert replacement
  - Span less than 19" or it's a bridge

<u>Action Items</u>:

- E-mail and mail hard copy of all invoices
- Encroachment Permit
- Remove exsting barriers
- Talk to Callie about dredging along Bolinas Road

<u>Meeting Name</u>: **Bolinas – Wye Progress Meeting**
<u>Date</u>: 12/18/2019
<u>Attendees</u>: Veronica Pearson (MCOSD), Brian Bartell (WRA), Ben Snyder (WRA), Julie Passalacqua, Kallie Kull
<u>Notes</u>:

- Kallie: Lewis Gulch Creek below Olema-Bolinas Road was dredged in 2010 between culvert and lagoon approximately 180 feet downstream of culvert. Too much trouble getting equipment downstream so dredging in 2018 and 2019 was approximately 60' below culvert.
- Kallie: MC Found steelhead in most years, but not many this year, but found CRLF this year for first time.
- Kallie: Is there any way to get mitigation credit for raising road out of floodplain?
- Moving SR-1? If we get feedback at the TAC that we should pursue (and they will support), we'll move to make it part of project. Julie thinks chances are very slim Caltrans can move quickly on this idea. Veronica: Perhaps we present idea to TAC, but designs should be based on current alignment of SR 1.
- Use a matrix similar to the AECOM matrix (P. 65 of Final Conceptual Design report). Tweak as needed. Consider how this project ties into larger vision.
- Take matrix and alternatives to TAC and Bolinas advisory council for recommendations.
- Reach between SR-1 and O-B Road. Concern that Caltrans culvert work could impact any work we did there. Per Veronica, we should consider lowering floodplain in that reach and use soils for fill on O-B Road. Private owners who have expressed support for overall project. Important to make sure whatever we would do is self-maintaining to not leave landowner or the county with something to maintain.
- No guarantee that what we design for SR-1 crossing will be implemented by Caltrans. Marin County will appeal to Caltrans Director to get our SR-1 alternative installed.

<u>Action Items</u>:

- Discuss Cape Ivy at next meeting.
- Kallie to send report and information on how much material has been dredged from the creek and this year's fish recovery effort on OB Road.
- Brian to email Veronica about property boundary survey issue.
- Draft of decision matrix for next meeting.
- Brian to cancel next meeting (01/01/20).

<u>Meeting Name</u>: **Bolinas – Wye Progress Meeting**
<u>Date</u>: 1/15/2020
<u>Attendees</u>: Veronica Pearson (MCOSD), Brian Bartell (WRA), Ben Snyder (WRA), Julie Passalacqua, Kallie Kull (MCDPW), Danny Franco (GGNPC), Erin Ciedemann (Crawford), Caroline Christman (GGNPC)
<u>Notes</u>:

- Review of alt analyses
- Per veronica – more beneficial to use alternatives that gets to a value, as a group, after concepts have been prepared.
- Changes to tables:
    - Add climate change longevity
    - appeal to community of Bolinas
    - Add hydrologic connectivity
    - General species habitat
    - Add items for specific modelling/metrics, esp. for fish passage
    - Benefits to individual special status species?
    - Add more weight to "Supports North End Vision"
    - Add more weight to "Climate Resiliency"
    - Subcategories under schedule:
        - Caltrans?
        -
- What metrics will we use for our evaluation? Need to determine to what level we take our design/modelling before conducting alt analyses.
- TAC will likely be interested in seeing our methodology.
- Define the metrics and analyses to be used, line by line.
- Use goals from North End study as "ideal" for qualitative assessment
- Per Kallie – start with absolute scoring, then consider qualitative
- For next time – refine analyses and metrics
- Cape Ivy
    - Veronica met with Cape Ivy USDA entomology invasive species and pollinator research (Scott Portman). Found that cape ivy gallfly has been successful in reducing vigor/productivity of populations, but does not eradicate. Next year they may have a moth that can be released that may eradicate.
    - Per Caroline –consider whether it would be more cost effective to remove cape ivy mechanically in areas of disturbance within the Wye prior to construction to avoid the need to manage cape ivy in soil during work. Also consider how this would fit in with proposed gallfly experiment.
- Danny can connect GIS folks with Marin County data/Mark Tuckman info needed
- No date yet for survey, Julie is thinking second week in February
- TAC Meeting goals:
    - Intro to site
    - Introduce analysis table
    - Send out analysis table and any concepts we may have at least one week prior to meeting

<u>Action Items</u>:

- Revise analysis tables and include metrics – send to Veronica as soon as finished
- Prepare concept designs prior to TAC (add to schedule)
- Follow up with Danny on field trip to analog site in GGNRA, Fort Cronkite area
- Site visit to determine if any relict channels exist prior to survey

<u>Meeting Name</u>: **Bolinas – Wye Progress Meeting**
<u>Date</u>: 1/29/2020
<u>Attendees</u>: Veronica Pearson (MCOSD), Brian Bartell (WRA), Ben Snyder (WRA), Sundaran Gillespie (WRA), Julie Passalacqua (MT), Erin Ciedemann (Crawford), Caroline Christman (GGNPC), Robert Young (CalTrans), Dan Chase (RES)

<u>Notes</u>:

- Most of meeting surrounded evaluating concepts and strategizing for upcoming TAC meeting
- Wharf Creek is not part of this phase of the project
- Raising Olema-Bolinas Road past what is needed to accommodate the new crossing is not in this phase of the project
- Concepts
    - Olema-Bolinas Road:
        - Mark Thomas provided three alternatives, 30' bottomless arch culvert, 80' bridge, and 300' causeway
        - Arch was discussed the most, width and height will be determined by 100-year flow event and sea level rise monitoring
        - Could use a combination of smaller bottomless arch structures
        - Aligning the crossing at an angle to the road so that the crossing is perpendicular to the flow path is more desirable from a hydraulics standpoint
        - Julie is concerned that skewing the angle of the culverts to the road may limit the ability to use pre-cast products
        - Veronica wants to ensure that the crossing width maximizes room for lateral channel migration and minimizes restrictions on channel morphology.
        - Veronica recommended that we look at what was modeled in HEC-RAS. This can help inform Julie as she is drafting concepts.
    - Reach 3:
        - Three alternatives – bankfull channel and floodplain grading ("worst case" scenario), low flow pilot channel, and restoration of a multi-channel alluvial fan
        - For all alternatives, large woody debris would be used to create hydrologic and topographic complexity
        - Dan feels that option 2, small pilot channel, would be more feasible from a fish passage perspective than the multi-channel alluvial fan design
        - Dan concerned that proving expanded fish passage may be difficult in alluvial fan concept
        - Caroline suggested that it may be desirable to consider designing pools or small ponds into the lower portions of the reach and adding side channels to alternative 2
        - Design of Reach 3 should not focus on spawning. Focus on rearing and refugia
        - Select Reach 3 design alternative first, this will guide selection of the Olema-Bolinas Road crossing alternative

- Reach 2:
  - Three alternatives – floodplain excavation, installation of wood structures to help raise grades, and some floodplain grading in conjunction with hardened riffle structures
  - Minimal work is desirable
  - Could do a combination of the three to balance earthwork and integrate more wood
  - Veronica: This reach is not part of the project. We can consider this work if it is found to be needed to ensure the success of Reach 3 and for the culvert work at SR1. This needs to be clear at the TAC. We first need to figure out the design to the SR1 culvert to determine if we need to do work within this reach. Remember that there will likely be phased work, part the County does, and part Caltrans will have to do.
- SR-1 Crossing – Julie will forward design concepts this week
  - Robert suggests assessing bottomless arch, oversize culvert or depressed culvert as options
  - Robert advises a natural bottom width of 2.5 times the channel width through the crossing
  - Crossing must pass at least the 25-year event flow
  - Culvert has not been evaluated for inclusion on FishPAC list yet
  - Consider usingse FishPAC criteria as main focus of alternatives analysis for this crossing to help facilitate CalTrans implementation; ask John Wooster at TAC meeting.

- Discussed plan changes for TAC meeting
  - Add goals for each reach and narrative for each option to each sheet
  - Crossing designs should include plan view, profile and section for each option
  - Add projected 50 and 100-year sea level rise estimates to all plans and profiles (where appropriate)
  - Add note that plans are conceptual, and final design may draw from elements of multiple concepts, a starting point for the design process conversation.

- TAC planning
  - Primary goal – present designs with list of pros and cons
  - Secondary goal – Present overview of decision matrix
  - Get feedback on both
  - Questions Veronica envisions at TAC:
    - How much disturbance with each concept?
    - Which design provides the best in terms of fish passage?
    - How will you determine channel geometry and planform.
  - Focus TAC members to a defined scope for their input at meeting to help manage time and the project
  - Present selected design concept and full alternatives analysis at next TAC meeting

- Sea level rise modelling – Send Veronica our selected method of assessing, most likely from C-Smart

Action Items:

- Send revised design alternatives and conceptual alternatives analysis (with larger categories only) to TAC members by 02/11. WRA to send to Veronica by 02/06
- Add SLR to all drawings
- Add narrative, goals to plans
- Send Robert alternatives
- Review final draft of alternatives analysis at next progress meeting

Meeting Name: **Bolinas – Wye Progress Meeting**
Date: 2/12/2020
Attendees: Veronica Pearson (MCOSD), Brian Bartell (WRA), Ben Snyder (WRA), Ellen Tiedemann (Crawford), Caroline Christman (GGNPC), Andrew Smith (WRA), Kallie Kull (MCDPW)

Notes:

- Review of project goals pulled from various sources
    - Agreed to use goals provided in Prop 1 funding grant as basis
    - Add traffic safety as a goal
    - Add self-sustaining/no maintenance as goal
    - Develop objectives from goals and include in presentation to TAC

- Review of Olema-Bolinas Road crossing design alternatives
    - Per Kallie - align angle of crossing to match natural flow path of channel, avoid sharp radius of curvature upstream and downstream of crossing
    - Per Ben – optimal width of crossing is amplitude of channel meanders. Proposed adding the following to alternatives analysis:
        - Width of crossing/availability of area for natural channel migration
        - Alignment of crossing to natural flow path
    - Changes to make on concepts:
        - Change section view to be perpendicular to crossing (not perpendicular to road) to show crossing opening details
        - Check road width, make as small as possible to help reduce impacts to channel, wetlands and riparian areas
        - Revise alignment – WRA to revise and send to Mark Thomas
    - Provide rough cost estimates for each option, order of magnitude will suffice
    - Add a single sheet showing three alternatives for outboard road treatments. This will be important to quantify impacts

- Review of State Route 1 crossing design alternatives
    - Considerations for alternatives analysis:
        - Impact of crossing on natural sediment transport ability, as well as other stream processes
        - Consider impacts to habitat, including existing scour pool below existing culvert
        - Fish passage
        - Width of crossing and availability of room for channel migration
        - Construction disturbance and ability to pass at least one lane of traffic during construction

- Review of Reach 3 (Wye Wetland) design alternatives
    - Move Olema-Bolinas Road crossing downstream and align with channel
    - Add road alignment from Mark Thomas to drawings
    - Show area of existing Olema-Bolinas Road/State Route 1 intersection to be removed (potential mitigation area)
    - Make existing condition labels darker/more legible
    - Add section just below culvert to show inset floodplain

- Review of Reach 2 design alternatives
  - WRA explained that main objective for Reach 2 is to allow for as much development as possible of alluvial fan processes
  - Channel appears incised based on field observations and 100-year flow modelling that shows most of flow contained in channel
  - Potentially rename riffles or explain concept of alternative 3 more clearly
  - Re-order goals so that alluvial processes are first and fish passage is last
  - Add reducing likelihood of channel eroding into State Route 1 road grade as goal

- Brief review of alternatives analysis. Brian to send draft master table to Veronica and Caroline for review
- TAC Meeting Preparation
  - Caroline will not send concepts ahead of meeting
  - Brian to meet Veronica and Caroline at Audubon Canyon Ranch around noon to help set up meeting room. Bring the following:
    - Easels
    - Full size prints of concepts
    - Foam core and clips
    - Laptop
  - WRA to prepare PDF deck for presentation
    - Project overview (use figure 2 from AECOM concept report
    - Refined goals and objectives
    - Concepts
    - Alternatives analysis table
  - Brian to set up Zoom meeting and send information to Caroline so members who are not able to attend can join (if wifi allows). Record meeting!

<u>Action Items:</u>

- WRA to finalize concepts for TAC meeting
- WRA to prepare PDF presentation for TAC meeting as described above

Meeting Name: **Bolinas – Wye Progress Meeting**
Date: 2/26/2020
Attendees: Veronica Pearson (MCOSD), Brian Bartell (WRA), Ben Snyder (WRA), Ellen Tiedemann (Crawford), Caroline Christman (GGNPC), Andrew Smith (WRA), Kallie Kull (MCDPW)

Notes:

SR-1 Crossing

- Per Robert – 857 – bill that says if a culvert is touched for repair or replacement, it must pass all flows for all fish if special status fish are there.

- SR-1 culvert is damaged per Robert Y, so could be completed at same time as replacement of Salt Creek culvert (within next 2 years). Robert to send "off the shelf" designs for us to consider.

- Hold off on design until Robert sends crossing designs.

O-B Road Intersection

- Moving to the southeast?
  - Check with traffic – Robert to track down contact at Caltrans Traffic.
  - Julie to provide rough costs for moving intersection and removing and building longer sections of road.(available at 3/11 meeting?)
  - Would limit crossing width of free span crossing to approx. 44'.
  - AECOM did not consider an intersection farther southeast to avoid impacts to trees (per VP).
  - Crossing could be shallower (4-5') and longer depending on hydraulics.

O-B Road Crossing

- Look at hydraulics of 100-yr and catastrophic flow (500-year).
- Move to north to take advantage of natural flow path.

O-B Road side slopes

- Three options: 2:1, 1.5:1 with engineered fill, walls.

Wye Wetland

- Three alternatives s as discussed last week

Alternatives Analysis

- Costs – get as close as possible, consider compare to lowest alt
- Veronica and Caroline to refine alt analysis to create a more streamlined evaluation process, and get back to Ben/Brian with revised version

Action Items:

- All edits to initial responses in comment matrix to be completed by next progress meeting (03/11). Everyone add initials next to response.
- Julie to provide rough costs for re-aligning O-B Road/SR-1 crossing to southeast
- April 8 – tentative date for alternatives analysis review with team

- Robert to send Caltrans traffic contact info

Meeting Name: **Bolinas – Wye Progress Meeting**
Date: 3/11/2020
Attendees: Veronica Pearson (MCOSD), Brian Bartell (WRA), Ben Snyder (WRA), Ellen Tiedemann (Crawford), Caroline Christman (GGNPC), Andrew Smith (WRA), Kallie Kull (MCDPW), Julie Passalacqua (MT), Dan Chase (RES)

Notes:

Discussion of re-alignment:

Discussion of crossing costs
$450/sf average bridge cost
Road alignment and structure discussion

Dan, Ben and Brian to discuss assumptions with re-alignment costs in follow-up meeting.

Olema-Bolinas Road Crossing:

- Re-aligning to the southeast will be cheaper(?), and require less conform than northwestern option. Julie to revisit estimates
- Increased level of disturbance and increased cost in re-alignment is not justified, as we can meet our design objectives (width, passage, conveyance) under existing alignment
- Bridge costs not greater for re-alignment, however.

Using Conspan sizing, let's figure out how high we can go, then back out the allowable span.

Conspan sits on footing, rise is opening height. All things being equal, arch culvert is probably the most economical way to go.

Impacts/permitting/mitigation:

Start discussing mitigation approach, need to involve Kari

V: Can get rehab credit for whole wye by removing cape ivy. Also, by delineating former channels, we can potentially get re-establishment credit.

B: Could potentially lower the berm along the right bank of LGC downstream of OBR for mitigation credit.

Alternatives Analysis:

In Parks new alt analysis table:

For Friday: Present plan, present categories, assessment considerations, available data to be used for assessment.

Remove Caltrans coordination?

Caroline to make adjustments to alt table.

We'll develop weighted scores for categories only; not subcategories.

Action Items:

- Brian, Ben and Julie to meet and resolve bridge/culvert design questions: cost, alignment, conveyance.
- Julie to QA/QC Realignment costs
- Brian to estimate acreage of impact, is it possible to mitigate on-site, still, after re-alignment? Also, estimate existing
- Invite Kari to next meeting.
- Brian/Ben Populate “available data” column in alternatives analysis table
- Ben - talk to Julie about whether to include Ellen in next meeting.
- Brian/Ben finalize responses to comments.
- Map relict channels in the Wye.

<u>Meeting Name</u>: **Bolinas – Wye Progress Meeting**
<u>Date</u>: 3/25/2020
<u>Attendees</u>: Veronica Pearson (MCP), Caroline Christman (GGNPC), Kallie Kull (MCDPW), Ben Snyder (WRA), Brian Bartell (WRA), Kari Dupler (WRA), Andrew Smith (WRA, Robert Young (CalTrans), Julia Passalacqua (MT)

<u>Notes</u>:

Review of design alternatives – Wye wetland area

Ben presented concepts and Q-1, Q1.5 and Q-100 models

Existing SR 1 culvert does not pass 100-year event, can only accommodate approx. 25 CFS

Veronica suggests pulling Laurel Collins into the design process to evaluate channel morphology and use of regional curves and local relationships to define morphology. Veronica will get recent regional curve developed by L. Collins and R. Leventhal for coastal streams. We can also look at PWA curve developed in 2002.

Kallie likes idea of 100-year flow breaking out of channel in many areas, especially above SR-1

When designing Bolinas North End Project, Laurel Collins had advocated for reconnecting Lewis Gulch creek to the remnant alluvial fan on the northeast side of SR-1, but NPS did not want to relocate the driveway to Wilkins Ranch.

WRA to ground truth topography south of the Bo-Fax Road, topo appears to be picking up dense veg. Also look for relict channels based on flow paths.

Review of crossing alternatives

Appears that 30' arch on Olema Bolinas Road will not pass 100-yr event based on current design, Ben/Julie to revisit

Advantage to eastern (new O-B Road) alignment is lower invert (less height needed for road), and reduction of skew to LGC.

Per Julie, costs are roughly equivalent for eastern and western alignments

Per Julie, culvert needs more rise and may not be able to accommodate bottomless arch with western alignment without resulting in a hump

Recap – AECOM chose western alignment to reduce impacts to trees and wetlands

Veronica likes eastern alignment, need verification from Caltrans (through ICE) to make sure that will work with the pull off area

Julie to engage Caltrans ICE to get things started, to make sure it will work.

Permitting/Mitigation

Kari discussed strategies for mitigating impacts

- Straight re-establishment for Bo-Fax Road removal and re-aligned intersection
- Corps may call dewatered/raised channel an impact
- Concern over conversion of wetlands to waters in Wye (RWQCB); however, may be able to convert the existing channel along O-B Road to wetland, to compensate for lost wetland in the Wye; the new channel in Wye could compensate for lost channel along O-B Road.
- Could potentially call reduction of veg clearing along roads as mitigation as well as rewatering of Wye enhancement
- Concern of how to show the channel re-establishment of stage 1 acreage and potential for it being a fish passage barrier
- Reduction of dredging of channel could be benefit

Kari to check on limits for CDFW restoration permit, 500 LF of stream

Kari to come to next TAC meeting

*Consensus is do not show phase 3 on drawings for permitting reasons

Per Kallie, we would need to address phases 2 and 3 in CEQA documents, otherwise would be considered piecemeal

Per Veronica, phase 3 is a vision, not part of a defined Master Plan project. The Bolinas Wye is a standalone project with its own independent utility.

Site Access

Can access open space for work, must notify Veronica first, and must maintain safe distances

Action Items:

Kari to email team CDFW restoration permit requirements

Kari to come to next TAC meeting

Julie to begin ICE inquiries for changing the O-B Road intersection with SR1

<u>Meeting Name</u>: **Bolinas – Wye Progress Meeting**
<u>Date</u>: 4/29/2020
<u>Attendees</u>: Veronica Pearson (MCP), Caroline Christman (GGNPC), Brian Bartell (WRA), Andrew Smith (WRA), Eric Miller, (DPW), Dan Chase (RES), Kallie Kull (DPW)

<u>Notes</u>:

Under current alignment of creek and east alignment of O-B Road, a channel slope of 4.4% would be required to maintain 2 feet of freeboard over the end of century 100 year WSE. Shear stress in reach maximum is 7 PSF and velocities over 10 FPS.

Discussed slope issues, shear stress with existing alternative. High shear stress and velocities would require a roughened channel (per Dan).

Group agreed to move look at a crossing farther to the south, which would allow for a lower channel invert and higher road crossing elevation.

Other potential means for addressing issues were discussed, including:

- Adding a secondary high flow culvert.
- Allowing some flow to continue in the existing channel along Olema-Bolinas Road.
- Adding another culvert under Olema-Bolinas Road as shown in the AECOM plan.

Per Veronica, project should meet code requirements, meet project goals, minimize flooding to community. Want more “green” than “gray” in the channel, so less rock and armoring and more reliance on natural processes.

Could get exemption from 2’ freeboard requirement, but will depend on how it affects community of Bolinas per Eric. Have to consider C-SMART predictions, removal of Bolinas-Fairfax Road.

Could we raise the slope at some distance away from the proposed intersection? Ask Julie for maximum slope/bridge elevation.

Under current conditions, Olema-Bolinas Road starts to flood at 1.5 year storm per the existing conditions model, verified by Veronica and Kallie that flooding usually occurs on a yearly basis.

WRA to look at a crossing farther to the south.

Per Dan, keep slopes lower than 3%, or we will be required to do stream simulation or some type of roughened channel.

Will discuss permitting/CEQA and budgeting with Veronica in separate call.

<u>Action Items:</u>

1. WRA to look into an alignment farther to the south
2. Ask Mark Thomas to look at a road profile that will allow for higher road elevation at a crossing farther to the south.
3. Get back to group with preliminary results.

Meeting Name: **Bolinas – Wye Progress Meeting**
Date: 5/13/2020
Attendees: Veronica Pearson (MCP), Caroline Christman (GGNPC), Brian Bartell (WRA), Andrew Smith (WRA), Kallie Kull (DPW), Dan Chase (RES), Dan Bloomquist (MT), Kari Dupler (WRA), Ellen Tiedemann (Crawford)

Notes:

- Creek alignment does not change with eastern and western alignment
- Check freeboard upstream of crossing for western alignment (or both depending on model results)
- Would likely need a wall for western alignment
- No response yet from CalTrans on ICE. Veronica will push if needed, CalTrans sometimes slow when not funding the project
- Team agreed to go with eastern alignment if modeling shows we meet freeboard requirement with no need to armor stream
- Mark Thomas now has what they need (given model results are favorable)
- MT will provide:
  - Geometric approval drawings, plan, profile and typical sections
- MCDPW should be able to review in 3 weeks, would want to route through traffic, real estate at 30% which may take longer. Reach out to Eric Miller now.
- Veronica (MCP) will route to various county agencies directly

Action Items:

1. WRA to hold off on continuing the 30% design until we receive feedback on moving intersection (ICE). WRA can still start on some of the stream plans before confirmation of intersection
2. Julie and Brian to prepare summary of what will be included in 30% design for submittal to County
3. WRA to create summary of project goals and benefits, include discussion of other coordination with CalTrans, other agencies
4. Plan to discuss coordination/construction scheduling near end of 30% design process

<u>Meeting Name</u>: **Bolinas – Wye Progress Meeting**
<u>Date</u>: 5/27/2020
<u>Attendees</u>: Veronica Pearson (MCP), Caroline Christman (GGNPC), Ben Snyder (WRA), Andrew Smith (WRA), Eric Miller, (DPW), Dan Chase (RES), Kallie Kull (DPW)

<u>Notes</u>:

1. Caltrans Review Process
    a. Intersection Control Evaluation (ICE) is b
    b. Permit Engineering Evaluation Report (PEER) Review Process
    c. Caltrans Review process will be funded as early as next week. However, submittals awaiting 30% Design. Results are expected one month from initiated review process.
    d. Erosion Bank Treatment will be included in the PEER Review
        i. WRA will include this treatment in the 30% Design Submittal
    e. Caltrans will review 30%, 60%, and 90% Submittals
        i. Their review should be built into project schedule
2. Guide Specs
    a. Project will follow Caltrans specification format
    b. Front-End Specs to follow Marin County Open Space District
3. Studies Memo
    a. All future studies are covered in current contracts
        i. Additional Topo was a future study during the development of the Memo, this effort is now under contract
        ii. Utilities Survey may be possible future survey pending results of Utility A Letters
4. HEC-RAS Validation
    a. WRA used limited data from ESA to validate model
        i. Manning's Roughness validated
        ii. WRA will continue to validate model with additional ESA data
5. Class C Cost Estimate
    a. Scope identifies a Class C Cost Estimate
        i. This will be deferred to Caltrans standards for cost estimating
    b. A contingency of 25% will be added to the cost estimate
    c. Large Woody Debris might be sourced from project partners
        i. Eucalyptus will not be allowed from Salmonid habitat
6. ESA Flow Monitoring
    a. 2019 Water Year from ESA
        i. Veronica received report this week
        ii. Still data being collected for summer
        iii. Developing Rating Curve
        iv. Data Loggers still out there
            1. ESA will summarize data

<u>Action Items:</u>

1. WRA to provide Signed PDF for Permitting/CEQA Contract (today)
2. Eric to provide Spec Example
3. Veronica to send ESA Data
4. Veronica to send Front-End template

Meeting Name: **Bolinas – Wye Progress Meeting**
Date: 06/10/2020
Attendees: Veronica Pearson (MCP), Caroline Christman (GGNPC), Andrew Smith (WRA), Brian Bartell (WRA), Ben Snyder (WRA), Eric Miller, (DPW), Dan Chase (RES), Kallie Kull (DPW)

Notes:

- Andrew Topo Debrief -2-4” Higher, found channel
- Caroline requested topo delta
- No r/s ditch along SR-1 per Brian
- No way to move road to avoid RN
- Sheet set
- M-T will have 5 Sheets
  - Per Brian, Add a site operations plan
  - Add sheet with typical E&S Measures
- Lit review comments
  - Add summaries for other pas materials
  - Include 2019 hydro report from ESA
- Kallie has BA for culvert Program, with send
- Sequence 2 Season
  - Phase 1 – O-B Road, Bridge, channel under Bridge 30-120 days settling
  - Phase 2 –Remove Bolinas-Fairfax, Tie In grades
    - Environmental work Detour +/1 2-3 months
  - Per Dan –limit time for diversions 6-8 months
    - Upstream fish are the biggest concern
    - Minimize time for diverting traffic to Horseshoe Hill Road
- Dan concern w/emergency access, Veronica to talk with Bolinas fire department
- Season 2 – Bypass Road May Be Needed
  - Veronica To Talk W/ Bolinas Fire Department, DPW about road closure

Action Items:

1. WRA
   a. 30% Plan Set Sheet List
   b. Staging/Stockpile/sequencing
      i. Site operations plan
   c. Lit review
2. MCP
   a. Veronica To Talk W/ Bolinas Fire Department, DPW about road closure

Meeting Name: **Bolinas – Wye Progress Meeting**
Date: 6/24/2020
Attendees: Veronica Pearson (MCP), Caroline Christman (GGNPC), Ben Snyder (WRA), Paul Curfman (WRA), Dan Chase (RES US), Kari Dupler (WRA), Ellen Tiedemann (Crawford Inc), Kallie Kull (MCP), Dan Blomquist, Bridgette Medeghini (WRA)

Notes:

- Paul Curfman Intro
  - kicking off CEQA Technical studies
  - Biology
  - Cultural Studies (road crossing on historical land)
    - Geomorphic technical memo with older maps of the site
- Kari Dupler Intro
  - Biological services starting soon
    - Wetland delineation
    - Tree service
      - Limit survey to 4 inches diameter or above
      - Assessment of condition, trunks, possible suitable habitat with experienced arborist
  - Bio studies in conjunction with AECOM reports
- TAC will be doing permitting
  - Water Board, Coastal Commission, etc
  - Will have everyone but USACE (need)
    - Brian—send out full list to Paul C.
- Marin County monthly permitting meetings
  - Review permits with all agencies
- Caltrans Review Status
  - No response yet (till July 1st)
  - Move forward with current alignment
- Pacific Galling Fly to control Cape Ivy
  - Releases near our project info (more info to come from Veronica)
  - Cape Ivy Study Link Here https://www.cal-ipc.org/wp-content/uploads/2019/02/Cal_IPC_Symposium_2018_Scott_Portman_Cape-ivy_shoot-tip-galling_fly_release-1.pdf
- Conservation Conservancy
  - Vegetation management
  - Prop 1 and prop 68
- Grants for more funding for design

Action Items:

1. WRA
   a. Update memo and review initial studies
   b. Design by End of July
   c. 30% design needs staging and access (Add erosion control detail)
2. MCP
   i. Set Date for TAC Meetings
      1. TAC Meeting --Permitting review by August 2020

2. Last two weeks Thursday/Friday Week of August 24, 2020 or first week of September 2020 (Monday august 31, 2020)
    a. 2.5 hours max with break

Meeting Name: **Bolinas – Wye Progress Meeting**
Date: 7/22/2020
Attendees: Veronica Pearson (MCP), Caroline Christman (GGNPC), Ben Snyder (WRA), Paul Curfman (WRA), Dan Chase (RES US), Kari Dupler (WRA), Ellen Tiedemann (Crawford Inc), Kallie Kull (MCP), Dan Blomquist, Bridgette Medeghini (WRA)

Notes:

- Main goal of meeting is to review 30% design

Permitting/Bio Studies Update (Kari)

- Tree Survey
    - Completed with limit of disturbance last week provided by Andrew Smith
- Wetland Delineation
    - Survey next week, using original AECOM
    - Differentiating wetlands for Fed and California state requirements
        - Take data at each boundary, state or fed, vegetation,
            - USACE and Water Board
            - CCC
                - AECOM did not have CCC, all lumped together
- CEQA
    - PD (project description) will start and review 30% design
        - Kallie Kull--Send previous biological studies to Paul Curfman and Brian Bartell
            - Little out dated, but helpful

August TAC Meeting

- Present 30% Design and BOD Report
- Caroline Christman will send WRA information on presentation material
    - Add mitigation area graphics
        - Coordinate with WRA GIS (Shindo) to create visual materials
- Request Definition of Coastal Act Wetlands
- Will use Team Meeting (not Zoom) due to federal limitations
    - Unknown ability to make notes
- Caroline make an agenda for the meeting and share
    - Next biweekly meeting
- Different alternatives
    - channel design, channel alignment, road crossing
- include schedule on draft agenda
    - permitting and phasing
        - ie 6 months CEQUA, 12 months construction
- question on CEQUA compliance
    - Are there several alternatives with a preferred action or will it be action or no action? (Question for Paul Carfman)

        - Doing an initial study, not an EIR
        - Alternatives analysis much less, notes in the appendices or background information on how it was selected

<u>30% Design Review</u>

- Ben Snyder walking through 30% drawings
    - WRA would like comments within the next week
    - County needs 30 days to make revisions—unable to do by TAC meeting
    - Caroline C. to make some small comments
- C-2.0 Grading Upstream
    - Culvert under Olema-Bolinas Road for flood relief
        - Possible small floodwall
    - Add circles to call out trees will be retained on site (C-2.0 & C-2.1)
- VP: How was rootwad placement determined?
    - BB: 30% not at level of detail, sizing discussed in 60% Design
    - Nymphs will have questions about rootwad placement
- VP: Agency question, are the rootwads here for channel placement?
    - Protects channel, creates fish habitat, not providing the rootwads to maintenance channel, focus on dynamism
    - Placing wood in floodplain if the channel potential does migrate and could cause floodplain scour pools
    - Relying on existing vegetation, rather than placing wood to avoid potential stranding issues
- C-2.1 channel plug ½ slope (wont affect the downstream where landslide occurs)
- C-3.1—Sections
    - Have number of sections to match the grading plan (have notes what page number section is on)
- C-4.0 Profile
    - switch position of profiles with bank stabilization first
- C-5.0 Channel details
    - Move existing ground call out so it's not covered
    - 60% design will have force log calculations to ensure that the logs stay in place
        - Needed for biological and permitting agencies
            - Ballast
    - #2 change direction downstream
- Mark Thomas --L-1
    - take out dashed side channel
    - Not with relocating the signage for turnout
- General plan –abutment
    - Driving piles based on water table and soils
        - None Noise restrictions
- Planting plan
    - Vegetation management team will let WRA know by next week if they are available to assist
    - CalTrans: Is any vegetation being placed in the CalTrans right-of-way?
        - BB: No, but it will be discussed with CalTrans if changes
    - Will plant over two seasons
        - Need to reseed over winter
    - CC note: double check if seeding is sterile, send suggestions to BB

- 5-10 years on biological monitoring
- KK: will set up log storage area, eucalyptus will reseed
- CC: expand grading to remove invasives and weeds
  - Be clear what vegetation will be removed in Cal Trans right-of-way
  - Add Cal Trans boundary
- KK: red willow or yellows may be better species, arroyo can clog waterways
  - BB: use live stakes
- KD: add in herbaceous plants to avoid erosion until plants get thicker
- Erosion control
  - fix detail to trench fiber rolls
- WRA would like formal/informal comments from CalTrans
- KK: distributed to DPW

<u>Action Items:</u>

1. <u>MCP</u>
   a. Kallie Kull--Send previous biological studies to Paul Curfman and Brian Bartell
2. GGNPC
   a. Caroline Christman --send WRA information on TAC presentation material
   b. CC to create TAC meeting agenda and share by next meeting (7/5/2020)
   c. CC-send Brian vegetation suggestions
3. WRA
   a. CAD edits
      i. Grading Plan--Add tree symbols to legend and grading sheet (C-2.0 & C-2.1)
         1. Include figure with construction sequencing on grading plan
      ii. C-3.0 Sections—add # on sections views to match sections on grading plan view (easier to find)
      iii. C-4.0 Profile --switch position of profiles with bank stabilization first
      iv. Erosion control detail
         1. Add trench for fiber rolls

Meeting Name: **Bolinas – Wye Progress Meeting**
Date: 8/19/2020
Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Ben Snyder (WRA), Paul Curfman (WRA), Dan Chase (RES US), Ellen Tiedemann (Crawford Inc), Kallie Kull (MCP), Dan Blomquist, Bridgette Medeghini (WRA)

Notes:
Project Team Transition

- Brian B to take on project management role
- Andrew will be lead engineer and will be at TAC meeting

Further Comments on 30% Design

- Veronica P concern: Calculations of the Manning's coefficient 0.03 the area will not be maintained,
    - DBW will NOT be clearing the area yearly, willows may grow, vegetation in this region are shade tolerant,
        - suggested 0.04 Manning's roughness
    - Ben answer : willows will not be growing under the bridge in that roughness area due to the amount of shade
        - Run a sensitivity analysis if it will effect free board under bridge, run model up to 0.06
- Veronica P – updated two sections above and below the floodplain?

August TAC Meeting Preparation

- Review agendas prepared by Caroline
    - Caroline is making a sharepoint to share with team. TAC will add comments into one sheet
    - Comment have been added to tac meeting agenda
    - WRA members attending TAC meeting—Paul Curfman, Erik Smitt, Andrew Smith, Kari Dulper, Brian Bartell
    -
- Presentation Format
    - Proposed PowerPoint presentation
        - Intro – 1 slide
        - Review of project goals and Objectives
        - Design alternatives analysis overview (quick) – 1 slide
            - Andrew and Brian will lead (9:15-9:50)
        - Design overview (will divert from PowerPoint to review drawings) – 2 slides (10-10:50)
        - CEQA status and strategy – 2-3 slides (Paul)

            - Becky Miller (F&W)
        - Permitting strategy – 4-5 slides (Kari, Erik)
            - Army Corp presenting first
        - Next steps – 1 slide

Project Description

- Draft review for comment—change to vision of the North End Project
- Project is fully funded by PROP 1 and coastal conversancy
- Goals and Objectives
    - Goal 3 wording
- ADD Project benefits section to project description
        - Measurement of benefits?
    - Dial in wording for impact and mitigation areas
        - Species habitat area increase
    - Show graphically, from GIS
        -
- Impacts removed from the PD

Action Items:

1. WRA--Send updated BOD and 30% drawings tonight 8/19/20
2. TAC comments due 10th of September

Bolinas – Wye Wetland Restoration Project

Progress Meeting September 02, 2020

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Andrew Smith (WRA), Paul Curfman (WRA), Dan Chase (RES US), Ellen Tiedemann (Crawford Inc), Kallie Kull (MCP), Dan Blomquist, Bridgette Medeghini (WRA)

August TAC Meeting Review

- **Drainage Solutions**
  - Drainage has not been properly or fully designed from the WYE and overall drainage into the Lewis Gulch Creek
  - Option 1: Culvert at the top of the WYE,
    - close to intersection of state route 1 and OB road
      - Would a single culvert be feasible?
        - Check in with DPW maintenance
  - Option 2: Drainage ditch and change of grade
    - Design team will add a culvert into the hydraulic model to test where a culvert would be best and if it will be feasible
      - Andrew S proposed ditch along the road that would feed into the LWC to reduce high velocities
        - Performance of the culvert is depended of the WSE (water surface elevation) upstream and downstream
    - Other possibility to change grade of the upstream of wye
      - May cause high shear stress near bridge
    - Can use a combination of changing grade with ditch along road
      - Avoid impacting the tree
  - Option 3: Adding additional bridge section
    - Mark Thomas will need to review
    - If the bridge is moved closer to the road, the channel elevation will be higher than the road and required design freeboard will be lost
  - Option 4: Causeway
    - Revisit --Reach 3 structure alternatives option 3 sketch
      - Benefits of full span bridge –allow for sediment and materials to flow through
      - Negative –need piers

- Floodplain is designed to overtop at the 1.5 year event can raise the elevation so it overtops at the 2 year
  - Trees are deflecting the flow, causing stress near the bridge
- Station 2100 elevated in HEC-RAS model
  - Grade elevated for the water to move around tree and move into creek
- **Option 5 (Selected Option)** Group Agreement on Upstream WYE Drainage
  - Start with potentially removing the trees/vegetation closest to the bridge and change the grade floodplain
    - Cheapest option instead of culvert, causeway, floodway
- High tide for 100 year flood with sea level rise –11.1 ft NAVD88

- **Drainage Ditch along OB Road**
  - Permeant block to divert water into the bridge instead of the bridge
    - The ditch still receives water from the downstream hill slope, 0.8 miles of drainage
      - Drainage the ditch, but avoid salmonids going down ditch and being isolated
        - Solution—add 2 culvert in the through of OB road
          - Reduce chance of surface flow to remain in the drainage ditch
  - Group Conclusion on OB Road Ditch
    - 1) Permeant block at bridge
    - 2) Two culverts in under OB road to feed water to wye (above and below cross over road) to help more wetland habitat
- **Edits to Wood on Floodplain**
  - 1) reduce amount of root wads in the channel and balance it with what is on site
    - Old Alders are within the wye, will fall and add habitat
    - Kari D. adding condition assessment in tree survey
  - 2) add existing alders and other trees on plan set that can be used as habitat
    - Redwood and oak –more permanent than alders
  - Ground water data unavailable downstream of wye near culvert

Action Items

- WRA
  - Change upcoming bi-weekly meeting to 9/11/2020 2:30 pm
  - Design Issues
    - 1) Remove trees and regrade near OB bridge
    - 2) add culverts under OB road
    - 3) reduce trees within the channel
    - 4) review the model results with team
- Next week's meeting
  - Review TAC comments
  - Review permitting and environmental compliance not discussed during this meeting (9/2/2020)

Bolinas – Wye Wetland Restoration Project

Progress Meeting September 11, 2020

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Andrew Smith (WRA), Paul Curfman (WRA), Kallie Kull (MCP), Bridgette Medeghini (WRA),

Continuation of 9/2/2020 Meeting

- Vegetation Planning –Alders vs Willows
  - Why are the Alders dying?
  - Soil Sampling for Salinity
- Hydraulic Model Update
  - Andrew S and Brian B updated the hydraulic model with tree removed and fixed the grading upstream of the bridge
  - model was run with two new manning's roughness, one with slight vegetation under bridge and one with full vegetation under the bridge
  - culverts for inundation of floodplain and dispersal of flows —look at the 1.5 year rather than the 100 year event
    - model does not account for rain runoff from road
  - Hydraulic modeling based on historical conditions possible discussions of a more forward thinking model
  - 90 degree turn at bridge is a concern
    - Possible solutions—adding rock to reduce shear stress, culverts north east of bridge (better solution with agencies)
    - Discuss with Mark Thomas
    - Model shows 3 lb/sf for 100 year event under bridge which can be solved with a bioengineering solution
    - Point bar could occur with a tight curve and landslides
- TAC Comment Response
  - Laurel's comments will be reviewed by WRA by the next meeting and will be discussed
- Sediment modeling?
  - Possibility of collecting bed samples during storm events
- Permitting/Environmental Compliance
  - CEQA
    - ISEA –similar language to NEPA
    - WRA revising draft Project Description to emphasize restoration focus of project
      - Use "resiliency" or "restoration"

            - Could use sea level rise, but it may assume buildings or infrastructures
            - Currently Bolinas Lagoon Wye Wetland Project
            - Changed name to Bolinas Wye Wetland Resiliency Project – better received by permitting agencies
        - Project area vs study area
            - Project area = Limit of Disturbance
            - Study Area is the wye, but may change to the great wye due to invasive species
                - Short term efforts, long term management strategies
    - NEPA
        - USFWS rather than Corps
    - NMFS Programmatic BO
        - Bank stabilization is covered, rename the "bank stabilization"
            - Add more plantings, frame more to the resiliency of project
            - Already been stabilized by CalTrans –now need to naturalize area
    - Corps 404- NWp 27 and 14 appropriate
    - CDFW -Traditional LSAA
    - RWQCB 401 Cert- Use standard 401
    - Coastal Zone
        - NMFS may cover, don't have to pay for development fees on county land
    - Marin County Grading Permit
        - Not needed

Action Items

- WRA
    - Review tac comments before next meeting
- Kallie Kull
    - Check to MCP permit
- Permitting review with Veronica Pearson
- Next week's meeting
    - Bi weekly meeting – no longer on the 16th of aug
    - Caltrans Meeting on 9/18/2020

MARIN COUNTY PARKS
PRESERVATION RECREATION

wra
ENVIRONMENTAL CONSULTANTS

MARIN COUNTY PARKS PRESERVATION RECREATION

ENVIRONMENTAL CONSULTANTS

Bolinas – Wye Wetland Restoration Project

Progress Meeting September 30, 2020

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Andrew Smith (WRA), Paul Curfman (WRA), Audriana Ossenberg (WRA), Ellen Tiedemann (Crawford), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Daniel Chase (RES)

9/30/2020 Meeting

Grants

- So far final design has been denied for grants
- One grant still possible by WCB, likely a big stretch - more for larger central valley projects that can show quantifiable change in stream flow
- If grant comes through, might not begin until Spring 2021
- Brainstorm any other quantifiable stream flow changes from project besides time of concentration
- Grants want measurable quantifiable change for stream flow, not recharge
- Not a lot of projects nearby that have baseline data that can be compared to post project
  - There are Eastern Oregon project we can point to
  - Lagunitas has different approach, and is newly constructed
- Could we advertise this project as a pilot project that would have a large monitoring component?
- This project will keep water in stream instead of road
  - Flood frequency
  - Looking to how this will change cfs
  - Volume accumulation (acre-ft) is going on the road now vs after project completion
  - Veronica will send email with grant questions and Andrew will send along what would make sense

CEQA/NEPA

- Archeological report
  - CEQA compliance for geotech investigation
  - There are currently piezometers on the site for groundwater monitoring wells (by coastal permit)
  - Hoping to amend this permit, but might have to apply for a seperate CE
  - Tribe will be copied on CE application
    - Veronica has not talked to the tribe, does not think they are aware of our project
  - Would be a good idea to initiate cultural report and request for consultation
    - Do this in advance of the Geotech report to get tribe involved early on in the process
  - CEQA/NEPA letter to tribe before archeological report is submitted
  - Paul (WRA) will contact NHHC regarding tribes

        - Will start search soon
    - Tribe may request less invasive Geotech techniques prior to borings
    - AECOM didn't have require permits/tribe notification because they were in the road ROW
        - AECOM described presence of resources in LGC
        - This might be at where Oyster house used to be – historical artifacts
        - Getting cultural resources data from Chris will be helpful for the design
    - Geotech proposed borings
        - Two proposed boring locations are concerning because they are in the Wye and near the big box elder/redwood
        - Borings won't be too close to the tree because of clearance
        - These two borings are important because of settlement estimate for proposed construction
        - Traffic control will be required – Kalli will put together an encroachment permit
        - Describe activities for coastal permit
        - Potential to convert old wells to groundwater monitoring stations
            - Monitoring strategy with this project
            - Should we leave/create piezometers in Geotech borings?
        - Could decommission old wells
        - WRA could create another figure with proposed monitoring points
    - Cultural resources investigation
        - Proposed excavation in stream alignment
        - Anything deeper than 3 feet bgs has to be approved by permit
    - Geotech borings, new monitoring points, and cultural resources excavation deeper than 3 feet bgs will all be included in one modified CE or new CE permit
    - First step is initiate contact with tribe, talk to archeologists to know what will be needed in the stream

30% Comments

- Brian went through comments and provided initial responses
    - 41 comments that would be helpful to discuss now
    - Some comments suggest completely redesigning
- E-3: This project does not affect Wilkins Gulch Creek
    - Project boundary question
    - Respond Wilkins Gulch Creek is outside of project boundary (Veronica)
- E-4
    - Three data sets merged together (AECOM, WRA, LiDAR)
    - See if we can adjust linetype to make it more readable
    - Do we think survey data is accurate for our model?
        - All groups should check survey data to QC
        - Brian will go through base map and see if anything jumps out on him as another QA/QC
    - Caroline and Dan B. to address PGE minutes/comments
    - There are modifications needed based on Caltrans reference

- Make left turn onto new roadway
- ICE is getting ramped up this week
    - This will verify if left turn is required/not
    - Dan B recommends we get this started
    - Veronica is okay with that based on Dan B recommendation
- About $17k in contingency
    - ICE may need some of this contingency because scope minimal
- Traffic
    - Single lane traffic control will be possible during construction instead of detours – preferred option
    - Discuss with DPW further

- Kalli Comments
    - Her comment may be only addressing upstream due to potential backwater/pinch point area
    - Eucalyptus can have narcolyptic effects on steelhead
        - NMFS said we should shy from eucalyptus, or somethings that has aged
- Brian will send comments to Veronica and Caroline to review internal notes Brian has written
- Laurel comments for next time
    - Interaction of groundwater and surface water
    - HEC-RAS assumes no infiltration
    - Every parameter you add adds uncertainty exponentially
    - Modeling groundwater will add to the uncertainty when it doesn't have much impact on the project
- Modeling anticipated elevations at 100 year, rather than existing
    - Would coastal commission ask for that?
    - Paper she referenced doesn't have woody debris and trees which makes predictability difficult
    - Could model sediment deposition – but not sure what we would get from that
    - Flag this comment, Brian to comment and have Veronica add to response
- Design change potential
    - Not a good idea to have floodplain necking down to bridge
        - Could create scour issues
        - Will change design to maintain width (pull back floodplain above bridge)
        - Narrow floodplain to size of bridge before
        - Should eliminate issue
        - Takes out some habitat benefit, but has merit
- Modeling Wilkins and Salt Creek backwater
    - We have hydrology for this to model
    - Adjust boundary conditions
    - We don't think the creeks will affect bridge
    - But we can incorporate into the model
- Area upstream of bridge – why is there flooding except near oaks?
    - Oaks are at higher elevation because we're not grading within those oaks and oaks are right on shoulder of the road
    - Should we remove those oaks?

    - Revaluate after upper floodplain is adjusted
- Room between floodplain and road to plant oaks?
    - Yes – mitigation area would actually be improved
    - Veronica can dedicate Friday to go through comments
    - Andrew and Stewart check velocity under bridge when floodplain changes
- Goby are not currently at the site and no past history

Action Items

- WRA
    - Create another figure with proposed monitoring points
    - Modify floodplain and re-run model
    - Check velocity under bridge after floodplain change
- Kallie Kull
    - Put together encroachment permit
- Address PGE minutes/comments
    - Dan Blomquist and Caroline Christman
- 30% Design Comments
    - Entire team to review and address assigned comments

Bolinas – Wye Wetland Restoration Project

Progress Meeting October 14, 2020

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Andrew Smith (WRA), Audriana Ossenberg (WRA), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Kallie Kull (MCP), Ellen Tiedemann (Crawford), Julie Passalacqua (Mark Thomas)

10/14/20 Meeting

30% Comments

- Veronica needs to check with coastal conservancy to see what is required for grant
  - A final 30% design may be needed
- Any new comments from Caltrans?
  - No – but there has been communication
  - Caltrans sent accident data
- Several weeks before we will know about ICE scheduling (Dan Blomquist)

Rail Habitat

- There has not been a rail survey – Caroline will check with Jules for recommendation
- Veronica suggests we bring the mounds down to have a more continuous inundation
  - Brian responds this could cause more fish to swim up that channel – not sure if this is a serious concern
  - Would create elevation differences which is good (but not mimicking natural conditions)
  - This could create transplant material, rich topsoil, could be used where ivy removal is, create rail habitat
  - Is this a concern for DPW? No.
  - Berms could be from dredging spoils
  - Check how the berms were delineated – this could be enhancement if the hydrology is improved
  - Confirm berm will be removed as best as possible with trees
    - Tree survey will be done
- Limited work window with rail/northern spotted owl/salmonid season

Sediment

- Biggest fear from Laurel is there will be sediment buildup where crossover road – channel will avulse and there will be backwater flooding
- Site visit next Tuesday with Caroline and Brian
- Current model looks at shear stress
  - Based on shear stress we know what sediment size will move or not and how often

- Pebble count has been done at cross sections upstream of intersection
- Laurel is concerned about changes from future sea level rise
- Would the sediment be able to move far down the channel?
  - We can model 1.5-year event with sea level rise to check

<u>Action Items</u>

- Veronica
  - Check with Coastal Conservancy on grant requirements (final 30% submittal required?)
- Caroline
  - Discuss possible rail habitat with Jules
- WRA
  - Check on how berms were delineated
  - Setup separate meeting about remaining 30% Comments
  - Discuss tree survey surrounding berm area
  - Check possibility of sediment buildup near bridge
    - Model 1.5-year storm with 100-year SLR

Bolinas – Wye Wetland Restoration Project

Progress Meeting October 28, 2020

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Andrew Smith (WRA), Audriana Ossenberg (WRA), Erik Schmidt (WRA), Laurel Collins, Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Kallie Kull (MCP), Ellen Tiedemann (Crawford),

10/28/20 Meeting

30% Comments

- Clarify design comments (Laurel)
  - LC-36
    - Design is planned to not require maintenance
    - WRA modeling based on available topo data
    - Kallie removes sediment every 3 or 4 years in necking ditch area along road (150-200 feet in length). It doesn't fill to the brim every year
    - ESA monitoring profiles and annual cross section geometry
      - Has not changed much
      - Recently sent final year report
    - Bridge crossing is downstream of natural channel and along part of the onboard ditch
    - Laurel suggests looking at existing channel and confirm the depositional area won't affect proposed bridge
    - WRA is aware and avoiding depositional issues
  - LC-73
    - There is a large difference in flood prone (2.5X bankfull width) width between bridge and downstream area
    - Upstream velocity will increase through bridge – could create plunge pool and eddies
    - Design will be revised to about 70 foot width upstream of bridge
      - Will neck only slightly
      - Only see velocity increase in 50- and 100-year flows
  - LC-74
    - If deposition, thalweg could get stuck at one side of channel and undermine the bridge
    - WRA will coordinate with Mark Thomas to make sure there is enough scour prevention at abutments (liquefaction and fault line requirements will make sure the bridge is very reinforced)
    - Wider than bankfull width – this could cause deposition
      - WRA is designing to avoid maintenance
    - Laurel suggested circular intersection, move bridge location
      - Would have to raise SR – 1 to pass 100-yr flood event if bridge location moved where suggested

- Downstream Question by Laurel
  - What happens to channel and ditch spoils downstream of existing culvert?
    - Channel downstream of existing culvert will be untouched, add culverts to help disperse flow into the Wye
    - This channel could be historic (mills, loading dock, etc.)
    - Laurel thinks it is just ditch spoils – consider putting breaches at height of spoils to match rest of floodplain level for sea level rise
- Should new channel be longer so it matches existing grade in ditch? Replicating profile and connecting to the lower marsh
  - Chosen tie in point based on natural conditions – natural transition point
  - Don't want same slope as existing condition because then there will be more deposition in channel – there isn't enough stream power to move it
  - We expect channel to move naturally, want to work with natural conditions for this reason
  - Where will sedimentation occur with current design – will it move upstream?
    - Will wave action and SLR affect this
    - We want sedimentation around the Wye
    - SLR prediction is based on current topo, the topo will raise which means the SLR prediction will move closer to lagoon
    - Delta formation – channel will fill towards the bottom
    - Better to have sedimentation built up closer to bridge sooner
      - That it what we are expecting to happen with current design (minimize channel size)
      - Then the sedimentation will move downstream
    - WRA will look into making the profile longer and with a flatter slope
- Look into empirical studies on existing coastal streams
  - See if we can mimic that
  - Issue is most of them have been impacted in some way
  - Talk to Brian (NOAA) and John (NOAA)

<u>Permitting</u>

- Geotech update
  - Define project area to complete project description
  - Needs to be sent to notify tribes for drilling
  - Determine if we will do anything with drudge mound
    - Should know more about soil for this decision
    - Based on Jules conversation, rail are not located in this area
    - Makes sense to move mounds for flow

        - Would increase disturbance area
        - Would it add to mitigation area?
        - If soil is good, does it make more sense to grade it out and use it at other areas of property
        - Would it be too difficult to get equipment through to fully remove ditch
        - **Include the ditch for removal**
            - Kallie says they used to be able to put a small bobcat into channel
            - Existing permit allows work on side bank and to conduct removal
- Should we add any groundwater wells?
    - Included in tribe description and permits
    - Tribes care about wells, even if hand augered
    - Place wells above and below berm and downstream of Fairfax-Bolinas Road right bank
    - WRA to create this map (3 locations)
- DPW/TAC – Caroline wants to send something along to them
    - Need to consolidate by 11/16
    - Adjust commentor DPW/TAC in spreadsheet
- WRA has tribe list and will contact them
    - Initiate contact and let them know they will be getting subsequent letters
    - Becky has a specific protocol

  Ask tribes if they want to have a monitor for Geotech exploration onsite once permit goes through (likely a few months or so)
- Paul will double check tribe list (NAHC)
- Jules is in Oregon
    - Helpful to have someone who can visit site to check Rail habitat
        - WRA has staff
    - Jules did survey last year – will send along to Caroline

<u>Action Items</u>

- WRA
    - Create another figure with proposed GW monitoring points
    - Adjust commentator column for DPW/TAC
    - Check with staff about rail habitat

DRAFT

Bolinas – Wye Wetland Restoration Project

Progress Meeting November 18, 2020

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Andrew Smith (WRA), Audriana Ossenberg (WRA), Erik Schmidt (WRA), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Kallie Kull (MCDPW), Kari Dupler (WRA), Paul Curfman (WRA), Julie Passalacqua (Mark Thomas)

11/18/20 Meeting

Black Rail WRA Biologist Conversation Review

- Salinity change is not much of a concern for rail
- Jason (WRA biologist) agreed with Jules' recommendations
- Suggest calls be conducted a year before construction to establish if rail are present
    - 2-3 surveys/visits
    - Rail are very vocal and easy to detect
- Project would not receive take permit
    - Project would likely have to buffer construction (likely 500') before September 1
- Jason will be able to distinguish rail habitat during site visits
    - Habitat impact for grading/revegetation?
        - No – thinks our project will be an improvement
        - Mounds aren't necessary for habitat (like occasional flooding, not daily)
    - Gradual elevation gain moving away from lagoon is beneficial (rail don't like steep slopes)
- 500' buffer
    - After habitat assessment a buffer will be defined
    - Calls will determine if we can reduce buffer/habitat boundary
    - Surveys in April/Map (1 each month)
    - Assuming presence for CEQA
- Kallie – experience with rails while building new pump station
    - Decibel levels near nesting areas is important
    - Thought about hanging curtains to reduce this
    - Instead working through winter (Jan 31)
    - Fish and Wildlife is very firm on rail

Tribal Letter and CDP Application Update

- Tribal letter didn't meet template from Michelle – will be updated
- Most recent project description is being updated, then will be sent to Michelle
- Boring locations
    - Forwarded information recently to Marin County
    - Add piezometers to Geotech and Environmental Contaminant map
    - Michelle will also use staging map detailed construction map
        - Comment on tribal monitoring for borings

- Would equipment stay overnight for Geotech borings?
  - Last time they parked along highway
  - Veronica will add description in permit
- Need depths for Geotech and environmental screening – WRA (Audriana) to send
  - Track mounted drill rig recommended
- Need BMPs?
  - Veronica has BMPs that are typically used
  - Will send to WRA to look at to make sure not missing anything before submitting (Thursday/Friday)
  - Coastal commission will review and likely add more BMPs

- CDP application and tribal consultation letter require similar content, but are separate processes with some different requirements

Caltrans Review

- **Address formal responses only**
- Maintenance does not need pullouts
  - Don't have to maintain during project
- Recommend not including it in project description
  - Summer 2021 this should be resolved
- Could we add pavement where a left turn pocket would go but not call it out as a left turn pocket
  - That will cause project site to be several hundred feet into NPS property
- **Will not address additional left-turn project components unless Caltrans requires this, as it is outside project scope and goals**

Limit of Disturbance

- Spoils pile does not have access area
- Modify study area description to also say vegetation management area

Vegetation Management

- Two areas that have non-native blackberries
- Outside of yellow area
- Cape ivy removal is intense
- Vegetation management should be included in project description
- Vegetation management plan is in the works – should have a draft by the end of the week for WRA (Paul) to include
- Do we have to include intense removal areas to limit of disturbance?
  - Instead, call them enhancement areas
- Plan removal in area left of Olema-Bolinas – won't need to affect trees, just remove biomass
- Will evolve for 60/65% Design

Tsunami

- As water is receding after tsunami, it would be concentrated at bridge
- Should we calculate and design for tsunami scour?
  - Purpose of bridge design is to make sure the bridge doesn't fail
  - Caltrans loose guidelines say assume tsunami elevation 40' – so if bridge is at 20' assume 20' wave
- Could calculate by creating a stage hydrograph downstream of bridge
- Temporary increase of sea level height
- Is this a DPW question?
- Caltrans is vague on guideline – but suggest mitigations
  - Deep foundations (already doing based on site characteristics)
- Kallie will look into other projects to see if they were designed for tsunami scour
  - Plans made within 5 years would mention scour data table
- Mark Thomas does not think bridge design would change much to account for tsunami scour
- Mark Thomas (Julie) will reach out to Eric (MCDPW)

Bolinas – Wye Wetland Restoration Project

Progress Meeting December 2, 2020

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Audriana Ossenberg (WRA), Erik Schmidt (WRA), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Kallie Kull (MCDPW), Paul Curfman (WRA), Julie Passalacqua (Mark Thomas), Ellen Tiedemann (Crawford)

12/2/20 Meeting

Caltrans DEER (Design Engineering Evaluation Report) submittal (Dan Blomquist – MT)

- Project description required for DEER submittal
- Most recent project description – in review by County
- Edits should be done by 12/9
- Current draft or wait for final to include in submittal?
  - Want to submit DEER mid-December
  - Michelle prefers to wait for finalized version
  - Mark Thomas agrees – sounds like timeline should be fine, will wait if necessary
  - County will try to get edits to WRA beginning of next week, WRA can complete edits end of next week

Vegetation Management Plan

- Different areas of grading
- Non-native blackberry zones will need to be cleared and grub
  - Not considered grading
  - Replacing a certain amount of soil in that area
- LOD will need to be changed to include two non-native blackberry areas
- LOD is narrowly confined to roadways and channel
  - Vegetation management will extend outside of LOD
  - Certain vegetation management (outside LOD) isn't considered disturbance
  - Cape Ivy removal doesn't require same level of disturbance as non-native blackberry removal
  - Expand LOD to include non-native blackberry areas (will require disturbance to remove)
    - Two patches – by CA state route 1 (Paul (WRA) will send link to vegetation management plan)
- Wisteria to the left of study area is removing branches, okay to not include within LOD
- Caroline will have updated draft Vegetation Management Plan within a few weeks
  - Need tree survey from WRA, dredge mound area
  - VM Plan will be more conceptual instead of numbers until 60% design

Traffic Assessment Update (Dan Blomquist - MT)

- Just received traffic assessment from sub
- Veronica – water district, general community interests
- Veronica will be presenting 12/16 for Water District and General Community Interest:
    - New intersection concerns
    - Crossover provides larger site distance for someone who wants to head north on CA-1 than new intersection
    - How will our project improve the safety of that intersection ?
    - Mark Thomas has graphics showing sight distance will be improved post project
    - There will not be a new turn lane onto SR 1
    - Southbound onto Olema-Bolinas road will have to slow down to make a turn (25 mph), instead of now
    - Analog other Bolinas intersections by Point Reyes section where right turn is not a problem (Kallie)

Tsunami Scour

- Eric (MCDPW) is off most of the month, Julie will call to follow up

Coastal Permit

- Application was received on Monday (11/30), currently under review
- Hopefully will hear back before 30-day period

Encroachment Permit

- Kallie was discussing with Travis
- Should Crawford (Ellen) will fill out encroachment permit and Kallie would submit it so no fee is necessary?
    - Traffic Control Plan from Crawford
    - Have permit application from County (Crawford to fill out)
    - Then have Ellen submit it and mention Kallie
- Likely book drillers end of January (last two weeks)
- Will also need drilling permit (fee is not waived)
    - Need to put piezometers on drilling permit (Crawford to WRA when application is complete to add piezometer information)
    - Veronica will submit the drilling permit and pay for it
    - Usually a 1-week turnaround
- 1-3 week TAT for encroachment permit
- Nesting is beginning of February
- No drilling/work can happen before Coastal Permit is received/approved
    - There will likely be a board meeting in January
    - If not, BMPs for coastal permit included for biologists (for nesting period)

Grading Changes

- Add notching berms on the right bank below existing crossing
- Show the two areas of non-native blackberries as clear and grub
- Area above the Olema-Bolinas proposed crossing, whatever Oaks need to be removed will be removed (change LOD?)
- Won't prepare impact figures until County reviews plan so we don't have to revise
  - Impact analysis after 60% is reviewed
- WRA 60% Design plans will likely be ready end of December/early January
- MT cannot finish 60% design until Geotech results
  - Design will only change for underground, not footprint based on Geotech results
- MT will likely finish in March if drilling happens end of January
  - Numbers will only change in pile data table
- MT bridge plan will be done end of December
- Roadway (MT) needs Geotech before moving forward with 60%
- Crawford needs a few weeks after drilling to receive lab results and conduct pavement section analysis
  - Settlement analysis would take longer

Real Estate

- Is there an issue drilling on Park land because it hasn't been officially converted yet?
  - (LDPW) Land development may get confused in the future
  - Shouldn't need an additional permit for Parks land
- More important to have Road ROW on plans
  - Who determines width of ROW?
  - Will need to be clear about what can be called mitigation/ROW moving forward with permitting
  - Mark Thomas will look into this (should figure out now for 65% design)

Bolinas – Wye Wetland Restoration Project

Progress Meeting December 16, 2020

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Audriana Ossenberg (WRA), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Kallie Kull (MCDPW), Paul Curfman (WRA), Julie Passalacqua (Mark Thomas), Ellen Tiedemann (Crawford)

12/16/20 Meeting

Wetland Delineation

- WRA has made changes, needs QA/QC
  - Should be submitted end of week

Tree Survey

- Draft sent to Caroline two weeks ago
- Table needs to be updated with new floodplain grading (more trees removed)
- Recently added berm area
  - Tree survey required in that area to prove no trees will be affected in that area
  - Out of budget for this task – how can this be completed?
    - Brian may be able to survey the 10-20 trees during his break

Biological Assessment (BA) update

- Biological assessments area underway
- Will get update from Kari (WRA) for estimated completion date
- BAs helpful for initial study?
  - Yes – should get draft to Paul
- Mandy from CDFW (before 1600 permit), PD and BA confirm no incidental take permit are needed
  - If we assume frogs are present, may need incidental take permit
  - There is good evidence coho are not present

Grading

- Use aerial image to ensure no trees are impacted from design modification
- Berm grading:
  - 2 breaches that are 15' wide at the bottom, slope at 3:1 to meet top of berm
  - This will be beneficial for rail, they will be able to walk up 3:1 slope during flood event or king tide
- May have to use contingency funding for grading modifications – Brian and Veronica to discuss separately

Project Description

- Paul will forward scope to Veronica
  - Cassidy will provide language and Paul would forward scope to Veronica

<u>Coastal Permit Update</u>

- Veronica wants to talk to Coastal Commission
  - Standard norm for archaeological investigation
  - Will push to not receive application incomplete notice at end of 30-day review period
    - Otherwise, CC has another 30 days to review
- Tribal notification
  - Letters are going out today (Michelle)
  - Tribes have 30 days to respond/review
  - Can letters be followed up with a phone call prior to 30 days?
    - Normally Michelle sets up meeting after a response to letter or 30 days
  - Could have informal call?
    - Then could convey to Commission we are in communication
    - Michelle thinks this could disrupt the process
    - Need to check in about if tribes are okay with drilling for two reasons (Geotech and Archeology)
  - Would lack of response hold up Coastal Permit application?
    - Veronica thinks she would have to provide some communication about tribe requesting presence for drilling (if they want) and confirm they are not opposed to drilling
    - Tribes have been turning around form letters quickly (not taking 30 days)
    - If we don't hear anything from tribes by early next week then Michelle can check-in
    - Cassidy could help as well (good relationship with Buffy)
  - Veronica will call Coastal Commission tomorrow to see if tribe response is required, or if this would trigger an incomplete application
  - In budget to pay tribal monitor?
    - No, but they have the right to be onsite
    - Around $50/hour to pay tribal monitor
    - Should assume $1600 for three days
    - Cassidy is under contract to monitor for one day only
      - Need to coordinate with drillers to make sure problematic cultural areas are done in one day
  - Contract with Rancheria to pay for monitoring?
    - Caroline can have contract with them (done before)
    - Michelle is talking this through with legal counsel
  - MCP likely wouldn't have archaeological monitoring
- Ellen (Crawford) – drilling may take 3-4 days
  - Has had tribal monitors onsite once before
  - Has not had a tribal monitor in Marin County before
- Adjustment in scope to accommodate Cassidy monitoring oversight?

DRAFT

Project Description

- Brian will go through PD first, then will put into correct format
- Revise figures/impacts based on grading changes

Bolinas Utilities

- Veronica thought there was a digital copy of PG&E easement, but couldn't locate it
    - Asked Craig Richardson (works with PG&E often)
    - Craig couldn't find anything either, is contacting PG&E directly to try to obtain easement
    - Hopefully will receive something in the next day or two
- We have utilities from A letters, but not easements
    - Only telecom and electric (confirmed by MT and WRA)
    - Telecom runs within ROW
- Sometimes PG&E lines don't run within PG&E easement
- USA won't ,ark utilities until Crawford contacts them 1-2 weeks before drill date
- Title for this parcel may have a description (metes and bounds) WRA could re-create
    - Veronica doesn't think she has a title
    - Official survey that was done – Veronica will send along to WRA

Tree Survey

- Gently changing outer limit
    - To not create complicated hydraulics
- Will re-plant area afterwards
- Oak trees being removed
    - Larger than 18"?

Tsunami Scour

- Eric called and left voicemail for Julie on Monday
- Needs some more information from Julie, then will make a decision
- Should know answer to this before moving forward with project description?
    - Should only affect bridge design
        - Only would affect depth of piles

Caltrans Update

- Design standard Decision Document (DSDD)
- Requested during comments
- Will finalize and send this week
- Nothing new from Caltrans

Public Utilities Meeting

- Tonight – nothing else needed
- Submitted presentation using information from MT traffic assessment
- Veronica will summarize meeting next session

60% Design

- WRA had internal meeting
- Will be necking down channel in the Wye
- This will decrease capacity of channel coming into the Wye to spread water into floodplain
- Laurel comments
  - Put together heat map and translate that to particle size so we can see where we expect things to settle
  - Which storms are going to be more prominent for deposition?
    - Likely use 2 and 5-year event because more frequent
    - Veronica agrees to this
    - ESA is about to finalize last year's monitoring report
      - Rating curve developed using data collected multiple cross sections
      - Measured discharge during some storm events
      - Could use this sparingly to get idea of what discharge could be based on depth
      - Veronica has draft right now – will send to WRA
- How flow is handled on west side of Olema-Bolinas road
  - Challenge because LGC will be running through it during year 2 of construction
    - Then will become roadside ditch
  - Culverts under new road to discharge into Wye
    - Preliminary looked at inverts – will not be able to work by gravity
    - Construct trapezoidal channel during year 1 of construction
    - 2nd year – raise bottom of it so culverts will be able to run into Wye
  - First year of construction will grade until bridge
    - Will need to create barrier to make sure crossover road doesn't get flooded if there is a significant storm
  - Four different channel cross sections
    - Under bridge
    - Small channel above wye
    - Smaller channel in center of wye
    - Tidally influenced
  - Sediment deposition map
    - Will go in BoD report
    - Will list upper limit of deposition size
    - Velocities will be evaluated to decide log structure placement
      - Encourage scour to create deeper pools

- Not planning to import any material (bed material)
- Good size cobble onsite
- Will likely have a period where fines move out (degradation, then storms move sediment in to create aggregation) because not importing bedding

▪ Fluvial geomorphologist will be guiding project
  - Virginia Mahacek - design team leader at WRA

▪ Model is run by hydraulics, not existing D50 in area
  - Veronica will send existing pebble count
    - From pools and riffles, not just riffles
  - Using a variable value for Manning's n as channel vegetates more over time?
    - No, using anticipated ultimate condition (not right after construction)
    - Maybe performance measure should include this for the first two years
    - Should have good vegetation cover within 2 years

▪ Should Caroline include Brian (NOAA) in future communications with the TAC?
  - Yes

No meeting on 12/30/20 – next meeting on 1/6/20

Bolinas – Wye Wetland Restoration Project

Progress Meeting January 6, 2021

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Audriana Ossenberg (WRA), Kallie Kull (MCDPW), Ellen Tiedemann (Crawford), Jake Weir (Mark Thomas)

01/06/21 Meeting

Specifications

- Sir Francis Drake Boulevard specification example
    - Caltrans format

  WRA uses a different spec format (CSI)
    - York Creek example
- Marin County Parks doesn't use a certain spec format
- WRA will use Caltrans format because Caltrans will be reviewing project specs
- Kallie to send WRA specs for past fish passage projects
    - By Joanna Dixon (water resources engineer)
- Revegetation specifications
    - Can Caroline or someone from her team complete
        - Were not planning to
    - Same contractor to be doing revegetation as construction?
        - Unsure – should discuss more
    - Caroline's team will have figures for revegetation area
        - Information on how to plant into erosion control material
        - Should be able to convert information into spec format
    - Initial vegetation, then infill planting later on
        - Will need to group specs for construction phasing accordingly
    - First draft of revegetation plan will be ready soon, WRA will schedule an additional call to discuss later this month
        - Could discuss contracting strategy during this meeting
        - Will affect what to include in plans and specifications
- MCDPW (Kallie) puts pre-qualification requirements in their bid packages
    - Will schedule meeting with Veronica, Kallie and Joanna Dixon to discuss MCDPW normal bid process and pre-qualifying contractors
    - Kallie cautions on setting too many pre-qualifications as the contractors could come in with too high of a bid
- Restoration Design Group
    - Vegetation survival methods challenged
    - Monitoring and performance metrics suggested
    - Kallie will forward email to team from Restoration Design Group
    - Suggest installing vertical posts in through stream and captures wood by racking
        - A MCDPW project is trying this method out
    - Muir Woods Creek used the post method recently

Construction Phasing

- Design roughed in for keeping the creek on west side of OB road after first year of construction
- How do we want to manage flows after first year of construction?
    - Should flow be kept out of the wye
    - Or allow to go through the wye?
        - This will cross Fairfax Bolinas road
        - Would it flood OB road anyways?
- Would be beneficial to disperse flood water within the wye
- New channel will be excavated under the bridge in the first year of construction
    - Big event will flood Fairfax Bolinas Road
- OB road can be flooded if drainage ditch is full (ex - collapse of hillside)
- Veronica will send pictures of high flooding
- Quick to close road and suggest horseshoe hill detour when heavy rain occurs
- **Will allow some flow under bridge after first year of construction, second year the channel will be fully constructed**

Proposed Drainage Channel

- Proposing to tie into Koons' property line (not encroach on property)
- Veronica will talk to Koons landowner to notify them of project
    - Kallie has spoken with owner for past projects
- If drainage channel capacity is heavily impacted WRA will look into continuing drainage channel into Koons property

Coastal Permit Update

- Working on description update
- Veronica will work with her staff biologist to include proper BMPs in project description
    - Will also check for RLF and nesting birds
- Black rail buffer is 700'
- Will talk to Jules about proposed drilling scope and time period
    - See if he thinks there would be impact to rail and if we can reduce buffer
    - WRA will check with rail biologist (Jason) to see if he has experience reducing buffers afterVeronica and Caroline will discuss with Jules
    - If calls are needed, could discuss using contingency for WRA rail biologist to conduct (Jason)
- Sampling/drilling is loud
    - Could sound barriers be used?
    - Likely not
- Rail habitat with buffer mapped?
    - No, just back of napkin measurements

- Assumed Fish and Wildlife permit was not necessary for drilling task because it would be before nesting season
    - Will check with Jules
- Geotech drillings and archeological borings that will be loudest/most disturbing
    - Piezometers will be hand augered
- Crawford has only gotten Fish and Wildlife permits when they are drilling in a stream/river/creek
- WRA will check in with permitting team

Left Turn Lane (Jake Weir – Mark Thomas)

- Mark Thomas prepared exhibit and cost estimate (worst case assumed to be conservative)
- Bank stabilization shortened a bit and added rock slope protection
    - WRA would likely change current bank stabilization design to a more hardscape choice if left turn pocket was required
        - MT assumed 2:1 slope, but could go flatter
        - MT moved channel a few feet for LT pocket design
- MT will send CAD files to WRA
- F line is toe of slope
- ETW – Edge of traveled way
- Currently turnout is on WGC culvert
    - MT could move turnout away from culvert
- Within Caltrans ROW
    - We may be limited to what Caltrans would approve
    - They may require riprap (more hardscape than we would prefer)
    - Joint planting will probably be best compromise
- Conservative construction cost estimate is $770,000
    - Assumed bringing entire road up to code
- MT will send estimate and exhibit with team
- Assumed 4:1 grading slope (Caltrans preferred) (except for creek stabilization)
- Veronica will discuss with supervisor
    - Will want to know impacts
    - WRA will look into amount of wetlands that would be impacted – will need to make impact analysis public to prove it was fully considered
        - Make sure Paul includes this in initial study
    - **Would the project be self-mitigated or require outside mitigation with the LT pocket added?**
- Project description
    - Waiting on left turn pocket decision to finalize

Tsunami scour

- Julie (MT) is out today

Bolinas – Wye Wetland Restoration Project

Progress Meeting January 20, 2021

Attendees: Brian Bartell (WRA), Greg Sproull (WRA), Paul Curfman (WRA) Veronica Pearson (MCP), Caroline Christman (GGNPC), Audriana Ossenberg (WRA), Kallie Kull (MCDPW), Ellen Tiedemann (Crawford), Julie Passalacqua (Mark Thomas), Dan Blomquist (Mark Thomas), Michelle Julene (MCP), Eric Miller (MCDPW)

01/20/21 Meeting

Bridge Design Tsunami Scour

- Julie spoke with Eric (MCDPW) last week
- This project is on the cusp of needing to design for tsunami scour
- But because SLR and taking out wye (open floodplain), it will be required unless it causes cost increases significantly
    - If cost is substantially increases, then circle back with County to discuss
- Tsunami modeling
    - WRA will discuss internally about level of effort required
- Would affect Geotech needs?
    - No
    - Liquefaction and fault drive Geotech needs
- Footings will be dropped (larger excavations, more concrete)
    - Likely won't lengthen piles

Geotech/Coastal Permit Update

- Cultural team is looking into what will be needed
    - Sound barriers?
- If work is done in February
- Not begin construction until after dusk and dawn each day
- Could work be conducted in March? (mating Season)
    - Maybe with sound barriers
- Finding mates in February - don't want to affect calls
- Coastal Commission hasn't completed application because they haven't received tribal communication
- 30 days has just passed for AB-52
- Commission has 30 days from when we re-submit
- Michelle has reached out a few times to tribe, they are not responding
- Coastal Commission is reaching out to chairman
- Sound barriers are very expensive and cumbersome
- Could staff up to make things go faster
- Do birds communicate all day?
    - Starting after 9 am and before 4 pm

- Should have conversation with Jules
- Birds are more active at dusk
- MCP will have biologists monitoring – however many needed
  - Will work with Jules
  - MCP will pay for sound barriers and setup
  - Maybe two sound barriers
    - Setup one barrier while drill rig is working
    - Depends on how easy they are to use
- FHWA says 70-80 decibels is average for 50 feet from highway
  - Ellen (Crawford) says peak is 140, average is 110
  - Will likely need to use sound barrier
- Ask someone from Muir Woods project (Caroline GGNPC) about their experience with sound barriers
- Caroline will check in with Jules on work window
  - If March/April or later is feasible (nesting season)
  - With barriers and operation times
- If Coastal Commision agrees to waiver we can start work
- If nest is within area of operation we cannot work
- Michelle will file a notice of exemption
- Michelle will let tribes know days once they are set
- Biologists will do a recon survey no more than 5 days before work is scheduled
- Caroline to setup call with Muir Woods project and Parks team
  - Hanford did Muir Woods – only one sound barrier

<u>Permitting</u>

- Greg will be taking over for Kari Dupler (Permitting)
- Wetland verification survey with Scott and Corps
- Expects a smooth visit
- Veronica may join

<u>Interpretive Panel</u>

- Architecture historian is classifying whole area has historic landscape because of impact to highway one, loading dock, oyster house
  - Yarbrough recommends we offer an interpretive panel as mitigation
  - Suggested Olema-Bolinas Road originally, but team would suggest existing pullout
- O-B intersection with Highway 1
  - Where the project begins
  - Preferred because of the visual length to Wilkins ranch, ability to look down old road alignment
  - Other options are small, not in project area, lack of visual
  - Having it in project area is strong benefit

- Existing Fairfax Bolinas intersection would be much better from traffic perspective (MT input)
- Prepared matrix with advantage/disadvantages of multiple sites

- Creating a pullout to have signage doesn't seem in line with project goals
- Caroline has done projects that offset cultural by removing artifacts
- Cultural reports haven't been completed yet
  - Trying to fast track because we are already in 60%
  - US Fish and Wildlife cultural team discussion (Becky)

<u>Left Turn Pocket</u>

- 0.3 acres of additional impact
- Lose 0.08 acres of restoration enhancement (where removing Fairfax Bolinas Road)
- Final impact study is not completed yet
  - Will be cutting close now to be a fully self mitigating project
  - Would need to get creative with side slopes and grading to ensure it is self-mitigating
- Likely enough reason to push back on this Left Turn Pocket
- Useful to have this written up
  - WRA to write a memo with figure with additional impact
- Michelle's initial reaction is to include it as background in initial study
  - Not to reference memo in study but summarize it
- Will wait to see how Caltrans responds after next packet is sent to them revised GAD (not showing left turn pocket)
- Would outreach to bike group be helpful?
  - MCBC
  - In transition with contact
- Best to respond to Caltrans comments that are almost ready to go
- Public will want to know what Caltrans said

<u>Project Description</u>

- MCP and GGNP (Caroline and Veronica) agree to just copy goals from alternative analysis

MARIN COUNTY PARKS PRESERVATION RECREATION

wra ENVIRONMENTAL CONSULTANTS

Bolinas – Wye Wetland Restoration Project

Progress Meeting February 3, 2021

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Audriana Ossenberg (WRA), Kallie Kull (MCDPW), Ellen Tiedemann (Crawford), Julie Passalacqua (Mark Thomas), Jake Weir (Mark Thomas), Michelle Julene (MCP), Eric Miller (MCDPW)

02/03/21 Meeting

Coastal Permit

- Commission has new tribal policy
  - Communication with tribe has to be documented to show we are meeting intent of new policy
  - Drilling work is exempt under CEQA
    - After response from tribe we should be good to go
  - Commission wants more information on how tribe was informed of archaeological drilling work
  - Haven't heard back from tribe yet – they are busy with other projects
  - Michelle will reach out to Buffy again
  - Coastal Commission is communicating with tribe directly without MCP input, which is further confusing and delaying the process
  - Caroline is coordinating with CDFW and Coastal Conservancy to coordinate tribal consultation to reduce confusion in the future
- Drilling won't happen this March
- Impact schedule –
  - Borings for MT
  - PD can't be finished until archeological results
  - Rest of permits
  - Barring finding insane Geotech results, footprint of project won't change
    - Scour numbers from WRA is more critical
- Would like to finalize footprint of project
- Send drawing sets (as much as possible) to keep things moving forward minus what is needed from borings
  - This will break up review of 65% design plans, but save time later on

Project Description

- Questions
  - MCP Governing Documents
    - Can we use what they had in the Cascade Canyon document?
      - Unsure
    - Road and trail plan is so comprehensive – lots of things that would not relate
    - Could pull BMPs

- Vegetation and Biodiversity Management Plan
  - Email Michelle to ask about Cascade Canyon, CC Veronica and Caroline
- Fencing and signage section
  - Not planning to fence
  - Only signage would be interpretive panel (maybe)
  - If there is no fencing/signage do we have to complete that section?
    - Put none, don't omit
    - Roadway signage?
      - Brian will check if roadway signage counts
  - Outreach section
    - Veronica has write up she can send along from a grant

Wetland Delineation

- Corps site visit Friday 2/5
- Veronica and Caroline both can't make it

Design

- More upland planting (oak)
- Making channel smaller as moving downstream
- Wider channel where tidally influenced to increase capacity
- Won't show grading where blackberry is removed
  - Model will be changed to half a foot lower
- Berm notches
- Grading to keep long term flow in channel (final condition)
- Culverts
  - Likely can input only one
  - Will raise ditch elevation to allow for gravity flow through culvert
  - Southern existing culvert will remail
- Will have sheets to show phased staging and grading
- Assuming most soil excavated from channel will go to fill crossover road
  - What type of fill is needed?
  - DPW was stockpiling material that was pulled from road material
- Use onsite excavated soil for onsite fill where planting will be
- New Road fill
  - Soil is regional and not great (low R value)
  - Different fill requirements will be needed by bridge as compared to roadway
  - Area under the bridge requirement?
    - Backfill in front of the abutmen
  - Local soil is sometimes placed on pullouts
    - Or stocked in Nicassio (haul, but free)
    - How long will we have that material? Should we start looking at it now?
    - Likely should wait
  - MT requesting PD

      - To be consistent with other permitting documents (DEER, design decision document)
- Should Crawford setup drilling dates?
    - End of March

Caltrans Update

- Caltrans have been given plans without left turn lane
    - Waiting to hear back on comments
    - Traffic study was sent, did not include recommendation on left turn lane
    - May suggest it in comments
- Veronica is presenting to Caltrans environmental this Friday
    - Tell them where we are at
    - Not shop staff/maintenance
    - WRA will send along memo

Bolinas – Wye Wetland Restoration Project

Progress Meeting February 24, 2021

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Caroline Christman (GGNPC), Audriana Ossenberg (WRA), Kallie Kull (MCDPW), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Michelle Julene (MCP)

02/24/21 Meeting

Pacific Flyway Grant

- Potential Implementation funding or Phase 1 construction
- Submitted letter of interest a couple of months earlier
    - Funding for removal of vegetation and construction
    - Didn't provide too much detail
    - Phase 1 construction (bridge, road, veg removal) – first year
    - Hasn't been defined yet, can be flexible
    - Tentative ask of 950k, need to stay in that ballpark
    - Some funding for bridge construction already from different grant
    - Review costs again
- Construction Phasing
    - More considerations of first year
        - Staging
    - When will upper floodplain be graded
        - Easiest to do first, but lose staging area
        - Staging area on newly constructed road first
    - Build road up, then construct bridge
    - Want to stockpile soil to use for Crossover road grading
        - Maybe don't want to use for species, unless capped with channel excavated soil
        - Might be off hauled
        - Maybe clear channel and keep soil in the alignment
- Cape ivy removal is year before first year of construction ($350-400k estimated)
    - Likely overestimated
- Leaves $500k for other work
- Could use it for bridge, wouldn't cover all of it
- State other amounts would be covered from different grants
- Other grants would be less likely to cover infrastructure
- Want to spread infrastructure costs between multiple grants so one grant is not just covering road
- How much would bridge cost go up (considering tsunami addition)
    - If bridge cost goes up significantly, we would circle back to tsunami requirement
    - $500/SF is super conservative, $450/SF is more likely

Marin County Bicycle Coalition Meeting

- Bike pullout options
- Wait to respond until we start the public process
- Would be implemented in SR-1 & Bolinas intersection
- Space for turnout isn't an issue at either intersection
  - Mark Thomas concern is the coalition is likely going to look for a more complete connection between new connection and Fairfax Bolinas Road
  - This would need to widen connection
  - Would need 4-7' shoulders, currently have 0-1'
- More defined jug handle to just add pavement in intersection for Fairfax Bolinas left turn
  - Also add some pavement
  - Don't define as bike space on SR-1, would cause issues with Caltrans
  - Leave pavement so they have room to cue up for turn
- Explain to coalition State Road, don't have power to do more than leave pavement
  - Will widen shoulders slightly so there is room for bikers
- New Olema Bolinas road has 4' shoulders (minimum for bikers)
- On plans we would just show leaving pavement, no designation for bikes
  - Designation could cause issue with Caltrans

Coastal Permit

- Update on tribal communication
- Heard back from Graton Rancheria
  - Meeting on March 9th
  - Michelle coordinated
  - Requested Cassidy be included in meeting, waiting to hear back
  - Initial consultation meeting
    - Get their questions answered regarding Geotech and Geoarch testing
  - Hoping to get the okay to move permit along
  - Ellen has drillers scheduled for 4/5-4/8
    - Unsure if we can make this work
  - Safer to move drillers to the end of April
- DPW has said there is no funding available for this project
  - From Eric
  - There is a new director, check again
  - Dennis has contingency funding

Schedule

- Grant for Bolinas final design approved at last OPC meeting
- Look at scope of work again (restricted by total ask)
- Grant managers want to join meeting?
  - Not as of now
- TAC review of 60% before or after bridge information

- Before is okay
- No response from Caltrans
  - Maybe schedule meeting
  - Wait to hear back from Caltrans before scheduling TAC meeting

Bolinas – Wye Wetland Restoration Project

Progress Meeting March 10, 2021

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Audriana Ossenberg (WRA), Kallie Kull (MCDPW), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Michelle Julene (MCP), Ed Yarbrough, Cassidy, Paul Curfman (WRA)

03/10/21 Meeting

Coastal Permit

- Tribal Consultation Update
  - Call with Graton (3/9/21), outline next steps forward
  - Veronica will enter into contract with Cassidy (Far Western)
    - Needs to include plan for how both the subsurface work for archeological and Geotech is conducted – identifying what we will do if artifacts are encountered
  - Cassidy and tribal monitor will be present for all investigative work (including piezometers)
  - Should have all the subsurface work occur around the same time to be conservative with oversight
    - Archeological work first (Cassidy will create plan/methodology and Graton will review and approve)
  - Haven't setup tribal monitor contract yet, Veronica will contract with Far Western and tribal monitors will contract with Far Western
  - Ed Yarbrough roll
    - Tribe had questions
    - Cultural landscape report is satisfying part of CEQA and section 106 for historic preservation protections
    - Technical study
    - Finding of effects if meets national/state register
    - Long tradition of historical narratives of Native American groups being left out of history
      - Ed will make sure they are included in this report
    - Ed will work with Cassidy's contact with tribe historian to make sure they have input to the report
      - Timing?
      - Work with them to streamline schedule
    - Tribe would want to see boundaries of cultural landscape
  - Draft schedule?
    - Adequate PD initiates it (boundaries)
    - Consultation initiation with Fish and Wildlife
    - APE boundary will be the same as cultural landscape boundary
    - Archeology boundary will likely be different
  - Lead agency for section 106 will decide on Oyster House significance

- NEPA document
  - Does it address Oyster house?
  - No – didn't know of project at that time
  - AECOM Report:
    - Calls out where Oyster House was thought to have been, survey didn't locate it
    - Far Western surveys found it
- How does the meeting yesterday help the permit?
  - Still on hold until Cassidy can send proposed plan and Graton approves it
  - Geoarch and Geotech can stay as one permit
  - Piezometers are included in Geotech work
  - Buffy is on vacation end of this month
  - Earliest to review is early next month
- Call with WRA, Far Western and Veronica to expedite work
  - One week or two to process through County
  - Proposal early next week (Tuesday) proposal to WRA/County
    - Schedule a call once we have that
- Geotech and piezometer methodology needs to be included in Cassidy's plan
  - WRA to get her piezometer information and get in touch with Ellen on Geotech installation
- Cassidy to include Oyster House as a line item for proposal
- AB-52 is Native American consulation/tribe resources
- NHPA (section 106) identification of historic resources
  - Native American consultation included (if eligible)
  - Informs the NEPA findings
- Would we have to change the design if we find artifacts?

<u>Construction Sequencing</u>

- Should reconvene with entire team next week

<u>Schedule Update</u>

- Project Description
  - Ready to send out (doesn't include left turn pocket)

<u>Left Turn Pocket</u>

- No update from Caltrans

Bolinas – Wye Wetland Restoration Project

Progress Meeting March 24, 2021

Attendees: Brian Bartell (WRA), Veronica Pearson (MCP), Audriana Ossenberg (WRA), Kallie Kull (MCDPW), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Michelle Julene (MCP)

03/24/21 Meeting

Coastal Permit

- Veronica emailed check-in with Coastal Commission
  - Shared meeting notes and slides from presentation to Graton Rancheria
  - Agreement is Cassidy would put together cultural resources protection action plan to be reviewed by tribe, new SOW with Far Western
- Tribe will bill through Far Western for tribal monitors, haven't indicated they would bill for comments on action plan (WRA will check in with Cassidy on likeliness of this)
- Best case scenario – get on the May commission meeting to get coastal permit approved
- Would still be in nesting rail season
  - MCP is working on scoping sound barriers/bio tech monitors, etc.
  - CDFW permit?
  - WRA is working with Kallie on a pump station that will install during rail nesting season

Project Description

- MCP still reviewing
- Meeting with Mandy in a few weeks for questions about Oak tree ratios, have PD ready to share and could ask about Geotech borings

Caltrans

- Veronica emailed yesterday to setup meeting to talk about intersection analysis and asking if comments would be received early this week as promised
- Bicycle coalition discussion
  - Asphalt turnouts enough?
  - They seem satisfied, wanted a sign or other demarking possible?
  - Haven't responded yet – wait to see what Caltrans comments are first

Construction Phasing

- Phasing spreadsheet (MT and WRA)
  - When O-B road is closed, traffic will be routed to Crossover Road until bridge and new road is opened

- Virgin land for new O-B road needs to be surcharge loaded for a year
- When existing O-B road needs to be raised to meet bridge elevation, one lane traffic will be required
- Could use Horseshoe Hill road detour and not have to lift Crossover Road to O-B road (waste of construction) (approx. 2-4 days)
  - To prevent one lane closure
- Grading channel under bridge
  - Install bridge abutments and grade floodplain/channel
  - Contractor will buy boulder based on WRA specs
  - Scour protection for abutments
    - Would be sub surface if necessary
- Bridge deck can be installed afterwards
- Then excavate LOD downstream of bridge in wye to place soil from O-B road demo/floodplain development
- Kallie hasn't been allowed to stockpile on wetland for a full season
  - A lot of stockpile pullouts in Bolinas
  - Will need to stockpile wood for structures as well
- Install bank stabilization treatment during first phase of construction
- Will need to pump around LGC and install channel for one year
- Numbered map to go along with staging excel?
- MT is ok with disking and planting banks/slopes of new roadway
  - Hand broadcast with natives, then hydroseed regreen
- Clear corridor first year
  - Not necessary to clear below crossover road (less weed challenges)
- Soil management plan for 90% plan set
- Consider adding headwall and endwall for new culvert
- Add erosion control to construction sequencing

Bolinas – Wye Wetland Restoration Project

Progress Meeting April 7, 2021

Attendees: Audriana Hossfeld (WRA), Brian Bartell (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Caroline Christman (GGNPC), Ellen Tiedemann (Crawford)

04/07/21 Meeting

Caltrans Meeting

- Sea level vulnerability report
  - Adaptation measures are needed
- MCP and Caltrans will try to work together to figure out priority projects
  - Caltrans requesting state funding for these projects
- Didn't talk much about Bolinas Wye project
- Talked to MCP director
  - Will try to accommodate Caltrans request for a gravel shoulder (details below) so no future requests/requirements
  - Estimate additional costs for reports/CEQA/etc.
    - Potentially use Measure A costs
- Caltrans comment
  - Current sight triangle goes into Caltrans maintenance area
    - Could extend shoulder to reduce maintenance requirements
    - This would extend project area
    - Would add less than $50k for gravel, more like $200k for paving in construction costs
    - Additional topo survey may be required
  - Veronica and MCP director want to comply with request
    - Show paved shoulder extension (add to 65% design)
    - This will mean PD, wetland delineation, Cultural, historic report edits
    - Remove existing turnout
      - 8'-10' feet wide (20' long) then tapers to 4' on each end
  - First update design to gravel shoulder, then change to paved if Caltrans requests it
    - New impervious are to be added for CEQA
    - Could CEQA consider both scenarios?
      - Say we're investigating pavement in case Caltrans requires it, but prefer gravel
    - Michelle will comment this in the PD
    - Need updated drawings from MT to quantify
    - Get costs to Veronica ASAP, Veronica will review PD next week
  - Check in with Far Western to make sure they don't have any additional costs for this added area
  - Use sight distance area for extended disturbance area

- Figure updates will be time intensive
- Veronica has to go back to board of supervisors for any update
  - MT has 108k, MT wouldn't need more than half – could use half of 108k (for Far Western additional work?) and if more is needed it can be incorporated in 100p proposal

Coastal Permit

- Updated Coastal Commission on Graton Rancheria consultation
  - CCC can't expedite permit
  - Contract with Far Western before cultural action plan can be completed
    - Could take a few weeks to process
    - If contract is done 4/21, plan could be prepared in May, Tribe could take a few weeks to review (end of May), could potentially make June meeting for Coastal Commission
    - May need to add a follow up consultation meeting with tribe after plan is submitted – could extend schedule

Drilling Permit Coordination

- Best to do three different applications?
  - Well drilling permits and piezometers on one application and indicate who different drillers are
  - Simpler to have WRA submit application

Project Description

- Veronica will review next week
- Send Caroline the area where existing turnout it being modified for seeding
- Groundwater monitoring well at existing pullout – try to protect it?
- How much needs to be excavated to install base for road/turnout?
  - 6 inches of gravel base
  - Need to cut slope too
  - Survey needs to be done
- Cassidy is on vacation this week

Bolinas – Wye Wetland Restoration Project

Progress Meeting April 21, 2021

Attendees: Audriana Hossfeld (WRA), Brian Bartell (WRA), Greg Sproull (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Caroline Christman (GGNPC), Kallie Kull (MCDPW), Ellen Tiedemann (Crawford)

04/21/21 Meeting

Caltrans

- Scheduling Caltrans meeting to review comments
  - Waiting on MT's updated plans to schedule
  - Usually 2 weeks out for scheduling (morning of 5/6 (before 11 am) and 5/7 as options)

Road Design Update

- Based on discussion with WRA last week, looked at design speed for roadway
  - Controlled by bridge, was 25 mph
  - DPW had concerns about this
  - Increased curve radius and superelevation
  - Increased speed to 30 mph – this is the fastest possible
- Maintain south end of bridge, shifts north end 3 feet to the NW
  - Changes skew of the bridge slightly
- Eric Miller (DPW) had concern of direct angle of the bridge
  - Dan followed up and talked to Eric directly, Eric's concen was about sight distance on Olema-Bolinas Road, specifically if vegetation would block stop sigh with OB and SR1
    - Only using grasses, so should be fine
  - Adding grind and overlay on SR-1 to smooth out transition
- These design changes likely won't affect tree removal plan
- Eric still wants overall project discussion about funding for project
- Should plan area to only plant grasses, not trees to ensure good sight distance (MT to specify areas)
- MT will send grading to WRA when finished as well as tree survey to ensure continuity

Costal Permit

- WRA sub agreement sent to Far Western
- Will coordination with Far Western on schedule

Project Description

- Veronica will work on PD comments soon
- Will need to update pending Olema-Bolinas Road design revisions and Caltrans input
- Should have final major comments from Caltrans in next meeting (hopefully 5/6 or 5/7)

Scheduled DPW and Parks Visit on 4/29

- SLR adaptation projects
- Board of supervisors – what priority projects all the agencies have to address SLR (especially DPW)
- DPW doesn't have a prioritized list of projects that pertain to SLR funding
- Director has put pressure on DPW to prioritize this project, to use county funds other than measure A to fund our projects
- DPW has a project list that are prioritized for the next 10 years, none of our projects are on there
- Will try to get DPW support during this site visit
- For optics, it would be good if county would put money in for road construction
- Board meeting 5/18

Bolinas – Wye Wetland Restoration Project

Progress Meeting May 7, 2021

Attendees: Audriana Hossfeld (WRA), Brian Bartell (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Caroline Christman (GGNPC), Kallie Kull (MCDPW)

05/07/21 Meeting

Caltrans

- Some treatment on shoulder will be necessary
- Call Caltrans to see what final treatment is required to be
- No guarantees this will be last comment
- May meeting with Board of supervisors - Caltrans director will be on that call
    - Veronica will start meeting with Bolinas project update, will say hoping no further requirements for SR-1 that's not related to restoration work (due to grant funding)

Cultural Survey

- Will need to pull back Wysteria
- Will have bio monitor sweep the site for nesting birds before they go out
- Will have to set a buffer if nesting birds are found, can go back to buffer area after birds have fledged
- Need to physically see the ground for this survey, pulling vegetation would disturb nests if they are there
- Biologists will weigh in on buffer, should be less than construction buffer because there isn't any noise/heavy equipment

Costal Permit

- Geoarch plan
    - Draft to review by May 11
    - When can we get this to Graton?
    - A week for County staff review before sending to Graton
    - Michelle is out of the office next week
    - Cassidy will send plan once reviewed by County (end of last week of May)
    - If we assume 2 weeks to review (2nd week of June)
    - Will likely meet and review plan with Graton
    - Guessing middle of June earliest for resolution with Graton (in concurrence or not with cultural action plan)
    - Then need the coastal permit (early July?)
    - Mid/late of July to complete borings
        - Have Ellen schedule drillers

- Should we wait until September for Rail?
  - Sound curtain?

Project Description Review

- Veronica's review complete
- Caroline can review it next week
- Michelle is out next week, she can have review done end of May (last week of May)
- Bringing OPC grant to Board on 5/18
  - New contract for WRA
  - After that date, funds will be available a week after Board signs (after 5/18)
  - End of May can expect signed contract
- Favorable review from public works director (Rosemary)
  - Happy to be partner with Parks
  - Moving forward on DPW side
  - Rosemary gave nod to management, working more together
- When 65% design is done, meet with Eric to talk through implementation plan
  - Look at Horseshoe hill road improvements to use as detour instead of single lane during construction

MARIN COUNTY PARKS PRESERVATION RECREATION

wra ENVIRONMENTAL CONSULTANTS

Bolinas – Wye Wetland Restoration Project

Progress Meeting May 19, 2021

Attendees: Audriana Hossfeld (WRA), Brian Bartell (WRA), Andrew Smith (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Caroline Christman (GGNPC), Kallie Kull (MCDPW), Ellen Tiedemann (Crawford)

05/19/21 Meeting

Rare Plant Survey

- Scheduled for 5/27
- Biologist has reviewed previous surveys
- Will report back results

Caltrans

- Successful meeting
- AB is required for shoulder, do not have to pave
- Draft DEER (might be PEER)
    - Same supporting materials, different cover letter
    - Design standard decision document (DSDD)
        - Non standard features need to be documented and approved
        - Normally a comment period
        - Will submit mid-June, prior to 65% design
- PEER – staff can bill to non County funded project
    - Wouldn't have to pay Caltrans for their time
- Need updated project description for the DEER/PEER review (consistent with environmental project description (initial study))
- Upcoming meeting with Caltrans heads
    - Veronica will be updating on Project
    - Eddy asked for costs (design and construction)
    - Amount of improvements in their right of way
    - Passed a certain amount graduate from Peer to project report (above 3 million?)
    - Eddy has been given amount projected in state ROW
    - No reason he should need engineering/design costs
    - Veronica will re-send projected costs for state ROW improvements
- Stop bar location
    - May adjust during 65% design, just a striping change

Cultural Survey

- Oyster house recorded on 5/12 and 5/13

- No ground nests found during nesting bird survey
- Oyster House recording for report that will be submitted to WRA
    - Depending on cultural mitigation, this will determine what agencies the recording will be sent to
    - Veronica and Caroline may want to meet with Becky and Sue to update them on PD/Cultural evaluation
        - 3 weeks from now – would want to have PD draft (week of June 21)
        - Paul Curfman, Ed Yarbrough, Brian, Cassidy, Michelle, Caroline, Veronica, Audriana for meeting attendance
        - Brian will be off last week of June and first week of July

Coastal Permit

- Geo-arch plan is almost ready for tribe submission
    - Boring next to piezometer location
    - Can use the same boring location as piezometer instead?
        - Likely yes
    - Timeline:
        - One week doing arch drilling/investigation
        - One week doing the Geotech
        - Same week of Geotech we are doing the arch
        - Need to plan piezometer with ESA
        - Can work out efficient schedule
    - Veronica to talk to ESA about how long piezometers take to be installed
    - Schedule for ground disturbing activity – need to let Graton Rancheria know in case they want tribal monitor
    - Call with Cassidy and ESA to coordinate
- Who will submit geoarch plan
    - Cassidy will submit on behalf of Parks
    - Any meeting that has Graton Rancheria attorney Parks needs to have representation as well
- Cassidy would be conduit for Graton Rancheria comments to Parks
- WRA to double check geoarch plan, confirm Parks comments addressed and have her send to the tribe

Project Description Review

- Caroline has completed review – sent to Michelle and Veronica
    - Michelle has a full plate – = optimistically expect comments next week (expect 6/28)
- Does PD need to have Engineering review?
    - Veronica will reach out to Rachel Reed (who reviews draft initial studies) and Eric (engineering)
- County oversight during construction not included
    - Eric recommends oversight that is not part of the design team (outside CM)
    - Should add to costs – will check if it was included

  - WRA used Green Valley last year in that capacity
  - Will include in 65% cost estimate – ball park is 15% of construction costs
- Lots of comments/ edits
  - Should Carline/Veronica review comments/edits with Paul?
    - Some edits weren't addressed from the first round
    - Give Paul a week to review edits, then make smaller meeting
    - Caroline out on vacation 6/4-6/10

Bolinas – Wye Wetland Restoration Project

Progress Meeting June 2, 2021

Attendees: Audriana Hossfeld (WRA), Brian Bartell (WRA), Andrew Smith (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Caroline Christman (GGNPC), Kallie Kull (MCDPW), Ellen Tiedemann (Crawford), Cassidy DeBaker (Far Western), Ed Yarbrough (Yarbrough Arch Resources), Eric Miller (MCDPW), Paul Curfman (WRA)

06/02/21 Meeting

Rare Plant Survey

- No rare plants found during survey in project area
- Confirmed rare plant was in bloom at reference area
- Discovered by Shelley Benson? Clover discovered south of the site?
    - Not found in the Wye – Brian to double check
    - Covered in biological section
- Short memo as an attachment for the IS that describes
    - BRA as appendix in initial study
    - Strict on Section 508, don't include attachments to CEQA documents
    - Pulling in pertinent information normally referenced in CEQA document itself
        - Should reference study within text
        - Follow template that Michelle provided
    - Entire/all CEQA document needs to be 508 compliant
        - Paul will review
    - Scott and Greg doing BRA
        - Section 508 compliant as well

Cultural Resources

- Cassidy Fieldwork
    - Went back out to complete identification of Oyster house remains and survey where the Wysteria will be removed and Caltrans right of way (all clear of cultural resources)
    - Two days recording remains, relocate 4 corners of building, paving of where cars would've parked
    - Glass, ceramics, metal scattered with subsurface potential
    - When Oyster house was torn down lots of moving of soil and domestic refuse, industrial refuse that was pushed around
    - Some burn locations
    - Still piecing together the orientation based on aerial photographs/historians
    - Bolinas museum doesn't have much on it except photographs
    - A lot of the maps show the building was there

- Found remains behind the oyster house that may have been the remains of a residence (perimeter walls)
  - May have been there prior to Oyster House
  - Thought it was a blur in previous aerials
  - Looking into this further
- Detailed mapping to represent info in revised APE
- Only project related activity in the remains/residence locations is vegetation clearance, so no proposed ground disturbance
- Not a significant impact
- Not an area that was proposed to do cores
  - Only where bridge abutments were going
  - And augering down the channel where restoration work will be conducted
- Ed is writing the form, separate reports to inform the cultural portion

- Archeology
  - Areas that are being affected/changed is Ed's kicking off point
  - Cultural landscape is what will be changed from the project
  - Other rules around vetting historical resources
    - Includes the view shed
      - Wilkins ranch – doesn't have a good parcel boundary
  - Cassidy is focused on ground disturbance, Ed's area is larger because of the visual landscape
  - Boundaries of the parcel map increase the extent of the delineated/mapped areas
  - APE map made together to be submitted to USFWS
  - Form has a short PD, attachments that are requested are just maps
    - Don't have to include entire PD, just include some of the essential maps (invasive species botanical removal work, map that shows the different depths)
  - Ed already pulled in relevant PD pieces
    - Parks will review and make sure they are ok with it
    - Then Parks will forward to Becky as draft/kicking off point
  - USFWS will want to discuss APE
- Parks/Caroline/Michelle will review then send to USFWS
- Becky said she was okay to get draft form/map to get it started
  - Don't want to receive a finalized report - they want to give guidance during draft period
  - Same with Graton/Native American consultation
- Send draft to USFWS and Tribe
  - Have to rectify both of their comments in the document
  - Tribe already has the APE map with the geoarch proposal, previous version
  - Will resend updated map, tribe hasn't responded to geoarch plan
  - Once USFWS says APE map is good, we will update tribe and say we're moving forward with it
  - USFWS could change subsurface methods?
    - Unlikely because tribe requested methods, USFWS will see we are going above and beyond for tribe

      - Subsurface investigation is being conducted for the tribe before Geotech investigation, not necessary by USFWS
      - Doing work in advance instead of monitoring during Geotech because of cultural sensitivity
      - Want to start USFWS early, because we want the boundaries to be the same so all CEQA studies are the same
    - Caroline is trying to get meeting with USFWS (Becky and Sue)
    - USFWS meeting once Cassidy and Brian are back from vacation
    - Cassidy will follow up with Buffy on comments/ input to hopefully have feedback for USFWS meeting
      - That will let them that USFWS will be contacting them
    - We need email from Buffy of acceptance to show we have consulted them for CCC permit
    - USFWS application map appendix
      - Pull from Project description
      - Veronica needs to have everything to submit
      - Ed to let us know which figures are appropriate – Ed to email after this
    - Veronica will try to send the application this week

<u>Vacation</u>

- Veronica potentially off week 6/14
- Caroline out weeks 7/12 and 7/19

Bolinas – Wye Wetland Restoration Project

Progress Meeting July 7, 2021

Attendees: Audriana Hossfeld (WRA), Brian Bartell (WRA), Jenn Hyman (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Kallie Kull (MCDPW), Ellen Tiedemann (Crawford),

07/07/21 Meeting

Left Turn Pocket

- On the phone with Eddie (Caltrans) for over an hour
    - Optimistic about bicycle turnout
    - MCBC sent figure with pullout in San Rafael – Eddie worked on that project
    - If we did this is would be a win for Caltrans – show they're working with the bicyclists
    - Eddie wants to make it work, Veronica isn't getting charged for Caltrans time
    - Going to talk to Caltrans cyclist planners
        - Bollards, minimal signage
    - May need an updated traffic survey
- Eric Miller may prefer to have a left turn lane
    - Will include DPW on Caltrans calls
- Julie had a follow up call with Eric Miller on why he wants left turn pocket
    - Eric seemed comforted that Caltrans will not be requiring a left turn pocket
    - Understood Julie's explanation for what warrants a left turn pocket
    - This is a DPW /Parks project, so it is DPW right of way
    - Eric needs to be comfortable with the design
    - Eric thinks DPW would be responsible for what happens on SR-1
- Conclusion is if Caltrans does not require left turn pocket then DPW will approve
- How long will it take Caltrans to make decision?
    - Eddie suggested he would get on it this week
    - Don might be circulating the DSDD with old traffic data
    - Veronica will keep checking in with Eddie
- Can we do left turn pocket and not increase impacts on the East side of the road?
    - And would it work out to reduce impacts on the west side
    - Parks director said they would make it work
    - Hard to meet mitigation requirements – would have to look offsite which is very difficult
- Wetland impacts
    - As of now looks like we'll have to mitigate offsite
    - Could get creative with mitigation (rehab credits for invasives removals, etc)
- Added costs to contract for left turn lane conversation
    - Has been brought up in public settings
    - Create change order
    - Could be placed in alternatives considered section

- Need to add left turn lane to CEQA document
  - Can we leave it open?
  - Do we have to say where offsite mitigation will be?
  - Likely will have to identify it
- Big task to figure out where and how offsite mitigation would be
  - Would be included in APE for cultural resources (need to change) and access/staging
  - Last resort – will first try to get creative with invasive removal
- Will start with the analysis of impacts
  - MT sent CAD of left turn lane LOG/LOD
  - Use this because it is more conservative (should be included in APE)
  - Could say 8 foot shoulder – currently using 4 foot shoulder and expect that should be fine
- Could use an 8 foot shoulder instead of left turn pocket?
  - On east side it would be pretty equivalent
  - Likely wouldn't be too beneficial
    - 20 feet added for left turn pocket
    - 16 feet added for 8 foot shoulders
- After we figure out this issue should have another TAC meeting
- Invasives had been 5:1 to 10:1 on other projects
- One mitigation bank just opened in Marin
  - But not many options
- Can we call grading upstream wetlands?
  - Hopefully, will investigate further

<u>Coastal Permit</u>

- Moving forward!
- Going to August CCC meeting
- So close to the end of black rail season, makes sense to wait until nesting season is over
  - Could start in September? End of nesting season is August 31
- Meeting setup next week to coordinate borings
  - Figuring out piezometers installed with Cassidy in the field
    - Only do one hole for both piezometer and geoarch
  - ESA thinks they could be there with Cassidy in the field and install after Cassidy does her sampling
    - Also coordinate with EHS
- Application will have two different drillers on different dates (Geoarch and Geotech)
  - WRA will put application together
  - Veronica has to transfer money within the County to conduct the work
- Drillers won't set a date until they have a permit?
  - Can put them on the calendar and update them in mid-August confirming permit
  - Need to schedule after 9/1
- Maybe Cassidy first week of September and Ellen the second week

MARIN COUNTY PARKS PRESERVATION RECREATION

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- How long does it take for Cassidy to go through borings?
  - WRA will ask if it's onsite or office analysis
  - Will do this before meeting next week to have the conversation prepped
- Encroachment permit?
  - Crawford already completed this – will confirm date
  - Cassidy's team doesn't have that
  - No fee encroachment permit – should be simple process
- Will have WRA team note when tasks are out of scope so we can track it for additional funds
  - $15k contingency we can dip into
- Sequencing
  - Cassidy first to see if there are any cultural resources
  - If there aren't then maybe no tribal monitors needed for Geotech drilling?

<u>Rare Plant Survey</u>

- Final survey happened yesterday – waiting on results
- Need to schedule field day to decide on locations for piezometers
  - Try to make it in August – ideally the 12th of August
  - Veronica will check with ESA
- Check on Ed's submittal (CEQA)
  - Paul needs to review before sending to Veronica

MARIN COUNTY PARKS PRESERVATION RECREATION

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Bolinas – Wye Wetland Restoration Project

Progress Meeting July 21, 2021

Attendees: Audriana Hossfeld (WRA), Brian Bartell (WRA), Rob Carnachan (WRA), Andrew Smith (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Kallie Kull (MCDPW)

07/21/21 Meeting

Marin County Sea Level Rise Meeting

- Do projects have to start analyzing how they affect neighborhoods?
- CEQA requires analysis of how project affects environment, not how environment affects the project
    - CEQA doesn't address sea level rise
- Sea level rise impacts to neighborhoods based on project construction
- Currently our project has flexibility
- Hydrology section of CEQA checklist
    - Sub heading to addressing sea level rise explaining there won't be negative impacts on neighborhood, tying back to how purpose is to prevent SLR

Introducing Rob

- Will run CEQA process for WRA
- Getting up to speed this past week on the Bolinas status
    - A few questions on PD, schedule a meeting with Michelle
    - Will propose some meeting times later today/tomorrow
- Parks Conservancy
    - Danny Franco and Rob will assist

Left Turn Pocket

- Email to Eddy (Caltrans) by Veronica
    - Eddy is checking in with team – hopefully will hear back by the end of the week
    - Shared picture by chronicle (bike striping example)
        - Are there standards for striping?
            - Yes for bicycle lanes

Coastal Permit

- Should be approved in August CCC meeting
    - Veronica should hear soon if there are any issues/clarifications
    - CCC is down to 2 planners in Marin County region
    - County has one staffer doing permitting for EHS drilling
        - Sooner we can get application to EHS to them the better
        - Marin County EHS staff may want to be present during all drilling

- County is going to have one time funding available for SLR (around $5 million)
    - Hoping to have some of that funding for the construction of this project
    - DPW wants to add a construction manager
- Ellen (Crawford) is trying to schedule Geotech work the first week of October
- Cassidy sent an email to Buffy with schedule and to tell her about the contaminant screening (wasn't mentioned in the original geoarch plan)

<u>Bolinas – Wye Wetland Restoration Project</u>

<u>Progress Meeting August 4, 2021</u>

<u>Attendees</u>: Audriana Hossfeld (WRA), Brian Bartell (WRA), Rob Carnachan (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Kallie Kull (MCDPW), Indigo Bannister (MCP), Danny Franco (GGNPC)

08/04/21 Meeting

<u>Introducing</u>

- Indigo – new MCP assistant planner
    - Past senior planner retired, Indigo is taking on his work
    - Outreach to TAC team and facilitation
- Danny Franco – taking over for Caroline until she's back
    - Bring in Rob later on to review design documents
    - Helped with Cape Ivy plan previously

<u>Left Turn Pocket</u>

- Waiting to see if Caltrans will require left turn permit
    - No update, Veronica recently re-messaged Eddy (Caltrans)

<u>Drilling Update</u>

- Coastal commission permit for Geotech and geoarch permit
- Solidifying drilling dates (assuming approval next week by CC)
- Review BMPs for special status species
    - Unlikely for red legged frog, but MCP may have a biologist go out to do a pre-inspection
    - Kallie will do the survey with Serena (MCP biologist)
        - One before geoarch, one before Geotech
        - Also during drilling for heavy equipment
- Geoarch drilling dates– 9/13-14
- Geotech drilling dates – 10/4-8
- Rails:
    - Outside of breeding season
- Need to finalize meeting to set location for piezometers (WRA and ESA)
    - Next week
- Permits
    - Ellen and Cassidy put together forms
    - WRA will be listed as consultant
    - Submit one application and second sheet listing all the drillers (geoarch, Geotech and piezometers)
    - Veronica will review and submit permit

Bolinas – Wye Wetland Restoration Project

Progress Meeting August 18, 2021

Attendees: Audriana Hossfeld (WRA), Brian Bartell (WRA), Andrew Smith (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Kallie Kull (MCDPW), Danny Franco (GGNPC), Ellen Tiedemann (Crawford)

08/18/21 Meeting

Caltrans response

- Requirements from Bike Ped group
- Requirements for shoulder
    - Met these requirements with current design
- Dan (MT) followed up with Caltrans designer on shoulder widening
    - Won't require it because project has environmental constraints for widening SR-1
- Left turn pocket
    - Caltrans sent Guidance document
    - Mark Thomas will review and figure out next steps

Drilling Update

- Drilling permits
    - Coastal permit waiver went to Board yesterday
        - Confirmed and complete
        - Veronica has emailed planner to verify
    - EHS has drilling permit applications
- Piezometers and Geoarch: (9/13-9/14)
- Geotech borings: (10/4-10/8)
- Have to coordinate inspections
- Set general piezometer locations last week (ESA and WRA)
    - Brian will go back out with updated LOD on GPS to confirm
- Environmental sampling
    - Shouldn't be an issue for RLF because all along road
    - Less than 24" and hand augered
- RLF clearance
    - Kallie and MCP staff
    - Veronica will stop by one day each week for drilling
    - Brian will be there one day for Geotech and one day for piezometers (9/14)

Vacation

- Audriana going on vacation for 3 weeks

MCP Local Coastal Program

- LCP was updated
- Does this affect Bolinas Project?
- Veronica will review updated LCP and see if anything was changed related to project

CEQA update

- Meeting tomorrow with Rob, Michelle, Veronica, Brian

Film

- Short video being made by Ocean Protection Council (OPC)
- Released on 8/31

Update

- Eric Miller has been promoted to interim Assistant Director of DPW

MARIN COUNTY PARKS PRESERVATION RECREATION

wra ENVIRONMENTAL CONSULTANTS

Bolinas – Wye Wetland Restoration Project

Progress Meeting September 01, 2021

Attendees: Brian Bartell (WRA), Andrew Smith (WRA), Rob Carnachan (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Julie Passalacqua (Mark Thomas), Kallie Kull (MCDPW), Danny Franco (GGNPC), Ellen Tiedemann (Crawford)

Left Turn Pocket

- Update
  - No updates from Caltrans (Mark Thomas)
  - Need interpretation of guidance document: AASHTO Green Book 1984
  - Need a formal write up
    - "This is what we interpret, this is how we applied it"
    - Try again to get concurrence
- Considerations for Design
  - Roadway widening on east side would be required but would still be within the ROW (Mark Thomas)
  - Caltrans can add the left turn pocket later after the project, but County would be liable for accidents from people turning left.
    - So concurrence with Caltrans is preferred.

Piezometer, Geoarch, and Geotech

  - Drilling permits
    - Should be approved
  - Piezometer Locations
    - Existing piezometer overlaps with Log Structure
      - Log structure will be moved to avoid existing piezometer
    - Proposed piezometer locations have no changes
    - Piezometers will monitor changes in ground water levels pre- and post-project although not necessary of permit or grant requirements.

Schedule

  - Piezometers, Geocaching (9/13-9/14)
  - Geotech borings (10/4-10/8)

MARIN COUNTY PARKS PRESERVATION RECREATION

wra ENVIRONMENTAL CONSULTANTS

Bolinas – Wye Wetland Restoration Project

Progress Meeting September 22, 2021

Attendees: Brian Bartell (WRA), Rob Carnachan (WRA), Audriana Hossfeld (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Kallie Kull (MCDPW), Danny Franco (GGNPC), Ellen Tiedemann (Crawford)

CRCR Form Submittal

- Follow up with Becky (USFWS)
  - We have a path forward now
- Cassidy (Far Western) wants to know if the APE for cultural landscape and cultural resources is okay
  - Set up a meeting with Becky that Ed and Cassidy are on on once Becky starts reviewing
- Becky hasn't finished reviewing
  - APE maps were submitted
  - Veronica will follow up with Becky on review status
- Ed and Cassidy would like the check in with USFWS before comment

Piezometer, Geoarch, and Geotech

- Work completed last week
  - Quite a few RLFs seen in culvert
  - Protocol was to walk in front of heavy equipment
  - No RLFs were seen where piers are proposed
  - Will have a biologisit onsite for Geotech work
    - not need survey before – check permit
    - night survey wasdone to detect presence and location
    - Veronica to check-in
- No significant findings in geoarch drilling
- Geotech work scheduled for 10/04 - 10/08
  - Still a go – encroachment and drilling permits have been obtained
  - One of the locations is in the wetland area
    - Where the new interchange is with CA-1
  - Can brush be moved? How much?
    - 5-10 feet?
    - Coastal permit wasn't for significant vegetation removal
    - Greater than 5'x5' could bring attention to project
  - May add a hand boring to account for rig availability
  - Planning to mark boring locations early next week
  - WRA will meet up with geotech
- Piezometers
  - ESA didn't instrument them, may do it next month
  - Groundwater was hit during boring

- 8'-10' range
- Saltwater intrusion?
  - There wasn't any in existing Wye piezometer
- Geoarch hit refusal shallower than expected

Left Turn Pocket

- ICE Requirement
  - Clear requirement by Caltrans to conduct ICE
  - Why wasn't is requested before? Different people look at it every time
  - Modifying intersections
    - Document in a memo that different control was considered
  - Fehr and Peers will have to weigh in on budget/schedule
    - Hopefully this week
  - Will conduct another traffic count because numbers are 5 years old (peak summer)
    - Left turn warrant will hinge on new numbers
    - Peak hour counts (usually video, maybe tube counters) – typically about 3 days up to a week
- Shoulder widening for bikes
  - Caltrans is pushing us to make the decision
    - Won't require more than the pullouts we are already including
  - Does the County have additional guidance to push for 4' shoulders (widening)?
    - No
- Warrants – Mark Thomas to submit next week
  - Won't submit until ICE
    - Mark Thomas will update on cost/schedule once known
  - Want to submit as one package
  - No idea how long it will take Caltrans to give a decision once submitted?
    - 4-8 weeks possibly
- CEQA document
  - Section that describes alternatives were considered
  - Can include Left Turn Pocket evaluation
  - Could include in project description as possible alternative and carry through CEQA checklist
    - Makes CEQA document more complicated
- Budget
  - Need to take CEQA budget to the Board soon
    - WRA can submit costs end of next week
  - Add contingency for left turn pocket
    - Shouldn't be an issue because of the request from DPW
- WRA oversight for Geotech drill rigs (Andrew or Audriana)

Bolinas – Wye Wetland Restoration Project

Progress Meeting October 06, 2021

Attendees: Brian Bartell (WRA), Rob Carnachan (WRA), Audriana Hossfeld (WRA), Andrew Smith (WRA), Jenn Hyman (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Kallie Kull (MCDPW), Danny Franco (GGNPC), Ellen Tiedemann (Crawford)

USFWS Coordination

- Meeting with Becky
- Veronica and Brian to have a meeting with USFWS to talk about it they should be the agency lead for road related work of Bolinas Wye Project in the next week or two
- Did Becky say she would do Environmental Assessment (EA)?
  - Not sure, but WRA didn't scope for EA.
  - Assumed no need for NEPA
- If Becky doesn't take on NEPA work, then Army Corps would be lead agency for roads
- Might be additional permit requirements by Army Corps (additional budget)
  - Would Caltrans have a roll in that?
- Becky would talk to Army Corps to decide
  - Hopefully she can make a justification that this is a restoration project and take role of lead agency

Piezometer, Geoarch and Geotech

- Creek is dry from Site to existing culvert
- Groundwater not detected until 20 feet bgs
- Piezometers groundwater at 8-10 feet bgs (below ground surface)
- ADL reports
  - Timeline on reports
  - Sampling today – sent to lab
  - 1-2 weeks for report then able to do the report
- Far Western to visit lab when samples are opened
  - No budget with WRA
  - Can on call with MCP be used?
    - Likely yes, but will need an estimate
    - Cassidy to send Michelle an estimate
  - Tribal monitor?
    - Do not need to be at lab, but want Cassidy there
- Instrumentation for piezometers
  - Yesterday Veronica had an estimate from Solaris for repairs for piezometer equipment
  - Will be at least 2 weeks before finished and shipped from Canada
  - No piezometers as of now because they all had to be pulled for maintenance

Left Turn Pocket

- WRA to send costs this week for additional CEQA work
- Covered for additional design work for left turn lane
- Brian will put together CEQA costs tomorrow
    - From Rob C. as well

ICE Requirements by Caltrans

- New counts and analysis by Fehr & Peers
    - Budget +/- $20,000
    - We have data from 2015 but it's old and we don't want Caltrans to delay the project further by asking for new counts
- Draft ICE Report – December 2021
    - Need to pull encroachment permit (4-6 week process)
    - Collect counts and analysis (additional 4-6 weeks)
        - 1 week to collect data
        - 3-5 weeks to analyze
    - NPE now, could be done around December 2021
    - There is budget in the first contract design task but would need to be refilled
    - Added more money to original contract
        - Can use that now
    - WRA Billing
        - Setup additional meeting to discuss with Veronica
        - Add cushion of budget if Ed gets triggered for his additional cultural work
            - EA? NEPA?
- Assessing a roundabout, stop sign and signal

Bolinas – Wye Wetland Restoration Project

Progress Meeting October 20, 2021

Attendees: Brian Bartell (WRA), Rob Carnachan (WRA), Audriana Hossfeld (WRA), Jenn Hyman (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Dan Blomquist (Mark Thomas), Indigo Banister (MCP), Ellen Tiedemann (Crawford)

Piezometer, Geoarch and Geotech

- Far Western visited lab to open samples – 10/19 and 10/20
    - Cassidy (Far Western) has been coordinating with Ellen (Crawford)
    - Only have to look at the first 15 feet bgs (below ground surface) because below pre-dates anything that could have artifacts
    - Finished review and did not find any artifacts

ICE

- Left pocket turn lane requests
    - By DPW and public
- Will this be discussed in the ICE?
    - Yes – document warrants as attached in the ICE
        - 1984 guidelines
    - Additional intersection options
- Should officially start – had funding issues
- First step is traffic counts
    - Will get counts before holiday traffic

CEQA

- Update on lead federal agency
    - Yesterday Greg had conversation with Will Conner from Army Corps
        - Jayme (Army Corps) is on vacation
        - Will said that the Corps will assume the role of federal lead for NEPA, assuming there is not a different agency with greater federal control and responsibility
    - Meet next week with Will
        - Have Becky (USFWS) on the call too
        - NOAA involved with Programmatic BO
    - Haven't heard back from Becky about clarifying project scope with her team

MARIN COUNTY PARKS PRESERVATION RECREATION

wra ENVIRONMENTAL CONSULTANTS

Bolinas – Wye Wetland Restoration Project

Progress Meeting November 03, 2021

Attendees: Brian Bartell (WRA), Rob Carnachan (WRA), Audriana Hossfeld (WRA), Greg Sproull (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Indigo Banister (MCP), Ellen Tiedemann (Crawford)

CEQA/NEPA

- Army Corps will be lead agency, USFWS would still put together their sections
- Will share information with each other
- Constitute NEPA coverage
- USACE uses MFR instead EA
- Send USFWS what WRA has for BA
  - Becky sent examples WRA is using
- Which Nationwides will be used?
  - They can be stacked
  - USACE will decide which ones they will approve
- NOAA's Programmatic EIS
  - Use for stream related project components? Road?
  - Is it necessary?
  - Section 7 consultation – NMFS, through NOAA
    - Draft BA, converted to BO
    - Programmatic by utilizing what's already been approved
    - More species related than stream impacts
    - Part of Army Corps permit
    - Permitting, not NEPA related
    - But a lot of the similar information
  - EIS
    - NEPA related
- Waterboard representative through TAC
  - TAC counted as pre-meeting requirements
- Prop 1 from Coastal Conservancy
  - Funding to final design
  - Need another extension
  - **March 2023 will be last extension**
- Joe (NOAA) and Erik (WRA) have been in contact with project updates

Geotech

- Caltrans update
  - Geotech report and fault line
  - Project location – close to large faults
    - Caltrans website is going through ADA compliancy
    - Took a lot of the resources down to change

        - Designing surface fault ruptures – horizontal displacement
        - Resources are not on Caltrans website right now
        - Ellen reached out – Caltrans is updating how they do the process
            - Want to schedule a meeting
        - Ellen will schedule and CC Eddy (Caltrans Project Manager) and Veronica
        - Geotech reports in progress – should have a draft in the next few weeks
    - Ask Mark Thomas why Caltrans is being asked about faults when not on Caltrans highway

Traffic counts/ICE

- Dan and Julie out of office
- Request for information
    - Should be starting in a few weeks

Site Update

- Veronica drove by last week – looks like flooding at culvert
    - Mainly from Wharf Creek
    - Water flowing in LGC
    - Water on Crossover road
    - Loggers haven't been deployed yet

Bolinas – Wye Wetland Restoration Project

Progress Meeting November 17, 2021

Attendees: Brian Bartell (WRA), Rob Carnachan (WRA), Audriana Hossfeld (WRA), Jenn Hyman (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Indigo Banister (MCP), Ellen Tiedemann (Crawford), Julie Passalacqua (Mark Thomas), Dan Blomquist (Mark Thomas)

Traffic Counts/ICE

- Encroachment permit from Caltrans
- Best case – middle of December for counts
  - Mid to Late January ICE to Caltrans
- Caltrans feedback from Mid February
- Eddy (Caltrans) meeting with Veronica
  - He thought could push back on the ICE requirement
  - Still do traffic count
  - Veronica is going to email supervisor and Caltrans assistant director
    - Limited time to use grant funding, need to complete this review
    - Caltrans didn't request ICE before, had plans for 2 years
    - Would they reconsider the ICE requirement?
  - Could take the risk and not do the ICE and continue with 65% design and finalize it
    - CEQA studies the impacts of that
    - That is a risk
    - Would take months to review ICE then 65% design
    - This could influence Prop 1 time period
  - Don't think we'll be required to have left turn pocket
  - Have Julie (Mark Thomas) talk to Eric (DPW) (good relationship)
- Tandemly send ICE and 65% design for review by Caltrans
  - If traffic counts show similar results to past traffic count
- Have Julie and Eric talk again
  - Email from DPW with approval to have ICE and 65% design review at same time assuming no left turn pocket is required
- Can we get 65% design by end of January?
  - Mark Thomas can meet that deadline
  - WRA can meet that deadline

Geotech Report

- What does Mark Thomas need to complete 65% design?
  - Need Geotech report and recommendations
- Crawford update
  - Caltrans surface fault rupture guidelines
  - Because site is located in complicated fault area recommend a paleo seismologist look at it and do an analysis (2 weeks)

- Right now assuming 9.5 meters displacement - conservative
- Should we try to reduce displacement? Or just precede with conservative value?
- Not crossing bridge – so shouldn't be an issue?
- Move forward without paleo seismologist
- Would that increase cost of bridge?
  - Would this affect design of bridge? No. (Mark Thomas)
- Can work tandemly with Crawford
  - Mark Thomas and Crawford can both be done end of January
- Scour numbers – Mark Thomas and WRA to coordinate

Permitting

- Confirm use of NOAA RC consistency determination in lieu of CDP
  - Yes
- Will from Army Corps
  - Do we want to apply for permits after 65% design?
  - Yes – use 65% design drawings
  - Cost of permit? Does not have a fee
  - Regional Board and CDFW have fees
- Usually wait until CEQA is substantially done before doing permit applications for CDFW and Regional Board – help permits go through more smoothly
  - But will likely get comments anyways so maybe should start earlier
  - WRA is scoped to do permitting
- Start setting up TAC meeting in Mid February 2022?
  - Are TAC members set?
  - Jayme/Will from Army Corps? – Jayme was at last TAC meeting

Funding

- Highest project for County to be funded for sea level rise set funding
- Go to board on 12/14 to accept funding for construction
  - $1.5 million total for construction
- Once CEQA is through, there will be more opportunities for federal funding

Bolinas – Wye Wetland Restoration Project

Progress Meeting December 01, 2021

Attendees: Brian Bartell (WRA), Rob Carnachan (WRA), Greg Sproull (WRA), Audriana Hossfeld (WRA), Andrew Smith (WRA), Jenn Hyman (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Indigo Banister (MCP), Ellen Tiedemann (Crawford), Kallie Kull (MCDPW), Su Corbaley (Coastal Conservancy), Danny Franco (Parks Conservancy)

Project Schedule

- Existing Prop 1 funding ends January 31, 2023
  - All invoicing needs to be sent in February 2023 to wrapped up in March 2023
  - May be able to extend past 2023, but can't plan on it
  - CEQA and permitting will be difficult to meet January 2023
    - Maybe additional funding by the Conservancy?
    - Funds for resiliency - $350 million next year
- CEQA
  - Mitigated Negative Declaration
  - Timeline
    - County and public review – minimum 5-7 months because it has to go through MCP council
    - Performance measures/BMPs may cause County review comments
    - Admin draft to County staff then after revisions will go to council for review
    - Draft initial study (admin draft) by March 2022 earliest
      - Need to check with historical and cultural subcontractors
      - Historical report is dependent on lead agency feedback (APE delineation and cultural landscape)
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        - They can talk even though we don't have an application in
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      - 1 month turn around time (September 2022) for public review
      - 1 month public review (October 2022)
      - Responses to public comments
      - Then to MCP council for review (January 2023)
- Permitting Timeline?
  - Generally 10 -12 months
  - USFWS BO has been problematic recently
- Design
  - Will require input from TAC and agencies reviewing permit apps to move to 90%

  - Assuming no left turn pocket
  - Submit 65% design for permitting (final after incorporating MCP comments)
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- Vegetation plan in 65% design?
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Major Timeline Elements

- 65% Design – required to be complete, including review by MCP before permitting and finalization of PD
- Permitting – revised figures, impact and mitigation calcs based on approved 65% design
- CEQA PD – will require revised figures and calculations of impacts based on final design

CEQA Alternative

- Submit a SERP request (Statutory Exemption for Restoration Projects)
  - “Construction” work can all be claimed as necessary for restoration/resilience
    - Prove with substantial evidence
  - Could reduce timeline for finishing planning stage of project
  - Will still require going through Section 106 consult
  - NEPA implications?
  - Lead agency would be involved in decision
  - Need MCP legal buy off to make sure this project doesn’t get hung up on lawsuits
    - No public review
    - Could be a risk
    - Michelle will check in with counsel next week
  - Monitoring and management plan

DRAFT

Bolinas – Wye Wetland Restoration Project
Progress Meeting December 15, 2021

- **Project Schedule Update**
  - 65% Design in progress
    - Geotech report should be wrapped up soon – waiting for tsunami scour from WRA
      - WRA potentially working with Golder on tsunami scour – meeting with them this week
      - Scour number should be done by end of Dec – gives everyone enough time to complete designs by end of Jan
    - Fault rupture
      - Conservative fault rupture is 5m – need to design to conservative value since do not have any specific fault studies
      - May need to do additional studies to try to reduce that design number – could potentially get down to 1m. Seismologist expert would need to go to site to refine percentage – no ground disturbance work would be needed. Just surface level survey and review of studies and boring studies.
      - $20-25K for CalTrans to do their fault rupture study – Ellen could look into what other consultants could do that if we decide to go down that path
      - Would greatly increase the cost of the project and design needs to design to 5m
      - CEQA: From a hazard perspective is it better to realign over current road path? There is an alternative route on Horseshoe Hill Rd for tsunami perspective. From earthquake perspective – harder to say since could be cracked pavement.
      - DPW would be the one to make the decision from County. VP to reach out to Julie about conversation with Eric and timeline
  - Deadline – end of January 2022

- **Traffic Study**
  - In progress
    - Supposed to start 12/14
    - Some worry that rain would invalidate study, but relatively light for the next couple of days
    - In past, if CalTrans says not valid, they have gone back out for a smaller study
    - Can confirm with 2015 count as well

  - **Revegetation Plan**
    - Will reveg be completed by contractor or others?
    - Incorporating into plan set

        - GGNPC capacity has changed since last discussed
        - Nursery could maybe do seed collection and plant propagation (Caroline)
            - Bulk seed is unknown - If need large volume, could include option to bid on seed amplification – GGNPC could provide seed stock
            - 18 month lead time for request for container stock
        - GGNPC no longer has capacity in house to do any on the ground vegetation management – if they do have a role, could advise/oversee a contractor
        - GGNPC does not have capacity for invasive plant management – could recommend contractors that currently work with. Best scenario would be to support contractors.
            - Decided to bring in CCNB – have cost estimates for initial removal work. Would have to find contractors/seasonals for post-construction removal
            - Danny/GGNPC to advise CCNB
- **BOS updates**
    - Contracts
    - $700K from ARPA approved

Bolinas – Wye Wetland Restoration Project

Progress Meeting January 12, 2022

Attendees: Brian Bartell (WRA), Rob Carnachan (WRA), Greg Sproull (WRA), Bridgette Medeghini (WRA), Andrew Smith (WRA), Jenn Hyman (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Indigo Banister (MCP), Ellen Tiedemann (Crawford), Kallie Kull (MCDPW), Su Corbaley (Coastal Conservancy), Danny Franco (Parks Conservancy),

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  - "Construction" work can all be claimed as necessary for restoration/resilience
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  - Could reduce timeline for finishing planning stage of project
  - Will still require going through Section 106 consult
  - NEPA implications?
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  - Need MCP legal buy off to make sure this project doesn't get hung up on lawsuits
    - No public review
    - Could be a risk
    - Michelle will check in with counsel next week
  - Monitoring and management plan

Bolinas – Wye Wetland Restoration Project

Progress Meeting January 26, 2022

Attendees: Brian Bartell (WRA), Rob Carnachan (WRA), Greg Sproull (WRA), Bridgette Medeghini (WRA), Andrew Smith (WRA), Jenn Hyman (WRA), Veronica Pearson (MCP), Michelle Julene (MCP), Indigo Banister (MCP), Ellen Tiedemann (Crawford), Kallie Kull (MCDPW), Su Corbaley (Coastal Conservancy), Danny Franco (Parks Conservancy),

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MARIN COUNTY PARKS PRESERVATION RECREATION

wra ENVIRONMENTAL CONSULTANTS

Bolinas – Wye Wetland Restoration Project

Progress Meeting February 9, 2022

- **Fault Rupture/Tsunami Scour Recap**
    - DPW will talk Friday on the Fault Rupture and Tsunami Study
    - May not bring on seismologist
    - Tsunami likely to lead design load case

- **Section 106 Meeting with Corps (02/08) Recap**
    - Updated Corps on Project
    - Goal was to obtain general concurrence from Corps on historic resource evaluation approach and area of project effect (APE) delineation
    - Corps staff concur with our proposed cultural landscape approach to historic evaluation
    - Corps cannot do a detailed review of our proposed APE until the 404 permit application is submitted
    - Ed and Cassidy have enough guidance to proceed with drafting the cultural report

- **Question about role of USFWS in cultural study review**
    - If the Corps is the federal lead for 106, how will Corps staff interface with FWS cultural team?
    - Veronica may reach out to Sue from Coastal Conservancy or Becky from FWS for clarification on this

- **TAC Meeting on the 11th**
- **WRA will provide 60% Drawings on Monday February 14th**
- **WRA Permitting Lead is switching from Greg to Hope Kingma**

Appendix H: Intersection Control Evaluation Memo

FEHR & PEERS

Memorandum

Date: February 7, 2022

To: Daniel Blomquist, Mark Thomas

From: Geoff Rubendall and Zoey Zhang, Fehr & Peers

Subject: **State Route 1 / Olema Bolinas Road – Intersection Control Evaluation**

SF20-1132

Fehr & Peers has completed an Intersection Control Evaluation (ICE), as described in Caltrans Traffic Operation Policy Directive 13-02 (TOPD 13-02), for the State Route 1 (SR1) / Olema Bolinas Road / Fairfax-Bolinas Road intersection. SR1 is also referred to as Shoreline Highway. This memorandum presents the results of the ICE for the Existing (2021) and Existing Plus Project Conditions.

Project Background

The Marin County Open Space District Bolinas Lagoon Wye Wetlands Project is aimed at providing roadway improvements to restore wetlands/streams, protect wildlife, improve safety, reduce flooding, and create climate change resiliency. The SR1 / Olema Bolinas Road / Fairfax-Bolinas Road intersection will be realigned approximately 200 feet to the south for the proposed realignment/restoration of Lewis Gulch Creek. A single-span bridge approximately 38 feet wide and 60 feet long is proposed for the new Lewis Gulch Creek crossing. The project also includes the removal of the existing Olema Bolinas Road and SR1 intersection and approximately 525 feet of Fairfax-Bolinas Road to restore natural wetlands, with the existing SR1 / Fairfax-Bolinas Rd remaining as a T-intersection.

Caltrans guidance (TOPD 13-02) requires that an ICE process be completed when modifying intersections on a state highway. Fehr & Peers completed a traffic analysis to determine appropriate and feasible control options based on existing traffic volumes under AM, PM and weekend mid-day peak hour conditions.

The purpose of the ICE process is to:

- Identify effective intersection control strategies and alternative treatments
- Estimate the relative effectiveness and impacts of specific control strategies

- Justify the need for installation of a traffic signal system, yield control (roundabouts), and multi-way stop control at state highway intersections.

Analysis Methodology

Data Collection

Intersection turning movement counts during weekday AM peak period (7:00 AM to 9:00 AM) and PM peak period (4:00 PM to 6:00 PM), Saturday midday (12:00 PM to 2:00 PM) at the SR1 / Olema Bolinas Road and SR1 / Fairfax-Bolinas Road were collected in December 2021 (see **Attachment 1**). Segment counts for a 7-day period were also collected in December 2021, at the following locations:

- SR1 – West of Olema Bolinas Road
- SR1 – Between Olema Bolinas Road and Fairfax-Bolinas Road
- SR1 – East of Fairfax-Bolinas Road
- Olema Bolinas Road – South of SR1
- Fairfax-Bolinas Road – South of SR1
- Olema Bolinas Road – South of Fairfax-Bolinas Road

Figure 1 displays AM and PM peak hour volumes and weekend midday volume. Based on the collected data, the AM peak hour is 8:00 to 9:00 AM, the PM peak hour is 4:00 to 5:00 PM, and the weekend midday peak hour is 1:00 PM to 2:00 PM. **Figure 2** presents the peak hour volumes under existing plus project condition, where the roadway is re-aligned, and volumes are combined at SR1/ Olema Bolinas intersection.

Intersection Operations

The study intersection was analyzed using procedures and methodologies contained in the *Highway Capacity Manual 6th Edition* (Transportation Research Board, 2016) (HCM 6). These HCM 6 methodologies were applied using the Synchro 11 software, which considers vehicle volumes, lane configurations, bicycle and pedestrian volumes, heavy vehicle percentages and other pertinent parameters of intersection operations.

The following describes specific inputs used in the analysis.

- Lane configurations were entered based on field observations and aerial imagery.
- A heavy vehicle percentage of 2 percent was used on SR1 based on Caltrans Annual Average Daily Truck Traffic 2020 – AADT Truck Report.

- A peak hour factor (PHF) of 0.86 during the AM peak hour, 0.84 during the PM peak hour, and 0.94 during weekend midday peak hour, were used based on the traffic count data collected.
- Default HCM 6 capacity parameters were used for the roundabout analysis.

Level of Service Definition

Level of service (LOS) is a quantitative measure of traffic operating conditions whereby a letter grade from A (the best) to F (the worst) is assigned. In general, LOS A represents free-flow traffic condition with little or no delay and LOS F represents over-saturated conditions where traffic flows exceed capacity resulting in long queues and delays.

A LOS grade is assigned to each intersection based on the methodologies contained in the *Highway Capacity Manual 6th Edition (HCM 6)*. The *HCM 6* methodology determines the LOS at signalized intersections, all-way stop controlled intersections, and roundabouts by comparing the weighted average control delay per vehicle at the intersection. At unsignalized side-street stop-controlled intersections, LOS is calculated for each movement in addition to the intersection as a whole. **Table 1** presents delay ranges for each LOS for unsignalized (roundabout and side-street stop controlled) and signalized intersections. The side-street yield control intersection is conservatively analyzed as a side-street stop controlled.

TABLE 1. INTERSECTION LEVEL OF SERVICE (LOS) CRITERIA

Level of Service	Average Control Delay (seconds / vehicle)	
	Unsignalized	Signalized
A	≤ 10	≤ 10
B	> 10 to 15	> 10 to 20
C	> 15 to 25	> 20 to 35
D	> 25 to 35	> 35 to 55
E	> 35 to 50	> 55 to 80
F	> 50	> 80

Source: *Highway Capacity Manual*, Transportation Research Board, 2016

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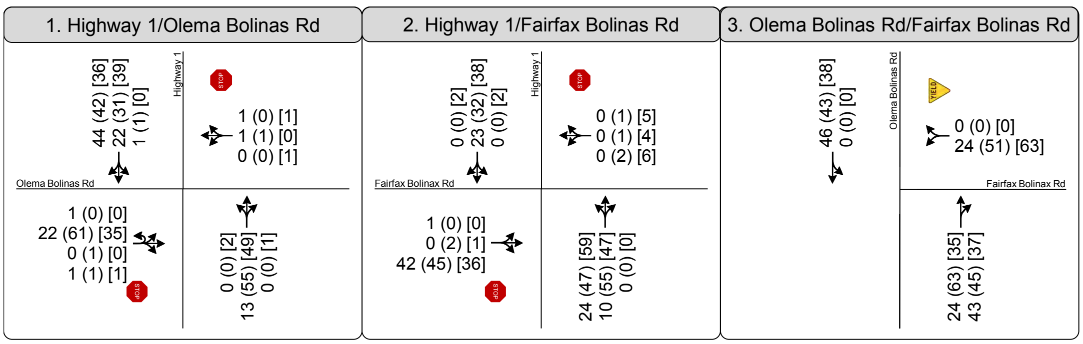
Source: W:\San Francisco N Drive\Projects\2020_Projects\SF20-1132_Hwy1-Olema-Bolinas\Graphics\PDF\Volume Figure



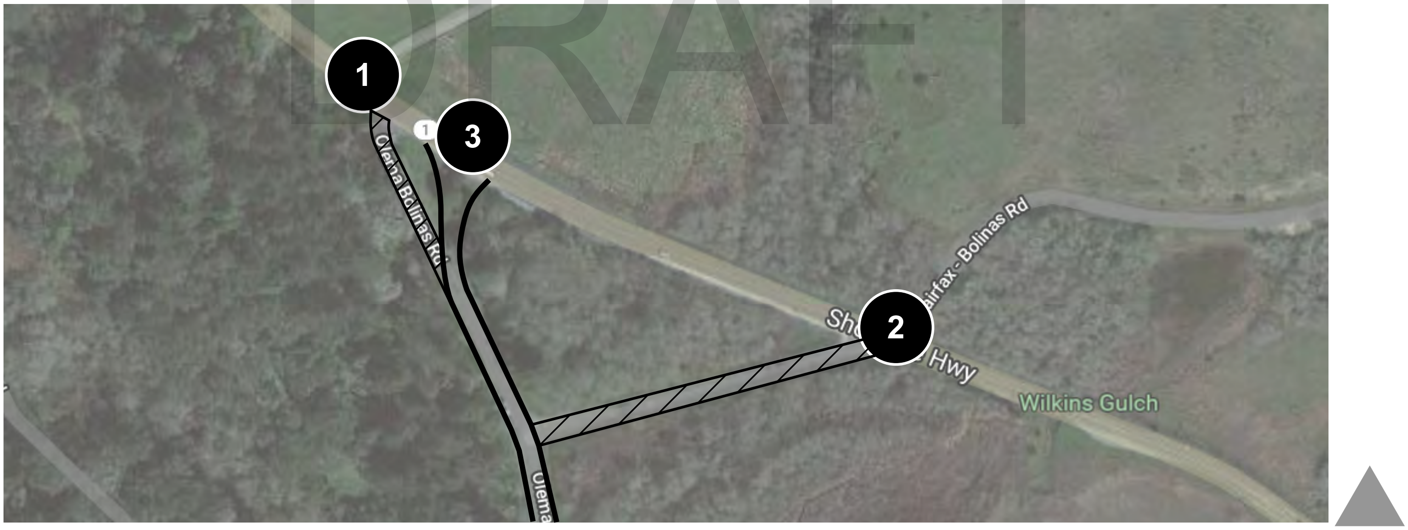
Legend:

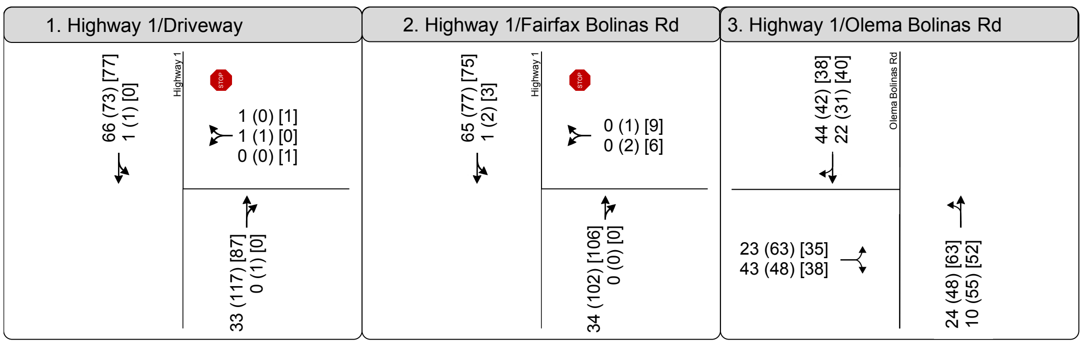
#	Study Location
(turn arrow)	Turn Lane
AM (PM) [Weekend Midday]	Peak Hour Traffic Volume
STOP	Stop Sign
YIELD	Yield Sign

Figure 1

Peak Hour Traffic Volumes and Lane Configurations - Existing Condition

Source: W:\San Francisco N Drive\Projects\2020_Projects\SF20-1132_Hwy1-Olema-Bolinas\Graphics\PDF\Volume Figure





Legend:

#	Study Location
	Turn Lane
AM (PM) [Weekend Midday]	Peak Hour Traffic Volume
STOP	Stop Sign
	Remove Existing Pavement

Figure 2

Peak Hour Traffic Volumes and Lane Configurations
Existing Plus Project Condition

Existing Conditions

Collision data in the study area was queried from the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) database. SWITRS data shows that a total of six collisions occurred over a five-year period at or near the SR1 / Olema Bolinas Road intersection, twelve collisions occurred at the SR1 / Fairfax-Bolinas Road intersection, and two collisions at the Olema Bolinas Road / Fairfax-Bolinas Road intersection. **Table 2** lists the collisions by type in the study area. The collisions occurred between January 1, 2016, and December 31, 2020.

TABLE 2. COLLISION HISTORY

Intersection	Year	Collision Type	Motor Vehicle Involved With	Severity
1. SR1/Olema Bolinas Road	2016	Hit Object	Fixed Object	Other Visible Injury
	2017	Sideswipe, Rear End	Other Motor Vehicle	Property Damage Only
	2020	Hit Object, Overturned	Fixed Object	Severe Injury, Other Visible Injury, Complaint of Pain Injury
2. SR1/Fairfax-Bolinas Road	2016	Broadside, Overturned	Other Motor Vehicle, Non-Collision	Severe Injury, Property Damage Only
	2017	Head-On, Hit Object	Other Motor Vehicle, Fixed Object	Fatal, Complaint of Pain Injury
	2018	Hit Object, Overturned, Head-On	Fixed Object, Non-Collision, Other Motor Vehicle	Property Damage Only, Complaint of Pain Injury, Fatal
	2019	Hit Object	Fixed Object	Property Damage Only
	2020	Rear End, Hit Object, Sideswipe, Overturned	Other Motor Vehicle, Other Object, Other Motor Vehicle, Non-Collision	Property Damage Only, Other Visible Injury, Severe Injury, Severe Injury
3. Olema Bolinas Road/Fairfax-Bolinas Road	2017	Rear End	Other Motor Vehicle	Property Damage Only
		Broadside	Other Motor Vehicle	Property Damage Only

Source: *Statewide Integrated Traffic Records System,* California Highway Patrol, 2021

Table 3 shows the existing weekday peak hour and weekend mid-day intersection operations at study intersections. Technical calculations are provided in **Attachment 2**.

TABLE 3. INTERSECTION OPERATIONS – EXISTING CONDITIONS

Intersection	Control Type	Peak Hour	Delay[1]	LOS[1]
1. SR1/Olema Bolinas Road	Two-Way Stop	AM	9.0	A
		PM	9.9	A
		Weekend Mid-day	9.4	A
2. SR1/Fairfax-Bolinas Road	Two-Way Stop	AM	8.6	A
		PM	10.1	B
		Weekend Mid-day	9.9	A
3. Olema Bolinas Road/Fairfax-Bolinas Road	Side-Street Yield[2]	AM	9.2	A
		PM	9.6	A
		Weekend Mid-day	9.3	A

Note: 1. Delay for a two-way stop-controlled intersection is reported in seconds per vehicle for the (worst-case) movement.
2. Side-street yield controlled intersection is analyzed conservatively as side-street stop controlled intersection.
Source: Fehr & Peers, 2022

As displayed, both SR1 / Olema Bolinas Road and SR1 / Fairfax-Bolinas Road intersections operate at LOS A or B during the AM and PM peak hours, and weekend mid-day peak hour. The highest delay is experienced by motorists heading east on SR1 during peak hours. The existing queue is one vehicle or less on all approaches.

Intersection Control Evaluation

TOPD 13-02 requires a two-step evaluation process to support the timely and efficient selection of intersection traffic control strategies and access configurations for an intersection.

Intersection Control Evaluation Step One

The intent of the Step One analysis is to identify access solution concepts that are most viable and practical for an intersection. Access solutions that are not viable or practical are removed from further consideration to avoid unnecessary expenditure of planning and engineering resources.

Two screening tools were used to identify which control options should be considered for further analysis. The following table, from the ICE Process Informational Guide, provides traffic volume ranges and thresholds to help determine what control options may be appropriate for an intersection. A preliminary screening based on the existing traffic volumes, an ADT of 2,600 vehicles entering the intersection, and **Table 4** below, indicates All-Way Stop, Signal, Single Lane Roundabout or Grade Separation at the SR1 / Olema Bolinas Road / Bolinas intersection may not be feasible.

TABLE 4. CALTRANS ICE PROCESS INFORMATIONAL GUIDE INITIAL SCREENING TOOL				
Total ADT Entering	**All-Way Stop**	**Signal**	**Single Lane Roundabout**	**Grade Separation**
7,500 – 15,000	X		X	
15,000 – 25,000	X	X	X	
25,000 – 80,000		X	X	
>80,000				X

Source: Caltrans ICE Informational Processing Guide, 2013

Exhibit 17 in the *National Cooperative Highway Research Program (NCHRP) Report 825 Planning and Preliminary Engineering Application Guide to the Highway Capacity Manual* was the second screening tool used to determine which control strategies should be analyzed based on existing volumes. Consistent with the findings of the first screening tool, side-street stop control is recommended for analysis. The signal and grade separation options can be removed based on both screening tools.

Intersection Control Evaluation Step Two

The Step Two ICE analysis was completed for the following control options under the Existing Plus Project condition for the SR1 / Olema Bolinas Road / Fairfax-Bolinas Road intersection, to understand the intersection operations with different options:

- Option A – Two-way stop control intersection.
- Option B – All-way stop control with a shared left/through/right lane on all approaches.
- Option C – Single-lane roundabout with a shared left/through/right lane on all approaches.

Table 5 presents the results of the operations analysis under Existing Plus Project condition. As shown, the intersection would operate at LOS A or B during both the AM and PM peak hours under all scenarios. The technical calculations are presented in **Attachment 2**.

TABLE 5. INTERSECTION OPERATIONS – EXISTING PLUS PROJECT				
Scenario	**Control Type**	**Peak Hour**	**Delay**	**LOS**
Option A	Two-Way Stop	AM	9.1	A
		PM	10.2	B
		Weekend Mid-day	9.8	A
Option B	All-Way Stop	AM	7.2	A
		PM	7.9	A
		Weekend Mid-day	7.7	A
Option C	Roundabout	AM	7.2	A
		PM	7.8	A
		Weekend Mid-day	7.7	A

Notes: Synchro 11 was used to calculate intersection delay and LOS.
Delay is reported in seconds per vehicle for the overall intersection for AWSC, signal, and roundabout. Delay for TWSC is reported in seconds per vehicle for the worst-case movement.

Source: Fehr & Peers, 2022

Under Existing Plus Project Scenario, with the realignment of the study intersection, the average 95th percentile queue is one vehicle or less on all approaches for all three options. Option A has no control along SR1; therefore, the intersection operation wouldn't result in any delay along SR1. However, Option B and C would both result in delay for SR1 through traffic.

SR1 is a designated California Legal KPRA Advisory route, Section 405.10(3) of *Highway Design Manual (HDM)* suggests that for California Legal design vehicle, the inscribed circle diameter (ICD) for a signal lane roundabout should range between 105 feet and 150 feet. At this intersection, a roundabout with an ICD of 105 feet would require additional right-of-way and would likely result in a loss of protected wetland habitat. The largest ICD that could be accommodated within the existing right-of-way is approximately 78 feet. At this size, the California Legal KPRA trucks would have difficulty navigating through the roundabout.

Additional Analysis

Signal Warrant Analysis

In addition to the operations analysis, the peak hour signal warrant (consistent with methodologies published in the *California Manual on Uniform Traffic Control Devices 2014)* was evaluated to determine if Existing would satisfy the warrant for installation of a traffic signal. Technical calculations are provided in **Attachment 3.**

During the AM peak hour, with the traffic volume of 34 vehicles per hour (vph) on northbound approach, 66 vph on southbound approach, and 66 vph on eastbound approach, the signal warrant is not satisfied at SR1 / Olema Bolinas Road / Fairfax-Bolinas Road intersection.

During the PM peak hour, with the traffic volume of 103 vph on northbound approach, 73 vph on southbound approach, and 111 vph on eastbound approach, the signal warrant is not satisfied at SR1 / Olema Bolinas Road / Fairfax-Bolinas Road intersection. Therefore, a signal at the study intersection does not meet the peak hour warrant under Existing Plus Project Condition.

Safety Analysis

The crash modification factors of converting of a four-legged, two-way stop-controlled intersection to all-way stop control and to a single roundabout in a rural setting can be found on the CMF Clearinghouse website. A CMF of 0.32 was used for the all-way stop control analysis and a CMF of 0.29 was used for the roundabout analysis. Besides, installing a signal may reduce broadside collisions but would likely to result in a higher rear-end crashes number than implementing the side-street stop control at the intersection.

Bicycle and Pedestrian System

SR1 is a typical rural highway. While all-way stop control (Option B) would accommodate more time for bicyclists and pedestrian to cross the SR1 at the intersection, the benefits would be minimal, given the low expected volume of bicycles or pedestrians cross the SR1 at the intersection.

Conclusion and Recommendation

With the realignment of the SR1 / Olema Bolinas Road / Fairfax-Bolinas Road intersection and the removal of the existing SR1 / Fairfax-Bolinas Road intersection, intersection delays are similar with either all-way stop control, two-way stop control, or a roundabout.

A traffic signal was screened from further consideration during Intersection Control Evaluation Step One.

A roundabout was screened from further consideration due to its potential environmental impact and significant additional cost, including requiring more right-of-way acquisition.

An all-way stop control is not appropriate for this location, as it would create delay along SR1 and would introduce an all-way stop control condition along the rural highway where side-street stop control is the most common configuration in developed areas and for similar intersections along this corridor (e.g., Stinson, Olema, Valley Ford).

Therefore, in consideration of the above, a two-way stop control is the most appropriate traffic control configuration for the SR1 / Olema Bolinas Road / Bolinas intersection.

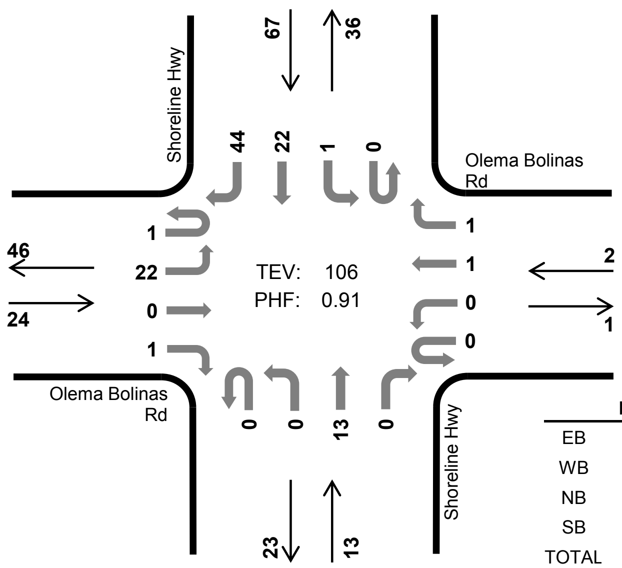
ATTACHMENT 1

Shoreline Hwy
Olema Bolinas Rd

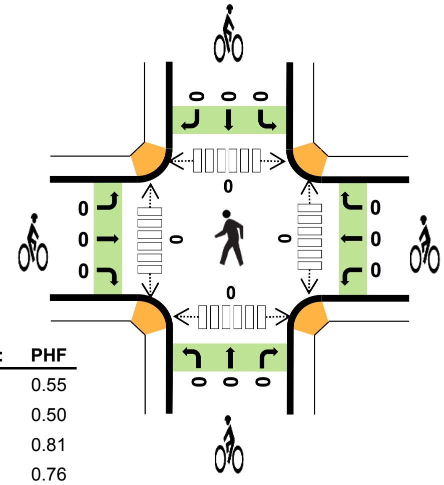
idax

Date: 12-16-2021
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 7:45 AM to 8:45 AM

Peak Hour



	HV %:	PHF
EB	0.0%	0.55
WB	0.0%	0.50
NB	0.0%	0.81
SB	3.0%	0.76
TOTAL	1.9%	0.91



Two-Hour Count Summaries

Interval Start	Olema Bolinas Rd Eastbound				Olema Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	1	0	0	0	0	0	0	0	0	2	0	0	0	2	7	12	0
7:15 AM	0	4	0	1	0	0	0	1	0	0	1	0	0	0	5	9	21	0
7:30 AM	0	9	0	0	0	0	0	0	0	0	1	0	0	0	6	10	26	0
7:45 AM	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**9**	**13**	**29**	88
8:00 AM	**1**	**4**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**5**	**15**	**27**	103
8:15 AM	**0**	**4**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**6**	**6**	**21**	103
8:30 AM	**0**	**11**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**4**	**0**	**0**	**1**	**2**	**10**	**29**	**106**
8:45 AM	0	3	0	1	0	1	0	0	0	1	1	0	0	0	2	14	23	100
Count Total	1	39	0	3	0	1	1	2	0	1	18	0	0	1	37	84	188	0
Peak Hour All	**1**	**22**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**13**	**0**	**0**	**1**	**22**	**44**	**106**	**0**
Peak Hour HV	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**0**
Peak Hour HV%	**0%**	**0%**	**-**	**0%**	**-**	**-**	**0%**	**0%**	**-**	**-**	**0%**	**-**	**-**	**0%**	**5%**	**2%**	**2%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
7:15 AM	0	0	0	1	*1*	0	0	0	0	*0*	0	0	0	0	*0*
7:30 AM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
7:45 AM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:00 AM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:15 AM	**0**	**0**	**0**	**1**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:30 AM	**0**	**0**	**0**	**1**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:45 AM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	0	0	0	3	*3*	0	0	0	0	*0*	0	0	0	0	*0*
Peak Hour	**0**	**0**	**0**	**2**	***2***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Olema Bolinas Rd Eastbound UT	LT	TH	RT	Olema Bolinas Rd Westbound UT	LT	TH	RT	Shoreline Hwy Northbound UT	LT	TH	RT	Shoreline Hwy Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	1
8:00 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	1
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	1
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Olema Bolinas Rd Eastbound LT	TH	RT	Olema Bolinas Rd Westbound LT	TH	RT	Shoreline Hwy Northbound LT	TH	RT	Shoreline Hwy Southbound LT	TH	RT	15-min Total	Rolling One Hour
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:00 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

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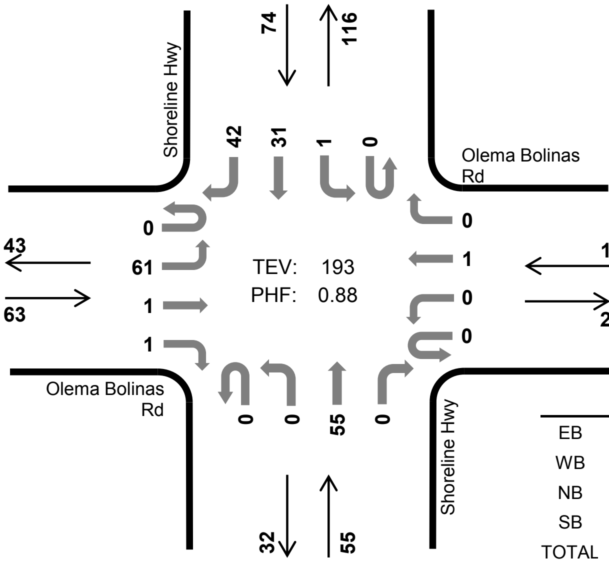
DRAFT

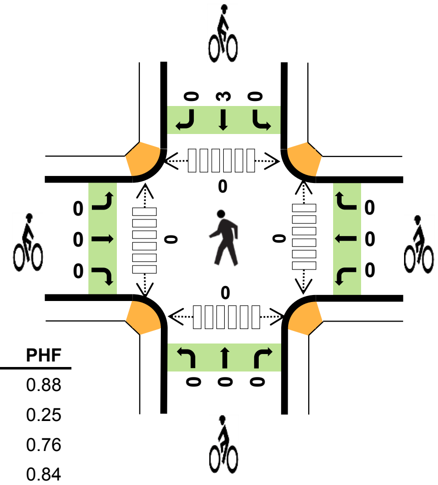
Shoreline Hwy
Olema Bolinas Rd

Date: 12-16-2021
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:00 PM to 5:00 PM

Peak Hour



	HV %:	PHF
EB	1.6%	0.88
WB	0.0%	0.25
NB	0.0%	0.76
SB	2.7%	0.84
TOTAL	1.6%	0.88



Two-Hour Count Summaries

Interval Start	Olema Bolinas Rd Eastbound				Olema Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	**0**	**16**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**17**	**0**	**0**	**0**	**8**	**13**	**55**	0
4:15 PM	**0**	**16**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**7**	**12**	**51**	0
4:30 PM	**0**	**11**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18**	**0**	**0**	**1**	**11**	**10**	**51**	0
4:45 PM	**0**	**18**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**5**	**7**	**36**	**193**
5:00 PM	0	12	0	0	0	0	0	0	0	0	5	0	0	0	3	6	26	164
5:15 PM	0	13	0	0	0	0	0	0	1	0	11	0	0	0	4	8	37	150
5:30 PM	0	8	0	2	0	0	0	0	0	3	6	0	0	0	5	4	28	127
5:45 PM	0	10	0	0	0	0	0	1	0	0	3	0	0	0	1	13	28	119
Count Total	0	104	1	3	0	0	1	1	1	3	80	0	0	1	44	73	312	0
Peak Hour All	**0**	**61**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**55**	**0**	**0**	**1**	**31**	**42**	**193**	**0**
Peak Hour HV	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**0**
Peak Hour HV%	**-**	**2%**	**0%**	**0%**	**-**	**-**	**0%**	**-**	**-**	**-**	**0%**	**-**	**-**	**0%**	**3%**	**2%**	**2%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	**0**	**0**	**0**	**1**	*1*	**0**	**0**	**0**	**0**	*0*	**0**	**0**	**0**	**0**	*0*
4:15 PM	**0**	**0**	**0**	**0**	*0*	**0**	**0**	**0**	**2**	*2*	**0**	**0**	**0**	**0**	*0*
4:30 PM	**0**	**0**	**0**	**1**	*1*	**0**	**0**	**0**	**0**	*0*	**0**	**0**	**0**	**0**	*0*
4:45 PM	**1**	**0**	**0**	**0**	*1*	**0**	**0**	**0**	**1**	*1*	**0**	**0**	**0**	**0**	*0*
5:00 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
5:15 PM	0	0	1	0	*1*	0	0	0	0	*0*	0	0	0	0	*0*
5:30 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
5:45 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	1	0	1	2	*4*	0	0	0	3	*3*	0	0	0	0	*0*
Peak Hour	**1**	**0**	**0**	**2**	*3*	**0**	**0**	**0**	**3**	*3*	**0**	**0**	**0**	**0**	*0*

Project Manager: (415) 310-6469 project.manager.ca@idaxdata.com

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Olema Bolinas Rd				Olema Bolinas Rd				Shoreline Hwy				Shoreline Hwy				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	0
4:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	0
4:45 PM	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**3**
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	3
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Count Total	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	4	0
Peak Hour	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Olema Bolinas Rd			Olema Bolinas Rd			Shoreline Hwy			Shoreline Hwy			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
4:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**3**
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	3	0	3	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**0**

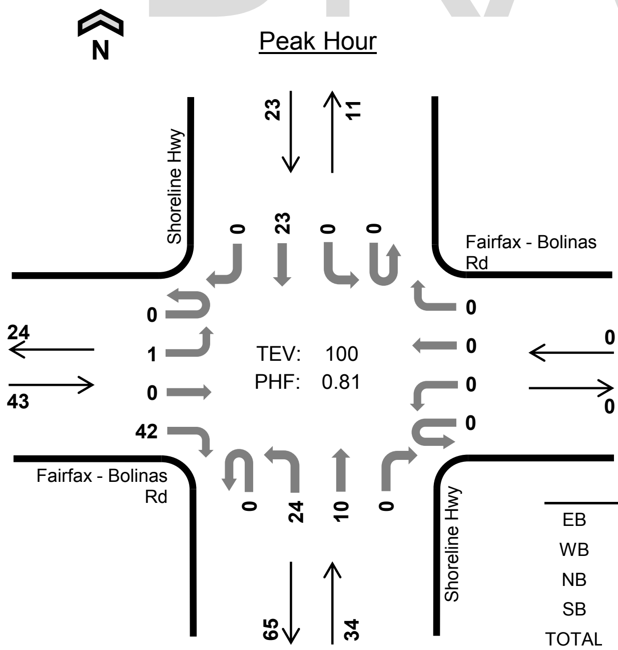
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

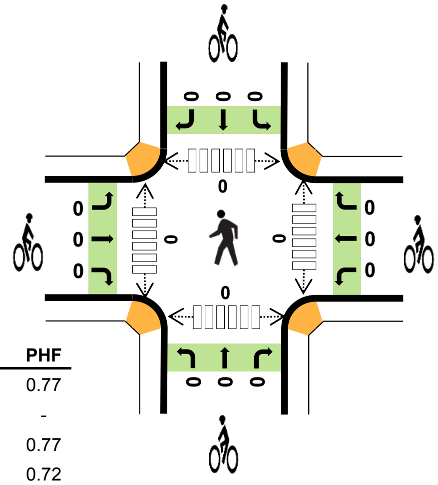
Shoreline Hwy
Fairfax - Bolinas Rd

idax

Date: 12-16-2021
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 7:45 AM to 8:45 AM

Peak Hour





	HV %:	PHF
EB	0.0%	0.77
WB	-	-
NB	8.8%	0.77
SB	4.3%	0.72
TOTAL	4.0%	0.81

Two-Hour Count Summaries

Interval Start	Fairfax - Bolinas Rd Eastbound UT	LT	TH	RT	Fairfax - Bolinas Rd Westbound UT	LT	TH	RT	Shoreline Hwy Northbound UT	LT	TH	RT	Shoreline Hwy Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
7:00 AM	0	0	0	5	0	0	0	0	0	4	2	0	0	0	2	0	13	0
7:15 AM	0	0	0	9	0	0	0	0	0	3	1	0	0	0	6	0	19	0
7:30 AM	0	0	0	10	0	0	0	0	0	4	3	0	0	0	6	0	23	0
7:45 AM	**0**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**0**	**9**	**2**	**0**	**0**	**0**	**8**	**0**	**31**	86
8:00 AM	**0**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**9**	**1**	**0**	**0**	**0**	**6**	**0**	**24**	97
8:15 AM	**0**	**1**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**0**	**7**	**0**	**21**	99
8:30 AM	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**0**	**0**	**0**	**2**	**0**	**24**	**100**
8:45 AM	0	0	0	11	0	0	0	0	0	9	2	0	0	1	3	0	26	95
Count Total	0	1	0	77	0	0	0	0	0	44	18	0	0	1	40	0	181	0
Peak Hour All	**0**	**1**	**0**	**42**	**0**	**0**	**0**	**0**	**0**	**24**	**10**	**0**	**0**	**0**	**23**	**0**	**100**	**0**
Peak Hour HV	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**1**	**0**	**4**	**0**
Peak Hour HV%	**-**	**0%**	**-**	**0%**	**-**	**-**	**-**	**-**	**-**	**13%**	**0%**	**-**	**-**	**-**	**4%**	**-**	**4%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals EB	WB	NB	SB	Total	Bicycles EB	WB	NB	SB	Total	Pedestrians (Crossing Leg) East	West	North	South	Total
7:00 AM	1	0	0	0	*1*	0	0	0	0	*0*	0	0	0	0	*0*
7:15 AM	1	0	0	1	*2*	0	0	0	0	*0*	0	0	0	0	*0*
7:30 AM	1	0	0	0	*1*	0	0	0	0	*0*	0	0	0	0	*0*
7:45 AM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:00 AM	**0**	**0**	**2**	**0**	***2***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:15 AM	**0**	**0**	**0**	**1**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:30 AM	**0**	**0**	**1**	**0**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
8:45 AM	0	0	1	0	*1*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	3	0	4	2	*9*	0	0	0	0	*0*	0	0	0	0	*0*
Peak Hour	**0**	**0**	**3**	**1**	***4***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Fairfax - Bolinas Rd Eastbound				Fairfax - Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
7:15 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	2	0
7:30 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
7:45 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	4
8:00 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	5
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	4
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**4**
8:45 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	5
Count Total	0	0	0	3	0	0	0	0	0	4	0	0	0	0	2	0	9	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**1**	**0**	**4**	**0**

Two-Hour Count Summaries - Bikes

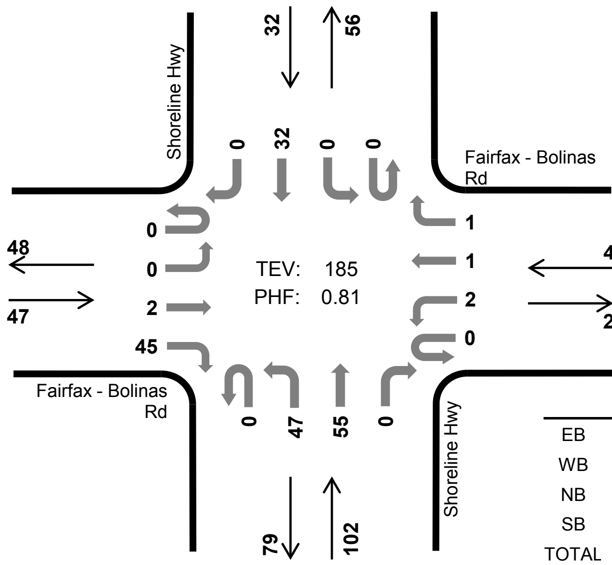
Interval Start	Fairfax - Bolinas Rd Eastbound			Fairfax - Bolinas Rd Westbound			Shoreline Hwy Northbound			Shoreline Hwy Southbound			15-min Total	Rolling One Hour
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:00 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

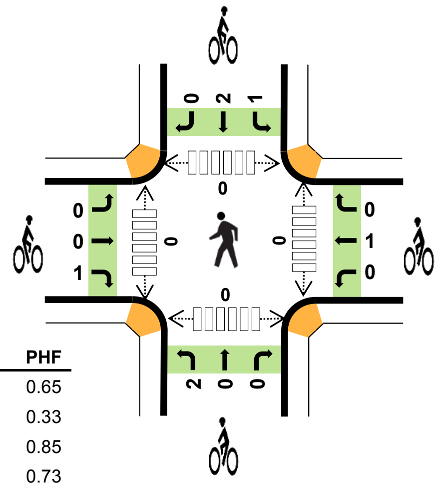
Shoreline Hwy
Fairfax - Bolinas Rd

Date: 12-16-2021
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:00 PM to 5:00 PM

Peak Hour



	HV %:	PHF
EB	2.1%	0.65
WB	0.0%	0.33
NB	2.9%	0.85
SB	3.1%	0.73
TOTAL	2.7%	0.81



Two-Hour Count Summaries

Interval Start	Fairfax - Bolinas Rd Eastbound UT	LT	TH	RT	Fairfax - Bolinas Rd Westbound UT	LT	TH	RT	Shoreline Hwy Northbound UT	LT	TH	RT	Shoreline Hwy Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
4:00 PM	0	0	0	10	0	0	0	0	0	11	18	0	0	0	5	0	44	0
4:15 PM	0	0	0	9	0	0	1	0	0	15	15	0	0	0	11	0	51	0
4:30 PM	0	0	2	16	0	2	0	1	0	9	16	0	0	0	11	0	57	0
4:45 PM	0	0	0	10	0	0	0	0	0	12	6	0	0	0	5	0	33	185
5:00 PM	0	0	0	13	0	1	0	1	0	9	5	0	0	0	2	0	31	172
5:15 PM	0	0	0	12	0	0	0	0	0	7	11	0	0	1	5	0	36	157
5:30 PM	0	1	0	9	0	1	2	1	0	9	7	0	0	0	7	0	37	137
5:45 PM	0	0	0	5	0	0	0	0	0	7	3	0	0	0	1	0	16	120
Count Total	0	1	2	84	0	4	3	3	0	79	81	0	0	1	47	0	305	0
Peak Hour All	0	0	2	45	0	2	1	1	0	47	55	0	0	0	32	0	185	0
Peak Hour HV	0	0	0	1	0	0	0	0	0	3	0	0	0	0	1	0	5	0
Peak Hour HV%	-	-	0%	2%	-	0%	0%	0%	-	6%	0%	-	-	-	3%	-	3%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals EB	WB	NB	SB	Total	Bicycles EB	WB	NB	SB	Total	Pedestrians (Crossing Leg) East	West	North	South	Total
4:00 PM	0	0	0	0	*0*	1	0	2	0	*3*	0	0	0	0	*0*
4:15 PM	1	0	2	0	*3*	0	0	0	2	*2*	0	0	0	0	*0*
4:30 PM	0	0	0	1	*1*	0	0	0	0	*0*	0	0	0	0	*0*
4:45 PM	0	0	1	0	*1*	0	1	0	1	*2*	0	0	0	0	*0*
5:00 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	2	2	0	*4*
5:15 PM	1	0	1	0	*2*	0	0	0	0	*0*	0	0	0	0	*0*
5:30 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
5:45 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	2	0	4	1	*7*	1	1	2	3	*7*	0	2	2	0	*4*
Peak Hour	1	0	3	1	*5*	1	1	2	3	*7*	0	0	0	0	*0*

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Fairfax - Bolinas Rd Eastbound				Fairfax - Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:15 PM	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	0
4:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**5**
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
5:15 PM	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	2	4
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Count Total	0	0	0	2	0	0	0	0	0	3	1	0	0	0	1	0	7	0
Peak Hour	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**1**	**0**	**5**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Fairfax - Bolinas Rd Eastbound			Fairfax - Bolinas Rd Westbound			Shoreline Hwy Northbound			Shoreline Hwy Southbound			15-min Total	Rolling One Hour
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
4:00 PM	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**3**	0
4:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:45 PM	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**7**
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	4
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	1	0	1	0	2	0	0	1	2	0	7	0
Peak Hour	**0**	**0**	**1**	**0**	**1**	**0**	**2**	**0**	**0**	**1**	**2**	**0**	**7**	**0**

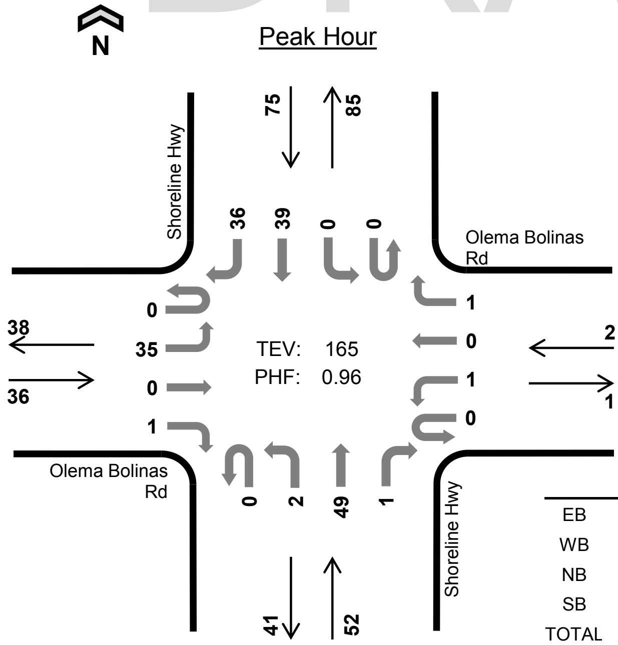
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

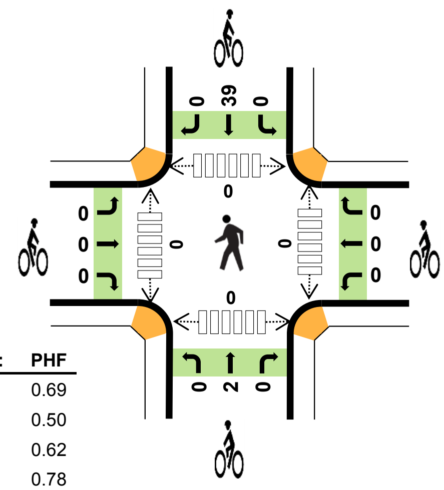
Shoreline Hwy
Olema Bolinas Rd

idax

Date: 12-18-2021
Count Period: 12:00 PM to 2:00 PM
Peak Hour: 1:00 PM to 2:00 PM

Peak Hour





	HV %:	PHF
EB	2.8%	0.69
WB	0.0%	0.50
NB	0.0%	0.62
SB	0.0%	0.78
TOTAL	0.6%	0.96

Two-Hour Count Summaries

Interval Start	Olema Bolinas Rd Eastbound				Olema Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
12:00 PM	0	2	0	1	0	0	0	0	0	1	10	0	0	0	10	6	30	0
12:15 PM	0	7	0	2	0	0	0	0	0	1	18	0	0	0	8	8	44	0
12:30 PM	0	6	0	0	0	0	0	0	0	0	13	0	0	0	11	8	38	0
12:45 PM	1	7	0	4	0	0	0	0	0	0	12	0	0	0	8	10	42	154
1:00 PM	**0**	**7**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**11**	**0**	**0**	**0**	**11**	**8**	**38**	162
1:15 PM	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**10**	**1**	**0**	**0**	**10**	**8**	**43**	161
1:30 PM	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**19**	**0**	**0**	**0**	**4**	**10**	**41**	164
1:45 PM	**0**	**9**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**0**	**14**	**10**	**43**	**165**
Count Total	1	57	0	8	0	1	0	1	0	4	102	1	0	0	76	68	319	0
Peak Hour All	**0**	**35**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**2**	**49**	**1**	**0**	**0**	**39**	**36**	**165**	**0**
Peak Hour HV	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
Peak Hour HV%	**-**	**3%**	**-**	**0%**	**-**	**0%**	**-**	**0%**	**-**	**0%**	**0%**	**0%**	**-**	**-**	**0%**	**0%**	**1%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
12:00 PM	0	0	0	0	*0*	0	0	3	7	*10*	0	0	0	0	*0*
12:15 PM	0	0	0	0	*0*	0	0	1	3	*4*	0	0	0	0	*0*
12:30 PM	0	0	0	0	*0*	0	0	0	7	*7*	0	0	0	0	*0*
12:45 PM	0	0	1	1	*2*	0	0	1	0	*1*	0	0	0	0	*0*
1:00 PM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**1**	**3**	***4***	**0**	**0**	**0**	**0**	*0*
1:15 PM	**1**	**0**	**0**	**0**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
1:30 PM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**1**	**33**	***34***	**0**	**0**	**0**	**0**	*0*
1:45 PM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**3**	***3***	**0**	**0**	**0**	**0**	***0***
Count Total	1	0	1	1	*3*	0	0	7	56	*63*	0	0	0	0	*0*
Peak Hour	**1**	**0**	**0**	**0**	***1***	**0**	**0**	**2**	**39**	***41***	**0**	**0**	**0**	**0**	***0***

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Olema Bolinas Rd Eastbound UT	LT	TH	RT	Olema Bolinas Rd Westbound UT	LT	TH	RT	Shoreline Hwy Northbound UT	LT	TH	RT	Shoreline Hwy Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	2
1:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	2
1:15 PM	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	3
1:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	3
1:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Count Total	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3	0
Peak Hour	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Olema Bolinas Rd Eastbound LT	TH	RT	Olema Bolinas Rd Westbound LT	TH	RT	Shoreline Hwy Northbound LT	TH	RT	Shoreline Hwy Southbound LT	TH	RT	15-min Total	Rolling One Hour
12:00 PM	0	0	0	0	0	0	0	3	0	0	7	0	10	0
12:15 PM	0	0	0	0	0	0	0	1	0	0	3	0	4	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	7	0	7	0
12:45 PM	0	0	0	0	0	0	0	1	0	0	0	0	1	22
1:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**3**	**0**	**4**	16
1:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	12
1:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**33**	**0**	**34**	39
1:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**41**
Count Total	0	0	0	0	0	0	0	7	0	0	56	0	63	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**39**	**0**	**41**	**0**

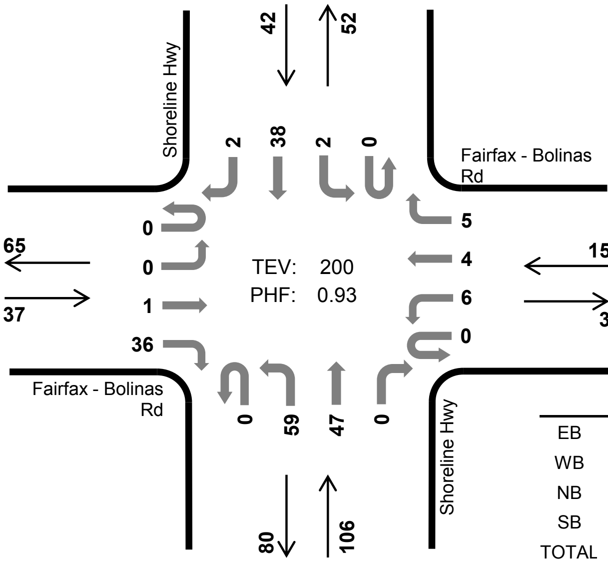
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

Shoreline Hwy
Fairfax - Bolinas Rd

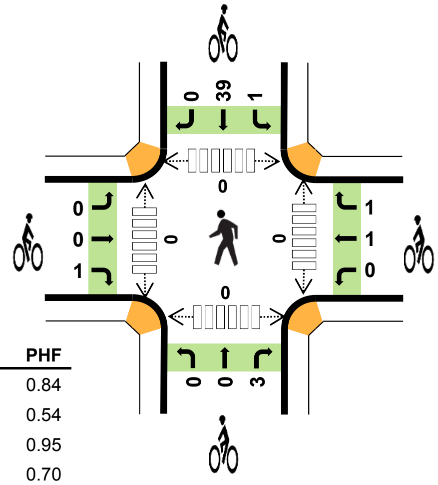
idax

Date: 12-18-2021
Count Period: 12:00 PM to 2:00 PM
Peak Hour: 1:00 PM to 2:00 PM

Peak Hour



	HV %:	PHF
EB	0.0%	0.84
WB	0.0%	0.54
NB	0.9%	0.95
SB	0.0%	0.70
TOTAL	0.5%	0.93



Two-Hour Count Summaries

Interval Start		Fairfax - Bolinas Rd Eastbound UT	LT	TH	RT	Fairfax - Bolinas Rd Westbound UT	LT	TH	RT	Shoreline Hwy Northbound UT	LT	TH	RT	Shoreline Hwy Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
12:00 PM		0	0	1	5	0	1	0	4	0	11	7	0	0	0	10	1	40	0
12:15 PM		0	0	1	4	1	2	0	0	0	12	19	1	0	0	9	0	49	0
12:30 PM		0	0	0	14	0	0	0	0	0	12	12	0	0	0	12	0	50	0
12:45 PM		0	1	0	8	0	0	0	0	0	12	12	0	0	0	11	0	44	183
1:00 PM		**0**	**0**	**0**	**11**	**0**	**1**	**0**	**0**	**0**	**13**	**11**	**0**	**0**	**1**	**12**	**0**	**49**	192
1:15 PM		**0**	**0**	**0**	**7**	**0**	**2**	**3**	**2**	**0**	**18**	**10**	**0**	**0**	**1**	**8**	**1**	**52**	195
1:30 PM		**0**	**0**	**0**	**9**	**0**	**1**	**1**	**2**	**0**	**9**	**19**	**0**	**0**	**0**	**3**	**1**	**45**	190
1:45 PM		**0**	**0**	**1**	**9**	**0**	**2**	**0**	**1**	**0**	**19**	**7**	**0**	**0**	**0**	**15**	**0**	**54**	**200**
Count Total		0	1	3	67	1	9	4	9	0	106	97	1	0	2	80	3	383	0
Peak Hour	**All**	**0**	**0**	**1**	**36**	**0**	**6**	**4**	**5**	**0**	**59**	**47**	**0**	**0**	**2**	**38**	**2**	**200**	**0**
	HV	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
	HV%	**-**	**-**	**0%**	**0%**	**-**	**0%**	**0%**	**0%**	**-**	**2%**	**0%**	**-**	**-**	**0%**	**0%**	**0%**	**1%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals EB	WB	NB	SB	Total	Bicycles EB	WB	NB	SB	Total	Pedestrians (Crossing Leg) East	West	North	South	Total
12:00 PM	0	0	0	0	*0*	0	0	4	6	*10*	0	0	0	0	*0*
12:15 PM	0	0	1	0	*1*	11	2	0	1	*14*	0	0	0	0	*0*
12:30 PM	1	0	0	0	*1*	1	0	0	9	*10*	0	0	0	0	*0*
12:45 PM	0	0	1	0	*1*	0	1	3	0	*4*	0	0	0	0	*0*
1:00 PM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**1**	**3**	***4***	**0**	**0**	**0**	**0**	*0*
1:15 PM	**0**	**0**	**0**	**0**	***0***	**1**	**1**	**0**	**0**	***2***	**0**	**0**	**0**	**0**	*0*
1:30 PM	**0**	**0**	**1**	**0**	***1***	**0**	**1**	**0**	**33**	***34***	**0**	**0**	**0**	**0**	*0*
1:45 PM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**2**	**4**	***6***	**0**	**0**	**0**	**0**	***0***
Count Total	1	0	3	0	*4*	13	5	10	56	*84*	0	0	0	0	*0*
Peak Hour	**0**	**0**	**1**	**0**	***1***	**1**	**2**	**3**	**40**	***46***	**0**	**0**	**0**	**0**	***0***

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Fairfax - Bolinas Rd Eastbound				Fairfax - Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
12:30 PM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
12:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	3
1:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	3
1:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	2
1:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	2
1:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Count Total	0	0	0	1	0	0	0	0	0	2	1	0	0	0	0	0	4	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Fairfax - Bolinas Rd Eastbound			Fairfax - Bolinas Rd Westbound			Shoreline Hwy Northbound			Shoreline Hwy Southbound			15-min Total	Rolling One Hour
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
12:00 PM	0	0	0	0	0	0	1	3	0	5	1	0	10	0
12:15 PM	0	1	10	1	0	1	0	0	0	0	1	0	14	0
12:30 PM	0	1	0	0	0	0	0	0	0	1	8	0	10	0
12:45 PM	0	0	0	0	0	1	2	1	0	0	0	0	4	38
1:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**3**	**0**	**4**	32
1:15 PM	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	20
1:30 PM	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**33**	**0**	**34**	44
1:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**3**	**0**	**6**	**46**
Count Total	0	2	11	1	1	3	3	4	3	7	49	0	84	0
Peak Hour	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**0**	**3**	**1**	**39**	**0**	**46**	**0**

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

Location: Hwy 1, North of Olema Bolinas Rd
Date Range: 12/14/2021 - 12/20/2021
Site Code: 01

DRAFT

idax DATA SOLUTIONS

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	0	1	1	0	0	0	0	0	0	0	1	1	2	0	2	2	3	5	1	0	1	0	0	0
1:00 AM	0	0	0	0	0	0	2	1	3	2	1	3	1	0	1	2	2	4	0	0	0	1	0	1
2:00 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0
3:00 AM	0	1	1	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1
4:00 AM	0	0	0	1	0	1	0	0	0	1	1	2	1	0	1	1	0	1	1	2	3	0	0	0
5:00 AM	1	2	3	1	3	4	2	1	3	3	1	4	2	0	2	3	2	5	1	2	3	1	2	3
6:00 AM	13	17	30	10	13	23	12	12	24	11	7	18	7	3	10	3	2	5	5	7	12	12	14	26
7:00 AM	14	**80**	94	20	59	79	26	60	86	29	32	61	17	26	43	12	13	25	17	28	45	20	**66**	86
8:00 AM	37	55	92	32	**64**	96	33	**61**	94	42	**66**	108	24	38	62	38	8	46	36	45	81	34	60	94
9:00 AM	37	67	**104**	**53**	53	**106**	39	53	92	57	64	**121**	58	46	104	33	23	56	50	31	81	43	58	101
10:00 AM	**44**	56	100	46	26	72	41	58	99	57	49	106	69	31	100	49	**34**	83	57	31	88	44	47	90
11:00 AM	38	58	96	47	47	94	**67**	58	**125**	**59**	51	110	**81**	**49**	**130**	**80**	**34**	**114**	**65**	**51**	**116**	**51**	54	**105**
12:00 PM	61	41	102	52	48	100	50	65	115	69	61	130	79	66	145	59	38	97	49	46	95	54	51	106
1:00 PM	65	46	111	57	44	101	67	65	132	94	54	148	87	68	155	65	42	107	75	45	120	63	52	115
2:00 PM	55	46	101	56	**54**	110	67	56	123	70	**64**	134	83	67	150	53	**55**	108	81	48	129	59	52	111
3:00 PM	**98**	52	150	**85**	46	**131**	95	**71**	166	103	53	156	**96**	**84**	**180**	61	51	**112**	87	**65**	**152**	93	**56**	149
4:00 PM	**98**	**66**	**164**	79	33	112	**114**	64	**178**	**118**	52	**170**	83	74	157	**66**	44	110	**92**	48	140	**97**	54	**151**
5:00 PM	58	32	90	38	34	72	66	18	84	70	42	112	51	32	83	47	42	89	53	34	87	54	28	82
6:00 PM	14	17	31	15	24	39	26	11	37	40	32	72	26	40	66	17	26	43	17	12	29	18	17	36
7:00 PM	8	1	9	13	10	23	9	3	12	15	26	41	16	18	34	9	13	22	13	13	26	10	5	15
8:00 PM	6	2	8	5	8	13	7	5	12	9	12	21	8	10	18	10	4	14	3	14	17	6	5	11
9:00 PM	4	2	6	4	3	7	4	7	11	6	8	14	7	5	12	6	10	16	6	4	10	4	4	8
10:00 PM	2	2	4	1	0	1	2	6	8	6	8	14	8	2	10	4	7	11	3	2	5	2	3	4
11:00 PM	3	6	9	3	1	4	0	4	4	5	3	8	1	8	9	3	0	3	1	4	5	2	4	6
Total	656	650	1,306	618	570	1,188	729	680	1,409	866	690	1,556	807	667	1,474	623	453	1,076	714	532	1,246	668	633	1,301
Percent	50%	50%	-	52%	48%	-	52%	48%	-	56%	44%	-	55%	45%	-	58%	42%	-	57%	43%	-	51%	49%	-
AM Peak	10:00	07:00	09:00	09:00	08:00	09:00	11:00	08:00	11:00	11:00	08:00	09:00	11:00	11:00	11:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	07:00	11:00
Vol.	44	80	104	53	64	106	67	61	125	59	66	121	81	49	130	80	34	114	65	51	116	51	66	105
PM Peak	15:00	16:00	16:00	15:00	14:00	15:00	16:00	15:00	16:00	16:00	14:00	16:00	15:00	15:00	15:00	16:00	14:00	15:00	16:00	15:00	15:00	16:00	15:00	16:00
Vol.	98	66	164	85	54	131	114	71	178	118	64	170	96	84	180	66	55	112	92	65	152	97	56	151

1. Mid-week average includes data between Tuesday and Thursday.

idax DATA SOLUTIONS

Location: **Hwy 1, Between Olema Bolinas Rd & Fairfax - Bolinas Rd**
Date Range: **12/14/2021 - 12/20/2021**
Site Code: **02**

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	0	0	0	0	0	0	0	0	0	0	1	1	2	2	4	2	0	2	0	0	0	0	0	0
1:00 AM	0	0	0	0	0	0	1	1	2	3	1	4	1	0	1	2	3	5	0	0	0	0	0	1
2:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0
3:00 AM	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:00 AM	0	2	2	0	0	0	0	0	0	0	1	1	0	0	0	0	4	4	0	0	0	0	1	1
5:00 AM	1	0	1	2	1	3	0	1	1	0	0	0	2	0	2	2	2	4	0	0	0	1	1	2
6:00 AM	8	9	17	2	9	11	4	4	8	5	7	12	2	4	6	0	1	1	3	3	6	5	7	12
7:00 AM	6	**40**	46	15	30	45	13	23	36	16	21	37	12	9	21	8	3	11	11	25	36	11	31	42
8:00 AM	14	22	36	19	19	38	11	20	31	17	34	51	26	14	40	25	10	35	19	23	42	15	20	35
9:00 AM	14	35	**49**	**32**	36	**68**	20	22	42	28	**46**	**74**	40	23	63	19	18	37	21	25	46	22	31	53
10:00 AM	16	24	40	17	24	41	18	27	45	**40**	33	73	46	29	75	35	**31**	66	35	27	62	17	25	42
11:00 AM	**21**	27	48	20	**42**	62	**34**	**33**	**67**	36	32	68	**58**	**41**	**99**	**67**	26	**93**	**36**	**39**	**75**	**25**	**34**	**59**
12:00 PM	35	**32**	67	29	**27**	56	31	35	66	38	35	73	60	58	118	**47**	41	88	29	33	62	32	**31**	63
1:00 PM	27	22	49	30	20	50	37	33	70	43	30	73	55	65	120	42	36	78	41	35	76	31	25	56
2:00 PM	24	25	49	29	19	48	32	25	57	43	**56**	99	54	57	111	36	46	82	50	35	85	28	23	51
3:00 PM	47	18	65	**54**	25	**79**	50	33	83	69	41	110	**67**	**68**	**135**	39	58	97	57	**40**	97	50	25	76
4:00 PM	**64**	27	**91**	45	19	64	**67**	**37**	**104**	**85**	43	**128**	63	63	126	39	**59**	**98**	**59**	39	**98**	**59**	28	**86**
5:00 PM	33	22	55	24	13	37	38	19	57	49	24	73	29	47	76	25	34	59	32	32	64	32	18	50
6:00 PM	10	10	20	7	7	14	13	9	22	31	10	41	14	26	40	10	14	24	10	1	11	10	9	19
7:00 PM	8	7	15	5	5	10	4	4	8	9	10	19	5	3	8	2	5	7	13	10	23	6	5	11
8:00 PM	4	4	8	3	1	4	7	0	7	7	7	14	3	7	10	2	2	4	4	5	9	5	2	6
9:00 PM	3	1	4	1	1	2	1	4	5	3	6	9	4	7	11	4	5	9	2	4	6	2	2	4
10:00 PM	1	0	1	1	0	1	0	0	0	0	1	1	4	2	6	2	2	4	3	1	4	1	0	1
11:00 PM	2	0	2	2	1	3	0	0	0	6	7	13	0	5	5	0	0	0	1	0	1	1	0	2
Total	338	328	666	337	299	636	381	331	712	528	446	974	547	530	1,077	408	401	809	427	377	804	352	319	671
Percent	51%	49%	-	53%	47%	-	54%	46%	-	54%	46%	-	51%	49%	-	50%	50%	-	53%	47%	-	52%	48%	-
AM Peak	11:00	07:00	09:00	09:00	11:00	09:00	11:00	11:00	11:00	10:00	09:00	09:00	11:00	11:00	11:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00
Vol.	21	40	49	32	42	68	34	33	67	40	46	74	58	41	99	67	31	93	36	39	75	25	34	59
PM Peak	16:00	12:00	16:00	15:00	12:00	15:00	16:00	16:00	16:00	16:00	14:00	16:00	15:00	15:00	15:00	12:00	16:00	16:00	16:00	15:00	16:00	16:00	12:00	16:00
Vol.	64	32	91	54	27	79	67	37	104	85	56	128	67	68	135	47	59	98	59	40	98	59	31	86

1. Mid-week average includes data between Tuesday and Thursday.

DRAFT

Location: Hwy 1, South of Fairfax - Bolinas Rd
Date Range: 12/14/2021 - 12/20/2021
Site Code: 03

idax DATA SOLUTIONS

Time	Tuesday 12/14/2021			Wednesday 12/15/2021			Thursday 12/16/2021			Friday 12/17/2021			Saturday 12/18/2021			Sunday 12/19/2021			Monday 12/20/2021			Mid-Week Average		
	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	1	0	1	2	1	3	1	0	1	2	2	4	6	1	7	4	2	6	2	0	2	1	0	2
1:00 AM	2	1	3	0	0	0	4	1	5	2	1	3	2	0	2	3	7	10	2	0	2	2	1	3
2:00 AM	0	0	0	1	0	1	2	0	2	0	0	0	1	0	1	1	3	4	1	0	1	1	0	1
3:00 AM	0	2	2	1	4	5	0	4	4	1	1	2	1	0	1	0	0	0	1	1	2	0	3	4
4:00 AM	0	4	4	1	3	4	1	3	4	0	2	2	0	2	2	2	0	2	1	3	4	1	3	4
5:00 AM	2	3	5	3	2	5	1	5	6	4	2	6	1	5	6	1	4	5	0	2	2	2	3	5
6:00 AM	9	18	27	5	20	25	6	16	22	9	19	28	7	5	12	1	8	9	10	19	29	7	18	25
7:00 AM	25	66	91	33	60	93	26	59	85	31	45	76	25	27	52	17	14	31	24	51	75	28	62	90
8:00 AM	27	69	96	**48**	62	110	34	58	92	41	70	111	42	30	72	32	25	57	39	45	84	36	63	99
9:00 AM	47	**71**	**118**	**48**	**75**	**123**	61	50	111	58	**101**	**159**	73	50	123	47	54	101	46	57	103	52	**65**	117
10:00 AM	**56**	62	**118**	41	44	85	46	67	113	**75**	72	147	82	**68**	150	68	64	132	62	69	131	48	58	105
11:00 AM	43	54	97	**48**	72	120	**74**	**69**	**143**	62	75	137	**95**	60	**155**	**98**	**73**	**171**	**74**	**81**	**155**	**55**	65	**120**
12:00 PM	69	**75**	144	52	55	107	71	73	144	91	88	179	107	83	190	**85**	73	158	59	78	137	64	**68**	132
1:00 PM	80	62	142	61	**64**	**125**	96	68	164	85	69	154	**109**	94	203	63	65	128	84	81	165	79	65	144
2:00 PM	62	63	125	60	41	101	59	59	118	103	**99**	202	103	99	202	59	79	138	87	**83**	170	60	54	115
3:00 PM	93	56	149	62	37	99	**102**	**81**	**183**	**131**	83	**214**	94	**130**	**224**	54	92	146	**96**	80	**176**	86	58	144
4:00 PM	**99**	63	**162**	**67**	39	106	**102**	79	181	114	88	202	85	113	198	64	**105**	**169**	82	66	148	**89**	60	**150**
5:00 PM	64	61	125	41	34	75	59	59	118	80	58	138	54	88	142	41	65	106	64	67	131	55	51	106
6:00 PM	23	19	42	27	14	41	31	19	50	48	19	67	28	44	72	31	22	53	25	15	40	27	17	44
7:00 PM	23	11	34	18	8	26	16	8	24	34	20	54	27	13	40	17	12	29	26	15	41	19	9	28
8:00 PM	17	7	24	12	4	16	21	5	26	13	10	23	19	12	31	19	6	25	12	8	20	17	5	22
9:00 PM	10	7	17	14	2	16	18	7	25	11	12	23	6	7	13	10	8	18	7	6	13	14	5	19
10:00 PM	7	0	7	10	3	13	7	1	8	11	3	14	8	3	11	9	3	12	12	1	13	8	1	9
11:00 PM	4	0	4	4	2	6	5	1	6	7	4	11	4	5	9	3	0	3	5	0	5	4	1	5
Total	763	774	1,537	659	646	1,305	843	792	1,635	1,013	943	1,956	979	939	1,918	729	784	1,513	821	828	1,649	755	737	1,492
Percent	50%	50%	-	50%	50%	-	52%	48%	-	52%	48%	-	51%	49%	-	48%	52%	-	50%	50%	-	51%	49%	-
AM Peak	10:00	09:00	09:00	08:00	09:00	09:00	11:00	11:00	11:00	10:00	09:00	09:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	09:00	11:00
Vol.	56	71	118	48	75	123	74	69	143	75	101	159	95	68	155	98	73	171	74	81	155	55	65	120
PM Peak	16:00	12:00	16:00	16:00	13:00	13:00	15:00	15:00	15:00	15:00	14:00	15:00	13:00	15:00	15:00	12:00	16:00	16:00	15:00	14:00	15:00	16:00	12:00	16:00
Vol.	99	75	162	67	64	125	102	81	183	131	99	214	109	130	224	85	105	169	96	83	176	89	68	150

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

idax DATA SOLUTIONS

Location: Olema Bolinas Rd, South of Hwy 1
Date Range: 12/14/2021 - 12/20/2021
Site Code: 04

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	0	1	1	0	0	0	0	0	0	0	0	0	3	0	3	0	3	3	2	0	2	0	0	0
1:00 AM	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	3	1	4	0	0	0	0	0	0
2:00 AM	0	0	0	0	0	0	0	1	1	0	1	1	0	2	2	0	0	0	0	1	1	0	0	0
3:00 AM	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	1	1	0	0	0	0	0	0
4:00 AM	2	0	2	2	0	2	0	2	2	1	0	1	1	1	2	4	0	4	2	1	3	1	1	2
5:00 AM	2	2	4	0	3	3	4	2	6	6	2	8	2	0	2	1	2	3	2	2	4	2	2	4
6:00 AM	12	10	22	17	8	25	15	12	27	14	13	27	10	1	11	6	4	10	4	4	8	15	10	25
7:00 AM	16	**44**	60	27	37	64	34	39	73	34	39	73	14	19	33	11	12	23	21	35	56	26	40	66
8:00 AM	53	39	92	36	**48**	84	49	**48**	**97**	57	**40**	**97**	14	31	45	22	7	29	37	**42**	79	46	**45**	**91**
9:00 AM	**55**	39	94	55	28	83	33	35	68	**59**	27	86	**51**	35	86	22	19	41	39	20	59	48	34	82
10:00 AM	54	42	**96**	59	29	88	45	35	80	42	29	71	48	28	76	44	21	65	38	25	63	**53**	35	88
11:00 AM	35	40	75	**60**	33	**93**	**50**	36	86	43	33	76	49	**40**	**89**	**51**	**27**	**78**	**55**	35	**90**	48	36	85
12:00 PM	49	29	78	55	28	83	35	35	70	46	45	91	50	35	85	47	25	72	37	25	62	46	31	77
1:00 PM	57	31	88	46	31	77	66	45	111	68	30	98	60	38	98	56	**40**	**96**	74	28	102	56	36	92
2:00 PM	49	34	83	42	37	79	66	37	103	51	38	89	65	40	105	40	32	72	65	32	97	52	36	88
3:00 PM	**80**	**46**	**126**	**80**	**49**	**129**	65	**47**	112	64	**53**	117	61	**44**	105	53	29	82	76	**43**	**119**	75	**47**	**122**
4:00 PM	77	44	121	72	27	99	**93**	43	**136**	**96**	47	**143**	66	40	**106**	**66**	24	90	**83**	31	114	**81**	38	119
5:00 PM	66	26	92	30	23	53	63	34	97	56	39	95	**69**	22	91	48	23	71	50	34	84	53	28	81
6:00 PM	11	13	24	13	17	30	29	20	49	35	28	63	31	22	53	16	17	33	15	25	40	18	17	34
7:00 PM	9	6	15	14	6	20	12	8	20	22	22	44	25	15	40	12	10	22	10	8	18	12	7	18
8:00 PM	7	14	21	4	7	11	3	15	18	9	10	19	13	10	23	18	12	30	2	13	15	5	12	17
9:00 PM	4	5	9	4	3	7	4	7	11	5	6	11	6	6	12	8	7	15	11	4	15	4	5	9
10:00 PM	2	2	4	0	5	5	4	7	11	12	10	22	11	8	19	5	6	11	5	2	7	2	5	7
11:00 PM	4	6	10	2	1	3	0	4	4	6	6	12	4	7	11	5	8	13	0	5	5	2	4	6
Total	644	473	1,117	618	420	1,038	671	512	1,183	726	520	1,246	653	444	1,097	538	330	868	628	415	1,043	644	468	1,113
Percent	58%	42%	-	60%	40%	-	57%	43%	-	58%	42%	-	60%	40%	-	62%	38%	-	60%	40%	-	58%	42%	-
AM Peak	09:00	07:00	10:00	11:00	08:00	11:00	11:00	08:00	08:00	09:00	08:00	08:00	09:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	11:00	10:00	08:00	08:00
Vol.	55	44	96	60	48	93	50	48	97	59	40	97	51	40	89	51	27	78	55	42	90	53	45	91
PM Peak	15:00	15:00	15:00	15:00	15:00	15:00	16:00	15:00	16:00	16:00	15:00	16:00	17:00	15:00	16:00	16:00	13:00	13:00	16:00	15:00	15:00	16:00	15:00	15:00
Vol.	80	46	126	80	49	129	93	47	136	96	53	143	69	44	106	66	40	96	83	43	119	81	47	122

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

Location: Fairfax - Bolinas Rd, Between Olema Bolinas Rd & HWY 1
Date Range: 12/14/2021 - 12/20/2021
Site Code: 05

idax DATA SOLUTIONS

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
12:00 AM	0	1	1	1	2	3	0	1	1	1	2	3	0	5	5	2	2	4	0	2	2	0	1	2
1:00 AM	1	2	3	0	0	0	0	3	3	0	0	0	0	1	1	4	1	5	0	1	1	0	2	2
2:00 AM	0	0	0	0	1	1	0	2	2	0	0	0	0	1	1	3	1	4	0	0	0	0	1	1
3:00 AM	2	0	2	4	1	5	3	0	3	1	1	2	0	1	1	0	0	0	2	1	3	3	0	3
4:00 AM	2	0	2	3	1	4	3	2	5	1	0	1	2	0	2	0	2	2	4	1	5	3	1	4
5:00 AM	3	1	4	1	2	3	5	1	6	2	3	5	5	0	5	2	0	2	2	0	2	3	1	4
6:00 AM	11	3	14	12	3	15	12	2	14	13	6	19	3	6	9	7	1	8	16	7	23	12	3	14
7:00 AM	32	22	54	37	25	62	37	18	55	24	18	42	16	18	34	11	10	21	25	17	42	35	22	57
8:00 AM	**50**	17	67	46	29	**75**	42	24	66	40	29	69	22	19	41	24	11	35	20	27	47	**46**	23	69
9:00 AM	41	35	76	**47**	24	71	30	39	69	**58**	34	**92**	28	32	60	37	29	66	36	23	59	39	33	**72**
10:00 AM	41	**44**	**85**	25	29	54	43	28	71	45	**38**	83	**45**	36	**81**	35	36	71	45	30	75	36	**34**	70
11:00 AM	32	24	56	35	**32**	67	**45**	**45**	**90**	46	32	78	25	**43**	68	**49**	**43**	**92**	**48**	**40**	**88**	37	**34**	71
12:00 PM	**48**	38	86	33	28	61	43	42	85	**59**	55	**114**	38	52	90	41	**48**	**89**	50	30	80	**41**	36	77
1:00 PM	42	**56**	**98**	**42**	34	**76**	37	55	92	37	41	78	37	**64**	101	32	31	63	**51**	44	**95**	40	**48**	**89**
2:00 PM	43	36	79	25	**45**	70	37	33	70	45	64	109	43	51	94	36	29	65	**51**	43	94	35	38	73
3:00 PM	39	52	91	26	23	49	**56**	**56**	**112**	43	**71**	**114**	**67**	44	**111**	39	20	59	36	**48**	84	40	44	84
4:00 PM	36	50	86	20	31	51	45	49	94	53	51	104	54	39	93	**46**	39	85	33	33	66	34	43	77
5:00 PM	39	38	77	22	22	44	43	35	78	37	48	85	42	38	80	37	23	60	38	37	75	35	32	66
6:00 PM	10	19	29	7	21	28	11	21	32	12	27	39	23	16	39	10	22	32	15	18	33	9	20	30
7:00 PM	5	19	24	4	14	18	5	13	18	12	25	37	10	24	34	7	16	23	6	18	24	5	15	20
8:00 PM	4	14	18	4	9	13	5	16	21	6	10	16	7	17	24	5	17	22	3	10	13	4	13	17
9:00 PM	5	8	13	1	11	12	2	17	19	9	8	17	2	4	6	3	7	10	4	6	10	3	12	15
10:00 PM	0	6	6	5	10	15	1	7	8	2	11	13	1	6	7	1	7	8	0	9	9	2	8	10
11:00 PM	0	3	3	1	2	3	1	5	6	1	4	5	1	4	5	0	3	3	0	4	4	1	3	4
Total	486	488	974	401	399	800	506	514	1,020	547	578	1,125	471	521	992	431	398	829	485	449	934	464	467	931
Percent	50%	50%	-	50%	50%	-	50%	50%	-	49%	51%	-	47%	53%	-	52%	48%	-	52%	48%	-	50%	50%	-
AM Peak	08:00	10:00	10:00	09:00	11:00	08:00	11:00	11:00	11:00	09:00	10:00	09:00	10:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	10:00	09:00
Vol.	50	44	85	47	32	75	45	45	90	58	38	92	45	43	81	49	43	92	48	40	88	46	34	72
PM Peak	12:00	13:00	13:00	13:00	14:00	13:00	15:00	15:00	15:00	12:00	15:00	12:00	15:00	13:00	15:00	16:00	12:00	12:00	13:00	15:00	13:00	12:00	13:00	13:00
Vol.	48	56	98	42	45	76	56	56	112	59	71	114	67	64	111	46	48	89	51	48	95	41	48	89

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

Location: Olema Bolinas Rd, South of Fairfax - Bolinas Rd
Date Range: 12/14/2021 - 12/20/2021
Site Code: 06

idax DATA SOLUTIONS

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	0	2	2	1	2	3	0	1	1	1	2	3	2	5	7	2	5	7	1	2	3	0	2	2
1:00 AM	1	1	2	0	0	0	1	3	4	0	0	0	0	1	1	6	2	8	0	1	1	1	1	2
2:00 AM	0	1	1	0	1	1	0	3	3	0	1	1	0	3	3	2	1	3	0	1	1	0	2	2
3:00 AM	2	0	2	4	1	5	3	0	3	1	2	3	1	1	2	0	1	1	1	1	2	3	0	3
4:00 AM	3	0	3	4	1	5	3	2	5	2	0	2	2	1	3	2	2	4	4	1	5	3	1	4
5:00 AM	4	3	7	1	4	5	6	4	10	5	5	10	6	0	6	3	2	5	4	3	7	4	4	7
6:00 AM	20	13	33	21	12	33	20	12	32	21	19	40	10	7	17	10	5	15	18	11	29	20	12	33
7:00 AM	40	64	104	47	59	106	52	57	109	43	58	101	26	35	61	19	22	41	37	49	86	46	60	106
8:00 AM	**81**	58	139	62	**80**	**142**	66	71	137	67	68	135	29	48	77	41	17	58	44	70	114	**70**	**70**	**139**
9:00 AM	66	76	142	**77**	49	126	52	70	122	**91**	64	**155**	58	65	123	56	48	104	66	46	112	65	65	130
10:00 AM	79	**84**	**163**	59	55	114	70	65	135	68	**69**	137	**75**	65	140	62	56	118	70	55	125	69	68	137
11:00 AM	56	61	117	70	64	134	**80**	**78**	**158**	77	66	143	63	**82**	**145**	**77**	**70**	**147**	**83**	**74**	**157**	69	68	136
12:00 PM	81	68	149	64	53	117	66	74	140	96	101	197	65	85	150	67	69	136	69	54	123	70	65	135
1:00 PM	82	83	165	69	68	137	74	99	173	86	71	157	72	**101**	173	66	**71**	137	**91**	73	164	75	83	158
2:00 PM	76	72	148	59	**81**	140	76	68	144	77	95	172	82	89	171	66	58	124	**91**	74	**165**	70	74	144
3:00 PM	**98**	**95**	**193**	**77**	65	**142**	103	**105**	**208**	94	**127**	**221**	**100**	86	**186**	73	49	122	77	**86**	163	**93**	**88**	**181**
4:00 PM	90	94	184	68	57	125	**108**	94	202	**102**	101	203	94	79	173	**96**	61	**157**	84	65	149	89	82	170
5:00 PM	79	65	144	40	45	85	87	70	157	71	82	153	80	58	138	68	44	112	66	73	139	69	60	129
6:00 PM	21	30	51	16	38	54	32	40	72	35	55	90	40	38	78	19	38	57	24	41	65	23	36	59
7:00 PM	10	22	32	12	20	32	12	22	34	22	47	69	23	39	62	14	26	40	12	26	38	11	21	33
8:00 PM	8	28	36	5	16	21	7	31	38	13	21	34	15	26	41	15	30	45	5	21	26	7	25	32
9:00 PM	7	13	20	4	13	17	6	24	30	13	14	27	7	9	16	7	13	20	11	10	21	6	17	22
10:00 PM	1	8	9	3	16	19	2	13	15	9	22	31	7	15	22	4	13	17	2	11	13	2	12	14
11:00 PM	2	9	11	2	3	5	1	9	10	5	10	15	4	11	15	3	11	14	0	9	9	2	7	9
Total	907	950	1,857	765	803	1,568	927	1,015	1,942	999	1,100	2,099	861	949	1,810	778	714	1,492	860	857	1,717	866	923	1,789
Percent	49%	51%	-	49%	51%	-	48%	52%	-	48%	52%	-	48%	52%	-	52%	48%	-	50%	50%	-	48%	52%	-
AM Peak	08:00	10:00	10:00	09:00	08:00	08:00	11:00	11:00	11:00	09:00	10:00	09:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	08:00	08:00
Vol.	81	84	163	77	80	142	80	78	158	91	69	155	75	82	145	77	70	147	83	74	157	70	70	139
PM Peak	15:00	15:00	15:00	15:00	14:00	15:00	16:00	15:00	15:00	16:00	15:00	15:00	15:00	13:00	15:00	16:00	13:00	16:00	13:00	15:00	14:00	15:00	15:00	15:00
Vol.	98	95	193	77	81	142	108	105	208	102	127	221	100	101	186	96	71	157	91	86	165	93	88	181

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

ATTACHMENT 2

Intersection	
Int Delay, s/veh	2.3

Movement	EBU	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations													
Traffic Vol, veh/h	1	22	0	1	0	1	1	0	13	0	1	22	44
Future Vol, veh/h	1	22	0	1	0	1	1	0	13	0	1	22	44
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	86	86	86	86	86	86	86	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	1	26	0	1	0	1	1	0	15	0	1	26	51

Major/Minor	Minor2				Minor1			Major1			Major2		
Conflicting Flow All	0	70	69	52	69	94	15	77	0	0	15	0	0
Stage 1	0	54	54	-	15	15	-	-	-	-	-	-	-
Stage 2	0	16	15	-	54	79	-	-	-	-	-	-	-
Critical Hdwy	-	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	-	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	-	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	-	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	0	922	822	1016	923	796	1065	1522	-	-	1603	-	-
Stage 1	0	958	850	-	1005	883	-	-	-	-	-	-	-
Stage 2	0	1004	883	-	958	829	-	-	-	-	-	-	-
Platoon blocked, %	-								-	-		-	-
Mov Cap-1 Maneuver	0	919	821	1016	921	795	1065	1522	-	-	1603	-	-
Mov Cap-2 Maneuver	0	919	821	-	921	795	-	-	-	-	-	-	-
Stage 1	0	958	849	-	1005	883	-	-	-	-	-	-	-
Stage 2	0	1002	883	-	956	828	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9	9	0	0.1
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1522	-	-	923	910	1603	-	-
HCM Lane V/C Ratio	-	-	-	0.029	0.003	0.001	-	-
HCM Control Delay (s)	0	-	-	9	9	7.2	0	-
HCM Lane LOS	A	-	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	0	-	-

Intersection	
Int Delay, s/veh	5.5

Movement	EBL	EBR	NBL	NBT	NBR	SBL	SBT	SBR	SWL	SWR
Lane Configurations										
Traffic Vol, veh/h	0	42	24	10	0	0	23	0	0	0
Future Vol, veh/h	0	42	24	10	0	0	23	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	-	None	-	-	None	-	-
Storage Length	0	-	-	-	-	-	-	-	-	0
Veh in Median Storage, #	0	-	-	0	-	-	0	-	0	-
Grade, %	0	-	-	0	-	-	0	-	0	-
Peak Hour Factor	86	86	86	86	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	49	28	12	0	0	27	0	0	0

Major/Minor	Minor2		Major1			Major2			Minor1	
Conflicting Flow All	95	27	27	0	0	12	0	0	-	12
Stage 1	27	-	-	-	-	-	-	-	-	-
Stage 2	68	-	-	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.22	4.12	-	-	4.12	-	-	-	6.22
Critical Hdwy Stg 1	6.12	-	-	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	-	-	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	2.218	-	-	-	3.318
Pot Cap-1 Maneuver	888	1048	1587	-	-	1607	-	-	0	1069
Stage 1	990	-	-	-	-	-	-	-	0	-
Stage 2	942	-	-	-	-	-	-	-	0	-
Platoon blocked, %				-	-		-	-		
Mov Cap-1 Maneuver	876	1048	1587	-	-	1607	-	-	-	1069
Mov Cap-2 Maneuver	876	-	-	-	-	-	-	-	-	-
Stage 1	972	-	-	-	-	-	-	-	-	-
Stage 2	925	-	-	-	-	-	-	-	-	-

Approach	EB	NB	SB	SW
HCM Control Delay, s	8.6	5.2	0	0
HCM LOS	A			A

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	SBL	SBT	SBR	SWLn1
Capacity (veh/h)	1587	-	-	1043	1607	-	-	-
HCM Lane V/C Ratio	0.018	-	-	0.048	-	-	-	-
HCM Control Delay (s)	7.3	0	-	8.6	0	-	-	0
HCM Lane LOS	A	A	-	A	A	-	-	A
HCM 95th %tile Q(veh)	0.1	-	-	0.2	0	-	-	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	24	0	24	43	0	46
Future Volume (Veh/h)	24	0	24	43	0	46
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	28	0	28	50	0	53
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	106	53			78	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	106	53			78	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	100			100	
cM capacity (veh/h)	892	1014			1520	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	28	78	53
Volume Left	28	0	0
Volume Right	0	50	0
cSH	892	1700	1520
Volume to Capacity	0.03	0.05	0.00
Queue Length 95th (ft)	2	0	0
Control Delay (s)	9.2	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.2	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	13.9%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	3.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	61	1	1	0	1	0	0	55	0	1	31	42
Future Vol, veh/h	61	1	1	0	1	0	0	55	0	1	31	42
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	84	84	84	84	84	84	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	73	1	1	0	1	0	0	65	0	1	37	50

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	130	129	62	130	154	65	87	0	0	65	0	0
Stage 1	64	64	-	65	65	-	-	-	-	-	-	-
Stage 2	66	65	-	65	89	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	843	762	1003	843	738	999	1509	-	-	1537	-	-
Stage 1	947	842	-	946	841	-	-	-	-	-	-	-
Stage 2	945	841	-	946	821	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	841	761	1003	840	737	999	1509	-	-	1537	-	-
Mov Cap-2 Maneuver	841	761	-	840	737	-	-	-	-	-	-	-
Stage 1	947	841	-	946	841	-	-	-	-	-	-	-
Stage 2	944	841	-	943	820	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.7	9.9	0	0.1
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1509	-	-	842	737	1537	-	-
HCM Lane V/C Ratio	-	-	-	0.089	0.002	0.001	-	-
HCM Control Delay (s)	0	-	-	9.7	9.9	7.3	0	-
HCM Lane LOS	A	-	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0.3	0	0	-	-

Intersection	
Int Delay, s/veh	4.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	2	45	2	1	1	47	55	0	0	32	0
Future Vol, veh/h	0	2	45	2	1	1	47	55	0	0	32	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	84	84	84	84	84	84	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	2	54	2	1	1	56	65	0	0	38	0

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	216	215	38	243	215	65	38	0	0	65	0	0
Stage 1	38	38	-	177	177	-	-	-	-	-	-	-
Stage 2	178	177	-	66	38	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	740	683	1034	711	683	999	1572	-	-	1537	-	-
Stage 1	977	863	-	825	753	-	-	-	-	-	-	-
Stage 2	824	753	-	945	863	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	717	658	1034	653	658	999	1572	-	-	1537	-	-
Mov Cap-2 Maneuver	717	658	-	653	658	-	-	-	-	-	-	-
Stage 1	941	863	-	794	725	-	-	-	-	-	-	-
Stage 2	791	725	-	894	863	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.8	10.1	3.4	0
HCM LOS	A	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1572	-	-	1009	716	1537	-	-
HCM Lane V/C Ratio	0.036	-	-	0.055	0.007	-	-	-
HCM Control Delay (s)	7.4	0	-	8.8	10.1	0	-	-
HCM Lane LOS	A	A	-	A	B	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.2	0	0	-	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	51	0	63	45	0	43
Future Volume (Veh/h)	51	0	63	45	0	43
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84
Hourly flow rate (vph)	61	0	75	54	0	51
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	153	102			129	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	153	102			129	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	93	100			100	
cM capacity (veh/h)	839	953			1457	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	61	129	51
Volume Left	61	0	0
Volume Right	0	54	0
cSH	839	1700	1457
Volume to Capacity	0.07	0.08	0.00
Queue Length 95th (ft)	6	0	0
Control Delay (s)	9.6	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.6	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	16.1%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	2.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	35	0	1	1	0	1	2	49	1	0	39	36
Future Vol, veh/h	35	0	1	1	0	1	2	49	1	0	39	36
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	37	0	1	1	0	1	2	52	1	0	41	38

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	117	117	60	118	136	53	79	0	0	53	0	0
Stage 1	60	60	-	57	57	-	-	-	-	-	-	-
Stage 2	57	57	-	61	79	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	859	773	1005	858	755	1014	1519	-	-	1553	-	-
Stage 1	951	845	-	955	847	-	-	-	-	-	-	-
Stage 2	955	847	-	950	829	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	857	772	1005	856	754	1014	1519	-	-	1553	-	-
Mov Cap-2 Maneuver	857	772	-	856	754	-	-	-	-	-	-	-
Stage 1	950	845	-	954	846	-	-	-	-	-	-	-
Stage 2	953	846	-	949	829	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	9.4	8.9	0.3	0
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1519	-	-	861	928	1553	-	-
HCM Lane V/C Ratio	0.001	-	-	0.044	0.002	-	-	-
HCM Control Delay (s)	7.4	0	-	9.4	8.9	0	-	-
HCM Lane LOS	A	A	-	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.1	0	0	-	-

Intersection	
Int Delay, s/veh	4.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Vol, veh/h	0	1	36	6	4	5	59	47	0	2	38	2
Future Vol, veh/h	0	1	36	6	4	5	59	47	0	2	38	2
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	1	38	6	4	5	63	50	0	2	40	2

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	226	221	41	241	222	50	42	0	0	50	0	0
Stage 1	45	45	-	176	176	-	-	-	-	-	-	-
Stage 2	181	176	-	65	46	-	-	-	-	-	-	-
Critical Hdwy	7.12	6.52	6.22	7.12	6.52	6.22	4.12	-	-	4.12	-	-
Critical Hdwy Stg 1	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.12	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.518	4.018	3.318	3.518	4.018	3.318	2.218	-	-	2.218	-	-
Pot Cap-1 Maneuver	729	678	1030	713	677	1018	1567	-	-	1557	-	-
Stage 1	969	857	-	826	753	-	-	-	-	-	-	-
Stage 2	821	753	-	946	857	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	698	650	1030	664	649	1018	1567	-	-	1557	-	-
Mov Cap-2 Maneuver	698	650	-	664	649	-	-	-	-	-	-	-
Stage 1	929	856	-	792	722	-	-	-	-	-	-	-
Stage 2	779	722	-	909	856	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.7	9.9	4.1	0.3
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1567	-	-	1014	746	1557	-	-
HCM Lane V/C Ratio	0.04	-	-	0.039	0.021	0.001	-	-
HCM Control Delay (s)	7.4	0	-	8.7	9.9	7.3	0	-
HCM Lane LOS	A	A	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0.1	-	-	0.1	0.1	0	-	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	63	0	35	37	0	38
Future Volume (Veh/h)	63	0	35	37	0	38
Sign Control	Yield		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	67	0	37	39	0	40
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	96	56			76	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	96	56			76	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	93	100			100	
cM capacity (veh/h)	903	1010			1523	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	67	76	40
Volume Left	67	0	0
Volume Right	0	39	0
cSH	903	1700	1523
Volume to Capacity	0.07	0.04	0.00
Queue Length 95th (ft)	6	0	0
Control Delay (s)	9.3	0.0	0.0
Lane LOS	A		
Approach Delay (s)	9.3	0.0	0.0
Approach LOS	A		

Intersection Summary			
Average Delay	3.4		
Intersection Capacity Utilization	14.3%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection	
Int Delay, s/veh	0

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Vol, veh/h	34	0	0	65	0	0
Future Vol, veh/h	34	0	0	65	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	40	0	0	76	0	0

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	40	0	116	40
Stage 1	-	-	-	-	40	-
Stage 2	-	-	-	-	76	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1570	-	880	1031
Stage 1	-	-	-	-	982	-
Stage 2	-	-	-	-	947	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1570	-	880	1031
Mov Cap-2 Maneuver	-	-	-	-	880	-
Stage 1	-	-	-	-	982	-
Stage 2	-	-	-	-	947	-

Approach	NB	SB	SW
HCM Control Delay, s	0	0	0
HCM LOS			A

Minor Lane/Major Mvmt	NBT	NBR	SBL	SBT	SWLn1
Capacity (veh/h)	-	-	1570	-	-
HCM Lane V/C Ratio	-	-	-	-	-
HCM Control Delay (s)	-	-	0	-	0
HCM Lane LOS	-	-	A	-	A
HCM 95th %tile Q(veh)	-	-	0	-	-

Intersection							
Int Delay, s/veh	4.7						

Movement	EBU	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations							
Traffic Vol, veh/h	1	23	43	24	10	22	44
Future Vol, veh/h	1	23	43	24	10	22	44
Conflicting Peds, #/hr	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	0	-
Grade, %	-	0	-	-	0	0	-
Peak Hour Factor	86	86	86	86	86	86	86
Heavy Vehicles, %	2	2	2	2	2	2	2
Mvmt Flow	1	27	50	28	12	26	51

Major/Minor	Minor2			Major1		Major2	
Conflicting Flow All	0	120	52	77	0	-	0
Stage 1	0	52	-	-	-	-	-
Stage 2	0	68	-	-	-	-	-
Critical Hdwy	-	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	-	5.42	-	-	-	-	-
Critical Hdwy Stg 2	-	5.42	-	-	-	-	-
Follow-up Hdwy	-	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	0	876	1016	1522	-	-	-
Stage 1	0	970	-	-	-	-	-
Stage 2	0	955	-	-	-	-	-
Platoon blocked, %	-				-	-	-
Mov Cap-1 Maneuver	0	859	1016	1522	-	-	-
Mov Cap-2 Maneuver	0	859	-	-	-	-	-
Stage 1	0	952	-	-	-	-	-
Stage 2	0	955	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.1	5.2	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1522	-	955	-	-
HCM Lane V/C Ratio	0.018	-	0.08	-	-
HCM Control Delay (s)	7.4	0	9.1	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.3	-	-

Intersection	
Int Delay, s/veh	0.2

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Vol, veh/h	102	0	2	77	2	1
Future Vol, veh/h	102	0	2	77	2	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	84	84	84	84	84	84
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	121	0	2	92	2	1

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	121	0	217	121
Stage 1	-	-	-	-	121	-
Stage 2	-	-	-	-	96	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1467	-	771	930
Stage 1	-	-	-	-	904	-
Stage 2	-	-	-	-	928	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1467	-	770	930
Mov Cap-2 Maneuver	-	-	-	-	770	-
Stage 1	-	-	-	-	904	-
Stage 2	-	-	-	-	927	-

Approach	NB	SB	SW
HCM Control Delay, s	0	0.2	9.4
HCM LOS			A

Minor Lane/Major Mvmt	NBT	NBR	SBL	SBT	SWLn1
Capacity (veh/h)	-	-	1467	-	817
HCM Lane V/C Ratio	-	-	0.002	-	0.004
HCM Control Delay (s)	-	-	7.5	0	9.4
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	-	0

Intersection							
Int Delay, s/veh	5.2						

Movement	EBL	EBR		NBL	NBT	SBT	SBR
Lane Configurations	Y				↰↑	↑↱	
Traffic Vol, veh/h	63	48		48	55	31	42
Future Vol, veh/h	63	48		48	55	31	42
Conflicting Peds, #/hr	0	0		0	0	0	0
Sign Control	Stop	Stop		Free	Free	Free	Free
RT Channelized	-	None		-	None	-	None
Storage Length	0	-		-	-	-	-
Veh in Median Storage, #	0	-		-	0	0	-
Grade, %	0	-		-	0	0	-
Peak Hour Factor	84	84		84	84	84	84
Heavy Vehicles, %	2	2		2	2	2	2
Mvmt Flow	75	57		57	65	37	50

Major/Minor	Minor2			Major1		Major2	
Conflicting Flow All	241	62		87	0	-	0
Stage 1	62	-		-	-	-	-
Stage 2	179	-		-	-	-	-
Critical Hdwy	6.42	6.22		4.12	-	-	-
Critical Hdwy Stg 1	5.42	-		-	-	-	-
Critical Hdwy Stg 2	5.42	-		-	-	-	-
Follow-up Hdwy	3.518	3.318		2.218	-	-	-
Pot Cap-1 Maneuver	747	1003		1509	-	-	-
Stage 1	961	-		-	-	-	-
Stage 2	852	-		-	-	-	-
Platoon blocked, %					-	-	-
Mov Cap-1 Maneuver	718	1003		1509	-	-	-
Mov Cap-2 Maneuver	718	-		-	-	-	-
Stage 1	924	-		-	-	-	-
Stage 2	852	-		-	-	-	-

Approach	EB			NB		SB	
HCM Control Delay, s	10.2			3.5		0	
HCM LOS	B						

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1509	-	819	-	-
HCM Lane V/C Ratio	0.038	-	0.161	-	-
HCM Control Delay (s)	7.5	0	10.2	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.6	-	-

Intersection	
Int Delay, s/veh	0.8

Movement	NBT	NBR	SBL	SBT	SWL	SWR
Lane Configurations						
Traffic Vol, veh/h	106	0	3	75	6	9
Future Vol, veh/h	106	0	3	75	6	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	113	0	3	80	6	10

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	113	0	199	113
Stage 1	-	-	-	-	113	-
Stage 2	-	-	-	-	86	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1476	-	790	940
Stage 1	-	-	-	-	912	-
Stage 2	-	-	-	-	937	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1476	-	788	940
Mov Cap-2 Maneuver	-	-	-	-	788	-
Stage 1	-	-	-	-	912	-
Stage 2	-	-	-	-	935	-

Approach	NB	SB	SW
HCM Control Delay, s	0	0.3	9.2
HCM LOS			A

Minor Lane/Major Mvmt	NBT	NBR	SBL	SBT	SWLn1
Capacity (veh/h)	-	-	1476	-	873
HCM Lane V/C Ratio	-	-	0.002	-	0.018
HCM Control Delay (s)	-	-	7.4	0	9.2
HCM Lane LOS	-	-	A	A	A
HCM 95th %tile Q(veh)	-	-	0	-	0.1

Intersection	
Int Delay, s/veh	4.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	35	38	63	52	40	38
Future Vol, veh/h	35	38	63	52	40	38
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	94	94	94	94	94	94
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	37	40	67	55	43	40

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	252	63	83	0	-	0
Stage 1	63	-	-	-	-	-
Stage 2	189	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	737	1002	1514	-	-	-
Stage 1	960	-	-	-	-	-
Stage 2	843	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	703	1002	1514	-	-	-
Mov Cap-2 Maneuver	703	-	-	-	-	-
Stage 1	916	-	-	-	-	-
Stage 2	843	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.8	4.1	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1514	-	832	-	-
HCM Lane V/C Ratio	0.044	-	0.093	-	-
HCM Control Delay (s)	7.5	0	9.8	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0.1	-	0.3	-	-

Intersection	
Intersection Delay, s/veh	7.2
Intersection LOS	A

Movement	EBU	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations								
Traffic Vol, veh/h	1	23	43	0	24	10	22	44
Future Vol, veh/h	1	23	43	0	24	10	22	44
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86
Heavy Vehicles, %	2	2	2	2	2	2	2	2
Mvmt Flow	1	27	50	0	28	12	26	51
Number of Lanes	0	1	0	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	7.2	7.5	7.1
HCM LOS	A	A	A

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	71%	35%	0%
Vol Thru, %	29%	0%	33%
Vol Right, %	0%	65%	67%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	34	67	66
LT Vol	24	23	0
Through Vol	10	0	22
RT Vol	0	44	44
Lane Flow Rate	40	78	77
Geometry Grp	1	1	1
Degree of Util (X)	0.047	0.082	0.079
Departure Headway (Hd)	4.27	3.812	3.7
Convergence, Y/N	Yes	Yes	Yes
Cap	837	935	965
Service Time	2.306	1.856	1.736
HCM Lane V/C Ratio	0.048	0.083	0.08
HCM Control Delay	7.5	7.2	7.1
HCM Lane LOS	A	A	A
HCM 95th-tile Q	0.1	0.3	0.3

Intersection	
Intersection Delay, s/veh	7.9
Intersection LOS	A

Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations							
Traffic Vol, veh/h	63	48	0	48	55	31	42
Future Vol, veh/h	63	48	0	48	55	31	42
Peak Hour Factor	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Heavy Vehicles, %	2	2	2	2	2	2	2
Mvmt Flow	75	57	0	57	65	37	50
Number of Lanes	1	0	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	8	8.2	7.5
HCM LOS	A	A	A

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	47%	57%	0%
Vol Thru, %	53%	0%	42%
Vol Right, %	0%	43%	58%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	103	111	73
LT Vol	48	63	0
Through Vol	55	0	31
RT Vol	0	48	42
Lane Flow Rate	123	132	87
Geometry Grp	1	1	1
Degree of Util (X)	0.147	0.156	0.097
Departure Headway (Hd)	4.326	4.251	4.019
Convergence, Y/N	Yes	Yes	Yes
Cap	815	848	895
Service Time	2.423	2.254	2.027
HCM Lane V/C Ratio	0.151	0.156	0.097
HCM Control Delay	8.2	8	7.5
HCM Lane LOS	A	A	A
HCM 95th-tile Q	0.5	0.6	0.3

Intersection	
Intersection Delay, s/veh	7.7
Intersection LOS	A

Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations							
Traffic Vol, veh/h	35	38	0	63	52	40	38
Future Vol, veh/h	35	38	0	63	52	40	38
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Heavy Vehicles, %	2	2	2	2	2	2	2
Mvmt Flow	37	40	0	67	55	43	40
Number of Lanes	1	0	0	0	1	1	0

Approach	EB	NB	SB
Opposing Approach		SB	NB
Opposing Lanes	0	1	1
Conflicting Approach Left	SB	EB	
Conflicting Lanes Left	1	1	0
Conflicting Approach Right	NB		EB
Conflicting Lanes Right	1	0	1
HCM Control Delay	7.6	8	7.3
HCM LOS	A	A	A

Lane	NBLn1	EBLn1	SBLn1
Vol Left, %	55%	48%	0%
Vol Thru, %	45%	0%	51%
Vol Right, %	0%	52%	49%
Sign Control	Stop	Stop	Stop
Traffic Vol by Lane	115	73	78
LT Vol	63	35	0
Through Vol	52	0	40
RT Vol	0	38	38
Lane Flow Rate	122	78	83
Geometry Grp	1	1	1
Degree of Util (X)	0.144	0.088	0.089
Departure Headway (Hd)	4.244	4.069	3.871
Convergence, Y/N	Yes	Yes	Yes
Cap	840	866	915
Service Time	2.295	2.163	1.94
HCM Lane V/C Ratio	0.145	0.09	0.091
HCM Control Delay	8	7.6	7.3
HCM Lane LOS	A	A	A
HCM 95th-tile Q	0.5	0.3	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Yield			Yield	Yield	
Traffic Volume (vph)	24	43	24	10	22	44
Future Volume (vph)	24	43	24	10	22	44
Peak Hour Factor	0.86	0.86	0.86	0.86	0.86	0.86
Hourly flow rate (vph)	28	50	28	12	26	51

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	78	40	77
Volume Left (vph)	28	28	0
Volume Right (vph)	50	0	51
Hadj (s)	-0.28	0.17	-0.36
Departure Headway (s)	3.9	4.3	3.7
Degree Utilization, x	0.08	0.05	0.08
Capacity (veh/h)	902	808	938
Control Delay (s)	7.2	7.5	7.1
Approach Delay (s)	7.2	7.5	7.1
Approach LOS	A	A	A

Intersection Summary			
Delay	7.2		
Level of Service	A		
Intersection Capacity Utilization	19.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Yield			Yield	Yield	
Traffic Volume (vph)	63	48	48	55	31	42
Future Volume (vph)	63	48	48	55	31	42
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91
Hourly flow rate (vph)	69	53	53	60	34	46

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	122	113	80
Volume Left (vph)	69	53	0
Volume Right (vph)	53	0	46
Hadj (s)	-0.11	0.13	-0.31
Departure Headway (s)	4.2	4.4	4.0
Degree Utilization, x	0.14	0.14	0.09
Capacity (veh/h)	818	791	870
Control Delay (s)	7.9	8.1	7.4
Approach Delay (s)	7.9	8.1	7.4
Approach LOS	A	A	A

Intersection Summary			
Delay	7.8		
Level of Service	A		
Intersection Capacity Utilization	25.3%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Sign Control	Yield			Yield	Yield	
Traffic Volume (vph)	35	38	63	52	40	38
Future Volume (vph)	35	38	63	52	40	38
Peak Hour Factor	0.94	0.94	0.94	0.94	0.94	0.94
Hourly flow rate (vph)	37	40	67	55	43	40

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total (vph)	77	122	83
Volume Left (vph)	37	67	0
Volume Right (vph)	40	0	40
Hadj (s)	-0.18	0.14	-0.26
Departure Headway (s)	4.2	4.3	3.9
Degree Utilization, x	0.09	0.15	0.09
Capacity (veh/h)	823	813	888
Control Delay (s)	7.6	8.0	7.3
Approach Delay (s)	7.6	8.0	7.3
Approach LOS	A	A	A

Intersection Summary			
Delay	7.7		
Level of Service	A		
Intersection Capacity Utilization	23.8%	ICU Level of Service	A
Analysis Period (min)	15		

ATTACHMENT 3

FEHR & PEERS

Sheet No 1 of 1

Major Street	Highway 1
Minor Street	Olema-Bolinas
Project	Hwy 1/Oleam-Bolinas ICE
Scenario	Existing Plus Project
Peak Hour	AM

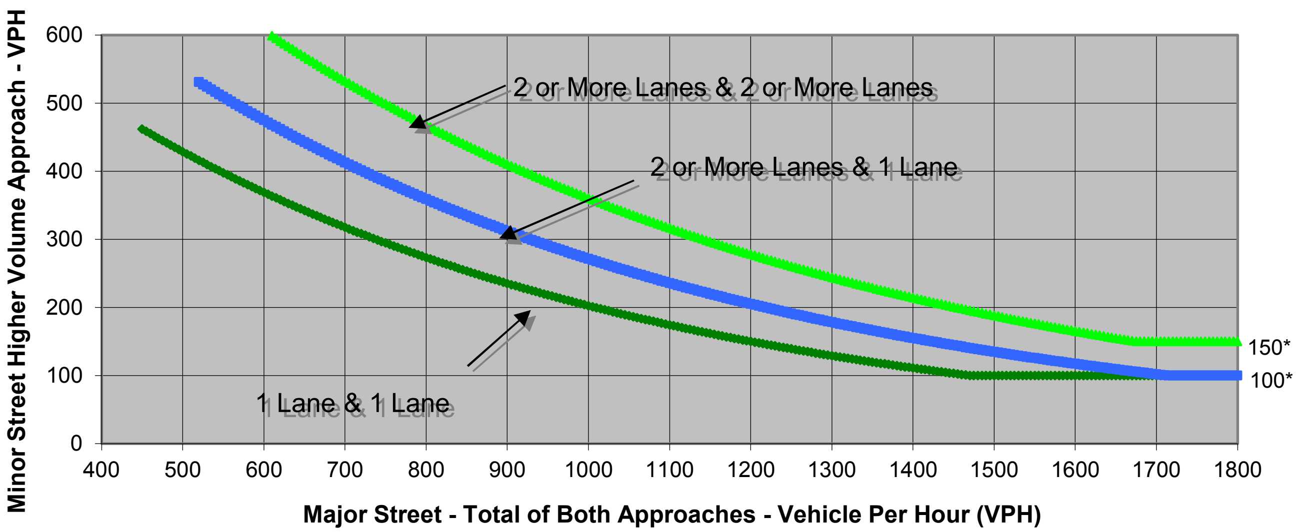
Turn Movement Volumes

	NB	SB	EB	WB
Left	24	0	23	0
Through	10	22	0	0
Right	0	44	43	0
Total	34	66	66	0

Major Street Direction

X	North/South
	East/West

Figure 4C-3. Warrant 3, Peak Hour



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2012

	Major Street Highway 1	Minor Street Olema-Bolinas	Warrant Met
Number of Approach Lanes	**1**	**1**	**NO**
Traffic Volume (VPH) *	**100**	**66**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

FEHR PEERS

Sheet No 1 of 1

Major Street	Highway 1	Project	Hwy 1/Oleam-Bolinas ICE
Minor Street	Olema-Bolinas	Scenario	Existing Plus Project
		Peak Hour	PM

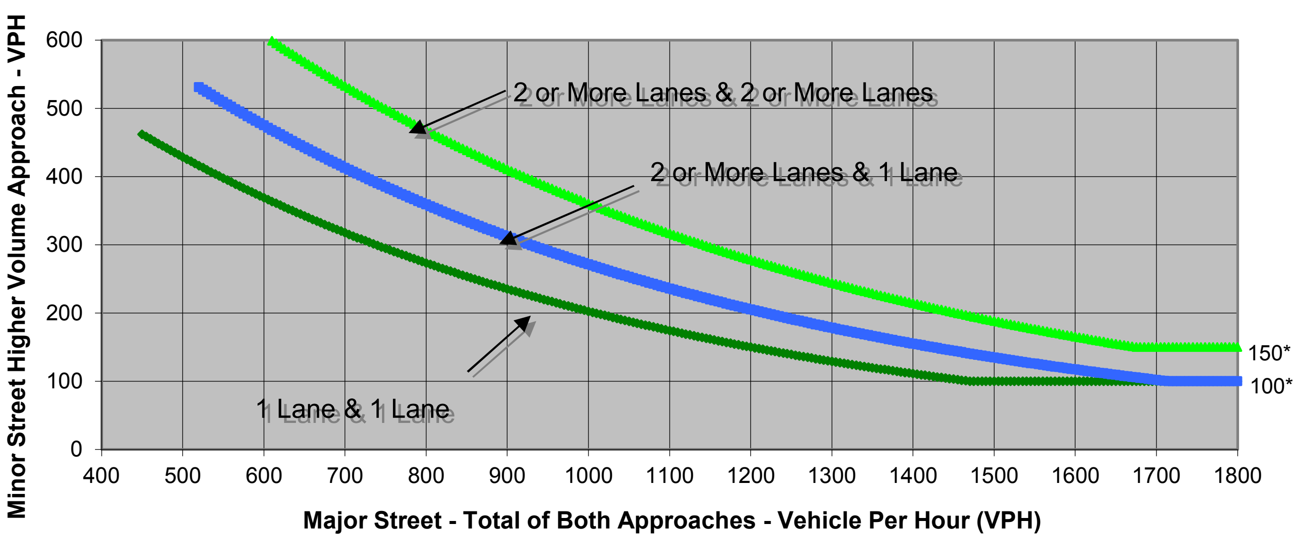
Turn Movement Volumes

	NB	SB	EB	WB
Left	48	0	63	0
Through	55	31	0	0
Right	0	42	48	0
Total	103	73	111	0

Major Street Direction

X	North/South
	East/West

Figure 4C-3. Warrant 3, Peak Hour



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2012

	Major Street Highway 1	Minor Street Olema-Bolinas	Warrant Met
Number of Approach Lanes	**1**	**1**	**NO**
Traffic Volume (VPH) *	**176**	**111**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

FEHR & PEERS

Sheet No 1 of 1

Major Street	Highway 1	Project	Hwy 1/Oleam-Bolinas ICE
Minor Street	Olema-Bolinas	Scenario	Existing Plus Project
		Peak Hour	Weekend Mid-day

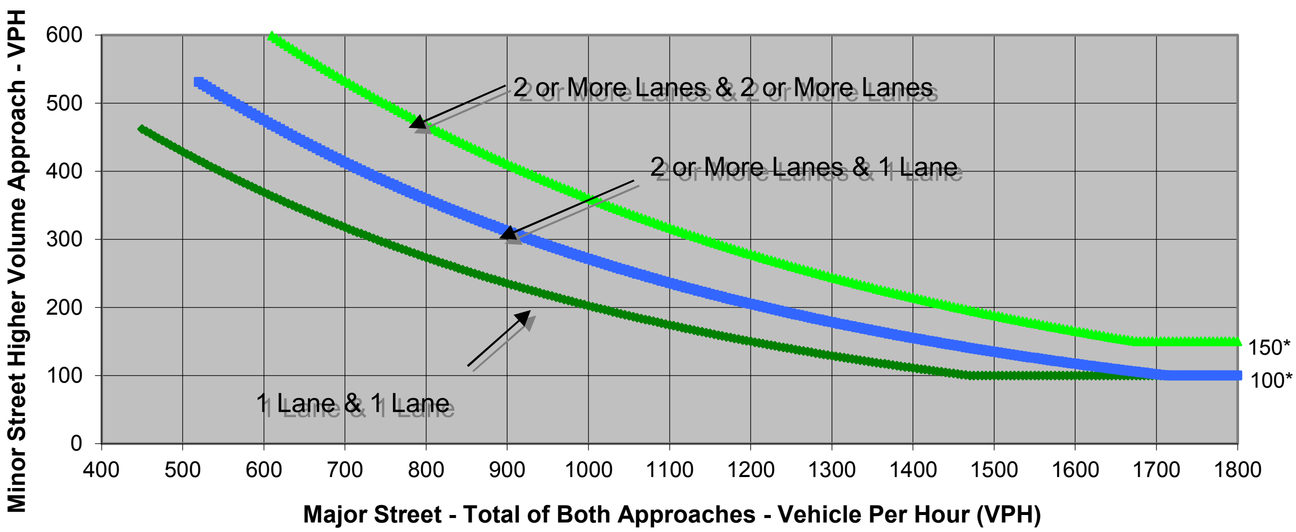
Turn Movement Volumes

	NB	SB	EB	WB
Left	63	0	35	0
Through	52	40	0	0
Right	0	38	38	0
Total	115	78	73	0

Major Street Direction

X	North/South
	East/West

Figure 4C-3. Warrant 3, Peak Hour



* Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Source: *California Manual on Uniform Traffic Control Devices*, Caltrans, 2012

	Major Street Highway 1	Minor Street Olema-Bolinas	Warrant Met
Number of Approach Lanes	**1**	**1**	**<u>NO</u>**
Traffic Volume (VPH) *	**193**	**73**	

* Note: Traffic Volume for Major Street is Total Volume of Both Approches.
Traffic Volume for Minor Street is the Volume of High Volume Approach.

Memorandum

Date: February 7, 2022

To: Daniel Blomquist, Mark Thomas

From: Geoff Rubendall and Zoey Zhang, Fehr & Peers

Subject: State Route 1/Olema Bolinas Road/Fairfax-Bolinas Road Intersection Reconfiguration – Traffic Engineering Assessment

SF20-1132

Introduction

The Bolinas Lagoon Wye Wetlands project ("Project"), led by the Marin County Open Space District ("County"), seeks to restore wetlands and streams in the northwest portion of Bolinas Lagoon. To accommodate the Project, a portion of State Route 1 (SR1), also known locally as Shoreline Highway, requires partial reconstruction and reconfiguration. Specifically, the Project proposes to remove the extension of Fairfax-Bolinas Road between SR1 and Olema Bolinas Road, and realign the SR1/Olema Bolinas Road intersection approximately 200 feet to the south.

Caltrans has requested traffic engineering studies as part of their review and approval of improvements in the state right of way. In November 2020, Fehr & Peers prepared a traffic engineering assessment, which presented analysis to support of the Caltrans Design Engineering Evaluation Report (DEER) process. This memorandum is an update to the memo prepared in November 2020 to include updated traffic counts and collision history, including a left-turn lane warrant analysis. For simplicity in this memo, roads are assumed to align with cardinal directions as follows: SR1 is aligned with north-south directions, while Olema-Bolinas and Fairfax-Bolinas Roads are aligned with east-west directions. This memo is organized in the following sections:

- Traffic Data
- Collision History
- Sight Distance Assessment
- Left-Turn Pocket Warrant Analysis
- Conclusion

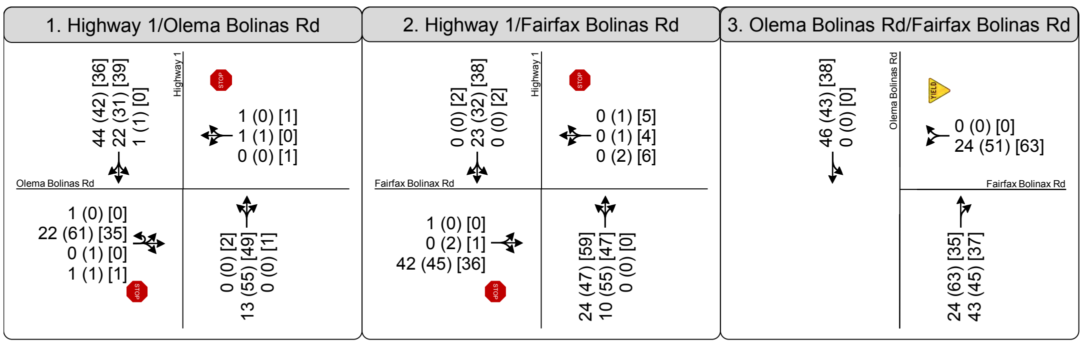
Traffic Data

As part of a previous project traffic study prepared by AECOM in December 2015, 24-hour roadway volume counts ("tube counts") were taken for a week in June 2015 (see **Attachment A**).

In December 2021, intersection turning movement counts during weekday AM peak period (7:00 AM to 9:00 AM), PM peak period (4:00 PM to 6:00 PM), Saturday midday (12:00 PM to 2:00 PM) at the SR1 / Olema-Bolinas Road and SR1 / Fairfax-Bolinas Road were collected (see **Attachment B**). Segment counts for a 7-day period were also collected in December 2021, at the following locations:

- SR1 – West of Olema-Bolinas Road
- SR1 – Between Olema-Bolinas Road and Fairfax-Bolinas Road
- SR1 – East of Fairfax-Bolinas Road
- Olema-Bolinas Road – South of SR1
- Fairfax-Bolinas Road – South of SR1
- Olema-Bolinas Road – South of Fairfax-Bolinas Road

Figure 1 displays AM and PM peak hour volumes and weekend midday volume. Based on the collected data, the AM peak hour is 8:00 to 9:00 AM, the PM peak hour is 4:00 to 5:00 PM, and the weekend midday peak hour is 1:00 PM to 2:00 PM.



Legend:

#	Study Location
(arrow)	Turn Lane
AM (PM) [Weekend Midday]	Peak Hour Traffic Volume
STOP	Stop Sign
YIELD	Yield Sign

Figure 1

Peak Hour Traffic Volumes and Lane Configurations - Existing Condition

Collision History

Collision data in the study area was queried from the California Highway Patrol's Statewide Integrated Traffic Records System (SWITRS) database. SWITRS data shows that a total of six collisions, including three left-turn related accidents, occurred over a five-year period at or near the SR1 / Olema-Bolinas Road intersection, twelve collisions occurred at or near the SR 1 / Fairfax-Bolinas Road intersection, and two collisions at or near the Olema-Bolinas Road / Fairfax-Bolinas Road intersection. **Table 1** lists the collisions by type in the study area. The collisions occurred between January 1, 2016, and December 31, 2020.

TABLE 1. COLLISION HISTORY

Intersection	Year	Collision Type	Motor Vehicle Involved With	Severity
1. SR 1/Olema-Bolinas Road	2016	Hit Object	Fixed Object	Other Visible Injury
	2017	Sideswipe, Rear End	Other Motor Vehicle	Property Damage Only
	2020	Hit Object, Overturned	Fixed Object	Severe Injury, Other Visible Injury, Complaint of Pain Injury
2. SR 1/Fairfax-Bolinas Road	2016	Broadside, Overturned	Other Motor Vehicle, Non-Collision	Severe Injury, Property Damage Only
	2017	Head-On, Hit Object	Other Motor Vehicle, Fixed Object	Fatal, Complaint of Pain Injury
	2018	Hit Object, Overturned, Head-On	Fixed Object, Non-Collision, Other Motor Vehicle	Property Damage Only, Complaint of Pain Injury, Fatal
	2019	Hit Object	Fixed Object	Property Damage Only
	2020	Rear End, Hit Object, Sideswipe, Overturned	Other Motor Vehicle, Other Object, Other Motor Vehicle, Non-Collision	Property Damage Only, Other Visible Injury, Severe Injury, Severe Injury
3. Olema-Bolinas Road/Fairfax-Bolinas Road	2017	Rear End	Other Motor Vehicle	Property Damage Only
		Broadside	Other Motor Vehicle	Property Damage Only

Source: *Statewide Integrated Traffic Records System,* California Highway Patrol, 2021

Sight Distance Assessment

Fehr & Peers conducted a corner sight distance analysis for the existing and the proposed intersection configurations of the SR1/Olema-Bolinas Road intersection. Corner sight distance, or intersection sight distance, is a measurement for vehicles stopped at the side street. Corner sight distance is calculated based on the HDM (Topic 405) formula 1.47VT, where V is the design speed (mph) and T is the time gap (seconds) for the minor road vehicle to enter the major road. For a passenger car, the standard time gap is 7.5 seconds for a left turn and 6.5 seconds for a right turn.

Existing Conditions

The provided corner sight distance for vehicles stopped at the existing Olema-Bolinas Road is estimated to be approximately 680 feet looking north (for a right turn and a left turn) and 700 feet looking south (for a left turn only). Based on the HDM, these corner sight distances correspond to a design speed of 60 mph.

The available corner sight distance for vehicles stopped at the existing Fairfax-Bolinas Road is estimated to be approximately 680 feet looking north (for a right turn and a left turn) and 470 feet looking south (for a left turn only). Based on the HDM, these corner sight distances correspond to a design speed of 45 mph.

Proposed Conditions

The analysis for the proposed conditions is based on the proposed SR1/Olema-Bolinas Road intersection configuration as shown in Mark Thomas' Bolinas Wye Wetland Restoration 30% design plans (dated 6/19/2020; see **Attachment C**) and discussions with Mark Thomas staff. Caltrans has reviewed and accepted the Corner Sight Distance Exhibit prepared by Mark Thomas staff (see **Attachment D**).

The provided corner sight distance for vehicles stopped on the proposed Olema-Bolinas Road at the intersection with SR1 is estimated to be approximately 880 feet looking north (for a right turn and a left turn) and 1,000 feet looking south (for a left turn only). Based on the HDM, these corner sight distances correspond to a design speed of over 65 mph.

The corner sight distances of the proposed intersection configuration are larger than those provided with the existing configuration of both SR1/Olema-Bolinas Road and SR1/Fairfax-Bolinas Road intersections.

Left-Turn Pocket Warrant Analysis

Following the Guidelines for Reconstruction of Intersection (herein referred as the "*Guidelines*"; see **Attachment E**), provided by Caltrans, Fehr & Peers evaluated the left-turn lane warrant to determine the need for a northbound left-turn pocket or lane as part of the proposed project improvements.

Traffic Volumes

One of the factors in the guidelines is the hourly volume of opposing traffic in a signal direction and maximum advancing volume without a left-turn lane. The counts collected in December 2021 found a maximum advancing volume of 115 vehicles per hour (vph) in the northbound and the opposing volume of 78 vph in the southbound. Per the Guidelines, under the maximum design speed of 60 mph, 240 vph in the northbound and 100 vph in the southbound would be needed to warrant a left turn pocket. Hence, the data collected is lower than the thresholds from the Guidelines.

Crash History

Collision History is another factor in the Guidelines. Per the Guidelines, the critical number of crashes that would support the installation of a left-turn pocket is four left-turn-related accidents per year or six in two years at an unsignalized intersection. Documented collision data from SWITRS found three left-turn-related collisions at or near the intersection in the past five years. Therefore, the crash history does not show the number of left-turn-related crashes to support the need for a left-turn pocket.

Conclusion

As part of the Bolinas Lagoon Wye Wetland project, the realigning of Olema-Bolinas and Fairfax-Bolinas Roads includes the removal of the existing Olema-Bolinas Road and SR 1 intersection and approximately 525 feet of Fairfax-Bolinas Road to restore natural wetlands.

Fehr & Peers collected traffic counts in December 2021, reviewed the collision history from the SWITRS database, conducted corner sight distance analysis, and conducts a left-turn pocket warrant analysis to assess the proposed improvements from a traffic engineering and safety perspective.

The corner sight distance analysis presented above shows that the proposed SR1/Olema-Bolinas Road intersection design provides larger corner sight distances than existing conditions and corresponds to a design speed of over 65 mph on SR1. The left-turn pocket warrant analysis presented above shows that traffic volume and the number of left-turn-related accidents are less than the critical value to warrant a left-turn lane or pocket. Therefore, the proposed improvements are consistent with applicable design methodologies.

Attachments

Attachment A – Previous Traffic Study (2015, AECOM)

Attachment B – Traffic Counts (December 2021)

Attachment C – State Route 1/Olema-Bolinas Road Intersection Realignment Design Plans (30%)

Attachment D – Bolinas Lagoon Wye Corner Sight Distance Exhibit

Attachment E – Guideline for Intersection Reconstruction (Caltrans, 1985)

ATTACHMENT A

DRAFT

MEMORANDUM

To: David Halsing

From: Swathi Korpu/Phong Vo

Date: December 15, 2015

Re: Bolinas Lagoon North End Restoration Project – Roadway/Intersection Modification Traffic Analysis

This memo documents the traffic analysis completed for Bolinas Lagoon North End Restoration Project in unincorporated Marin County near the community of Bolinas. Part of that project involves considering a number of changes to the existing roadways, and the traffic counts and level of service analysis summarized here serve to inform future decisions about possible changes to the roads and intersections. The figure below shows the vicinity of the project and the three study intersections identified for the analysis.

Project Vicinity and Location of the Study Intersections

The study included traffic counts and analyses of three intersections under three scenarios:

1. Existing condition: how the roads are configured today
2. The future 2040 no-build condition: the current road configuration but with projected traffic levels in the year 2040

3. The future 2040 build condition: the projected 2040 traffic levels in a scenario where the crossover road has been removed

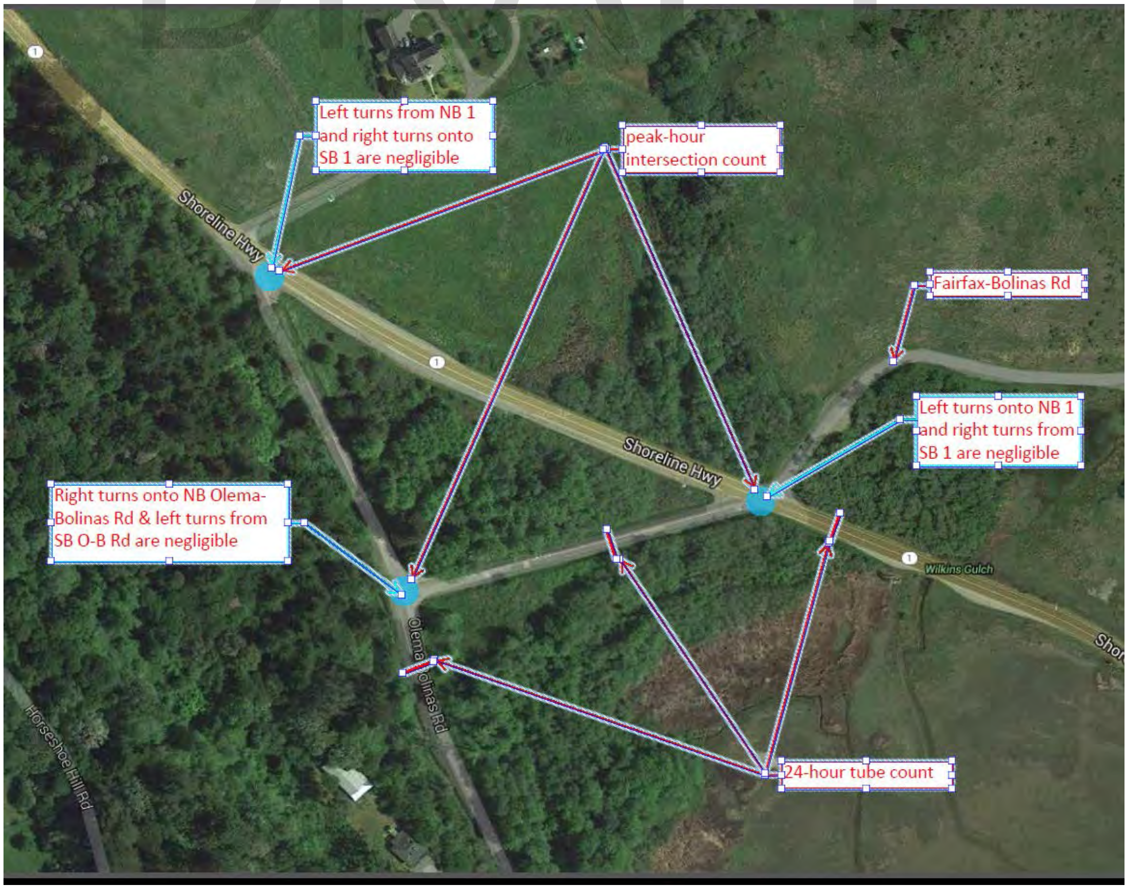
The intersections studied are

1. Shoreline Highway (State Route (SR) 1) with Fairfax – Bolinas Road (to the east) and the crossover road (to the west); this is a two-way stop
2. Olema Bolinas Road with the crossover road; this is a yield-only intersection
3. Olema Bolinas Road and SR 1; this is a one-way stop)

Methodology:

- Average Daily Traffic (ADT) bi-directional tube counts were collected at three locations (listed below) in June 2015. The tube counts were 24-hour counts collected continuously and aggregated in 15 min intervals for seven full days.
  1. On SR1 south of intersection with Fairfax-Bolinas Road and crossover road
  2. On crossover road between SR 1 and Olema Bolinas Road
  3. On Olema Bolinas Road south of the crossover road

  Several simplifying assumptions about traffic flows guided the choice of these three locations. The count locations and the assumptions about intersections are shown on the figure below.



- Using the ADT volumes from the tube counts, the traffic pattern was identified for weekday and weekend, and peak hours for both weekend and weekday analysis were selected. Those peak hours are as follows:

  Weekday AM: 8 am to 9 am
  Weekday PM: 3 pm to 4 pm
  Weekend AM: 11 am to 12 pm
  Weekend PM: 3 pm to 4 pm

- The turning movements were calculated for these hours based on the ADT volumes obtained.

- Future growth percentage was assumed as 1 percent per year for conservative purposes, though there is no growth identified from last three years based on Caltrans census data on SR 1 at this location. Further, the community of Bolinas has some restrictions against growth, and most of the land in the immediate vicinity is already held by public-sector entities, including the National Park Service.

- The Year 2040 no-build analysis was completed with the same lane configuration as currently exists and applies the annual 1 percent growth rate to the existing volumes.

- For the future 2040 build scenario, the crossover road (the south leg of the triangle of roads shown on the figures above) was assumed to be removed. That would force all of the traffic movements to form a single intersection (at SR 1 and Olema Bolinas Road) into which the projected 2040 traffic was routed. That simulated the future build traffic volumes (again including the annual 1 percent growth rate) at that intersection (labeled as intersection 3 above).

- The Synchro software HCM 2000 analysis procedures (from the Transportation Research Board manuals for that software package) were used to conduct the Level of Service (LOS) analysis.

<u>Results:</u>

All of the intersections operate at LOS A or B in the existing conditions, the 2040 no-build conditions, and the 2040 build conditions. Levels of Service range from A to F, with LOS A and B representing the highest levels of service and represent the lowest amounts of delay due to traffic congestion. The analysis results are tabulated in Table 1 below, which shows the average seconds of delay per vehicle and the current and projected LOS at each intersection.

Table 1: Calculated Level of Service for Weekdays and Weekends during peak hours, based on 24 hour counts collected over seven days.

Int. No.	Intersection/Condition	Weekday		Weekend	
		AM, LOS	PM, LOS	AM, LOS	PM, LOS
Existing					
1	SR 1 and crossover road/Fairfax – Bolinas Road	8.7, A	8.7, A	8.9, A	9.4, A
2	Crossover road and Olema Bolinas Road	9.2, A	9.3, A	9.8, A	9.6, A
3	Olema Bolinas Rd and SR 1	9.1, A	9.5, A	10.8, B	10.9, B
2040 No-build					
1	SR 1 and crossover road/Fairfax – Bolinas Road	8.9, A	8.8, A	9.1, A	9.7, A
2	Crossover road and Olema Bolinas Road	9.3, A	9.6, A	10.2, B	9.9, A
3	Olema Bolinas Rd and SR 1	9.3, A	9.9, A	11.7, B	11.8, B
2040 No-build plus project (i.e. crossover road removal)					
1	Full/New intersection (previously Int. #3)	9.5, A	10.7, B	13.0, B	12.9, B

Delay (average seconds/vehicle) and LOS at study intersections during peak hours (Source: AECOM)

Conclusion:

The results of the analysis indicate that the potentially greatest roadway modification – the removal of the crossover road – does not cause any substantially increased delays or changes in the levels of service. The projections for the future build scenario are that there would be an increase in average delay of 0.2 to 1.1 second at the SR 1 – Olema Bolinas Rd intersection at various weekend or weekday AM or PM peak hours. In only one case (the PM weekday hours) would the LOS decrease from LOS A to LOS B, as the average delay increases by 0.8 seconds. Therefore, no road volume improvements, such as pocket lanes or turn-only lanes or signals, would be needed at the intersection if the crossover road were removed.

ATTACHMENT B

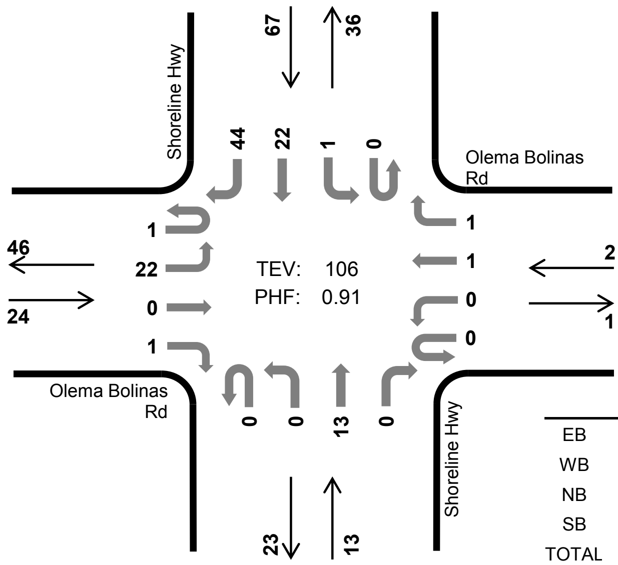
Shoreline Hwy
Olema Bolinas Rd

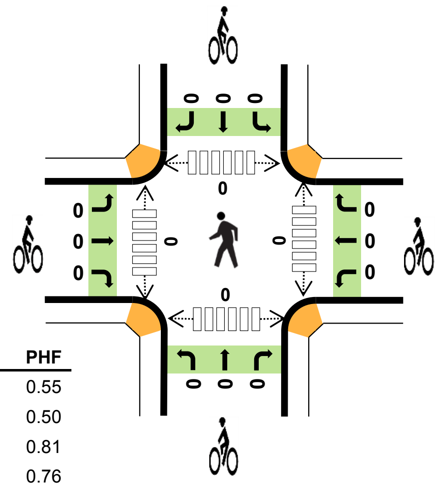
idax

Date: 12-16-2021
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 7:45 AM to 8:45 AM

N

Peak Hour





	HV %:	PHF
EB	0.0%	0.55
WB	0.0%	0.50
NB	0.0%	0.81
SB	3.0%	0.76
TOTAL	1.9%	0.91

Two-Hour Count Summaries

Interval Start	Olema Bolinas Rd Eastbound				Olema Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	1	0	0	0	0	0	0	0	0	2	0	0	0	2	7	12	0
7:15 AM	0	4	0	1	0	0	0	1	0	0	1	0	0	0	5	9	21	0
7:30 AM	0	9	0	0	0	0	0	0	0	0	1	0	0	0	6	10	26	0
7:45 AM	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**9**	**13**	**29**	88
8:00 AM	**1**	**4**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**5**	**15**	**27**	103
8:15 AM	**0**	**4**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**6**	**6**	**21**	103
8:30 AM	**0**	**11**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**4**	**0**	**0**	**1**	**2**	**10**	**29**	**106**
8:45 AM	0	3	0	1	0	1	0	0	0	1	1	0	0	0	2	14	23	100
Count Total	1	39	0	3	0	1	1	2	0	1	18	0	0	1	37	84	188	0
Peak Hour All	**1**	**22**	**0**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**13**	**0**	**0**	**1**	**22**	**44**	**106**	**0**
Peak Hour HV	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**0**
Peak Hour HV%	**0%**	**0%**	**-**	**0%**	**-**	**-**	**0%**	**0%**	**-**	**-**	**0%**	**-**	**-**	**0%**	**5%**	**2%**	**2%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
7:15 AM	0	0	0	1	*1*	0	0	0	0	*0*	0	0	0	0	*0*
7:30 AM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
7:45 AM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:00 AM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:15 AM	**0**	**0**	**0**	**1**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:30 AM	**0**	**0**	**0**	**1**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
8:45 AM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	0	0	0	3	*3*	0	0	0	0	*0*	0	0	0	0	*0*
Peak Hour	**0**	**0**	**0**	**2**	***2***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Olema Bolinas Rd Eastbound UT	LT	TH	RT	Olema Bolinas Rd Westbound UT	LT	TH	RT	Shoreline Hwy Northbound UT	LT	TH	RT	Shoreline Hwy Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	1
8:00 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	1
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	1
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**2**	**0**

Two-Hour Count Summaries - Bikes

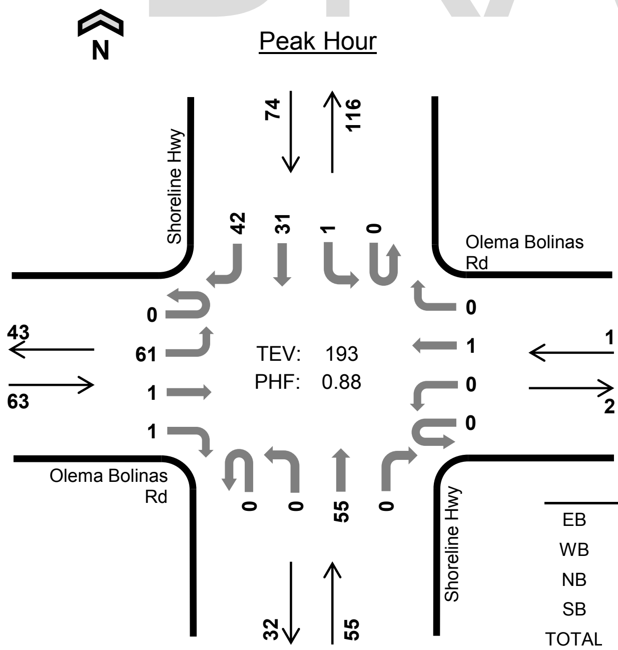
Interval Start	Olema Bolinas Rd Eastbound LT	TH	RT	Olema Bolinas Rd Westbound LT	TH	RT	Shoreline Hwy Northbound LT	TH	RT	Shoreline Hwy Southbound LT	TH	RT	15-min Total	Rolling One Hour
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:00 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

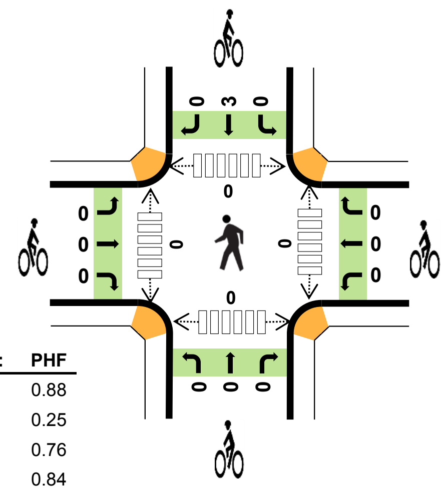
Shoreline Hwy
Olema Bolinas Rd

Date: 12-16-2021
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:00 PM to 5:00 PM

Peak Hour



	HV %:	PHF
EB	1.6%	0.88
WB	0.0%	0.25
NB	0.0%	0.76
SB	2.7%	0.84
TOTAL	1.6%	0.88



Two-Hour Count Summaries

Interval Start		Olema Bolinas Rd Eastbound				Olema Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
		UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM		**0**	**16**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**17**	**0**	**0**	**0**	**8**	**13**	**55**	0
4:15 PM		**0**	**16**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**7**	**12**	**51**	0
4:30 PM		**0**	**11**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**18**	**0**	**0**	**1**	**11**	**10**	**51**	0
4:45 PM		**0**	**18**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**5**	**7**	**36**	**193**
5:00 PM		0	12	0	0	0	0	0	0	0	0	5	0	0	0	3	6	26	164
5:15 PM		0	13	0	0	0	0	0	0	1	0	11	0	0	0	4	8	37	150
5:30 PM		0	8	0	2	0	0	0	0	0	3	6	0	0	0	5	4	28	127
5:45 PM		0	10	0	0	0	0	0	1	0	0	3	0	0	0	1	13	28	119
Count Total		0	104	1	3	0	0	1	1	1	3	80	0	0	1	44	73	312	0
Peak Hour	**All**	**0**	**61**	**1**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**55**	**0**	**0**	**1**	**31**	**42**	**193**	**0**
	HV	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**0**
	HV%	**-**	**2%**	**0%**	**0%**	**-**	**-**	**0%**	**-**	**-**	**-**	**0%**	**-**	**-**	**0%**	**3%**	**2%**	**2%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	**0**	**0**	**0**	**1**	*1*	**0**	**0**	**0**	**0**	*0*	**0**	**0**	**0**	**0**	*0*
4:15 PM	**0**	**0**	**0**	**0**	*0*	**0**	**0**	**0**	**2**	*2*	**0**	**0**	**0**	**0**	*0*
4:30 PM	**0**	**0**	**0**	**1**	*1*	**0**	**0**	**0**	**0**	*0*	**0**	**0**	**0**	**0**	*0*
4:45 PM	**1**	**0**	**0**	**0**	*1*	**0**	**0**	**0**	**1**	*1*	**0**	**0**	**0**	**0**	*0*
5:00 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
5:15 PM	0	0	1	0	*1*	0	0	0	0	*0*	0	0	0	0	*0*
5:30 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
5:45 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	1	0	1	2	*4*	0	0	0	3	*3*	0	0	0	0	*0*
Peak Hour	**1**	**0**	**0**	**2**	*3*	**0**	**0**	**0**	**3**	*3*	**0**	**0**	**0**	**0**	*0*

Project Manager: (415) 310-6469

project.manager.ca@idaxdata.com

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Olema Bolinas Rd Eastbound UT	LT	TH	RT	Olema Bolinas Rd Westbound UT	LT	TH	RT	Shoreline Hwy Northbound UT	LT	TH	RT	Shoreline Hwy Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
4:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	0
4:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	0
4:45 PM	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**3**
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:15 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	3
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Count Total	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	4	0
Peak Hour	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**3**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Olema Bolinas Rd Eastbound LT	TH	RT	Olema Bolinas Rd Westbound LT	TH	RT	Shoreline Hwy Northbound LT	TH	RT	Shoreline Hwy Southbound LT	TH	RT	15-min Total	Rolling One Hour
4:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**3**
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	3
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	1
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	3	0	3	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**0**

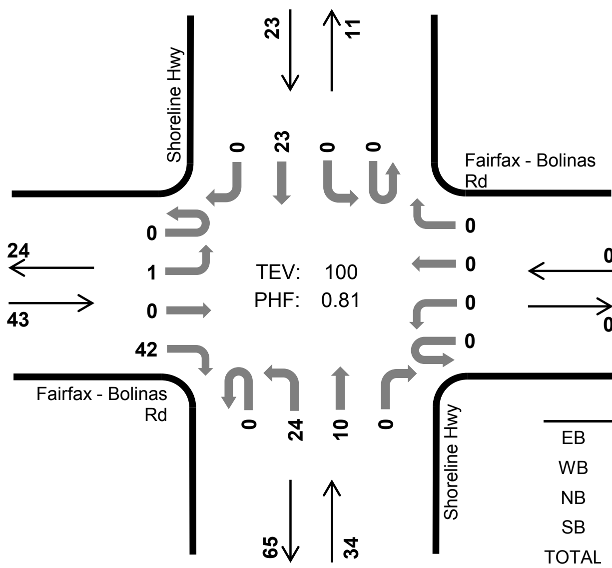
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

Shoreline Hwy
Fairfax - Bolinas Rd

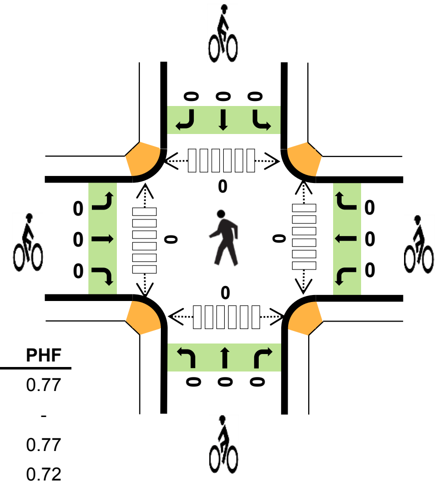
idax

Date: 12-16-2021
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 7:45 AM to 8:45 AM

Peak Hour



	HV %:	PHF
EB	0.0%	0.77
WB	-	-
NB	8.8%	0.77
SB	4.3%	0.72
TOTAL	4.0%	0.81



Two-Hour Count Summaries

Interval Start	Fairfax - Bolinas Rd Eastbound				Fairfax - Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	0	0	5	0	0	0	0	0	4	2	0	0	0	2	0	13	0
7:15 AM	0	0	0	9	0	0	0	0	0	3	1	0	0	0	6	0	19	0
7:30 AM	0	0	0	10	0	0	0	0	0	4	3	0	0	0	6	0	23	0
7:45 AM	**0**	**0**	**0**	**12**	**0**	**0**	**0**	**0**	**0**	**9**	**2**	**0**	**0**	**0**	**8**	**0**	**31**	86
8:00 AM	**0**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**9**	**1**	**0**	**0**	**0**	**6**	**0**	**24**	97
8:15 AM	**0**	**1**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**2**	**3**	**0**	**0**	**0**	**7**	**0**	**21**	99
8:30 AM	**0**	**0**	**0**	**14**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**0**	**0**	**0**	**2**	**0**	**24**	**100**
8:45 AM	0	0	0	11	0	0	0	0	0	9	2	0	0	1	3	0	26	95
Count Total	0	1	0	77	0	0	0	0	0	44	18	0	0	1	40	0	181	0
Peak Hour All	**0**	**1**	**0**	**42**	**0**	**0**	**0**	**0**	**0**	**24**	**10**	**0**	**0**	**0**	**23**	**0**	**100**	**0**
Peak Hour HV	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**1**	**0**	**4**	**0**
Peak Hour HV%	**-**	**0%**	**-**	**0%**	**-**	**-**	**-**	**-**	**-**	**13%**	**0%**	**-**	**-**	**-**	**4%**	**-**	**4%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	1	0	0	0	*1*	0	0	0	0	*0*	0	0	0	0	*0*
7:15 AM	1	0	0	1	*2*	0	0	0	0	*0*	0	0	0	0	*0*
7:30 AM	1	0	0	0	*1*	0	0	0	0	*0*	0	0	0	0	*0*
7:45 AM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:00 AM	**0**	**0**	**2**	**0**	***2***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:15 AM	**0**	**0**	**0**	**1**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:30 AM	**0**	**0**	**1**	**0**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
8:45 AM	0	0	1	0	*1*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	3	0	4	2	*9*	0	0	0	0	*0*	0	0	0	0	*0*
Peak Hour	**0**	**0**	**3**	**1**	***4***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Fairfax - Bolinas Rd				Fairfax - Bolinas Rd				Shoreline Hwy				Shoreline Hwy				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
7:15 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	2	0
7:30 AM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
7:45 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	4
8:00 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	5
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	4
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**4**
8:45 AM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	5
Count Total	0	0	0	3	0	0	0	0	0	4	0	0	0	0	2	0	9	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**1**	**0**	**4**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Fairfax - Bolinas Rd			Fairfax - Bolinas Rd			Shoreline Hwy			Shoreline Hwy			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:00 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

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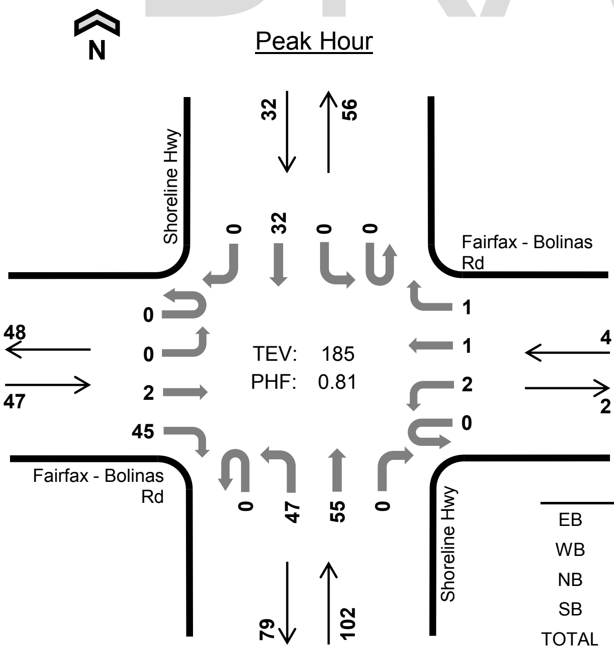
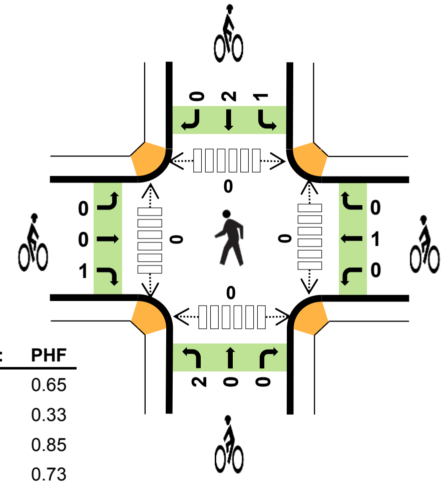
Shoreline Hwy
Fairfax - Bolinas Rd

Date: 12-16-2021
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 4:00 PM to 5:00 PM

Peak Hour





	HV %:	PHF
EB	2.1%	0.65
WB	0.0%	0.33
NB	2.9%	0.85
SB	3.1%	0.73
TOTAL	2.7%	0.81

Two-Hour Count Summaries

Interval Start	Fairfax - Bolinas Rd				Fairfax - Bolinas Rd				Shoreline Hwy				Shoreline Hwy				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	0	0	10	0	0	0	0	0	11	18	0	0	0	5	0	44	0
4:15 PM	0	0	0	9	0	0	1	0	0	15	15	0	0	0	11	0	51	0
4:30 PM	0	0	2	16	0	2	0	1	0	9	16	0	0	0	11	0	57	0
4:45 PM	0	0	0	10	0	0	0	0	0	12	6	0	0	0	5	0	33	185
5:00 PM	0	0	0	13	0	1	0	1	0	9	5	0	0	0	2	0	31	172
5:15 PM	0	0	0	12	0	0	0	0	0	7	11	0	0	1	5	0	36	157
5:30 PM	0	1	0	9	0	1	2	1	0	9	7	0	0	0	7	0	37	137
5:45 PM	0	0	0	5	0	0	0	0	0	7	3	0	0	0	1	0	16	120
Count Total	0	1	2	84	0	4	3	3	0	79	81	0	0	1	47	0	305	0
Peak Hour All	0	0	2	45	0	2	1	1	0	47	55	0	0	0	32	0	185	0
Peak Hour HV	0	0	0	1	0	0	0	0	0	3	0	0	0	0	1	0	5	0
Peak Hour HV%	-	-	0%	2%	-	0%	0%	0%	-	6%	0%	-	-	-	3%	-	3%	0

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	0	0	0	0	*0*	1	0	2	0	*3*	0	0	0	0	*0*
4:15 PM	1	0	2	0	*3*	0	0	0	2	*2*	0	0	0	0	*0*
4:30 PM	0	0	0	1	*1*	0	0	0	0	*0*	0	0	0	0	*0*
4:45 PM	0	0	1	0	*1*	0	1	0	1	*2*	0	0	0	0	*0*
5:00 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	2	2	0	*4*
5:15 PM	1	0	1	0	*2*	0	0	0	0	*0*	0	0	0	0	*0*
5:30 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
5:45 PM	0	0	0	0	*0*	0	0	0	0	*0*	0	0	0	0	*0*
Count Total	2	0	4	1	*7*	1	1	2	3	*7*	0	2	2	0	*4*
Peak Hour	1	0	3	1	*5*	1	1	2	3	*7*	0	0	0	0	*0*

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Fairfax - Bolinas Rd				Fairfax - Bolinas Rd				Shoreline Hwy				Shoreline Hwy				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:15 PM	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	0
4:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**5**
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
5:15 PM	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	2	4
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Count Total	0	0	0	2	0	0	0	0	0	3	1	0	0	0	1	0	7	0
Peak Hour	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**0**	**0**	**0**	**1**	**0**	**5**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Fairfax - Bolinas Rd			Fairfax - Bolinas Rd			Shoreline Hwy			Shoreline Hwy			15-min Total	Rolling One Hour
	Eastbound			Westbound			Northbound			Southbound				
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
4:00 PM	**0**	**0**	**1**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**3**	0
4:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	0
4:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	0
4:45 PM	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**2**	**7**
5:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	4
5:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	2
5:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Count Total	0	0	1	0	1	0	2	0	0	1	2	0	7	0
Peak Hour	**0**	**0**	**1**	**0**	**1**	**0**	**2**	**0**	**0**	**1**	**2**	**0**	**7**	**0**

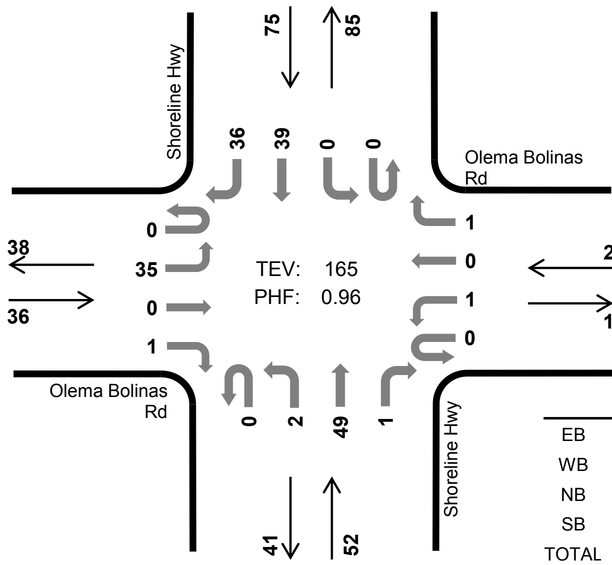
Note: U-Turn volumes for bikes are included in Left-Turn, if any.

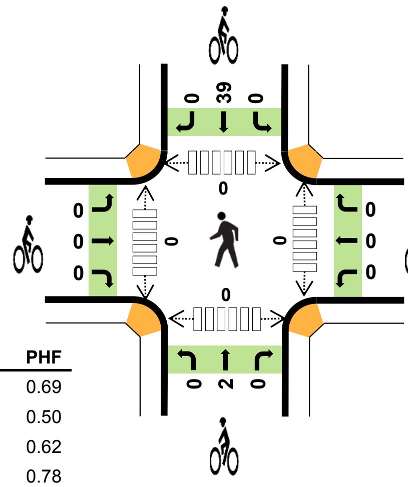
Shoreline Hwy
Olema Bolinas Rd

idax

Date: 12-18-2021
Count Period: 12:00 PM to 2:00 PM
Peak Hour: 1:00 PM to 2:00 PM

Peak Hour





	HV %:	PHF
EB	2.8%	0.69
WB	0.0%	0.50
NB	0.0%	0.62
SB	0.0%	0.78
TOTAL	0.6%	0.96

Two-Hour Count Summaries

Interval Start	Olema Bolinas Rd Eastbound				Olema Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
12:00 PM	0	2	0	1	0	0	0	0	0	1	10	0	0	0	10	6	30	0
12:15 PM	0	7	0	2	0	0	0	0	0	1	18	0	0	0	8	8	44	0
12:30 PM	0	6	0	0	0	0	0	0	0	0	13	0	0	0	11	8	38	0
12:45 PM	1	7	0	4	0	0	0	0	0	0	12	0	0	0	8	10	42	154
1:00 PM	**0**	**7**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**11**	**0**	**0**	**0**	**11**	**8**	**38**	162
1:15 PM	**0**	**13**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**10**	**1**	**0**	**0**	**10**	**8**	**43**	161
1:30 PM	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**19**	**0**	**0**	**0**	**4**	**10**	**41**	164
1:45 PM	**0**	**9**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**0**	**14**	**10**	**43**	**165**
Count Total	1	57	0	8	0	1	0	1	0	4	102	1	0	0	76	68	319	0
Peak Hour All	**0**	**35**	**0**	**1**	**0**	**1**	**0**	**1**	**0**	**2**	**49**	**1**	**0**	**0**	**39**	**36**	**165**	**0**
Peak Hour HV	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
Peak Hour HV%	**-**	**3%**	**-**	**0%**	**-**	**0%**	**-**	**0%**	**-**	**0%**	**0%**	**0%**	**-**	**-**	**0%**	**0%**	**1%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
12:00 PM	0	0	0	0	*0*	0	0	3	7	*10*	0	0	0	0	*0*
12:15 PM	0	0	0	0	*0*	0	0	1	3	*4*	0	0	0	0	*0*
12:30 PM	0	0	0	0	*0*	0	0	0	7	*7*	0	0	0	0	*0*
12:45 PM	0	0	1	1	*2*	0	0	1	0	*1*	0	0	0	0	*0*
1:00 PM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**1**	**3**	***4***	**0**	**0**	**0**	**0**	*0*
1:15 PM	**1**	**0**	**0**	**0**	***1***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
1:30 PM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**1**	**33**	***34***	**0**	**0**	**0**	**0**	*0*
1:45 PM	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**3**	***3***	**0**	**0**	**0**	**0**	***0***
Count Total	1	0	1	1	*3*	0	0	7	56	*63*	0	0	0	0	*0*
Peak Hour	**1**	**0**	**0**	**0**	***1***	**0**	**0**	**2**	**39**	***41***	**0**	**0**	**0**	**0**	***0***

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Olema Bolinas Rd Eastbound				Olema Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	2
1:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	2
1:15 PM	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	3
1:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	3
1:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Count Total	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3	0
Peak Hour	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Olema Bolinas Rd Eastbound			Olema Bolinas Rd Westbound			Shoreline Hwy Northbound			Shoreline Hwy Southbound			15-min Total	Rolling One Hour
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
12:00 PM	0	0	0	0	0	0	0	3	0	0	7	0	10	0
12:15 PM	0	0	0	0	0	0	0	1	0	0	3	0	4	0
12:30 PM	0	0	0	0	0	0	0	0	0	0	7	0	7	0
12:45 PM	0	0	0	0	0	0	0	1	0	0	0	0	1	22
1:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**3**	**0**	**4**	16
1:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	12
1:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**33**	**0**	**34**	39
1:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**0**	**3**	**41**
Count Total	0	0	0	0	0	0	0	7	0	0	56	0	63	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**39**	**0**	**41**	**0**

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

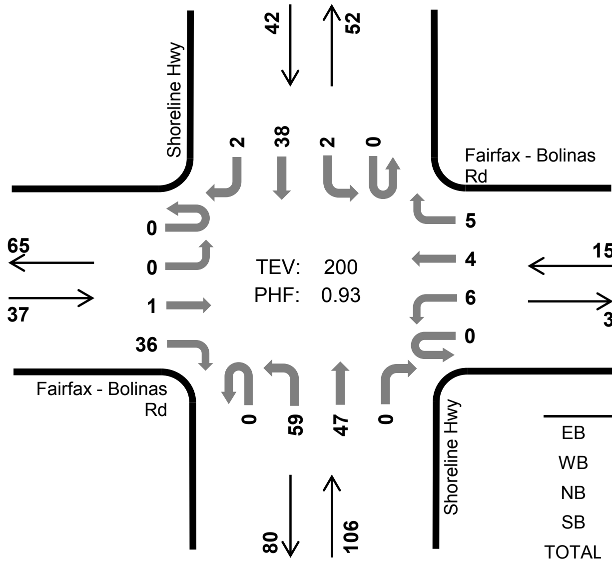
Shoreline Hwy
Fairfax - Bolinas Rd

idax

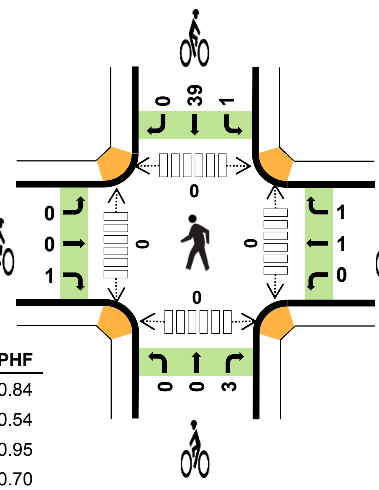
Date: 12-18-2021
Count Period: 12:00 PM to 2:00 PM
Peak Hour: 1:00 PM to 2:00 PM

N

Peak Hour



	HV %:	PHF
EB	0.0%	0.84
WB	0.0%	0.54
NB	0.9%	0.95
SB	0.0%	0.70
TOTAL	0.5%	0.93



Two-Hour Count Summaries

Interval Start	Fairfax - Bolinas Rd Eastbound UT	LT	TH	RT	Fairfax - Bolinas Rd Westbound UT	LT	TH	RT	Shoreline Hwy Northbound UT	LT	TH	RT	Shoreline Hwy Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
12:00 PM	0	0	1	5	0	1	0	4	0	11	7	0	0	0	10	1	40	0
12:15 PM	0	0	1	4	1	2	0	0	0	12	19	1	0	0	9	0	49	0
12:30 PM	0	0	0	14	0	0	0	0	0	12	12	0	0	0	12	0	50	0
12:45 PM	0	1	0	8	0	0	0	0	0	12	12	0	0	0	11	0	44	183
1:00 PM	**0**	**0**	**0**	**11**	**0**	**1**	**0**	**0**	**0**	**13**	**11**	**0**	**0**	**1**	**12**	**0**	**49**	192
1:15 PM	**0**	**0**	**0**	**7**	**0**	**2**	**3**	**2**	**0**	**18**	**10**	**0**	**0**	**1**	**8**	**1**	**52**	195
1:30 PM	**0**	**0**	**0**	**9**	**0**	**1**	**1**	**2**	**0**	**9**	**19**	**0**	**0**	**0**	**3**	**1**	**45**	190
1:45 PM	**0**	**0**	**1**	**9**	**0**	**2**	**0**	**1**	**0**	**19**	**7**	**0**	**0**	**0**	**15**	**0**	**54**	**200**
Count Total	0	1	3	67	1	9	4	9	0	106	97	1	0	2	80	3	383	0
Peak Hour All	**0**	**0**	**1**	**36**	**0**	**6**	**4**	**5**	**0**	**59**	**47**	**0**	**0**	**2**	**38**	**2**	**200**	**0**
Peak Hour HV	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
Peak Hour HV%	**-**	**-**	**0%**	**0%**	**-**	**0%**	**0%**	**0%**	**-**	**2%**	**0%**	**-**	**-**	**0%**	**0%**	**0%**	**1%**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals EB	WB	NB	SB	Total	Bicycles EB	WB	NB	SB	Total	Pedestrians (Crossing Leg) East	West	North	South	Total
12:00 PM	0	0	0	0	*0*	0	0	4	6	*10*	0	0	0	0	*0*
12:15 PM	0	0	1	0	*1*	11	2	0	1	*14*	0	0	0	0	*0*
12:30 PM	1	0	0	0	*1*	1	0	0	9	*10*	0	0	0	0	*0*
12:45 PM	0	0	1	0	*1*	0	1	3	0	*4*	0	0	0	0	*0*
1:00 PM	**0**	**0**	**0**	**0**	*0*	**0**	**0**	**1**	**3**	*4*	**0**	**0**	**0**	**0**	*0*
1:15 PM	**0**	**0**	**0**	**0**	*0*	**1**	**1**	**0**	**0**	*2*	**0**	**0**	**0**	**0**	*0*
1:30 PM	**0**	**0**	**1**	**0**	*1*	**0**	**1**	**0**	**33**	*34*	**0**	**0**	**0**	**0**	*0*
1:45 PM	**0**	**0**	**0**	**0**	*0*	**0**	**0**	**2**	**4**	*6*	**0**	**0**	**0**	**0**	*0*
Count Total	1	0	3	0	*4*	13	5	10	56	*84*	0	0	0	0	*0*
Peak Hour	**0**	**0**	**1**	**0**	*1*	**1**	**2**	**3**	**40**	*46*	**0**	**0**	**0**	**0**	*0*

Two-Hour Count Summaries - Heavy Vehicles

Interval Start	Fairfax - Bolinas Rd Eastbound				Fairfax - Bolinas Rd Westbound				Shoreline Hwy Northbound				Shoreline Hwy Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
12:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:15 PM	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
12:30 PM	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0
12:45 PM	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	3
1:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	3
1:15 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	2
1:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	2
1:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
Count Total	0	0	0	1	0	0	0	0	0	2	1	0	0	0	0	0	4	0
Peak Hour	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**

Two-Hour Count Summaries - Bikes

Interval Start	Fairfax - Bolinas Rd Eastbound			Fairfax - Bolinas Rd Westbound			Shoreline Hwy Northbound			Shoreline Hwy Southbound			15-min Total	Rolling One Hour
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT		
12:00 PM	0	0	0	0	0	0	1	3	0	5	1	0	10	0
12:15 PM	0	1	10	1	0	1	0	0	0	0	1	0	14	0
12:30 PM	0	1	0	0	0	0	0	0	0	1	8	0	10	0
12:45 PM	0	0	0	0	0	1	2	1	0	0	0	0	4	38
1:00 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**3**	**0**	**4**	32
1:15 PM	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	20
1:30 PM	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**33**	**0**	**34**	44
1:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**1**	**3**	**0**	**6**	**46**
Count Total	0	2	11	1	1	3	3	4	3	7	49	0	84	0
Peak Hour	**0**	**0**	**1**	**0**	**1**	**1**	**0**	**0**	**3**	**1**	**39**	**0**	**46**	**0**

Note: U-Turn volumes for bikes are included in Left-Turn, if any.

Location: Hwy 1, North of Olema Bolinas Rd
Date Range: 12/14/2021 - 12/20/2021
Site Code: 01

idax DATA SOLUTIONS

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	0	1	1	0	0	0	0	0	0	0	1	1	2	0	2	2	3	5	1	0	1	0	0	0
1:00 AM	0	0	0	0	0	0	2	1	3	2	1	3	1	0	1	2	2	4	0	0	0	1	0	1
2:00 AM	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0
3:00 AM	0	1	1	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1
4:00 AM	0	0	0	1	0	1	0	0	0	1	1	2	1	0	1	1	0	1	1	2	3	0	0	0
5:00 AM	1	2	3	1	3	4	2	1	3	3	1	4	2	0	2	3	2	5	1	2	3	1	2	3
6:00 AM	13	17	30	10	13	23	12	12	24	11	7	18	7	3	10	3	2	5	5	7	12	12	14	26
7:00 AM	14	**80**	94	20	59	79	26	60	86	29	32	61	17	26	43	12	13	25	17	28	45	20	**66**	86
8:00 AM	37	55	92	32	**64**	96	33	**61**	94	42	**66**	108	24	38	62	38	8	46	36	45	81	34	60	94
9:00 AM	37	67	**104**	**53**	53	**106**	39	53	92	57	64	**121**	58	46	104	33	23	56	50	31	81	43	58	101
10:00 AM	**44**	56	100	46	26	72	41	58	99	57	49	106	69	31	100	49	**34**	83	57	31	88	44	47	90
11:00 AM	38	58	96	47	47	94	**67**	58	**125**	**59**	51	110	**81**	**49**	**130**	**80**	**34**	**114**	**65**	**51**	**116**	**51**	54	**105**
12:00 PM	61	41	102	52	48	100	50	65	115	69	61	130	79	66	145	59	38	97	49	46	95	54	51	106
1:00 PM	65	46	111	57	44	101	67	65	132	94	54	148	87	68	155	65	42	107	75	45	120	63	52	115
2:00 PM	55	46	101	56	**54**	110	67	56	123	70	**64**	134	83	67	150	53	**55**	108	81	48	129	59	52	111
3:00 PM	**98**	52	150	**85**	46	**131**	95	**71**	166	103	53	156	**96**	**84**	**180**	61	51	**112**	87	**65**	**152**	93	**56**	149
4:00 PM	**98**	**66**	**164**	79	33	112	**114**	64	**178**	**118**	52	**170**	83	74	157	**66**	44	110	**92**	48	140	**97**	54	**151**
5:00 PM	58	32	90	38	34	72	66	18	84	70	42	112	51	32	83	47	42	89	53	34	87	54	28	82
6:00 PM	14	17	31	15	24	39	26	11	37	40	32	72	26	40	66	17	26	43	17	12	29	18	17	36
7:00 PM	8	1	9	13	10	23	9	3	12	15	26	41	16	18	34	9	13	22	13	13	26	10	5	15
8:00 PM	6	2	8	5	8	13	7	5	12	9	12	21	8	10	18	10	4	14	3	14	17	6	5	11
9:00 PM	4	2	6	4	3	7	4	7	11	6	8	14	7	5	12	6	10	16	6	4	10	4	4	8
10:00 PM	2	2	4	1	0	1	2	6	8	6	8	14	8	2	10	4	7	11	3	2	5	2	3	4
11:00 PM	3	6	9	3	1	4	0	4	4	5	3	8	1	8	9	3	0	3	1	4	5	2	4	6
Total	656	650	1,306	618	570	1,188	729	680	1,409	866	690	1,556	807	667	1,474	623	453	1,076	714	532	1,246	668	633	1,301
Percent	50%	50%	-	52%	48%	-	52%	48%	-	56%	44%	-	55%	45%	-	58%	42%	-	57%	43%	-	51%	49%	-
AM Peak	10:00	07:00	09:00	09:00	08:00	09:00	11:00	08:00	11:00	11:00	08:00	09:00	11:00	11:00	11:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	07:00	11:00
Vol.	44	80	104	53	64	106	67	61	125	59	66	121	81	49	130	80	34	114	65	51	116	51	66	105
PM Peak	15:00	16:00	16:00	15:00	14:00	15:00	16:00	15:00	16:00	16:00	14:00	16:00	15:00	15:00	15:00	16:00	14:00	15:00	16:00	15:00	15:00	16:00	15:00	16:00
Vol.	98	66	164	85	54	131	114	71	178	118	64	170	96	84	180	66	55	112	92	65	152	97	56	151

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

Location: Hwy 1, Between Olema Bolinas Rd & Fairfax - Bolinas Rd
Date Range: 12/14/2021 - 12/20/2021
Site Code: 02

idax DATA SOLUTIONS

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	0	0	0	0	0	0	0	0	0	0	1	1	2	2	4	2	0	2	0	0	0	0	0	0
1:00 AM	0	0	0	0	0	0	1	1	2	3	1	4	1	0	1	2	3	5	0	0	0	0	0	1
2:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0
3:00 AM	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
4:00 AM	0	2	2	0	0	0	0	0	0	0	1	1	0	0	0	0	4	4	0	0	0	0	1	1
5:00 AM	1	0	1	2	1	3	0	1	1	0	0	0	2	0	2	2	2	4	0	0	0	1	1	2
6:00 AM	8	9	17	2	9	11	4	4	8	5	7	12	2	4	6	0	1	1	3	3	6	5	7	12
7:00 AM	6	**40**	46	15	30	45	13	23	36	16	21	37	12	9	21	8	3	11	11	25	36	11	31	42
8:00 AM	14	22	36	19	19	38	11	20	31	17	34	51	26	14	40	25	10	35	19	23	42	15	20	35
9:00 AM	14	35	**49**	**32**	36	**68**	20	22	42	28	**46**	**74**	40	23	63	19	18	37	21	25	46	22	31	53
10:00 AM	16	24	40	17	24	41	18	27	45	**40**	33	73	46	29	75	35	**31**	66	35	27	62	17	25	42
11:00 AM	**21**	27	48	20	**42**	62	**34**	**33**	**67**	36	32	68	**58**	**41**	**99**	**67**	26	**93**	**36**	**39**	**75**	**25**	**34**	**59**
12:00 PM	35	**32**	67	29	**27**	56	31	35	66	38	35	73	60	58	118	**47**	41	88	29	33	62	32	**31**	63
1:00 PM	27	22	49	30	20	50	37	33	70	43	30	73	55	65	120	42	36	78	41	35	76	31	25	56
2:00 PM	24	25	49	29	19	48	32	25	57	43	**56**	99	54	57	111	36	46	82	50	35	85	28	23	51
3:00 PM	47	18	65	**54**	25	**79**	50	33	83	69	41	110	**67**	**68**	**135**	39	58	97	57	**40**	97	50	25	76
4:00 PM	**64**	27	**91**	45	19	64	**67**	**37**	**104**	**85**	43	**128**	63	63	126	39	**59**	**98**	**59**	39	**98**	**59**	28	**86**
5:00 PM	33	22	55	24	13	37	38	19	57	49	24	73	29	47	76	25	34	59	32	32	64	32	18	50
6:00 PM	10	10	20	7	7	14	13	9	22	31	10	41	14	26	40	10	14	24	10	1	11	10	9	19
7:00 PM	8	7	15	5	5	10	4	4	8	9	10	19	5	3	8	2	5	7	13	10	23	6	5	11
8:00 PM	4	4	8	3	1	4	7	0	7	7	7	14	3	7	10	2	2	4	4	5	9	5	2	6
9:00 PM	3	1	4	1	1	2	1	4	5	3	6	9	4	7	11	4	5	9	2	4	6	2	2	4
10:00 PM	1	0	1	1	0	1	0	0	0	0	1	1	4	2	6	2	2	4	3	1	4	1	0	1
11:00 PM	2	0	2	2	1	3	0	0	0	6	7	13	0	5	5	0	0	0	1	0	1	1	0	2
Total	338	328	666	337	299	636	381	331	712	528	446	974	547	530	1,077	408	401	809	427	377	804	352	319	671
Percent	51%	49%	-	53%	47%	-	54%	46%	-	54%	46%	-	51%	49%	-	50%	50%	-	53%	47%	-	52%	48%	-
AM Peak	11:00	07:00	09:00	09:00	11:00	09:00	11:00	11:00	11:00	10:00	09:00	09:00	11:00	11:00	11:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00
Vol.	21	40	49	32	42	68	34	33	67	40	46	74	58	41	99	67	31	93	36	39	75	25	34	59
PM Peak	16:00	12:00	16:00	15:00	12:00	15:00	16:00	16:00	16:00	16:00	14:00	16:00	15:00	15:00	15:00	12:00	16:00	16:00	16:00	15:00	16:00	16:00	12:00	16:00
Vol.	64	32	91	54	27	79	67	37	104	85	56	128	67	68	135	47	59	98	59	40	98	59	31	86

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

idax DATA SOLUTIONS

Location: Hwy 1, South of Fairfax - Bolinas Rd
Date Range: 12/14/2021 - 12/20/2021
Site Code: 03

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	1	0	1	2	1	3	1	0	1	2	2	4	6	1	7	4	2	6	2	0	2	1	0	2
1:00 AM	2	1	3	0	0	0	4	1	5	2	1	3	2	0	2	3	7	10	2	0	2	2	1	3
2:00 AM	0	0	0	1	0	1	2	0	2	0	0	0	1	0	1	1	3	4	1	0	1	1	0	1
3:00 AM	0	2	2	1	4	5	0	4	4	1	1	2	1	0	1	0	0	0	1	1	2	0	3	4
4:00 AM	0	4	4	1	3	4	1	3	4	0	2	2	0	2	2	2	0	2	1	3	4	1	3	4
5:00 AM	2	3	5	3	2	5	1	5	6	4	2	6	1	5	6	1	4	5	0	2	2	2	3	5
6:00 AM	9	18	27	5	20	25	6	16	22	9	19	28	7	5	12	1	8	9	10	19	29	7	18	25
7:00 AM	25	66	91	33	60	93	26	59	85	31	45	76	25	27	52	17	14	31	24	51	75	28	62	90
8:00 AM	27	69	96	**48**	62	110	34	58	92	41	70	111	42	30	72	32	25	57	39	45	84	36	63	99
9:00 AM	47	**71**	**118**	**48**	**75**	**123**	61	50	111	58	**101**	**159**	73	50	123	47	54	101	46	57	103	52	**65**	117
10:00 AM	**56**	62	**118**	41	44	85	46	67	113	**75**	72	147	82	**68**	150	68	64	132	62	69	131	48	58	105
11:00 AM	43	54	97	**48**	72	120	**74**	**69**	**143**	62	75	137	**95**	60	**155**	**98**	**73**	**171**	**74**	**81**	**155**	**55**	65	**120**
12:00 PM	69	**75**	144	52	55	107	71	73	144	91	88	179	107	83	190	**85**	73	158	59	78	137	64	**68**	132
1:00 PM	80	62	142	61	**64**	**125**	96	68	164	85	69	154	**109**	94	203	63	65	128	84	81	165	79	65	144
2:00 PM	62	63	125	60	41	101	59	59	118	103	**99**	202	103	99	202	59	79	138	87	**83**	170	60	54	115
3:00 PM	93	56	149	62	37	99	**102**	**81**	**183**	**131**	83	**214**	94	**130**	**224**	54	92	146	**96**	80	**176**	86	58	144
4:00 PM	**99**	63	**162**	**67**	39	106	**102**	79	181	114	88	202	85	113	198	64	**105**	**169**	82	66	148	**89**	60	**150**
5:00 PM	64	61	125	41	34	75	59	59	118	80	58	138	54	88	142	41	65	106	64	67	131	55	51	106
6:00 PM	23	19	42	27	14	41	31	19	50	48	19	67	28	44	72	31	22	53	25	15	40	27	17	44
7:00 PM	23	11	34	18	8	26	16	8	24	34	20	54	27	13	40	17	12	29	26	15	41	19	9	28
8:00 PM	17	7	24	12	4	16	21	5	26	13	10	23	19	12	31	19	6	25	12	8	20	17	5	22
9:00 PM	10	7	17	14	2	16	18	7	25	11	12	23	6	7	13	10	8	18	7	6	13	14	5	19
10:00 PM	7	0	7	10	3	13	7	1	8	11	3	14	8	3	11	9	3	12	12	1	13	8	1	9
11:00 PM	4	0	4	4	2	6	5	1	6	7	4	11	4	5	9	3	0	3	5	0	5	4	1	5
Total	763	774	1,537	659	646	1,305	843	792	1,635	1,013	943	1,956	979	939	1,918	729	784	1,513	821	828	1,649	755	737	1,492
Percent	50%	50%	-	50%	50%	-	52%	48%	-	52%	48%	-	51%	49%	-	48%	52%	-	50%	50%	-	51%	49%	-
AM Peak	10:00	09:00	09:00	08:00	09:00	09:00	11:00	11:00	11:00	10:00	09:00	09:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	09:00	11:00
Vol.	56	71	118	48	75	123	74	69	143	75	101	159	95	68	155	98	73	171	74	81	155	55	65	120
PM Peak	16:00	12:00	16:00	16:00	13:00	13:00	15:00	15:00	15:00	15:00	14:00	15:00	13:00	15:00	15:00	12:00	16:00	16:00	15:00	14:00	15:00	16:00	12:00	16:00
Vol.	99	75	162	67	64	125	102	81	183	131	99	214	109	130	224	85	105	169	96	83	176	89	68	150

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

idax DATA SOLUTIONS

Location: Olema Bolinas Rd, South of Hwy 1
Date Range: 12/14/2021 - 12/20/2021
Site Code: 04

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	0	1	1	0	0	0	0	0	0	0	0	0	3	0	3	0	3	3	2	0	2	0	0	0
1:00 AM	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	3	1	4	0	0	0	0	0	0
2:00 AM	0	0	0	0	0	0	0	1	1	0	1	1	0	2	2	0	0	0	0	1	1	0	0	0
3:00 AM	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	1	1	0	0	0	0	0	0
4:00 AM	2	0	2	2	0	2	0	2	2	1	0	1	1	1	2	4	0	4	2	1	3	1	1	2
5:00 AM	2	2	4	0	3	3	4	2	6	6	2	8	2	0	2	1	2	3	2	2	4	2	2	4
6:00 AM	12	10	22	17	8	25	15	12	27	14	13	27	10	1	11	6	4	10	4	4	8	15	10	25
7:00 AM	16	**44**	60	27	37	64	34	39	73	34	39	73	14	19	33	11	12	23	21	35	56	26	40	66
8:00 AM	53	39	92	36	**48**	84	49	**48**	**97**	57	**40**	**97**	14	31	45	22	7	29	37	**42**	79	46	**45**	**91**
9:00 AM	**55**	39	94	55	28	83	33	35	68	**59**	27	86	**51**	35	86	22	19	41	39	20	59	48	34	82
10:00 AM	54	42	**96**	59	29	88	45	35	80	42	29	71	48	28	76	44	21	65	38	25	63	**53**	35	88
11:00 AM	35	40	75	**60**	33	**93**	**50**	36	86	43	33	76	49	**40**	**89**	**51**	**27**	**78**	**55**	35	**90**	48	36	85
12:00 PM	49	29	78	55	28	83	35	35	70	46	45	91	50	35	85	47	25	72	37	25	62	46	31	77
1:00 PM	57	31	88	46	31	77	66	45	111	68	30	98	60	38	98	56	**40**	**96**	74	28	102	56	36	92
2:00 PM	49	34	83	42	37	79	66	37	103	51	38	89	65	40	105	40	32	72	65	32	97	52	36	88
3:00 PM	**80**	**46**	**126**	**80**	**49**	**129**	65	**47**	112	64	**53**	117	61	**44**	105	53	29	82	76	**43**	**119**	75	**47**	**122**
4:00 PM	77	44	121	72	27	99	**93**	43	**136**	**96**	47	**143**	66	40	**106**	**66**	24	90	**83**	31	114	**81**	38	119
5:00 PM	66	26	92	30	23	53	63	34	97	56	39	95	**69**	22	91	48	23	71	50	34	84	53	28	81
6:00 PM	11	13	24	13	17	30	29	20	49	35	28	63	31	22	53	16	17	33	15	25	40	18	17	34
7:00 PM	9	6	15	14	6	20	12	8	20	22	22	44	25	15	40	12	10	22	10	8	18	12	7	18
8:00 PM	7	14	21	4	7	11	3	15	18	9	10	19	13	10	23	18	12	30	2	13	15	5	12	17
9:00 PM	4	5	9	4	3	7	4	7	11	5	6	11	6	6	12	8	7	15	11	4	15	4	5	9
10:00 PM	2	2	4	0	5	5	4	7	11	12	10	22	11	8	19	5	6	11	5	2	7	2	5	7
11:00 PM	4	6	10	2	1	3	0	4	4	6	6	12	4	7	11	5	8	13	0	5	5	2	4	6
Total	644	473	1,117	618	420	1,038	671	512	1,183	726	520	1,246	653	444	1,097	538	330	868	628	415	1,043	644	468	1,113
Percent	58%	42%	-	60%	40%	-	57%	43%	-	58%	42%	-	60%	40%	-	62%	38%	-	60%	40%	-	58%	42%	-
AM Peak	09:00	07:00	10:00	11:00	08:00	11:00	11:00	08:00	08:00	09:00	08:00	08:00	09:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	11:00	10:00	08:00	08:00
Vol.	55	44	96	60	48	93	50	48	97	59	40	97	51	40	89	51	27	78	55	42	90	53	45	91
PM Peak	15:00	15:00	15:00	15:00	15:00	15:00	16:00	15:00	16:00	16:00	15:00	16:00	17:00	15:00	16:00	16:00	13:00	13:00	16:00	15:00	15:00	16:00	15:00	15:00
Vol.	80	46	126	80	49	129	93	47	136	96	53	143	69	44	106	66	40	96	83	43	119	81	47	122

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

Location: Fairfax - Bolinas Rd, Between Olema Bolinas Rd & HWY 1
Date Range: 12/14/2021 - 12/20/2021
Site Code: 05

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total	EB	WB	Total
12:00 AM	0	1	1	1	2	3	0	1	1	1	2	3	0	5	5	2	2	4	0	2	2	0	1	2
1:00 AM	1	2	3	0	0	0	0	3	3	0	0	0	0	1	1	4	1	5	0	1	1	0	2	2
2:00 AM	0	0	0	0	1	1	0	2	2	0	0	0	0	1	1	3	1	4	0	0	0	0	1	1
3:00 AM	2	0	2	4	1	5	3	0	3	1	1	2	0	1	1	0	0	0	2	1	3	3	0	3
4:00 AM	2	0	2	3	1	4	3	2	5	1	0	1	2	0	2	0	2	2	4	1	5	3	1	4
5:00 AM	3	1	4	1	2	3	5	1	6	2	3	5	5	0	5	2	0	2	2	0	2	3	1	4
6:00 AM	11	3	14	12	3	15	12	2	14	13	6	19	3	6	9	7	1	8	16	7	23	12	3	14
7:00 AM	32	22	54	37	25	62	37	18	55	24	18	42	16	18	34	11	10	21	25	17	42	35	22	57
8:00 AM	**50**	17	67	46	29	**75**	42	24	66	40	29	69	22	19	41	24	11	35	20	27	47	**46**	23	69
9:00 AM	41	35	76	**47**	24	71	30	39	69	**58**	34	**92**	28	32	60	37	29	66	36	23	59	39	33	**72**
10:00 AM	41	**44**	**85**	25	29	54	43	28	71	45	**38**	83	**45**	36	**81**	35	36	71	45	30	75	36	**34**	70
11:00 AM	32	24	56	35	**32**	67	**45**	**45**	**90**	46	32	78	25	**43**	68	**49**	**43**	**92**	**48**	**40**	**88**	37	**34**	71
12:00 PM	**48**	38	86	33	28	61	43	42	85	**59**	55	**114**	38	52	90	41	**48**	**89**	50	30	80	**41**	36	77
1:00 PM	42	**56**	**98**	**42**	34	**76**	37	55	92	37	41	78	37	**64**	101	32	31	63	**51**	44	**95**	40	**48**	**89**
2:00 PM	43	36	79	25	**45**	70	37	33	70	45	64	109	43	51	94	36	29	65	**51**	43	94	35	38	73
3:00 PM	39	52	91	26	23	49	**56**	**56**	**112**	43	**71**	**114**	**67**	44	**111**	39	20	59	36	**48**	84	40	44	84
4:00 PM	36	50	86	20	31	51	45	49	94	53	51	104	54	39	93	**46**	39	85	33	33	66	34	43	77
5:00 PM	39	38	77	22	22	44	43	35	78	37	48	85	42	38	80	37	23	60	38	37	75	35	32	66
6:00 PM	10	19	29	7	21	28	11	21	32	12	27	39	23	16	39	10	22	32	15	18	33	9	20	30
7:00 PM	5	19	24	4	14	18	5	13	18	12	25	37	10	24	34	7	16	23	6	18	24	5	15	20
8:00 PM	4	14	18	4	9	13	5	16	21	6	10	16	7	17	24	5	17	22	3	10	13	4	13	17
9:00 PM	5	8	13	1	11	12	2	17	19	9	8	17	2	4	6	3	7	10	4	6	10	3	12	15
10:00 PM	0	6	6	5	10	15	1	7	8	2	11	13	1	6	7	1	7	8	0	9	9	2	8	10
11:00 PM	0	3	3	1	2	3	1	5	6	1	4	5	1	4	5	0	3	3	0	4	4	1	3	4
Total	486	488	974	401	399	800	506	514	1,020	547	578	1,125	471	521	992	431	398	829	485	449	934	464	467	931
Percent	50%	50%	-	50%	50%	-	50%	50%	-	49%	51%	-	47%	53%	-	52%	48%	-	52%	48%	-	50%	50%	-
AM Peak	08:00	10:00	10:00	09:00	11:00	08:00	11:00	11:00	11:00	09:00	10:00	09:00	10:00	11:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	10:00	09:00
Vol.	50	44	85	47	32	75	45	45	90	58	38	92	45	43	81	49	43	92	48	40	88	46	34	72
PM Peak	12:00	13:00	13:00	13:00	14:00	13:00	15:00	15:00	15:00	12:00	15:00	12:00	15:00	13:00	15:00	16:00	12:00	12:00	13:00	15:00	13:00	12:00	13:00	13:00
Vol.	48	56	98	42	45	76	56	56	112	59	71	114	67	64	111	46	48	89	51	48	95	41	48	89

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

DRAFT

idax DATA SOLUTIONS

Location: Olema Bolinas Rd, South of Fairfax - Bolinas Rd
Date Range: 12/14/2021 - 12/20/2021
Site Code: 06

	Tuesday			Wednesday			Thursday			Friday			Saturday			Sunday			Monday					
	12/14/2021			12/15/2021			12/16/2021			12/17/2021			12/18/2021			12/19/2021			12/20/2021			Mid-Week Average		
Time	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total	NB	SB	Total
12:00 AM	0	2	2	1	2	3	0	1	1	1	2	3	2	5	7	2	5	7	1	2	3	0	2	2
1:00 AM	1	1	2	0	0	0	1	3	4	0	0	0	0	1	1	6	2	8	0	1	1	1	1	2
2:00 AM	0	1	1	0	1	1	0	3	3	0	1	1	0	3	3	2	1	3	0	1	1	0	2	2
3:00 AM	2	0	2	4	1	5	3	0	3	1	2	3	1	1	2	0	1	1	1	1	2	3	0	3
4:00 AM	3	0	3	4	1	5	3	2	5	2	0	2	2	1	3	2	2	4	4	1	5	3	1	4
5:00 AM	4	3	7	1	4	5	6	4	10	5	5	10	6	0	6	3	2	5	4	3	7	4	4	7
6:00 AM	20	13	33	21	12	33	20	12	32	21	19	40	10	7	17	10	5	15	18	11	29	20	12	33
7:00 AM	40	64	104	47	59	106	52	57	109	43	58	101	26	35	61	19	22	41	37	49	86	46	60	106
8:00 AM	**81**	58	139	62	**80**	**142**	66	71	137	67	68	135	29	48	77	41	17	58	44	70	114	**70**	**70**	**139**
9:00 AM	66	76	142	**77**	49	126	52	70	122	**91**	64	**155**	58	65	123	56	48	104	66	46	112	65	65	130
10:00 AM	79	**84**	**163**	59	55	114	70	65	135	68	**69**	137	**75**	65	140	62	56	118	70	55	125	69	68	137
11:00 AM	56	61	117	70	64	134	**80**	**78**	**158**	77	66	143	63	**82**	**145**	**77**	**70**	**147**	**83**	**74**	**157**	69	68	136
12:00 PM	81	68	149	64	53	117	66	74	140	96	101	197	65	85	150	67	69	136	69	54	123	70	65	135
1:00 PM	82	83	165	69	68	137	74	99	173	86	71	157	72	**101**	173	66	**71**	137	**91**	73	164	75	83	158
2:00 PM	76	72	148	59	**81**	140	76	68	144	77	95	172	82	89	171	66	58	124	**91**	74	**165**	70	74	144
3:00 PM	**98**	**95**	**193**	**77**	65	**142**	103	**105**	**208**	94	**127**	**221**	**100**	86	**186**	73	49	122	77	**86**	163	**93**	**88**	**181**
4:00 PM	90	94	184	68	57	125	**108**	94	202	**102**	101	203	94	79	173	**96**	61	**157**	84	65	149	89	82	170
5:00 PM	79	65	144	40	45	85	87	70	157	71	82	153	80	58	138	68	44	112	66	73	139	69	60	129
6:00 PM	21	30	51	16	38	54	32	40	72	35	55	90	40	38	78	19	38	57	24	41	65	23	36	59
7:00 PM	10	22	32	12	20	32	12	22	34	22	47	69	23	39	62	14	26	40	12	26	38	11	21	33
8:00 PM	8	28	36	5	16	21	7	31	38	13	21	34	15	26	41	15	30	45	5	21	26	7	25	32
9:00 PM	7	13	20	4	13	17	6	24	30	13	14	27	7	9	16	7	13	20	11	10	21	6	17	22
10:00 PM	1	8	9	3	16	19	2	13	15	9	22	31	7	15	22	4	13	17	2	11	13	2	12	14
11:00 PM	2	9	11	2	3	5	1	9	10	5	10	15	4	11	15	3	11	14	0	9	9	2	7	9
Total	907	950	1,857	765	803	1,568	927	1,015	1,942	999	1,100	2,099	861	949	1,810	778	714	1,492	860	857	1,717	866	923	1,789
Percent	49%	51%	-	49%	51%	-	48%	52%	-	48%	52%	-	48%	52%	-	52%	48%	-	50%	50%	-	48%	52%	-
AM Peak	08:00	10:00	10:00	09:00	08:00	08:00	11:00	11:00	11:00	09:00	10:00	09:00	10:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	11:00	08:00	08:00	08:00
Vol.	81	84	163	77	80	142	80	78	158	91	69	155	75	82	145	77	70	147	83	74	157	70	70	139
PM Peak	15:00	15:00	15:00	15:00	14:00	15:00	16:00	15:00	15:00	16:00	15:00	15:00	15:00	13:00	15:00	16:00	13:00	16:00	13:00	15:00	14:00	15:00	15:00	15:00
Vol.	98	95	193	77	81	142	108	105	208	102	127	221	100	101	186	96	71	157	91	86	165	93	88	181

1. Mid-week average includes data between Tuesday and Thursday.

Project Manager: (415) 310-6469
project.manager.ca@idaxdata.com

ATTACHMENT C

GENERAL NOTES:

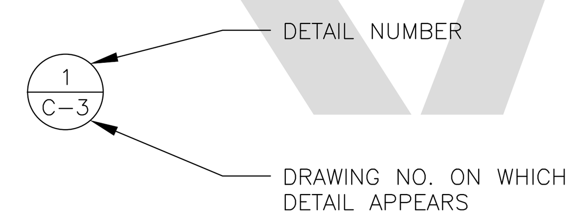
1. ALL WORK SHOWN ON THESE PLANS SHALL BE ACCOMPLISHED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS OF THE CITIES OF MARIN AND COUNTY OF MARIN DATED JUNE, 1992, THE UNIFORM CONSTRUCTION STANDARDS OF THE CITIES OF MARIN AND THE COUNTY OF MARIN DATED MAY, 2008, THE STATE STANDARD PLANS DATED MAY, 2018, AND THE STATE STANDARD SPECIFICATIONS DATED MAY, 2018, (INSOFAR AS THE SAME MAY APPLY) AS MODIFIED BY THE SPECIAL PROVISIONS FOR THIS PROJECT.

2. THE LOCATION FOR UTILITIES SHOWN ON THESE PLANS IS APPROXIMATE ONLY. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY LOCATION AND DEPTH. THIS VERIFICATION SHALL BE COORDINATED BY THE CONTRACTOR WITH THE APPROPRIATE UTILITY COMPANY. CALL U.S.A. (UNDERGROUND SERVICE ALERT) FOR UTILITY LOCATION QUESTIONS AT LEAST 24 HOURS BEFORE DIGGING. PHONE 1-800-642-2444.

3. ALL EXISTING STREET SURFACE FEATURES (MANHOLES, CLEAN-OUTS, MONUMENTS, STRIPING, PAVEMENT MARKINGS, ETC.) SHALL BE REFERENCED BY THE CONTRACTOR PRIOR TO START OF ANY WORK.

ABBREVIATIONS

AB	AGGREGATE BASE
AC	ASPHALT CONCRETE
AP	ANGLE POINT
BB	BEGIN BRIDGE
BC	BEGIN HORIZONTAL CURVE
Beg	BEGIN
BOW	BACK OF WALK
BVC	BEGIN VERTICAL CURVE
Cl	CLASS
CONC	CONCRETE
CONT	CONTINUOUS
CONST	CONSTRUCT
CP	CATCH POINT
CT	CALTRANS
DBL	DOUBLE
DIA	DIAMETER
DWG	DRAWING
EA	EACH
EB	END BRIDGE
EC	END HORIZONTAL CURVE
ELEV	ELEVATION
EP	EDGE OF PAVEMENT
ES	EDGE OF SHOULDER
EVC	END VERTICAL CURVE
EXC	EXCAVATION
EXIST	EXISTING
ETW	EDGE OF TRAVELED WAY
FG	FINISHED GRADE
FL	FLOW LINE
FOW	FRONT OF WALK
HMA	HOT MIX ASPHALT
HP	HINGE POINT
Lt	LEFT
LF	LINEAR FEET
Max	MAXIMUM
Min	MINIMUM
MH	MANHOLE
O.C.	ON CENTER
OG	ORIGINAL GROUND
PCC	POINT OF COMPOUND CURVE
PG	PROFILE GRADE
RCP	REINFORCED CONCRETE PIPE
RSP	ROCK SLOPE PROTECTION
Rt	RIGHT
R/W	RIGHT OF WAY
SHLD	SHOULDER
SHT	SHEET
STA	STATION
STD	STANDARD
TEMP	TEMPORARY
TYP	TYPICAL
VAR	VARIES
WSEL	WATER SURFACE ELEVATION



INDEX OF SHEETS

BOLINAS LAGOON WYE PROJECT		
SHEET NO.	SHEET TITLE	
1	GENERAL NOTES	GN-1
2	TYPICAL CROSS SECTIONS	X-1
3	DEMOLITION PLAN	DM-1
4	LAYOUT PLAN	L-1
5	PROFILE	P-1
6	STRUCTURES PLANS	S-1

NOTE: THE CONTRACTOR SHALL POSSESS CLASS "A" LICENSE

CALL USA (UNDERGROUND SERVICE ALERT) AT LEAST 24HRS IN ADVANCE OF WORK - 1-(800)-642-2444.

GENERAL NOTES
GN-1
SCALE: NTS

No.	DATE	DESCRIPTION	BY:
7			
6			
5			
4			
3			
2			
1			

REVISIONS

COUNTY OF MARIN
DEPARTMENT OF PUBLIC WORKS
3501 CIVIC CENTER DR, SUITE 304, SAN RAFAEL, CA 94903

DESIGNED: KHD
DRAWN: KHD
CHECKED: SO
DATE: 6/19/2020

APPROVAL RECOMMENDED
PRINCIPAL ENGINEER, LICENSE NO. XXXXX DATE
APPROVAL RECOMMENDED
ASSIST. DIRECTOR OF PUBLIC WORKS, LICENSE NO. XXXXX DATE

REGISTERED PROFESSIONAL ENGINEER DANIEL THOMAS BLOMQUIST No. 65875 Exp. 12/31/21 CIVIL STATE OF CALIFORNIA

BOLINAS WYE WETLAND RESTORATION
30% DESIGN - NOT FOR CONSTRUCTION

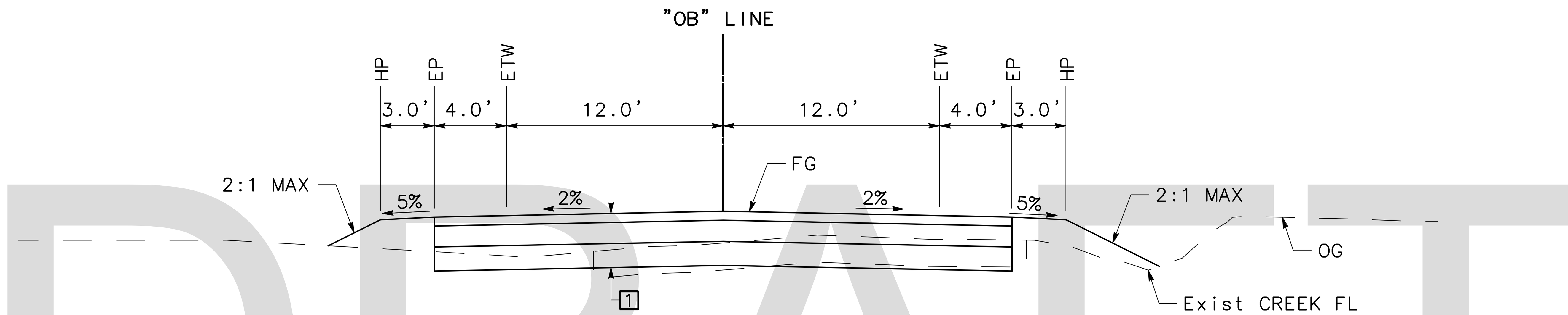
MARK THOMAS
701 UNIVERSITY AVE, SUITE 200
SACRAMENTO, CA 95825
Tel: 916.381.9100
Fax: 916.381.9180

CITY PROJECT NO.
XXXXX

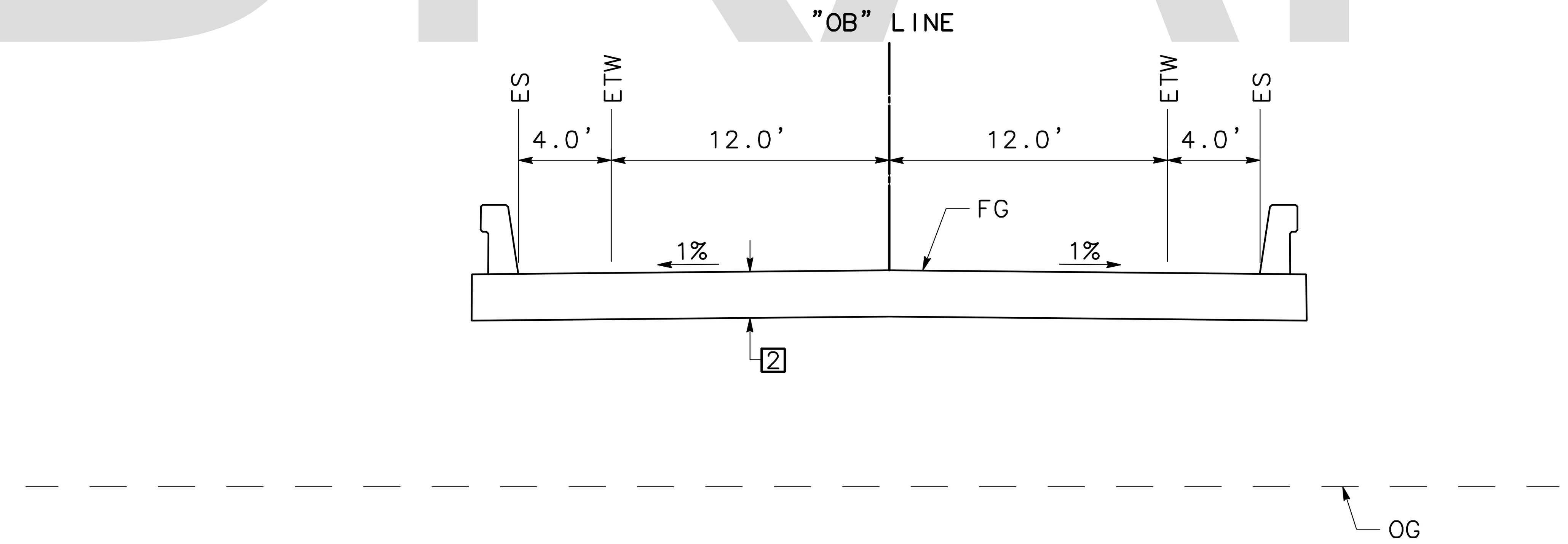
NOTES:

DIMENSIONS OF THE PAVEMENT STRUCTURES (STRUCTURAL SECTIONS) ARE SUBJECT TO TOLERANCES SPECIFIED IN THE STANDARD SPECIFICATIONS.

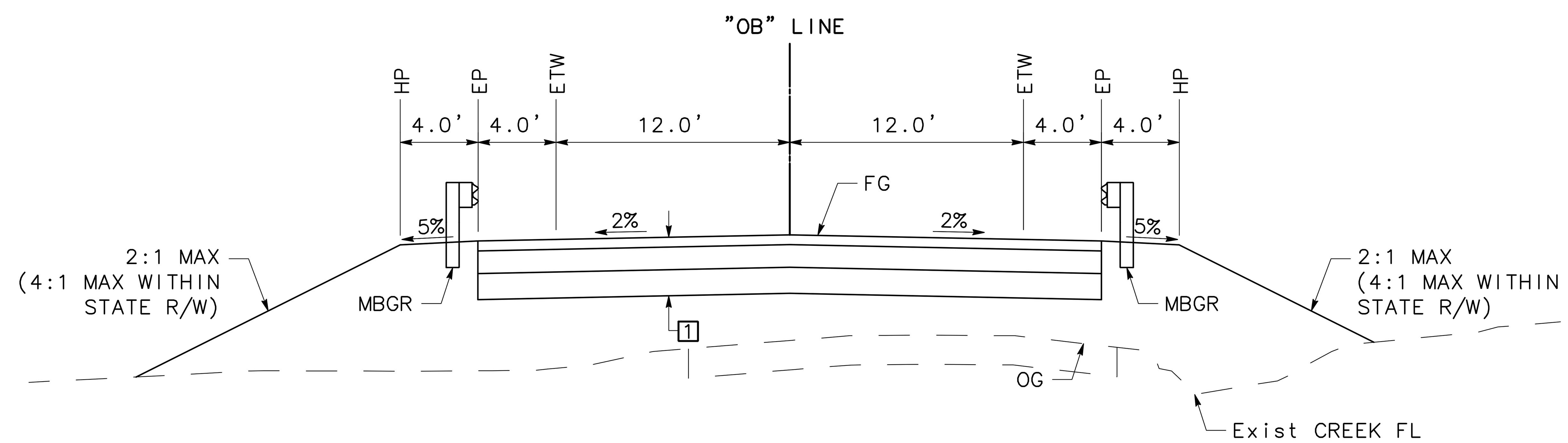
STRUCTURAL SECTIONS: #	
1	6" HMA; 14" CLASS 2 AB; 16" CLASS 4 AB
2	SINGLE SPAN BRIDGE (STRUCTURE DEPTH TO BE DETERMINED)



"OB" LINE 14+25.75 TO 16+76.02



"OB" LINE 11+35.00 TO 11+95.00



"OB" LINE 10+00.00 TO 11+35.00
"OB" LINE 11+95.00 TO 14+25.75

TYPICAL SECTIONS
X-1
SCALE: 1"=5'

No.	DATE	DESCRIPTION	BY:
7			
6			
5			
4			
3			
2			
1			

REVISIONS

COUNTY OF MARIN
DEPARTMENT OF PUBLIC WORKS
3501 CIVIC CENTER DR, SUITE 304, SAN RAFAEL, CA 94903

DESIGNED: KHD
DRAWN: KHD
CHECKED: SO
DATE: 6/19/2020

APPROVAL RECOMMENDED
PRINCIPAL ENGINEER, LICENSE NO. XXXXX — DATE
APPROVAL RECOMMENDED
ASSIST. DIRECTOR OF PUBLIC WORKS, LICENSE NO. XXXXX — DATE

REGISTERED PROFESSIONAL ENGINEER — DANIEL THOMAS BLOMQUIST — No. 65875 — Exp. 12/31/21 — CIVIL — STATE OF CALIFORNIA

BOLINAS WYE WETLAND RESTORATION
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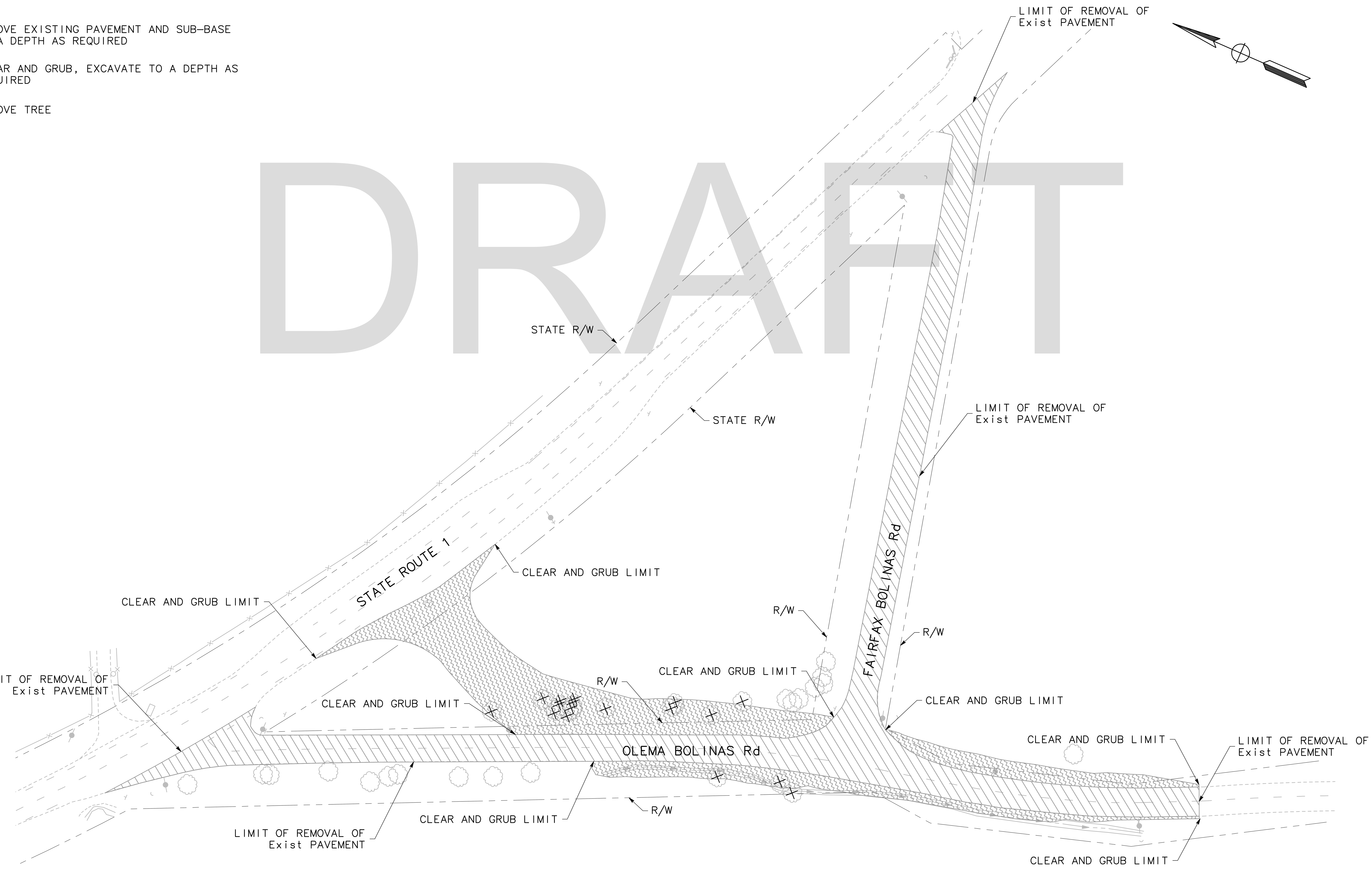
CITY PROJECT NO.
XXXXX

LEGEND:

(diagonal hatch)	REMOVE EXISTING PAVEMENT AND SUB-BASE TO A DEPTH AS REQUIRED
(wavy hatch)	CLEAR AND GRUB, EXCAVATE TO A DEPTH AS REQUIRED
×	REMOVE TREE



DEMOLITION PLAN
DM-1
SCALE: 1"–40'

No.	DATE	DESCRIPTION	BY:
7			
6			
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1			

REVISIONS

COUNTY OF MARIN
DEPARTMENT OF PUBLIC WORKS
3501 CIVIC CENTER DR, SUITE 304, SAN RAFAEL, CA 94903

DESIGNED: KHD
DRAWN: KHD
CHECKED: SO
DATE: 6/19/2020

APPROVAL RECOMMENDED
PRINCIPAL ENGINEER, LICENSE NO. XXXXX DATE
APPROVAL RECOMMENDED
ASSIST. DIRECTOR OF PUBLIC WORKS, LICENSE NO. XXXXX DATE

REGISTERED PROFESSIONAL ENGINEER
DANIEL THOMAS BLOMQUIST
No. 65875
Exp. 12/31/21
CIVIL
STATE OF CALIFORNIA

BOLINAS WYE WETLAND RESTORATION
30% DESIGN – NOT FOR CONSTRUCTION

MARK THOMAS
701 UNIVERSITY AVE, SUITE 200
SACRAMENTO, CA 95825
Tel: 916.381.9100
Fax: 916.381.9180

3 of 6
CITY PROJECT NO.
XXXXX

LEGEND:

- ◆ REMOVE AND SALVAGE EXISTING ROADSIDE SIGN
- ⬢ EXISTING ROADSIDE SIGN TO REMAIN
- ✳ INSTALL ROADSIDE SIGN
- EXISTING ROADSIDE SIGN LOCATION
- ROADSIDE SIGN LOCATION (ONE-POST)
- SNS STREET NAME SIGN
- MAS MAST ARM MOUNTED SIGN
- ○ BC/EC
- △ ANGLE POINT
- (No.) L=XX' MUTCD STRIPING DETAIL NUMBER L= LENGTH
- (#) SIGN REFERENCE NUMBER
- ■ RELOCATE SIGN
- STOP "STOP" PAVEMENT MARKING
- NEW CREEK
- HINGE POINT
- — — F — LIMIT OF FILL

NOTE:

1. ALL TRAFFIC STRIPES AND PAVEMENT MARKINGS TO BE THERMO PLASTIC UNLESS OTHERWISE NOTED.
2. EXACT LOCATION AND POSITION OF ROADSIDE SIGNS SHALL BE VERIFIED BY THE ENGINEER.

SIGNING AND STRIPING NOTES:

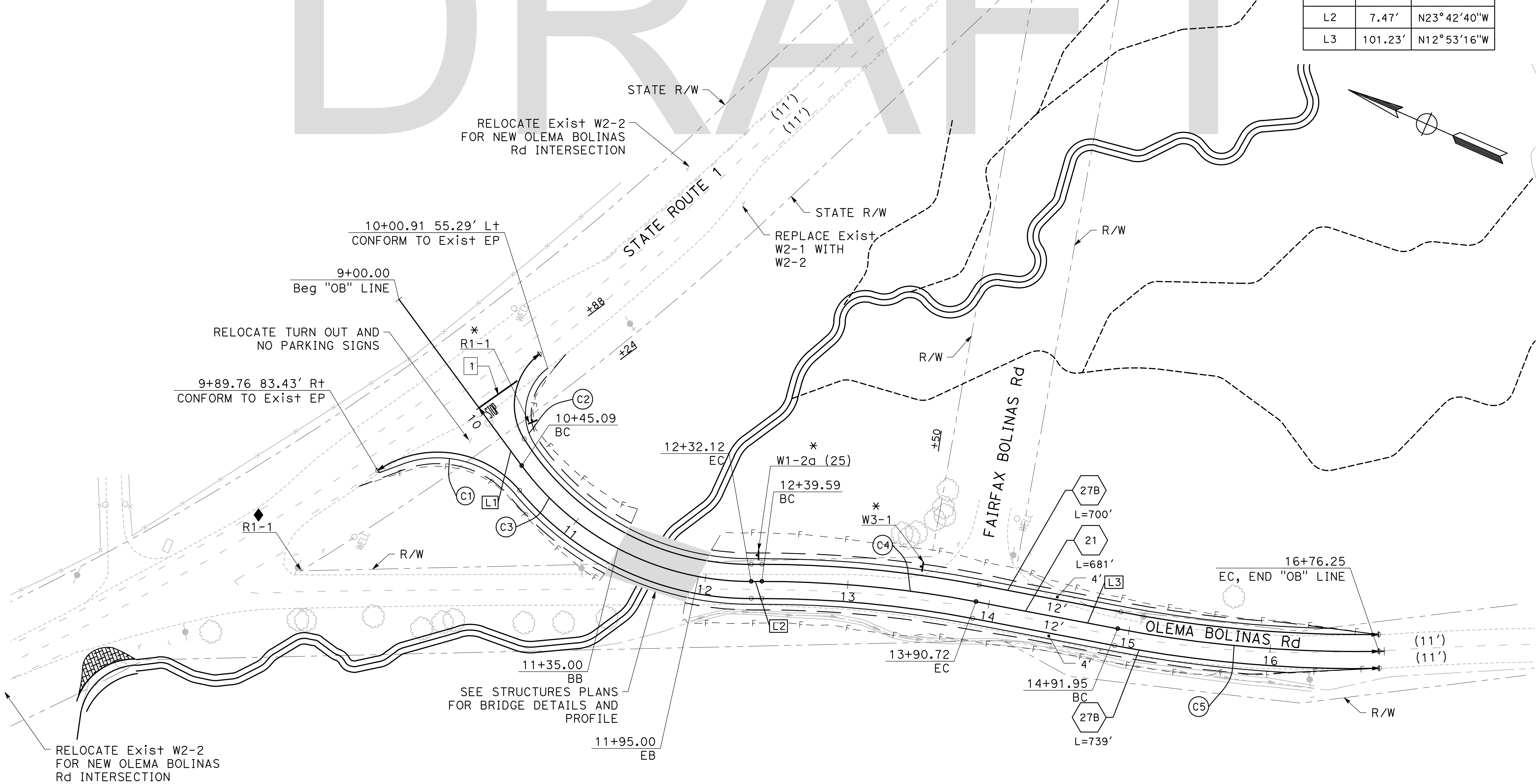
[1] INSTALL 12" WHITE THERMOPLASTIC LIMIT LINE

CURVE TABLE

CURVE #	RADIUS	DELTA	TANGENT	LENGTH
C1	71.00'	70°25'42"	50.11'	87.27'
C2	40.00'	87°13'36"	38.11'	60.90'
C3	200.00'	53°34'50"	100.98'	187.03'
C4	800.00'	10°49'25"	75.79'	151.13'
C5	900.00'	11°43'05"	92.36'	184.07'

LINE TABLE

LINE #	LENGTH	DIRECTION
L1	145.09'	N29°52'10"E
L2	7.47'	N23°42'40"W
L3	101.23'	N12°53'16"W



LAYOUT
L-1
SCALE: 1"-40'

No.	DATE	DESCRIPTION	BY:
7			
6			
5			
4			
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2			
1			

REVISIONS

COUNTY OF MARIN
DEPARTMENT OF PUBLIC WORKS
3501 CIVIC CENTER DR, SUITE 304, SAN RAFAEL, CA 94903

DESIGNED: KHD
DRAWN: KHD
CHECKED: SO
DATE: 6/19/2020

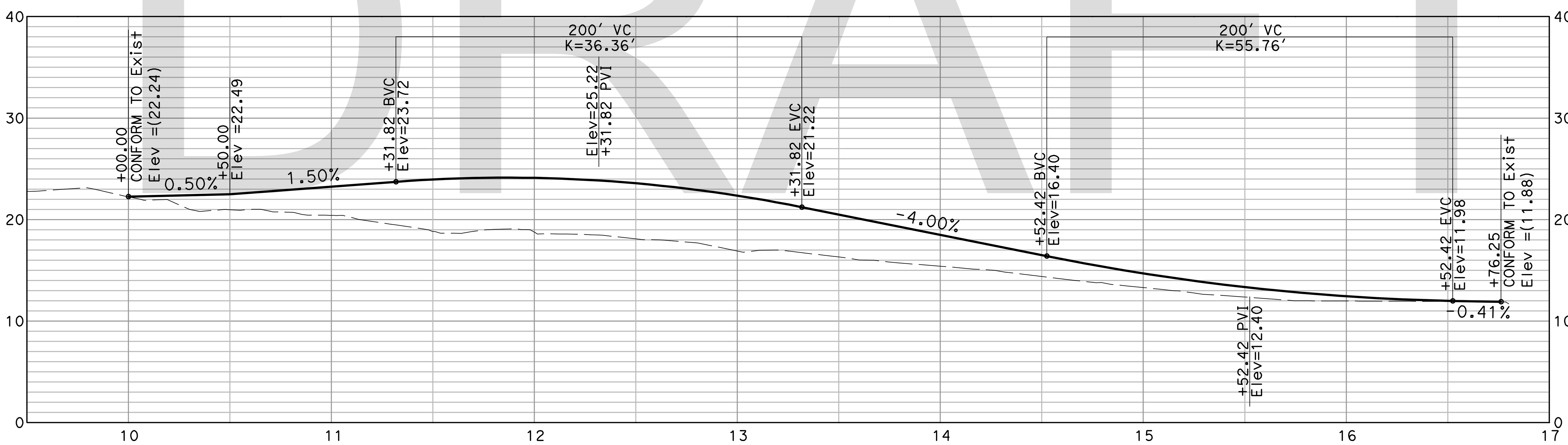
APPROVAL RECOMMENDED
PRINCIPAL ENGINEER, LICENSE NO. XXXXX DATE
APPROVAL RECOMMENDED
ASSIST. DIRECTOR OF PUBLIC WORKS, LICENSE NO. XXXXX DATE

REGISTERED PROFESSIONAL ENGINEER DANIEL THOMAS BLOMQUIST No. 65875 Exp. 12/31/21 CIVIL STATE OF CALIFORNIA

BOLINAS WYE WETLAND RESTORATION
30% DESIGN - NOT FOR CONSTRUCTION

MARK THOMAS
701 UNIVERSITY AVE, SUITE 200
SACRAMENTO, CA 95825
Tel: 916.381.9100
Fax: 916.381.9180

4 of 6
CITY PROJECT NO.
XXXXX



OLEMA BOLINAS Rd PROFILE

Horiz SCALE: 1" - 40'
Vert SCALE: 1" - 8'

PROFILE
P-1
SCALE: 1"-40'

No.	DATE	DESCRIPTION	BY:
7			
6			
5			
4			
3			
2			
1			

REVISIONS

COUNTY OF MARIN
DEPARTMENT OF PUBLIC WORKS
3501 CIVIC CENTER DR, SUITE 304, SAN RAFAEL, CA 94903

DESIGNED: KHD
DRAWN: KHD
CHECKED: SO
DATE: 6/19/2020

APPROVAL RECOMMENDED
PRINCIPAL ENGINEER, LICENSE NO. XXXXX DATE
APPROVAL RECOMMENDED
ASSIST. DIRECTOR OF PUBLIC WORKS, LICENSE NO. XXXXX DATE

REGISTERED PROFESSIONAL ENGINEER
DANIEL THOMAS BLOMQUIST
No. 65875
Exp. 12/31/21
CIVIL
STATE OF CALIFORNIA

BOLINAS WYE WETLAND RESTORATION
30% DESIGN – NOT FOR CONSTRUCTION

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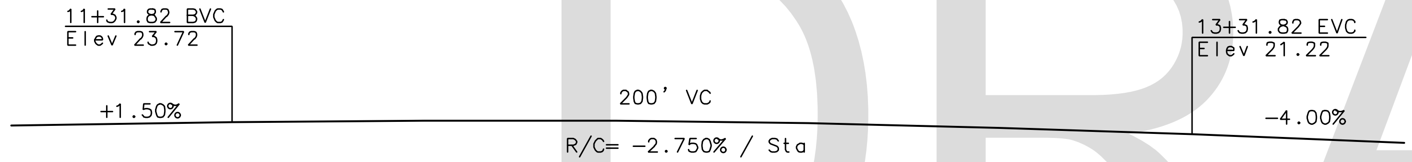
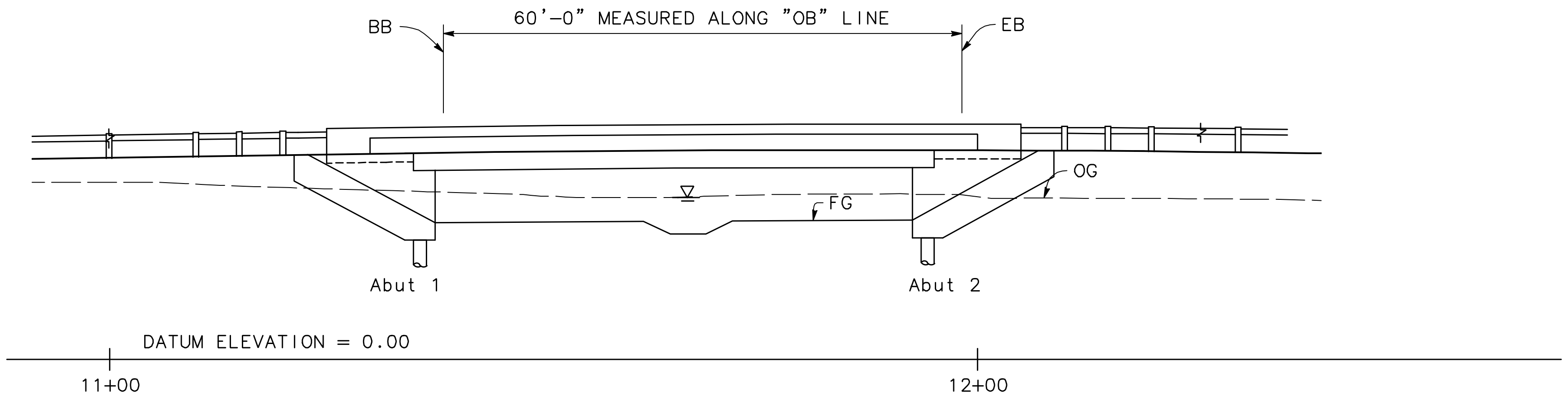
SACRAMENTO, CA 95825
Tel: 916.381.9100
Fax: 916.381.9180

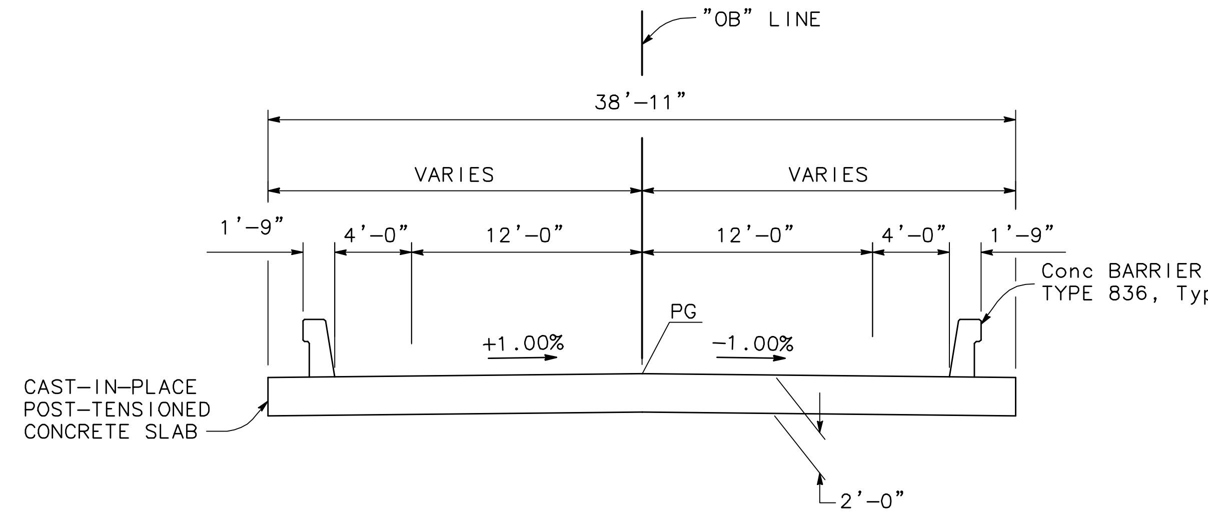
5 of 6
CITY PROJECT NO.
XXXXX



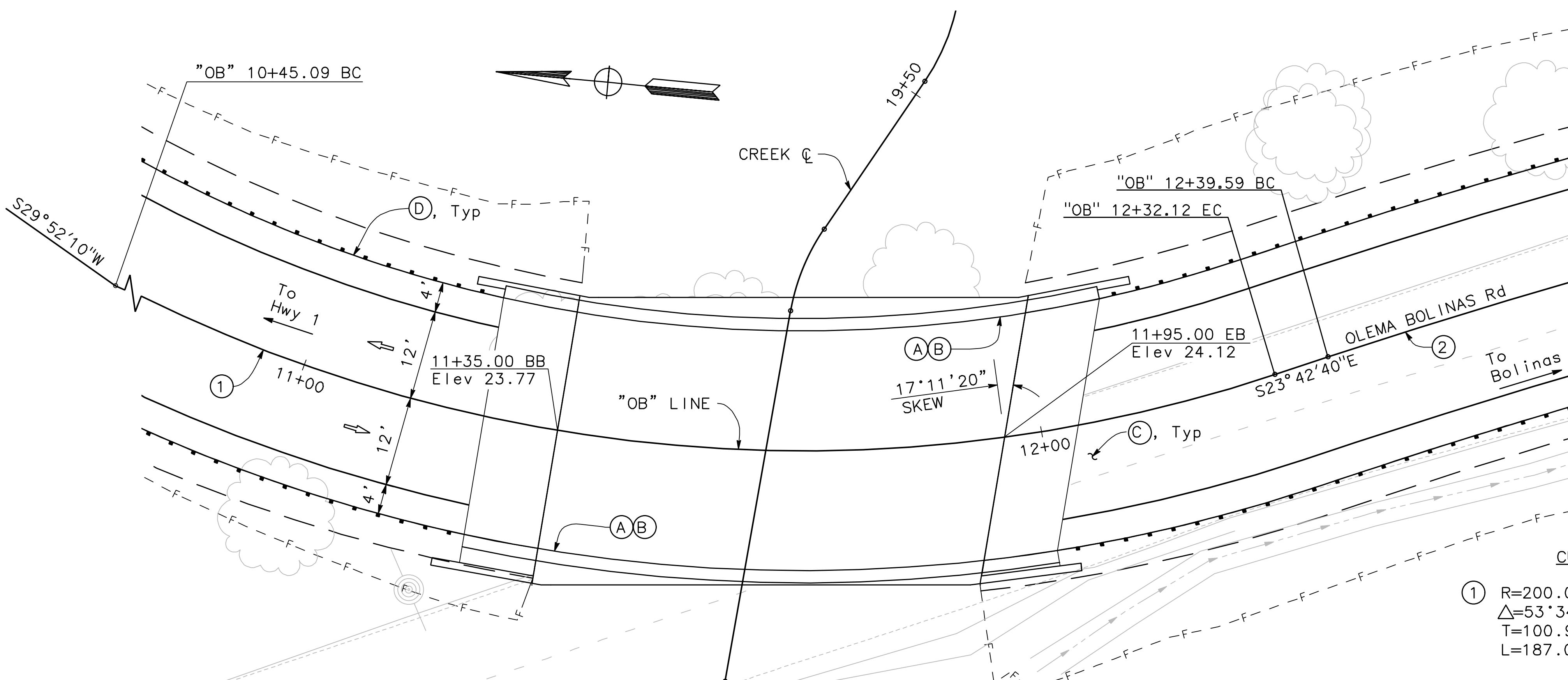
PROFILE GRADE
NO SCALE



ELEVATION
1"=10'



TYPICAL SECTION
1"=5'



PLAN
1"=10'

CURVE DATA

① R=200.00'
△=53°34'50"
T=100.98'
L=187.03'

② R=800.00'
△=10°49'25"
T=75.79'
L=151.13'

NOTES

Ⓐ Paint "OLEMA BOLINAS RD"
Ⓑ Paint "BR No. XX-NEW"
Ⓒ Structure Approach Type EQ (10)
Ⓓ MGS, see "Road Plans"

GENERAL PLAN
S-1

No.	DATE	DESCRIPTION	BY:
7			
6			
5			
4			
3			
2			
1			

REVISIONS

COUNTY OF MARIN
DEPARTMENT OF PUBLIC WORKS
3501 CIVIC CENTER DR, SUITE 304, SAN RAFAEL, CA 94903

DESIGNED: JP
DRAWN: JD
CHECKED: EF
DATE: 6/12/2020

BENCHMARK DESCRIPTION: NAVD88 ELEV XXX.XX NGS BENCHMARK SXXXX, A BRASS DISK SET VERTICALLY ON EXPOSED BEDROCK, LOCATED ALONG SIR FRANCIS DRAKE BLVD, NORTHEAST OF THE SIR FRANCIS DRAKE BLVD AND MOUNTAIN VIEW ROAD INTERSECTION.

APPROVAL RECOMMENDED
PRINCIPAL ENGINEER, LICENSE NO. XXXXX — DATE
APPROVAL RECOMMENDED
ASSIST. DIRECTOR OF PUBLIC WORKS, LICENSE NO. XXXXX — DATE

BOLINAS WYE WETLAND RESTORATION
30% DESIGN - NOT FOR CONSTRUCTION

MARK THOMAS
701 UNIVERSITY AVE, SUITE 200
SACRAMENTO, CA 95825
Tel: 916.381.9100
Fax: 916.381.9180

####of 6
CITY PROJECT NO.
XXXXX

ATTACHMENT D

SCALE: 1" = 100'

LEGEND

ROADWAY TO BE REMOVED

AGGREGATE BASE

0 100 200 400

Graphic Scale

BOLINAS LAGOON WYE WETLAND PROJECT
PROPOSED SIGHT DISTANCE
OLEMA-BOLINAS ROAD

MARK THOMAS

SCALE: 1" = 50'

Graphic Scale

BOLINAS LAGOON WYE WETLAND PROJECT
EXISTING SIGHT DISTANCE
OLEMA-BOLINAS ROAD

MARK THOMAS

0 50 100 200

Graphic Scale

SCALE: 1" = 50'

BOLINAS LAGOON WYE WETLAND PROJECT
EXISTING SIGHT DISTANCE
FAIRFAX-BOLINAS ROAD

MARK THOMAS

ATTACHMENT E

1. Delay to through vehicles stopped and waiting for a left turner to select a gap and clear the through lane.

2. Delay to through vehicles decelerating from highway running speed and the subsequent acceleration to running speed.

3. Accident potential due to left turners decelerating, stopping and standing in the through lane.

4. Reduction in the ability of the intersection to accommodate the traffic demand.

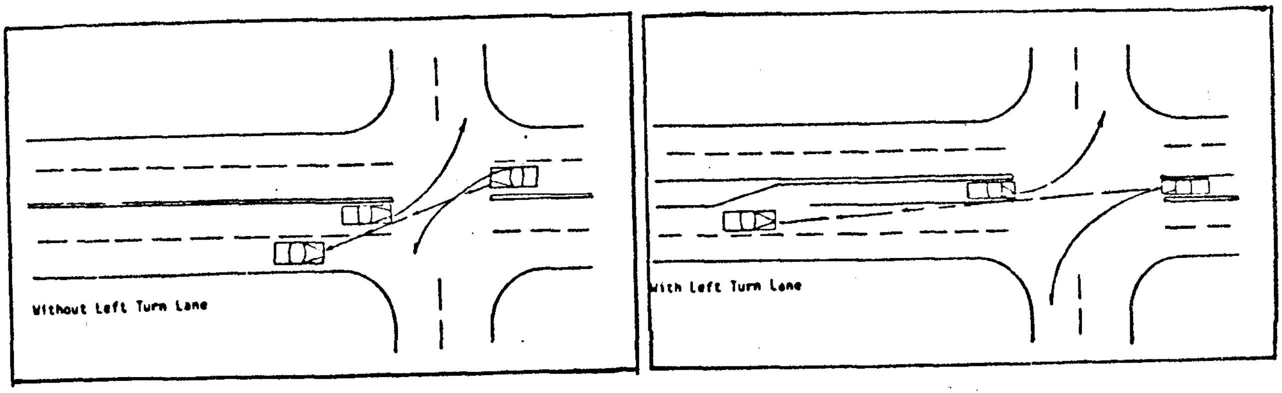


Fig. V-4 Improved Sight Distance With Left-Turn Lanes

A. WARRANTS

The addition of left-turn lanes always provide an improvement in the traffic flow; however, left-turn lanes cannot be built at all locations. It is suggested that the following warrants be considered as guidelines to aid in determining when the need for left-turn lanes becomes critical in a reconstruction project:

1. Volume warrants for left-turn lanes on two lane highways at unsignalized intersections. Table V-1 is a guide to traffic volume warrants where left-turn lanes should be considered. On the volumes shown, the left turns and the right turns from the minor street can be equal to, but not greater than, the left turns from the major street.

2. A suitable volume warrant for left-turn lanes on four lane highways at unsignalized intersections for the various types of highway is not available. The usual method of analyzing each intersection on the basis of past experience, accident records, complaints from the public and engineering judgement should be continued.

3. At signalized intersections, the capacity analysis procedure should be used to determine the need for the left turn lane. See Appendix, Planning Analysis of Signalized Intersections. However, the following "rules of thumb" are useful in evaluating the need for the left-turn lane. Separate treatment for left turns may be required if:

   a. Left turn design volumes exceed 20 percent of the approach volume.

   b. Left turn design volume exceeds 100 vehicles per hour during peak hours.

4. Accident experience. Install a left-turn lane if the critical number of left turn related accidents has

Opposing Volume, VPH	Advancing Volume, VPH 5% Left Turns	10% Left Turns	20% Left Turns	30% Left Turns
40-mph Operating Speed				
800	330	240	180	160
600	410	305	225	200
400	510	380	275	245
200	640	470	350	305
100	720	575	390	340
50-mph Operating Speed				
800	280	210	165	135
600	350	260	195	170
400	430	320	240	210
200	550	400	300	270
100	615	445	335	295
60-mph Operating Speed				
800	230	170	125	115
600	290	210	160	140
400	365	270	200	175
200	450	330	250	215
100	505	370	275	240

Table V-1 Warrants for left-turn lanes on two-lane highways. (Source: Ref. 2)

occurred. Four left turn related accidents per year or six in two years at an unsignalized intersection and five per year at a signalized intersection in a period of one year is considered critical.

A left turn related accident is defined as follows:

a. When a left turn vehicle turns into the path of an oncoming vehicle.

b. When a left turning vehicle was struck in the rear while waiting for a gap in the opposing traffic.

c. When a vehicle weaving around a vehicle stopped to turn left was involved in an accident.

5. Left turn may also be considered based on approach geometrics. If more than minimum sight distance is not available to the intersection, it may be appropriate to include left-turn lanes regardless of demand volume. This may help to reduce the rear-end accident potential.

B. DESIGN ELEMENTS FOR LEFT TURN CHANNELIZATION

The purpose of the left-turn lane is to expedite the movement of through traffic, to provide for and permit the controlled movement of turning traffic, to promote the capacity of the intersection and the safety of all traffic.

The design elements of left-turn lane, as shown on Figure V-5, include the approach taper, bay taper and deceleration lane plus storage.

Appendix I: Preliminary Site Investigation Report

DRAFT PRELIMINARY SITE INVESTIGATION REPORT

Marin County Open Space District Bolinas Lagoon Wye Wetlands Project
Marin County, California

Prepared By:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

1100 Corporate Way, Suite 230
Sacramento, CA 95831

February 16, 2022
Project No. 19-570.1

Prepared For:

wra
ENVIRONMENTAL CONSULTANTS
WRA
2168-G East Francisco Blvd
San Rafael, CA 94901

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services
Sacramento | Modesto | Pleasanton | Rocklin | Ukiah

Corporate Office: 1100 Corporate Drive, Suite 230 | Sacramento, CA 95831 | (916) 455-4225
Modesto: 1165 Scenic Drive, Suite B | Modesto, CA 95350 | (209) 312-7668
Pleasanton: 6200 Stoneridge Mall Road, Suite 330 | Pleasanton, CA 94588 | (925) 401-3515
Rocklin: 4220 Rocklin Road, Suite 1 | Rocklin, CA 95677 | (916) 455-4225
Ukiah: 100 North Pine Street | Ukiah, CA 95482| (707) 240-4400

19-570.1
February 16, 2022

Mr. Brian Bartell
WRA, Inc.
2168-G East Francisco Blvd
San Rafael, CA 94901

Subject: **Draft Preliminary Site Investigation Report**
Marin County Open Space District Bolinas Lagoon Wye Wetlands Project
Marin County, California

Dear Mr. Bartell:

This report presents the results of a Preliminary Site Investigation for the Marin County Open Space District Bolinas Lagoon Wye Wetlands Project in Marin County, California. The purpose of this assessment is to evaluate if concentrations of metals, soil pH, or petroleum hydrocarbons in the soil within the project alignment exceeds hazardous waste thresholds.

We include a description of the project alignment, a description of our sampling methodologies, a summary of laboratory testing results, a discussion of our findings, recommendations, and limitations in this report.

We appreciate the opportunity to be on your team for the Marin County Open Space District Bolinas Lagoon Wye Wetlands Project. Please call us if you have questions or comments.

Sincerely,

CRAWFORD & ASSOCIATES, INC.

Maria Ayala E.I.T. 171351 Staff Engineer	Stephen J. Carter P.G. 5577 Senior Geologist

Reviewed by:

David P. Castro P.E. C78093 Senior Engineer	Christopher Trumbull G.E. GE2492 Senior Project Manager

Draft Preliminary Site Investigation Report submitted for review on XX/XX/XXXX
Draft Preliminary Site Investigation Report approved with/without comment by Caltrans on XX/XX/XXXX
Final Preliminary Site Investigation Report submitted XX/XX/XXXX

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TABLES (APPENDIX B)

APPENDICIES

1 EXECUTIVE SUMMARY

Crawford & Associates, Inc. (Crawford) prepared this draft Preliminary Site Investigation (PSI) Report for the Marin County Open Space District (MCOSD) Bolinas Lagoon Wye Wetlands Project in Marin County, California. This project will redirect Lewis Gulch Creek from its present course (along the west side of Olema-Bolinas Road [OBR]) into an existing wetland area east of OBR and north of Fairfax-Bolinas Road (FBR). This diversion will require construction of a new bridge over Lewis Gulch Creek, reconstruction of the State Route (SR) 1 / OBR intersection, and removal of FBR between SR 1 and OBR.

Crawford prepared this Draft PSI Report to assess if concentrations of metals, soil pH, or automotive-related petroleum hydrocarbons in the soil within the project alignment exceeds hazardous waste thresholds, or might impact adversely impact implementation of the proposed project.

Based on analytical data from our soil samples collected within the project alignment on October 6 and 7, 2021, Crawford makes the following findings:

- Metals concentrations do not exceed hazardous waste thresholds;
- Soil pH values do not exceed hazardous waste thresholds;
- Total Petroleum Hydrocarbons as gasoline (TPHg) were not reported in any of the soil samples;
- Compounds reported as Total Petroleum Hydrocarbons as diesel (TPHd) and as motor oil (TPHmo) do not appear related to motor vehicle use within the alignment; and
- Toluene concentrations are below environmental screening levels. No other volatile organic compounds (VOCs) were reported in the soil samples. Based on the absence of other VOCs and TPHg in soil samples, the toluene does not appear related to motor vehicle use within the project alignment.

Based on the finding presented above, Crawford makes the following recommendations:

- No further assessment with respect to metals, soil pH, or motor vehicle fuel hydrocarbons and VOCs within the project alignment appears to warranted.
- Based on the analytical data presented in this report, it appears that soil excavated within the project alignment may be reused within the project alignment without restriction regarding hazardous waste contamination in the soil.

2 INTRODUCTION

2.1 PURPOSE

Crawford prepared this Draft PSI Report for the MCOSD Bolinas Lagoon Wye Wetlands Project in Marin County, California, to assess if concentrations of metals, soil pH, or automotive-related petroleum hydrocarbons in the soil within the project alignment exceeds hazardous waste thresholds, or might impact adversely impact implementation of the proposed project. This Draft PSI report was prepared for use by WRA, Inc. and MCOSD for this specific project, in accordance with the agreement between WRA and Crawford dated December 18, 2019.

2.2 PROJECT LOCATION

The project alignment is located in western Marin County, about 2 miles north of Bolinas, California. The project alignment comprises about 800 lineal feet of OBR and about 500 lineal feet of FBR. The intersection of these two roads is located at about latitude 37.9343° north and longitude 122.6993° west. An Exploration Map (Figure 1) depicting the project alignment and vicinity is provided in Appendix A.

2.3 SCOPE OF SERVICES

To prepare this report, Crawford performed the following tasks:

- Discussed the proposed improvements along FBR and OBR with the design team;
- Collected soil samples from eight locations within the project alignment; and
- Submitted the soil samples to an accredited laboratory for analysis.

2.4 PROJECT DESCRIPTION

This project will redirect Lewis Gulch Creek from its present course (along the west side of OBR) into existing wetland area east of OBR and north of FBR. This will require construction of a new bridge over Lewis Gulch Creek, reconstruction of the SR 1 / OBR intersection, and removal of FBR between SR 1 and OBR. The proposed realignment of OBR and reconfiguration of the OBR / SR 1 intersection are shown on Figure 1.

3 ENVIRONMENTAL ANALYSIS

3.1 SAMPLE COLLECTION

Crawford collected discrete soil samples from the road shoulders at eight locations within the project alignment on October 6 and 7, 2021. Sample locations are shown on Figure 1.

A hand auger was used to advance a shallow boring at all eight locations. Discrete soil samples were collected in each boring from select intervals (0 to 6 inches, 12 to 18 inches, and 24 to 30 inches below the top of the native soil). A hand-operated slide hammer was used to advance a soil core sampling device (fitted with a clean, 2-inch-diameter by 6-inch-long steel sample sleeve) into undisturbed soil at each sample interval. After retrieval of the sampling device from the boring, the sample liner was capped on each end with fitted plastic caps, labeled, and entered on a chain-of-custody (COC) form. Each sample was then wrapped in a resealable plastic bag, and then placed in a chilled cooler. Samples were transported under COC to BC Laboratories, Inc (ELAP #1186) for analysis.

Decontamination

All sampling equipment (hand auger, hand tools, and soil core sampler) was washed with a weak detergent bath and rinsed with clean, potable water between sample locations. Wash and rinse water from the cleaning process was disposed of at the site away from drainage inlets or known environmentally sensitive areas.

3.2 HAZARDOUS WASTE CLASSIFICATION CRITERIA

Regulatory criteria to classify waste as “California hazardous” for handling and disposal purposes are contained in the California Code of regulations (CCR), Title 22, Division 4.5, Chapter 11, Article 3, §66261.24. Criteria to classify waste as “Resource, Conservation and Recovery Act (RCRA) hazardous” are contained in Chapter 40 of the Code of Federal Regulations (40 CFR), §261. Waste that is classified as either “California hazardous” or “RCRA hazardous” requires management as a hazardous waste and disposal at an appropriately permitted disposal facility.

3.2.1 METALS

Waste is classified based in part on toxicity. For waste containing lead, the waste is classified as “California hazardous” when: (1) the total lead content exceeds 1,000 milligram/kilogram (mg/kg), the Total Threshold Limit Concentration (TTLC); or (2) the soluble lead content exceeds 5.0 milligrams/liter (mg/L), the Soluble Threshold Limit Concentration (STLC) based on the Waste Extraction Test (WET). A waste has the potential of exceeding the STLC when the waste’s total lead content is greater than or equal to ten times the STLC value, since the WET uses a 1:10 dilution ratio. When the total lead concentration is greater than or equal to 50 mg/kg (ten times the STLC, and assuming that 100 percent of the total lead is soluble), soluble lead analysis is performed.

Waste is classified as “RCRA hazardous” when the soluble lead content exceeds the Federal Regulatory Level of 5.0 mg/L, based on the Toxicity Characteristic Leaching Procedure (TCLP). The WET and TCLP methodologies are similar; the WET method uses a citric acid extractant applied for 48 hours, whereas the TCLP uses an acetic acid extractant applied for 18 hours, and the TCLP uses a 20:1 dilution.

A similar procedure is used to classify waste containing other metals. TTLCs and STLCs for the CAM 17 metals analyzed are summarized in Table 1 (Appendix B).

3.2.2 CORROSIVITY

The above regulatory criteria are based on toxicity. Waste may also be classified as hazardous based on other criteria such as ignitability, corrosivity, and reactivity. For the purposes of this investigation, toxicity and corrosivity (i.e. chemical concentrations and soil pH values, respectively) are the primary factors considered for waste classification. Soil with a pH less than 2.5 or greater than 12 are classified as hazardous.

3.2.3 PETROLEUM HYDROCARBONS

Except for a few specific volatile organic compounds, hazardous waste limits based on specific concentrations of petroleum hydrocarbons have not been established. In cases involving unauthorized release of petroleum hydrocarbons to the environment, laboratory results are generally evaluated against clean-up levels established by governmental environmental oversight agencies. Applicable screening levels are summarized in Table 2 (Appendix B).

3.3 ANALYTICAL LABORATORY RESULTS

CAM 17 metals analytical results are summarized in Table 1, and petroleum hydrocarbon and soil pH analytical results are summarized in Table 2 (both tables are included in Appendix B).

The BC Laboratories, Inc. report and COC documentation are included in Appendix C. Refer to the laboratory report for analytical methods and reporting limits.

3.3.1 METALS ANALYSES

All metals analytical results are below their respective TTLC. Sample HA-21-004B contains a total chromium concentration that exceeds the threshold requiring analysis for soluble chromium. Sample HA-21-006A contained a total lead concentration that exceeds the threshold requiring additional analysis for soluble lead. Both samples were therefore further analyzed using both the WET and TCLP procedures.

Soluble chromium concentrations in HA-21-004B are below the STLC (WET procedure) and the Federal Regulatory Level (TCPL procedure). Soluble lead concentrations in in HA-21-006A are also below STLC (WET procedure) and the Federal Regulatory Level (TCPL procedure). Further analysis of metals content in the soil does not appear warranted.

3.3.2 CORROSION

Three soil samples were analyzed for pH. Results range from 6.09 to 8.59, within the range considered non-corrosive with respect to hazardous waste classification (<2.5 or >12). Further analysis of soil with respect to pH does not appear warranted.

3.3.3 PETROLEUM HYDROCARBONS

Total Petroleum Hydrocarbons as gasoline (TPHg, carbon range C4 to C14) – TPHg concentrations in all samples are below the method detection limit. Further assessment for TPHg does not appear warranted.

Total Petroleum Hydrocarbons as diesel (TPHd, carbons range C12 to C23) – Compounds eluting in the diesel range were reported in 16 of the soil samples analyzed, at concentrations ranging from 18 to 84 mg/kg. The laboratory noted in all cases that the chromatograms are not typical of diesel. The analytical procedure used for TPHd is not compound-specific; it appears that non-petroleum compounds in the samples may be eluting in the TPHd range. Further assessment for TPHd does not appear warranted.

Total Petroleum Hydrocarbons as motor oil (TPHmo, carbons range C23 to C32) – Compounds eluting in the motor oil range were reported in all soil samples analyzed, at concentrations ranging from 22 to 900 mg/kg. The laboratory noted in all cases that the chromatograms are not typical of motor oil. The analytical procedure used for TPHmo is not compound-specific; it appears that non-petroleum compounds in the samples may be eluting in the TPHmo range. Further assessment for TPHmo does not appear warranted.

Volatile Organic Compounds (VOCs) – Each sample was analyzed for 63 specific compounds, including gasoline constituents benzene, toluene, ethylbenzene and xylenes, and oxygenating compounds (including methyl t-butyl ether, or MTBE). Toluene is reported in 16 samples, at concentrations ranging from 0.0011 to 0.0093 mg/kg; no other VOC compounds are reported in any of the samples. The absence of TPHg and other VOC compounds suggests the toluene is from a non-motor vehicle source. Toluene concentrations are all several orders of magnitude below the San Francisco Bay Regional Water Quality Control Board's Tier 1 Screening Level[1] for toluene of 2.9 mg/kg. Further assessment of VOCs in soil does not appear warranted.

[1] San Francisco Bay Regional Water Quality Control Board, Environmental Screening Levels, Tier 1 ESLs, Rev. 3

4 FINDINGS AND RECOMMENDATIONS

Based on analytical data from soil samples collected from the project alignment on October 6 and 7, 2021, Crawford makes the following findings.

- Metals concentrations do not exceed hazardous waste thresholds.
- Soil pH values do not exceed hazardous waste thresholds.
- TPHg is not reported in any of the soil samples.
- Compounds reported as TPHd and TPHmo do not appear related to motor vehicle use within the alignment.
- Toluene concentrations are below the environmental screening level. No other VOC compounds were reported in the soil samples. Based on the absence of other VOCs and TPHg in soil samples, the toluene does not appear related to motor vehicle use within the project alignment.

5 RECOMMENDATIONS

Based on the finding presented above, Crawford makes the following recommendations:

- No further assessment with respect to metals, soil pH, or motor vehicle fuel hydrocarbons within the project alignment is warranted.
- Based on the analytical data presented in this report, it appears that soil excavated within the project alignment as part of this project may be reused within the project alignment without restriction.

6 LIMITATIONS

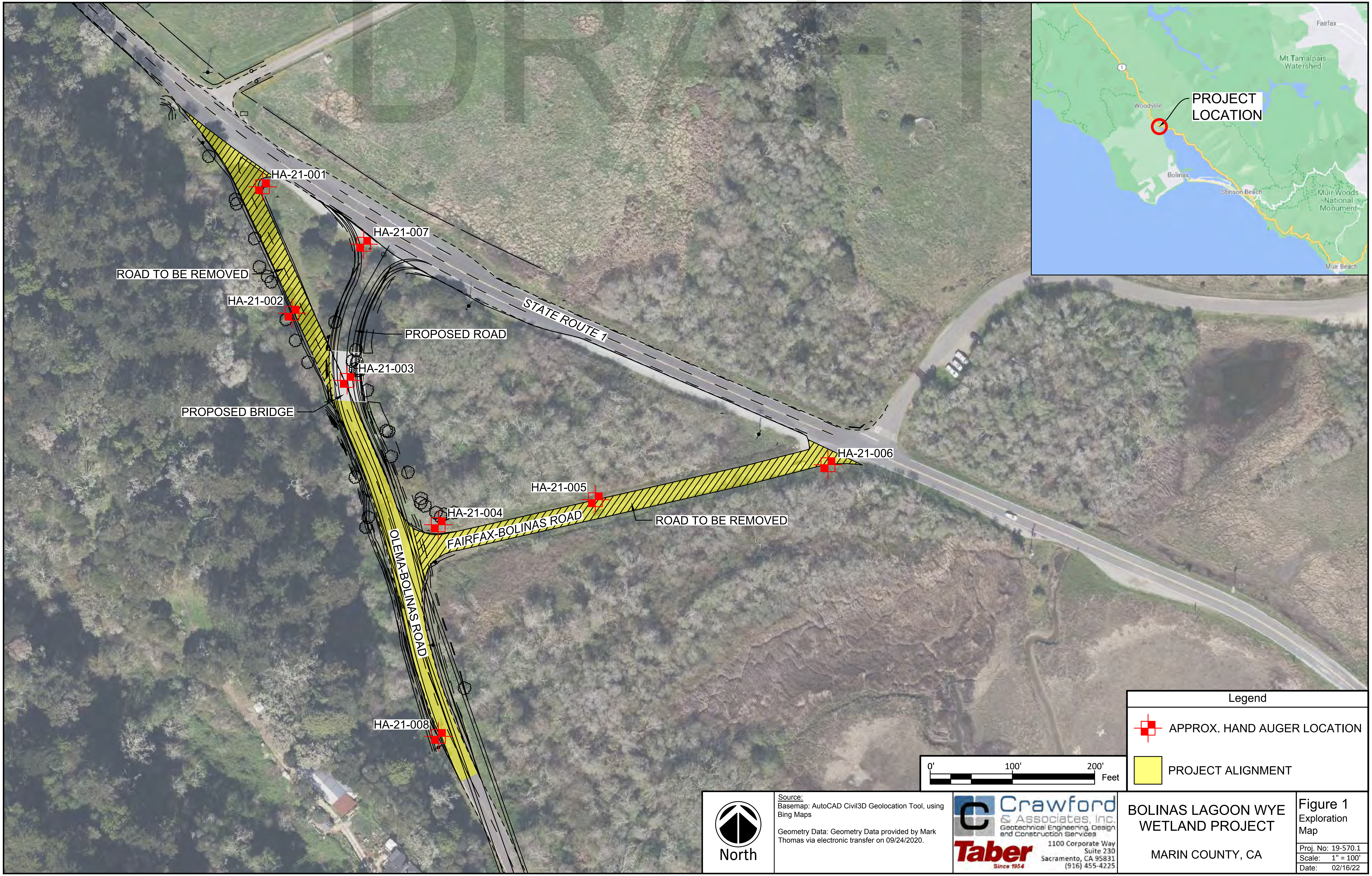
This report summarizes the findings and opinions of Crawford, with regard to the potential for the presence of contamination/hazardous materials within the project alignment at concentrations likely to warrant mitigation under current statutes and guidelines. Analytical results reported in this study are specific to discrete locations and depths. Concentrations may vary depending on sample location or depth. Findings and opinions within this report are based on information obtained on given dates, or provided by specified individuals, through record reviews, site review, and related activities. Crawford's information is only as good as the information provided by these sources. Site conditions may change after documented observations have been made. A warranty or guarantee cannot be made that hazardous materials do not exist at the site. To further help reduce risk, an extensive invasive exploration could be completed prior to project implementation.

This report was prepared for the specific use of WRA, MCOSD, and their agents for this project, and applies only to the area identified as the project alignment. Crawford is not responsible for interpretations by others of data presented in this report. This report does not represent a legal opinion. No warranty is expressed or implied. Conclusions in this report are based on professional judgment and experience. Work for this assessment was performed in accordance with generally accepted standards of practice in northern California at the time of the assessment.

(dated February 2016).

APPENDIX A

Figure 1. Exploration Map



Source:
Basemap: AutoCAD Civil3D Geolocation Tool, using Bing Maps

Geometry Data: Geometry Data provided by Mark Thomas via electronic transfer on 09/24/2020.

Crawford & Associates, Inc.
Geotechnical Engineering Design and Construction Services

Taber Since 1954

1100 Corporate Way
Suite 230
Sacramento, CA 95831
(916) 455-4225

BOLINAS LAGOON WYE WETLAND PROJECT

MARIN COUNTY, CA

Figure 1
Exploration Map

Proj. No: 19-570.1
Scale: 1" = 100'
Date: 02/16/22

APPENDIX B

Analytical Summary Tables

Table 1. Summary of Analytical Results – Metals

Table 2. Summary of Analytical Results – Organic Compounds

Table 2 - Summary of Analytical Results - Hydrocarbons and Soil pH

MCOSD Bolinas Lagoon Wye Wetlands Project

Sampled - October 6 and 7, 2021

Sample ID	Toluene** (mg/kg)	TPHg (mg/kg)	TPHd (mg/kg)	TPHmo (mg/kg)	pH
HA-21-001A	<0.00069	<0.058	28 *†	160 *‡	6.09
HA-21-001B	<0.00069	<0.058	27 *†	110 *‡	---
HA-21-001C	<0.00069	<0.058	<2.2	49 ‡	---
HA-21-002A	0.0011 J	<0.058	59 *†	430 *‡	---
HA-21-002B	0.0014 J	<0.058	84 *†	900 *‡	---
HA-21-002C	0.0016 J	<0.058	26 *†	160 *‡	---
HA-21-003A	0.0011 J	<0.058	55 *†	490 *‡	---
HA-21-003B	0.0011 J	<0.058	38 J*†	170 *‡	---
HA-21-003C	0.0029 J	<0.058	<2.2	22 ‡	---
HA-21-004A	0.0012 J	<0.058	54 *†	330 *‡	---
HA-21-004B	0.0029 J	<0.058	61 *†	420 *‡	---
HA-21-004C	0.0033 J	<0.058	<2.2	44 ‡	---
HA-21-005A	<0.00069	<0.058	56 *†	290 *‡	6.11
HA-21-005B	<0.00069	<0.058	60 *†	370 *‡	---
HA-21-005C	0.0054	<0.058	52 *†	200 *‡	---
HA-21-006A	<0.00069	<0.058	65 *†	460 *‡	---
HA-21-006B	<0.00069	<0.058	50 *†	270 *‡	---
HA-21-006C	<0.00069	<0.058	<2.2	42 ‡	---
HA-21-007A	0.0093	<0.058	18 J*†	80 *‡	8.59
HA-21-007B	0.0025 J	<0.058	<2.2	38 ‡	---
HA-21-007C	0.0017 J	<0.058	<2.2	8.1 J‡	---
HA-21-008A	0.0050	<0.058	20 *†	100 *‡	---
HA-21-008B	0.0080	<0.058	<11 *	360 *‡	---
HA-21-008C	0.0047 J	<0.058	<4.4 *	29 J*‡	---
TTLC / STLC	NA	NA	NA	NA	Haz. Waste Limits <2.5 or >12
Screening level #	3.2	100	260	1,600	

Explanation

TPHg - Total Petroleum Hydrocarbons as gasoline (C4-C14)

TPHd - Total Petroleum Hydrocarbons as diesel (C12-C23)

TPHmo - Total Petroleum Hydrocarbons as motor oil (C23-C32)

mg/kg = milligrams/kilogram

mg/L = milligrams/liter

TTLC - Total Threshold Limit Concentration

STLC - Soluble Threshold Limit Concentration

J - estimated value

† Laboratory notes chromatogram not typical of diesel.

‡ Laboratory notes chromatogram not typical of motor oil.

* Laboratory notes the detection and quantitation limits were raised due to matrix interference.

** All other Volatile Organic Compounds (VOCs) were below reporting limits.

--- = sample not analyzed for this analyte.

NA = not applicable

https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.html, dated July 25, 2019.

Table 1 - Summary of Analytical Results - Metals
MCOSD Bolinas Lagoon Wye Wetlands Project
Sampled - October 6 and 7, 2021

Sample ID	Total Antimony (mg/kg)	Total Arsenic (mg/kg)	Total Barium (mg/kg)	Total Beryllium (mg/kg)	Total Cadmium (mg/kg)	Total Chromium (mg/kg)	Total Cobalt (mg/kg)	Total Copper (mg/kg)	Total Lead (mg/kg)	Total Mercury (mg/kg)	Total Molybdenum (mg/kg)	Total Nickel (mg/kg)	Total Selenium (mg/kg)	Total Silver (mg/kg)	Total Thallium (mg/kg)	Total Vanadium (mg/kg)	Total Zinc (mg/kg)
HA-21-001A	1.3 J	6.2	67	0.36 J	0.43 J	39	7.4	22	26	0.075 J	0.37 J	42	<1.0	0.073 J	<5.0	28	70
HA-21-001B	1.0 J	6.0	69	0.36 J	0.38 J	43	7.3	19	14	0.068 J	0.46 J	43	<0.98	<0.067	<0.64	28	57
HA-21-001C	1.4 J	8.4	73	0.40 J	0.39 J	45	8.1	20	9.4	0.067 J	0.48 J	49	<0.98	<0.067	<0.64	31	50
HA-21-002A	0.78 J	7.2	80	0.33 J	0.44 J	37	7.7	22	19	0.052 J	0.48 J	36	<0.98	<0.067	<0.64	31	67
HA-21-002B	0.56 J	6.0	73	0.36 J	0.42 J	39	7.7	19	18	0.061 J	0.43 J	39	<0.98	<0.067	<0.64	31	57
HA-21-002C	1.0 J	6.9	92	0.42 J	0.32 J	42	7.9	19	8.3	0.033 J	0.54 J	41	<0.98	<0.067	<0.64	31	46
HA-21-003A	0.94 J	6.6	66	0.34 J	0.34 J	37	8.5	20	28	0.24	0.47 J	38	<0.98	<0.067	<0.64	30	54
HA-21-003B	0.96 J	6.3	74	0.36 J	0.37 J	40	8.7	20	21	0.089 J	0.44 J	41	<0.98	<0.067	<0.64	32	54
HA-21-003C	1.5 J	9.2	63	0.41 J	0.37 J	45	10	21	9.9	0.041 J	0.16 J	42	<0.98	<0.067	<0.64	35	54
HA-21-004A	0.81 J	11	74	0.33 J	0.47 J	40	8.8	30	45	0.054 J	0.38 J	41	<0.98	<0.067	<0.64	32	90
HA-21-004B	1.4 J	5.7	65	0.33 J	0.33 J	54 †	7.4	19	25	0.082 J	0.68 J	49	<0.98	<0.067	<0.64	29	66
HA-21-004C	0.65 J	8.2	59	0.38 J	0.36 J	46	9.1	20	9.6	0.16	0.36 J	43	<0.98	<0.067	<0.64	32	51
HA-21-005A	0.56 J	6.8	62	0.30 J	0.33 J	30	8.7	18	23	0.033 J	0.32 J	40	<0.98	<0.067	<0.64	26	79
HA-21-005B	1.0 J	10	77	0.39 J	0.31 J	34	8.4	18	10	0.046 J	0.30 J	39	<0.98	<0.067	<0.64	28	42
HA-21-005C	0.84 J	4.9	76	0.38 J	0.34 J	42	8.4	22	8.7	0.046 J	0.38 J	45	<0.98	<0.067	<0.64	29	44
HA-21-006A	0.94 J	16	70	0.40 J	0.54	35	9.0	43	95 ‡	0.13 J	0.80 J	36	<0.98	0.12 J	<0.64	27	90
HA-21-006B	0.93 J	19	67	0.41 J	0.38 J	33	8.7	41	35	1.7	0.62 J	33	<0.98	0.083 J	<0.64	27	59
HA-21-006C	0.91 J	12	63	0.42 J	0.36 J	35	9.0	37	25	<0.016	0.49 J	33	<0.98	<0.067	<0.64	28	56
HA-21-007A	0.41 J	3.3	38	0.42 J	0.15 J	21	6.6	11	5.0	0.022 J	0.20 J	25	<0.85	<0.058	<0.56	24	30
HA-21-007B	1.4 J	8.1	60	0.42 J	0.36 J	37	8.6	20	16	0.019 J	0.46 J	35	<0.87	<0.059	<0.57	34	58
HA-21-007C	1.1 J	5.4	76	0.45 J	0.39 J	43	9.3	21	7.9	<0.016	0.18 J	48	<0.98	<0.067	<0.64	41	61
HA-21-008A	1.3 J	15	54	0.34 J	0.41 J	44	9.1	24	14	<0.016	0.34 J	48	<0.98	<0.067	<0.64	28	50
HA-21-008B	0.86 J	17	63	0.35 J	0.44 J	42	9.1	25	26	<0.016	0.55 J	45	<0.98	<0.067	<0.64	28	53
HA-21-008C	<0.33	7.6	54	0.28 J	0.31 J	35	6.9	13	10	0.087 J	0.37 J	36	<0.98	<0.067	<0.64	22	40
TTLC (mg/kg)	500	50	10,000	75	100	2,500	8,000	2,500	1,000	20	3,500	2,000	100	500	700	2,400	5,000
STLC (mg/L)	15	5	100	0.75	1	5	80	25	5	0.2	350	20	1	5	7	24	250

Explanation

† Soluble chromium reported as 0.20 mg/L (WET) and <0.0075 mg/L (TCLP)
‡ Soluble lead reported as 3.5 mg/L (WET) and <0.030 mg/L (TCLP)
mg/kg = milligrams/kilogram
mg/L = milligrams/liter
J = estimated value
TTLC = Total Threshold Limit Concentration
STLC = Soluble Threshold Limit Concentration
WET = Waste Extraction Test
TCLP = Threshold Concentration Limit Procedure

APPENDIX C

BC Laboratories, Inc. Report
Dated October 29, 2021

Date of Report: 10/29/2021

Steve Carter

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Client Project:	19-570.1 PSA
BCL Project:	Solid Samples
BCL Work Order:	2131909
Invoice ID:	B432122, B432920

Enclosed are the results of analyses for samples received by the laboratory on 10/9/2021. If you have any questions concerning this report, please feel free to contact me.

Revised Report: This report supercedes Report ID 1001234003

Sincerely,

Contact Person: Vanessa Sandoval
Client Service Rep

Stuart Buttram
Technical Director

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Chain of Custody and Cooler Receipt Form for 2131909 Page 1 of 7

1 of 3

BC LABORATORIES

4100 Atlas Court Bakersfield, Ca. 93308
(661) 327-4911 • FAX (661) 327-1918 • www.bclabs.com

Chain of Custody

* Required Fields 21-31909

TEMP: ______

Client/Company Name *:	Report Attention *:	Phone * #: (916) 813-8778 FAX * #:
Crawford & Associates, Inc.	Steve Carter	E-mail: steve.carter@crawford-inc.com

Address *: 1100 Corporate Way Suite 230 City *: Sacramento State *: CA Zip *: 95831

Project Information: 21-731.1 Bolinas ISA Scope
PO #:
BCL Quote #:

How would you like your completed results sent? [x] E-Mail [ ] Fax [ ] EDD [ ] Mail Only

Sampler Name Printed / Signature: Maria Ayala

QC Request: [x] STD [ ] Level II

Result Request ** Surcharge: [x] STD [ ] 5 Day** [ ] 2 Day** [ ] 1 Day**

Carbon Copies: CDHS [ ] Fresno Co [ ] EPA [ ] Merced Co [ ] Tulare Co [ ] Other:

Regulatory Compliance
Electronic Data Transfer: Y [ ] N [ ]
System No. *

Matrix Types: RSW = Raw Surface Water; RGW = Raw Ground Water; CFW = Chlorinated Finished Water; FW = Finished Water; CWW = Chlorinated Waste Water; WW = Waste Water; SW = Storm Water; BW = Bottled Water; DW = Drinking Water; SO = Solid

ANALYSIS REQUESTED: HOLD

Sample #	# Bottles	Sampled Date	Sampled Time	Sample Description / Location *	Matrix *	Comments / Station Code	HOLD
-1		10/5/21	840am	HA-21-001A	SO		X
-2		10/5/21	850am	HA-21-001B	↓		↓
-3		10/5/21	905am	HA-21-001C	↓		↓
-4		10/6/21	1000	HA-21-002A	↓		↓
-5		10/6/21	1010	HA-21-002B	↓		↓
-6		10/6/21	1025	HA-21-002C	↓		↓
-7		10/6/21	1115	HA-21-003A	↓		↓
-8		10/6/21	1155	HA-21-003B	↓		↓
-9		10/6/21	1245pm	HA-21-003C	↓		↓
-10		10/6/21	124pm	HA-21-004A	↓		↓
-11		10/6/21	140pm	HA-21-004B	↓		↓

CHK BY [signature] DISTRIBUTION [handwritten initials] SUB-OUT [ ]

Relinquished by: (Signature and Printed Name)	Company	Date	Time	Received by (Signature and Print Name)	Company
[signature] Mark Ellis	BCL	10/8/21	1602	[signature] Freddy Bueno 10/9/2021 850AM	
Relinquished by: (Signature and Printed Name)	Company	Date	Time	Received by (Signature and Print Name)	Company
Received for Lab by: (Signature and Printed Name)		Date	Time	Payment Received at Delivery: Date: Amount: Check/Cash/Card PIA # Init.	

Shipping Method: CAO UPS GSO WALK-IN SJVC FED EX OTHER

Cooling Method: WET BLUE NONE

Packing Material:

2 of 3

BC LABORATORIES

4100 Atlas Court Bakersfield, Ca. 93308
(661) 327-4911 • FAX (661) 327-1918 • www.bclabs.com

Chain of Custody

* Required Fields 21-31909

TEMP:

Client/Company Name *:	Report Attention *:	Phone * #:	FAX * #:
Crawford & Assoc.	Steve Carter	E-mail:	

Address * / City * State * Zip *

Project Information: PO # BCL Quote #

Carbon Copies: CDHS ☐ Fresno Co ☐ EPA ☐ Merced Co ☐ Tulare Co ☐ Other:

How would you like your completed results sent? ☐ E-Mail ☐ Fax ☐ EDD ☐ Mail Only

Regulatory Compliance Electronic Data Transfer: Y☐ N☐ System No. *

Sampler Name Printed / Signature

QC Request ☐ STD ☐ Level II

Result Request ** Surcharge ☐ STD ☐ 5 Day** ☐ 2 Day** ☐ 1 Day**

Matrix Types: RSW = Raw Surface Water CFW = Clorinated Finished Water CWW = Chorinated Waste Water BW = Bottled Water RGW = Raw Ground Water FW = Finished Water WW = Waste Water SW = Storm Water DW = Drinking Water SO = Solid

ANALYSIS REQUESTED

Sample #	# Bottles	Sampled Date	Sampled Time	Sample Description / Location *	Matrix *	Comments / Station Code	Hold								
-12		10/6/21	237	HA-21-004C	SO		X								
-13		10/6/21	310	HA-21-005A	↓		↓								
-14		10/6/21	320	HA-21-005B											
-15		10/6/21	330	HA-21-005C											
-16		10/7/21	852am	HA-21-006A											
-17		10/7/21	850	HA-21-006B											
-18		10/7/21	919	HA-21-006C											
-19		10/7/21	955	HA-21-007A											
-20		10/7/21	1019	HA-21-007B											
-21		10/7/21	1030	HA-21-007C											
-22		10/7/21	1100	HA-21-008A	↓		↓								

Relinquished by: (Signature and Printed Name)	Company	Date	Time	Received by (Signature and Print Name)	Company
[signature] Maubt Ellie	BCL	10/9/21	1602	[signature] FREDDY BUENO 10/9/2021 850 AM	
Relinquished by: (Signature and Printed Name)	Company	Date	Time	Received by (Signature and Print Name)	Company
Received for Lab by: (Signature and Printed Name)		Date	Time	Payment Received at Delivery: Date: Amount: Check/Cash/Card PIA # Init.	

Shipping Method: CAO UPS GSO WALK-IN SJVC FED EX OTHER

Cooling Method: WET BLUE NONE

Packing Material:

3 of 3

BC LABORATORIES

4100 Atlas Court Bakersfield, Ca. 93308
(661) 327-4911 • FAX (661) 327-1918 • www.bclabs.com

Chain of Custody

* Required Fields 21-31909

TEMP: RUSH!!

Client/Company Name *: Crawford & Associates
Report Attention *: Steve Carter
Phone * #: FAX * #:
E-mail:
Address * City * State * Zip *
Project Information: PO # BCL Quote #
How would you like your completed results sent? ☐ E-Mail ☐ Fax ☐ EDD ☐ Mail Only
Sampler Name Printed / Signature
QC Request ☐ STD ☐ Level II
Result Request ** Surcharge ☐ STD ☐ 5 Day** ☐ 2 Day** ☐ 1 Day**
Carbon Copies: CDHS ☐ Fresno Co ☐ EPA ☐ Merced Co ☐ Tulare Co ☐ Other:
Regulatory Compliance Electronic Data Transfer: Y ☐ N ☐ System No. *

Matrix Types: RSW = Raw Surface Water CFW = Clorinated Finished Water CWW = Chorinated Waste Water DW = Bottled Water RGW = Raw Ground Water FW = Finished Water WW = Waste Water SW = Storm Water DW = Drinking Water SO = Solid

ANALYSIS REQUESTED

Sample #	# Bottles	Sampled Date	Sampled Time	Sample Description / Location *	Matrix *	Comments / Station Code	HOLD
-23		10/7/21	1108	HA-21-008B	SO		X
-24		10/7/21	1115	HA-21-008C	↓		X

Relinquished by: (Signature and Printed Name)	Company	Date	Time	Received by (Signature and Print Name)	Company
[signature] Maribel Muñoz	BCL	10/9/21	1602		
Relinquished by: (Signature and Printed Name)	Company	Date	Time	Received by (Signature and Print Name)	Company
Received for Lab by: (Signature and Printed Name)		Date	Time	Payment Received at Delivery: Date: Amount: Check/Cash/Card PIA # Init.	

Shipping Method: CAO UPS GSO WALK-IN SJVC FED EX OTHER
Cooling Method: WET BLUE NONE
Packing Material:

SR-FL-0012-03

Chain of Custody and Cooler Receipt Form for 2131909 Page 4 of 7

21- 31909

- Total lead
- pH
- hydrocarbons (gasoline and diesal)
- CAM 17 metals
- Petroleum hydrocarbons

10/6/21 2:37pm HA-21-004C
10/6/21 3:20pm HA-21-005B
10/6/21 310pm HA-21-005A
10/6/21 330pm HA-21-005C

Chain of Custody and Cooler Receipt Form for 2131909 Page 5 of 7

BC LABORATORIES INC. COOLER RECEIPT FORM Page 1 Of 3

Submission #: 21-31909

SHIPPING INFORMATION
Fed Ex ☐ UPS ☐ GSO / GLS ☒ Hand Delivery ☐
BC Lab Field Service ☐ Other ☐ (Specify)______

SHIPPING CONTAINER
Ice Chest ☒ None ☐ Box ☐
Other ☐ (Specify)______

FREE LIQUID
YES ☒ NO ☐
W / (S)

Refrigerant: Ice ☒ Blue Ice ☐ None ☐ Other ☐ Comments:

Custody Seals: Ice Chest ☐ Intact? Yes ☐ No ☐ | Containers ☐ Intact? Yes ☐ No ☐ | None ☒ Comments:

All samples received? Yes ☒ No ☐ All samples containers intact? Yes ☒ No ☐ Description(s) match COC? Yes ☒ No ☐

COC Received ☒ YES ☐ NO

Emissivity: 0.30 Container: Soil Sleeve Thermometer ID: 208
Temperature: (A) 2.4 °C / (C) 2.4 °C

Date/Time 10/9/2021 8:50
Analyst Init FB

SAMPLE CONTAINERS	1	2	3	4	5	6	7	8	9	10
QT PE UNPRES										
4oz / 8oz / 16oz PE UNPRES										
2oz Cr^{+6}										
QT INORGANIC CHEMICAL METALS										
INORGANIC CHEMICAL METALS 4oz / 8oz / 16oz										
PT CYANIDE										
PT NITROGEN FORMS										
PT TOTAL SULFIDE										
2oz. NITRATE / NITRITE										
PT TOTAL ORGANIC CARBON										
PT CHEMICAL OXYGEN DEMAND										
PtA PHENOLICS										
40ml VOA VIAL TRAVEL BLANK										
40ml VOA VIAL										
QT EPA 1664B										
PT ODOR										
RADIOLOGICAL										
BACTERIOLOGICAL										
40 ml VOA VIAL- 504										
QT EPA 508/608.3/8081A										
QT EPA 515.1/8151A										
QT EPA 525.2										
QT EPA 525.2 TRAVEL BLANK										
40ml EPA 547										
40ml EPA 531.1										
8oz EPA 548.1										
QT EPA 549.2										
QT EPA 8015M										
QT EPA 8270C										
8oz / 16oz / 32oz AMBER										
8oz / 16oz / 32oz JAR										
SOIL SLEEVE A1.	A	A	A	A	A	A	A	A	A	A
PCB VIAL										
PLASTIC BAG										
TEDLAR BAG										
FERROUS IRON										
ENCORE										
SMART KIT										
SUMMA CANISTER										

Comments:______
Sample Numbering Completed By: CAB Date/Time: 10/11/21 0348
A = Actual / C = Corrected

Rev 22 04/13/21
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BC LABORATORIES INC. COOLER RECEIPT FORM Page 2 Of 3

Submission #: 21-31909

SHIPPING INFORMATION
Fed Ex ☐ UPS ☐ GSO / GLS ☒ Hand Delivery ☐
BC Lab Field Service ☐ Other ☐ (Specify)

SHIPPING CONTAINER
Ice Chest ☒ None ☐ Box ☐
Other ☐ (Specify)

FREE LIQUID
YES ☒ NO ☐
W / (S)

Refrigerant: Ice ☒ Blue Ice ☐ None ☐ Other ☐ Comments:

Custody Seals: Ice Chest ☐ Intact? Yes ☐ No ☐ | Containers ☐ Intact? Yes ☐ No ☐ | None ☒ Comments:

All samples received? Yes ☒ No ☐ All samples containers intact? Yes ☒ No ☐ Description(s) match COC? Yes ☒ No ☐

COC Received ☒ YES ☐ NO

Emissivity: 0.30 Container: Soil sleeve Thermometer ID: 208 Date/Time 10/9/2021 850AM

Temperature: (A) 2.4 °C / (C) 2.4 °C Analyst Init FB

SAMPLE CONTAINERS	SAMPLE NUMBERS 20									
	1	2	3	4	5	6	7	8	9	10
QT PE UNPRES										
4oz / 8oz / 16oz PE UNPRES										
2oz Cr^{+6}										
QT INORGANIC CHEMICAL METALS										
INORGANIC CHEMICAL METALS 4oz / 8oz / 16oz										
PT CYANIDE										
PT NITROGEN FORMS										
PT TOTAL SULFIDE										
2oz. NITRATE / NITRITE										
PT TOTAL ORGANIC CARBON										
PT CHEMICAL OXYGEN DEMAND										
PtA PHENOLICS										
40ml VOA VIAL TRAVEL BLANK										
40ml VOA VIAL										
QT EPA 1664B										
PT ODOR										
RADIOLOGICAL										
BACTERIOLOGICAL										
40 ml VOA VIAL- 504										
QT EPA 508/608.3/8081A										
QT EPA 515.1/8151A										
QT EPA 525.2										
QT EPA 525.2 TRAVEL BLANK										
40ml EPA 547										
40ml EPA 531.1										
8oz EPA 548.1										
QT EPA 549.2										
QT EPA 8015M										
QT EPA 8270C										
8oz / 16oz / 32oz AMBER										
8oz / 16oz / 32oz JAR										
SOIL SLEEVE A1	A	A	A	A	A	A	A	A	A	A
PCB VIAL										
PLASTIC BAG										
TEDLAR BAG										
FERROUS IRON										
ENCORE										
SMART KIT										
SUMMA CANISTER										

Comments:
Sample Numbering Completed By: CAG Date/Time: 10/11/21 0848
A = Actual / C = Corrected

Rev 22 04/13/21
[S:\WPDocs\WordPerfect\LAB_DOCS\FORMS\SAMREC rev 22]

BC LABORATORIES INC. COOLER RECEIPT FORM Page 3 Of 3

Submission #: 21-31909

SHIPPING INFORMATION
Fed Ex ☐ UPS ☐ GSO / GLS ☒ Hand Delivery ☐
BC Lab Field Service ☐ Other ☐ (Specify)________

SHIPPING CONTAINER
Ice Chest ☒ None ☐ Box ☐
Other ☐ (Specify)________

FREE LIQUID
YES ☒ NO ☐
W / (S)

Refrigerant: Ice ☒ Blue Ice ☐ None ☐ Other ☐ Comments:

Custody Seals: Ice Chest ☐ Intact? Yes ☐ No ☐ Containers ☐ Intact? Yes ☐ No ☐ None ☒ Comments:

All samples received? Yes ☒ No ☐ All samples containers intact? Yes ☒ No ☐ Description(s) match COC? Yes ☒ No ☐

COC Received ☒ YES ☐ NO

Emissivity: 0.30 Container: [illegible] Thermometer ID: 208 Date/Time 10/9/2021 850 am
Temperature: (A) 2.4 °C / (C) 2.4 °C Analyst Init FB

SAMPLE CONTAINERS	21	22	23	24	5	6	7	8	9	10
QT PE UNPRES										
4oz / 8oz / 16oz PE UNPRES										
2oz Cr^{+6}										
QT INORGANIC CHEMICAL METALS										
INORGANIC CHEMICAL METALS 4oz / 8oz / 16oz										
PT CYANIDE										
PT NITROGEN FORMS										
PT TOTAL SULFIDE										
2oz. NITRATE / NITRITE										
PT TOTAL ORGANIC CARBON										
PT CHEMICAL OXYGEN DEMAND										
PtA PHENOLICS										
40ml VOA VIAL TRAVEL BLANK										
40ml VOA VIAL										
QT EPA 1664B										
PT ODOR										
RADIOLOGICAL										
BACTERIOLOGICAL										
40 ml VOA VIAL- 504										
QT EPA 508/608.3/8081A										
QT EPA 515.1/8151A										
QT EPA 525.2										
QT EPA 525.2 TRAVEL BLANK										
40ml EPA 547										
40ml EPA 531.1										
8oz EPA 548.1										
QT EPA 549.2										
QT EPA 8015M										
QT EPA 8270C										
8oz / 16oz / 32oz AMBER										
8oz / 16oz / 32oz JAR										
SOIL SLEEVE Al.	A	A	A	A						
PCB VIAL										
PLASTIC BAG										
TEDLAR BAG										
FERROUS IRON										
ENCORE										
SMART KIT										
SUMMA CANISTER										

Comments:________
Sample Numbering Completed By: CMS Date/Time: 10/11/21 0844
A = Actual / C = Corrected

Rev 22 04/13/21
[S:\WPDoc\WordPerfect\LAB_DOCS\FORMS\SAMREC rev 38]

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
2131909-01	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/05/2021 08:40
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-001A	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-02	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/05/2021 08:50
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-001B	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-03	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/05/2021 09:05
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-001C	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-04	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 10:00
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-002A	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-05	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 10:10
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-002B	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-06	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 10:25
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-002C	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-07	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 11:15
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-003A	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
2131909-08	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 11:55
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-003B	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-09	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 12:45
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-003C	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-10	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 13:29
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-004A	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-11	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 13:40
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-004B	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-12	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 14:37
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-004C	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-13	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 15:10
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-005A	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-14	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 15:20
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-005B	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
2131909-15	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/06/2021 15:30
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-005C	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-16	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 08:52
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-006A	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-17	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 08:50
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-006B	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-18	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 09:19
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-006C	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-19	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 09:55
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-007A	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-20	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 10:19
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-007B	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-21	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 10:30
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-007C	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
2131909-22	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 11:00
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-008A	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-23	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 11:08
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-008B	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil
2131909-24	**COC Number:**	---	**Receive Date:**	10/09/2021 08:50
	Project Number:	---	**Sampling Date:**	10/07/2021 11:15
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	HA-21-008C	**Lab Matrix:**	Solids
	Sampled By:	Maria Ayala	**Sample Type:**	Soil

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-01 **Client Sample Name:** HA-21-001A, 10/5/2021 8:40:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-01 **Client Sample Name:** HA-21-001A, 10/5/2021 8:40:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	101	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	97.6	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-01 **Client Sample Name:** HA-21-001A, 10/5/2021 8:40:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	94.3	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 19:17	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-01 **Client Sample Name:** HA-21-001A, 10/5/2021 8:40:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**28**	**mg/kg**	**20**	**4.4**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**160**	**mg/kg**	**40**	**14**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	95.4	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 03:20	BUP	GC-2	2.027	B122535	EPA 3550B

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Chemical Analysis

BCL Sample ID: 2131909-01 | **Client Sample Name:** HA-21-001A, 10/5/2021 8:40:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
pH	**6.09**	**pH Units**	**0.05**	**0.05**	**EPA-9045D**	ND	**pH1:3**	1
pH Measurement Temperature	**21.7**	**C**	**0.1**	**0.1**	**EPA-9045D**	ND		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-9045D	10/20/21 11:35	10/20/21 11:35	JT3	MANUAL	1	B122803	EPA 9045

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-01 | **Client Sample Name:** HA-21-001A, 10/5/2021 8:40:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.3**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**6.2**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**67**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.36**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.43**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**39**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**7.4**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**22**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**26**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.075**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.37**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**42**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	**0.073**	**mg/kg**	**0.50**	**0.067**	**EPA-6010B**	500	**J**	1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**28**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**70**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:24	JCC	PE-OP3	1	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 13:57	TMT	CETAC3	0.977	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-02 **Client Sample Name:** HA-21-001B, 10/5/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-02 **Client Sample Name:** HA-21-001B, 10/5/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	98.3	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.2	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-02 **Client Sample Name:** HA-21-001B, 10/5/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	93.8	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 19:38	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-02 **Client Sample Name:** HA-21-001B, 10/5/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**27**	**mg/kg**	**20**	**4.4**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**110**	**mg/kg**	**40**	**14**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	115	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 03:43	BUP	GC-2	1.993	B122535	EPA 3550B

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-02 **Client Sample Name:** HA-21-001B, 10/5/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.0**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**6.0**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**69**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.36**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.38**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**43**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**7.3**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**19**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**14**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.068**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.46**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**43**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**28**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**57**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:35	JCC	PE-OP3	0.971	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:08	TMT	CETAC3	0.992	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-03 | **Client Sample Name:** HA-21-001C, 10/5/2021 9:05:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-03 **Client Sample Name:** HA-21-001C, 10/5/2021 9:05:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	99.5	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.7	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-03 **Client Sample Name:** HA-21-001C, 10/5/2021 9:05:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	93.1	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 20:00	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-03 | **Client Sample Name:** HA-21-001C, 10/5/2021 9:05:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	ND	mg/kg	10	2.2	EPA-8015B/FFP	ND		1
TPH - Motor Oil	**49**	**mg/kg**	**20**	**7.0**	**EPA-8015B/FFP**	ND	**A57**	1
Tetracosane (Surrogate)	102	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/15/21 08:42	BUP	GC-2	1.017	B122535	EPA 3550B

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-03 | **Client Sample Name:** HA-21-001C, 10/5/2021 9:05:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.4**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**8.4**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**73**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.40**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.39**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**45**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**8.1**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**20**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**9.4**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.067**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.48**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**49**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**31**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**50**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:41	JCC	PE-OP3	0.971	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:10	TMT	CETAC3	0.962	B122407	EPA 7471A

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Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-04 **Client Sample Name:** HA-21-002A, 10/6/2021 10:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-04 | **Client Sample Name:** HA-21-002A, 10/6/2021 10:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0011**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	100	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	97.5	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-04 **Client Sample Name:** HA-21-002A, 10/6/2021 10:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	89.2	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 20:21	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-04 | **Client Sample Name:** HA-21-002A, 10/6/2021 10:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**59**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**430**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	4.4	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 04:06	BUP	GC-2	5.051	B122535	EPA 3550B

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-04 **Client Sample Name:** HA-21-002A, 10/6/2021 10:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.78**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**7.2**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**80**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.33**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.44**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**37**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**7.7**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**22**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**19**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.052**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.48**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**36**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**31**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**67**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:43	JCC	PE-OP3	0.935	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:12	TMT	CETAC3	1.025	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-05 | **Client Sample Name:** HA-21-002B, 10/6/2021 10:10:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-05 **Client Sample Name:** HA-21-002B, 10/6/2021 10:10:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0014**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	103	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	96.7	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-05 **Client Sample Name:** HA-21-002B, 10/6/2021 10:10:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	85.7	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 20:43	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID:	2131909-05	**Client Sample Name:**	HA-21-002B, 10/6/2021 10:10:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**84**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**900**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	51.6	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 04:53	BUP	GC-2	5.068	B122535	EPA 3550B

Crawford & Associates, Inc.		
1100 Corporate Way, Suite 230	**Reported:**	10/29/2021 16:32
Sacramento, CA 95831	Project:	Solid Samples
	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-05 | **Client Sample Name:** HA-21-002B, 10/6/2021 10:10:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.56**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**6.0**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**73**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.36**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.42**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**39**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**7.7**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**19**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**18**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.061**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.43**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**39**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**31**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**57**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:44	JCC	PE-OP3	0.971	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:18	TMT	CETAC3	0.992	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-06 **Client Sample Name:** HA-21-002C, 10/6/2021 10:25:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

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Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-06 | **Client Sample Name:** HA-21-002C, 10/6/2021 10:25:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0016**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	98.5	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	99.4	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-06 | **Client Sample Name:** HA-21-002C, 10/6/2021 10:25:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	93.3	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 21:04	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-06 | **Client Sample Name:** HA-21-002C, 10/6/2021 10:25:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**26**	**mg/kg**	**20**	**4.4**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**160**	**mg/kg**	**40**	**14**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	92.0	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 05:16	BUP	GC-2	1.993	B122535	EPA 3550B

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-06 | **Client Sample Name:** HA-21-002C, 10/6/2021 10:25:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.0**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**6.9**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**92**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.42**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.32**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**42**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**7.9**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**19**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**8.3**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.033**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.54**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**41**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**31**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**46**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:46	JCC	PE-OP3	0.943	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:20	TMT	CETAC3	1.008	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-07 | **Client Sample Name:** HA-21-003A, 10/6/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-07 **Client Sample Name:** HA-21-003A, 10/6/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0011**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	95.4	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.6	%	81 - 117 (LCL - UCL)		EPA-8260B			1

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Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-07 **Client Sample Name:** HA-21-003A, 10/6/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	92.9	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 21:26	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-07 **Client Sample Name:** HA-21-003A, 10/6/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**55**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**490**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	20.8	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 05:39	BUP	GC-2	5.017	B122535	EPA 3550B

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-07 | **Client Sample Name:** HA-21-003A, 10/6/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.94**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**6.6**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**66**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.34**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.34**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**37**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**8.5**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**20**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**28**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.24**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20		2
Molybdenum	**0.47**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**38**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**30**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**54**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:48	JCC	PE-OP3	0.952	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:23	TMT	CETAC3	1.008	B122407	EPA 7471A

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-08 **Client Sample Name:** HA-21-003B, 10/6/2021 11:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-08 **Client Sample Name:** HA-21-003B, 10/6/2021 11:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0011**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	94.6	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.2	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-08 **Client Sample Name:** HA-21-003B, 10/6/2021 11:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	94.4	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 21:48	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-08 **Client Sample Name:** HA-21-003B, 10/6/2021 11:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**38**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**J,A10,A52**	1
TPH - Motor Oil	**170**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	29.7	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10,S09	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/15/21 07:09	BUP	GC-2	5.034	B122535	EPA 3550B

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1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-08 **Client Sample Name:** HA-21-003B, 10/6/2021 11:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.96**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**6.3**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**74**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.36**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.37**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**40**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**8.7**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**20**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**21**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.089**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.44**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**41**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**32**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**54**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:50	JCC	PE-OP3	0.980	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:25	TMT	CETAC3	1.008	B122407	EPA 7471A

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-09 **Client Sample Name:** HA-21-003C, 10/6/2021 12:45:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

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1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-09 **Client Sample Name:** HA-21-003C, 10/6/2021 12:45:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0029**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	97.4	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	99.4	%	81 - 117 (LCL - UCL)		EPA-8260B			1

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1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-09 **Client Sample Name:** HA-21-003C, 10/6/2021 12:45:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	94.1	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 22:09	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.
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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-09 | **Client Sample Name:** HA-21-003C, 10/6/2021 12:45:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	ND	mg/kg	10	2.2	EPA-8015B/FFP	ND		1
TPH - Motor Oil	**22**	**mg/kg**	**20**	**7.0**	**EPA-8015B/FFP**	ND	**A57**	1
Tetracosane (Surrogate)	99.5	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/15/21 08:19	BUP	GC-2	1.017	B122535	EPA 3550B

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-09 | **Client Sample Name:** HA-21-003C, 10/6/2021 12:45:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.5**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**9.2**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**63**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.41**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.37**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**45**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**10**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**21**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**9.9**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.041**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.16**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**42**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**35**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**54**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:52	JCC	PE-OP3	0.971	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:27	TMT	CETAC3	1.025	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-10 | **Client Sample Name:** HA-21-004A, 10/6/2021 1:29:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-10 **Client Sample Name:** HA-21-004A, 10/6/2021 1:29:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0012**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	97.5	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.7	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-10 **Client Sample Name:** HA-21-004A, 10/6/2021 1:29:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	92.7	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 22:31	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-10 **Client Sample Name:** HA-21-004A, 10/6/2021 1:29:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**54**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**330**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	51.0	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 06:26	BUP	GC-2	4.918	B122535	EPA 3550B

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1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-10 | **Client Sample Name:** HA-21-004A, 10/6/2021 1:29:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.81**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**11**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**74**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.33**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.47**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**40**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**8.8**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**30**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**45**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.054**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.38**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**41**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**32**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**90**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 12:54	JCC	PE-OP3	0.990	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:29	TMT	CETAC3	0.992	B122407	EPA 7471A

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Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-11 **Client Sample Name:** HA-21-004B, 10/6/2021 1:40:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
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Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-11 | **Client Sample Name:** HA-21-004B, 10/6/2021 1:40:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0029**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	97.1	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	97.2	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-11 **Client Sample Name:** HA-21-004B, 10/6/2021 1:40:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	88.4	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 22:52	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-11 | **Client Sample Name:** HA-21-004B, 10/6/2021 1:40:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**61**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**420**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	44.9	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 06:49	BUP	GC-2	5.017	B122535	EPA 3550B

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

WET Test (STLC)

BCL Sample ID: 2131909-11 | **Client Sample Name:** HA-21-004B, 10/6/2021 1:40:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	STLC Limits	Lab Quals	Run #
Chromium	**0.20**	**mg/L**	**0.10**	**0.0092**	**EPA-6010B**	5.0		1
Lead	**0.63**	**mg/L**	**0.50**	**0.13**	**EPA-6010B**	5.0		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/28/21 13:30	10/29/21 11:42	JCC	PE-OP3	1	B123668	EPA 3005A

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

TCLP Toxicity

BCL Sample ID: 2131909-11 **Client Sample Name:** HA-21-004B, 10/6/2021 1:40:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TCLP Limits	Lab Quals	Run #
Chromium	ND	mg/L	0.10	0.0075	EPA-6010B	5.0		1
Lead	ND	mg/L	0.50	0.030	EPA-6010B	5.0		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/26/21 13:40	10/27/21 21:31	AK1	PE-OP3	1	B123402	EPA 3050B

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-11 | **Client Sample Name:** HA-21-004B, 10/6/2021 1:40:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.4**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**5.7**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**65**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.33**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.33**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**54**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**7.4**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**19**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**25**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.082**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.68**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**49**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**29**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**66**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:00	JCC	PE-OP3	0.962	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:31	TMT	CETAC3	0.962	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-12 **Client Sample Name:** HA-21-004C, 10/6/2021 2:37:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

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Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-12 | **Client Sample Name:** HA-21-004C, 10/6/2021 2:37:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0033**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	93.7	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.5	%	81 - 117 (LCL - UCL)		EPA-8260B			1

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1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-12 | **Client Sample Name:** HA-21-004C, 10/6/2021 2:37:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	94.5	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 23:14	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-12 | **Client Sample Name:** HA-21-004C, 10/6/2021 2:37:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	ND	mg/kg	10	2.2	EPA-8015B/FFP	ND		1
TPH - Motor Oil	**44**	**mg/kg**	**20**	**7.0**	**EPA-8015B/FFP**	ND	**A57**	1
Tetracosane (Surrogate)	90.4	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/15/21 09:52	BUP	GC-2	0.984	B122535	EPA 3550B

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1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-12 | **Client Sample Name:** HA-21-004C, 10/6/2021 2:37:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.65**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**8.2**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**59**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.38**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.36**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**46**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**9.1**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**20**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**9.6**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.16**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20		2
Molybdenum	**0.36**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**43**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**32**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**51**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:01	JCC	PE-OP3	0.917	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:33	TMT	CETAC3	0.977	B122407	EPA 7471A

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-13 | **Client Sample Name:** HA-21-005A, 10/6/2021 3:10:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

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Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-13 **Client Sample Name:** HA-21-005A, 10/6/2021 3:10:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	97.3	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	95.6	%	81 - 117 (LCL - UCL)		EPA-8260B			1

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Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-13 **Client Sample Name:** HA-21-005A, 10/6/2021 3:10:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	88.1	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 23:35	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-13 | **Client Sample Name:** HA-21-005A, 10/6/2021 3:10:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**56**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**290**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	21.7	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10,S09	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 07:13	BUP	GC-2	5.068	B122535	EPA 3550B

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Chemical Analysis

BCL Sample ID: 2131909-13 **Client Sample Name:** HA-21-005A, 10/6/2021 3:10:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
pH	**6.11**	**pH Units**	**0.05**	**0.05**	**EPA-9045D**	ND	**pH1:3**	1
pH Measurement Temperature	**21.6**	**C**	**0.1**	**0.1**	**EPA-9045D**	ND		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-9045D	10/20/21 11:35	10/20/21 11:35	JT3	MANUAL	1	B122803	EPA 9045

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
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Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-13 **Client Sample Name:** HA-21-005A, 10/6/2021 3:10:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.56**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**6.8**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**62**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.30**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.33**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**30**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**8.7**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**18**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**23**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.033**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.32**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**40**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**26**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**79**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:03	JCC	PE-OP3	0.980	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:35	TMT	CETAC3	1.025	B122407	EPA 7471A

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-14 **Client Sample Name:** HA-21-005B, 10/6/2021 3:20:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-14 **Client Sample Name:** HA-21-005B, 10/6/2021 3:20:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	100	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	97.2	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.	**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-14 **Client Sample Name:** HA-21-005B, 10/6/2021 3:20:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	89.2	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/13/21 23:57	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-14 | **Client Sample Name:** HA-21-005B, 10/6/2021 3:20:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**60**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**370**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	14.0	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 08:22	BUP	GC-2	5	B122535	EPA 3550B

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-14 **Client Sample Name:** HA-21-005B, 10/6/2021 3:20:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.0**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**10**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**77**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.39**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.31**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**34**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**8.4**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**18**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**10**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.046**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.30**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**39**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**28**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**42**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:05	JCC	PE-OP3	0.962	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:37	TMT	CETAC3	0.962	B122407	EPA 7471A

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Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-15 | **Client Sample Name:** HA-21-005C, 10/6/2021 3:30:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

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1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-15 | **Client Sample Name:** HA-21-005C, 10/6/2021 3:30:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0054**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	94.8	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.8	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.
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Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-15 **Client Sample Name:** HA-21-005C, 10/6/2021 3:30:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	96.3	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/14/21 00:18	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

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Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-15 | **Client Sample Name:** HA-21-005C, 10/6/2021 3:30:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**52**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**200**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	49.7	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 08:45	BUP	GC-2	4.918	B122535	EPA 3550B

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-15 | **Client Sample Name:** HA-21-005C, 10/6/2021 3:30:00PM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.84**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**4.9**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**76**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.38**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.34**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**42**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**8.4**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**22**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**8.7**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.046**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.38**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**45**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**29**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**44**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:07	JCC	PE-OP3	0.926	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:44	TMT	CETAC3	0.962	B122407	EPA 7471A

Crawford & Associates, Inc.
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Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-16 **Client Sample Name:** HA-21-006A, 10/7/2021 8:52:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

DRAFT

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-16 **Client Sample Name:** HA-21-006A, 10/7/2021 8:52:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	95.7	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	99.0	%	81 - 117 (LCL - UCL)		EPA-8260B			1

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Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-16 **Client Sample Name:** HA-21-006A, 10/7/2021 8:52:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	94.4	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/14/21 00:40	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-16 | **Client Sample Name:** HA-21-006A, 10/7/2021 8:52:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**65**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**460**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	62.1	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 09:32	BUP	GC-2	5.017	B122535	EPA 3550B

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

WET Test (STLC)

BCL Sample ID: 2131909-16 | **Client Sample Name:** HA-21-006A, 10/7/2021 8:52:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	STLC Limits	Lab Quals	Run #
Chromium	**0.16**	**mg/L**	**0.10**	**0.0092**	**EPA-6010B**	5.0		1
Lead	**3.5**	**mg/L**	**0.50**	**0.13**	**EPA-6010B**	5.0		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/28/21 13:30	10/29/21 11:44	JCC	PE-OP3	1	B123668	EPA 3005A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

TCLP Toxicity

BCL Sample ID: 2131909-16 | **Client Sample Name:** HA-21-006A, 10/7/2021 8:52:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TCLP Limits	Lab Quals	Run #
Chromium	ND	mg/L	0.10	0.0075	EPA-6010B	5.0		1
Lead	ND	mg/L	0.50	0.030	EPA-6010B	5.0		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/26/21 13:40	10/27/21 21:33	AK1	PE-OP3	1	B123402	EPA 3050B

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-16 | **Client Sample Name:** HA-21-006A, 10/7/2021 8:52:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.94**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**16**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**70**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.40**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.54**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100		1
Chromium	**35**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**9.0**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**43**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**95**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.13**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.80**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**36**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	**0.12**	**mg/kg**	**0.50**	**0.067**	**EPA-6010B**	500	**J**	1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**27**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**90**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:09	JCC	PE-OP3	0.943	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:46	TMT	CETAC3	0.992	B122407	EPA 7471A

Crawford & Associates, Inc.	
1100 Corporate Way, Suite 230	**Reported:** 10/29/2021 16:32
Sacramento, CA 95831	Project: Solid Samples
	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-17 **Client Sample Name:** HA-21-006B, 10/7/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-17 **Client Sample Name:** HA-21-006B, 10/7/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	95.1	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.6	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-17 | **Client Sample Name:** HA-21-006B, 10/7/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	92.5	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/14/21 01:01	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

BC Laboratories, Inc.
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Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-17 **Client Sample Name:** HA-21-006B, 10/7/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**50**	**mg/kg**	**50**	**11**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**270**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	57.3	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 09:55	BUP	GC-2	4.918	B122535	EPA 3550B

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-17 **Client Sample Name:** HA-21-006B, 10/7/2021 8:50:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.93**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**19**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**67**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.41**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.38**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**33**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**8.7**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**41**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**35**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**1.7**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20		2
Molybdenum	**0.62**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**33**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	**0.083**	**mg/kg**	**0.50**	**0.067**	**EPA-6010B**	500	**J**	1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**27**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**59**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:11	JCC	PE-OP3	0.935	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:51	TMT	CETAC3	0.992	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-18 **Client Sample Name:** HA-21-006C, 10/7/2021 9:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-18 **Client Sample Name:** HA-21-006C, 10/7/2021 9:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	93.5	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	99.1	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-18 **Client Sample Name:** HA-21-006C, 10/7/2021 9:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	96.1	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/14/21 01:23	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-18 **Client Sample Name:** HA-21-006C, 10/7/2021 9:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	ND	mg/kg	10	2.2	EPA-8015B/FFP	ND		1
TPH - Motor Oil	**42**	**mg/kg**	**20**	**7.0**	**EPA-8015B/FFP**	ND	**A57**	1
Tetracosane (Surrogate)	102	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/15/21 09:05	BUP	GC-2	0.987	B122535	EPA 3550B

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-18 | **Client Sample Name:** HA-21-006C, 10/7/2021 9:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.91**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**12**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**63**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.42**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.36**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**35**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**9.0**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**37**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**25**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	ND	mg/kg	0.16	0.016	EPA-7471A	20		2
Molybdenum	**0.49**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**33**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**28**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**56**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:13	JCC	PE-OP3	0.935	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:54	TMT	CETAC3	0.992	B122407	EPA 7471A

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-19 | **Client Sample Name:** HA-21-007A, 10/7/2021 9:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-19 **Client Sample Name:** HA-21-007A, 10/7/2021 9:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0093**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	90.9	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	99.5	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-19 | **Client Sample Name:** HA-21-007A, 10/7/2021 9:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	92.5	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/13/21 14:38	10/14/21 01:44	RCC	MS-V17	1	B122262	EPA 5030 Soil MS

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Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-19 | **Client Sample Name:** HA-21-007A, 10/7/2021 9:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**18**	**mg/kg**	**20**	**4.4**	**EPA-8015B/FFP**	ND	**J,A10,A52**	1
TPH - Motor Oil	**80**	**mg/kg**	**40**	**14**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	20.9	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/16/21 06:03	BUP	GC-2	1.993	B122535	EPA 3550B

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Chemical Analysis

BCL Sample ID: 2131909-19 **Client Sample Name:** HA-21-007A, 10/7/2021 9:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
pH	**8.59**	**pH Units**	**0.05**	**0.05**	**EPA-9045D**	ND	**pH1:3**	1
pH Measurement Temperature	**22.3**	**C**	**0.1**	**0.1**	**EPA-9045D**	ND		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-9045D	10/20/21 11:35	10/20/21 11:35	JT3	MANUAL	1	B122803	EPA 9045

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-19 **Client Sample Name:** HA-21-007A, 10/7/2021 9:55:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.41**	**mg/kg**	**4.3**	**0.29**	**EPA-6010B**	500	**J**	1
Arsenic	**3.3**	**mg/kg**	**0.87**	**0.35**	**EPA-6010B**	500		1
Barium	**38**	**mg/kg**	**0.43**	**0.16**	**EPA-6010B**	10000		1
Beryllium	**0.42**	**mg/kg**	**0.43**	**0.041**	**EPA-6010B**	75	**J**	1
Cadmium	**0.15**	**mg/kg**	**0.43**	**0.045**	**EPA-6010B**	100	**J**	1
Chromium	**21**	**mg/kg**	**0.43**	**0.043**	**EPA-6010B**	2500		1
Cobalt	**6.6**	**mg/kg**	**2.2**	**0.085**	**EPA-6010B**	8000		1
Copper	**11**	**mg/kg**	**0.87**	**0.043**	**EPA-6010B**	2500		1
Lead	**5.0**	**mg/kg**	**2.2**	**0.36**	**EPA-6010B**	1000		1
Mercury	**0.022**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.20**	**mg/kg**	**2.2**	**0.043**	**EPA-6010B**	3500	**J**	1
Nickel	**25**	**mg/kg**	**0.43**	**0.13**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	0.87	0.85	EPA-6010B	100		1
Silver	ND	mg/kg	0.43	0.058	EPA-6010B	500		1
Thallium	ND	mg/kg	4.3	0.56	EPA-6010B	700		1
Vanadium	**24**	**mg/kg**	**0.43**	**0.096**	**EPA-6010B**	2400		1
Zinc	**30**	**mg/kg**	**2.2**	**0.076**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:14	JCC	PE-OP3	0.870	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:56	TMT	CETAC3	0.977	B122407	EPA 7471A

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-20 **Client Sample Name:** HA-21-007B, 10/7/2021 10:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-20 **Client Sample Name:** HA-21-007B, 10/7/2021 10:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0025**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	94.5	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.5	%	81 - 117 (LCL - UCL)		EPA-8260B			1

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-20 **Client Sample Name:** HA-21-007B, 10/7/2021 10:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	97.4	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/14/21 07:45	10/14/21 16:22	RCC	MS-V17	1	B122300	EPA 5030 Soil MS

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-20 **Client Sample Name:** HA-21-007B, 10/7/2021 10:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	ND	mg/kg	10	2.2	EPA-8015B/FFP	ND		1
TPH - Motor Oil	**38**	**mg/kg**	**20**	**7.0**	**EPA-8015B/FFP**	ND	**A57**	1
Tetracosane (Surrogate)	95.8	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 08:15	10/15/21 09:29	BUP	GC-2	1.014	B122535	EPA 3550B

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-20 | **Client Sample Name:** HA-21-007B, 10/7/2021 10:19:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.4**	**mg/kg**	**4.4**	**0.29**	**EPA-6010B**	500	**J**	1
Arsenic	**8.1**	**mg/kg**	**0.88**	**0.35**	**EPA-6010B**	500		1
Barium	**60**	**mg/kg**	**0.44**	**0.16**	**EPA-6010B**	10000		1
Beryllium	**0.42**	**mg/kg**	**0.44**	**0.042**	**EPA-6010B**	75	**J**	1
Cadmium	**0.36**	**mg/kg**	**0.44**	**0.046**	**EPA-6010B**	100	**J**	1
Chromium	**37**	**mg/kg**	**0.44**	**0.044**	**EPA-6010B**	2500		1
Cobalt	**8.6**	**mg/kg**	**2.2**	**0.087**	**EPA-6010B**	8000		1
Copper	**20**	**mg/kg**	**0.88**	**0.044**	**EPA-6010B**	2500		1
Lead	**16**	**mg/kg**	**2.2**	**0.36**	**EPA-6010B**	1000		1
Mercury	**0.019**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.46**	**mg/kg**	**2.2**	**0.044**	**EPA-6010B**	3500	**J**	1
Nickel	**35**	**mg/kg**	**0.44**	**0.13**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	0.88	0.87	EPA-6010B	100		1
Silver	ND	mg/kg	0.44	0.059	EPA-6010B	500		1
Thallium	ND	mg/kg	4.4	0.57	EPA-6010B	700		1
Vanadium	**34**	**mg/kg**	**0.44**	**0.097**	**EPA-6010B**	2400		1
Zinc	**58**	**mg/kg**	**2.2**	**0.077**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 13:16	JCC	PE-OP3	0.885	B122438	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 14:58	TMT	CETAC3	1.008	B122407	EPA 7471A

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Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-21 **Client Sample Name:** HA-21-007C, 10/7/2021 10:30:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-21 **Client Sample Name:** HA-21-007C, 10/7/2021 10:30:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0017**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	94.4	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	99.5	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-21 | **Client Sample Name:** HA-21-007C, 10/7/2021 10:30:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	97.9	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/14/21 07:45	10/14/21 16:44	RCC	MS-V17	1	B122300	EPA 5030 Soil MS

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-21 **Client Sample Name:** HA-21-007C, 10/7/2021 10:30:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	ND	mg/kg	10	2.2	EPA-8015B/FFP	ND		1
TPH - Motor Oil	**8.1**	**mg/kg**	**20**	**7.0**	**EPA-8015B/FFP**	ND	**J,A57**	1
Tetracosane (Surrogate)	82.9	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 15:45	10/14/21 14:56	BUP	GC-19	0.987	B122279	EPA 3550B

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Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-21 | **Client Sample Name:** HA-21-007C, 10/7/2021 10:30:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.1**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**5.4**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**76**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.45**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.39**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**43**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**9.3**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**21**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**7.9**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	ND	mg/kg	0.16	0.016	EPA-7471A	20		2
Molybdenum	**0.18**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**48**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**41**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**61**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 09:41	JCC	PE-OP3	1	B122441	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 15:19	TMT	CETAC3	0.962	B122408	EPA 7471A

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-22 **Client Sample Name:** HA-21-008A, 10/7/2021 11:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-22 | **Client Sample Name:** HA-21-008A, 10/7/2021 11:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0050**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	96.4	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	97.9	%	81 - 117 (LCL - UCL)		EPA-8260B			1

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-22 **Client Sample Name:** HA-21-008A, 10/7/2021 11:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	91.5	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/14/21 07:45	10/14/21 17:05	RCC	MS-V17	1	B122300	EPA 5030 Soil MS

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Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-22 **Client Sample Name:** HA-21-008A, 10/7/2021 11:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	**20**	**mg/kg**	**20**	**4.4**	**EPA-8015B/FFP**	ND	**A10,A52**	1
TPH - Motor Oil	**100**	**mg/kg**	**40**	**14**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	81.8	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 15:45	10/14/21 16:46	BUP	GC-19	2.013	B122279	EPA 3550B

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-22 | **Client Sample Name:** HA-21-008A, 10/7/2021 11:00:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**1.3**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	J	1
Arsenic	**15**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**54**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.34**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	J	1
Cadmium	**0.41**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	J	1
Chromium	**44**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**9.1**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**24**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**14**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	ND	mg/kg	0.16	0.016	EPA-7471A	20		2
Molybdenum	**0.34**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	J	1
Nickel	**48**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**28**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**50**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 09:53	JCC	PE-OP3	0.980	B122441	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 15:21	TMT	CETAC3	1.025	B122408	EPA 7471A

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-23 **Client Sample Name:** HA-21-008B, 10/7/2021 11:08:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-23 **Client Sample Name:** HA-21-008B, 10/7/2021 11:08:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0080**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**			1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	94.6	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.4	%	81 - 117 (LCL - UCL)		EPA-8260B			1

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-23 **Client Sample Name:** HA-21-008B, 10/7/2021 11:08:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	94.2	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/14/21 07:45	10/14/21 17:27	RCC	MS-V17	1	B122300	EPA 5030 Soil MS

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID:	2131909-23	**Client Sample Name:**	HA-21-008B, 10/7/2021 11:08:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	ND	mg/kg	50	11	EPA-8015B/FFP	ND	A10	1
TPH - Motor Oil	**360**	**mg/kg**	**100**	**35**	**EPA-8015B/FFP**	ND	**A10,A57**	1
Tetracosane (Surrogate)	95.4	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 15:45	10/14/21 16:18	BUP	GC-19	5.034	B122279	EPA 3550B

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1100 Corporate Way, Suite 230
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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-23 **Client Sample Name:** HA-21-008B, 10/7/2021 11:08:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	**0.86**	**mg/kg**	**5.0**	**0.33**	**EPA-6010B**	500	**J**	1
Arsenic	**17**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**63**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.35**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.44**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**42**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**9.1**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**25**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**26**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	ND	mg/kg	0.16	0.016	EPA-7471A	20		2
Molybdenum	**0.55**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**45**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**28**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**53**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 09:59	JCC	PE-OP3	0.990	B122441	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 15:23	TMT	CETAC3	1.008	B122408	EPA 7471A

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1100 Corporate Way, Suite 230	Project:	Solid Samples
Sacramento, CA 95831	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-24 **Client Sample Name:** HA-21-008C, 10/7/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B			1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B			1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B			1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B			1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B			1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B			1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B			1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B			1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B			1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B			1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B			1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B			1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B			1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B			1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B			1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B			1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B			1
Total 1,2-Dichloroethene	ND	mg/kg	0.010	0.0043	EPA-8260B			1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1

Crawford & Associates, Inc.		
1100 Corporate Way, Suite 230	**Reported:**	10/29/2021 16:32
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	Project Number:	19-570.1 PSA
	Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-24 **Client Sample Name:** HA-21-008C, 10/7/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B			1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Total 1,3-Dichloropropene	ND	mg/kg	0.010	0.0013	EPA-8260B			1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B			1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B			1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B			1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B			1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B			1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B			1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B			1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B			1
Tetrachloroethene	ND	mg/kg	0.0050	0.00097	EPA-8260B			1
Toluene	**0.0047**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**		**J**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B			1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B			1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B			1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	2040		1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B			1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B			1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B			1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B			1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B			1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B			1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B			1
Total Trihalomethanes	ND	mg/kg	0.020	0.0032	EPA-8260B			1
Total Purgeable Petroleum Hydrocarbons	ND	mg/kg	0.20	0.058	Luft-GC/MS			1
1,2-Dichloroethane-d4 (Surrogate)	90.9	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	98.9	%	81 - 117 (LCL - UCL)		EPA-8260B			1

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2131909-24 | **Client Sample Name:** HA-21-008C, 10/7/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
4-Bromofluorobenzene (Surrogate)	95.3	%	74 - 121 (LCL - UCL)		EPA-8260B			1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8260B	10/14/21 07:45	10/14/21 17:48	RCC	MS-V17	1	B122300	EPA 5030 Soil MS

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Petroleum Hydrocarbons

BCL Sample ID: 2131909-24 | **Client Sample Name:** HA-21-008C, 10/7/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	Run #
TPH - Diesel (FFP)	ND	mg/kg	20	4.4	EPA-8015B/FFP	ND	A10	1
TPH - Motor Oil	**29**	**mg/kg**	**40**	**14**	**EPA-8015B/FFP**	ND	**J,A10,A57**	1
Tetracosane (Surrogate)	85.3	%	40 - 130 (LCL - UCL)		EPA-8015B/FFP		A10	1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B/FFP	10/13/21 15:45	10/14/21 15:24	BUP	GC-19	2.020	B122279	EPA 3550B

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Concentrations (TTLC)

BCL Sample ID: 2131909-24 | **Client Sample Name:** HA-21-008C, 10/7/2021 11:15:00AM, Maria Ayala

Constituent	Result	Units	PQL	MDL	Method	TTLC Limits	Lab Quals	Run #
Antimony	ND	mg/kg	5.0	0.33	EPA-6010B	500		1
Arsenic	**7.6**	**mg/kg**	**1.0**	**0.40**	**EPA-6010B**	500		1
Barium	**54**	**mg/kg**	**0.50**	**0.18**	**EPA-6010B**	10000		1
Beryllium	**0.28**	**mg/kg**	**0.50**	**0.047**	**EPA-6010B**	75	**J**	1
Cadmium	**0.31**	**mg/kg**	**0.50**	**0.052**	**EPA-6010B**	100	**J**	1
Chromium	**35**	**mg/kg**	**0.50**	**0.050**	**EPA-6010B**	2500		1
Cobalt	**6.9**	**mg/kg**	**2.5**	**0.098**	**EPA-6010B**	8000		1
Copper	**13**	**mg/kg**	**1.0**	**0.050**	**EPA-6010B**	2500		1
Lead	**10**	**mg/kg**	**2.5**	**0.41**	**EPA-6010B**	1000		1
Mercury	**0.087**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	20	**J**	2
Molybdenum	**0.37**	**mg/kg**	**2.5**	**0.050**	**EPA-6010B**	3500	**J**	1
Nickel	**36**	**mg/kg**	**0.50**	**0.15**	**EPA-6010B**	2000		1
Selenium	ND	mg/kg	1.0	0.98	EPA-6010B	100		1
Silver	ND	mg/kg	0.50	0.067	EPA-6010B	500		1
Thallium	ND	mg/kg	5.0	0.64	EPA-6010B	700		1
Vanadium	**22**	**mg/kg**	**0.50**	**0.11**	**EPA-6010B**	2400		1
Zinc	**40**	**mg/kg**	**2.5**	**0.087**	**EPA-6010B**	5000		1

Run #	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	10/15/21 11:00	10/18/21 10:01	JCC	PE-OP3	0.901	B122441	EPA 3050B
2	EPA-7471A	10/15/21 09:20	10/15/21 15:29	TMT	CETAC3	1.025	B122408	EPA 7471A

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Method Blank Analysis

QC Batch ID: B122262

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Benzene	B122262-BLK1	ND	mg/kg	0.0050	0.00067	
Bromobenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00087	
Bromochloromethane	B122262-BLK1	ND	mg/kg	0.0050	0.00081	
Bromodichloromethane	B122262-BLK1	ND	mg/kg	0.0050	0.00078	
Bromoform	B122262-BLK1	ND	mg/kg	0.0050	0.00070	
Bromomethane	B122262-BLK1	ND	mg/kg	0.0050	0.0017	
n-Butylbenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00076	
sec-Butylbenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00071	
tert-Butylbenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00085	
Carbon tetrachloride	B122262-BLK1	ND	mg/kg	0.0050	0.00078	
Chlorobenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00077	
Chloroethane	B122262-BLK1	ND	mg/kg	0.0050	0.0011	
Chloroform	B122262-BLK1	ND	mg/kg	0.0050	0.00090	
Chloromethane	B122262-BLK1	ND	mg/kg	0.0050	0.0011	
2-Chlorotoluene	B122262-BLK1	ND	mg/kg	0.0050	0.00087	
4-Chlorotoluene	B122262-BLK1	ND	mg/kg	0.0050	0.00070	
Dibromochloromethane	B122262-BLK1	ND	mg/kg	0.0050	0.00080	
1,2-Dibromo-3-chloropropane	B122262-BLK1	ND	mg/kg	0.0050	0.00096	
1,2-Dibromoethane	B122262-BLK1	ND	mg/kg	0.0050	0.00082	
Dibromomethane	B122262-BLK1	ND	mg/kg	0.0050	0.0014	
1,2-Dichlorobenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00079	
1,3-Dichlorobenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00073	
1,4-Dichlorobenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00073	
Dichlorodifluoromethane	B122262-BLK1	ND	mg/kg	0.0050	0.00079	
1,1-Dichloroethane	B122262-BLK1	ND	mg/kg	0.0050	0.00064	
1,2-Dichloroethane	B122262-BLK1	ND	mg/kg	0.0050	0.00073	
1,1-Dichloroethene	B122262-BLK1	ND	mg/kg	0.0050	0.0011	
cis-1,2-Dichloroethene	B122262-BLK1	ND	mg/kg	0.0050	0.00054	
trans-1,2-Dichloroethene	B122262-BLK1	ND	mg/kg	0.0050	0.0037	
Total 1,2-Dichloroethene	B122262-BLK1	ND	mg/kg	0.010	0.0043	
1,2-Dichloropropane	B122262-BLK1	ND	mg/kg	0.0050	0.00080	
1,3-Dichloropropane	B122262-BLK1	ND	mg/kg	0.0050	0.00067	
2,2-Dichloropropane	B122262-BLK1	ND	mg/kg	0.0050	0.00067	
1,1-Dichloropropene	B122262-BLK1	ND	mg/kg	0.0050	0.00067	

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B122262						
cis-1,3-Dichloropropene	B122262-BLK1	ND	mg/kg	0.0050	0.00058	
trans-1,3-Dichloropropene	B122262-BLK1	ND	mg/kg	0.0050	0.00066	
Total 1,3-Dichloropropene	B122262-BLK1	ND	mg/kg	0.010	0.0013	
Ethylbenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00069	
Hexachlorobutadiene	B122262-BLK1	ND	mg/kg	0.0050	0.00067	
Isopropylbenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00080	
p-Isopropyltoluene	B122262-BLK1	ND	mg/kg	0.0050	0.00059	
Methylene chloride	B122262-BLK1	ND	mg/kg	0.010	0.0011	
Methyl t-butyl ether	B122262-BLK1	ND	mg/kg	0.0050	0.00056	
Naphthalene	B122262-BLK1	ND	mg/kg	0.0050	0.00099	
n-Propylbenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00071	
Styrene	B122262-BLK1	ND	mg/kg	0.0050	0.00062	
1,1,1,2-Tetrachloroethane	B122262-BLK1	ND	mg/kg	0.0050	0.00095	
1,1,2,2-Tetrachloroethane	B122262-BLK1	ND	mg/kg	0.0050	0.00084	
Tetrachloroethene	B122262-BLK1	ND	mg/kg	0.0050	0.00097	
Toluene	B122262-BLK1	ND	mg/kg	0.0050	0.00069	
1,2,3-Trichlorobenzene	B122262-BLK1	ND	mg/kg	0.0050	0.0015	
1,2,4-Trichlorobenzene	B122262-BLK1	ND	mg/kg	0.0050	0.0014	
1,1,1-Trichloroethane	B122262-BLK1	ND	mg/kg	0.0050	0.00067	
1,1,2-Trichloroethane	B122262-BLK1	ND	mg/kg	0.0050	0.00094	
Trichloroethene	B122262-BLK1	ND	mg/kg	0.0050	0.00074	
Trichlorofluoromethane	B122262-BLK1	ND	mg/kg	0.0050	0.0015	
1,2,3-Trichloropropane	B122262-BLK1	ND	mg/kg	0.0050	0.0019	
1,1,2-Trichloro-1,2,2-trifluoroethane	B122262-BLK1	ND	mg/kg	0.0050	0.0010	
1,2,4-Trimethylbenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00080	
1,3,5-Trimethylbenzene	B122262-BLK1	ND	mg/kg	0.0050	0.00066	
Vinyl chloride	B122262-BLK1	ND	mg/kg	0.0050	0.00059	
Total Xylenes	B122262-BLK1	ND	mg/kg	0.010	0.0025	
Total Trihalomethanes	B122262-BLK1	ND	mg/kg	0.020	0.0032	
Total Purgeable Petroleum Hydrocarbons	B122262-BLK1	ND	mg/kg	0.20	0.058	
1,2-Dichloroethane-d4 (Surrogate)	**B122262-BLK1**	**101**	%	**70 - 121 (LCL - UCL)**		
Toluene-d8 (Surrogate)	**B122262-BLK1**	**98.8**	%	**81 - 117 (LCL - UCL)**		
4-Bromofluorobenzene (Surrogate)	**B122262-BLK1**	**100**	%	**74 - 121 (LCL - UCL)**		

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831

Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Method Blank Analysis

QC Batch ID: B122300

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
Benzene	B122300-BLK1	ND	mg/kg	0.0050	0.00067	
Bromobenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00087	
Bromochloromethane	B122300-BLK1	ND	mg/kg	0.0050	0.00081	
Bromodichloromethane	B122300-BLK1	ND	mg/kg	0.0050	0.00078	
Bromoform	B122300-BLK1	ND	mg/kg	0.0050	0.00070	
Bromomethane	B122300-BLK1	ND	mg/kg	0.0050	0.0017	
n-Butylbenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00076	
sec-Butylbenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00071	
tert-Butylbenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00085	
Carbon tetrachloride	B122300-BLK1	ND	mg/kg	0.0050	0.00078	
Chlorobenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00077	
Chloroethane	B122300-BLK1	ND	mg/kg	0.0050	0.0011	
Chloroform	B122300-BLK1	ND	mg/kg	0.0050	0.00090	
Chloromethane	B122300-BLK1	ND	mg/kg	0.0050	0.0011	
2-Chlorotoluene	B122300-BLK1	ND	mg/kg	0.0050	0.00087	
4-Chlorotoluene	B122300-BLK1	ND	mg/kg	0.0050	0.00070	
Dibromochloromethane	B122300-BLK1	ND	mg/kg	0.0050	0.00080	
1,2-Dibromo-3-chloropropane	B122300-BLK1	ND	mg/kg	0.0050	0.00096	
1,2-Dibromoethane	B122300-BLK1	ND	mg/kg	0.0050	0.00082	
Dibromomethane	B122300-BLK1	ND	mg/kg	0.0050	0.0014	
1,2-Dichlorobenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00079	
1,3-Dichlorobenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00073	
1,4-Dichlorobenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00073	
Dichlorodifluoromethane	B122300-BLK1	ND	mg/kg	0.0050	0.00079	
1,1-Dichloroethane	B122300-BLK1	ND	mg/kg	0.0050	0.00064	
1,2-Dichloroethane	B122300-BLK1	ND	mg/kg	0.0050	0.00073	
1,1-Dichloroethene	B122300-BLK1	ND	mg/kg	0.0050	0.0011	
cis-1,2-Dichloroethene	B122300-BLK1	ND	mg/kg	0.0050	0.00054	
trans-1,2-Dichloroethene	B122300-BLK1	ND	mg/kg	0.0050	0.0037	
Total 1,2-Dichloroethene	B122300-BLK1	ND	mg/kg	0.010	0.0043	
1,2-Dichloropropane	B122300-BLK1	ND	mg/kg	0.0050	0.00080	
1,3-Dichloropropane	B122300-BLK1	ND	mg/kg	0.0050	0.00067	
2,2-Dichloropropane	B122300-BLK1	ND	mg/kg	0.0050	0.00067	
1,1-Dichloropropene	B122300-BLK1	ND	mg/kg	0.0050	0.00067	

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Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B122300						
cis-1,3-Dichloropropene	B122300-BLK1	ND	mg/kg	0.0050	0.00058	
trans-1,3-Dichloropropene	B122300-BLK1	ND	mg/kg	0.0050	0.00066	
Total 1,3-Dichloropropene	B122300-BLK1	ND	mg/kg	0.010	0.0013	
Ethylbenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00069	
Hexachlorobutadiene	B122300-BLK1	ND	mg/kg	0.0050	0.00067	
Isopropylbenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00080	
p-Isopropyltoluene	B122300-BLK1	ND	mg/kg	0.0050	0.00059	
Methylene chloride	B122300-BLK1	ND	mg/kg	0.010	0.0011	
Methyl t-butyl ether	B122300-BLK1	ND	mg/kg	0.0050	0.00056	
Naphthalene	B122300-BLK1	ND	mg/kg	0.0050	0.00099	
n-Propylbenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00071	
Styrene	B122300-BLK1	ND	mg/kg	0.0050	0.00062	
1,1,1,2-Tetrachloroethane	B122300-BLK1	ND	mg/kg	0.0050	0.00095	
1,1,2,2-Tetrachloroethane	B122300-BLK1	ND	mg/kg	0.0050	0.00084	
Tetrachloroethene	B122300-BLK1	ND	mg/kg	0.0050	0.00097	
Toluene	B122300-BLK1	ND	mg/kg	0.0050	0.00069	
1,2,3-Trichlorobenzene	B122300-BLK1	ND	mg/kg	0.0050	0.0015	
1,2,4-Trichlorobenzene	B122300-BLK1	ND	mg/kg	0.0050	0.0014	
1,1,1-Trichloroethane	B122300-BLK1	ND	mg/kg	0.0050	0.00067	
1,1,2-Trichloroethane	B122300-BLK1	ND	mg/kg	0.0050	0.00094	
Trichloroethene	B122300-BLK1	ND	mg/kg	0.0050	0.00074	
Trichlorofluoromethane	B122300-BLK1	ND	mg/kg	0.0050	0.0015	
1,2,3-Trichloropropane	B122300-BLK1	ND	mg/kg	0.0050	0.0019	
1,1,2-Trichloro-1,2,2-trifluoroethane	B122300-BLK1	ND	mg/kg	0.0050	0.0010	
1,2,4-Trimethylbenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00080	
1,3,5-Trimethylbenzene	B122300-BLK1	ND	mg/kg	0.0050	0.00066	
Vinyl chloride	B122300-BLK1	ND	mg/kg	0.0050	0.00059	
Total Xylenes	B122300-BLK1	ND	mg/kg	0.010	0.0025	
Total Trihalomethanes	B122300-BLK1	ND	mg/kg	0.020	0.0032	
Total Purgeable Petroleum Hydrocarbons	B122300-BLK1	ND	mg/kg	0.20	0.058	
1,2-Dichloroethane-d4 (Surrogate)	**B122300-BLK1**	**92.9**	%	**70 - 121 (LCL - UCL)**		
Toluene-d8 (Surrogate)	**B122300-BLK1**	**99.8**	%	**81 - 117 (LCL - UCL)**		
4-Bromofluorobenzene (Surrogate)	**B122300-BLK1**	**96.8**	%	**74 - 121 (LCL - UCL)**		

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Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B122262										
Benzene	B122262-BS1	LCS	0.11937	0.12500	mg/kg	95.5		70 - 130		
Bromodichloromethane	B122262-BS1	LCS	0.12994	0.12500	mg/kg	104		70 - 130		
Chlorobenzene	B122262-BS1	LCS	0.12825	0.12500	mg/kg	103		70 - 130		
Chloroethane	B122262-BS1	LCS	0.13105	0.12500	mg/kg	105		70 - 130		
1,4-Dichlorobenzene	B122262-BS1	LCS	0.12714	0.12500	mg/kg	102		70 - 130		
1,1-Dichloroethane	B122262-BS1	LCS	0.11899	0.12500	mg/kg	95.2		70 - 130		
1,1-Dichloroethene	B122262-BS1	LCS	0.12489	0.12500	mg/kg	99.9		70 - 130		
Toluene	B122262-BS1	LCS	0.13253	0.12500	mg/kg	106		70 - 130		
Trichloroethene	B122262-BS1	LCS	0.12684	0.12500	mg/kg	101		70 - 130		
1,2-Dichloroethane-d4 (Surrogate)	B122262-BS1	LCS	0.049760	0.050000	mg/kg	99.5		70 - 121		
Toluene-d8 (Surrogate)	B122262-BS1	LCS	0.050260	0.050000	mg/kg	101		81 - 117		
4-Bromofluorobenzene (Surrogate)	B122262-BS1	LCS	0.050360	0.050000	mg/kg	101		74 - 121		
QC Batch ID: B122300										
Benzene	B122300-BS1	LCS	0.11675	0.12500	mg/kg	93.4		70 - 130		
Bromodichloromethane	B122300-BS1	LCS	0.12346	0.12500	mg/kg	98.8		70 - 130		
Chlorobenzene	B122300-BS1	LCS	0.12587	0.12500	mg/kg	101		70 - 130		
Chloroethane	B122300-BS1	LCS	0.12596	0.12500	mg/kg	101		70 - 130		
1,4-Dichlorobenzene	B122300-BS1	LCS	0.12231	0.12500	mg/kg	97.8		70 - 130		
1,1-Dichloroethane	B122300-BS1	LCS	0.11470	0.12500	mg/kg	91.8		70 - 130		
1,1-Dichloroethene	B122300-BS1	LCS	0.12091	0.12500	mg/kg	96.7		70 - 130		
Toluene	B122300-BS1	LCS	0.13050	0.12500	mg/kg	104		70 - 130		
Trichloroethene	B122300-BS1	LCS	0.12627	0.12500	mg/kg	101		70 - 130		
1,2-Dichloroethane-d4 (Surrogate)	B122300-BS1	LCS	0.047510	0.050000	mg/kg	95.0		70 - 121		
Toluene-d8 (Surrogate)	B122300-BS1	LCS	0.050110	0.050000	mg/kg	100		81 - 117		
4-Bromofluorobenzene (Surrogate)	B122300-BS1	LCS	0.049900	0.050000	mg/kg	99.8		74 - 121		

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Project: Solid Samples
Project Number: 19-570.1 PSA
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Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Precision & Accuracy

QC Batch ID: B122262 Used client sample: N

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Benzene	MS	2130342-68	ND	0.12277	0.12500	mg/kg		98.2		70 - 130	
	MSD	2130342-68	ND	0.12627	0.12500	mg/kg	2.8	101	20	70 - 130	
Bromodichloromethane	MS	2130342-68	ND	0.13955	0.12500	mg/kg		112		70 - 130	
	MSD	2130342-68	ND	0.14028	0.12500	mg/kg	0.5	112	20	70 - 130	
Chlorobenzene	MS	2130342-68	ND	0.13821	0.12500	mg/kg		111		70 - 130	
	MSD	2130342-68	ND	0.13614	0.12500	mg/kg	1.5	109	20	70 - 130	
Chloroethane	MS	2130342-68	ND	0.13467	0.12500	mg/kg		108		70 - 130	
	MSD	2130342-68	ND	0.14139	0.12500	mg/kg	4.9	113	20	70 - 130	
1,4-Dichlorobenzene	MS	2130342-68	ND	0.13682	0.12500	mg/kg		109		70 - 130	
	MSD	2130342-68	ND	0.13473	0.12500	mg/kg	1.5	108	20	70 - 130	
1,1-Dichloroethane	MS	2130342-68	ND	0.12293	0.12500	mg/kg		98.3		70 - 130	
	MSD	2130342-68	ND	0.12673	0.12500	mg/kg	3.0	101	20	70 - 130	
1,1-Dichloroethene	MS	2130342-68	ND	0.12833	0.12500	mg/kg		103		70 - 130	
	MSD	2130342-68	ND	0.13622	0.12500	mg/kg	6.0	109	20	70 - 130	
Toluene	MS	2130342-68	ND	0.13783	0.12500	mg/kg		110		70 - 130	
	MSD	2130342-68	ND	0.14208	0.12500	mg/kg	3.0	114	20	70 - 130	
Trichloroethene	MS	2130342-68	ND	0.13301	0.12500	mg/kg		106		70 - 130	
	MSD	2130342-68	ND	0.13730	0.12500	mg/kg	3.2	110	20	70 - 130	
1,2-Dichloroethane-d4 (Surrogate)	MS	2130342-68	ND	0.048660	0.050000	mg/kg		97.3		70 - 121	
	MSD	2130342-68	ND	0.050380	0.050000	mg/kg	3.5	101		70 - 121	
Toluene-d8 (Surrogate)	MS	2130342-68	ND	0.049830	0.050000	mg/kg		99.7		81 - 117	
	MSD	2130342-68	ND	0.050060	0.050000	mg/kg	0.5	100		81 - 117	
4-Bromofluorobenzene (Surrogate)	MS	2130342-68	ND	0.051230	0.050000	mg/kg		102		74 - 121	
	MSD	2130342-68	ND	0.050550	0.050000	mg/kg	1.3	101		74 - 121	

QC Batch ID: B122300 Used client sample: N

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Benzene	MS	2130342-69	ND	0.11539	0.12500	mg/kg		92.3		70 - 130	
	MSD	2130342-69	ND	0.11515	0.12500	mg/kg	0.2	92.1	20	70 - 130	
Bromodichloromethane	MS	2130342-69	ND	0.12952	0.12500	mg/kg		104		70 - 130	
	MSD	2130342-69	ND	0.13234	0.12500	mg/kg	2.2	106	20	70 - 130	
Chlorobenzene	MS	2130342-69	ND	0.12815	0.12500	mg/kg		103		70 - 130	
	MSD	2130342-69	ND	0.12821	0.12500	mg/kg	0.0	103	20	70 - 130	
Chloroethane	MS	2130342-69	ND	0.12405	0.12500	mg/kg		99.2		70 - 130	
	MSD	2130342-69	ND	0.12387	0.12500	mg/kg	0.1	99.1	20	70 - 130	
1,4-Dichlorobenzene	MS	2130342-69	ND	0.12570	0.12500	mg/kg		101		70 - 130	
	MSD	2130342-69	ND	0.12815	0.12500	mg/kg	1.9	103	20	70 - 130	
1,1-Dichloroethane	MS	2130342-69	ND	0.11437	0.12500	mg/kg		91.5		70 - 130	
	MSD	2130342-69	ND	0.11448	0.12500	mg/kg	0.1	91.6	20	70 - 130	

Crawford & Associates, Inc.
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Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Precision & Accuracy

QC Batch ID: B122300 Used client sample: N

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
1,1-Dichloroethene	MS	2130342-69	ND	0.11771	0.12500	mg/kg		94.2		70 - 130	
	MSD	2130342-69	ND	0.11799	0.12500	mg/kg	0.2	94.4	20	70 - 130	
Toluene	MS	2130342-69	ND	0.12961	0.12500	mg/kg		104		70 - 130	
	MSD	2130342-69	ND	0.13032	0.12500	mg/kg	0.5	104	20	70 - 130	
Trichloroethene	MS	2130342-69	ND	0.12383	0.12500	mg/kg		99.1		70 - 130	
	MSD	2130342-69	ND	0.12469	0.12500	mg/kg	0.7	99.8	20	70 - 130	
1,2-Dichloroethane-d4 (Surrogate)	MS	2130342-69	ND	0.045430	0.050000	mg/kg		90.9		70 - 121	
	MSD	2130342-69	ND	0.045580	0.050000	mg/kg	0.3	91.2		70 - 121	
Toluene-d8 (Surrogate)	MS	2130342-69	ND	0.049780	0.050000	mg/kg		99.6		81 - 117	
	MSD	2130342-69	ND	0.049900	0.050000	mg/kg	0.2	99.8		81 - 117	
4-Bromofluorobenzene (Surrogate)	MS	2130342-69	ND	0.050040	0.050000	mg/kg		100		74 - 121	
	MSD	2130342-69	ND	0.050170	0.050000	mg/kg	0.3	100		74 - 121	

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Total Petroleum Hydrocarbons

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B122279						
TPH - Diesel (FFP)	B122279-BLK1	ND	mg/kg	10	2.2	
TPH - Motor Oil	B122279-BLK1	ND	mg/kg	20	7.0	
Tetracosane (Surrogate)	**B122279-BLK1**	**55.5**	%	**40 - 130 (LCL - UCL)**		
QC Batch ID: B122535						
TPH - Diesel (FFP)	B122535-BLK1	ND	mg/kg	10	2.2	
TPH - Motor Oil	B122535-BLK1	ND	mg/kg	20	7.0	
Tetracosane (Surrogate)	**B122535-BLK1**	**103**	%	**40 - 130 (LCL - UCL)**		

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Total Petroleum Hydrocarbons

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B122279										
TPH - Diesel (FFP)	B122279-BS1	LCS	72.602	83.893	mg/kg	86.5		64 - 124		
Tetracosane (Surrogate)	B122279-BS1	LCS	2.7094	3.3557	mg/kg	80.7		40 - 130		
QC Batch ID: B122535										
TPH - Diesel (FFP)	B122535-BS1	LCS	69.312	82.508	mg/kg	84.0		64 - 124		
Tetracosane (Surrogate)	B122535-BS1	LCS	3.2236	3.3003	mg/kg	97.7		40 - 130		

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

Total Petroleum Hydrocarbons

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B122279	Used client sample: N										
TPH - Diesel (FFP)	MS	2130342-65	ND	51.111	82.781	mg/kg		61.7		52 - 131	
	MSD	2130342-65	ND	53.629	84.746	mg/kg	4.8	63.3	30	52 - 131	
Tetracosane (Surrogate)	MS	2130342-65	ND	1.6753	3.3113	mg/kg		50.6		40 - 130	
	MSD	2130342-65	ND	1.8222	3.3898	mg/kg	8.4	53.8		40 - 130	
QC Batch ID: B122535	Used client sample: Y - Description: HA-21-003B, 10/06/2021 11:55										
TPH - Diesel (FFP)	MS	**2131909-08**	**37.792**	**77.206**	**81.967**	**mg/kg**		**48.1**		**52 - 131**	**A10,Q03**
	MSD	**2131909-08**	**37.792**	**91.436**	**82.508**	**mg/kg**	**16.9**	**65.0**	**30**	**52 - 131**	**A10**
Tetracosane (Surrogate)	MS	2131909-08	ND	1.6705	3.2787	mg/kg		51.0		40 - 130	A10
	MSD	2131909-08	ND	2.0297	3.3003	mg/kg	19.4	61.5		40 - 130	A10

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
1100 Corporate Way, Suite 230		Project:	Solid Samples
Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Chemical Analysis

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B122803						
pH	B122803-BLK1	ND	pH Units	0.05	0.05	
pH Measurement Temperature	B122803-BLK1	ND	C	0.1	0.1	

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Chemical Analysis

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B122803										
pH	B122803-BS1	LCS	4.0350	4.0000	pH Units	101		95 - 105		

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Chemical Analysis

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B122803	Used client sample: Y - Description: HA-21-005A, 10/06/2021 15:10										
pH	DUP	2131909-13	6.1060	6.1720		pH Units	1.1		20		

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

WET Test (STLC)

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B123668						
Chromium	B123668-BLK1	ND	mg/L	0.10	0.0092	
Lead	B123668-BLK1	ND	mg/L	0.50	0.13	

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

WET Test (STLC)

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B123668										
Chromium	B123668-BS1	LCS	19.942	20.000	mg/L	99.7		85 - 115		
Lead	B123668-BS1	LCS	20.156	20.000	mg/L	101		85 - 115		

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

WET Test (STLC)

Quality Control Report - Precision & Accuracy

QC Batch ID: B123668 Used client sample: N

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Chromium	DUP	2133050-01	0.54896	0.53965		mg/L	1.7		20		
	MS	2133050-01	0.54896	19.961	20.408	mg/L		95.1		75 - 125	
	MSD	2133050-01	0.54896	20.448	20.408	mg/L	2.4	97.5	20	75 - 125	
Lead	DUP	2133050-01	0.17490	ND		mg/L			20		
	MS	2133050-01	0.17490	19.137	20.408	mg/L		92.9		75 - 125	
	MSD	2133050-01	0.17490	19.839	20.408	mg/L	3.6	96.4	20	75 - 125	

Crawford & Associates, Inc. 1100 Corporate Way, Suite 230 Sacramento, CA 95831	**Reported:** 10/29/2021 16:32 Project: Solid Samples Project Number: 19-570.1 PSA Project Manager: Steve Carter

TCLP Toxicity

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B123402						
Chromium	B123402-BLK1	ND	mg/L	0.10	0.0075	
Lead	B123402-BLK1	ND	mg/L	0.50	0.030	

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TCLP Toxicity

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B123402										
Chromium	B123402-BS1	LCS	19.906	20.000	mg/L	99.5		85 - 115		
Lead	B123402-BS1	LCS	20.387	20.000	mg/L	102		85 - 115		

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Project Manager: Steve Carter

TCLP Toxicity

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B123402	Used client sample: N										
Chromium	DUP	2132599-08	ND	ND		mg/L			20		
	MS	2132599-08	ND	19.329	20.000	mg/L		96.6		75 - 125	
	MSD	2132599-08	ND	19.705	20.000	mg/L	1.9	98.5	20	75 - 125	
Lead	DUP	2132599-08	0.045456	ND		mg/L			20		
	MS	2132599-08	0.045456	19.772	20.000	mg/L		98.6		75 - 125	
	MSD	2132599-08	0.045456	19.855	20.000	mg/L	0.4	99.0	20	75 - 125	

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Project: Solid Samples
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Project Manager: Steve Carter

Total Concentrations (TTLC)

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B122407						
Mercury	B122407-BLK1	ND	mg/kg	0.16	0.016	
QC Batch ID: B122408						
Mercury	B122408-BLK1	ND	mg/kg	0.16	0.016	
QC Batch ID: B122438						
Antimony	B122438-BLK1	ND	mg/kg	5.0	0.33	
Arsenic	B122438-BLK1	ND	mg/kg	1.0	0.40	
Barium	B122438-BLK1	ND	mg/kg	0.50	0.18	
Beryllium	B122438-BLK1	ND	mg/kg	0.50	0.047	
Cadmium	B122438-BLK1	ND	mg/kg	0.50	0.052	
Chromium	**B122438-BLK1**	**0.13281**	**mg/kg**	**0.50**	**0.050**	**J**
Cobalt	B122438-BLK1	ND	mg/kg	2.5	0.098	
Copper	**B122438-BLK1**	**0.33819**	**mg/kg**	**1.0**	**0.050**	**J**
Lead	B122438-BLK1	ND	mg/kg	2.5	0.41	
Molybdenum	B122438-BLK1	ND	mg/kg	2.5	0.050	
Nickel	B122438-BLK1	ND	mg/kg	0.50	0.15	
Selenium	B122438-BLK1	ND	mg/kg	1.0	0.98	
Silver	B122438-BLK1	ND	mg/kg	0.50	0.067	
Thallium	B122438-BLK1	ND	mg/kg	5.0	0.64	
Vanadium	B122438-BLK1	ND	mg/kg	0.50	0.11	
Zinc	**B122438-BLK1**	**0.50205**	**mg/kg**	**2.5**	**0.087**	**J**
QC Batch ID: B122441						
Antimony	B122441-BLK1	ND	mg/kg	5.0	0.33	
Arsenic	B122441-BLK1	ND	mg/kg	1.0	0.40	
Barium	B122441-BLK1	ND	mg/kg	0.50	0.18	
Beryllium	B122441-BLK1	ND	mg/kg	0.50	0.047	
Cadmium	B122441-BLK1	ND	mg/kg	0.50	0.052	
Chromium	**B122441-BLK1**	**0.13161**	**mg/kg**	**0.50**	**0.050**	**J**
Cobalt	B122441-BLK1	ND	mg/kg	2.5	0.098	
Copper	B122441-BLK1	ND	mg/kg	1.0	0.050	
Lead	B122441-BLK1	ND	mg/kg	2.5	0.41	
Molybdenum	B122441-BLK1	ND	mg/kg	2.5	0.050	
Nickel	B122441-BLK1	ND	mg/kg	0.50	0.15	
Selenium	B122441-BLK1	ND	mg/kg	1.0	0.98	

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Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Concentrations (TTLC)

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B122441						
Silver	B122441-BLK1	ND	mg/kg	0.50	0.067	
Thallium	B122441-BLK1	ND	mg/kg	5.0	0.64	
Vanadium	B122441-BLK1	ND	mg/kg	0.50	0.11	
Zinc	**B122441-BLK1**	**0.46088**	**mg/kg**	**2.5**	**0.087**	**J**

Crawford & Associates, Inc.
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Reported: 10/29/2021 16:32
Project: Solid Samples
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Total Concentrations (TTLC)

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B122407										
Mercury	B122407-BS1	LCS	0.84160	0.80000	mg/kg	105		80 - 120		
QC Batch ID: B122408										
Mercury	B122408-BS1	LCS	0.81280	0.80000	mg/kg	102		80 - 120		
QC Batch ID: B122438										
Antimony	B122438-BS1	LCS	94.701	100.00	mg/kg	94.7		75 - 125		
Arsenic	B122438-BS1	LCS	17.041	20.000	mg/kg	85.2		75 - 125		
Barium	B122438-BS1	LCS	102.30	100.00	mg/kg	102		75 - 125		
Beryllium	B122438-BS1	LCS	9.4798	10.000	mg/kg	94.8		75 - 125		
Cadmium	B122438-BS1	LCS	9.7359	10.000	mg/kg	97.4		75 - 125		
Chromium	B122438-BS1	LCS	98.429	100.00	mg/kg	98.4		75 - 125		
Cobalt	B122438-BS1	LCS	97.568	100.00	mg/kg	97.6		75 - 125		
Copper	B122438-BS1	LCS	98.539	100.00	mg/kg	98.5		75 - 125		
Lead	B122438-BS1	LCS	102.48	100.00	mg/kg	102		75 - 125		
Molybdenum	B122438-BS1	LCS	97.346	100.00	mg/kg	97.3		75 - 125		
Nickel	B122438-BS1	LCS	96.270	100.00	mg/kg	96.3		75 - 125		
Selenium	B122438-BS1	LCS	18.239	20.000	mg/kg	91.2		75 - 125		
Silver	B122438-BS1	LCS	9.6463	10.000	mg/kg	96.5		75 - 125		
Thallium	B122438-BS1	LCS	110.93	100.00	mg/kg	111		75 - 125		
Vanadium	B122438-BS1	LCS	96.747	100.00	mg/kg	96.7		75 - 125		
Zinc	B122438-BS1	LCS	95.328	100.00	mg/kg	95.3		75 - 125		
QC Batch ID: B122441										
Antimony	B122441-BS1	LCS	95.344	100.00	mg/kg	95.3		75 - 125		
Arsenic	B122441-BS1	LCS	17.564	20.000	mg/kg	87.8		75 - 125		
Barium	B122441-BS1	LCS	102.87	100.00	mg/kg	103		75 - 125		
Beryllium	B122441-BS1	LCS	9.5988	10.000	mg/kg	96.0		75 - 125		
Cadmium	B122441-BS1	LCS	9.7729	10.000	mg/kg	97.7		75 - 125		
Chromium	B122441-BS1	LCS	99.303	100.00	mg/kg	99.3		75 - 125		
Cobalt	B122441-BS1	LCS	98.375	100.00	mg/kg	98.4		75 - 125		
Copper	B122441-BS1	LCS	98.378	100.00	mg/kg	98.4		75 - 125		
Lead	B122441-BS1	LCS	102.85	100.00	mg/kg	103		75 - 125		
Molybdenum	B122441-BS1	LCS	97.928	100.00	mg/kg	97.9		75 - 125		
Nickel	B122441-BS1	LCS	98.230	100.00	mg/kg	98.2		75 - 125		
Selenium	B122441-BS1	LCS	17.601	20.000	mg/kg	88.0		75 - 125		

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Total Concentrations (TTLC)

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B122441										
Silver	B122441-BS1	LCS	9.7226	10.000	mg/kg	97.2		75 - 125		
Thallium	B122441-BS1	LCS	111.60	100.00	mg/kg	112		75 - 125		
Vanadium	B122441-BS1	LCS	97.162	100.00	mg/kg	97.2		75 - 125		
Zinc	B122441-BS1	LCS	97.762	100.00	mg/kg	97.8		75 - 125		

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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B122407	Used client sample: Y - Description: HA-21-001A, 10/05/2021 08:40										
Mercury	DUP	2131909-01	0.074844	0.074531		mg/kg	0.4		20		J
	MS	2131909-01	0.074844	0.79688	0.78125	mg/kg		92.4		80 - 120	
	MSD	2131909-01	0.074844	0.77344	0.78125	mg/kg	3.0	89.4	20	80 - 120	
QC Batch ID: B122408	Used client sample: N										
Mercury	DUP	2131385-01	0.12413	0.11825		mg/kg	4.8		20		J
	MS	2131385-01	0.12413	0.90159	0.79365	mg/kg		98.0		80 - 120	
	MSD	2131385-01	0.12413	0.93175	0.79365	mg/kg	3.3	102	20	80 - 120	
QC Batch ID: B122438	Used client sample: Y - Description: HA-21-001A, 10/05/2021 08:40										
Antimony	DUP	2131909-01	1.3467	1.3840		mg/kg	2.7		20		J
	MS	2131909-01	1.3467	21.623	100.00	mg/kg		20.3		16 - 119	
	MSD	2131909-01	1.3467	22.950	100.00	mg/kg	6.0	21.6	20	16 - 119	
Arsenic	DUP	**2131909-01**	**6.2088**	**6.2453**		**mg/kg**	**0.6**		**20**		
	MS	**2131909-01**	**6.2088**	**21.150**	**20.000**	**mg/kg**		**74.7**		**75 - 125**	**Q03**
	MSD	**2131909-01**	**6.2088**	**21.355**	**20.000**	**mg/kg**	**1.0**	**75.7**	**20**	**75 - 125**	
Barium	DUP	2131909-01	67.307	67.095		mg/kg	0.3		20		
	MS	2131909-01	67.307	160.25	100.00	mg/kg		92.9		75 - 125	
	MSD	2131909-01	67.307	159.13	100.00	mg/kg	0.7	91.8	20	75 - 125	
Beryllium	DUP	2131909-01	0.36456	0.35123		mg/kg	3.7		20		J
	MS	2131909-01	0.36456	8.7973	10.000	mg/kg		84.3		75 - 125	
	MSD	2131909-01	0.36456	8.9206	10.000	mg/kg	1.4	85.6	20	75 - 125	
Cadmium	DUP	2131909-01	0.42661	0.38953		mg/kg	9.1		20		J
	MS	2131909-01	0.42661	8.9166	10.000	mg/kg		84.9		75 - 125	
	MSD	2131909-01	0.42661	9.0552	10.000	mg/kg	1.5	86.3	20	75 - 125	
Chromium	DUP	2131909-01	38.959	40.627		mg/kg	4.2		20		
	MS	2131909-01	38.959	125.80	100.00	mg/kg		86.8		75 - 125	
	MSD	2131909-01	38.959	128.88	100.00	mg/kg	2.4	89.9	20	75 - 125	
Cobalt	DUP	2131909-01	7.3699	7.6872		mg/kg	4.2		20		
	MS	2131909-01	7.3699	88.091	100.00	mg/kg		80.7		75 - 125	
	MSD	2131909-01	7.3699	90.183	100.00	mg/kg	2.3	82.8	20	75 - 125	
Copper	DUP	2131909-01	22.336	19.634		mg/kg	12.9		20		
	MS	2131909-01	22.336	109.82	100.00	mg/kg		87.5		75 - 125	
	MSD	2131909-01	22.336	113.20	100.00	mg/kg	3.0	90.9	20	75 - 125	
Lead	DUP	2131909-01	26.003	24.261		mg/kg	6.9		20		
	MS	2131909-01	26.003	107.21	100.00	mg/kg		81.2		75 - 125	
	MSD	2131909-01	26.003	108.60	100.00	mg/kg	1.3	82.6	20	75 - 125	
Molybdenum	DUP	2131909-01	0.37397	0.32939		mg/kg	12.7		20		J
	MS	2131909-01	0.37397	78.942	100.00	mg/kg		78.6		75 - 125	
	MSD	2131909-01	0.37397	81.366	100.00	mg/kg	3.0	81.0	20	75 - 125	

Crawford & Associates, Inc.		**Reported:**	10/29/2021 16:32
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Sacramento, CA 95831		Project Number:	19-570.1 PSA
		Project Manager:	Steve Carter

Total Concentrations (TTLC)

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B122438	Used client sample: Y - Description: HA-21-001A, 10/05/2021 08:40										
Nickel	DUP	2131909-01	42.460	39.609		mg/kg	6.9		20		
	MS	2131909-01	42.460	120.20	100.00	mg/kg		77.7		75 - 125	
	MSD	2131909-01	42.460	122.72	100.00	mg/kg	2.1	80.3	20	75 - 125	
Selenium	DUP	2131909-01	ND	ND		mg/kg			20		
	MS	2131909-01	ND	16.295	20.000	mg/kg		81.5		75 - 125	
	MSD	2131909-01	ND	15.154	20.000	mg/kg	7.3	75.8	20	75 - 125	
Silver	DUP	2131909-01	0.072984	ND		mg/kg			20		
	MS	2131909-01	0.072984	8.3978	10.000	mg/kg		83.2		75 - 125	
	MSD	2131909-01	0.072984	8.5855	10.000	mg/kg	2.2	85.1	20	75 - 125	
Thallium	DUP	2131909-01	ND	ND		mg/kg			20		
	MS	2131909-01	ND	84.313	100.00	mg/kg		84.3		75 - 125	
	MSD	2131909-01	ND	86.000	100.00	mg/kg	2.0	86.0	20	75 - 125	
Vanadium	DUP	2131909-01	28.175	27.774		mg/kg	1.4		20		
	MS	2131909-01	28.175	113.66	100.00	mg/kg		85.5		75 - 125	
	MSD	2131909-01	28.175	115.96	100.00	mg/kg	2.0	87.8	20	75 - 125	
Zinc	DUP	2131909-01	69.664	67.944		mg/kg	2.5		20		
	MS	2131909-01	69.664	147.61	100.00	mg/kg		77.9		75 - 125	
	MSD	2131909-01	69.664	150.80	100.00	mg/kg	2.1	81.1	20	75 - 125	
QC Batch ID: B122441	Used client sample: Y - Description: HA-21-007C, 10/07/2021 10:30										
Antimony	DUP	2131909-21	1.1474	1.3430		mg/kg	15.7		20		J
	MS	2131909-21	1.1474	22.308	100.00	mg/kg		21.2		16 - 119	
	MSD	2131909-21	1.1474	22.425	100.00	mg/kg	0.5	21.3	20	16 - 119	
Arsenic	DUP	**2131909-21**	**5.3583**	**5.3948**		**mg/kg**	**0.7**		**20**		
	MS	**2131909-21**	**5.3583**	**19.846**	**20.000**	**mg/kg**		**72.4**		**75 - 125**	**Q03**
	MSD	**2131909-21**	**5.3583**	**20.664**	**20.000**	**mg/kg**	**4.0**	**76.5**	**20**	**75 - 125**	
Barium	DUP	2131909-21	76.197	75.829		mg/kg	0.5		20		
	MS	2131909-21	76.197	170.11	100.00	mg/kg		93.9		75 - 125	
	MSD	2131909-21	76.197	176.86	100.00	mg/kg	3.9	101	20	75 - 125	
Beryllium	DUP	2131909-21	0.44749	0.44473		mg/kg	0.6		20		J
	MS	2131909-21	0.44749	9.0878	10.000	mg/kg		86.4		75 - 125	
	MSD	2131909-21	0.44749	9.0194	10.000	mg/kg	0.8	85.7	20	75 - 125	
Cadmium	DUP	2131909-21	0.38860	0.40516		mg/kg	4.2		20		J
	MS	2131909-21	0.38860	9.1551	10.000	mg/kg		87.7		75 - 125	
	MSD	2131909-21	0.38860	9.1815	10.000	mg/kg	0.3	87.9	20	75 - 125	
Chromium	DUP	2131909-21	43.363	42.764		mg/kg	1.4		20		
	MS	2131909-21	43.363	129.95	100.00	mg/kg		86.6		75 - 125	
	MSD	2131909-21	43.363	136.48	100.00	mg/kg	4.9	93.1	20	75 - 125	

Crawford & Associates, Inc.
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Reported: 10/29/2021 16:32
Project: Solid Samples
Project Number: 19-570.1 PSA
Project Manager: Steve Carter

Total Concentrations (TTLC)

Quality Control Report - Precision & Accuracy

QC Batch ID: B122441 Used client sample: Y - Description: HA-21-007C, 10/07/2021 10:30

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
Cobalt	DUP	2131909-21	9.2863	9.2649		mg/kg	0.2		20		
	MS	2131909-21	9.2863	91.881	100.00	mg/kg		82.6		75 - 125	
	MSD	2131909-21	9.2863	91.390	100.00	mg/kg	0.5	82.1	20	75 - 125	
Copper	DUP	2131909-21	21.371	19.943		mg/kg	6.9		20		
	MS	2131909-21	21.371	110.47	100.00	mg/kg		89.1		75 - 125	
	MSD	2131909-21	21.371	113.16	100.00	mg/kg	2.4	91.8	20	75 - 125	
Lead	DUP	2131909-21	7.8842	8.0648		mg/kg	2.3		20		
	MS	2131909-21	7.8842	91.872	100.00	mg/kg		84.0		75 - 125	
	MSD	2131909-21	7.8842	91.808	100.00	mg/kg	0.1	83.9	20	75 - 125	
Molybdenum	DUP	2131909-21	0.17762	ND		mg/kg			20		
	MS	2131909-21	0.17762	77.500	100.00	mg/kg		77.3		75 - 125	
	MSD	2131909-21	0.17762	76.630	100.00	mg/kg	1.1	76.5	20	75 - 125	
Nickel	DUP	2131909-21	47.900	47.384		mg/kg	1.1		20		
	MS	2131909-21	47.900	129.43	100.00	mg/kg		81.5		75 - 125	
	MSD	2131909-21	47.900	132.56	100.00	mg/kg	2.4	84.7	20	75 - 125	
Selenium	DUP	2131909-21	ND	ND		mg/kg			20		
	MS	2131909-21	ND	15.988	20.000	mg/kg		79.9		75 - 125	
	MSD	2131909-21	ND	15.244	20.000	mg/kg	4.8	76.2	20	75 - 125	
Silver	DUP	2131909-21	ND	ND		mg/kg			20		
	MS	2131909-21	ND	8.6554	10.000	mg/kg		86.6		75 - 125	
	MSD	2131909-21	ND	8.6064	10.000	mg/kg	0.6	86.1	20	75 - 125	
Thallium	DUP	2131909-21	ND	ND		mg/kg			20		
	MS	2131909-21	ND	85.384	100.00	mg/kg		85.4		75 - 125	
	MSD	2131909-21	ND	82.721	100.00	mg/kg	3.2	82.7	20	75 - 125	
Vanadium	DUP	2131909-21	40.743	39.281		mg/kg	3.7		20		
	MS	2131909-21	40.743	125.90	100.00	mg/kg		85.2		75 - 125	
	MSD	2131909-21	40.743	131.41	100.00	mg/kg	4.3	90.7	20	75 - 125	
Zinc	DUP	2131909-21	60.925	62.263		mg/kg	2.2		20		
	MS	2131909-21	60.925	140.52	100.00	mg/kg		79.6		75 - 125	
	MSD	2131909-21	60.925	143.77	100.00	mg/kg	2.3	82.8	20	75 - 125	

Crawford & Associates, Inc.	**Reported:** 10/29/2021 16:32
1100 Corporate Way, Suite 230	Project: Solid Samples
Sacramento, CA 95831	Project Number: 19-570.1 PSA
	Project Manager: Steve Carter

Notes And Definitions

J	Estimated Value (CLP Flag)
MDL	Method Detection Limit
ND	Analyte Not Detected
PQL	Practical Quantitation Limit
A10	Detection and quantitation limits were raised due to matrix interference.
A52	Chromatogram not typical of diesel.
A57	Chromatogram not typical of motor oil.
pH1:3	pH result reported on a 1:3 dilution of sample
Q03	Matrix spike recovery(s) was(were) not within the control limits.
S09	The surrogate recovery for this compound was not within the control limits.

DRAFT

Appendix J: Vegetation Management Plan (Draft)

DRAFT

FEBRUARY 26, 2021

BOLINAS WYE WETLANDS RESILIENCY PROJECT

DRAFT VEGETATION MANAGEMENT PLAN

GOLDEN GATE NATIONAL PARKS CONSERVANCY
201 Fort Mason, San Francisco, CA 94123

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1.0 Overview

The Bolinas Wye Wetland Resiliency Project Area is in Marin County near the town of Bolinas, California. The project site is bordered by State Route 1 on the east, Olema-Bolinas Road on the west, and Bolinas Lagoon to the south. The north end of the project is bordered by private land and the east side is bordered by Point Reyes National Seashore.

The proposed project will reroute Lewis Gulch Creek (LGC) through the historic alluvial fan before entering Bolinas Lagoon. This realignment will reconnect LGC to its floodplain, restore natural hydrologic and geomorphic processes, and reduce flooding on Olema-Bolinas Road. Other actions include raising part of Olema-Bolinas Road above the end of century Sea Level Rise level where it crosses LGC via a bridge, removing the Crossover Road section of the Fairfax Bolinas Road, and removing large patches of invasive species where follow-up treatment is possible. See 60% Basis of Design report (WRA, 2020) for more details.

This plan addresses the vegetation management portion of the project including revegetation of disturbance areas post-construction and invasive species management pre-, during-, and post-construction. It also describes special status species habitat enhancement actions and chemical control of invasive species. The Limit of Disturbance polygon included in all Figures is a Vegetation Management

Limit of Disturbance (LOD) which has been adjusted from the LOD included in the design drawings. The Vegetation Management LOD includes all areas of vegetation disturbance and planned revegetation, but does not include areas of State Route 1 and associated road shoulder which will not be revegetated.

1.1 Goals

Goals for the Bolinas Wye Wetland Restoration Project focus on wetland restoration and sea level rise resiliency. Table 1 was taken from the Bolinas Wye Wetland Restoration Project Basis of Design Report – 30% Design (WRA et al., 2020). The goals that are relevant to this plan are highlighted on Table 1.

Table 1. Goals

Goals	Objectives
Restore hydrological, geomorphic, and ecological processes in the Wye	Allow for an unimpeded flow of surface and groundwater in the Wye
	Restore natural sediment transport processes in Lewis Gulch Creek.
	Direct Lewis Gulch Creek into the wetland and design channel system to promote natural geomorphic processes.
Enhance freshwater wetland communities	Increase the extent of estuarine and palustrine wetland vegetation.
Reconnect Lewis Gulch Creek with its historic floodplain	Design Lewis Gulch Creek to encourage frequent overbank flows.
Prevent further stream bank erosion and incision, to protect habitat and SR-1	Use bioengineering methods along Lewis Gulch Creek to protect areas experiencing accelerated erosion that impacts infrastructure.
Protect and restore native riparian and wetland species	Prevent non-native invasive species colonization by re-vegetating with native riparian and wetland species.
Accommodate Sea Level Rise and climate change by providing areas for the lagoon's habitats to migrate, and by restoring natural geomorphic and floodplain processes	Remove Crossover Road
	Raise roadway
	Reconnect Lewis Gulch Creek to its alluvial fan and allow for future reconnection with Wilkins Gulch Creek.
Improve anadromous fish and amphibian habitat; Improve habitat connectivity and	Raise roadways to provide opportunity for upslope habitat migration and lagoon expansion, thus providing an unimpeded transition zone for areas subject to backwater flooding and delta development.
	Design a creek/floodplain/wetland mosaic with resiliency to withstand climate variability, including extended drought

habitat for special-status species	and excessive rainfall.
	Remove anadromous fish and amphibian migration barriers including the Crossover Road and install bridge on Olema-Bolinas Road for LWG Creek.
Improve road safety	Install crossings to allow for volitional fish passage and migration corridors for non-fish species.
	Realign roads and State Route 1/Olema-Bolinas Road intersection to improve safety.
	Reduce roadway flooding during winter storms and high tide events.
Create a sustainable and self-maintaining system	Reduce or eliminate flooding of roadways.
	Decrease need for vegetation management.
	Reduce or eliminate dredging of roadside channel.

2.0 Revegetation

The Revegetation Plan describes methods used for revegetation and post-installation plant care, plant palettes for each habitat type, and tree planting to compensate for trees that will be removed during construction. Revegetation goals are to foster native plant communities that can accommodate sea level rise and climate variability, including large rain events and drought.

2.1 Revegetation Methods

Several methods will be used to restore vegetative cover within the Limit of Disturbance (LOD) or where invasive species removal has left an area bare. Methods include staking willows, planting container plants, direct seeding, and salvaging plants that would have otherwise been destroyed and planting them back in the LOD. Each revegetation method has benefits and drawbacks, which are discussed below. Recommendations for each revegetation area will depend on several factors: erosion control method, extent of soil disturbance, equipment access, vegetation type, hydrology, and plant community. Multiple methods of revegetation may be used in each area, depending on the needs and limitations of the location. Recommended revegetation methods for each area are shown in Figure 4.

2.1.1 Willow Stakes

Willow stakes are an extremely efficient way to establish erosion control and vegetative cover on a wetland restoration project. Willow stakes used along the creek channel and floodplain should be between 0.75-2 inches in diameter. The length will depend on the location for installation. Longer stakes are needed in higher elevations and shorter stakes can be used where the water table is higher. Willow stakes should be installed a minimum of 18 inches below grade, though final depth will depend on the final grade relative to the water table. Stakes should be trimmed after installation is complete to leave a minimum of one foot of wood above ground with at least two leaf nodes visible. An extra six inches of wood should be included when the stakes are harvested to account for damage to the wood as stakes are installed. With these parameters, the minimum length of stake harvested is three feet long. Stakes should be as straight as possible for ease of installation.

Where to Use this Method

This method should be used on the creek banks, in areas closer to Bolinas Lagoon where willows are the dominant species, and anywhere willows are specified in the plant palette.

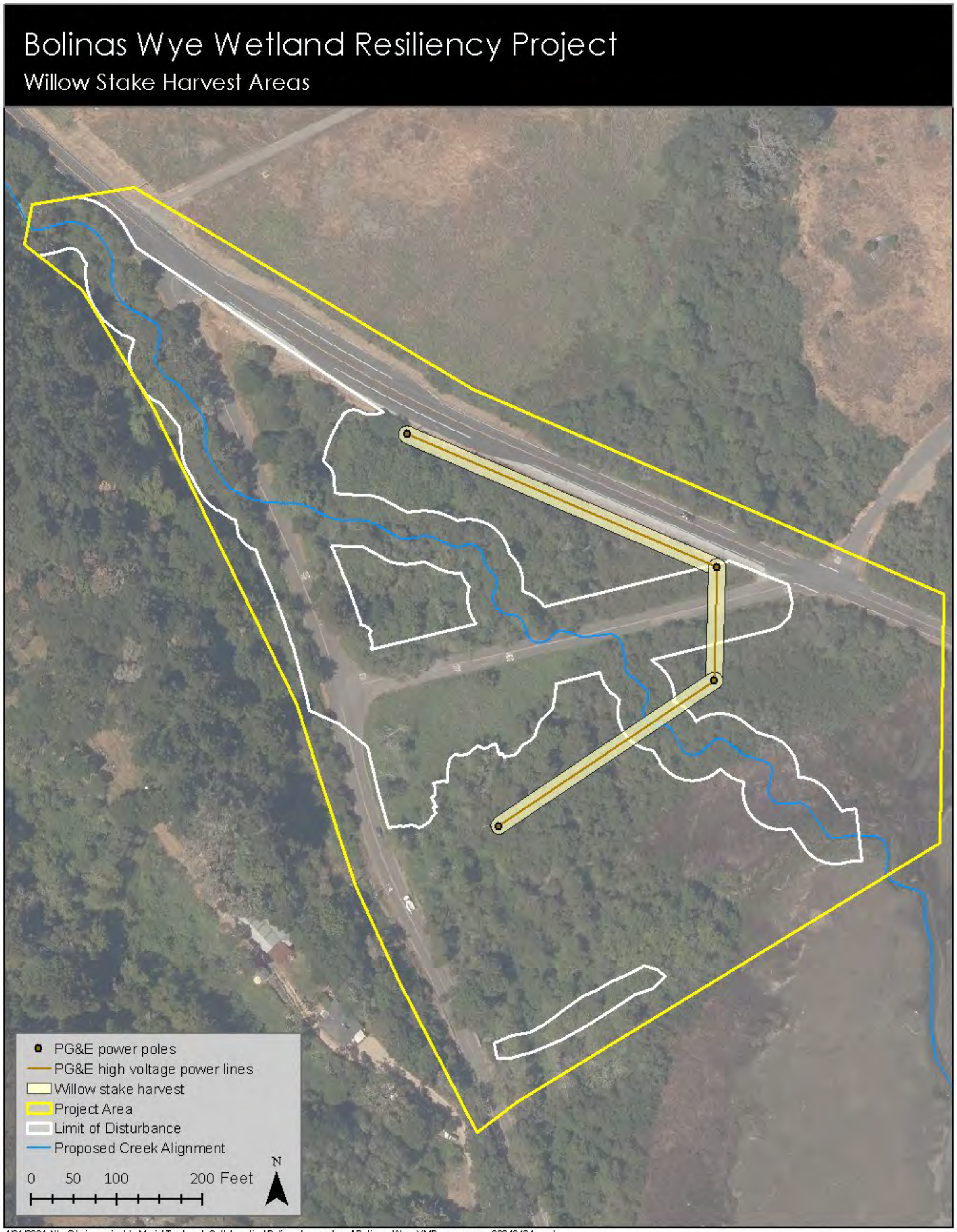
Willow stakes can be installed in net style rolled erosion control product (RECP) by placing the willow stake in a hole created by the net fabric. For installation in areas of tightly woven RECP, holes may need to be cut in the fabric to allow the stake to pass through. Fabric may need to be staked back closely next to the willow stake, depending on the design specifications.

Sourcing and Harvest

Source populations for willow stakes will be identified for installation along creek channel banks and floodplain. Willows growing along the lagoon and upstream of the project will be prioritized as source material.

Willows growing beneath the PG&E power lines within the Project Area have been “topped” and have grown replacement branches that are straight and long. These long willow poles are perfect for use as willow stakes in this project. See Figure 2 for locations for willow stake harvest.

Figure 2. Willow Stake Harvest



Stakes should be harvested as close to the installation date as possible. When stakes are harvested, they should be stripped of branches, leaves, and flower buds. Stakes should be stored with their bottom ends submerged in freshwater. If the stakes dry out, they will be less viable or may not sprout at all.

As stakes are harvested, they should be cut longer than the final installation specification.

Installation of Willow Stakes

Stakes will be installed between 6 ft to 8ft on-center spacing. Each planting area will have a specified number of willow stakes, which should be planted together to create small groupings of willows. The end result should be a mosaic of willows within the planting area. See Figure 4 and Appendix B for locations, quantities, and sizes of willow stakes. Willow stake length will depend upon the depth of the channel: the bottom of the willow stake should be installed such that it is approximately level with the channel thalweg. There should be at least two nodes on the stakes above the soil surface, with one additional foot of willow stake above the nodes which can be removed if the stake splits during installation.

The installation process involves pounding the stakes into the ground with a sledgehammer, post pounder, or dead blow hammer. If a post pounder is used, it may split the end of the stake where the post pounder made contact. To ensure the health and growth of the willow stakes, the split end should be cut off. A dead blow hammer will minimize splitting.

Willow stakes should be installed with the correct orientation. If installed upside down the branches will emerge pointing down to the ground and may not succeed.

Exclosures

Depending on the population of deer and other grazers, the willow stakes may require an exclosure. By providing a protective barrier to grazing, willows establish more quickly and provide cover faster than unprotected counterparts. This barrier can be made of plastic or metal. A design of six-foot rebar used as posts spaced eight feet apart with plastic fencing woven over the rebar is simple to install and remove. Zip ties should be used to secure the netting to the rebar and to itself. The netting needs to overlap itself on the ends by a minimum of two inches.

Exclosures are temporarily used during the dry season; they should be installed after the last large rain, which usually happens by end of March. Removal should be scheduled before rain begins in the fall, which is usually around the beginning of November. Exclosures should be installed for a minimum of three years while the willows grow large enough to survive deer browse. If this not possible, even one year of fencing would be helpful for the willow growth.

This design works best with smaller patches of willows being fenced rather than installing an exclosure over a large area. Fenced patches no wider than twelve feet and no longer than twenty-four feet are recommended. If patch is wider than twelve feet, deer may jump the fence to access the willows and if longer than this the exclosure creates a barrier to animal passage. The topography and current animal trails on site should be considered when installing exclosures to minimize negative impacts.

Example of possible exclosure material and installation.

2.1.2 Container Plants

Containers plants are plant species grown from seed and transplanted into pots. As these plants grow into the larger pot sizes, they have a longer root column that can support larger aboveground vegetation.

Where to Use This Method

Container plants should be used where design specifications allow safe access to the ground for digging, and a diversity of plant species beyond salvage material is desired.
See Figure 4 for recommended container planting locations.

Sourcing

Plant propagules sourced from Marin County within the Lewis Gulch Creek watershed are recommended. Plants should be sourced from a nursery with pathogen-free plants, including phytophthora (Working Group, 2015). The Conservancy native plant nursery program has capacity to collect seed and grow plants for this project. Marin County Parks has a native plant nursery that is not currently staffed but is available if needed.

Plants can be purchased in a variety of sizes. Common sizes for restoration planting are five-inch leach tubes (LT5), seven-inch leach tubes (LT7), deep pot 16 (DP16), and deep pot 40 (DP40). Trees are often grown into one- or two-gallon tree pots. These smaller plants are easier to transport to the site, transplant more easily, and grow more quickly than larger plants.

Installation of Container Plants

Plants should be visually inspected by receiving staff. Any plants that look unhealthy should not be planted. Holes should be dug by hand or with a gas-powered drill with an auger bit attached. Holes should be dug to the depth of the pot. It is important to not dig too deep; a deep hole could leave some roots exposed to air or allow the plant to sink into the hole. Care should be taken to plant each plant at final grade level; too high and the plant's exposed roots can dry out; too low, and the plant will drown or become smothered under soil. After each plant is installed, a flag or bamboo stake should be placed on a consistent side of the plant (such as on the north side) to aid in finding the plant again for watering, monitoring, and follow-up weeding.

Erosion Control

If container plants are specified in an area covered with rolled erosion control products (RECP), they need to be installed after the erosion control products are in place. If planting into net style RECP, the fabric will need to be cut prior to plant installation. This is accomplished by choosing a point where two pieces of the netting intersect and cutting both pieces of netting at that intersection. This creates a small hole where the fabric can be pulled back to expose the soil below. If this hole is not large enough, then more pieces of netting could be cut to widen the hole. Care should be taken to not cut a larger hole in the fabric than is necessary.

If tightly woven style RECP is installed under net style RECP, a larger hole will need to be made in the netting fabric to access the blanket style product below. Once the net style RECP is pulled back, an "X" is cut into the tightly woven RECP and the newly created flaps are tucked under the surrounding tightly woven RECP. Each cut in the "X" should be approximately eight inches long which would yield a six-inch-by-six-inch square for planting. This method should expose the soil enough to accommodate an individual plant. Hole size can be adjusted for larger container plants.

While digging the hole, a paper plate or other surface is useful to hold the excavated soil. Otherwise, this soil gets caught in the RECP and is difficult to reclaim when installing the plant. Project design specifications may require that the cut netting-style or tightly woven RECP be secured in place with landscape staples after the plant is installed.

Exclosures

Certain species will need deer browse protection in the form of woody debris or caging. Buckeye (*Aesculus californica*), red elderberry (*Sambucus racemosa*), and dogwood (*Cornus sericea*) are eaten quickly by deer if not protected. Exclosures for these species can be similar to the willow exclosures (see willow stake exclosure section) if several individuals are planted in a group. This method would work well for dogwood. Exclosures for buckeye and red elderberry need to be smaller to cover each individual plant and allow room for growth. The exclosure material can be the plastic mesh as recommended in the willow exclosures or one-inch gauge metal hardware cloth can be used.

Exclosures should be left in place as long as possible to ensure survival of young plants. If exclosures are installed in an area subject to inundation, the exclosures must be removed before the rainy season, much like the willow exclosures, and reinstalled when the rains have ceased for the season. It is ideal to leave the exclosures on the plants for as long as possible until the plant has outgrown the exclosure.

To install an exclosure, four pieces of four-foot-long rebar should be installed around the tree to make a square shape with the rebar at the corners. The rebar should be 18 inches from the center of the tree. The exclosure material is wrapped around the outside corners of the rebar to make a wall around the tree. The metal hardware cloth can be bent to seat around the corners. The exclosure material should overlap the start and end edges by two inches. Zip ties should be used to fasten the netting to itself and the rebar. The top of the exclosure should be covered no less than 18 inches from the top of the plant. Metal hardware cloth may need to be secured to the ground using six-inch landscape staples.

2.1.3 Direct Seeding

Direct seeding is an easy to implement method for revegetation. It can be used as the primary method or to supplement other methods as plants are getting established.

Where to Use This Method

Direct seeding is recommended in areas where sheet flow is not expected, planting area is without steep slopes, weed pressure is low, project design does not allow container plant installation, and in areas where other methods of revegetation are precluded. This method will work in areas with or without net style rolled erosion control product (RECP). See Figure 4 for recommended direct seeding locations.

Sourcing

Seeds local to Marin County within the Lewis Gulch Creek watershed are recommended. The Conservancy native plant nursery program has capacity to collect seed for this project.

The seeding rate per acre will depend on the species and desired density of live seed per square foot in the Project Area. Sources recommend anywhere from 15 to 60 live seeds per square foot, depending on the species (Natural Resource Conservation Service, Montana, 2013; NRCS, Colorado, 2011; NRCS, Texas, 2011; NRCS, Louisiana, 2019). This translates to a specific amount of pure live seed per acre per species. The seed mix for each location will determine the pounds per acre of seed needed for restoration. See recommended seed mixes in Section 2.2 Plant Palettes.

For side slopes of the new Olema Bolinas Rd, Regreen or other sterile grass seed mix can be used to quickly provide cover and erosion control. Native seeds can be added to this seed mix to provide long-term native species cover after the initial non-native grasses die back.

Distribution Method for Seed

Timing of direct seeding is important. If regular rains are not forecast, the seeds could germinate and dry up. If seeds are planted too late, the germinated plants may not have enough water to establish before the rainy season ends and could be outcompeted by early germinating weeds. Ideally seeds are broadcast after the first rain event and just before the next round of rain. At this point the ground will be moist and ready to accept both the seeds and incoming rainstorm. Each year is different, but generally this window falls in mid to late November.

If broadcasting seed in an area without RECP, the area should be raked to break up the soil surface. The soil surface should be raked flat to remove large depressions or clods of soil sticking out.

To hand-broadcast seeds, a five-gallon bucket should be used for mixing. Dry soil from the planting area is used as a "carrier" with the seeds (Hedgerow Farms, Inc., no year noted on document); this carrier will slightly scarify seeds and allow a more even distribution. One-part seeds to two parts dry soil carrier should be mixed in the bucket then broadcast in handfuls across the site. Once the seed is spread the area should be raked with a rigid rake. This allows for good contact with the soil which is important for germination (Hedgerow Farms, Inc.).

In areas where RECP has been installed, seeds can be broadcast before or after the RECP is installed, but broadcast seeding after RECP has been installed is best. If possible, shake the RECP in place after seeds are broadcast to gain better contact with the soil. To do this, place hands on the netting fabric and shuffle the fabric side to side along the ground.

2.1.4 Salvage Plants

Salvaging plants can be an efficient revegetation method where suitable native vegetation is available. Using existing plants to revegetate lowers costs and ensures genetically appropriate plants for revegetation. Two main methods for acquiring salvage plants are by mechanically harvesting sod masses or by manually harvesting individual desired plants.

Plant salvage is not recommended as a significant source of revegetation material on this site. As of December 2020, mapping of the roadside vegetation did not yield clean salvage for salvage sod material to be used efficiently (invasive species would need to be removed manually to avoid introducing invasive species into revegetation areas). There may be locations where individual plants could be salvaged, but generally this process is time-consuming and will likely not be worthwhile unless there are rare species found on site. When the 60% drawings are available, we can revisit the disturbance areas and determine if there is salvage that could be harvested manually from the lower creek channel, downstream of the Crossover Rd.

See Appendix C. Salvage Plant Methodology for more information.

2.2 Post-installation Care for All Revegetation Methods

Watering

If container or salvaged plants are installed and no rain is forecast within two weeks, plants should be watered every two weeks until rain is continually in the forecast; watering should continue through March. If there is no rain for any significant time period December through March, supplemental watering should continue every two weeks. If plants are installed in the summer and do not have the benefit of regular rains, plants should be watered every two to three weeks for three months.

Water should percolate into the soil column three to six inches to reach individual plant root zones. Approximately 13 gallons of water is needed for every 100 plants. Plants can be watered with a hose from a water tank or from a clean backpack sprayer dedicated to irrigation.

No supplemental watering is recommended for direct seeded plants.

Weeding & Mulching

A six-inch weed-free radius should be maintained around each installed container or salvage plant to reduce competition for water and sunlight. Use a combination of manual weed removal and mulch to maintain this area for three years after installation.

Mulch reduces weed growth, keeps in moisture, and encourages healthy soils around the plant. Place a one and one half-inch-deep and six-inch wide radius of weed-free straw mulch around the plant to create a “skirt” of mulch. The mulch skirt should be replaced annually in the spring for a minimum of three years after the previous years’ mulch has degraded or been washed away. For woody species, keep the straw mulch from touching the plant itself as mulch can encourage rot on woody species.

Weeding in direct seeding areas is not recommended until plants have gotten large enough to identify and will not be negatively impacted by weeding around their root zones. If plants are installed in the late fall/early winter, weeding can be done by June. Weeding too early can result in small native plants being dislodged as non-native species are being weeded nearby. Additionally, technicians responsible for weeding should have good plant identification skills to avoid removal of desired species.

Additionally, the entire LOD should be swept (surveyed and invasive species removed) for all invasive species listed in the Invasive Species Control section. This will prevent high priority species from invading the greater area and negatively impacting the plantings.

2.3 Plant Palettes

In the first year after construction, establishing native vegetative cover is one of the highest goals for project managers. Vegetation controls erosion by holding soil, slowing sheet flow, and softening rain as it hits the soil below. To achieve this cover, plants that establish quickly, grow reliably, and fill space are preferentially selected in higher quantities for the first year of planting. Examples of these species are small-fruiting bullrush (*Scirpus microcarpus*), bog rush (*Juncus effusus* and *J. hesperius*), and coyote brush (*Baccharis pilularis*). In-fill planting in subsequent years then increases the diversity of species.

Revegetation plant communities were created based on the vegetation community mapping done by AECOM; for descriptions of vegetation communities see AECOM’s report, Bolinas Lagoon North End Restoration Project – Site Conditions Report (2016). See Figure 3 for revegetation plant communities within the LOD. Each revegetation plant community is associated with a specific plant palette, see Table 2.

For each plant community, AECOM quantified plant cover for all species. These plant palettes were changed slightly to create revegetation plant communities ; non-native species were removed, and the percent cover was transferred to other plant species in that functional group (e.g. French broom was removed and coyote brush was increased in cover). In other instances, when a non-native plant was removed from the palette, that percent cover was transferred to other native species not originally specified in the palette that are better suited to a first-year planting area.

Coast redwood (*Sequoia sempervirens*) and box elder (*Acer negundo*) were added to accommodate the local community's desire to keep the feel of the area the same. Since one large coast redwood will have to be removed and possibly part of a large box elder, these species were added to one of the plant palettes.

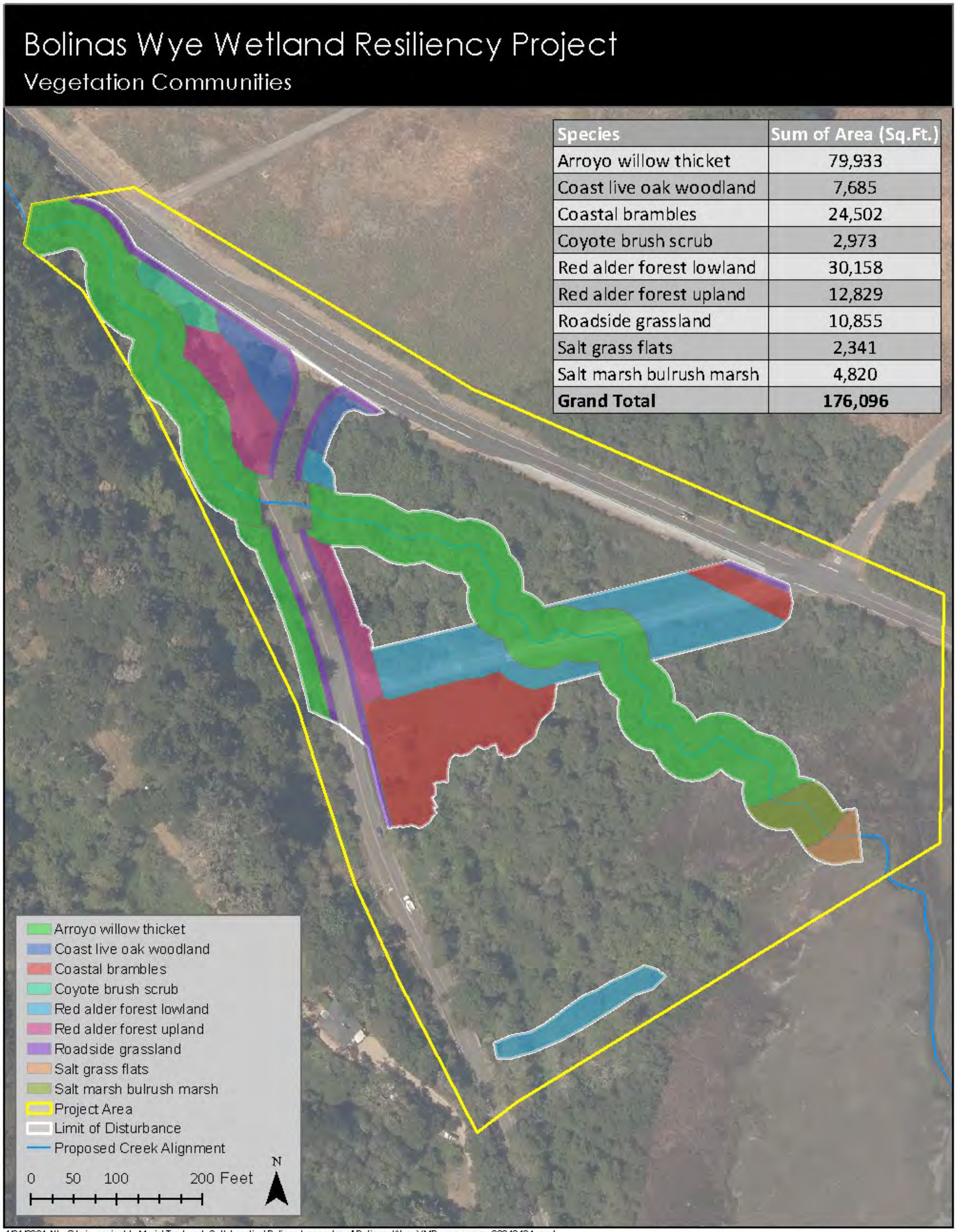
New plant palettes were developed to address project-specific needs. The Former Creek Channel palette is a mix of herbaceous plants to revegetate the drainage channel along Olema-Bolinas Rd and the spoils berm cut-outs downstream of the Olema-Bolinas Rd culvert. This channel will receive flow from the hillslope, which will drain to a downstream culvert. The channel is close to the road and is mowed to maintain sight lines and cleared to maintain drainage capacity. Species were selected which will survive regular disturbance and not impede drainage.

The Roadside Grassland palette is a seed mix for use on the road shoulders, especially the steep road shoulders along the new alignment of Olema-Bolinas Rd. A seed mix is preferred to avoid disturbance to engineered fill. This palette includes a mix of a commercially available sterile wheat product to provide immediate coverage and erosion control, along with native species which will grow more slowly and provide long-term coverage. All selected species will do well with regular mowing.

Another influence on the plant palettes is the availability of species at the nursery. While this should not affect the species of plants that will be planted, it may change the ratio of plants that are ultimately installed.

For revegetation plant lists for each planting area, see Appendix B – Revegetation Species and Quantities.

Figure 3. Vegetation Communities



Species	Sum of Area (Sq.Ft.)
Arroyo willow thicket	79,933
Coast live oak woodland	7,685
Coastal brambles	24,502
Coyote brush scrub	2,973
Red alder forest lowland	30,158
Red alder forest upland	12,829
Roadside grassland	10,855
Salt grass flats	2,341
Salt marsh bulrush marsh	4,820
Grand Total	**176,096**

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Table 2. Plant Palettes

SALT GRASS FLATS				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Distichlis spicata	Salt grass	90%	75%	75%
Salicornia pacifica	Pickleweed	5%	5%	10%
Jaumea carnosa	Marsh jaumea	3%	0%	5%
Bolboschoenus maritimus	Alkali bulrush	2%	0%	10%
Potentilla anserina	Silver cinquefoil	0%	10%	0%
Atriplex leucophylla	Beach salt bush	0%	10%	0%
	subtotal	100%	100%	100%

SALT MARSH BULRUSH MARSH				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Bolboschoenus maritimus	Alkali bulrush	65%	60%	65%
Distichlis spicata	Salt grass	10%	10%	15%
Salicornia pacifica	Pickleweed	10%	10%	15%
Jaumea carnosa	Marsh jaumea	5%	0%	5%
Frankenia salina	Alkali heath	5%	10%	0%
Grindelia stricta	Gumplant	5%	10%	0%
	subtotal	100%	100%	100%

ARROYO WILLOW THICKET				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Salix lasiolepis	Arroyo willow	30%	10%	0%
Scirpus microcarpus	Small-fruiting bulrush	30%	30%	20%
Rubus ursinus	California blackberry	15%	10%	5%
Persicaria punctata	Smartweed	2%	8%	15%
Cornus sericea	American dogwood	0%	5%	10%
Carex obnupta	Slough sedge	8%	10%	12%
Alnus rubra	Red alder	10%	5%	0%
Stachys chamissonis	Hedge nettle	3%	7%	14%
Oenanthe sarmentosa	Water parsley	1%	8%	14%
Woodwardia fimbriata	Western chain fern	1%	7%	10%
	subtotal	100%	100%	100%

RED ALDER FOREST - LOWLAND				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Alnus rubra	Red alder	30%	20%	0%
Scirpus microcarpus	Small-fruiting bulrush	30%	20%	25%
Salix lasiolepis	Arroyo willow	15%	5%	0%
Scrophularia californica	Bee plant	3%	5%	10%
Juncus lescurii	Dune rush	5%	8%	12%
Carex obnupta	Slough sedge	5%	8%	7%
Sambucus racemosa	Red elderberry	5%	5%	0%
Woodwardia fimbriata	Wester chain fern	1%	5%	2%
Potentilla anserina	Silver cinquefoil	2%	5%	11%
Stachys chamissonis	Hedge nettle	1%	5%	11%
Persicaria punctata	Smartweed	3%	8%	11%
Urtica dioica	Stinging nettle	0%	6%	11%
	subtotal	100%	100%	100%

RED ALDER FOREST - UPLAND				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Alnus rubra	Red alder	35%	20%	0%
Scrophularia californica	Bee plant	22%	20%	20%
Scirpus microcarpus	Small-fruiting bulrush	16%	10%	13%
Salix lasiolepis	Arroyo willow	10%	0%	0%
Juncus lescurii	Dune rush	5%	5%	10%
Sambucus racemosa	Red elderberry	3%	4%	0%
Acer negundo	Boxelder	2%	2%	0%
Sequoia sempervirens	Coast redwood	6%	7%	0%
Persicaria punctata	Smartweed	0%	3%	10%
Juncus hesperius	Coast rush	0%	5%	10%
Ribes menziesii	Gooseberry	0%	5%	5%
Woodwardia fimbriata	Western chain fern	1%	1%	2%
Potentilla anserina	Silver cinquefoil	0%	6%	10%
Stachys chamissonis	Hedge nettle	0%	7%	10%
Urtica dioica	Stinging nettle	0%	5%	10%
	subtotal	100%	100%	100%

COASTAL BRAMBLES				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Rubus ursinus	California blackberry	50%	40%	35%
Scirpus microcarpus	Small-fruiting bulrush	10%	11%	15%
Alnus rubra	Red alder	15%	8%	5%
Artemisia douglasiana	Mugwort	5%	11%	15%
Sambucus racemosa	Red elderberry	5%	5%	3%
Juncus lescurii	Dune rush	7%	10%	11%
Juncus hesperius	Coast rush	5%	10%	11%
Baccharis pilularis	Coyote brush	3%	5%	5%
	subtotal	100%	100%	100%

COAST LIVE OAK WOODLAND				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Quericus agrifolia	Coast live oak	40%	20%	10%
Umbellularia californica	California bay	10%	5%	5%
Heteromeles arbutifolia	Toyon	10%	5%	5%
Artemisia californica	Coastal sage brush	5%	7%	10%
Artemisia douglasiana	Mugwort	0%	5%	5%
Lupinus arboreus	Bush lupine	0%	5%	5%
Aesculus californica	California buckeye	5%	3%	3%
Fragaria vesca	Woodland strawberry	5%	5%	5%
Stipa pulchra	Purple needle grass	5%	5%	5%
Calystegia subacaulis	Hill morning glory	0%	5%	5%
Chlorogalum pomeridianum	Soap root	5%	5%	5%
Marah oregana	Coast man-root	5%	5%	5%
Scrophularia californica	Bee plant	5%	5%	10%
Lonicera hispidula	Pink honeysuckle	0%	5%	7%
Danthonia californica	California oatgrass	5%	5%	5%
Dichelostemma capitata	Blue dicks	0%	5%	5%
Triteleia laxa	Ithuriel's spear	0%	5%	5%
	subtotal	100%	100%	100%

COYOTE BRUSH SCRUB				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Baccharis pilularis	Coyote brush	50%	10%	10%
Artemisia californica	Coastal sage brush	20%	20%	10%
Stipa pulchra	Purple needle grass	7%	10%	10%
Rubus ursinus	California blackberry	14%	12%	10%
Mimulus aurantiacus	Sticky monkey-flower	3%	8%	10%
Frangula californica	Woodland strawberry	5%	4%	0%
Lonicera hispidula	Pink honeysuckle	1%	0%	0%
Lupinus variicolor	Varied lupine	0%	8%	10%
Juncus patens	Blue rush	0%	7%	10%
Clinopodium douglasii	Yerba buena	0%	7%	10%
Dryopteris arguta	Wood fern	0%	7%	10%
Sanicula crassicaulis	Snake root	0%	7%	10%
	subtotal	100%	100%	100%

FORMER CREEK ALIGNMENT				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
Carex obnupta	Slough sedge	10%	10%	5%
Juncus hesperius	Coast rush	25%	25%	25%
Juncus lescurii	Dune rush	25%	25%	25%
Persicaria punctata	Smartweed	10%	15%	15%
Scirpus microcarpus	Small-fruiting bulrush	25%	15%	15%
Oenanthe sarmentosa	Water persley	5%	10%	15%
	subtotal	100%	100%	100%

ROADSIDE GRASSLAND seed mix				
Scientific Name	**Common Name**	**Year 1**	**Year 2**	**Year 3**
ReGreen (seed mix)	ReGreen	50%	25%	0%
Festuca rubra	Red fescue	15%	25%	40%
Elymus glaucus	Blue wild rye	10%	10%	15%
Danthonia californica	California oatgrass	10%	15%	15%
Artemisia douglasiana	Mugwort	5%	10%	10%
Scrophularia californica	Bee plant	5%	10%	10%
Juncus patens	Blue rush	5%	5%	10%
	subtotal	100%	100%	100%

2.4 Planting Areas

Revegetation plant communities are numbered in Figure 4; each is a planting area. Appendix B includes plant species lists and quantities for each planting area. The information in Appendix B will be used for cost estimating. This information can also be used for ordering plants and organizing revegetation field work.

Planting densities will vary between planting areas based on current conditions, level of disturbance, and expected recovery of native vegetation following construction. In areas where native vegetation will be retained during construction, revegetation density will be lower. For example, downstream of the Crossover Rd, plates will be put down to reduce soil compaction and protect root structures. Native wetland vegetation is expected to rebound well and provide significant cover following construction

Within each planting area, each species has a specific on-center planting density and grouping as shown in Appendix B. This on center spacing and grouping is designed to promote greater survivorship of slower-growing or smaller species and to reflect the native mosaic of different habitats. Annuals and forbs benefit from being clumped together closely in sets of five or more while large woody species need to be spaced further apart so they have ample room to grow. For example, small-fruiting bulrush grows in large colonies and can be planted closely together in groups of 7, while gooseberry grows individually or in small sets of plants and is planted accordingly.

2.5 Tree planting

Tree species are included in many of the plant palettes. In addition, compensatory tree plantings are required to mitigate the impacts of tree removal. CDFW has provided the following example mitigation guidance for tree removal. These tree replacement ratios were used in determining the number of trees to be planted, see Table 3 and 4 below.

Questions for CDFW: Do a given percentage of trees need to survive for 5 years post-construction? Is SOD in the area and how does this impact the number of trees planted? Do willow stakes meet replacement requirements? A large number of oak trees are required using this replacement ratio, does this make sense for this project given the limited area appropriate for oak tree planting?

Native tree replacement guidelines from CDFW (example from a recent project):

"Tree Replacement. Permittee shall include compensatory tree plantings in the final Planting Plan at the following ratios for the removal of all trees greater than or equal to 6 inches in diameter at breast height: 3:1 ratio for removal of native species and a 1:1 ratio for removal of non-native species.

Oak trees removed from riparian zone shall be compensated at the following ratios:

4:1 replacement for impacted trees 5- to 10- inches in diameter

5:1 replacement for impacted trees greater than 10- to 15-inches in diameter

Trees greater than 15-inches in diameter are considered old growth oaks and shall be mitigated at a ratio of 15:1

Replacement oaks shall come from nursery stock grown from locally sourced acorns, or from acorns gathered locally, preferably from the same watershed in which they are planted. The trees should be able to survive the last two years of the minimum five-year monitoring period without supplemental irrigation. If at any time Permittee identifies additional trees that need to be removed, Permittee shall first get written approval from CDFW and Permittee shall revise the final Planting Plan to include additional tree plantings in accordance with the abovementioned ratios."

Table 3. Tree Replacement

Non-oak Tree Replacement

Species	Common Name	Count of Tag ID	Replacement Ratio	Replacement #
Acer negundo	Boxelder	1	3:1	3
Aesculus californica	Buckeye	1	3:1	3
Alnus rubra	Red alder	32	3:1	96
Hesperocyparis macrocarpa	Monterey cypress	1	1:1	1
Prunus cerasifera	Plum	1	1:1	1
Salix laevigata	Polished willow	1	3:1	3
Salix lasiolepis	Arroyo willow	24	3:1	72
Sequoia sempervirens	Coast redwood	2	3:1	6
Umbellularia californica	California bay	2	3:1	6
Grand Total		**91**		**273**

Two redwood trees will be removed during project implementation. During revegetation six redwoods will be planted, with the expectation that two or three will survive to maintain the current aesthetics of the area. However, a significantly larger number of alders and willows will be planted than is required, and the total number of trees planted will far exceed the mitigation requirements.

Table 4. Oak Tree Replacement

Oak Tree Replacement

Diameter	Replacement Ratio	# Existing Trees	# Trees to Plant
5-10	4:1	7	28
10-15	5:1	6	30
>15	15:1	15	225
Grand Total			**283**

2.5.1 Sourcing

Marin-sourced propagules are recommended for all tree species. It is especially important to make sure all oak and bay species are phytophthora-free. Trees should be in DP40 or 1-2-gallon tree pots.

The Conservancy native plant nursery program has capacity to collect seed and grow trees for this project. Liz Ponzini, the Conservancy's Marin Headlands Native Plant Nursery Manager, suggested that propagules should be collected in the fall, two years before planting.

Marin County Parks has a native plant nursery that is not currently staffed but is available if needed.

2.5.2 Installation of Trees

Trees should be planted with the root crown buried just below the surface soil. If trees are planted too deeply, the plants will die. If trees are planted too high with the root ball visible above the soil, the roots will dry out and the plant may die.

The root ball of trees should be scored along the sides and bottom to cut the circling roots around the root column, the scoring cut should be between one-quarter and one-half inches deep. Circling roots continue to grow and can eventually lead to failure of the trees.

Small trees may need exclosures placed around them to protect from deer browse. Oaks, buckeyes, and maple trees are vulnerable to deer browse. Solar tubes are not recommended.

A simple exclosure can be made using four pieces of rebar with one inch or smaller gauge mesh metal hardware cloth caging or one-inch mesh plastic netting van be used. To install, place four-foot-long rebar around the tree to make a square shape with the rebar at the corners. The rebar should be 18 inches from the center of the tree. The exclosure material is wrapped around the outside corners of the rebar to make a wall around the tree. The metal hardware cloth can be bent to seat around the corners. The exclosure material should overlap the start and end edges by two inches. Zip ties should be used to fasten the netting to itself and the rebar. The top of the exclosure should also be covered with material, which should be at least 18 inches from the top of the plant. Metal hardware cloth may need to be secured to the ground using six-inch landscape staples.

Flags or stakes should be used to mark the location of trees. The species name can be written on the pin flag to track individual plantings.

2.5.3 Post-Installation Care for Trees

Oak trees should be watered every other week through the rainy season if no rain is forecast. Through the summer and fall, oak trees should be watered once a month. If continuous rain is in the forecast, then watering can be paused until the forecast is dry. Enough water should be used to percolate through to the entire root ball. Trees can be watered along with other container and salvage plants, but they need to have more water than other plants due to the deeper root column.

After the first few times the trees are watered, if the trees appear to be sinking into the planting holes, it is important to replant them higher to assure survivorship.

Placing a six-inch-wide, one and one-half-inch-deep mulch skirt around the base of planted trees will hold in moisture and reduce weed pressure. Straw mulch should be placed one-half inch from the base of the tree; straw mulch on the trunk of the tree can lead to rot and failure of the tree.

As mulch degrades or is swept away with rain events, it should be replaced. It should also be replaced annually in the spring after the forecast dries out.

2.6 In-fill Planting

In-fill planting in the 2 years following construction is useful to both improve native species cover by planting in areas where survivorship has been low, and to increase diversity by planting a wider variety of native species. Some species are more successful when planted after more hardy species have become established. In-fill planting recommendations can be modified based on the success of the initial planting as part of the adaptive management of the site. Species, quantities and locations for infill in each planting area are included in Appendix B. (Appendix B to be developed with 60% designs) (Additional species for infill include- *Urtica, Atriplex leucophylla, Potentilla anserina, Woodwardia fimbriata, Dryopteris arguta, Sanicula crassicaulis, Chlorogalum pomeridianum, Marah fabacea*)

3.0 Invasive Species Control

Non-native invasive species (NNIS) threaten the habitat at the Bolinas Wye Wetland Resiliency Project Area. See Figure 5, All Non-native Invasive Species Mapped in 2020. Many of the species exclude native plants from establishing and suppress the growth of existing native plant populations. Native plants are the basis of the food web which supports an ecosystem, from insects to birds of prey (Tallamy, 2009). To have a healthy, functioning ecosystem, specific invasive plants should be controlled as resources allow.

Goals for invasive species management:

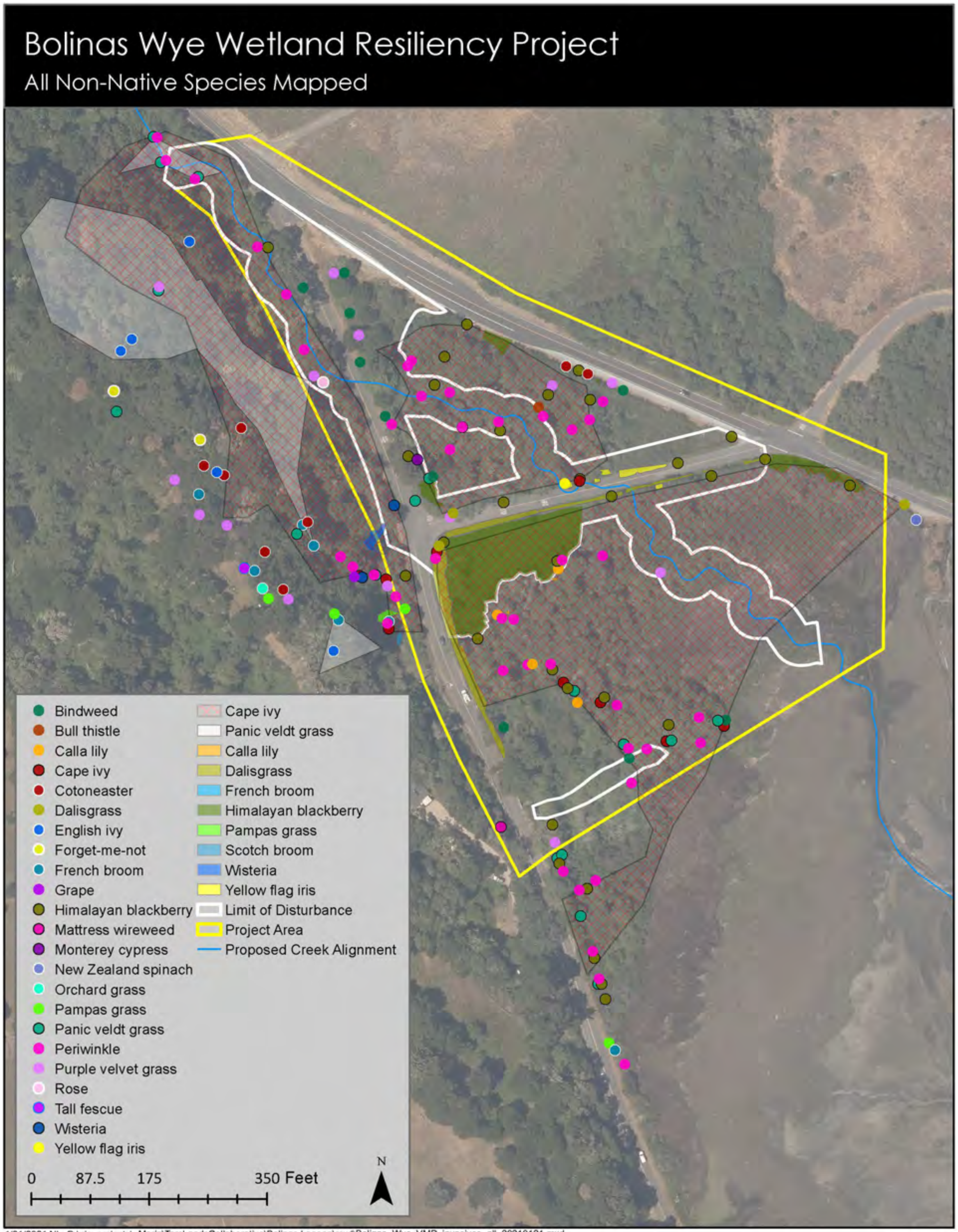
- Establish Active Management Zones for focused management of target invasive species: Cape ivy, Himalayan blackberry, and periwinkle.
- Reduce NNIS plant cover to 15% in revegetation areas to promote survivorship for five years post-construction.
- Fully control a subset of invasive species within the Project Area (see Full Control section).
- Reduce a subset of species to low levels within the Project Area (see Control to Low Levels section).

Great care should be taken during project implementation to ensure that all equipment, vehicles, and boots are clean and free of plant material and soil to prevent the introduction and movement of weed seeds. If project work needs to happen where weeds are present, use best management practices (BMPs) and, where possible, work in contaminated areas last. See Vegetation and Biodiversity Management Plan for Marin County Parks for approved BMPs (May & Associates, Inc. 2015). Within the site, boots, equipment, and vehicles should be cleaned before moving from a “dirty” area with weed seeds back to a “clean” area that does not have that same infestation. Minimize soil disturbance and soil movement as much as possible.

All invasive species control work is subject to BMPs for working in CRLF habitat (see California Red-Legged Frog (CRLF) section), including biomonitoring ahead of tool use and no piling of weeds on site for removal later.

This section focuses on how to control each species individually pre-, during-, and post-project. The post-project period is defined as a period of five years following construction. Appendix A outlines the target treatment month for each species in the five years after project completion. Should resources become available after the five-year follow-up period, treatment for each species should be evaluated based on the efficacy of the treatments to date.

Figure 5. All Non-Native Invasive Species



The following sections are not an exhaustive list of the NNIS on site; rather, they include high priority NNIS which should be controlled with the limited resources available. Species are listed in alphabetical order by common name. Consult the California Invasive Plants Council (www.cal-ipc.org), CalFlora (calflora.org), and local experts on species not listed in this report that appear to be invasive and impacting native revegetation.

It should be noted that the parcel west of Olema-Bolinas Road has minimal NNIS actions in this plan. This parcel was surveyed for NNIS and many were found: the area has large infestations of wisteria, Cape ivy, French and Scotch broom, panic veldt grass, and pampas grass. Recommendations were made based on the limited resources for initial and follow up control of the species. If more resources become available, NNIS management could expand into this area.

3.1 Invasive Species Control Categories and Definitions

Species are organized in three categories describing the priority level and approach for management: target species, full control species, and control to low level species.

Target Species: Due to the scale of the Cape ivy, Himalayan blackberry and periwinkle invasion in the Bolinas Wye, and the cost and effort involved with initial removal and on-going maintenance needed to control these species, complete removal is not possible at this time. To best use limited resources, only specific patches will be targeted for removal. Active Management Zones (AMZ) are described for focused management of target species.

Target Species AMZ: Within this area, the goal is full control of Cape ivy and Himalayan blackberry, and control of periwinkle to low levels within the construction Limit of Disturbance (LOD). The AMZ includes the LOD, two adjacent areas where Himalayan blackberry is located, and the entire “upper triangle” of the Wye north of the Crossover Road. The LOD encompasses the new LGC alignment, the graded floodplain area upstream of the new Olema-Bolinas road alignment, and the area where the Crossover Road will be removed. The entire upper triangle has been added to the AMZ because only small patches of un-treated Cape ivy are outside the LOD and would create a more difficult management situation if left in place rather than removed. See Figure 6, Target Invasive Species.

Full Control: This category includes species to be removed wherever they are found within the Project Area. These high priority invasive species are currently found in limited locations and it is feasible to completely control them in the Project Area. For some species, complete eradication may be more easily achieved with herbicide use.

Low Level Control: This category includes species which are present in many locations throughout the Project Area and surrounding areas making complete removal very challenging. Regular removal of new infestations, especially in the revegetation areas, will limit impacts and allow native vegetation to establish. If resources allow, control of these species could increase over time.

Other terms that will be used in this section are defined below.

Project Area: This is the complete Study Area as defined in the CEQA Project Description. Within this area, species will either be fully controlled or controlled to low levels as described below. Cape ivy, non-native blackberry, and periwinkle will not be controlled throughout the Project Area, only in the Target Species AMZ. The Project Area is shown as a yellow boundary line on all figures.

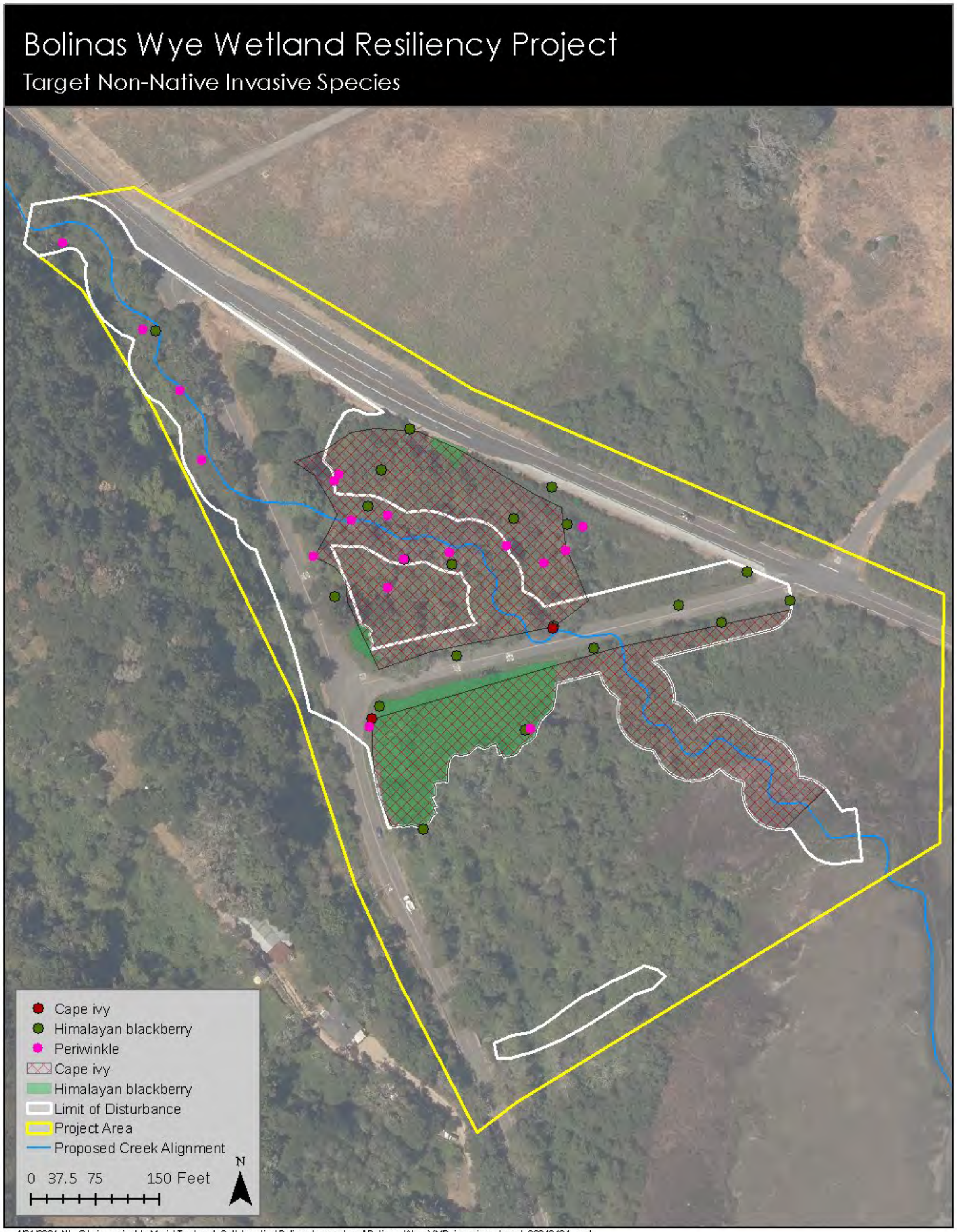
Limit of Disturbance (LOD): Within this area, equipment will disturb soil during construction which will be followed by revegetation with native species. Equipment can be used in this area to remove NNIS roots and rhizomes. Outside of this area, manual removal will be used to remove roots. The LOD is shown as a white boundary line on all figures.

Containment Lines: Depending on density and height of vegetation, containment lines may need to be established to separate the Target Species AMZ from the surrounding areas. Containment lines are areas where vegetation is cleared to separate an area where invasive species are managed from an area where they are not managed. Containment lines require regular maintenance. They should be flagged along each side of the line and then mapped using ESRI applications or a Trimble device. This shape can be added to a map which can be used in the field with ESRI applications or Avenza PDF Maps to locate the containment line in the future.

Sweeps: This refers to a crew carefully surveying an area to find priority NNIS and remove them.

3.2 Target Invasive Species

Figure 6. Target Invasive Species



Three species have been identified as high priority target species which are present throughout the Project Area and significantly impacting native habitat: Cape ivy, Himalayan blackberry, and periwinkle. Resources are not available to manage these species throughout the entire Project Area. An AMZ has been defined within which these species will be fully controlled, and they will not be controlled in other areas. See Figure 6, Target Invasive Species.

These species could be spread during construction or are best controlled with the assistance of heavy equipment, and therefore initial removal should occur prior to or during construction. Monitoring and treatment will occur regularly for 5 years following construction to ensure these species do not suppress native vegetation. Other NNIS will also be actively managed in the Target Species AMZ.

3.2.1 Cape Ivy (*Delairea odorata*)

Cape ivy has been mapped throughout the site (One Tam, 2020). Cape ivy is rated by Cal-IPC as 'highly' invasive. It is also on the California Department of Food and Agriculture's (CDFA) list of noxious weeds, rated B (A is the highest rating). This weed is found along coastal California; where it is found in wetlands it can cover a high percent of the area. This is the case in much of the Bolinas Wye.

Cape ivy spreads primarily through pieces of the plant that break off and relocate. A plant can grow from a one inch or greater piece of stem with at least one node that has contact with soil (DiTomasso, 2013). A node is the point of the stem where leaves and branches grow. At Bolinas Wye, infestations upstream are a continuous source of propagules as pieces break off and are brought into the Wye by Lewis Gulch Creek. Plants can also regrow in place after initial removal when small pieces of plant are left behind. Cape ivy can reproduce from seed, but this is rare in Marin County.

Cape ivy can be found in all habitats along the California coast. It is a vining species that winds itself around trees, forbs, and graminoids. It grows intermixed in thick scrub or dense rushes which are challenging locations for other invasive weeds. This species is fast-growing and persistent and requires a minimum of ten years follow up before an area can begin to be considered clear of Cape ivy.

Prior to Construction

Successful eradication of Cape ivy requires initial cutting and removal of much of the infested aboveground vegetation (both native and non-native) and frequent, thorough follow-up. Using chainsaws and hand tools, work crews cut infested vegetation to near ground level in order to rake and remove all traces of Cape ivy. Wherever possible native perennial vegetation is pruned-back to allow for removal of Cape ivy while leaving the root structures of desirable vegetation intact. Often a secondary pass using hand tools is necessary in order to remove all infested debris and Cape ivy root fragments.

As Cape ivy-infested slash and debris generated from initial cutting is raked and staged for off-haul, care is taken to work around desirable native plants. Cut vegetation is placed onto tarps and/or into bags and subsequently transported by hand or vehicle to an adjacent green waste debris container for off-haul and disposal. Final site conditions show exposed soils visibly free of Cape ivy, with pruned native vegetation left in situ. Large logs and sticks free of Cape ivy debris can be left on site if needed, but it is better to haul off as much material as possible.

To complete removal, monthly follow-up sweeps using manual removal methods are required. This task is best accomplished by a small contract crews with experience in Cape ivy follow up. See Workforce Options and Roles section for discussion.

Examples of material that can be left on site during Cape ivy removal.

Recommended Approach to Initial Removal

A trained field crew of six to twelve people will use chainsaws to cut vegetation as described above. One biomonitor would be needed for every one or two sawyers. We recommend renting a debris box which can be staged on the road or road shoulder. Biomass should be bagged or tarped to ensure that no loose stems escape during transport to the debris box. Biomass can be moved using wheelbarrows, power carriers, or small UTVs. To protect fragile wetland soils, place plates or plywood mats on the soil to reduce compaction and disturbance.

Alternative A

A professional, experienced work crew of six or twelve people can perform initial removal of Cape ivy. This option generally completes work more quickly and requires less staff oversight, but may be more expensive.

Alternative B

A job-training Conservation Corps, such as Conservation Corps North Bay (CCNB) could do the same work scoped for a professional crew above. This option provides job training and builds relationships, but does require additional training, staff oversight, and does not complete the work as quickly. For more information on this work group see Work Force Options section.

During Construction

Cape ivy is very easily moved around on site. Small pieces of the stem or roots can resprout and develop into a new plant. To avoid spreading Cape ivy, it is recommended that construction begin in areas clear of Cape ivy and move toward areas infested with Cape ivy. Movement of soil on site should take into account locations of cape ivy infestations and recognize Cape ivy will be moved with soil. If grading occurs where Cape ivy exists, machinery will need to be thoroughly cleaned and inspected before working in a “clean” area to avoid moving cape ivy.

Post-construction Follow Up

If resources allow, Cape ivy will be fully controlled within the Target Species AMZ during the five-year post-construction period. Full control means all new individuals are removed. Beyond that period, follow up will need to be re-evaluated based on available resources. Without dedicated resources it is impossible to control this species to eradication. Outside of the Target Species AMZ, treating Cape ivy is not recommended unless dedicated resources can be committed for follow-up.

After initial removal, follow-up sweeps for Cape ivy should be conducted on a monthly basis using trained staff or contractors. It is anticipated that during the first few years after initial removal it will take multiple days to sweep the entire site. To ensure successful recovery of native vegetation in the treatment area, follow-up should also include the removal of ruderal weed species and any secondary invasions of target weed species.

Cape ivy management for eradication requires diligence during the follow-up phase. Sweeps should be organized systematically to ensure that cleared areas are thoroughly monitored for Cape ivy resprouts. Follow-up personnel may use flagging to delineate their start/end points and/or to mark areas that will need additional follow-up focus. Staff/contractors should be instructed to use patience when performing sweeps; when resprouts are located they should be encouraged to take the time necessary to dig out the entire root structure. Pulling or tugging at resprouts will only break-off the above ground Cape ivy vegetation and is therefore discouraged. If a Cape ivy resprout is embedded in a dense clump of vegetation, the best approach is to dig up the entire infested root-mass and tease out any Cape ivy present. In some cases, rhizomatous native species can be separated into divisions and replanted. This will allow for more through Cape ivy removal and aid native plant revegetation efforts.

For follow up, monthly sweeps of the removal area are required in the first two years post-removal. In years three through five, sweeps are required every other month (Bolinas Wye Vegetation Management – Cape Ivy Removal Methods and ROM Costs Report, January 2020). Containment lines may be useful to create a boundary between the AMZ and untreated areas. For example, on the downstream side of the Crossover Road, Cape ivy will only be controlled along the new channel alignment. To support management of the Crossover Road revegetation area a containment line could be maintained on the downstream boundary.

3.2.2 Himalayan Blackberry (*Rubus armeniacus*)

Himalayan blackberry is rated as having a 'high' ecological impact in California by Cal-IPC and can grow in a variety of habitats including disturbed areas, riparian areas, and forests. This species quickly grows into dense patches that shade out native vegetation. It spreads vegetatively through cane rooting as well as via berries, which are often dispersed by wildlife.

One large and several small patches of Himalayan blackberry have been mapped within the Project Area. The large patch is at the intersection of Olema-Bolinas Road and the Crossover Road. See Figure 6, Target Invasive Species.

Recommended Approach to Aboveground Biomass Initial Removal

The above-ground biomass of the large blackberry thickets can be removed in several different ways: skid steer masticator, chainsaw by professional field crew, or chainsaw and brush cut by CCNB. Biomass removal should then be followed by excavation of root balls, ideally using equipment; see Figure 9, Invasive Species to be Removed by Equipment. The biomass removal should be done within a few months of root removal. The longer the interval between biomass removal and root excavation, the more aboveground biomass will be regrown making further removal difficult. Biomass and roots should be disposed of offsite using similar methods as described for Cape ivy.

Alternative A: Masticator

A masticator is a machine that quickly shreds the above ground vegetation. It can be used to progressively remove the tops of the blackberry thickets as a biomonitor observes, searching for CRLFs. Masticated vegetation can be raked onto tarps or into bags and hauled to a debris bin. The masticator is likely the fastest option for removing aboveground biomass but may not be the cheapest. Costs for this have not been explored fully.

Alternative B: Chainsaw by Field Crew

A work crew of six to twelve people can chainsaw the blackberry thicket, then haul the vegetation to a chipper or debris bin to dispose of the plant material off-site. Each sawyer would require a biomonitor to clear the area for CRLFs.

Below-ground Removal

After mastication, the area should be biomonitored for CRLFs and the root mass of the entire thicket should be removed with heavy equipment. Excavation of root balls should continue, increasing in depth, until a vegetation monitor decides they are not visibly present in the excavated hole. This could be as deep as three feet below grade in some locations.

It should be noted that Cape ivy, periwinkle, and dallisgrass are also growing in the same area as the Himalayan blackberry patches. It is recommended that these species be removed off-site with the blackberry vegetation and roots.

Post-Construction Follow Up

Himalayan blackberry can be treated by manually digging out roots and rhizomes. Young individual plants can be dug out with a hand pick or shovel. The entire Project Area should be swept annually in the fall to remove young individuals. The Target Species AMZ should be swept in the spring and fall to control existing and new populations using manual removal. Removal of the aboveground portion of the plants is recommended while the site is revegetating following Cape ivy removal, and extra care should be taken to remove Himalayan blackberry found in native planting areas.

Roots of established plants can go down as deep as three feet, so manual removal is only effective at suppressing – not removing – well-established plants. If older populations continue to persist, cut stump application of herbicide in the fall should be considered. See Chemical Control section for cut stump application information.

3.2.3 Periwinkle (*Vinca major*)

Periwinkle has been mapped throughout the Project Area. This species has a 'moderate' ecological impact rating from Cal-IPC. Periwinkle can grow in a variety of light and moisture conditions, but does best in moist, shady locations. Once introduced to a site, periwinkle can grow rapidly and establish dense root systems and groundcover that outcompetes native understory plants.

Periwinkle primarily spreads via above ground stems rooting at the tips, but can also spread by plant fragments that create new infestations once rooted. Ground disturbance and the movement of plant fragments during the project has the potential to increase the cover of periwinkle if it is not properly controlled.

Initial Removal During Construction

Where periwinkle is found within the Limit of Disturbance (LOD) and Himalayan blackberry removal areas, the surface soil should be scraped by heavy equipment to remove periwinkle roots and disposed off-site. This area, shown on Figure 9, includes the area of the new LGC alignment upstream of the Crossover Road. It is recommended this area be scraped to remove periwinkle in the first year of construction followed by on-going periwinkle removal as part of NNIS management. If possible, another pass for root removal should happen at the beginning of construction phase two.

The average depth of periwinkle roots is not clear in the literature, but local practice is to excavate eight inches to remove as much of the root ball as possible. A vegetation monitor should confirm that all roots have been removed. Since periwinkle spreads easily through stolons and pieces of roots, no soil infested with periwinkle should be moved and re-used anywhere on site, this material needs to be carefully transported to a debris box and removed from site. Plywood or plates can be placed for equipment access to protect surrounding vegetation which will allow it to quickly rebound following disturbance.

Depending on the extent of soil scraped, erosion control materials or temporary revegetation (from ReGreen or other sterile seed mix) may be used to control erosion. If the scraped area is a patchy mosaic erosion control may not be needed.

Post-Construction Follow Up

Periwinkle is difficult to control manually or mechanically due to extensive root systems and the ease of dispersal through plant fragments. All plant material, including roots, should be bagged and removed from site. Quarterly sweeps are needed to remove any resprouting fragments.

Control of periwinkle is recommended only where equipment can perform an initial scrape to remove roots; outside of the LOD and Himalayan blackberry removal areas (which will be scraped with equipment) periwinkle removal is not recommended unless foliar or cut stump chemical control can be used. In other areas of the Target Species AMZ where no equipment use is planned, removing periwinkle will not be worthwhile if herbicide cannot be used. See Chemical Control section.

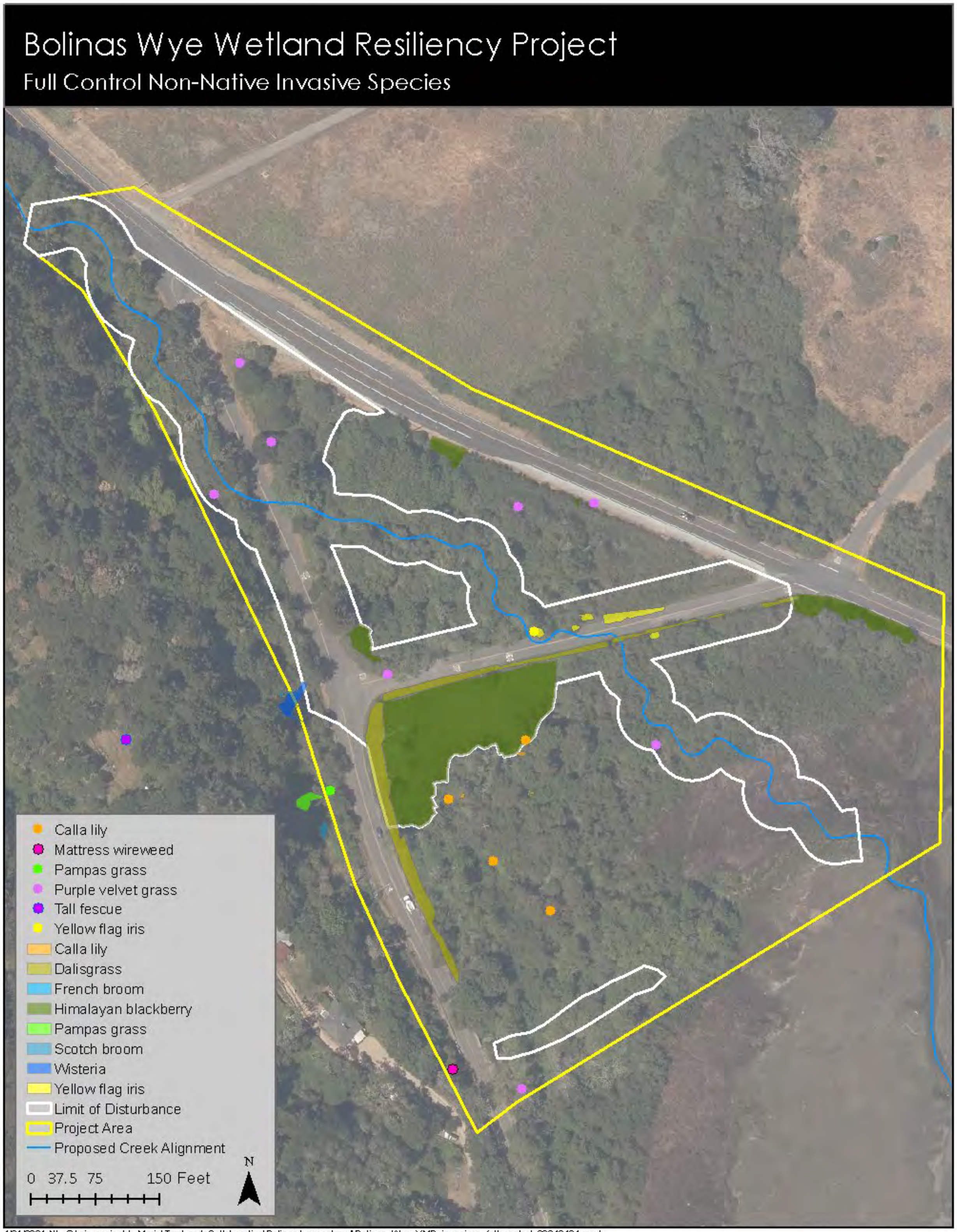
In the upper section of the Wye, there are Cape ivy removal areas outside of the LOD, and where periwinkle will not be removed with equipment. In these areas removal of the aboveground portion of periwinkle plants is recommended while the site is revegetating following Cape ivy removal. New and existing individuals can be removed during Cape ivy sweeps.

3.3. Full Control Species

These are high priority species that are of low enough density in the Project Area that they should be removed from the site while populations are small enough to make removal feasible. Any occurrence of these species should be removed within the Project Area, see Figure 7, Full Control Invasive Species.

Species were placed in this category based on California Invasive Species Council's rating as a high threat, institutional knowledge about how these species behave in the local area, and their ease of control. These factors were balanced against the limited resources for follow-up weed control.

Figure 7. Full Control Invasive Species



3.3.1 Calla Lily (Zantedeschia aethiopica)

Several small patches of calla lily have been mapped within the Project Area and west of Olema-Bolinas Rd. This species is present in low enough numbers that full control of the species is possible. Calla lily is listed by Cal-IPC as having 'limited' impact to habitats. In an article published by Cal-IPC (Randall and Lloyd 2003), researchers from the Department of Agriculture in Western Australia warn of the potential high impacts in wetland and pastureland. Local experience of land managers is that this species moves slowly but can be difficult to remove from riparian areas once established, especially without herbicide.

Calla lily is dispersed by birds that drop seeds and by rhizomes. To remove plants the entire root ball and rhizomes must be dug out. Flowers and root balls must be bagged and removed off site. Aboveground leaves and stems can be left on site.

If individuals are growing within the LOD, removal prior to construction is recommended. In all other areas, individuals can be removed as resources allow. Late fall and winter are best times for removal because vegetation has broken dormancy and plants may be flowering which makes them easy to find. Also, after a few rains the ground is softer and the plants area easier to dig out.

Herbicide control of this species reduces soil disturbance and need for long term follow up. See Chemical Control section for details on herbicide application.

3.3.2 Mattress Wireweed (*Muehlenbeckia complexa*)

Mattress wireweed is found on the edge of the Project Area, on the west side of Olema-Bolinas Road. Mattress wireweed is not rated by Cal-IPC but is known locally to be problematic. The vines form dense mats that can be several feet thick and exclude all other vegetation. This species appears not to spread quickly from seeds or broken off pieces of vegetation, rather, it moves out from ornamental plantings into wildlands. Vines from existing plants grow quickly. Small plants can be hand pulled. Large plants require mechanical removal.

Removal of the existing infestation on the west side Olema-Bolinas Road is not recommended, but this infestation may be a source of new plants in the Project Area. Sweep annually in the fall to survey for mattress wireweed and manually remove small plants.

3.3.3 Pampas Grass (*Cortaderia jubata/Cortaderia selloana*)

Several individual pampas grass plants have been mapped west of Olema-Bolinas Road. Mature pampas grass produces tall plumes in the fall which contain thousands of wind-dispersed seeds. Plants establish well in disturbed areas, but can also establish in intact marsh and upland habitat. Although unlikely to establish in brackish wetland areas, mature plants grow along the edges of other portions of Bolinas Lagoon as well as nearby freshwater wetland habitat. If allowed to colonize a disturbed area, pampas grass can grow and spread rapidly, outcompete native vegetation, and alter plant community structure. This plant is rated 'High' by Cal-IPC for its negative ecological impact.

Given that this plant readily colonizes disturbed areas, the pampas grass on the west side of Olema-Bolinas Road should be removed prior to construction to prevent further spread following ground disturbance. Initial removal of large plants can be done by CCNB or another contract field crew. During project implementation, the use of mulch and rolled erosion control products (RECPs) over disturbed areas will help prevent new plants from establishing.

This plant can be removed manually with hand tools (such as a sharp Pulaski) by grubbing the plant and root ball out of the soil. Large plants may need to be cut back first to access the roots. Plumes should be cut and bagged off site. Other plant material can be removed from site or left to compost on-site, so long as the plant is turned upside down to prevent roots from touching the soil and re-rooting. Removal activities will require CRLF monitoring.

Sweeps to remove pampas grass can be done annually in the fall when they are easiest to locate due to their inflorescences. Plants are easiest to find in the fall when plumes are present, but can be removed at any time. Initial removal of large plants will require more time and effort; time required for follow-up work will decrease as pampas grass seedlings struggle to compete as native vegetation cover increases. The number of pampas grass plants within the Project Area boundaries should decrease and any new plants found will be small and easy to remove.

3.3.4 Purple Velvet Grass (*Holcus lanatus*)

Purple velvet grass has been mapped throughout the Project Area; it is scattered in various locations east and west of Olema-Bolinas Road. Cal-IPC has rated this species as a ‘moderate’ threat to habitat, though in wetlands this species is known to create monotypic stands. Plants spread by prolific seed production which can be dispersed by water. Thatch from established plants suppresses growth of other plant species.

Plants can be hand pulled and either bagged off-site or composted on site provided roots are exposed to air and not allowed to re-root. Areas where grass was pulled should be mulched with no less than two inches of straw mulch to prevent recruitment from purple velvet grass seed bank or other weeds. Seed heads should be bagged and removed off-site.

If plants are growing in the LOD, these should be removed and mulched prior to construction. After construction, the Project Area should be swept twice in the spring annually to remove new plants before they go to seed. The months this occurs is subject to inundation on site (i.e. is the area accessible) and resource availability. Ideally these sweeps would happen in late April and early June.

3.3.5 Tall Fescue (*Festuca arundinacea*)

Tall fescue has been mapped in one location on the hillside west of the Olema-Bolinas Road. This perennial grass is often used as a turfgrass because of its ability to quickly grow and establish new populations. It creates thick, fibrous root systems and can withstand a variety of light, temperature, and moisture conditions. These same characteristics make the grass invasive in natural areas. Cal-IPC has rated it as having a ‘Moderate’ negative ecological impact, though locally it has been observed to be aggressive in wet meadows and floodplains.

Tall fescue readily establishes in disturbed areas and can spread vegetatively through rhizomes or by seed. Once established, tall fescue can create dense monocultures and a thick layer of thatch that outcompetes other vegetation. In at least one location in the Golden Gate National Recreation Area, Gerbode Valley, it has created a monotypic stand where a diverse wet meadow used to be.

Tall fescue plants can be manually removed using a hand pick or Pulaski to chop and grub the whole root ball out of the soil. This method is not always effective due to the difficulty in removing all rhizomes, especially in established patches of mature plants. Plant removal can occur any time of year, although tall fescue is easiest to identify in the spring when seed heads are present, and easiest to remove when soils are still moist. When removing mature tall fescue with seed heads, the seed heads should be cut, bagged, and removed from site before the plant is chopped out.

Before construction begins, if any plants are identified in the LOD, seeds should be cut, bagged, and removed. Mature plants should be dug out. All plant material besides seed can either be removed from site or left to compost on site so long as roots cannot contact moist soil to re-root.

Following construction, the Project Area should be swept annually in the spring to remove tall fescue before it becomes established.

3.3.6 Yellow Flag Iris (*Iris pseudacorus*)

Yellow flag iris is located near the Crossover Road within the construction LOD. This species has a 'limited' rating from Cal-IPC, but is known to form dense stands that displace native vegetation in wetland and riparian areas. This species spreads primarily by rhizomes where cool coastal climates prevent flowering and seed production. Where seeds are viable, they can be moved readily by fresh or salt water. Water can also move rhizomes to new locations.

Initial Removal During Construction

Just prior to construction, the aboveground biomass of yellow flag iris patches should be removed down to one inch above ground. A biomonitor will be required to prevent CRLF take. Aboveground biomass can be left on site, except for seed pods which should be bagged and taken off site.

As construction commences in the first year, construction equipment should excavate the plants north and south of the Crossover Road and remove the root balls and dispose of them off-site. See Figure 9 for removal locations. Roots are expected to be within the top six inches of soil but could go deeper in some areas. A vegetation monitor should confirm that all rhizomes have been removed.

Post-Construction Follow Up & Discovery of New Patches

If the initial removal is successful in removing all yellow flag iris roots, follow up may not be needed. This will not be discovered until the first post-construction sweep for resprouts is completed.

Sweeps should be done annually after winter inundation and before the rains start again. For the Bolinas Wye Project Area this window is May through October, though earlier is better while the ground is still moist. If new individuals are found, leaves and flowers can be cut and left on site, but rhizomes must be dug out and bagged off-site. Seed pods must also be bagged and disposed off-site.

It should be noted that the only way to fully control this species without herbicide is to completely excavate the plant rhizomes. If the patches of yellow flag iris are not initially scraped out with machinery and entirely removed, they will persist regardless of on-going manual removal. Herbicide treatment using a cut stump method is effective. See Chemical Control section for more discussion on cut stump application.

3.4 Control to Low Levels

These species are either present upstream or in surrounding areas making full control impossible; will not significantly impact established native vegetation; or are not possible to control without chemical treatment. It is not expected that these species can be effectively controlled throughout the Project Area, and dedicating resources to that effort would not be worthwhile. For many of these species, control is only recommended specifically in the LOD and revegetation areas where they could outcompete natives during post-construction establishment. Sweeps for these species outside of active revegetation areas can be performed less frequently and less thoroughly than species under full control. See Figure 9.

Figure 8. Control to Low Level Invasive Species

3.4.1 Broom Species (*Cytisus scoparius*, *Genista monspessulana*)

Control within Project Area

This perennial shrub has been rated 'high' by Cal-IPC for its ecological impact in California. French broom grows quickly, prolifically producing long-lived seeds that persist in the seed bank for decades and creating dense monocultures that outcompete native vegetation. This plant can establish in a variety of upland habitat types including open-canopy forests and streambanks.

Six locations of French broom have been mapped on the west side of Olema-Bolinas Road. The full extent of broom is not known, but it does not appear to extend into the Project Area at this time. If any plants are found within the LOD, remove plants in the spring before construction begins. Following construction, it will be important to remove any broom seedlings in disturbed areas before they become established.

To remove scattered individual broom plants, or smaller patches, remove plants with a weed wrench to ensure root material is removed. Seed pods with viable seeds need to be bagged and removed from the site, while the rest of the plant material can either be removed or left to compost on site. If it is not possible to bag all seeds, pile plants in as few piles as possible to contain the seeds to small locations.

French broom can be removed at any time of the year but is easiest in the spring when the soil is still moist, and the flowering plants are easiest to identify. Sweep the entire Project Area at Bolinas Wye yearly in the spring to remove any French broom and prevent populations from establishing in new areas.

3.4.2 Cotoneaster (*Cotoneaster sp.*)

Control within Project Area

A few cotoneaster individuals have been mapped in the Project Area in the disturbed area along Highway One, these plants are small statured probably from repeated mowing. No other individuals have been mapped in the Project Area.

Cotoneaster is a large woody shrub used as an ornamental plant that has become invasive in natural areas. The California Invasive Plants Council has rated this species as having 'moderate' impact on habitats. These species are aggressive along the Central Coast of California and should not be ignored.

All cotoneaster species are invasive and should be controlled similarly. Mature cotoneaster plants produce copious bright red berries in the fall, which can produce a dense carpet of seedlings. Berries are also dispersed by birds. Plants grow quickly and densely to outcompete native vegetation. Cotoneaster poses a risk to any upland habitat created or disturbed during this project (i.e., coyote brush scrub or coast live oak woodland); plants will likely not establish and thrive in lower, wetter locations.

Existing Mature Plants

Cotoneaster is extremely difficult to remove with manual and mechanical methods due to an extensive root system that readily resprouts (DiTomasso 2013). Digging out a mature plant is not feasible without creating high levels of disturbance which can destabilize slopes and flush other seeds. Mature plants can be cut down to soil level but will resprout vigorously from the roots if herbicide is not used. If manual removal is the only option, then control is generally not recommended. Treating cut stumps with herbicide is effective at achieving mortality in mature plants. Control mature plants with herbicide as needed in the fall. See Chemical Control section for details on cut stump application.

Plant material from mature plants can either be removed from site or piled and left to compost on site in its existing footprint. Piling the plants together in one location will consolidate the berries into one location. Control of these individuals can happen pre- or post-construction since they are not directly within the LOD.

Seedling Removal

Scattered seedlings and small plants (less than ~4 inches tall) not growing in a dense carpet can be manually or mechanically removed with a weed wrench by pulling out the entire plant before the root system is fully established. Removal of small plants works best when the soil is moist.

Small plants should be treated post-construction by sweeping the entire Project Area and removing any plants encountered. Plant material can either be removed from site or left to compost on site. Any plants with berries should be disposed off-site if possible. Sweep for cotoneaster seedlings in the spring or fall.

3.4.3 Dallisgrass (*Paspalum dilatatum*)

Control within LOD

Dallisgrass (*Paspalum dilatatum*) has been mapped in the Project Area primarily along mowed road edges. This perennial grass has not been rated by Cal-IPC for its ecological impact but can be found in disturbed areas as well as intact grasslands. This grass spreads by seed as well as vegetatively through rhizomes. Once established, manual or mechanical control of this plant is challenging due a thick, fibrous root system.

Dallisgrass will continue to be spread along the roadway from existing plants within and outside of the Project Area to new areas within the Bolinas Wye as the road edges are mowed. It is therefore not feasible to fully control dallisgrass due to this regular influx of seeds and rhizomes.

To reduce dallisgrass in revegetation areas, the dallisgrass found along Fairfax Bolinas Rd (Crossover Road) should be removed during construction by heavy equipment that can scrape the heavily infested roadsides clear. If this is not possible, plants can be removed by digging out the entire plant, roots, and rhizomes with a hand pick or Pulaski. Any seedy material present should be cut, bagged, and removed from the site. All other plant material can be removed from site or left to compost on site so long as the plant is turned upside down to prevent roots from touching the soil and re-rooting. Dallisgrass can be removed at any time of year but is easiest in the winter/spring when soils are still moist.

The LOD should be swept for dallisgrass post-construction in or late summer or early fall when seed heads are up, and plants are identifiable. Hand removal is recommended for any individuals found within the LOD post-construction.

3.4.4 English/Algerian Ivy (*Hedera helix/Hedera canariensis*)

Control within LOD, remove in other locations as resources allow

English and Algerian ivy are known to hybridize and are difficult to tell apart. In this section “ivy species” will be used to refer to both plants. Ivy species have been mapped west of Olema-Bolinas Road. These ivy species are both rated ‘high’ impact on habitats by Cal-IPC and are on CDFA’s ‘D’ list of noxious weeds. These species are rarely observed growing as a monocultural ground cover in wildlands, but it is possible. These ivy species grow as thick woody vines along the ground and up trees; most often they are observed growing up trees and shading out other plants. When the vines reach sunlight in the canopy, they flower and go to seed. The seed is dropped near the plant and moved by water downstream, or dispersed by birds. Plants can propagate from vines left along the ground as well where they root at leaf nodes.

If large individuals are present within the LOD, these should be removed prior to construction. If entire plants cannot be removed, it is important to remove the portion of the vines that grows up trees to keep the vines from spreading seed. To accomplish this, vines can be be girdled from trees. To girdle an ivy vine, cut once close to the base of the vine at the ground. Make a second cut at least six inches up the stem. This removes a portion of the vine and prevents it from growing back together. Vine material within the canopy can be left to degrade. Roots and plant material along the ground must be dug up and removed off-site. This plant cannot be composted on site.

Initial treatment of individuals or patches outside the LOD can be treated as resources are available. Post-construction, the Project Area should be swept for new individuals annually in the fall. New plants are often discovered in areas where birds perch or in the root balls of older trees. It is best to treat in the fall before the vines begin vigorous growth, but other times of year can be effective as well.

3.4.5 Orchard Grass (*Dactylis glomerata*)

Control within LOD
Orchard grass is rated as having 'limited' impact to habitats in California. Locally, this species is known to establish in a variety of habitats and soil types and can displace native plants in wetland areas. This species spreads by seeds and rhizomes and must be dug out by the roots, followed by heavy mulching to prevent regrowth and seed recruitment. This grass recruits more slowly than some other species, so while is has potential to displace native plants it can be controlled with moderate levels of manual removal. Seeds and root balls should be bagged and removed off site. Other parts of the plant can be composted on site.

This species has been mapped west of Olema-Bolinas Road and south of the crossover road. If orchard grass is growing in the LOD, then removal prior to construction is advised. This species should be removed in revegetation areas, and individuals growing outside of revegetation areas can be treated as resources are available. These plants can be removed any time of year, but removal before seeds drop prevents further infestations; ideally, sweeps should happen sometime in the spring.

3.4.6 Ornamental Trees (*Hesperocyparis macrocarpa, Pinus radiata, Pittosporum sp., Myoporum laetum*)

Control within LOD, remove in other locations as resources allow
Monterey cypress (*Hesperocyparis macrocarpa*) and Monterey pine (*Pinus radiata*) have been observed on site west of the Olema-Bolinas Road. No Pittosporum species individuals or ngaio tree (*Myoporum laetum*) individuals have been observed within the Marin County Parks property. All of these species have potential to displace native plants and negatively impact the habitat within the Bolinas Wye. Monterey cypress and pine are spread by wind and water (Roy, 1966) while Pittosporum and ngaio tree are spread by birds and other animals (Brusati, 2016).

Small individuals of all species can be dug out or pulled with a weed wrench. If saplings have grown too large for this type of removal, Monterey cypress and pine can be sawed down at the base of the tree.

The Pittosporum and ngaio trees can be cut but they will likely resprout and require follow up visits to remove coppice growth.

Large existing trees within the Project Area but outside the LOD may be managed as resources allow. Individuals within the LOD will be removed with construction. The LOD should be swept for these species annually in the fall, and it is recommended that the entire Project Area be swept annually to prevent establishment of these species.

3.4.7 Panic Veldt Grass (*Ehrharta erecta*)

Control within LOD

Panic veldt grass has been mapped west of Olema-Bolinas Road and additional plants have been observed throughout the Project Area. Cal-IPC has rated this plant as a 'moderate' ecological threat to habitat, though it has been observed to be aggressive in wet habitats. This disturbance-loving grass can grow under a wide range of environmental conditions ranging from part sun to shade, though shade is where it thrives.

Panic veldt grass produces a large amount of small seeds that can easily spread and germinate throughout the year; this allows the plant to create dense stands that can outcompete native vegetation. With frequent seed production and frequent germination, this plant is challenging to control once a seed bank is established. Movement of seeds from infested upstream habitat and the continued mowing of road edges is constant seed pressure on the site now and into the future.

Site-wide control is not feasible without extensive, regular resources directed to this effort. Complete control requires sweeping the entire site at least four times per year in perpetuity to pull and bag all plant material from the site. We recommend that removal actions be focused within the LOD where active revegetation is occurring. For control within the LOD, panic veldt grass should be removed ahead of construction commencement. Removal in revegetation areas should begin immediately following project implementation if possible, and should continue quarterly for as long as possible to allow native vegetation to establish.

Removal can be completed with hand tools; a hand pick, hori hori, or other small tool is sufficient to remove the plant, so long as the shallow root system is removed. Individuals should be bagged and disposed of off-site and the area should be covered with no less than two inches of mulch over bare ground to suppress seed germination.

3.4.8 Ruderal Species (*Cirsium vulgare, Myosotis latifolia, Tetragonia tetragonioides*, etc.)

Control within LOD

Ruderal species are plants that thrive in disturbed areas, such as recent construction sites or Cape ivy removal areas. Species such as radish (*Raphanus sativus*), short pod field mustard (*Hirschfeldia incana*), New Zealand spinach (*Tetragonia tetragonioides*), bull thistle (*Cirsium vulgare*), and forget-me-nots (*Myosotis latifolia*) are expected to show up within the Project Area where construction and weed removal actions have taken place.

Bull thistle and short-pod field mustard are rated as 'moderate' threats and radish, New Zealand spinach and forget-me-not are rated as 'limited' threats to habitats by Cal-IPC. These species should be controlled within the LOD: managing these species while impacted native vegetation and newly installed plants are beginning to grow will prevent them from establishing a seed bank and outcompeting the native plants. They are best removed in spring before seeds drop. No management is recommended for these species outside the LOD.

3.5 Monitor and Adapt Management

These species are not recommended for control at this point, but they should be monitored and management strategies adapted as needed.

3.5.1 Bindweed (Unknown *Convolvulus* sp./*Calystegia* sp.)

This species has been mapped in the Project Area but has not been identified to species and is not a perceived threat to the habitat. Identification for species in this plant family (Convolvulaceae) often requires both flower and fruit to make a positive identification which were not available in the fall and winter of 2020. Visibly, this species does not resemble short-stalked false bindweed (*Calystegia sylvatica*) which is becoming a large problem in nearby watersheds. It resembles both native and non-native morning glory species, so further investigation is needed.

West Marin County does not currently have a highly invasive morning glory species growing in any nearby watersheds. No management actions are currently recommended, but it is recommended that this species be visually monitored. If it appears to become more aggressive and begin to outcompete native plants, then appropriate management actions should be taken to control its growth and spread.

3.5.2 Wisteria (*Wisteria* sp.)

Wisteria is an aggressive perennial vine that grows quickly aboveground into trees and shrubs and along the ground via stolons. At Bolinas Wye, this vine has grown up one large Douglas fir tree (*Pseudotseuga menziesii*) and several nearby oaks (*Quercus* sp.). The understory is sparse, likely due to the wisteria invasion. This species is difficult to remove without herbicide; roots will resprout readily after being cut.

Cal-IPC has not rated this species, but it is a noxious weed in the southeast and has been observed to be an aggressive species in local gardens (Center of Aquatic and Invasive Plants, 2020). This plant mostly reproduces vegetatively, but it is possible that seedling recruitment is contributing to the growth of this patch. Seeds can be spread by water, so keeping this species away from Lewis Gulch Creek will control the spread.

Due to the large scale of this infestation, the need for herbicide application for removal to be effective, and the surrounding cape ivy infestation, no control is recommended for patch on the west side of Olema-Bolinas Road at this time. If resources are available to manage vegetation on the west side the Road and herbicide application is available, then treatment can be considered.

If this species is found within the Project Area, manual removal is recommended for immature individuals. If a large individual or patch is discovered, then manual removal or chemical control is recommended. It should be noted that it is unclear whether mechanical removal of Wisteria without chemical control is effective.

For manual removal, vines should be cut where they grow up trees or other tall vegetation, making the cut as high up as possible. Remaining green material can be left to desiccate in the trees. Material growing along the ground and in low growing vegetation must be removed and disposed of off-site. For effective removal, stems should be cut close to the ground and treated with herbicide using a cut stump application method (see Chemical Control section).

If herbicide is not an option, root material should be dug out by hand and disposed of off-site. This initial removal could be done efficiently with chainsaws and grubbing tools by a contract crew. Following initial removal, resprouts or seedlings should be dug out of the ground with the full root ball and stolons removed entirely. All parts of the plant should be bagged off-site.

If resprouts are being treated manually, follow up sweeps for this species should be done in tandem with monthly Cape ivy sweeps for the first year (see Cape Ivy section for details). After the first year, if resprouts are not found monthly, then the interval between sweeps can be increased.

If the number of resprouts is high, then using a small amount of herbicide with a cut-stump treatment method using glyphosate or triclopyr will be necessary to fully control this species. See Chemical Control section for methods. If resprouts can be treated with herbicide, sweeps for resprouts should be done twice in the first year. If many resprouts are found in the second sweep, consider sweeping for resprouts one more time before the end of the growing season.

3.6 Chemical Control

Chemical control involves the use of herbicide to control invasive plants. Herbicides should be used only if manual or mechanical control is not feasible, is ineffective, or is unsafe. Herbicide is an effective and valuable tool, which can be safely used in wildlands and near water by choosing the correct chemical, application rate, and application method for each species. Herbicide application methods include cut stump, foliar, spot spray, and wick/wipe. A registered, non-toxic dye may be added to the mixture to improve detection, ensure thorough application, and avoid overspray. Herbicides are often combined with a surfactant that assists the herbicide in sticking to the leaf cuticle or bark surface.

Herbicides are a type of pesticide. Pesticides are regulated in California by the Department of Pesticide Regulation. Any pesticide used in an agricultural setting require a pesticide recommendation to be written by a licensed Pest Control Advisor (PCA). All applications must follow label directions, further instructions contained in a pesticide recommendation, and guidelines established by the California Department of Pesticide Regulation.

While the PCA and guiding documents will create final parameters for herbicide application, best practices may include:

- No application in water bodies or active waterways unless treating aquatic plants.
- No foliar spraying occurs when wind speeds are greater than seven miles per hour.
- No foliar spraying when fog or rain is present.
- No application within 24 hours of predicted precipitation.

For personal protective equipment (PPE) for applying herbicides see both the product label and the California Department of Pesticide Regulation's Pesticide Safety Information Series sheets for non-agricultural application ("N" series found at https://www.cdpr.ca.gov/docs/whs/psisenglish.htm). Baseline PPE includes long pants, shoes with socks, chemical-resistant gloves, and eye protection. Additional PPE is required depending on the herbicide used.

Herbicides should be mixed over secondary containment away from water bodies. Care should be taken to mix only as much herbicide as will be used on site that day.

3.6.1 Foliar and Spot Spray Application

Foliar application is recommended for annual or perennial herbaceous or woody plants. Grasses such as panic veldt grass growing in a floodplain and ruderal weeds are often treated using this method. Application equipment can be a backpack sprayer or handheld pump sprayer. This method has the advantage of using an extremely small amount of herbicide. Many weeds can be killed with a concentration of only 1.5% herbicide.

Foliar and spot spraying would be strong tools for use on tall fescue, panic veldt grass, purple velvet grass, yellow flag iris, periwinkle, and cotoneaster resprouts.

3.6.2 Cut Stump Application

Cut stump application is recommended to control woody vines, shrubs, and trees. In this application method a higher concentration of herbicide product is applied directly to the cut stump using a dauber, squirt bottle, or sponge. This method has the advantage of using a very small amount of herbicide in a very targeted area. The concentration of herbicide is higher – usually 25%-50% herbicide product in water or another diluent as specified by the label. However, very little herbicide solution is needed, and its placement is very target specific, and the potential for wind drift is minimized.

Some herbicides need to be applied to the cut stem within a few minutes of cutting or the plant may not uptake the chemical.

Cut stump application would be a strong tool for controlling Himalayan blackberry, cotoneaster, English/Algerian ivy, periwinkle, and wisteria in the Bolinas Wye Project Area.

3.6.3 Wick/Wipe Application

Wick wipe application is recommended for windy locations where foliar application is infeasible; where accidental overspray could endanger plants and animals; or where tall plants make overspray during foliar application more likely. This method involves using a wick applicator, sponge, or mop to apply herbicide to the leaves and stem of a target species. Wick/wipe applications often use a higher concentration of herbicide than foliar but not usually as high as cut stump. Depending on the PCA, they might also recommend a different kind of surfactant to assist the herbicide in sticking to the plant.

4.0 Monitoring

Monitoring will be conducted to measure success of vegetation management strategies, revise management strategies as needed, and share progress toward vegetation management goals with regulatory agencies, grantors, and other stakeholders.

Vegetation monitoring will provide data that will be analyzed to understand if Bolinas Wye has an increase in biodiversity, native cover, and reduction of NNIS (and specifically reduction of cape ivy) following project implementation. It is essential to complete initial monitoring and data collection before initial invasive species removal to establish a baseline for comparison.

Suggested monitoring methods

The methods below are recommended because they require a relatively small amount of time and material to provide important data, are easily replicated, and locations can be selected to best measure outcomes related to specific project goals.

<u>Point Intercept Plots</u>

Randomly select locations for multiple plots across each vegetation community within the LOD (and outside LOD?). Some vegetation communities may to be too small in size for this method to be applicable and planting survivorship may be more appropriate (oak woodland).
Record vegetation at each plot with quadrats strung to create intercept points; record species at each point. Read plots during spring or summer to capture biggest growing time of year. Each subsequent year plots should be read around the same date for consistency. Results from plots can be used to estimate native vs. invasive percent cover and species abundance and diversity.

Example Language:
Vegetation composition should be recorded using the point-intercept method via a quadrat with 81 intercepts. Place a pin flag vertically at each intercept and each species that touches the pin flag will be counted once. All species that touch the pin flag should be recorded. Only consider vegetation with roots in the plot and that had been alive within the current growing season. Count substrate (duff, litter, dirt, bare ground) if no vegetation touches the pin flag, but otherwise do not record the substrate. After reading the quadrat, record all vegetation species in the plot to record any species that may have not been captured by the point-intercept reading. A photo of the plot should be taken facing south with the plot outlined by flagging tape or an unstrung quadrat.

<u>Survivorship monitoring</u>. For oaks specifically, potentially for other tree species as required by CDFW.

<u>Photomonitoring</u>. Choose locations where changes are planned and, ideally, where there are landmarks that make it easier to take photos of the same location in subsequent years. Take initial photos before large scale weed management or construction activities begin. Take follow up photos immediately post-construction then annually at minimum. Take photos at similar times of year to assist in comparison.

<u>RWQCB Performance Criteria; 401 Cert Section 11:</u>

a. Year 1: 20 percent cover or greater; 2-3 native species dominant; < 5% invasive species
b. Year 2: 40 percent cover or greater; 2-3 native species dominant; < 5% invasive species
c. Year 3: 60 percent cover or greater; 2-3 native species dominant; < 5-10% invasive species
d. Year 4: 80 percent cover or greater; 2-3 native species dominant; <5-10% invasive species
e. Year 5: 80 percent cover or greater; 2-3 native species dominant; <5-10% invasive species

DFW Performance Criteria; 1600-2020-0002; Section 2.31 Revegetation Monitoring:
To ensure a successful revegetation effort, all plantings shall be monitored and maintained as necessary for a minimum of five years. All plantings shall have a minimum of 75% survival at the end of the minimum monitoring period and understory plantings shall attain 60% cover after 3 years and 70% cover after 5 years. If the survival or cover requirements are not meeting these goals, the Permittee is responsible for replacement planting, additional watering, invasive exotic eradication, or any other practice, to achieve these requirements. Replacement plants shall be monitored with the same survival and growth requirements for five years after planting.

Figure X. Example Datasheet

Bolinas Wye Vegetation Monitoring Plots

Date:________________________

Plot #________________________ Photo taken (initial):____________

Readers:____

Habitat type (circle one): Arroyo wilow thicket Red alder forest Coast live oak woodland Coast brambles Coyote brush scrub Roadside grassland Other:________________

Species	# hits (use hash marks)	# Total

Total Monitoring Points 81
Total Hits __________________________

5.0 Special Status Species Habitat Requirements

5.1 California Black Rail

Per a study by Jules Evens on California black rail habitat, if nearby populations of black rails exist restored habitat is usually colonized within 5-10 years (Evens, 2020). The excavation of the new LGC alignment will disturb some existing rail habitat, and hydrology will change resulting in a change in current habitat conditions. Long-term impacts are expected to be beneficial as the new creek alignment will offer new habitat possibilities.

Habitat for black rails should include pickleweed (*Salicornia pacifica*) as the dominant species and salt grass (*Distichlis spicata*), alkali heath (*Frankenia salina*), gumplant (*Grindelia stricta*), and marsh jaumea (*Jaumea carnosa*) as associated species. These species are included in the slat grass flats and the salt marsh bulrush marsh plant palettes.

5.2 California Red-legged Frog (CRLF)

California red-legged frog (CRLF) best management practices (BMPs) for vegetation management will be described in the Biological Assessment and final USFWS Biological Opinion for the project.

BMPs for active vegetation management include biomonitoring ahead of power tool use, progressive cutting when removing vegetation with biomonitoring between cuts, and removing piles of weeds immediately if disposing off-site. CRLF will hide beneath vegetation to stay moist and out of predator's sight, so checking vegetation ahead of time and not leaving piles on site is important. If weeds must be piled on site and moved later, the pile needs to be checked for CRLF before it is moved.

5.3 Steelhead Trout

The recovery plan for northern California steelhead trout can be found at the National Marine Fisheries Service website: https://www.fisheries.noaa.gov/resource/document/final-coastal-multispecies-recovery-plan-california-coastal-chinook-salmon

In general, establishing cover of the creek channel as soon as possible will aid survivorship of steelhead trout. Cover can be from trees, forbs, or from emergent aquatic vegetation, but perennial cover is best.

The BMPs for working in aquatic habitat include good sanitization of waders or boots to prevent pathogen or invertebrate invaders, timing your creek work with the dry part of the year, and minimizing sedimentation into the water. For other BMPS see the Biological Opinion for the project.

6.0 Small Woody Debris Installation

Installation of small woody debris (SWD) bundles in the creek provides temporary cover for juvenile salmonids, increases complexity in the creek channel, and provides locations for emergent vegetation to grow. SWD bundles should be installed annually or until tree cover has adequately covered the creek channel.

Due to the narrow width of the new channel, SWD installation may not be required. Below is guidance and instructions should SWD be needed for temporary cover.

As the new creek channel path is cleared, woody debris can be cached for this project. Branches two inches in diameter or smaller should be kept on site. Leaving full branches with side branches intact is best for SWD, the open branching creates interstitial space for the fish to hide and plants to attach. The SWD bundles also hold together better and are lighter to move around when the branches are not broken down into individual sticks.

Two volunteers carry a small woody debris bundle at Muir Beach, 2012.

Bundles are created by piling branches together and tying the bundles together with sisal twine. Sisal twine is used because it is biodegradable and inexpensive. Doubling the twine allows more tension to be placed on the twine before it breaks. SWD bundles should be scaled in size so they do not block the entire creek flow, but provide cover along the banks. Longer bundles are heavier and more difficult to maneuver.

Furring strips – one and one-half inch by three-quarter inch pine planks used conventionally to prevent dampness, to make space for insulation, or to level and resurface ceilings or walls – can be cut to install the SWD bundles in the desired location. Furring strips are purchased from a lumber store in eight-foot lengths then cut onsite to give the exact length needed for each individual bundle and water depth. Two furring strips may be used on either end of the bundle and hammered into the creek bed to a depth that secures the furring strip in place. This depth will vary by location. Often multiple strips are cut before the correct length is achieved. Twine is used to secure the bundle to the furring strips.

Small woody debris bundles float. If bundles are being installed in an area where the water level will fluctuate significantly, sufficient play should be left in the twine so the bundle can rise and fall with the water level.

SWD bundles should be placed at a forty-five-degree angle into the water's flow with the upstream end against the bank and the downstream end jutting into the water. In instances where pools exist away from the creek channel, bundles should be placed parallel to the water flow within the pool.

SWD bundles or sets of bundles should be placed at least 10 feet apart along the creek channel. Placement will vary depending on the features of each creek section. Deep pools should be covered by two or more bundles. Longer and shallower sections of the creek require single bundles at regular intervals. Consult with an aquatic ecologist, fisheries biologist, or someone who has previously installed SWD bundles for final installation locations.

Installation of SWD bundles is best done near the end of the wet season. Large rains will wash SWD bundles away, so bundles should be installed in late March or April to ensure they stay in place over the summer. Salmonids nests (redds) are likely to be found in the creek channel during this period. Be sure to work with an aquatic ecologist or fisheries biologist to determine if any redds are in the Project Area. Work downstream of any redds to prevent sedimentation over redds.

7.0 Planning and Scheduling

7.1 Sequencing

It is important to think through sequencing and scheduling of vegetation management to be efficient and effective. Because travel to the site will take significant time, it will be best to group different management actions together to do as much as possible during a site visit. The tables in Appendix A provide a detailed schedule. The general outline is as follows:

- Install container plants and direct seed in winter and early spring (December- March). Water during planting if rain is not in the forecast.
- Water planted area if there is a gap in rain between December and March of more than two weeks.
- Install willow stakes after RECP is installed.
- Install tree exclosures after winter rains (April/May)
- If Small Woody Debris is wanted, build and lace SWD bundles in spring.
- Remove willow exclosures in November before rains begin to avoid creating barriers to winter flows.
- Non-native invasive species removal occurs throughout the year, see Appendix A for details for each species.

7.2 Pre-construction Non-Native Invasive Species Removal

The following species are recommended for removal prior to construction to reduce post-construction management needs. In order to have Cape ivy control established before construction disturbance, Cape ivy removal should occur the year prior to construction with, ideally, monthly follow-up removal actions.

Other species can be removed at the same time as Cape ivy, or in the spring directly prior to construction, timing should take into account when species flower and are most visible, and restrictions such as bird nesting seasons.

The LOD should be flagged after initial Cape ivy removal has been done. In some areas, this will serve as the scrape zone for different NNIS.

Several species can be most efficiently managed by using equipment to remove roots from the soil; this work can be done at the beginning of construction when equipment is mobilized. See Figure 9, Invasive Species to be Removed with Equipment.

Year one construction will realign the Olema-Bolinas Road, install the road bridge, and grade the floodplain upstream of the new bridge. Year two construction will remove the Crossover Road and complete excavation of the new LGC channel and reroute water into the new channel. NNIS removal actions should be planned according to the areas which will be disturbed during each construction year.

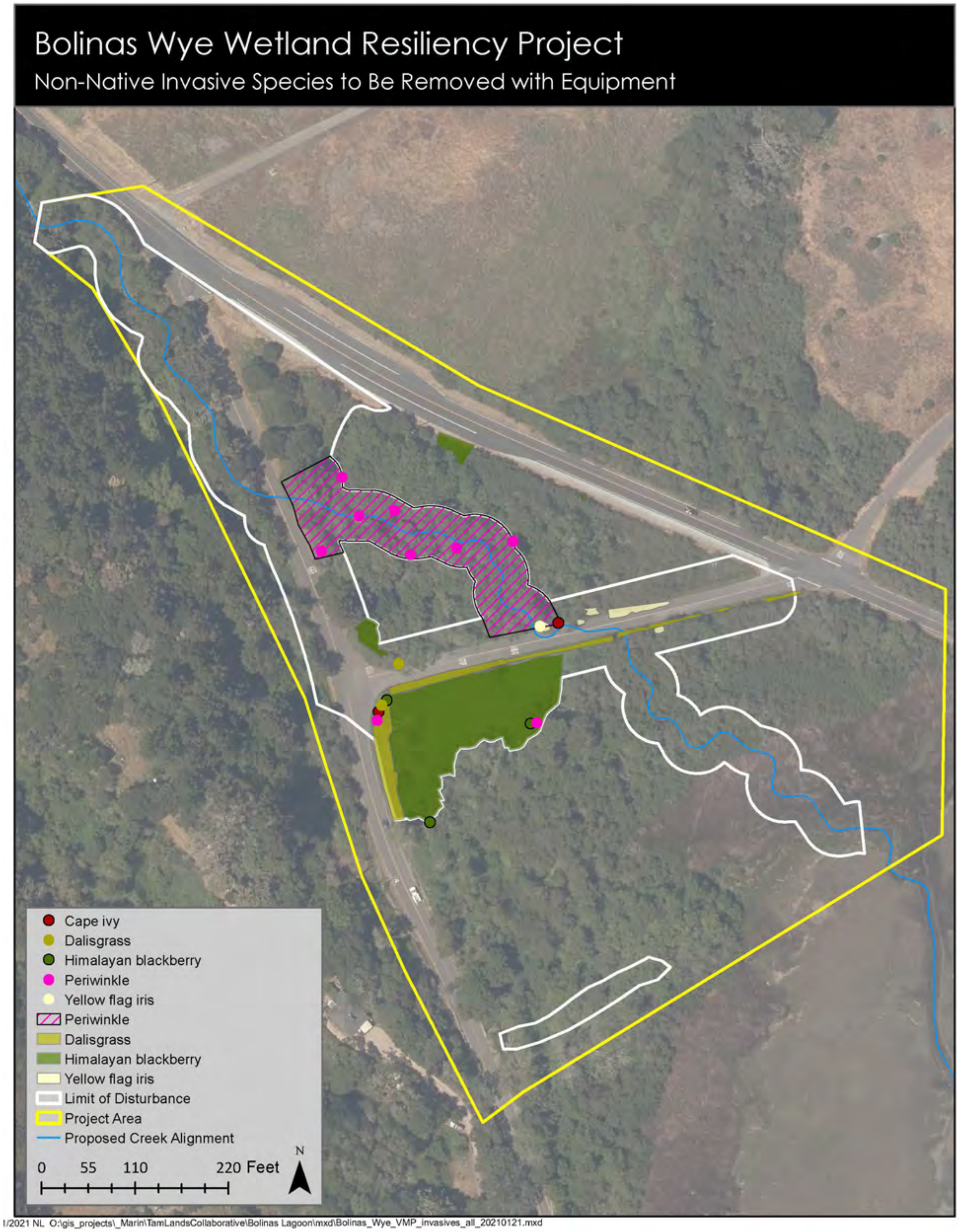
Species to be removed before or during the early phase of Year One Construction

- Cape ivy, within Target Species AMZ
- Periwinkle, within Target Species AMZ where equipment can remove
- Yellow flag iris, at edge of Crossover Rd, remove biomass pre-construction, during construction excavate roots
- Girdle other ivy species in trees and remove from soil in LOD
- Pampas grass, remove patch on west side of Olema-Bolinas Rd.
- Within LOD, remove the following species: broom, calla lily, orchard grass, purple velvet grass, panic veldt grass, and tall fescue.

Species to be removed before or during the early phase of Year Two Construction

- Himalayan blackberry, within Target Species AMZ, remove biomass pre-construction, during construction excavate roots
- Dallis grass, at edge of Crossover Rd where equipment can remove
- Girdle other ivy species in trees and remove from soil in LOD
- Within LOD, remove the following species: broom, calla lily, orchard grass, purple velvet grass, panic veldt grass, and tall fescue.

Figure 9. Invasive Species to be Removed by Equipment



7.3 Initial Revegetation

(Describe sequencing of reveg for year one and year two construction with 60% construction sequence)

Willow staking and salvage plants
Hydroseed road embankments
Container plant and tree installation and direct seeding
Place mulch around container plants

7.4 On-Going Maintenance

Vegetation management is a year-round effort. See Appendix A for vegetation management schedules. On-going management and maintenance includes non-native invasive species control, monitoring and repairing erosion control as needed, watering plantings in upland areas, adding mulch, repairing or removing exclosures, infill planting, re-installing SWD bundles, and vegetation monitoring. Regular site visits and monitoring are also critical for determining when vegetation management actions are not successful and new methods should be tried. For example, it may be determined that frequency of NNIS sweeps should be altered, or that herbicide is needed to control a priority species.

It will be most efficient to group different types of work activities together to accomplish multiple tasks with a limited number of site visits. Cape ivy sweeps and watering can be grouped with general invasive species removal, installing exclosures, etc. to reduce the number of site visits needed.

Post-construction Year One and Two Management Actions

- Monthly AMZ Sweep: Remove Cape ivy, Himalayan blackberry, and periwinkle in AMZ
- Monthly oak tree watering; only water container plants in December through March if needed

- Spring Sweep (April):
  - Sweep Project Area for broom, cotoneaster seedlings, purple velvet grass, tall fescue, yellow flag iris
  - Sweep LOD for panic veldt grass and ruderal species
  - Mulch around plantings
  - Install exclosures around trees
  - Install SWD if desired

- Spring/Summer Sweep (May/ June)
  - Sweep Project Area for broom, cotoneaster, purple velvet grass, tall fescue
  - Sweep LOD for panic veldt grass and ruderal species

- Vegetation Monitoring (May/June)

- Early Fall Sweep (September/October)

- Sweep Project Area for ivy species, mattress wire weed, cotoneaster, ornamental trees, pampas grass
- Sweep LOD for dallisgrass, panic veldt grass

- Late Fall Sweep (November)
  - Sweep Project Area for calla lily
  - Sweep LOD for dallisgrass, panic veldt grass
  - Remove SWD and exclosures near creek

- Infill Planting (December/January/February)
  - Mulch and weed around plantings
  - Water if needed

Post-construction Year Three, Four, and Five Management Actions

- Bi-monthly AMZ Sweep: Remove Cape ivy, Himalayan blackberry, and periwinkle in AMZ
- Spring Sweep (April):
  - Sweep Project Area for broom, cotoneaster, purple velvet grass, tall fescue, yellow flag iris resprouts (if iris persists, consider use of herbicide)
  - Sweep LOD for panic veldt grass and ruderal species
  - Mulch around plantings
  - Install exclosures around trees, if needed
  - Install SWD if desired

- Spring/Summer Sweep (May/ June)
  - Sweep Project Area for broom, cotoneaster, purple velvet grass, tall fescue, yellow flag iris
  - Sweep LOD for panic veldt grass and ruderal species

- Vegetation Monitoring (May/June)

- Early Fall Sweep (September/October)
  - Sweep Project Area for ivy species, mattress wire weed, ornamental trees, pampas grass
  - Sweep LOD for dallisgrass, panic veldt grass

- Late Fall Sweep (November)
  - Sweep Project Area for calla lily
  - Sweep LOD for panic veldt grass
  - Remove SWD and exclosures near creek

7.4 Workforce Options and Roles

Different skills are needed to implement different types of vegetation management actions. This section outlines the different local options for field crews as well as the need for vegetation monitoring and management oversight.

7.4.1 Field Crews

Field crews are needed for initial removal of invasive species, teasing out salvage plants from salvage sod, planting native plants, mulching around plants, installing willow stakes, broadcasting native seed, watering plantings, and follow up weed work including regular sweeps (survey and removal actions).

Recommendations below are not exhaustive lists of what each field crew can accomplish but are highlights.

Conservation Corps North Bay (CCNB)

Conservation Corps North Bay (CCNB) is a job training program for young people. Corps members come with willingness to learn and a CCNB crew lead to help teach the team. These crews do not usually come with plant identification skills or power tool experience, so it is important to budget time and staff to train and oversee the crew. Crew size can be requested per project.

CCNB is good at pulling monotypic stand of weeds that do not require close plant identification, mulching large areas, planting, broadcasting seed, hauling material, installing willow stakes and SWD bundles, and general weeding around plantings. CCNB could do initial removal of Cape ivy and Himalayan blackberry, but it is important to budget more time for chainsaw training, and they will generally be less efficient than a contractor or more experienced field crew. CCNB generally requires more manager oversight and coordination as well which should be part of the budget calculus.

It is unclear if CCNB can apply herbicide.

Professional Field Crew

Several companies hire out field crews for all activities from initial removal of large weed infestations to planting and watering. These crews are more expensive than CCNB but are usually faster. Crews of any size can be requested and are overseen by a crew lead. Less time is usually required to oversee contract crews than CCNB, but this varies by crew and company. Certain contract crews can apply herbicide. This is generally the most efficient option for removing large amounts of biomass with power tools.

Contract crews are generally not as good for site-wide follow up sweeps for weeds which require more attention to detail and plant ID skills, or sweeps that require delicate removal like Cape ivy follow-up. Some crews have more experience in plant identification and restoration work than others, so oversight time should be determined based on the experience of the crew.

Golden Gate National Parks Conservancy Restoration Technicians

The Golden Gate National Parks Conservancy (Conservancy) has a field crew, the Restoration Technicians, who may be available to assist with vegetation management. This is a crew of up to five people with strong plant identification skills and experience with vegetation management for restoration. This crew is best for work that requires more attention to detail and plant ID skills.

The Restoration Technicians are a good option for invasive plant sweeps, planting, watering, mulching, hauling, broadcast seeding, teasing out salvage plants from sod, and identifying new weeds on site. All members of this team have their Qualified Applicator's Certificate which allows them to apply herbicide in the state of California. The Restoration Technician crew are not the best option for initial removal of Cape ivy or Himalayan blackberry, installing willow stakes, or using chain saws.

7.4.2 Vegetation Monitoring and Management Oversight

Vegetation management planning and oversight is needed to guide this plan through pre-, during-, and post-construction. Tasks envisioned include:

- Oversee initial removal of invasive species by contract field crews and construction crews
- During construction, interpret the vegetation plan and answer questions that come up related to vegetation
- Work with construction managers to ensure best management practices to prevent weeds from being moved on site are being followed
- Oversee willow stake harvest, installation, exclosure installation
- Coordinate and oversee initial revegetation
- Coordinate and oversee post-construction invasive species management
- Perform annual vegetation monitoring

The person in the vegetation management role should have experience in all activities they will be overseeing, experience working with and overseeing contract crews, strong ecological knowledge, and excellent plant identification skills. A vegetation monitor role could be utilized to reduce the field work for the vegetation manager; the monitor role is appropriate for someone with less experience who can oversee field tasks with guidance from the vegetation manager or a project manager.

7.5 Costs

(will be developed further with information from 60% designs and construction plan)
Cost estimate for
-purchasing plants, trees, seed
-planting container plants, trees – since planting is going to be part of contract, estimate based on Hanford planting costs- get from Danny.
-installing willow stakes
-site visits for watering, weed control, mulching, installing and removing exclosures, installing and removing SWD (similar cost per visit depending on the crew selected, est. cost /day for each crew type)

Costs will vary depending on the work force selected for each action. Contractors, conservation corps, agency staff, Parks Conservancy Restoration Technician team.

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Appendix A: Schedule and Sequencing Tables

Table One: Sequencing and Schedule (Placeholder, update with 60% design and construction plan)

See Excel spreadsheet: Bolinas Wye Vegetation Management Schedule_R1

Appendix B: Revegetation Species and Quantities

To be developed with 60% design information on grading.

Container Plants by Vegetation Community

Legend for container plant colors
= 10 feet on center
= 6 feet on center
= 4 feet on center
= 3 feet on center
= 2 feet on center
= 1 foot on center

SALT GRASS FLATS		Year 1		Year 2		Year 3	
Scientific Name	**Common Name**	**% of total**	**# Plants**	**% of total**	**# Plants**	**% of total**	**# Plants**
Distichlis spicata	Salt grass	90%	132	75%	35	75%	22
Salicornia pacifica	Pickleweed	5%	7	5%	2	10%	3
Jaumea carnosa	Marsh jaumea	3%	18	0%	0	5%	6
Bolboschoenus maritimus	Alkali bulrush	2%	1	0%	0	10%	1
Potentilla anserina	Silver cinquefoil	0%	0	10%	2	0%	0
Atriplex leucophylla	Beach salt bush	0%	0	10%	2	0%	0
	subtotal	100%	**158**	100%	**42**	100%	**32**

SALT MARSH BULRUSH MARSH		Year 1		Year 2		Year 3	
Scientific Name	**Common Name**	**% of total**	**# Plants**	**% of total**	**# Plants**	**% of total**	**# Plants**
Bolboschoenus maritimus	Alkali bulrush	65%	87	60%	26	65%	17
Distichlis spicata	Salt grass	10%	30	10%	10	15%	9
Salicornia pacifica	Pickleweed	10%	30	10%	10	15%	9
Jaumea carnosa	Marsh jaumea	5%	60	0%	0	5%	12
Frankenia salina	Alkali heath	5%	7	10%	4	0%	0
Grindelia stricta	Gumplant	5%	7	10%	4	0%	0
	subtotal	100%	**221**	100%	**54**	100%	**48**

ARROYO WILLOW THICKET		Year 1		Year 2		Year 3	
Scientific Name	**Common Name**	**% of total**	**# Plants**	**% of total**	**# Plants**	**% of total**	**# Plants**
Salix lasiolepis	Arroyo willow	30%	133	10%	16	0%	0
Scirpus microcarpus	Small-fruiting bulrush	30%	533	20%	124	25%	111
Rubus ursinus	California blackberry	15%	266	10%	62	15%	67
Persicaria punctata	Smartweed	2%	36	5%	31	12%	53
Cornus sericea	American dogwood	0%	0	10%	16	0%	0
Carex obnupta	Slough sedge	8%	142	5%	31	5%	22
Alnus rubra	Red alder	10%	44	10%	62	11%	49
Stachys chamissonis	Hedge nettle	3%	53	10%	62	10%	44
Oenanthe sarmentosa	Water parsley	1%	18	10%	62	12%	53
Woodwardia fimbriata	Western chain fern	1%	18	10%	62	10%	44
	subtotal	100%	**1,243**	100%	**528**	100%	**443**

RED ALDER FOREST - LOWLAND		Year 1		Year 2		Year 3	
Scientific Name	**Common Name**	**% of total**	**# Plants**	**% of total**	**# Plants**	**% of total**	**# Plants**
Alnus rubra	Red alder	30%	251	20%	50	0%	0
Scirpus microcarpus	Small-fruiting bulrush	30%	1,005	20%	201	25%	168
Salix lasiolepis	Arroyo willow	15%	126	5%	13	0%	0
Scrophularia californica	Bee plant	3%	101	5%	50	10%	67
Juncus lescurii	Dune rush	5%	168	8%	80	12%	80
Carex obnupta	Slough sedge	5%	168	8%	80	7%	47
Sambucus racemosa	Red elderberry	5%	168	5%	50	0%	0
Woodwardia fimbriata	Wester chain fern	1%	34	5%	50	2%	13
Potentilla anserina	Silver cinquefoil	2%	67	5%	50	11%	74
Stachys chamissonis	Hedge nettle	1%	34	5%	50	11%	74
Persicaria punctata	Smartweed	3%	101	8%	80	11%	74
Urtica dioica	Stinging nettle	0%	0	6%	60	11%	74
	subtotal	100%	**2,220**	100%	**817**	100%	**670**

RED ALDER FOREST - UPLAND		Year 1		Year 2		Year 3	
Scientific Name	**Common Name**	**% of total**	**# Plants**	**% of total**	**# Plants**	**% of total**	**# Plants**
Alnus rubra	Red alder	35%	100	20%	16	0%	0
Scrophularia californica	Bee plant	22%	251	20%	66	20%	43
Scirpus microcarpus	Small-fruiting bulrush	16%	182	10%	33	13%	28
Salix lasiolepis	Arroyo willow	10%	29	0%	0	0%	0
Juncus lescurii	Dune rush	5%	57	5%	16	10%	21
Sambucus racemosa	Red elderberry	4%	34	4%	13	0%	0
Acer negundo	Boxelder	7%	6	2%	2	0%	0
Sequoia sempervirens	Coast redwood	2%	6	7%	2	0%	0
Persicaria punctata	Smartweed	0%	0	3%	10	10%	21
Juncus hesperius	Coast rush	0%	0	5%	16	10%	21
Ribes menziesii	Gooseberry	0%	0	5%	16	5%	11
Woodwardia fimbriata	Western chain fern	1%	11	1%	3	2%	4
Potentilla anserina	Silver cinquefoil	0%	0	6%	20	10%	21
Stachys chamissonis	Hedge nettle	0%	0	7%	23	10%	21
Urtica dioica	Stinging nettle	0%	0	5%	16	10%	21
	subtotal	100%	**718**	100%	**253**	100%	**214**

COASTAL BRAMBLES		Year 1		Year 2		Year 3	
Scientific Name	**Common Name**	**% of total**	**# Plants**	**% of total**	**# Plants**	**% of total**	**# Plants**
Rubus ursinus	California blackberry	50%	1,361	40%	327	35%	191
Scirpus microcarpus	Small-fruiting bulrush	10%	272	11%	90	15%	82
Alnus rubra	Red alder	15%	102	8%	16	5%	7
Artemisia douglasiana	Mugwort	5%	136	11%	90	15%	82
Sambucus racemosa	Red elderberry	5%	136	5%	41	3%	16
Juncus lescurii	Dune rush	7%	191	10%	82	11%	60
Juncus hesperius	Coast rush	5%	136	10%	82	11%	60
Baccharis pilularis	Coyote brush	3%	82	5%	41	5%	27
	subtotal	100%	**2,416**	100%	**768**	100%	**524**

COAST LIVE OAK WOODLAND		Year 1		Year 2		Year 3	
Scientific Name	Common Name	% of total	# Plants	% of total	# Plants	% of total	# Plants
Quericus agrifolia	Coast live oak	40%	85	20%	13	10%	4
Umbellularia californica	California bay	10%	21	5%	3	5%	2
Heteromeles arbutifolia	Toyon	10%	21	5%	3	5%	2
Artemisia californica	Coastal sage brush	5%	43	7%	18	10%	17
Artemisia douglasiana	Mugwort	0%	0	5%	13	5%	9
Lupinus arboreus	Bush lupine	0%	0	5%	13	5%	9
Aesculus californica	California buckeye	5%	11	3%	2	3%	1
Fragaria vesca	Woodland strawberry	5%	96	5%	29	5%	19
Stipa pulchra	Purple needle grass	5%	384	5%	115	5%	77
Calystegia subacaulis	Hill morning glory	0%	0	5%	13	5%	9
Chlorogalum pomeridianum	Soap root	5%	43	5%	13	5%	9
Marah oregana	Coast man-root	5%	43	5%	13	5%	9
Scrophularia californica	Bee plant	5%	43	5%	13	10%	17
Lonicera hispidula	Pink honeysuckle	0%	0	5%	13	7%	12
Danthonia californica	California oatgrass	5%	384	5%	115	5%	77
Dichelostemma capitata	Blue dicks	0%	0	5%	13	5%	9
Triteleia laxa	Ithuriel's spear	0%	0	5%	13	5%	9
	subtotal	100%	**1,174**	100%	**414**	100%	**289**

COYOTE BRUSH SCRUB		Year 1		Year 2		Year 3	
Scientific Name	Common Name	% of total	# Plants	% of total	# Plants	% of total	# Plants
Baccharis pilularis	Coyote brush	50%	93	10%	6	10%	4
Artemisia californica	Coastal sage brush	20%	66	20%	20	10%	7
Stipa pulchra	Purple needle grass	7%	208	10%	89	10%	59
Rubus ursinus	California blackberry	14%	46	12%	12	10%	7
Mimulus aurantiacus	Sticky monkey-flower	3%	10	8%	8	10%	7
Frangula californica	Woodland strawberry	5%	4	4%	1	0%	0
Lonicera hispidula	Pink honeysuckle	1%	3	0%	0	0%	0
Lupinus variicolor	Varied lupine	0%	0	8%	8	10%	7
Juncus patens	Blue rush	0%	0	7%	7	10%	7
Clinopodium douglasii	Yerba buena	0%	0	7%	7	10%	7
Dryopteris arguta	Wood fern	0%	0	7%	7	10%	7
Sanicula crassicaulis	Snake root	0%	0	7%	7	10%	7
	subtotal	100%	**431**	100%	**171**	100%	**116**

Container Plants by Pot Size, On-Center Spacing, and Planting Clusters

Common Names	Species	On-Center Spacing	Pot Size	Planting Clusters
Boxelder	*Acer negundo*	6 ft.	1g tree band	1
California buckeye	*Aesculus californica*	6 ft.	1g tree band	1
Red alder	*Alnus rubra*	6 ft.	DP40	1
Coast sagebrush	*Artemisia californica*	3 ft.	DP16	3
Mugwort	*Artemisia douglasiana*	3 ft.	DP16	3
Beach salt bush	*Atriplex leucophylla*	3 ft.	DP16	3
Coyote brush	*Baccharis pilularis*	4 ft.	DP16	3
Alkali bulrush	*Bolboschoenus maritimus*	3 ft.	DP16	5
Hill morning glory	*Calystegia subacaulis*	3 ft.	DP16	3
Slough sedge	*Carex obnupta*	3 ft.	DP16	3
Soap root	*Chlorogalum pomeridianum*	3 ft.	DP16	3
Yerba buena	*Clinopodium douglasii*	3 ft.	4in	5
American dogwood	*Cornus sericea*	3 ft.	DP16	5
California oatgrass	*Danthonia californica*	1 ft.	LT7	7
Blue dicks	*Dichelostemma capitata*	3 ft.	4in	3
Salt grass	*Distichlis spicata*	2 ft.	DP16	5
Wood fern	*Dryopteris arguta*	3 ft.	4in	3
Woodland strawberry	*Fragaria vesca*	1 ft.	4in	5
Coffee berry	*Frangula californica*	6 ft.	DP40	1
Alkali heath	*Frankenia salina*	3 ft.	DP16	5
Gumweed	*Grindelia stricta*	3 ft.	DP16	3
Toyon	*Heteromeles arbutifolia*	6 ft.	DP40	1
Marsh jaumea	*Jaumea carnosa*	1 ft.	4in	7
Coast rush	*Juncus hesperius*	3 ft.	DP16	3
Dune rush	*Juncus lescurii*	3 ft.	DP16	5
Blue rush	*Juncus patens*	3 ft.	DP16	3
Pink honeysuckle	*Lonicera hispidula*	3 ft.	DP16	1
Coast bush lupine	*Lupinus arboreus*	3 ft.	DP16	1
Varied-color lupine	*Lupinus variicolor*	3 ft.	DP16	3
Coast man-root	*Marah oregana*	3 ft.	DP16	1
Sticky monkeyflower	*Mimulus aurantiacus*	3 ft.	DP16	3
Water parsley	*Oenanthe sarmentosa*	3 ft.	DP16	5
Smartweed	*Persicaria punctata*	3 ft.	DP16	3
Silver cinquefoil	*Potentilla anserina*	3 ft.	DP16	4
Coast live oak	*Quercus agrifolia*	6 ft.	1g tree	1

			band	
Gooseberry	*Ribes menziesii*	3 ft.	DP16	1
California blackberry	*Rubus ursinus*	3 ft.	DP16	3
Pickleweed	*Salicornia pacifica*	2 ft.	4in	7
Arroyo willow	*Salix lasiolepis*	6 ft.	stakes	3
Red elderberry	*Sambucus racemosa*	3 ft.	DP40	3
Snake root	*Sanicula crassicaulis*	3 ft.	DP16	3
Small-fruiting bulrush	*Scirpus microcarpus*	3 ft.	DP16	7
Bee plant	*Scrophularia californica*	3 ft.	DP16	5
Coast redwood	*Sequoia sempervirens*	10 ft.	1g tree band	1
Hedge nettle	*Stachys chamissonis*	3 ft.	DP16	5
Purple needle grass	*Stipa pulchra*	1 ft.	LT7	7
Ithuriel's spear	*Triteleia laxa*	3 ft.	4in	3
California bay	*Umbellularia californica*	6 ft.	DP40	1
Stinging nettle	*Urtica dioica*	3 ft.	DP16	5
Western chain fern	*Woodwardia fimbriata*	3 ft.	4in	3

Appendix C: Salvage Plant Methodology

Salvaging plants can be an efficient revegetation method where suitable native vegetation is available. Using existing plants to revegetate lowers costs and ensures genetically appropriate plants for revegetation. Two main methods for acquiring salvage plants are by mechanically harvesting sod masses or by manually harvesting individual desired plants.

Mechanical Harvest of Salvage Sod

This harvesting method uses heavy machinery to scrape mats of vegetation and keep them as "sod carpets." Before harvest, vegetation should be cut to a height of two to six inches to minimize biomass and water loss in the plants after harvest. Sod should be excavated to at least one foot below the surface to retain the soil with the plant rhizomes. The result is a mat that resembles a sod carpet. The length and width of these mats will depend on the machine used to harvest the plants and the area available for storing the salvage sod.

As plants are being removed from the ground, a vegetation monitor should assist as needed. See Workforce Options and Roles section for more discussion on the vegetation monitor. They should confirm species and location of harvest for quality assurance. They should also make sure the machine is digging the plants out to an appropriate depth and capturing the entire mat of plants.

The salvage sods mats should be staged on clean plastic tarps that have been sprayed with 70% isopropyl alcohol to minimize harmful plant pathogens. Sod mats should be stored in the shade and should be watered weekly to prevent the soil and roots from drying out. If mats appear to be drying out, more frequent watering will be required. It is recommended that the salvage sod mats not be kept out of the ground longer than one month. It may be possible to go longer without planting the salvage sod mats, but the viability of the plants may begin to decline.

Where to Use This Method

This method is good for areas that are accessible by heavy equipment and where plant material is growing in a continuous area. This method is not good for harvesting scattered individuals or on steep slopes or wet areas which equipment cannot access. Salvage sod is best used in areas that can accept large pieces of sod mat. Smaller revegetation locations may not be suitable for salvage sod mats. Additionally, it is important to find locations to store the salvage sod where it can be kept cool and moist until it can be installed.

Manual Harvest of Salvage Plants from the Ground

This harvesting method uses hand picks and Pulaskis to manually dig the plants from the ground. Like mechanical harvesting, salvage plants should first be cut to a height of two to six inches to minimize biomass and post-harvest water loss. After the plant has been manually dug out of the ground, rhizomes should be cut into pieces that have a minimum of two nodes, though plants that have only one node should be planted as well. A node is a location along the rhizome where roots and aboveground vegetation are attached.

Rhizomes can be stored on site for up to two weeks in buckets or covered in plastic sheeting. Buckets and plastic sheeting must be clean of dirt and debris and cleaned with 70% isopropyl alcohol. It is important to find a cool shady place to store manually harvested rhizomes or they will dry out and die. These plants need to be watered daily or every other day.

Where to Use This Method

This method is useful in areas where plants are not growing in continuous patches or are growing between less desirable plants. This method may take more time than mechanical harvest but could be more flexible since it does not require construction equipment.

Manual Harvest of Salvage Plants from Salvage Sod

Alternatively, individual salvage plants could be pulled from the harvested sod mat pieces. Contractors trained and overseen by the vegetation monitor should use hand picks to sort through the salvage sod and pull out useful plant material. Rhizomes should be cut into pieces that have a minimum of two nodes, though plants with only one node should still be planted. Green vegetation should be trimmed to about two to six inches.

Other plants that are undesirable or are not able to be successfully transplanted should be removed from the soil and composted off-site. Soil left over from the sort process can be returned to the site.

Where to Use This Method

Harvesting rhizomes from the salvage sod could be necessary if the sod mats do not end up fitting into the planned locations or if the machinery to move the sod carpet is not available. This method would give the speed of mechanical harvest and the flexibility of planting individual plants.

Installation of Salvage Plants

For all methods described, salvaged plants can be installed ahead of, and under net-style rolled erosion control products (RECP). If tightly woven RECP is specified, then installation of plants ahead of the RECP is not recommended. For revegetation in areas with tightly woven RECP see the Willow Stake and Container Plants sections.

Mechanical Installation of Salvage Sod

Salvage sod mat can be installed using heavy equipment. The area where the salvage sod is to be placed needs to be excavated slightly so the plants are planted at final grade. Mechanical installation of salvage sod will need to be timed ahead of other planting so other plants or seeds are not impacted by heavy equipment on site. Areas of sod installation need to be marked with flagging or stakes so areas may be located again for watering, weeding, or monitoring.

This method works best in areas where salvage sod can be placed in large swaths rather than in small patches in discrete locations. Mechanical installation is fast and efficient and is low cost due to ease of excavation and transport by heavy equipment. Challenges of this method include requiring equipment access to sod mat storage locations and planting sites . If plants are harvested from the ground close to installation and kept near the installation location, equipment access and storage space may not be an issue.

Where to Use This Method

This method should be used in areas where rhizomatous vegetation is desired, grades are low, there is equipment access, the RECP is loosely netted and not densely woven, and soil moisture will allow salvage sod to establish.

Hand Installation of Salvage Sod

Salvaged sod may also be installed by hand. Wheelbarrows or power carriers could be used to move chunks of salvage sod to planting locations. Planting locations need to be excavated (by hand or with equipment) ahead of sod installation. Care should be taken to plant salvage sod at final grade. Installation would need to be completed before netted erosion control is installed. Salvage sod should be marked for follow-up watering, weeding, or monitoring.

While this method takes more time than mechanical installation, it allows more detailed salvage sod planting, can be used where equipment access is limited, and could potentially result in higher survivorship of planted material.

Where to Use this Method

This method should be used in areas where rhizomatous vegetation is desired, equipment access is limited, and soil moisture will allow salvage sod to establish.

Hand Installation of Individual Salvage Plants

This method is used for individual salvaged plants either salvaged from site or from salvage sod. Rhizomes of individual salvage plants should be planted two to four inches below grade. Any green vegetation left on the plant should be oriented up and roots oriented down. Plants should be marked with a flag or bamboo stake on a consistent side of the plant (all to the north, for example) for future watering, weeding, and monitoring.

This is the most time-consuming method of salvage plant installation, but it allows plants to be spread out over a larger area rather than in more dense sod carpets. Individual salvage plants can be planted before or after container plants are planted, but must be installed before direct seed is broadcast. This method also avoids introducing unwanted plants and weeds to the planting areas.

Where to Use this Method

This method should be used in areas where rhizomatous vegetation is desired, equipment access is limited, and soil moisture will allow individual rhizomes to establish.

See Post-installation Care section for watering, weeding, and mulching recommendations for all salvaged plants.