City of Petaluma

PIPS FORCE MAIN
Constructability Analysis
For Alternative A Alignment
TECHNICAL MEMORANDUM

December 2019

NUTE ENGINEERING

TECHNICAL MEMORANDUM

CITY OF PETALUMA

PIPS FORCE MAIN CONSTRUCTABILITY ANALYSIS FOR ALTERNATIVE A ALIGNMENT

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CITY OF PETALUMA

PIPS FORCE MAIN CONSTRUCTABILITY ANALYSIS
FOR ALTERNATIVE A ALIGNMENT

BACKGROUND

This technical memorandum is preceded by the Nute Engineering City of Petaluma PIPS Force Main - Parallel Force Main Route Study - Technical Memorandum dated December 2014, which identified and compared four alternative parallel routes to the existing PIPS Force Main. Alternative A alignment was the recommended route, which involves construction of the parallel force main within the existing easements acquired in the original 1972 project.

In the first memorandum, the study objective included a review of the design capacity of the existing pipeline and pump station. It also included a review of preferred pipeline materials and concluded that non-corrosive HDPE fused pipe, or PVC pipe are preferred. The memorandum also included a review of pipeline installation methods, including trenchless methods and open cut direct burial. The final pipeline installation will likely include a combination of these methods due to crossing of the SMART right of way and Adobe Creek.

The objective of this technical memorandum is to expound in greater depth on the planning and construction issues identified in the previous review including:

- Further analysis of the recommended route for level of right of way acquisition effort required. Associated Right of Way Services (ARWS) of Pleasant Hill, CA, has prepared an analysis which is attached as an appendix and is summarized in this memorandum.
- Utilization of Prunuske Chatham, Inc. (PCI) of Sebastopol, CA, to further identify potential environmental and archaeological impacts on, and permitting requirements for, the recommended pipeline alignment. In addition, their work provides a description of required environmental permitting preparation tasks.
- An important part of the constructability analysis for any buried pipeline is the soil conditions and deeper ground conditions which will affect the construction methods. Miller Pacific Engineering Group (MPEG) of Novato, CA will include a summary of the available geotechnical record, review of aerial photographs to evaluate the history of previous site development, and preliminary evaluation of relevant geologic hazards including seismic shaking, liquefaction, settlement and other hazards. Finally, MPEG has provided a project feasibility report summarizing their findings and including preliminary geotechnical recommendations.

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- Nute Engineering will do the final compilation of the memorandum findings incorporating the different team member's contributions and the results of the utility identification enquiry to identify pre-project potholing needs. We will further assess feasible pipeline construction methods and appropriate pipeline materials.

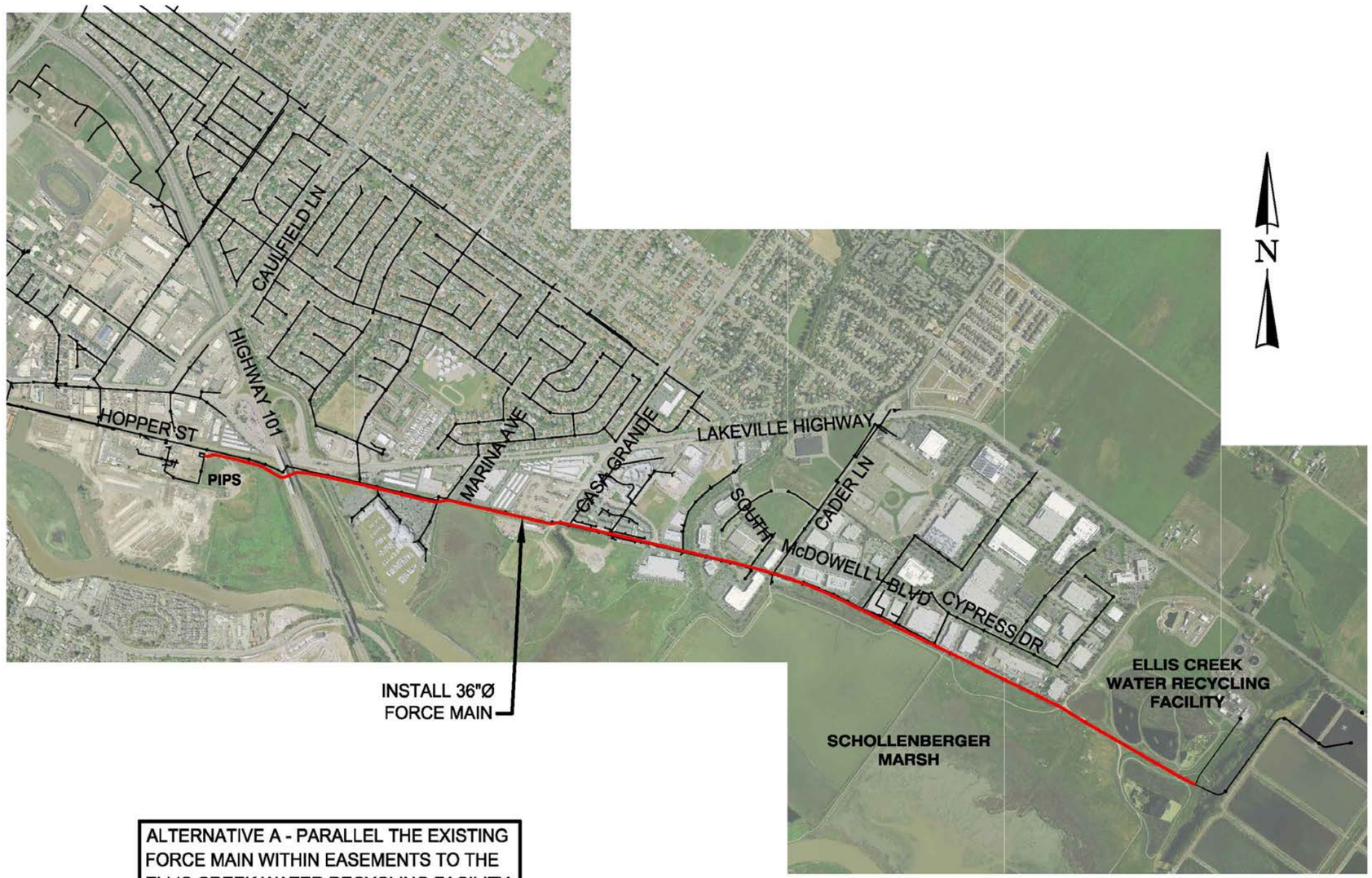
Existing Force Main Features – The City of Petaluma operates a single 36" diameter force main conveying the sewage from nearly the entire City for a distance of over 2.5 miles from the Plant Influent Pump Station (PIPS) to the Ellis Creek Water Recycling Facility (WRF). The PIPS force main was constructed in the mid 1970's, which means that it is now about 40 years old. The pipe material consists of a concrete lined and coated steel rod reinforced, steel cylinder (Concrete Cylinder Pipe).

PIPS Parallel Force Main Route Study and Description of Existing and Alternative A Alignment Routes – Nute Engineering was asked to prepare, and completed, the PIPS Force Main Parallel Force Main Route Study for the City in December 2014. Concern about the PIPS force main reliability was brought into focus during the 2013 Caltrans widening of the overhead viaduct, over the rail right of way and PIPS force main. City staff struggled with Caltrans Engineers over the driving of deep foundation piles for the new viaduct columns. One set of piles came within inches of the PIPS force main. When protective shoring was pulled, the pipeline had shifted enough to produce visible cracking of the force main at a joint. Caltrans installed a full circle repair clamp at this location.

Planning for the installation of a parallel force main therefore, was compelled by the above Caltrans experience and the history of the PIPS force main design. At the time that the original force main was constructed the City had the foresight to anticipate the need for a parallel force main. Relatively wide easements were acquired, presumably to accommodate the second force main. Even though it was found that this existing easement had been impacted by the contemporary development, the route study determined this original alignment, Alternative A, was the preferred one (**Figure 1**).

Existing Force Main - Alignment Route Description and Alternative A Alignment Route – The existing force main crosses under the Highway 101 overhead viaduct and then crosses under the SMART railroad tracks through a steel casing. The westerly section of the force main route followed the Donahue spur of the North-western Pacific Railroad (now SMART). The pipeline runs in a relatively straight alignment south of the Lakeville Highway to the WRF. In the 1970's when the force main was constructed, the land east of Casa Grande Road was mostly vacant farmland. The pipe was installed in steel casings where it crossed under creeks or drainage ditches.

The Alternative A Alignment, with a length of 12,200 feet, follows the alignment of the existing force main and should be able to be installed within the easements which are already on record. The 1972 plans for the force main actually showed an alignment for a future force main. Since much of the area over the easements has been developed, about



ALTERNATIVE A - PARALLEL THE EXISTING FORCE MAIN WITHIN EASEMENTS TO THE ELLIS CREEK WATER RECYCLING FACILITY.

PARALLEL PIPS FORCE MAIN
ALTERNATIVE A
FIGURE 1

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half of the length of a new force main construction work would have to cross streets and parking lots. In some places the new pipeline will be very close to buildings. It might be preferable to acquire new easements in a slightly different alignment to avoid existing structures and improvements.

TECHNICAL MEMORANDUM OBJECTIVE

For this memorandum, three professional specialists have contributed their research and findings, along with Nute Engineering in the following separate categories:

- A review and description of preliminary right of way issues identified along the proposed pipeline alignment.
- A review and presentation of environmental and archaeological issues for the project pipeline alignment.
- A review of the geotechnical feasibility of the planned pipeline alignment and construction methods based on existing geotechnical data for the area.
- Existing utilities survey
- Pipeline Constructability Issues

The following describes the objective of each specialist:

Preliminary Right of Way Issues (Associate Right of Way Services Report)) - The objective of the review of the right of way issues for the PIPS pipeline alignment was to track the pipeline across the various properties and identify if a current pipeline easement exists on these properties, and identify possible issues. Based on the information provided by the Client, there appears to be 31 individually impacted parcels for Alternative A pipeline alignment.

Preliminary Identification of Environmental and Archaeological Issues (Prunuske-Chatham Report) - The objective of the environmental and archaeological review is to evaluate existing ecological conditions along the proposed route and to identify the range of potential environmental conditions associated with the project, as well as the expected permitting requirements.

Geotechnical Feasibility Issues (Miller Pacific Engineering Group Report) - The objective of the geotechnical investigation is to review previous subsurface exploration by others and evaluate relevant geologic hazards which may affect the proposed project and develop conceptual mitigation measures. Based on this evaluation, MPEG will develop preliminary geotechnical recommendations and guidelines for the project.

Alternative A Existing Underground Utilities (Nute Engineering) - Despite the existing PIPS force main easement, a new parallel PIPS force main will encounter underground and aboveground utilities in the planned Alternative A. Although the existing force main was originally installed in easements across farmland, much of the area has been developed and underground water, gas, sewer, electric and communication have been installed. Therefore an

objective of this report will be to identify known utilities from the respective agencies through the use of utility agency information requests.

Alternative A Discussion of Pipeline Constructability Issues (Nute Engineering) - Based on the findings from the other subconsultants, Nute will further review the construction materials and methods identified in the 2014 report. The objective for this further review will be to recommend pipe material and installation methods based on the geotechnical conditions, which can be constructed readily in the alignment right of way, and are appropriate for the environmental concerns of an alignment area.

DISCUSSION OF MEMORANDUM FINDINGS

This memorandum attempts to summarize the findings of the professional specialists reports for the Alternative A pipeline alignment. The full reports will be attached as appendices to this memorandum for the reader.

Preliminary right of Way Issues (ARWS Report - The Association Right of Way Services July 12th Memorandum indicates that all of the adjacent or impacted parcels for this alignment are within the City of Petaluma, Marin County. The alignment may pass across nine parcels which could increase the potential impacts and damages from new construction. The alignment may pass along the property lines of 22 parcels which may have minimal impact. The proposed alignment may have potential impacts such as access, parking, landscaping, trails, structures, open space and waterways. Four vacant parcels appear to be planned for development.

Of the thirty-one parcels, eight are zoned BP (Business Park), four are CPSP – MU (Central Petaluma Specific Plan – Mixed Use), two are MU 1B (Mixed Use 1B), five are OSP (Open Space Park), eleven are PCD (Planned Community Development) and one is R5 (Residential 5). **Table 1**, Easement Acquisition Issues – Alternative A Alignment Impacted Parcels, presents the specific parcels and the identified potential issues.

Preliminary Identification of Environmental and Archaeological Issues (Prunuske-Chatham Report) - The attached Environmental Constraints Technical Memorandum provides the results of PCI's evaluation for the project and includes recommendations for additional studies needed for design and permitting. It should be noted that the installation of the parallel PIPS force main exceeds the one mile statutory exemption under Article 18 of the 2014 CEQA Guidelines, Statutory Exemptions, Section 15282 (k) and will be subject to CEQA review and compliance.

Biological Resources, Wetlands and Jurisdictional Waters, Sensitive Natural Communities, Special Status Species - The project area for Alternative A, Figure 1, is located within an urban setting. Most of the proposed route runs through developed land, including under Highway 101, under the SMART railroad tracks, and through office and residential parking areas, but portions of the alignment will be constructed within wetland and riparian habitats or directly adjacent to sensitive habitats. **Table 2**. Existing Conditions Along

ARWS EASEMENT ACQUISITION ISSUES
Table 1: Alternative A Alignment Impacted Parcels

Location	APN	Size (Acre)	Owner	Zoning	General Plan	Current Use	Easement Location	Potential Impacts	Easement Notes
PIPS to 101	136-690-002-000	1.37	PETALUMA JL LAND LLC	CPSP - MU (Central Petaluma Specific Plan - Mixed Use)	Mixed Use	Vacant Land	Across Property	Future Development	No easement reference information found. Plans show 30' Easement.
PIPS to 101	136-690-001-000	0.59	PETALUMA RIVERFRONT LLC	CPSP - MU (Central Petaluma Specific Plan - Mixed Use)	Mixed Use	Vacant Land	Across Property	Future Development	No easement reference information found. Plans show 30' Easement.
PIPS to 101	136-690-007-000	3.68	PETALUMA RIVERFRONT LLC	CPSP - MU (Central Petaluma Specific Plan - Mixed Use)	Mixed Use	Vacant Land	Property Line	Future Development	No easement reference information found. Plans show 30' Easement.
PIPS to 101	136-690-011-000	1.32	PETALUMA RIVERFRONT LLC	CPSP - MU (Central Petaluma Specific Plan - Mixed Use)	Mixed Use	Vacant Land	Property Line	Future Development	No easement reference information found. Plans show 30' Easement.
SMART Crossing	005-060-005-000	1.30	SONOMA-MARIN AREA RAIL TRANSIT DISTRICT	OSP (Open Space Park)	Flood Plain	Vacant Land	Property Line	Minimal	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-093-000	1.11	SONOMA COUNTY WATER AGENCY	OSP (Open Space Park)	Flood Plain	Vacant Land	Property Line	Minimal / Waterway	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-096-000	3.07	THE CALIFORNIA STATE UNIVERSITY	PCD (Planned Community Development)	Mixed Use	Hotel	Property Line	Parking / Access / Landscaping	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-097-000	1.49	PETALUMA MARINA OWNERS ASSOCIATION	PCD (Planned Community Development)	Mixed Use	Parking Lot	Across Property	Parking / Access / Landscaping	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-065-000	1.04	CITY OF PETALUMA	MU 1B (Mixed Use 1B)	N/A	Vacant Land	Across Property	Minimal / Landscaping	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-085-000	5.71	PETALUMA MARINA OWNERS ASSOC	PCD (Planned Community Development)	Mixed Use	Parking Lot	Property Line	Parking	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-059-000	14.76	STATE OF CALIFORNIA	OSP (Open Space Park)	Open Space	Open Space	Property Line	Minimal / Waterway	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
East of Marina (Petroleum Av) to Casa Grande	005-060-066-000	1.83	LAKEVILLE WHITE LLC	R5 (Residential 5)	Mixed Use	Vacant Land	Across Property	Minimal	12.5' Sewer Easement per 2715 OR 475 and 2717 OR 203
Casa Grande to Technology Lane	005-040-058-000	8.34	AJO, DAVID MANUEL	PCD (Planned Community Development)	Mixed Use	Apartments	Property Line	Parking	15' Sewer Easement per 2416 OR 548, 37.5' Sewer Easement per 2710 OR 630
Casa Grande to Technology Lane	005-060-067-000	0.76	BAYWOOD LLC	MU 1B (Mixed Use 1B)	High Density Residential	Vacant Land	Across Property	Minimal	15' Sewer Easement per 2416 OR 548, 37.5' Sewer Easement per 2710 OR 630

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Technology Lane to Cader Lane	005-280-051-000	5.72	MORESCO INVESTMENTS LLC	PCD (Planned Community Development)	Business Park	Office Building	Property Line	Parking / Access / Trail / Landscaping	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology lane to Cader Lane	005-280-046-000	4.82	CITY OF PETALUMA	OSP (Open Space Park)	Open Space	Open Space	Across Property	Minimal / Waterway / Trail	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-053-000	3.14	LANE PETALUMA EAT LLC	PCD (Planned Community Development)	Business Park	Office Building	Property Line	Parking / Access	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology lane to Cader Lane	005-280-054-000	2.13	SSCOP DE LLC	PCD (Planned Community Development)	Business Park	Office Building	Across Property	Parking / Access	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-010-000	4.36	UNITED STATES POSTAL SERVICE	PCD (Planned Community Development)	Public/Semi Public	Post Office	Property Line	Landscape / Parking / Minimal	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-034-000	4.74	SSCOP DE LLC	PCD (Planned Community Development)	Business Park	Office Building	Property Line	Parking / Structure/ Access	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-035-000	1.71	SSCOP DE LLC	PCD (Planned Community Development)	Business Park	Office Building	Property Line	Parking / Structure/ Access	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Cader Lane Industrial Park	005-290-011-000	8.39	SSCOP DE LLC	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-086-000	4.59	MKD MCDOWELL LLC	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-081-000	2.20	CLAUSEN W, B	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-082-000	2.34	CLAUSEN W B JR TR & CLAUSEN MURIEL C TR	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-310-COM	1.43	UNDISCOVERED - HOA	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-039-000	2.25	CALIFORNIA CYPRESS LLC	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-077-000	8.08	VALACAL COMPANY	BP (Business Park)	Business Park	Industrial	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-062-000	2.82	UNITED CEREBRAL PALSY OF NORTH BAY INC	BP (Business Park)	Business Park	School	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	017-170-001-000	212.19	CITY OF PETALUMA	OSP (Open Space Park)	City Park	Vacant Land	Property Line	Minimal / Open Space	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Oakmead North Park 1A (Includes Oakmead Pump Sta)	068-010-034-000	221.30	CITY OF PETALUMA	PCD (Planned Community Devel)	Public / Semi Public	Open Space /Vacant Land	Across Property	Minimal / Open Space	37.5' SSE per 2705 OR 623, Additional SSE 20' SSE Dedication west of Pump Sta

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Proposed Force Main Alignment, presents a summary of the existing natural, ecological/ biological conditions of the planned force main alignment.

Table 2 Existing Conditions Along Proposed Force Main Alignment

Location	Existing Conditions
PIPS to 101	Disturbed, ruderal
101 to SMART track	Disturbed, ruderal
East of SMART track to edge of Sheraton Hotel parking lot	Disturbed, ruderal, jurisdictional tidal waters with inlet from underground storm drain adjacent to force main. Subject to state and federal regulation and permitting.
Sheraton Hotel parking lot to Marina Avenue	Developed, ornamental landscaping
Marina Avenue to Casa Grande (at dog park)	Drainage and wetlands at end of Marine Avenue, wetlands adjacent to alignment at backside of commercial building complex along Marina Avenue, ruderal area with potential wetlands adjacent to industrial yard to west of Casa Grande
Casa Grande to Technology Lane	Drainage area adjacent to force main near Casa Grande; developed to east to Technology Way
Adobe Creek	Jurisdictional waters and riparian habitat, subject to state and federal regulation and permitting
Edge of Adobe Creek to Schollenberger Park Road	Developed, ornamental landscaping
Schollenberger Park Road to paved path at entrance to WRF	Developed, ornamental landscaping, borders wetland habitat that would be subject to state and federal permitting if disturbed during construction.
WRF	Pathways, jurisdictional wetlands subject to state and federal regulation and permitting

Within the pipeline alignment, wetlands and riparian woodlands are considered sensitive by California Department of Fish and Wildlife (CDFW). Based on this survey, the project alignment can possibly affect jurisdictional wetlands and riparian habitat (**Figure 2**). However, many of the identified jurisdictional water features may be avoided through project design and construction methods. The alignment does cross Adobe Creek and the report recommends that construction activities be designed to avoid impacts within the corridor to protect the riparian woodland community along Adobe Creek. Several trenchless pipeline construction methods such as horizontal directional drilling and bore and jack could achieve the crossing of the creek and riparian zones with little disruption of these sensitive areas.

The PCI report performed a background and database search to determine the potential for special-status species and utilized the California Department of Fish and Wildlife Natural Diversity Database (CNDDB). This database lists reported occurrences of special-status plant species, and special status animals. The PCI report presents a comprehensive table which identifies and describes potentially occurring special-status animals within the project area, and a listing from the database of actual reported occurrences of special-status species in the project area.

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Cultural Resources - The Sonoma State Anthropological Study Center (ASC) assisted PCI to complete a record search to identify cultural resources for the proposed project area. Their findings, in brief, were that no Native American archaeological resources have been recorded to date within the proposed project alignment. However, ASC recommends contacting the local Native American tribe regarding the traditional, cultural, and religious heritage values of the area. In addition to this, the ASC report reviewed the historical record for more contemporary cultural resources and found no recorded buildings or structures within the proposed project area.

Finally, the ASC recommends typical measures to be taken during construction activities, which are standard for a construction project, to protect cultural resources.

CEQA Review and Permitting - The PCI report finds that the PIPS Parallel Force Main Project does not appear to meet the conditions of any CEQA statutory or categorical exemptions and therefore, is subject to the requirements of CEQA. In addition the PCI report identifies other potential permitting requirements in the attached **Table 3**, Potential Federal, State, and Local Permits.

Recommended Additional Studies and Permitting - The PCI report identifies three additional studies that would be required to fully assess the resources discussed in the Environmental Constraints Technical Memorandum for the PIPS Parallel Force Main Project:

- *Biological Resources Assessment Report for design, CEQA requirements and permitting purposes*
- *Jurisdictional Wetland Delineation Report for design, CEQA and Army Corps and other permitting purposes*
- *Cultural Resources Report for CEQA and acquisition of Army Corps Permit*

Geotechnical Feasibility Issues (Miller Pacific Engineering Group Report) - The attached Miller Pacific Geotechnical Feasibility Evaluation performed a review of the available, published geologic mapping and geotechnical background information and a review of aerial photographs to evaluate the history of previous site development. They performed a preliminary evaluation of relevant geologic hazards including seismic shaking, liquefaction, settlement, and other hazards. Finally Miller Pacific performed a feasibility report which summarized the anticipated subsurface conditions.

Site Geologic Conditions and Site History - A summary of the regional geology for the proposed PIPS force main alignment is that it crosses alluvial soils consisting of silt, clay, sand and gravel that is typically poorly to moderately sorted and bedded and artificial fill over Bay Mud. Based on the review of historical aerial photographs in the 1940's the project area was used primarily for agricultural purposes with delineated land lots but no buildings. Highway 101 had not been paved, but Lakeville Highway existed, as well as

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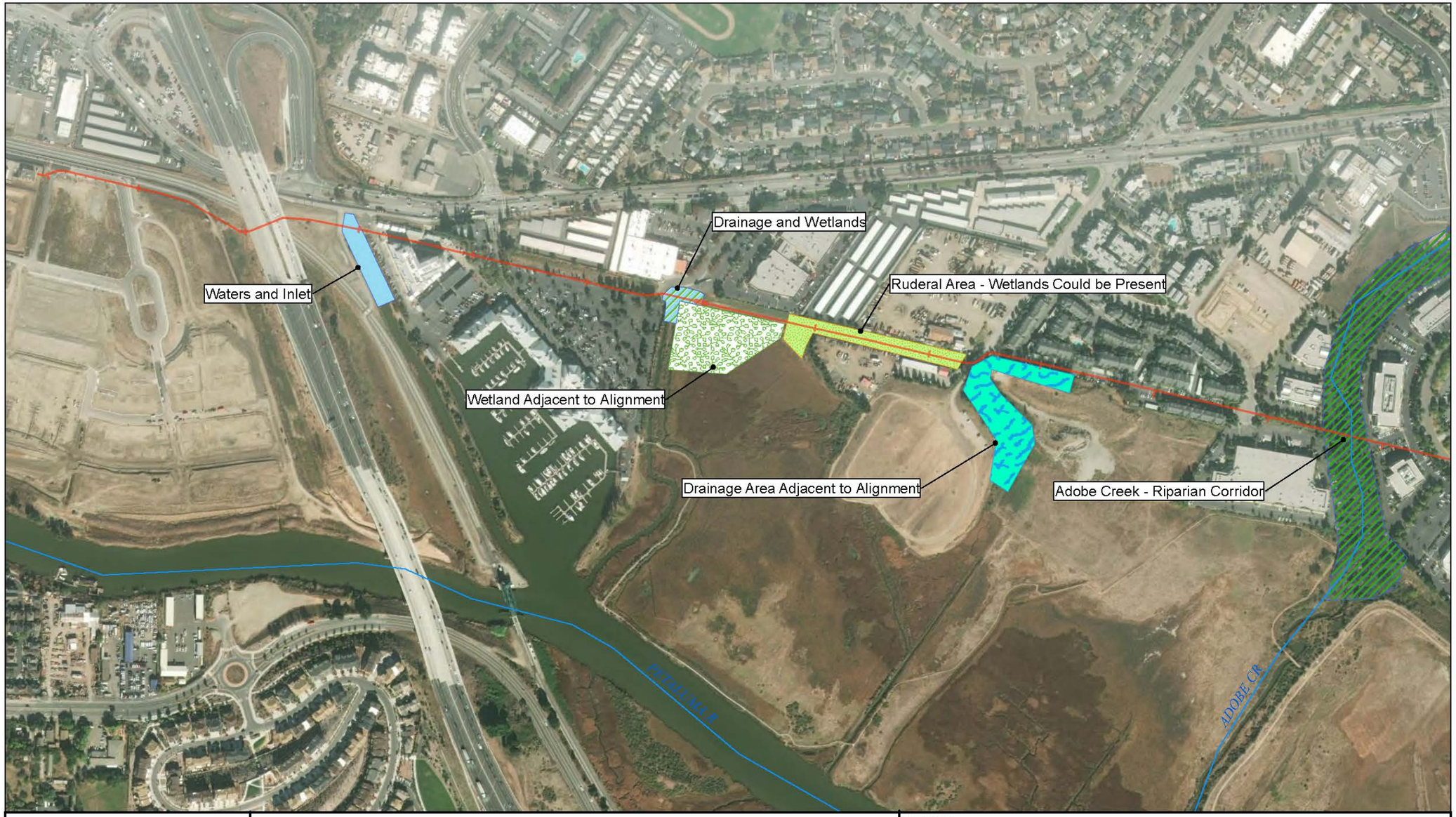

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Table 3. Potential Federal, State, and Local Permits

Agency	Permit	Resource Issue
Army Corps of Engineers	§404 Clean Water Act Permit	Jurisdictional Wetlands and Waters of the US
National Marine Fisheries Service	Incidental Take Permit	Special-status Species (Steelhead) in Adobe Creek
U.S. Fish and Wildlife Service	Incidental Take Permit	Special-status Species (California red-legged frog)
California Department of Fish and Wildlife	Lake or Streambed Alteration Agreement	Adobe Creek/Riparian Woodlands/Waters of the State
California Department of Fish and Wildlife	Incidental Take Permit	Special-status Species (Foothill yellow-legged frog)
San Francisco Bay Water Quality Control Board	§401 Water Quality Certification	Wetlands/Waters/Water Quality
State Water Resources Control Board	Approved SWPPP	Water Quality
Caltrans	Encroachment Permit	Highway 101
Sonoma-Marin Area Rail Transit (SMART)	Entry Permit	Train Tracks
City of Petaluma	Encroachment Permit, Building and Grading Permit	Local Roads
Sonoma County Water Agency	Encroachment Permit	Flood Control Channel

the rail system running from the north to the south, through the east side of the project area. By the 1950's, development is mostly unchanged, but more land lots appeared to be delineated in the Shollenberger Marsh. By 1965, Highway 101 is paved, and a few buildings have been constructed within the agricultural area. Shollenberger Marsh appears to have had some rough graded areas and many of the meandering channels within the marsh have disappeared. By the 1980's, the project area shows significant development with many large commercial buildings, several paved roads and rough graded roads throughout the area.

Geologic Hazards - For seismicity, the planned force main project is located within the seismically active San Francisco Bay area and will experience the effects of future earthquakes. However, because the project area is within Bay Mud, which is relatively soft ground, the earthquake energy will have a long, high-amplitude motion. A characteristic of earth quake affects in soft, wet ground can be liquefaction of the soil.

Alternative A Existing Underground Utility Issues - A new parallel PIPS force main will encounter underground and aboveground utilities in its Alternative A alignment. In its original alignment, the force main was installed in undeveloped farm land. This are has now been developed.

In streets a normal compliment of utilities should be expected. In parking areas landscaping irrigation pipes and control wires should be expected along with underground wires for street lighting.

There is a 16" diameter high pressure gas main which the new force main will need to cross in a couple of places. This line is marked by a couple of signs but the contractor will need to exercise caution while working near this line. It is likely PG&E will require one of their representatives to be present when the contractor is in the area.

Table 4 lists the known utilities within the project area.

Table 4 Alternative A – Utility Company Responses for Potential Conflict

STA Location	PG&E	AT&T	CableCom
PIPS to 101		See Note 5	See Note 1
101 to SMART			
East of SMART Track Edge of Sheraton Hotel Parking Lot			See Note 2
Sheraton Hotel parking Lot to Marina Ave		See Note 6	
Marina Ave to Casa Grande (at Dog Park)			
Casa Grande to Technology Lane		See Note 7	See Note 3
Adobe Creek		See Note 8	
Edge of Adobe Creek to Schollenberger Park Rd		See Note 9	See Note 4
Schollenberger Park Rd to Paved Path at WRF Entrance			
WRF Plant			

***Notes**

1 CABLECOM: (Between STA 1+00 and 5+00) – underground cable within immediate vicinity of PIPS force main as the force main leaves the pump station heading east on the south side of Hopper St. This cable has apparent longitudinal parallel alignment.
2 CABLECOM: (STA 21+00) – there is a CableCom crossing at Baywood Dr
3 CABLECOM: (STA 42+00 and 44+00) – CableCom facility parallel to PIPS force main
4 CABLECOM: (STA 63+00 and 65+00) – at Corporate Circle area the force main crosses the cable facility
5 AT&T: (STA 5+00) – Buried conduit crosses PIPS
6 AT&T: (STA 21+00) – PIPS force main crosses buried conduit
7 CASA GRANDE: (STA 42+00) – PIPS force main crosses AT&T conduit
8 TECHNOLOGY LANE: (STA 53+00) - PIPS force main crosses AT&T conduit
9 CORPORATE CIRCLE: (STA 62+00 TO Sta 67+00) – PIPS force main crosses AT&T conduit in three locations near Corporate Circle

AT&T TRANS-CONTINENTAL FIBER OPTICS – No conflicts with PIPS FORCE MAIN ALIGNMENT

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Alternative A Discussion of Constructability Issues – The Nute Engineering 2014 PIPS parallel Force Main Route Study Technical Memorandum identified preliminary design parameters for the PIPS parallel force main by recommending the new parallel force main match the existing force main in terms of pumping head characteristics at the PIPS. This require the new parallel force main would require a pipeline material with a minimum internal diameter of 36 inches.

The PIPS force main is construction of a composite of material referred to as a concrete cylinder pipe (CCP). The pipe material consists of a concrete lined and coated, rod reinforced steel cylinder. There have been no known failure or leaks of sewage to the environment of the existing PIPS force main. However, the 2104 Study identified risks to the existing pipe and reliability concerns for the City in operating the force main. The 2014 Study reviewed the following new pipeline materials:

- Welded Steel Cement Mortar Lined and Coated Pipe (WSL/C)
- Concrete Cylinder Pipe (CCP)
- High Density Polyethylene Pipe (HDPE)
- Polyvinyl Chloride Pipe (PVC)
- Ductile Iron Pipe (DIP)

The Study recommended pipe materials to be HDPE or PVC. Both of these materials are non-corrosive from the raw sewage and the pipe is relatively lightweight and easy to handle during construction placement.

Alternative A Pipeline Construction Methods – The 2014 Study also covered the appropriate construction methods for placement of a parallel force main utilizing the recommended construction materials. The Study identified variable construction constraints for Alternative A including:

- Crossing SMART alignment
- Open, unencumbered, easement area with possible environmental impacts
- Potential conflicting commercial area development improvements including buildings and parking lots.

The ability to utilize different construction methods will allow project phasing flexibility to address these constraints.

The construction methods identified in the 2014 Study are as follows:

- Open Trenching (conventionally dug trench for buried pipe)
- Directional Drilling (most appropriate for crossing Adobe Creek)
- Boring and Jacking (SMART will require this type of method for crossing operational train tracks)

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The Miller Pacific Engineering Group (MPEG) report identified anticipated subsurface conditions from previous explorations by others. This previous work indicated alluvial soils, sandy silt and clay in the upper 20-25 feet of soil. All three of the identified construction meth0ods can be successfully employed with alluvial subsurface soils.

Directional drilling of such a large (36") pipeline may not be appropriate for much of this project due to the following challenges:

- Drilling a successful, level, pilot bore can be difficult. Directional drilling contractors prefer to install pipe in a large, deep arc. (This arc would work well for crossing under Adobe Creek).
- Back reaming a large diameter (36") bore for installing the pipeline is time consuming. It creates large volumes of drilling spoil which need to be disposed.
- Maintaining the integrity of the bore hole wall in variable, less cohesive soils, can be difficult.
- Large capacity directional drilling equipment are less available among local directional drilling contractors.
- Large capacity directional drilling equipment requires bigger areas for staging the equipment to handle the drilling spoil. This can include 2-3 large Baker Tanks.

Open trenching for a 36" diameter pipe will require a trench width 4.5 to 5 feet wide and generally 7 to 8 feet deep. This method can be used for nearly all of the parallel pipeline alignment but will require a wide (24') temporary construction easement, and removal of large quantities of trench spoil. Boring and Jacking pipe construction methods will likely be necessary for crossing under the SMART rail right of way, as it relies on the installation of a larger diameter steel plate casing. This method may also prove cost effective for crossing under existing improvements.

All of the construction methods are discussed in more depth in the 2014 Study, along with possible work area staging needs for the respective methods.

Pipeline Construction Phasing – The 2014 Study identified a possible three-phase project and broke down the elements of each phase in detail (See Appendix B, 2014 PIPS Force Main Route Study).

- Ellis Creek Water Reclamation Facility to Cader Lane
- Cader Land to Marina Avenue
- Marina Avenue to PIPS

REPORT SUMMARY

Based on the 2014 PIPES Parallel Force Main Route Study recommendation of the Alternative A pipeline alignment, this memorandum identifies easement right of way impacts to at least nine parcels. These impacts include possible encumbrance to future development and impacts to existing improvements.

Because the long (2.5 mile) force main crosses both previously developed properties and borders wetland habitat alongside Schoellenberger Marsh, additional technical studies are recommended to complete the CEQA review process and acquire permits from Federal, State and Local agencies.

Expected subsurface conditions along the proposed pipeline alignment indicates that most construction methods for the new pipeline, including trenchless methods such as bore and jack placement and directional drilling will be effective. Each of these methods still pose significant challenges for staging of equipment within the developed areas. Because of this, construction phasing of the force main will likely be necessary. A potential phasing plan is described in detail in the 2014 Study.

APPENDIX A–Force Main InService Condition Assessment Methods

City of Petaluma

FORCE MAIN IN SERVICE CONDITION ASSESSMENT METHODS

Gravity sewer pipelines are commonly visually inspected utilizing closed circuit televised video inspection cameras and monitored by plugging off incoming sewage and allowing the pipeline to drain. Monitoring the condition of an existing sewage force main is more difficult, primarily because sewage force mains cannot be temporarily taken out of service for any length of time. In addition, the typical access facilities for gravity sewers, (e.g., manholes), for the condition assessment tools, (e.g., CCTV camera), are not provided for in the sewage force mains.

The existing PIPS force main has 10 air release valve which are installed with a 20" diameter stand pipe in 5" diameter manholes. As discussed in previous project contingency planning, it could be possible to use the ARV manholes for access for CCTV or other survey equipment. But, the significant sewage flow from the PIPS force main would need to be bypassed during the pipe survey period. Nute Engineering previously provided to City Staff the PIPS Force Main Contingency Planning Technical Memorandum, which recommended the implementation of the now constructed emergency sewage storage at the former Petaluma Wastewater Treatment Plant,

This emergency sewage storage provides an estimated 1.5 million gallons, or up to 8 hours of storage at the constructed emergency storage at the former plant for the estimate dry weather force main flow of 4.5 million gallons per day. This short time window could be used for implementation of a CCTV inspection program that would need to be able to isolate short sections of the 2.5 mile force main pipeline at a time, dewater the section, and insert a CCTV camera and inspect the section.

There are pipeline inspection technologies developed which are intended to be use in an operating sewage force main or pipeline. One of these is the SMART BALL. The SMART BALL uses acoustic and magnetic sensors and is intended to detect leaks and the flow turbulence occurring at pipeline air pockets. This ball is free rolling down the pipeline, pushed by pump flow. The ball can be inserted in a full, depressurized pipeline and needs to be retrieved downstream. This is the most applicable "in service" pipe inspection tool for the PIPS force main, the Ross Valley Sanitary District and San Rafael Sanitation District have used the SMART BALL for inspection of sewage force mains. For the existing PIPS concrete cylinder pipe which has regular sealed joints, early leak detection information could be valuable. In addition, the detection of pipeline air pockets could provide information of areas where the concrete lining is being damaged by the accumulation of hydrogen sulfide gas.

Other technologies have been developed for pipelines for both the water supply industry and the oil and gas industry. However, the particular composite pipe wall of the PIPS Force Main, Concrete Cylinder Pipe, CCP renders these technologies much less effective in practice. Part of the challenge for CCP is that the typical failure mechanism of a sewage pipeline is the

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chemical erosion of the cement mortar lining due to hydrogen sulfide gas accumulation at the top of the pipe. These technologies usually include pulling some type of in pipe sensor through the pipe. The sensor technologies include the production and measurement of an electromagnetic field, as in the case of the trade marked "Sea Snake". This technology is intended for inspection of the ferrous pipes, ductile iron and welded steel. Because of the mortar lining of the PIPS Force Main concrete cylinder pipe, the Sea Snake would have uncertain results and is not recommended.

There are other technologies for pipeline wall inspection which use X- Ray or ultrasonic energy. Both of these technologies rely on the production of the energy at the tool which is pulled through the pipe. The energy is reflected and or absorbed by the pipe wall. The reflected energy is measured by the sensor on the inspection tool which can quantify the thickness of the pipeline wall, in the case of ultrasonic sensors, or the presence of different densities of pipe wall materials, in the case of X Ray. In discussions with sensor equipment manufacturers, these technologies are complicated by the composite material pipe, which is the PIPS Force Main concrete cylinder pipe, and are not recommended for this use.

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APPENDIX B – ARWS Report

ASSOCIATED RIGHT OF WAY SERVICES, INC.

2300 Contra Costa Blvd.
Suite 525
Pleasant Hill, CA 94523

925.691.8500 *phone*
925.691.6505 *fax*
www.arws.com

MEMORANDUM

DATE: July 12, 2019

TO: **NUTE ENGINEERING**
Attn.: Mark T. Wilson
907 Mission Ave.
San Rafael, CA 94901

FROM: Gary Dowd – Associated Right of Way Services, Inc.

PROJECT: Parallel PIPS Force Main, Alternative A

SUBJECT: Preliminary Right of Way Issues

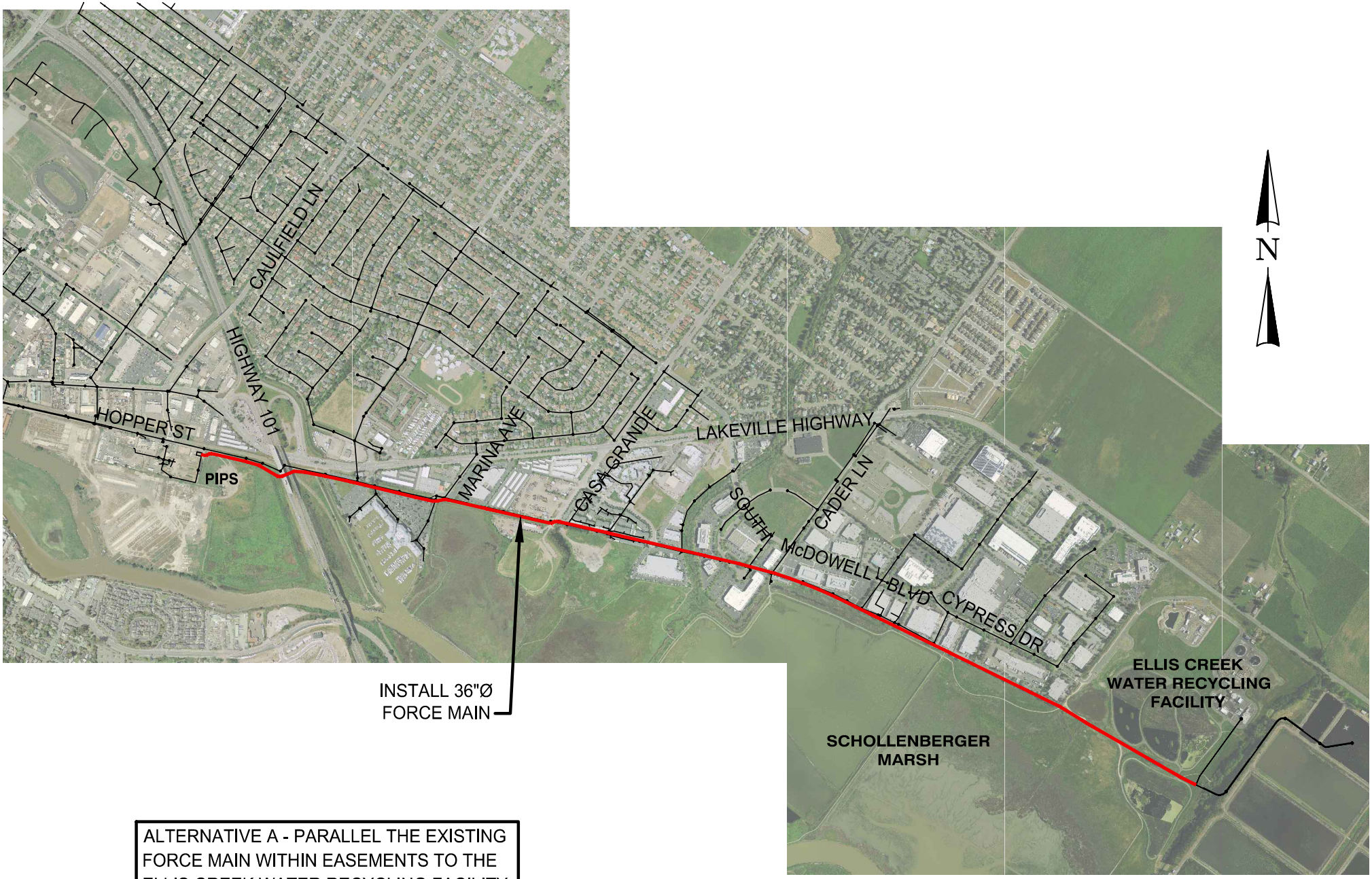
As requested, Associated Right of Way Services, Inc. ("AR/WS") has prepared this Preliminary Right of Way Issues Memorandum ("Memo") for Nute Engineering ("Client"). This Memo considers one project alternative, Alternative A. Based on the attached exhibit provided by the Client, there appears to be 31 individually impacted parcels for Alternative A.

All of the impacted parcels are located in Marin County, within the City of Petaluma, California. Of the 31 parcels, eight are zoned BP (Business Park), four are CPSP – MU (Central Petaluma Specific Plan – Mixed Use), two are MU 1B (Mixed Use 1B), five are OSP (Open Space Park), 11 are PCD (Planned Community Development) and one is R5 (Residential 5).

According to the exhibit provided by the Client, Alterative A may pass across nine parcels, which could increase the potential impacts and damages, and may pass along the property lines of 22 parcels which may have lesser or minimal impacts. The proposed alternative may have potential impacts such as access, parking, landscaping, trails, structures, open space and waterways. Four vacant parcels appear to be approaching development.

The impacted parcels are identified on the attached exhibits.

Attachments
1. Parallel PIPS Force Main Alternative A
2. Alternative A Potential Issues



ALTERNATIVE A - PARALLEL THE EXISTING FORCE MAIN WITHIN EASEMENTS TO THE ELLIS CREEK WATER RECYCLING FACILITY.

PARALLEL PIPS FORCE MAIN
ALTERNATIVE A

Alternative A Potential Issues

Location	APN	Size (Acre)	Owner	Zoning	General Plan	Current Use	Easement Location	Potential Impacts	Easement Notes
PIPS to 101	136-690-002-000	1.37	PETALUMA JL LAND LLC	CPSP - MU (Central Petaluma Specific Plan - Mixed Use)	Mixed Use	Vacant Land	Across Property	Future Development	No easement reference information found. Plans show 30' Easement.
PIPS to 101	136-690-001-000	0.59	PETALUMA RIVERFRONT LLC	CPSP - MU (Central Petaluma Specific Plan - Mixed Use)	Mixed Use	Vacant Land	Across Property	Future Development	No easement reference information found. Plans show 30' Easement.
PIPS to 101	136-690-007-000	3.68	PETALUMA RIVERFRONT LLC	CPSP - MU (Central Petaluma Specific Plan - Mixed Use)	Mixed Use	Vacant Land	Property Line	Future Development	No easement reference information found. Plans show 30' Easement.
PIPS to 101	136-690-011-000	1.32	PETALUMA RIVERFRONT LLC	CPSP - MU (Central Petaluma Specific Plan - Mixed Use)	Mixed Use	Vacant Land	Property Line	Future Development	No easement reference information found. Plans show 30' Easement.
SMART Crossing	005-060-005-000	1.30	SONOMA-MARIN AREA RAIL TRANSIT DISTRICT	OSP (Open Space Park)	Flood Plain	Vacant Land	Property Line	Minimal	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-093-000	1.11	SONOMA COUNTY WATER AGENCY	OSP (Open Space Park)	Flood Plain	Vacant Land	Property Line	Minimal / Waterway	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-096-000	3.07	THE CALIFORNIA STATE UNIVERSITY	PCD (Planned Community Development)	Mixed Use	Hotel	Property Line	Parking / Access / Landscaping	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-097-000	1.49	PETALUMA MARINA OWNERS ASSOCIATION	PCD (Planned Community Development)	Mixed Use	Parking Lot	Across Property	Parking / Access / Landscaping	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-065-000	1.04	CITY OF PETALUMA	MU 1B (Mixed Use 1B)	N/A	Vacant Land	Across Property	Minimal / Landscaping	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-085-000	5.71	PETALUMA MARINA OWNERS ASSOC	PCD (Planned Community Development)	Mixed Use	Parking Lot	Property Line	Parking	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
Old NWPPRR Donahue Spur N of Marina	005-060-059-000	14.76	STATE OF CALIFORNIA	OSP (Open Space Park)	Open Space	Open Space	Property Line	Minimal / Waterway	2799 OR 965 shown over FM. Various Sanitary Facilities plotted on map without easement references.
East of Marina (Petroleum Av) to Casa Grande	005-060-066-000	1.83	LAKEVILLE WHITE LLC	R5 (Residential 5)	Mixed Use	Vacant Land	Across Property	Minimal	12.5' Sewer Easement per 2715 OR 475 and 2717 OR 203
Casa Grande to Technology Lane	005-040-058-000	8.34	AJO, DAVID MANUEL	PCD (Planned Community Development)	Mixed Use	Apartments	Property Line	Parking	15' Sewer Easement per 2416 OR 548, 37.5' Sewer Easement per 2710 OR 630
Casa Grande to Technology Lane	005-060-067-000	0.76	BAYWOOD LLC	MU 1B (Mixed Use 1B)	High Density Residential	Vacant Land	Across Property	Minimal	15' Sewer Easement per 2416 OR 548, 37.5' Sewer Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-051-000	5.72	MORESCO INVESTMENTS LLC	PCD (Planned Community Development)	Business Park	Office Building	Property Line	Parking / Access / Trail / Landscaping	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630

Location	APN	Size (Acre)	Owner	Zoning	General Plan	Current Use	Easement Location	Potential Impacts	Easement Notes
Technology lane to Cader Lane	005-280-046-000	4.82	CITY OF PETALUMA	OSP (Open Space Park)	Open Space	Open Space	Across Property	Minimal / Waterway / Trail	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-053-000	3.14	LANE PETALUMA EAT LLC	PCD (Planned Community Development)	Business Park	Office Building	Property Line	Parking / Access	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology lane to Cader Lane	005-280-054-000	2.13	SSCOP DE LLC	PCD (Planned Community Development)	Business Park	Office Building	Across Property	Parking / Access	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-010-000	4.36	UNITED STATES POSTAL SERVICE	PCD (Planned Community Development)	Public/Semi Public	Post Office	Property Line	Landscape / Parking / Minimal	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-034-000	4.74	SSCOP DE LLC	PCD (Planned Community Development)	Business Park	Office Building	Property Line	Parking / Structure/ Access	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Technology Lane to Cader Lane	005-280-035-000	1.71	SSCOP DE LLC	PCD (Planned Community Development)	Business Park	Office Building	Property Line	Parking / Structure/ Access	15' Sewer Easement per 2416 OR 648, 37.5 Utility Easement per 2710 OR 630
Cader Lane Industrial Park	005-290-011-000	8.39	SSCOP DE LLC	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-086-000	4.59	MKD MCDOWELL LLC	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-081-000	2.20	CLAUSEN W, B	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-082-000	2.34	CLAUSEN W B JR TR & CLAUSEN MURIEL C TR	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-310-COM	1.43	UNDISCOVERED - HOA	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-039-000	2.25	CALIFORNIA CYPRESS LLC	BP (Business Park)	Business Park	Office Building	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-077-000	8.08	VALACAL COMPANY	BP (Business Park)	Business Park	Industrial	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	005-090-062-000	2.82	UNITED CEREBRAL PALSY OF NORTH BAY INC	BP (Business Park)	Business Park	School	Property Line	Parking	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Cader Lane Industrial Park	017-170-001-000	212.19	CITY OF PETALUMA	OSP (Open Space Park)	City Park	Vacant Land	Property Line	Minimal / Open Space	37.5' SSE per 2651 OR 704, Additional SSE 10' SEE 82-003208 eastern 2/3 of property
Oakmead North Park 1A (Includes Oakmead Pump Sta)	068-010-034-000	221.30	CITY OF PETALUMA	PCD (Planned Community Development)	Public / Semi Public	Open Space / Vacant Land	Across Property	Minimal / Open Space	37.5' SSE per 2705 OR 623, Additional SSE 20' SSE Dedication west of Pump Sta

APPENDIX C – PCI Report

Environmental Constraints Technical Memorandum
City of Petaluma PIPS Parallel Force Main
July 2019

Prepared for:
City of Petaluma
11 English Street
Petaluma, CA 94952

Nute Engineering
907 Mission Avenue
San Rafael, CA 94901

Prepared by:
Prunuske Chatham, Inc.
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Sebastopol, CA 95472

PRUNUSKE CHATHAM, INC.

Table of Contents

1 Introduction

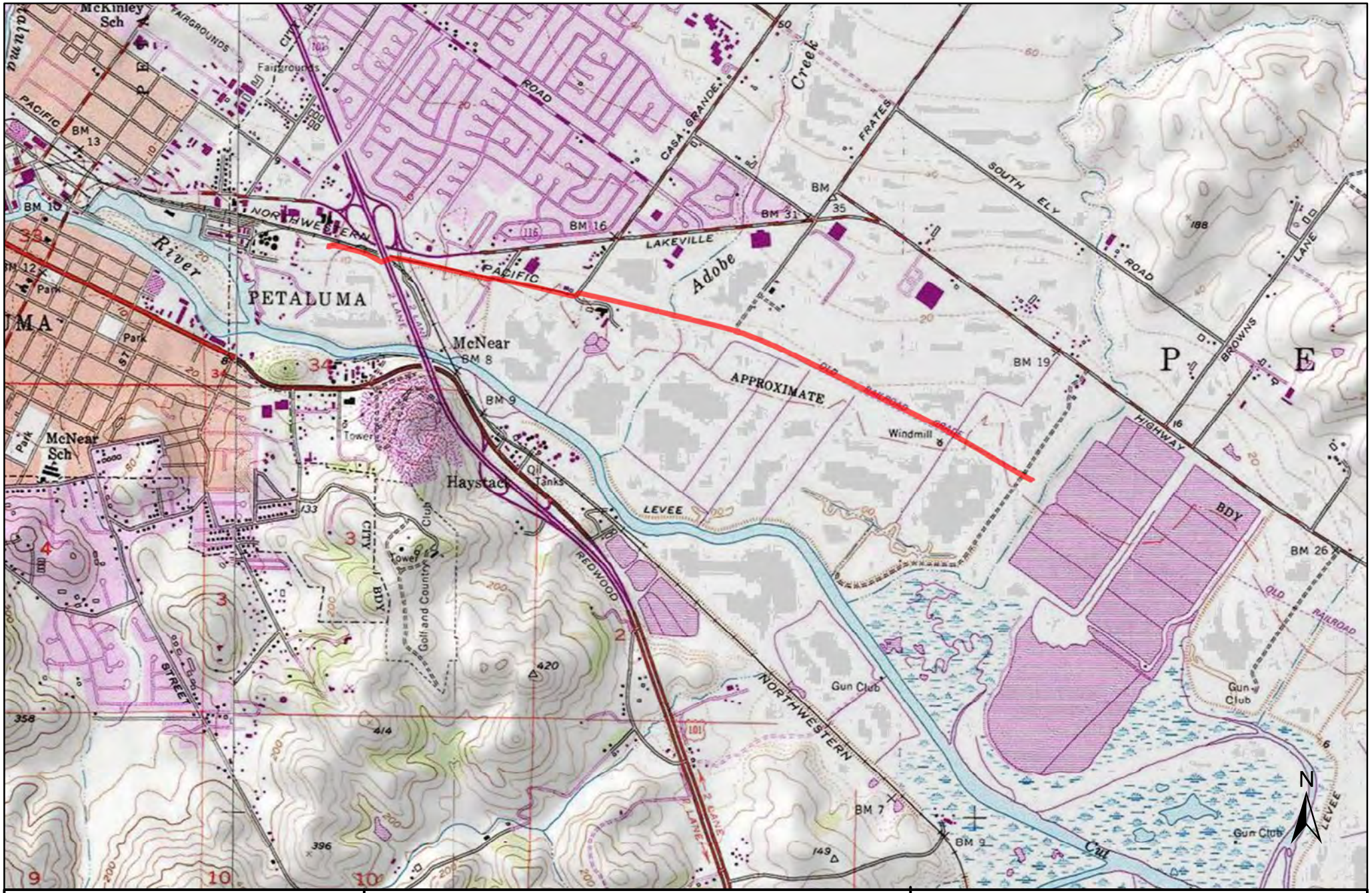
The City of Petaluma (City) and Nute Engineering are developing a project to construct a parallel force main to provide wastewater conveyance redundancy for an existing 36-inch force main running approximately 2.5 miles from the Hopper Street plant influent pump stations (PIPS) to the Ellis Creek Water Recycling Facility (WRF). Nute Engineering developed a suite of alternative routes for the new 36-inch force main and the City selected the Alternative A alignment, which runs within the footprint of and parallel to the existing force main.

Prunuske Chatham, Inc. (PCI) has been retained by the City and Nute Engineering to evaluate existing ecological conditions along the proposed route and to identify the range of potential environmental issues associated with the project. This Environmental Constraints Technical Memorandum provides the results of PCI's evaluation of the project and includes recommendations for additional studies needed for design and permitting. A summary of the project setting is provided in Section 2. Sections 3 and 6 evaluate potential project impacts related to biological resources, cultural resources, and land use. Section 7 identifies additional technical studies needed to complete the CEQA evaluation and permitting of the project.

2 Project Setting

The project is located on the east side of the City of Petaluma, in Sonoma County; see *Figure 1*. The proposed alignment for the new 36-inch force main runs approximately 2.5 miles, originating at the Hopper Street PIPS on its western end and running to the WRF on its eastern end. The proposed alignment parallels the existing force main and would be located within the same utility easement.

The project area is located within an urban setting. Most of the proposed route runs through developed land, including under Highway 101, under the SMART railroad tracks, and through office and residential parking areas. Some undeveloped areas rich in ecological resources, including Adobe Creek and the wetlands within the WRF, lie within the utility easement. Schollenberger Park is just south of the route.



PRUNUSKE CHATHAM, INC.

Date Created: 7/11/2019

Figure 1. Project Location
City of Petaluma PIPS Parallel Force Main Project
Sonoma County, CA

Proposed Force Main Alignment

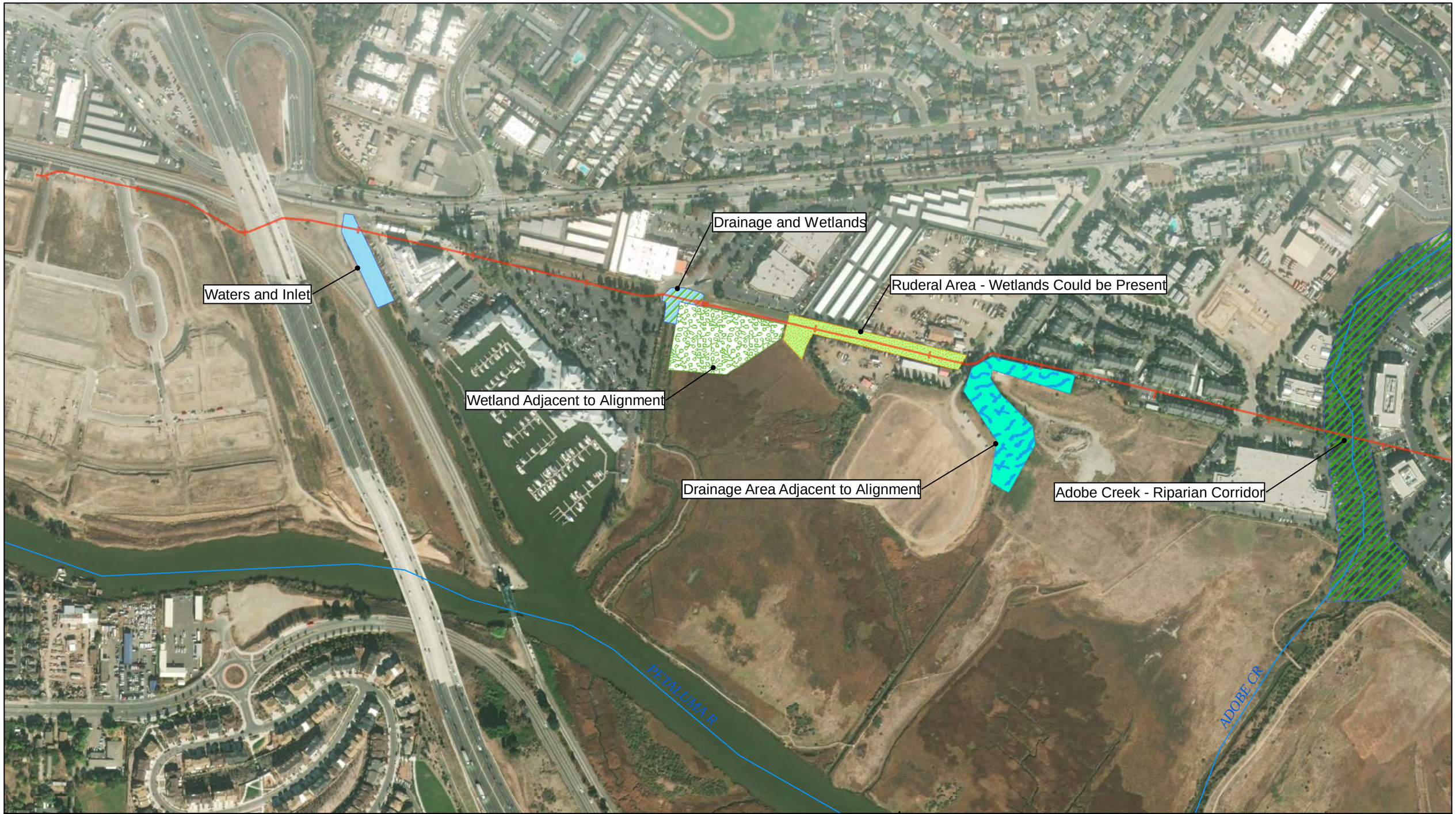
3 Biological Resources

3.1 Existing Conditions

The proposed alignment will be located primarily within developed areas, but portions of the alignment will be constructed within wetland and riparian habitats or directly adjacent to sensitive habitats. Table 1 below is a brief summary of the existing biological conditions along the proposed alignment; see *Figure 2. Potential Environmental Constraints - West* and *Figure 3. Potential Environmental Constraints - East* for specific mapped locations and *Wetlands and Other Waters* discussion below.

Table 1. Existing Conditions along Proposed Force Main Alignment

Location	Existing Conditions
PIPS to 101	Disturbed, ruderal
101 to SMART track	Disturbed, ruderal
East of SMART track to edge of Sheraton Hotel parking lot	Disturbed, ruderal, jurisdictional tidal waters with inlet from underground storm drain adjacent to force main. Subject to state and federal regulation and permitting.
Sheraton Hotel parking lot to Marina Avenue	Developed, ornamental landscaping
Marina Avenue to Casa Grande (at dog park)	Drainage and wetlands at end of Marine Avenue, wetlands adjacent to alignment at backside of commercial building complex along Marina Avenue, ruderal area with potential wetlands adjacent to industrial yard to west of Casa Grande
Casa Grande to Technology Lane	Drainage area adjacent to force main near Casa Grande; developed to east to Technology Way
Adobe Creek	Jurisdictional waters and riparian habitat, subject to state and federal regulation and permitting
Edge of Adobe Creek to Schollenberger Park Road	Developed, ornamental landscaping
Schollenberger Park Road to paved path at entrance to WRF	Developed, ornamental landscaping, borders wetland habitat that would be subject to state and federal permitting if disturbed during construction.
WRF	Pathways, jurisdictional wetlands subject to state and federal regulation and permitting



PRUNUSKE CHATHAM, INC.

Date Created: 7/11/2019

Figure 2. Potential Environmental Constraints - West
City of Petaluma PIPS Parallel Force Main Project
Sonoma County, CA

0 0.05 0.1 0.2 Miles

N

Legend

River or Stream

Proposed Force Main Alignment

Potential Environmental Constraints

Drainage Area Adjacent to Alignment

Drainage and Wetlands

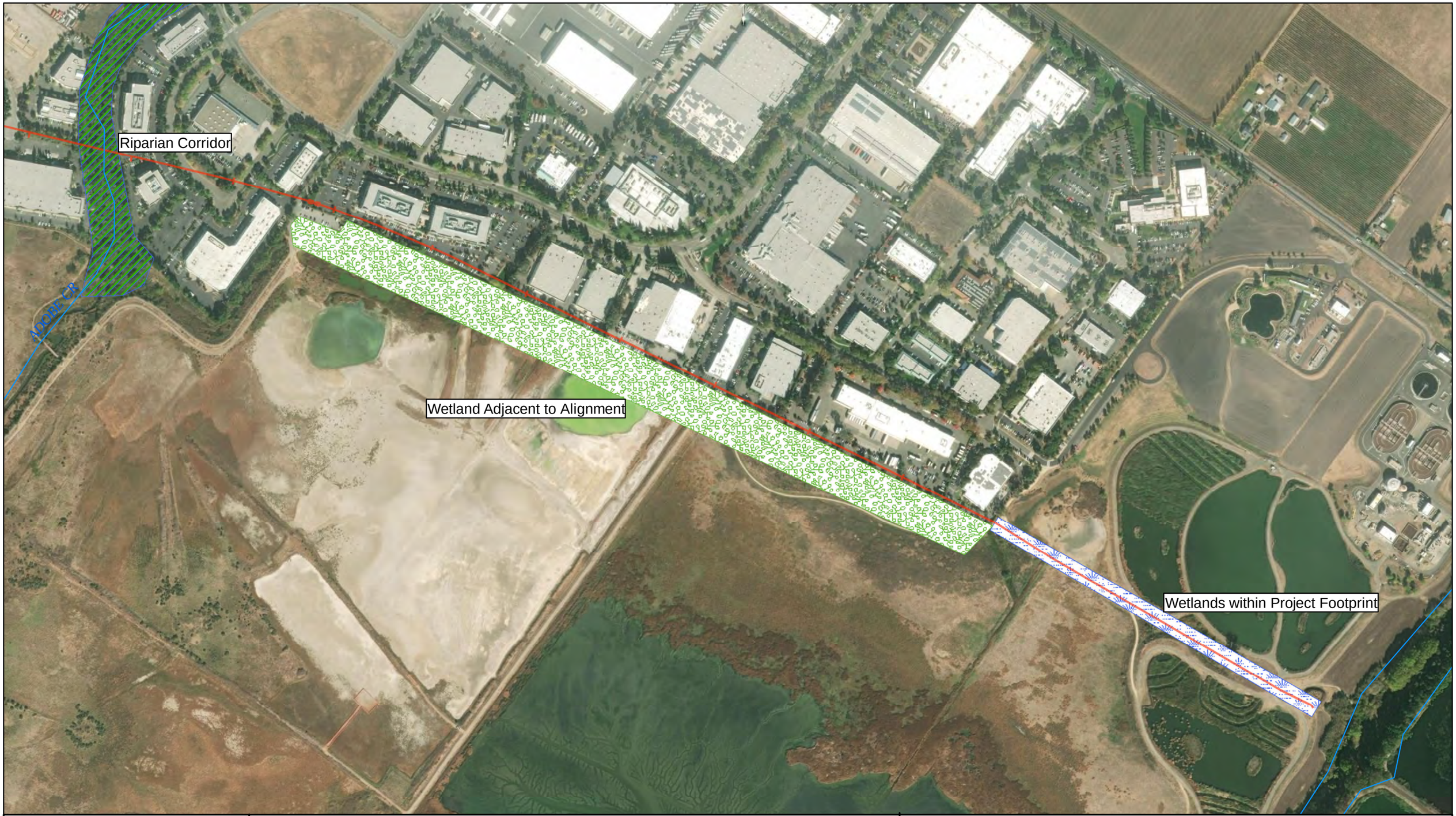
Ruderal Area - Wetlands Could be Present

Waters and Inlet

Riparian Corridor

Wetland Adjacent to Alignment

Wetlands within Project Footprint



PRUNUSKE CHATHAM, INC.
Date Created: 7/11/2019

Figure 3. Potential Environmental Constraints - East
City of Petaluma PIPS Parallel Force Main Project
Sonoma County, CA

0 0.05 0.1 0.2 Miles

N

Legend

River or Stream
Proposed Force Main Alignment

Potential Environmental Constraints

Drainage Area Adjacent to Alignment
Waters and Inlet
Wetland Adjacent to Alignment
Drainage and Wetlands
Riparian Corridor
Wetlands within Project Footprint
Ruderal Area - Wetlands Could be Present

3.2 Wetlands and Waters

Wetlands include a variety of permanent, seasonal, and ephemeral aquatic habitats. Regulations and policies that protect aquatic habitats have been enacted by a number of government agencies. Wetlands and waters fall under the jurisdiction of the U.S. Army Corps of Engineers (Corps), local Regional Water Quality Control Board, California Department of Fish and Wildlife, and City of Petaluma. Work within wetlands typically requires consultation with State, federal, and potentially local agencies. Any fill, removal of native riparian vegetation, or alteration of drainage patterns of a wetland would require permits and resource agency consultation.

A formal wetland delineation was not completed as part of this assessment. A visual assessment of the site vegetation characteristics provided information about the likelihood of wetlands in the area. Wetlands are delineated according to protocols established in the Corps of Engineers' *Wetland Delineation Manual* (Corps 1987) and Version 2.0 of the *Regional Supplement for the Arid West Region* (Corps 2008b). Corps wetland jurisdiction is based on a three-parameter definition; a site must meet criteria for hydrology, hydric soils, and hydrophytic vegetation to be considered a wetland (Corps 1987, 2008b). Waters are delineated according to *A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States* (Corps 2008a). Based on PCI's preliminary assessment of the force main alignment, several wetlands may be present within the project area; Adobe Creek is a waters of the State/U.S. and several drainages may also support wetlands or meet the definition of jurisdictional water; see *Figure 2. Potential Environmental Constraints - West* and *Figure 3. Potential Environmental Constraints - East*.

It appears that many of these jurisdictional water features may be avoided through project design and construction methods. PCI recommends using trenchless construction methods to install the pipeline under the drainage way east of Highway 101 and the SMART rail (Figure 2) and Adobe Creek (Figure 3) rather than using open trench construction methods to avoid disturbance in the creek channel. To avoid wetlands along Schollenberger Park (Figure 3), PCI recommends placement of the pipeline through the parking lot rather than placement of the pipe within the wetlands or close enough to the wetlands to cause impacts. Wetlands may be present along the ruderal areas shown on Figure 2; however, no obvious wetlands were observed during the assessment. **A formal jurisdictional delineation of the alignment would provide the information necessary to determine the extent of impacts to wetlands and waters, particularly through unpaved/undeveloped areas along the alignment.**

3.3 Sensitive Natural Communities

Natural Communities are considered sensitive by CDFW based on their level of rarity and threat. CDFW maintains a list of vegetation alliances present within the state, and ranks each in terms of their rarity and vulnerability on both the global (G) and state (S) level

(CDFW 2018b). Ranks range from 1 (very rare and threatened) to 5 (demonstrably secure). Natural communities with ranks of S1 to S3 are considered sensitive. A "?" indicates more information is needed.

Within the alignment, wetlands and riparian woodlands are considered sensitive by CDFW. These habitats are also protected by other State, federal, and local regulations; see *Wetlands and Other Waters* above. Ruderal and ornamental landscaping are not considered sensitive. Riparian woodlands are located within the riparian corridor along Adobe Creek. **PCI recommends that construction activities be designed to avoid impacts within the corridor to protect the riparian woodland community along Adobe Creek.**

4 Special-status Species

4.1 Background Research

A cursory background literature and database search was conducted to help determine the potential for special-status species and sensitive habitats to occur on or adjacent to the alignment. The search focused on reported occurrences for the Petaluma River 7 ½' USGS quadrangle where the force main alignment would be located. The search focused on reported occurrences in the California Department of Fish and Wildlife Natural Diversity Database (CNDDB)[1] (CDFW 2019a).

4.2 Plants

A number of extant special-status plant species are reported for the Petaluma River, Petaluma Marsh, and upland areas; see *Figure 4*. As part of the Ellis Creek Water Recycling Facility EIR, suitable habitat for several special-status plants was documented in the vicinity of that project, including the general area of the proposed force main (City of Petaluma 2002). These included species occupying grasslands, coastal salt marshes and swamps, and freshwater marshes, swales, and riparian scrub. Based on the background review and a review existing studies of the area, the proposed alignment could impact native riparian and wetland plant communities that may support special-status plants. **Focused plant surveys, during the reported blooming period of the focal species within native wetland and riparian habitats, would be needed to determine species presence within the proposed force main alignment if areas that could support special status plant species (wetlands and riparian woodlands) may be impacted during construction.**

[1] The California Natural Diversity Data Base (CNDDB) is a repository of information on sightings and collections of rare, threatened, or endangered plant and animal species within California. It is maintained by CDFW. CNDDB reports occurrences of special-status species that have been entered into the database and does not generally include inventories of more common animals or plants. The absence of a species from the database does not necessarily mean that they do not occur in the area, only that no sightings have been reported. In addition, sightings are subject to observer judgment and may not be entirely reliable as a result.

4.3 Animals

Based on the background literature review, a number of special-status animal species and species of local interest were identified as having potential to occur in the project area. Species with nearby reported occurrences or potential for occurrence within the proposed alignment are described in below; see *Table 2* and *Figure 4*. In addition, several migratory bird species of concern are reported for the project area (USFWS 2019). Some of these species may occur within the proposed alignment on a regular basis (i.e., Allen's hummingbird, Nuttall's woodpecker) but others are highly unlikely. See *Protected Nesting Birds* and *Heronries* for additional information.

Table 2. Special-status Animals with Potential for Occurrence in the Project Area

Common Name *Scientific Name*	**Listing Status[2] USFWS/CDFW[3]**	**Habitat Requirements**	**Local Occurrence**
Amphibians			
California Red-legged Frog *Rana draytonii*	FT/ SSC	Breeding habitat includes marshes, streams, lakes, reservoirs, ponds, and other water sources with plant cover. Breeding occurs in deep, slow-moving waters with dense, shrubby, or emergent vegetation. Breeds November through April depending on location. During the non-breeding season, California red-legged frogs can remain at the breeding site (in the presence or absence of water) or move into surrounding non-breeding habitats. Radio tracking of frogs in Marin County by Fellers and Kleeman (2007) noted the dispersal of frogs at a median distance of 150m from breeding sites (range of 30 to 1,400 meters). They also noted year-round small-scale (<30m) movements around breeding sites. These results indicate the importance of uplands for non-breeding season and migratory corridor habitat.	Documented in Ellis Creek, suitable habitat in Adobe Creek. **Project may require consultation and an Incidental Take Permit from USFWS if impacts on habitat cannot be avoided. Protection measures will be required during construction in and near Adobe Creek and along aquatic habitats.**

[2] Listing Status: FE-federally listed as endangered, FT-federally listed as threatened, BCC-Bird of Conservation Concern, SE-state listed as endangered, ST-state listed as threatened, Candidate SE-state candidate to be listed as endangered under CESA Candidate ST-state candidate to be listed as threatened under CESA, FP-State of California fully-protected species, SSC-California Species of Special Concern, and WL-Watch List.

[3] (CDFW 2018)

Table 2. Special-status Animals with Potential for Occurrence in the Project Area

Common Name *Scientific Name*	Listing Status[2] USFWS/CDFW[3]	Habitat Requirements	Local Occurrence
Foothill Yellow-legged Frog *Rana boylii*	--/Candidate ST, SSC	In or near partly shaded rocky streams that are shallow, slow, and moderately size from sea level to 6,300 feet. Breeding occurs from spring to early summer after high flows have receded. Eggs are laid at downstream end of rocks. Tadpoles require 3 to 4 months to attain metamorphosis. During all season, never found far from water.	Documented in Adobe Creek. **Project may require consultation and an Incidental Take Permi from CDFW if impacts on habitat cannot be avoided. Protection measures will be required to during construction in and near Adobe Creek and along aquatic habitats.**
Reptiles			
Northwestern Pond Turtle *Actinemys (Emys) marmorata*	--/SSC	A year-round resident of Sonoma County, found in or near permanent or semi-permanent water sources (e.g., ponds, lakes, rivers, streams) with suitable basking sites and underwater retreats. Eggs are laid in shallow holes dug by the female from April through August. Eggs hatch in late summer or fall. In northern California, hatchlings can remain buried until the following spring. Turtles may use uplands for overland migration (movements up to 5 km) and nesting sites (nesting can occur over 500 m from water).	Documented in Ellis Creek WRF and nearby aquatic habitats. Protection measures will be required to during construction in and near Adobe Creek and along aquatic habitats.
Birds			
Saltmarsh Common Yellowthroat *Geothlypsis trichas sinuosa*	BCC/SSC	This subspecies of common yellowthroat is endemic to the greater San Francisco Bay region in wetland and riparian habitats. This species is insectivorous and forages for insects and spiders. Breeding occurs from mid-March to late July. Open cup nests are constructed near the ground in grasses and herbaceous vegetation.	Suitable habitat present in adjacent marsh and wetland habitat.
California Black Rail *Laterallus jamaicensis cotruniculus*	BCC/ST and FP	An elusive and seldom seen marsh bird. Occurs in tidal saltwater marshes dominated by pickleweed, cordgrass, and bulrush, and low-elevation freshwater marshes. Primarily occurs in marshlands around San Francisco Estuary. Constructs woven cup nest near ground. Consumes insects, seeds, and small crustaceans.	Suitable habitat present in adjacent marsh habitat. **Project will need to avoid impacts to this fully protected species, which is primarily accomplished by**

Table 2. Special-status Animals with Potential for Occurrence in the Project Area

Common Name *Scientific Name*	Listing Status[2] USFWS/CDFW[3]	Habitat Requirements	Local Occurrence
			avoiding construction during nesting season and avoiding direct impacts on habitat.
San Pablo Song Sparrow *Melospiza melodia samuelis*	BCC/SSC	This subspecies of song sparrow occurs in tidal marshes throughout the San Pablo Bay, including Richardson Bay. This species occurs year-round throughout its range. They are primarily associated with high marsh habitats dominated by picklweed. This species feeds primarily on terrestrial invertebrates. Breeding occurs from early March to July, nests are constructed low to the ground in gum plants (*Grindelia* spp.). Sparrows have been documented in tidal habitats along the Bay.	Suitable habitat present in adjacent marsh and wetland habitat.
California Ridgway's Rail *Rallus obsoletus obsoletus*	FE/SE and FP	Occupy salt and brackish marshes within the San Francisco and San Pablo Bays. Prefer habitat dominated by pickleweed (*Salicornia virginica*) and Pacific cordgrass (*Spartina foliosa*). Breeding occurs from mid-March through July, with peak activity in late June.	Suitable habitat present in adjacent marsh habitat. **Project will need to avoid impacts to this fully protected species, which is primarily accomplished by avoiding construction during nesting season and avoiding direct impacts on habitat.**
Mammals			
Pallid Bat *Antrozous pallidus*	--/SSC	Grassland, shrubland, forest, and woodland habitats at low elevations up through mixed coniferous forests. A social species forming small colonies. Roosting sites include caves, mines, crevices, buildings, and hollow trees during day, more open sites used at night. Pallid bats feed on large flightless arthropods. A yearlong resident throughout most of its range. During non-breeding season, both sexes may be found roosting in groups of 20 or more individuals. One to three (typically twins) pups born from April to July.	Suitable habitat present in project area.
Salt-marsh Harvest Mouse	FE/SE and FP	Salt marshes and adjacent diked wetlands. Prefers habitat dominated by pickleweed, their primary foot source. Breeding occurs	Suitable habitat present in adjacent marsh habitat.

Table 2. Special-status Animals with Potential for Occurrence in the Project Area

Common Name *Scientific Name*	Listing Status[2] USFWS/CDFW[3]	Habitat Requirements	Local Occurrence
Reithrodontomys raviventris		from spring through autumn. Nests constructed in wetland habitat with dense cover.	**Project will need to avoid impacts to this fully protected species, which is primarily accomplished by avoiding impacts on habitat.**
Fish			
Steelhead – Central California Coast DPS *Oncorhynchus mykiss irideus*	FT/--	Spawn in fresh water and mature at sea. Steelhead generally spend their first and sometimes second year of life in freshwater creeks and then one to four years at sea. They return to spawn in their natal streams as many as four times as they do not always die after spawning like other salmonids. Juvenile steelhead generally occupy glides and riffles and less frequently pools. Adult steelhead spawn from December through April in cool, clear, well-oxygenated streams with pea to apple-sized gravel, usually at the head of a riffle. Federal listing applies to all coastal runs from Russian River south to Soquel Creek; it includes San Francisco and San Pablo Bay basins but excludes the Sacramento-San Joaquin Rivers.	Documented in Adobe Creek. **Project may require consultation and an ITP from NOAA Fisheries if impacts on habitat cannot be avoided. Protection measures will be required to during construction in Adobe Creek.**

Sacramento splittail

Franciscan onion
fragrant fritillary
red-bellied newt
alkali milk-vetch
western bumble bee

Pacific Grove clover
Sonoma spineflower
Petaluma popcornflower
Townsend's big-eared bat
Point Reyes checkerbloom
congested-headed hayfield tarplant

San Pablo song sparrow

California tiger salamander

Pitkin Marsh lily

western pond turtle

pallid bat

foothill yellow-legged frog

ADOBE CR

foothill yellow-legged frog

steelhead - central California coast DPS

saltmarsh common yellowthroat
salt-marsh harvest mouse

California Ridgway's rail

western pond turtle

California black rail

California black rail

western pond turtle

California red-legged frog

western pond turtle

PETALUMA R

California black rail

California Ridgway's rail

California black rail

mimic tryonia (=California brackishwater snail)

saltmarsh common yellowthroat

salt-marsh harvest mouse

Coastal Brackish Marsh

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Map Not For Public Review. The occurrences shown on this map represent the known locations of the species listed here as of the date of this version. There may be additional occurrences or additional species within this area which have not yet been surveyed and/or mapped. Lack of information in the CNDDB about a species or an area can never be used as proof that no special-status species occur in an area.

PRUNUSKE CHATHAM, INC.

Date Created: 7/11/2019

Figure 4. Reported Occurrences of Special-status Species
City of Petaluma PIPS Parallel Force Main Project
Sonoma County, CA

0 0.25 0.5 1 Miles

N

Proposed Force Main Alignment

4.4 Nesting Bird Protection

Nesting native bird species are protected under both federal and state regulations. According to US Fish and Wildlife Service, under the federal Migratory Bird Treaty Act of 1918 (MBTA; 50 CFR 10.13,), "it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg or any such bird, unless authorized under a permit issued by the Secretary of the Interior. Some regulatory exceptions apply. Take is defined as: 'pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect." Bald and golden eagles are also protected under the federal Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c) of 1940. See *Heronries* below.

Birds and their nests are also protected under the California Fish and Wildlife Code (§3503 and §3513). Under §3503, "it is unlawful to take, possess, or needlessly destroy the nest or eggs of any bird, except as otherwise provided by this code or any regulation made pursuant thereto". Under §3513, "it is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the Migratory Treaty Act". The federal Endangered Species Act and California Endangered Species Act also protect nesting threatened and endangered bird species.

Most bird species, with a few specific exceptions, are protected under the MBTA and California Fish and Game Code. Vegetation removal and/or construction activities in areas with suitable nesting habitat during the breeding period, typically mid-March to mid-August in this region (RHJV 2004), could result in nest abandonment or loss of native nesting birds unless appropriate actions are taken. Precautionary measures may include preconstruction surveys to determine if birds are nesting in or near the construction area, avoidance of impacts on habitat, and monitoring for potential impacts). Suitable nesting bird habitat is present along the proposed force main alignment.

4.5 Heronries

Heronries are colonies of breeding herons and egrets. Colonies may consist of several hundred nests or just a few pairs. Nests can be located in remote habitats or suburban neighborhoods. Heronries are protected under the MBTA and California Fish and Game Code; see above.

There is an established heronry at the Ellis Creek Water Recycling Facility. The heronry lies between Lakeville Highway and the Petaluma River. It borders the treatment ponds and is surrounded by fencing. The site was abandoned in 2003, but reestablished in 2005 and has been active since then. The site supports nesting double-crested cormorant, great blue heron, great egret, and snowy egret. Construction at the WTP near Ellis Creek may

disturb the heronry. Construction noise could disrupt the birds and an altered construction period may be required.

5 Cultural Resources

The Northwest Information Center at Sonoma State University completed a records search to identify cultural resources records and reports, historic-era maps, and literature for Sonoma County for the proposed project area. Records indicate that approximately 25% of the area along the proposed alignment has been included in previous cultural resources studies, although not all studies included field surveys.

The proposed alignment crosses through two historic-era cultural resources: P-49-002834 (Northwest Pacific Railroad) and P-49-002904 (Martinelli/Masciorini Ranch Complex) (NWIC 2019). Both these resources contain a combination of built environment components and archaeological components. No Native American archaeological resources have been recorded to date within the proposed project alignment.

A spur of the Northwest Pacific Railroad is recorded in the project area. The rails and ties of the line have been removed, and the site was deemed ineligible for the National Register of Historic of Historic Properties through the Section 106 process in 2012; however, the resource was not evaluated for the California Register or Local Listing. A portion of the railroad spur was removed as part of the Ellis Creek Water Recycling. LSA found the Martinelli/Masciorini Ranch Complex eligible for listing in the National Register in 2006 (NWIC 2019); however, maps at the NWIC show no recorded buildings or structures within the proposed project area and the ranch complex is located outside the project area. Nonetheless, **the Anthropological Studies Center at Sonoma State University (ASC) recommends a qualified archaeologist conduct further archival and field study to identify locations within the alignment that have the potential for previously unrecorded cultural resources.** An additional site evaluation would provide specific information for the area potentially affected by project construction.

The project area is located in an area of Clear Lake and Diablo soils that overlay Quaternary-period alluvium (ASC 2016). Clear Lake and Diablo soils are heavy textured and poorly drained. Clear Lake soils are usually too wet for a portion of the year to make good long term or permanent settlements; however, they are located adjacent to water sources and marshland, which may have been used for temporary hunting or fishing camps in dry months. ASC (2016) found the area surrounding the proposed pipeline alignment moderately sensitive for the presence of buried prehistoric archaeological resources. **ASC recommends contacting the local Native American tribes regarding traditional, cultural, and religious heritage values of the area. Tribes in this area include the Federated Indians of Graton Rancheria and Lytton Rancheria of California.**

ASC provided the following measure during construction activities, which is standard for project construction: If archaeological resources are encountered during construction, work should be temporarily halted in the vicinity of the discovered materials and workers should avoid altering the materials and their context until a qualified professional archaeologist has evaluated the situation and provided appropriate recommendations. Project personnel should not collect cultural resources. Native American resources include chert or obsidian flakes, projectile points, mortars, and pestles; and dark friable soil containing shell and bone dietary debris, heat-affected rock, or human burials. Historic-period resources include stone or adobe foundations or walls; structures and remains with square nails; and refuse deposits or bottle dumps, often located in old wells or privies.

6 Land Use

The majority of the proposed alignment runs through develop land used for commercial and residential purposes. Table 3 lists the parcels along the proposed route and their associated land use type. The alignment does not run through, or in the vicinity of, any hazardous waste or substance site listed on the CalEPA Cortese list.

Table 3. Parcels and Land Uses

APN	Land Use Type	Use Description
005-040-058	Multi-Family Residential	Over 100 Units
005-060-005	Residential	RIGHT-OF-WAY (Adjacent To Hwy 101)
005-060-065	Residential	RIGHT-OF-WAY (Parking Lot Near Marina)
005-060-093	Commercial	County Flood Control/Water Agency
005-060-066	Residential	RIGHT-OF-WAY (Grass Easement)
005-060-085	Commercial	Business Park Common Area
005-060-096	Commercial	Vacant Commercial Land W/Utilities
005-060-097	Commercial	Miscellaneous City Property
005-090-077	Commercial	Truck Terminal
005-090-039	Commercial	Light Manufacturing & Industrial
005-090-082	Commercial	Light Manufacturing & Industrial
005-090-062	Commercial	One Story Office Building
005-090-081	Commercial	Vacant Industrial Land W/Utilities
005-090-086	Commercial	Warehousing/Active
005-280-025	Residential	Common Area Without Structures
005-280-035	Commercial	Light Manufacturing & Industrial
005-280-010	Commercial	Federal Building
005-280-046	Commercial	Miscellaneous City Property
005-280-051	Commercial	Light Manufacturing & Industrial
005-280-034	Commercial	Business Park
005-280-053	Commercial	Two Story Office Building

Table 3. Parcels and Land Uses

APN	Land Use Type	Use Description
005-280-054	Commercial	Two Story Office Building
005-290-011	Commercial	Two Story Office Building
005-310-006	Commercial	Two Story Office Building
007-171-016	Commercial	Municipal Utility Property
068-010-025	Commercial	Municipal Utility Property
068-010-034	Commercial	Miscellaneous City Property
136-690-002	Commercial	Vacant Commercial Land/Undeveloped
136-690-007	Multi-Family Residential	Vacant Lots Zoned Apartments
136-690-011	Commercial	Heavy Industry

Currently, the only occupied residential development potentially impacted by the proposed alignment is the Azure apartment complex at APN 005-040-058. The proposed force main would run through the parking lot behind the development. The remainder of the developed areas impacted by the alignment are used for commercial purposes and are primarily office buildings, along with some industrial uses.

6.1 Noise, Traffic, and Utilities

Construction of the force main through parking areas and in the immediate vicinity of residences and offices could potentially result in noise and traffic impacts, which will need to be assessed during the CEQA evaluation. Nighttime work may be most appropriate for constructing portions of the alignment that run along offices, but daytime work would be required in the immediate vicinity of residences. Alternative parking and access arrangements will be necessary during the construction. Emergency access must be maintained to the area during construction.

As noted on page 8 of the December 2014 Technical Memorandum developed by Nute Engineering, underground utility lines likely run through much the proposed alignment, as the area has been intensively developed since the construction of the original force main. The project should be designed and implemented to avoid, or at least minimize, disruption to utility service lines in the area.

6.2 Roads and Trails

The proposed alignment crosses several public streets: Corporate Circle (in two locations), Schollenberger Park Road, Technology Lane, Casa Grande Road, Marina Avenue, and Baywood Drive. Depending on construction staging and methods and the exact location of trench excavations, use of these roads could be significantly impacted. Emergency access across most roads should be maintained, or an emergency access route must be identified. Construction of segments across roads should be planned and staged to minimize the duration and severity of disturbance, especially on roads where detours are not feasible. However, because the project will not impact Lakeville Highway and does

not entail widespread impacts to roads and transportation, a formal traffic study will likely not be required for CEQA analysis of the project. A traffic and emergency plan will be needed.

Construction of the segments across Casa Grande Road and Schollenberger Park Road could limit public access to Rocky Memorial Dog Park and Schollenberger Park, respectively. If the segment that crosses Adobe Creek is constructed via open trenching, small portions of the trails along both the creek will be disturbed and public use of the trail could be temporarily limited. Public use of some of the trails at the WRF property could also be disturbed during project construction. The impacts to public recreation will need to be analyzed during the CEQA evaluation, but such impacts would likely be found to be short-term during construction only.

6.3 Highway 101 and SMART Track

At its western edge near the PIPS, the proposed alignment crosses under Highway 101 and the Sonoma-Marin Area Rail Transit (SMART) tracks. The portion of Highway 101 crossed by the alignment is a raised viaduct, so the project would not result in any impacts to the highway itself. However, a Caltrans encroachment permit will be necessary to construct the project within the Caltrans right-of-way and the project will be subject to Caltrans requirements and specifications for work within the right-of-way.

The new force main will cross the SMART tracks underneath Highway 101. This segment will be constructed via boring and jacking a 48-inch steel casing under the tracks to avoid direct impacts to the train tracks. An Entry Permit from SMART will be required and the project will have to conform to applicable SMART specifications and requirements. Working around SMART tracks can be a complicated process and procuring the necessary permit can be time consuming.

7 CEQA Review and Permitting

The project does not appear to meet the conditions of any CEQA statutory or categorical exemptions, and therefore, is subject to the provisions of CEQA. PCI recommends that the City complete an Initial Study to analyze the project's potential impacts on the environment. At this time, a Mitigated Negative Declaration appears to be appropriate for the project, because it appears that impacts could be reduced to less-than-significant levels.

Additionally, the project will require permits from a range of federal, State, and local agencies. Table 4, below, summarizes the permits that are anticipated to be required for the project.

Table 4. Potential Federal, State, and Local Permits

Agency	Permit	Resource Issue
Army Corps of Engineers	§404 Clean Water Act Permit	Jurisdictional Wetlands and Waters of the US
National Marine Fisheries Service	Incidental Take Permit	Special-status Species (Steelhead) in Adobe Creek
U.S. Fish and Wildlife Service	Incidental Take Permit	Special-status Species (California red-legged frog)
California Department of Fish and Wildlife	Lake or Streambed Alteration Agreement	Adobe Creek/Riparian Woodlands/Waters of the State
California Department of Fish and Wildlife	Incidental Take Permit	Special-status Species (Foothill yellow-legged frog)
San Francisco Bay Water Quality Control Board	§401 Water Quality Certification	Wetlands/Waters/Water Quality
State Water Resources Control Board	Approved SWPPP	Water Quality
Caltrans	Encroachment Permit	Highway 101
Sonoma-Marin Area Rail Transit (SMART)	Entry Permit	Train Tracks
City of Petaluma	Encroachment Permit, Building and Grading Permit	Local Roads
Sonoma County Water Agency	Encroachment Permit	Flood Control Channel

8 Additional Studies

Additional technical studies will be required to fully assess the resources preliminarily described in Sections 3 through 5 and to identify the project's potential impacts, complete the CEQA review process, and acquire the permits identified in Section 6. The following studies are recommended:

- Biological Resources Assessment Report for project design, CEQA, and permitting purposes
- Jurisdictional Wetland Delineation Report for project design, CEQA and permitting purposes
- Cultural Resources Report for CEQA and acquisition of Army Corps permit

9 Conclusion

The proposed force main alignment runs primarily through developed land, including roads and parking lots associated with residential and commercial land uses. Open trenching through developed areas presents a range of potential issues related to public use, access, land ownership, utility services, noise, and traffic. Additionally, a number of biological resources could potentially be impacted by the project, including special-status species, Adobe Creek, riparian habitat, wetlands, and other waters. This document has provided a preliminary review of the potential environmental impacts associated with the proposed alignment. As described in Section 7, in order to complete the environmental review and permitting process for the project, a number of technical studies are required

to further evaluate resources in the project area and to identify the project's potential impacts to those resources.

10 References

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APPENDIX D – MPEG Report

GEOTECHNICAL FEASIBILTY EVALUATION
PETALUMA FORCE MAIN
PETALUMA, CALIFORNIA

August 23, 2019

Job No. 949.129

Prepared for:
NUTE Engineering
907 Mission Avenue
San Rafael, California 94901

CERTIFICATION

This document is an instrument of service, prepared by or under the direction of the undersigned professionals, in accordance with the current ordinary standard of care. The service specifically excludes the investigation of polychlorinated byphenols, radon, asbestos or any other hazardous materials. The document is for the sole use of the client and consultants on this project. No other use is authorized. If the project changes, or more than two years have passed since issuance of this report, the findings and recommendations must be updated.

MILLER PACIFIC ENGINEERING GROUP
(a California corporation)

REVIEWED BY:

Emily Carreno
Staff Geologist

Scott Stephens
Geotechnical Engineer No. 2398
(Expires 6/30/21)

MILLER PACIFIC ENGINEERING GROUP

GEOTECHNICAL FEASIBILTY EVALUATION
PETALUMA FORCE MAIN
PETALUMA, CALIFORNIA

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MILLER PACIFIC ENGINEERING GROUP

GEOTECHNICAL FEASIBILTY EVALUATION
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1.0 INTRODUCTION

This report presents the results of our Geotechnical Feasibility Evaluation to aid in the design and construction of a new sanitary sewer force main that will extend from the PIPS facility on Hopper Street to the Ellis Creek Water Recycling Facility (south side of Lakeville Highway) in Petaluma, California. As shown on Figure 1, the project area is an irregularly shaped area bounded by Lakeville Highway to the north and extending south up to 0.5-miles.

Our work was performed in accordance with our Agreement for Professional Services dated May 15, 2019. The purpose of our investigation is to review previous subsurface exploration by others and evaluate relevant geologic hazards which may affect the proposed project and develop conceptual mitigation measures. Based on our evaluation, we will develop preliminary geotechnical recommendations and guidelines for the project. The scope of our services includes:

- Review of available, published geologic mapping and geotechnical background information from our files, public sources, and any geologic/geotechnical background information supplied by you.
- Review of aerial photographs to evaluate the history of previous site development.
- Preliminary evaluation of relevant geologic hazards including seismic shaking, liquefaction, settlement, and other hazards.
- Preparing a feasibility report which summarizes the anticipated subsurface conditions, evaluation of relevant geologic hazards, and preliminary geotechnical recommendations and design criteria.

This report completes our Phase 1 services for the project. Subsequent phases of work would include; supplemental subsurface exploration and laboratory testing as part of design level investigation, geotechnical plan review and observation and testing of geotechnical-related work items during construction.

2.0 PROJECT DESCRIPTION

We understand that project details are not yet fully developed. However, we understand the project would generally consist of constructing a new, sanitary sewer force main that will extend from the PIPS facility on Hopper Street to the Ellis Creek Water Recycling Facility. We understand that several alternative alignments are being considered, which is reflected in the area chosen for our evaluation. The purpose of our evaluation is to aid in the planning and design of the project as well as identify potential significant geologic or geotechnical conditions that could have a significant impact on design or construction.

3.0 SITE CONDITIONS

3.1 Regional Geology

The project site is located within the Coast Ranges geomorphic province of California. It is typified by generally northwest-trending ridges and intervening valleys that formed as a result of movement along a group of northwest-trending fault systems, including the San Andreas Fault. Bedrock geology within the San Francisco bay area is dominated by sedimentary, igneous, and metamorphic rocks of the Jurassic-Cretaceous age Franciscan Complex. Most of Franciscan rock types are composed of sandstone and pervasively sheared shale. It also includes less common rocks such as chert, serpentinite, basalt, greenstone, and exotic low- to high-grade metamorphic rocks, including phyllite, schist, and eclogite.

Regional geologic mapping by the California Geological Survey (Wagner et al., 2002) indicates the site and proposed alignment crosses Quaternary-aged alluvial soils consisting of silt, clay, sand, and gravel that is typically poorly-to-moderately sorted and bedded and artificial fill over Bay Mud. A Regional Geologic Map and descriptions of the mapped geologic units are shown on Figure 3.

3.2 Seismicity

The project site is located within the seismically active San Francisco Bay Area and will therefore experience the effects of future earthquakes. Earthquakes are the product of the build-up and sudden release of strain along a “fault” or zone of weakness in the earth's crust. Stored energy may be released as soon as it is generated, or it may be accumulated and stored for long periods of time. Individual releases may be so small that they are detected only by sensitive instruments, or they may be violent enough to cause destruction over vast areas.

Faults are seldom single cracks in the earth's crust but are typically composed of localized shear zones which link together to form larger fault zones. Within the Bay Area, faults are concentrated along the San Andreas Fault zone. The movement between rock formations along either side of a fault may be horizontal, vertical, or a combination, and is radiated outward in the form of energy waves. The amplitude and frequency of earthquake ground motions partially depends on the material through which it is moving. The earthquake force is transmitted through hard rock in short, rapid vibrations, while this energy becomes a long, high-amplitude motion when moving through soft ground materials, such as Bay Mud.

3.2.1 Regional Active Faults

An “active” fault is one that shows displacement within the last 11,000 years (i.e., Holocene) and has a reported average slip rate greater than 0.1 mm per year. The California Division of Mines and Geology has mapped various active and inactive faults in the region. These faults are shown in relation to the project site on the attached Active Fault Map, Figure 4. The nearest known active faults are the Rodgers Creek, San Andreas, and Hayward Faults which are located roughly 7.6 kilometers (4.7 miles) east, 24.9 kilometers (15.5 miles) west, and 29.9 kilometers (18.6 miles) east of the site, respectively.

3.2.2 Historic Fault Activity

Numerous earthquakes have occurred in the region within historic times. A map showing the distribution of M>2.0 earthquakes since 1985 in the San Francisco Bay Region is shown on Figure 5. The site will likely experience moderate to strong ground shaking from future earthquakes originating on any of several active faults in the San Francisco Bay region.

3.2.3 Probability of Future Earthquakes

The site will likely experience moderate to strong ground shaking from future earthquakes originating on any of several active faults in the San Francisco Bay region. The historical records do not directly indicate either the maximum credible earthquake or the probability of such a future event. To evaluate earthquake probabilities in California, the USGS has assembled a group of researchers into the "Working Group on California Earthquake Probabilities" (USGS 2003, 2008, 2013) to estimate the probabilities of earthquakes on active faults. These studies have been published cooperatively by the USGS, CGS, and Southern California Earthquake Center (SCEC) as the Uniform California Earthquake Rupture Forecast, Versions 1, 2, and 3. In these studies, potential seismic sources were analyzed considering fault geometry, geologic slip rates, geodetic strain rates, historic activity, micro-seismicity, and other factors to arrive at estimates of earthquakes of various magnitudes on a variety of faults in California.

Conclusions from the most recent UCERF3 and USGS indicate the highest probability of an earthquake with a magnitude greater than 6.7 originating on any of the active faults in the San Francisco Bay region by 2043 is assigned to the Hayward/Rodgers Creek Fault system. The Rodgers Creek Fault is located approximately 7.6 kilometers (4.7 miles) east of the site and is assigned a probability of 33 percent. The San Andreas Fault, located approximately 24.9 kilometers (15.5 miles) west of the site, is assigned a 22 percent probability of an earthquake with a magnitude greater than 6.7 by 2043. Additional studies by the USGS regarding the probability of large earthquakes in the Bay Area are ongoing. These current evaluations include data from additional active faults and updated geological data.

3.3 Site History

In addition to available geotechnical and geologic reference information, we reviewed several historic aerial photographs and topographic maps to assess site history. Aerial photographs were obtained from UCSB FrameFinder, Sonoma Veg Map, and Google Earth aerial imagery. The photographs were taken between 1942 and 2018 at a variety of scales.

In 1942, the site area was used primarily for agricultural purposes with delineated land lots but no buildings. Highway 101 had not been paved yet, but Lakeville Highway is visible as well as the rail system running north-south through the east side of the site area. By 1953, meanders in the Petaluma River appear to lose some discharge and narrow significantly. Development is mostly unchanged; however, it appears that more land lots are delineated in Shollenberger Marsh. By 1965, Highway 101 is paved, and a few buildings have been constructed within the agricultural plots. Shollenberger Marsh appears to have had some activity as it appears roughly graded and many sinuous channels within the marsh have disappeared. By 1987 the project area has developed significantly with many large commercial buildings, several paved roads, and roughly

graded roads scattered throughout the site area. The eastern portion, where the Ellis Water Recycling Facility exists currently, remains undeveloped except for water storage fields just east of the site area. By 1993, Shollenberger Marsh appears to begin reverting back to its natural state along the edge of the Petaluma River (southeast of the current Ellis Water Recycling Facility) and land lots previously occupying the marsh lose their definition. By 2002, the edge of the marsh has moved farther north and several more buildings fill in the previously developed regions of the project site. From 2002 to present, developed regions continue to fill in with smaller commercial buildings and Shollenberger Park is established. The edge of the marsh land does not appear to move any farther north.

3.4 Surface Conditions

The project site encompasses an irregularly shaped area located east of Highway 101. The site is bounded to the north by Lakeville Highway and to the south by Shollenberger Park and undeveloped wetlands. The eastern extent of the project site includes the Ellis Creek Water Recycling Facility. The site is relatively level and is largely developed with commercial and institutional buildings. A natural creek crosses the middle portion of the site trending roughly north-south. Water within the creek flows south.

3.5 Reference Data

We reviewed subsurface boring data and soils reports from several past projects. The locations of reference borings and reference CPTs are shown in Figure 2 and boring logs are presented in Appendix A.

3.6 Anticipated Subsurface Conditions

Based on previous subsurface exploration by others, the site is generally underlain by alluvial deposits of sandy silt and clay in the upper 20-25-feet. Most reference borings encountered layers of clayey sands at depths greater than 20-25-feet. The alluvial soils are underlain by Franciscan Melange-type bedrock that includes serpentinite and claystone at depths of 80-110-feet.

3.7 Groundwater

We reviewed reference borings and CPTs and groundwater was measured at approximately 18-20-feet for borings on the western half of the project site. Groundwater was measured at 5 to 10-feet on the eastern most borings of the project site. Review of monitoring well data from the geotracker website indicate stabilized groundwater levels from 3 to 8 feet bgs. For preliminary design, we recommend that groundwater be anticipated at 5 feet below existing ground surface.

4.0 GEOLOGIC HAZARDS

This section summarizes our review of commonly considered geologic hazards and discusses their potential impacts on the planned improvements. The primary geologic hazard which could affect the proposed development is strong seismic ground shaking. Other geologic hazards are judged less than significant regarding the proposed project. Geologic hazards, potential impacts and mitigation measures are discussed in further detail in the following sections.

4.1 Fault Surface Rupture

Under the Alquist-Priolo Earthquake Fault Zoning Act, the California Division of Mines and Geology (now known as the California Geological Survey) produced 1:24,000 scale maps showing known active and potentially active faults and defining zones within which special fault studies are required. The nearest known active fault to the site is the Rodgers Creek Fault located approximately 7.6 kilometers (4.7 miles) to the east. The site is not located within an Alquist-Priolo Special Studies Zone. We therefore judge the potential for fault surface rupture in the development area to be low.

Evaluation: Less than significant. No mitigation measures are required.

4.2 Seismic Shaking

The site will likely experience seismic ground shaking similar to other areas in the seismically active Bay Area. The intensity of ground shaking will depend on the characteristics of the causative fault, distance from the fault, the earthquake magnitude and duration, and site-specific geologic conditions. Estimates of peak ground accelerations are based on either deterministic or probabilistic methods.

Deterministic methods use empirical attenuation relations that provide approximate estimates of median peak ground accelerations. A summary of the active faults that could most significantly affect the planning area, their maximum credible magnitude, closest distance to the center of the planning area, probable peak ground accelerations, and 84th percentile peak ground accelerations are summarized in Table 1. The calculated accelerations should only be considered as reasonable estimates. Many factors (e.g., soil conditions, orientation to the fault, etc.) can influence the actual ground surface accelerations.

Table 1 – Deterministic Peak Ground Accelerations for Active Faults

Fault	Moment Magnitude for Characteristic Earthquake	Closest Estimated Distance (km)	Median Peak Ground Acceleration (g)	84% Peak Ground Acceleration (g)
Rodgers Creek	7.3	7.6	0.34	0.54
San Andreas	8.0	24.9	0.22	0.34
Hayward	7.3	29.9	0.15	0.24
Maacama	7.4	33.3	0.14	0.23
San Gregorio	7.4	37.4	0.13	0.21

Reference: Caltrans ARS Online v2.3.09 accessed on July 15, 2019.

Probabilistic Seismic Hazard Analysis analyzes all possible earthquake scenarios while incorporating the probability of each individual event to occur. The probability is determined in the form of the recurrence interval, which is the average time for a specific earthquake acceleration to be exceeded. The design earthquake is not solely dependent on the fault with the closest

distance to the site and/or the largest magnitude, but rather the probability of given seismic events occurring on both known and unknown faults.

We calculated the peak ground acceleration for two separate probabilistic conditions; the 2 percent chance of exceedance in 50 years (2,475-year statistical return period) and the 10 percent chance of exceedance in 50 years (475-year statistical return period). The peak ground acceleration values were calculated utilizing the USGS Unified Hazard Tool (USGS, 2019). The results of the probabilistic analyses are presented below in Table 2.

Table 2 – Probabilistic Peak Ground Accelerations for Active Faults

Probability of Exceedance	Statistical Return Period	Magnitude	Peak Ground Acceleration (g)
2% in 50 years	2,475 years	7.03	0.78
10% in 50 years	475 years	7.02	0.49

Reference: USGS Unified Hazard Tool accessed on July 15, 2019.

Ground shaking can result in structural failure and collapse of structures or cause non-structural building elements (such as light fixtures, shelves, cornices, etc.) to fall, presenting a hazard to building occupants and contents. Compliance with provisions of the most recent version of the California Building Code (2016 CBC) should result in structures that do not collapse in an earthquake. Damage may still occur, and hazards associated with falling objects or non-structural building elements will remain.

The potential for strong seismic shaking at the project site is high. Due to their proximity and historic rates of activity, the Rodgers Creek and San Andreas Faults present the highest potential for severe ground shaking. The significant adverse impact associated with strong seismic shaking is potential damage to structures and improvements.

Evaluation: *Less than significant with mitigation.*
Design of new structures in accordance with the provisions of the 2016 California Building Code or subsequent codes in effect when final design occurs. Preliminary seismic design coefficients are presented in Section 5.1 of this report.

4.3 Liquefaction and Related Effects

Liquefaction refers to the sudden, temporary loss of soil strength during strong ground shaking. The strength loss occurs as a result of the build-up of excess pore water pressures and subsequent reduction of effective stress. While liquefaction most commonly occurs in saturated, loose, granular deposits, recent studies indicate that it can also occur in materials with relatively high fines content provided the fines exhibit lower plasticity.

The effects of liquefaction can vary from cyclic softening resulting in limited strain potential to flow failure which cause large settlements and lateral ground movements. Lateral spreading refers to a specific type of liquefaction-induced ground failure characterized primarily by horizontal displacement of surficial soil layers due to liquefaction of a subsurface granular layer (Youd,

1995). Lateral spreads generally move down gentle slopes or slip toward a free face such as an incised river channel. Regional mapping of seismic hazard zones (ABAG, 2019) indicates most of the project area lies within a zone of moderate liquefaction potential with the exception of the small creek which runs through the site which is mapped within a high liquefaction potential zone as shown on Figure 6.

Review of the reference borings indicates subsurface conditions consist of interbedded layers of clayey and sandy alluvial soils. The clayey soil layers are not liquefiable. There are several sandy soil layers below the groundwater level that appear liquefiable.

Evaluation: *Less than significant with mitigation.*
Thin liquefiable layers are not a significant hazard to buried utilities. Moderately thick liquefiable soils can create buoyance uplift issues for manholes or empty structures. The extent of liquefiable materials to be evaluated further based on subsurface exploration. Preliminary recommendations to is provide flexible connections.

4.4 Settlement

Significant settlement can occur when new loads are placed over soft, compressible clays or loose granular soils. While medium stiff soils are expected over most of the site. Fill and Bay Mud appear to exist in the eastern portion of the alignment. The fill materials and Bay Mud have a moderate potential for settlement. Reference boring indicate that in areas where Bay Mud was encountered it was medium stiff, partially consolidated with a less than typical settlement potential. For buried pressurized utilities, potential for significant damage from settlement is low, and for above grade structures or gravity lines the potential for settlement damage is moderate.

Evaluation: *Less than significant with mitigation.*
Borings and lab testing to determine extent of compressible Bay Mud and settlement potential. Lightweight backfill could be utilized in Bay Mud areas and deep foundations or zero load balancing (lightweight fill) used for sensitive above grade structures.

4.5 Flooding

The project site is located at about elevation +10 to +20 feet and is mapped within a designated 500-year and 100-year flood zone based upon the preliminary Flood Insurance Rate Map prepared by FEMA (Federal Emergency Management Agency, 2015) as shown on Figure 7. Mapped flood zones are located along the southern extent of the project site as well as a portion of the western half. Therefore, large scale flooding is considered a low to moderate hazard along the proposed alignment.

Evaluation: *Less than significant with mitigation.*
Mitigation: *The project Civil Engineer responsible for site drainage and should evaluate localized flooding potential and provide appropriate mitigation. Any equipment sensitive to water damage should be located above the flood elevation.*

5.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our geologic and geotechnical data review, we judge that construction of the proposed improvements is feasible from a geotechnical standpoint. Primary geotechnical considerations for the project include providing appropriate temporary support for excavations which will encounter predominantly loose to dense sands and shallow groundwater, providing appropriate groundwater control measures in areas where excavations extend below the water table, appropriate seismic / structural design for any new structures, and providing for proper bedding and trench backfill. Preliminary discussion and recommendations addressing these, and other considerations are presented in the following sections. Subsurface exploration and laboratory testing should be performed along the pipeline alignment to better evaluation subsurface conditions.

5.1 Seismic Design

Minimum mitigation of ground shaking includes seismic design of new structures in conformance with the provisions of the most recent edition (2016) of the California Building Code. The magnitude and character of these ground motions will depend on the earthquake and the site response characteristics. Based on the interpreted subsurface conditions and close proximity of the Rodgers Creek and San Andreas Faults, we recommend the CBC coefficients and site values shown in Table 3 be used to calculate the design base shear of new improvements as applicable. The values presented in Table 3 should be confirmed based on supplemental exploration.

Table 3 – Preliminary 2016 California Building Code Seismic Design Criteria

Parameter	Design Value
Site Class	D
Site Latitude	38.2330°N
Site Longitude	-122.6218°W
Spectral Response (short), S_S	1.600 g
Spectral Response (1-sec), S_1	0.600 g
Site Coefficient, F_a	1.0
Site Coefficient, F_V	1.5

Reference: USGS US Seismic Design Maps, accessed on July 15, 2019.

5.2 Earthwork

Earthwork is expected to consist of excavation and backfilling with excavations anticipated for the new sewer force main. Earthwork should be performed in accordance with the recommendations and criteria outlined in the following sections.

5.2.1 Trench Bottom Stabilization

Based on planned pipeline invert depths, we anticipate portions of the bottom of pipeline excavations will extend below the groundwater table and into soft compressible clays in mapped Bay Mud areas. In areas where trench bottoms are soft, loose, or otherwise

unstable, we recommend the trench bottoms be over-excavated a minimum of 12 inches below the planned pipe invert and backfilled with drain rock. The drain rock should be completely wrapped with a geotextile filter fabric consisting of Mirafi FW300 or an approved equivalent.

5.2.2 Excavations

Based on reference subsurface exploration data, site excavations will likely encounter soft to stiff clayey soils and loose to medium dense sandy soils. Bedrock conditions are not expected. The medium stiff to stiff clay generally classifies as OSHA Type B soil.

Soft Bay Mud and sandy soils will also likely be encountered in excavations in the eastern portion of the alignment. In unsupported excavations, the sandy soils will be susceptible to flowing below groundwater and running to fast raveling above groundwater, while the soft Bay Mud will be susceptible to squeezing. Temporary support of excavations will be required to ensure the safety of workers and to reduce the potential for failure of the excavation sidewalls and damage to surrounding improvements. The soft clay and loose sands classify as OSHA Type C soil. Excavation stability and the structural design of temporary shoring should be the responsibility of the Contractor.

5.2.3 Fill Materials, Placement and Compaction

Unless otherwise recommended by the City or the pipe manufacturer, pipe bedding and embedment materials should consist of well-graded sand with 90 to 100 percent of particles passing the No. 4 sieve and no more than five percent finer than the No. 200 sieve. Provide the minimum bedding thickness beneath the pipe in accordance with the manufacturer's recommendations (typically three to six inches).

Fill materials should consist of non-expansive materials that are free of organic matter, have a Liquid Limit of less than 40 (ASTM D 4318), a Plasticity Index of less than 20 (ASTM D 4318), Expansion Index less than 40 (ASTM D 4329) and a minimum R-value of 20 (California Test 301). The fill material should have a maximum particle size of 4 inches. Onsite soils may be suitable for use as fill, provided they meet the criteria specified above. Any imported fill material needs to be tested to determine its suitability.

Fill materials should be moisture conditioned to above the optimum moisture content prior to compaction. Properly moisture conditioned fill materials should subsequently be placed in loose, horizontal lifts of 8 inches-thick or less and uniformly compacted to at least 90 percent relative compaction. Where fill thicknesses are greater than 5 feet, fill materials should be compacted to at least 92 percent relative compaction. In pavement areas, the upper 12 inches of fill should be compacted to at least 95 percent relative compaction. The maximum dry density and optimum moisture content of fill materials should be determined in accordance with ASTM D1557.

5.3 Temporary Support of Excavations

Temporary support of excavations will be required to ensure the safety of workers and to reduce the potential for trench failure and damage to surrounding areas. Shoring types may include

trench boxes or shields, driven sheet piles, vertical hydraulic shores, or other systems. While a variety of systems are available, shoring that applies positive pressure and immediate support to the side walls of the excavation will be more effective in controlling ground movements and reducing the risk of damage to nearby utilities and structures. For excavations that extend below the groundwater table, sheet piles may be used to reduce groundwater seepage thereby reducing the amount of dewatering, pumping, and groundwater disposal that would be required.

The selected support system should be designed to resist lateral pressures from earth and construction surcharge loads. Watertight shoring systems (e.g. interlocking sheet piles) which do not allow for drainage should also be designed to resist hydrostatic pressures. As a minimum, shoring systems should be designed based on the geotechnical criteria developed as part of the design level investigation.

5.4 Temporary Dewatering

Temporary dewatering will be required where excavations extend below the groundwater table. While various systems are available, dewatering would most likely consist of wells spaced as needed to keep the groundwater level below the excavation bottom. The selection, design, installation, monitoring, and removal of temporary dewatering should be the responsibility of the Contractor in accordance with their means and methods. The Contractor should be required to submit dewatering plans for review by the City prior to implementation. Considering the granular soils are relatively permeable, dewatering will likely generate a large volume of water and temporary dewatering and groundwater disposal can add significant costs to the project.

5.5 Pavements

New pavements will be required for trenches that extend into traffic areas. We have provided preliminary pavement design in accordance with Caltrans procedures for flexible pavement (Caltrans, 2015). We assumed Traffic Index values ranging from four to seven depending on the expected traffic loads for a twenty-year design life. For our preliminary design, we assumed an R-value of 20 and 50 which are generally consistent with R-values for select fill and Class 2 aggregate subbase, respectively. During construction, we should test the backfill materials to confirm the R-value of the backfill material is consistent with our assumed values. The preliminary recommended pavement sections are presented in Table 5.

Table 5 – Preliminary Asphalt-Concrete Pavement Sections

Traffic Index[1]	Select Fill Backfill (R-Value = 20)		Class 2 Aggregate Subbase (R-Value = 50)	
	Asphalt Thickness (inches)	Class 2 Aggregate Base Thickness (inches)	Asphalt Thickness (inches)	Class 2 Aggregate Base Thickness (inches)
4	3.0	5.0	2.5	4.0
5	3.5	7.0	3.0	5.0
6	4.0	9.0	3.5	6.0
7	5.0	10.0	4.0	7.0

(1) Traffic Index to be determined by the project Civil Engineer

The Class 2 aggregate base should conform to the most recent version of Caltrans Standard Specifications and should be compacted to at least 95 percent relative compaction. Additionally, the aggregate base should be firm and unyielding under heavy, rubber-tired construction equipment. If heavier truck traffic or "superior" performance is desired, the thickness of the aggregate base and asphalt thickness may be increased.

6.0 SUPPLEMENTAL GEOTECHNICAL SERVICES

Following review and consideration of this report, we will consult with the project team regarding geologic or geotechnical issues. Supplemental exploration and laboratory testing will be required once development details are better defined (e.g., site grading, alignment, etc.) to prepare a design level geotechnical recommendations, criteria and report. We will also be available to provide consultation throughout the design process on other geotechnical-related items.

As project plans near completion, we should review them to ensure that the intent of our recommendations has been sufficiently incorporated. During construction, we should be present intermittently to observe and test the geotechnical portions of the work. The purpose of our observation and testing is to confirm that site conditions are as anticipated, to adjust our recommendations and design criteria if needed, and to confirm that the Contractor's work is performed in accordance with the project plans and specifications.

7.0 LIMITATIONS

We believe this report has been prepared in accordance with generally accepted geotechnical engineering practices in the San Francisco Bay Area at the time the report was prepared. This report has been prepared for the exclusive use of the project Owner and/or their assignees specifically for this project. No other warranty, expressed or implied, is made. Our evaluations and recommendations are based on the data obtained during our subsurface exploration program and our experience with soils in this geographic area.

8.0 LIST OF REFERENCES

American Society of Civil Engineers (ASCE) (2010), "Minimum Design Loads for Buildings and Other Structures" (2010 ASCE-7), Structural Engineering Institute of the American Society of Civil Engineers.

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Youd, T.L. "Liquefaction-Induced Lateral Ground Displacement" (April 2, 1995). *International Conferences on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics.* Paper 3.

SITE COORDINATES
LAT. 38.2330°
LON. -122.6218°

SITE LOCATION

N.T.S.

REFERENCE: Google Earth, 2019

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FILENAME: 949.129 Standard Figures.dwg

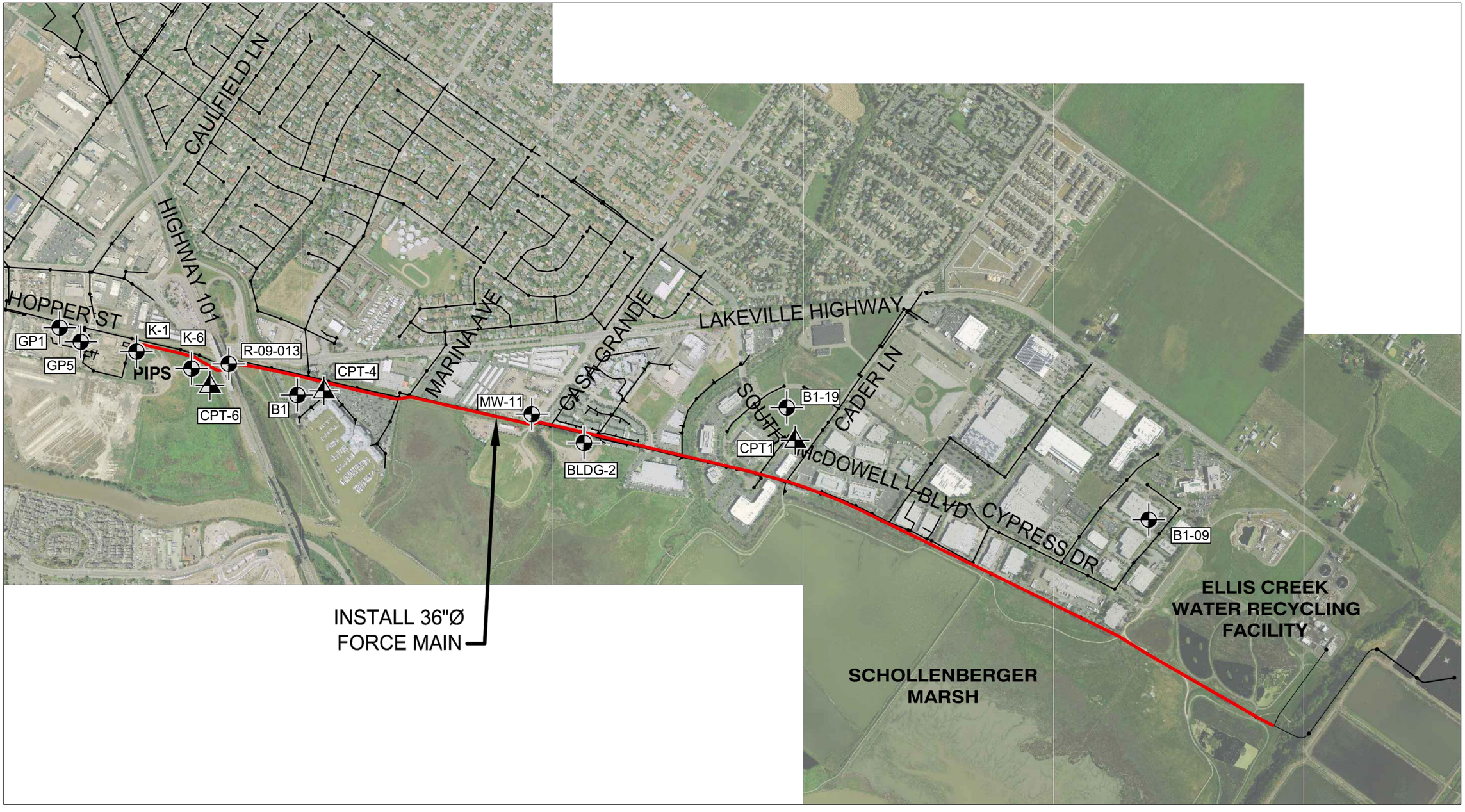
SITE LOCATION MAP

Nute - Petaluma Force Main
Petaluma, California

Project No. 949.129 Date: 6/26/2019

Drawn EIC
Checked

1
FIGURE



Approximate reference boring location.

Approximate reference CPT location.

SCALE

0 500 1000 2000 FEET

NORTH

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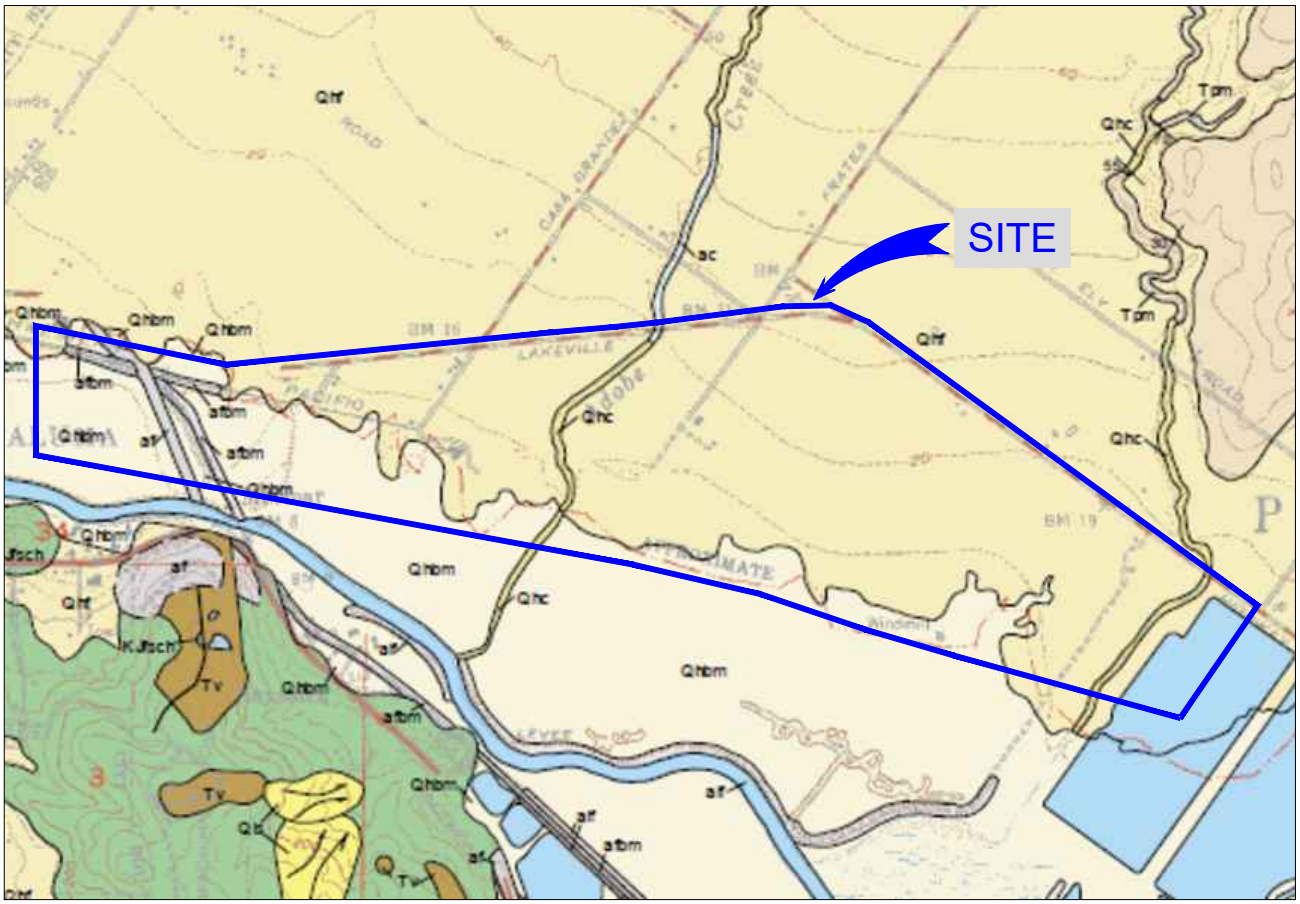
SITE PLAN - ALTERNATIVE A

Nute - Petaluma Force Main
Petaluma, California

Project No. 949.129 Date: 8/3/2016

Designed ABC
Drawn EIC
Checked ABC

2
FIGURE



REGIONAL GEOLOGIC MAP

(NOT TO SCALE)

NORTH

LEGEND

af	**Artificial Fill** [Quaternary] - Includes rock, soil, garbage and trash, placed by man. Highly variable in compisition and degree of compaction from location to location.
afbm	**Artificial Fill Over Bay Mud** [Quaternary] - Artificial fill placed over bay mud.
ac	**Artificial Stream Channel** [Quaternary] - Man-made stream channel.
Qhc	**Stream Channel Deposits** [Quaternary] - Deposits in active, natural stream channels which consist of loose alluvial sand, gravel, and silt.
Qhbm	**Bay Mud** [Quaternary] - Silt, clay, peat, and fine sand deposited at or near sea level in San Pablo Bay.
Qhf	**Alluvial Fan Deposits** [Quaternary] - Sand, gravel, silt, and clay deposited by streams emanating from canyons onto alluvial valley floors. Sediment is poorly to moderately sorted and bedded.
Tv	**Tertiary Volcanics** [Tertiary] - Mafic volcanic rocks, mostly basaltic andesite, similar to and probably part of Burdell Mt. Volcanics.
KJsch	**Franciscan Complex Schist** [Jurassic] - Schist, phyllite, and semischist.

Reference: California Geological Survey, "Geologic Map of the Petaluma River 7.5' Quadrangle, Marin and Sonoma Counties, California: A Digital Database. 2002.

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REGIONAL GEOLOGIC MAP

Nute - Petaluma Force Main
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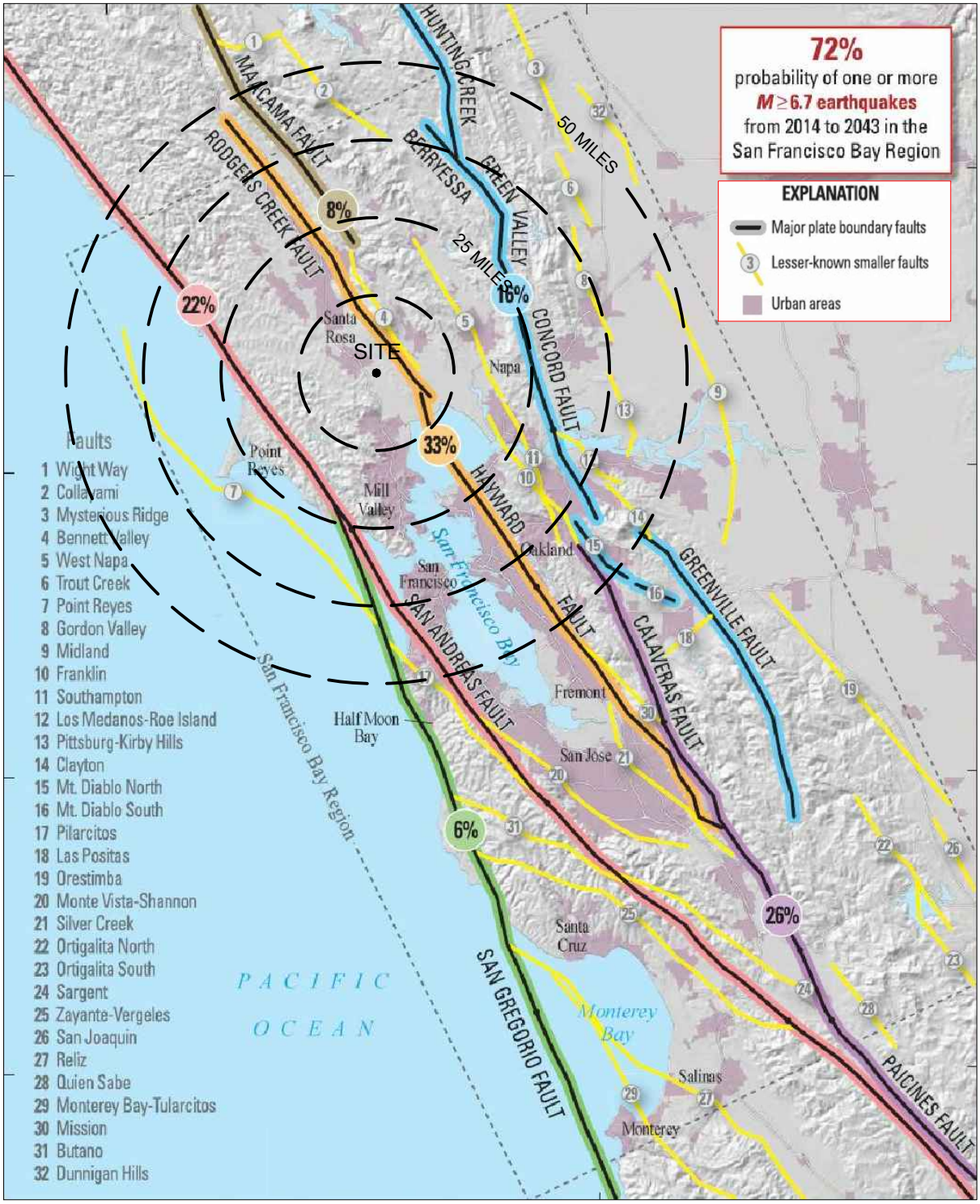
Checked

3
FIGURE



SITE COORDINATES
LAT. 38.2330°
LON. -122.6218°

SCALE
0 12.5 25 50 MILES

NORTH

DATA SOURCE:
1) U.S. Geological Survey, U.S. Department of the Interior, "Earthquake Outlook for the San Francisco Bay Region 2014-2043", Map of Known Active Faults in the San Francisco Bay Region, Fact Sheet 2016-3020, Revised August 2016 (ver. 1.1).

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ACTIVE FAULT MAP

Nute - Petaluma Force Main
Petaluma, California

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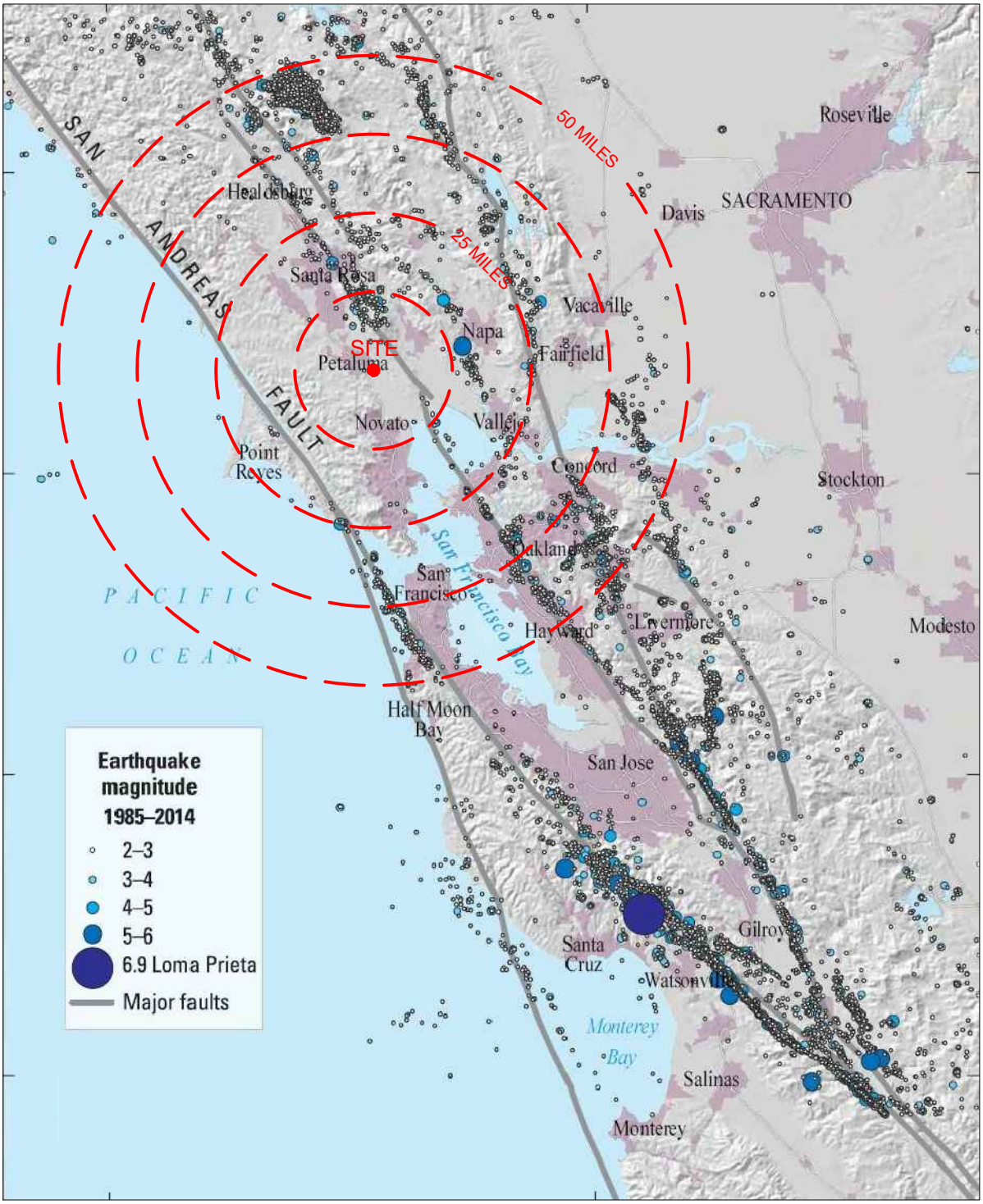
Project No. 949.129
Date: 6/26/2019

4
FIGURE



SITE COORDINATES
LAT. 38.2330°
LON. -122.6218°

SCALE
0 12.5 25 50 MILES

NORTH

DATA SOURCE:
1) U.S. Geological Survey, U.S. Department of the Interior, "Earthquake Outlook for the San Francisco Bay Region 2014-2043", Map of Earthquakes Greater Than Magnitude 2.0 in the San Francisco Bay Region from 1985-2014, Fact Sheet 2016-3020, Revised August 2016 (ver. 1.1).

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HISTORIC EARTHQUAKE MAP

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Petaluma, California

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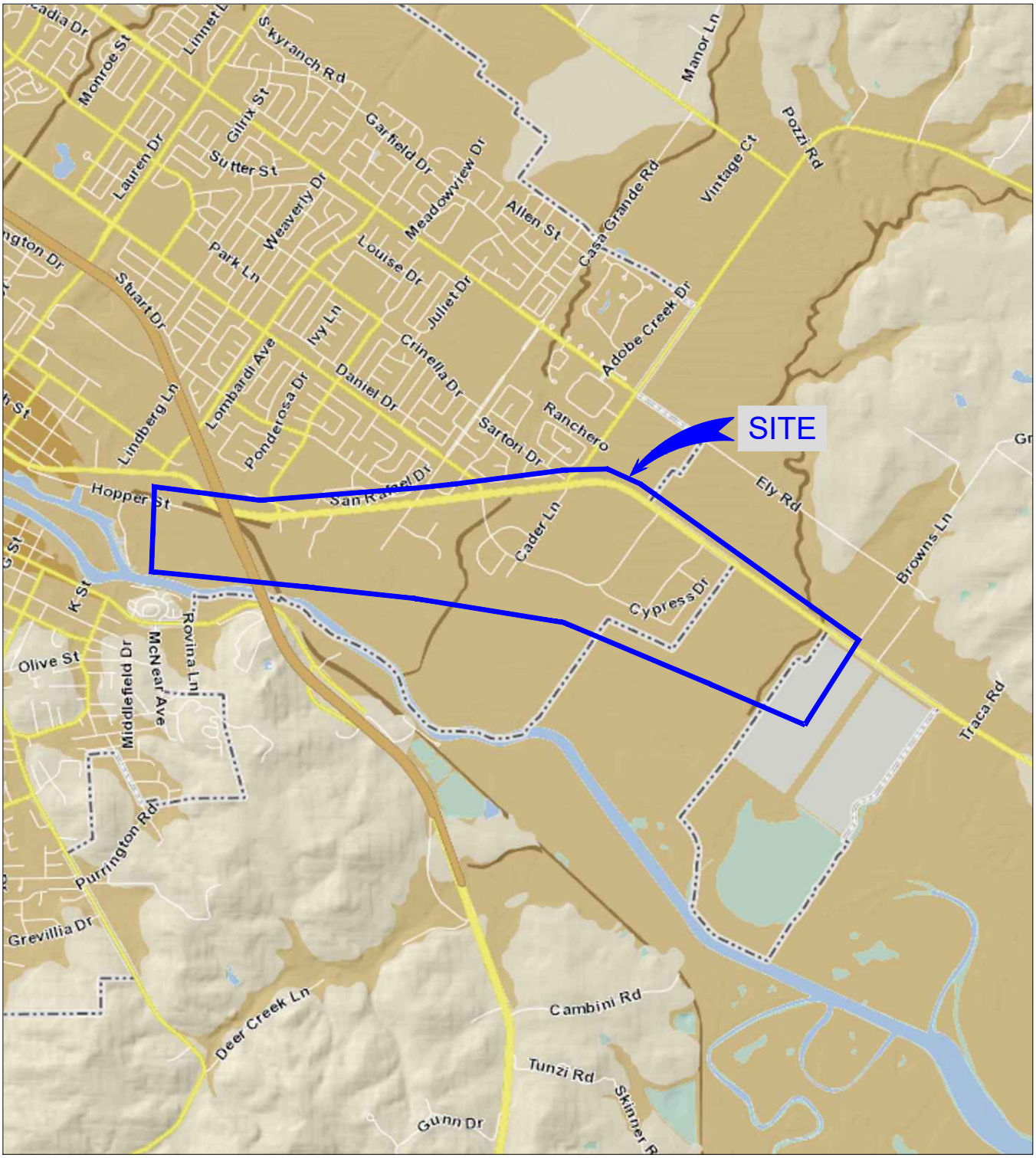
Date: 6/26/2019

FIGURE 5



Susceptibility Level:

Very High | Moderate | Very Low | Local Road

High | Low | Major Road

No Scale

NORTH

Map Reference: ABAG Geographic Information System.

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LIQUEFACTION SUSCEPTIBILITY MAP

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Petaluma, California

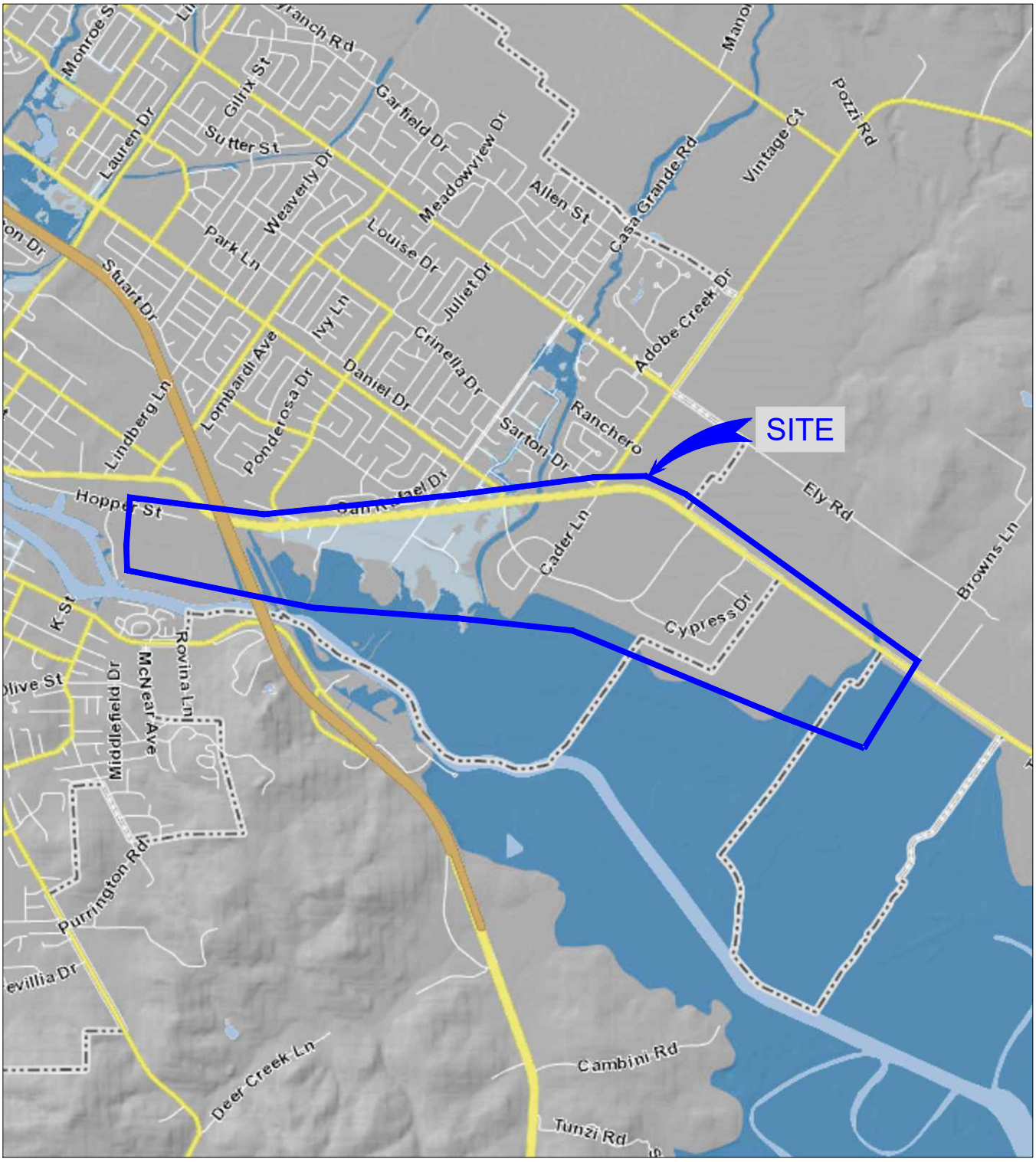
Project No. 949.129

Date: 6/26/2019

Drawn EIC

Checked

6
FIGURE



Flood Hazard Area:

Zone V- 100yr.

Zone A - 100yr.

Zone X - 500yr.

Urbanized Area

No Scale

Zone V: This code identifies an area inundated by 1% annual chance flooding with velocity hazard (wave action).
Zone A: This code identifies an area inundated by 1% annual chance flooding.

Zone X 500yr: This code identifies an area inundated by .02% annual chance flooding and area inundated by 1% annual chance of flooding with average depth of less than 1 foot of with drainage areas less than 1 square mile or an area protected by levees form 1% annual chance flooding.

NORTH

Map Reference: ABAG Geographic Information System.

MPEG MILLER PACIFIC ENGINEERING GROUP
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www.millerpac.com

FILENAME: 949.129 Standard Figures.dwg

FEMA FLOOD MAP

Nute - Petaluma Force Main
Petaluma, California

Project No. 949.129

Date: 6/26/2019

Drawn EIC
Checked

7
FIGURE

MILLER PACIFIC
ENGINEERING GROUP

APPENDIX A

Reference Geotechnical Borings

BORING GP1

EQUIPMENT: Truck-Mounted Drill Rig
DATE: 05/21/02
ELEVATION: +10 feet
*REFERENCE: Topographic map Future Cots Site, Steven J. Lafranchi and Assoc., 9/6/02

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
					0	0			SANDY CLAY with GRAVEL (SC) (FILL) dark brown, moist, medium stiff
			18.4				X		
					1				
						5			SANDY SILT lense, wet, soft, approximately 6-inches thick.
			36.2		2		X		SILTY CLAY (CL) (BAY MUD) dark gray brown, moist, medium stiff in upper one to two feet then soft.
					3	10			grades to medium stiff
					4		X		
						15			SILTY CLAY (CL) (ALLUVIUM) blue gray, wet, stiff to very stiff.
			23.3		5		X		
									▽
			21.9		6	20	X		CLAYEY SAND (SC) tan, dense, wet
									Bottom of hole at 20 feet Free water encountered at 18 feet

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlog.dwg

Miller Pacific
ENGINEERING GROUP

BORING LOG
Petaluma Homeless Shelter
Petaluma, California

5

Project No. 924.01 Date 9/3/02 Approved By:

Figure

BORING GP5

EQUIPMENT: Truck-Mounted Drill Rig
DATE: 05/21/02
ELEVATION: +13 feet
*REFERENCE: Topographic map Future Cots Site, Steven J. Lafranchi and Assoc., 9/6/02

OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
			12.5		0	0	X		SANDY CLAY with GRAVEL (SC) (FILL) dark brown, moist, medium stiff
			21.4		1	5	X		
			31.3		3	10	X		? SILTY CLAY (CL) (BAY MUD) dark gray, wet, medium stiff
			20.4		4	15	X		SILTY CLAY (CL) (ALLUVIUM) dark gray, wet, very stiff
			17.5		5		X		CLAYEY SAND (SC) tan, dense, wet
			16.6		6	20	X		Bottom of hole at 23 feet No free water encountered

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

FILE: boringlog.dwg

Miller Pacific
ENGINEERING GROUP

BORING LOG
Petaluma Homeless Shelter
Petaluma, California

Project No. 924.01 Date 9/3/02 Approved By:

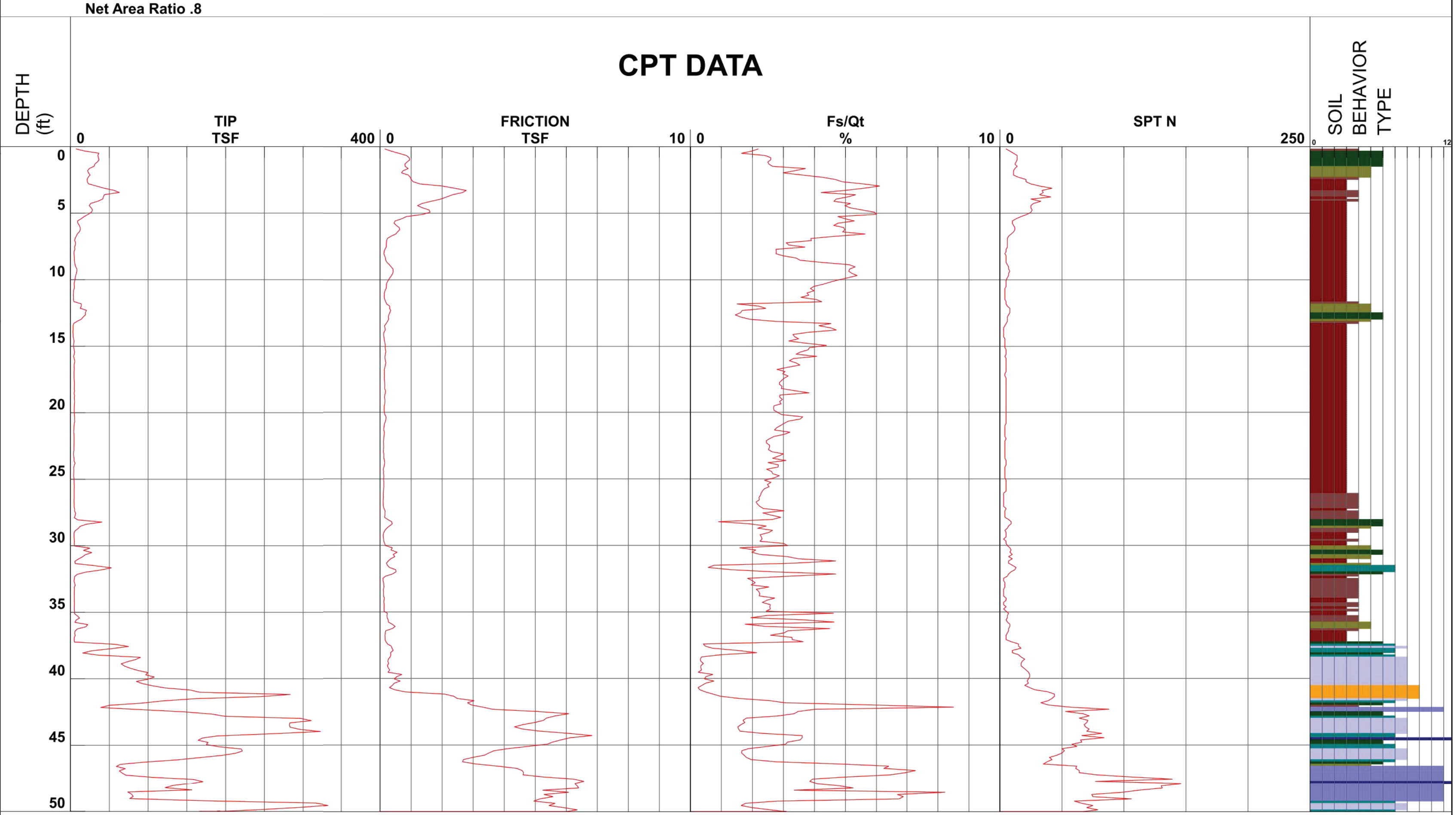
Figure

Miller Pacific Engineering Group

Project	Basin Street Riverfront	Operator	CB/MM	Filename	SDF(268).cpt
Job Number	1130.08	Cone Number	DDG1298	GPS	
Hole Number	CPT-06	Date and Time	9/4/2014 9:23:47 AM	Maximum Depth	50.52 ft
EST GW Depth During Test		13.00 ft			

Net Area Ratio .8

CPT DATA



- 1 - sensitive fine grained
- 2 - organic material
- 3 - clay
- 4 - silty clay to clay
- 5 - clayey silt to silty clay
- 6 - sandy silt to clayey silt
- 7 - silty sand to sandy silt
- 8 - sand to silty sand
- 9 - sand
- 10 - gravelly sand to sand
- 11 - very stiff fine grained (*)
- 12 - sand to clayey sand (*)

Cone Size 10cm squared

S*Soil behavior type and SPT based on data from UBC-1983

Miller Pacific
ENGINEERING GROUP

FILE: 1130.08 CPT 14.dwg

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www.millerpac.com

CPT-6 DATA PLOT

Basin Street Properties
Riverfront Development
Petaluma, California

Project No. 1130.08 Date: 11/20/14

Drawn MMT
Checked

A-31
FIGURE

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/ft. *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
						1			**SANDY CLAY WITH GRAVEL** - gray-brown, dry to moist, very stiff, fine to medium sand, subangular gravel to 1/2", shrinkage cracks, concrete debris, scattered yellow-brown silty sand lenses (Fill)
				22		2			
						3			
77	37.7	1.0		13		4			
						5			
74	45.7	0.7		10		6			**CLAYEY SILT/SILTY CLAY** - brown/red-brown with gray mottling, moist, firm to stiff, rootlets, organic matter, stiff at 3.5' (Fill)
						7			
						8			
						9		CH	
						10			**SILTY CLAY** - olive-brown with blue and orange mottling, moist, firm to stiff, organics (rootlets), plastic, decreasing silt content with depth
				8		11			
						12			
						13			**SILTY CLAY WITH SAND AND TRACE GRAVEL** - light olive, moist, stiff, subangular gravel to 1/2", moderately plastic
						14			
						15			
101	22.5			15		16		CL/CH	
						17			
						18			
						19			
						20			**SANDY SILT** - light yellow-brown with gray mottling, moist, very stiff, trace black rootlets
				22		21			
						22		ML	▽
						23			
						24			**SILTY SAND WITH GRAVEL** - gray-yellow-brown, wet, dense, fine to coarse sand, subangular to subrounded gravel to 1/2" switched to mud rotary @ 24'
						25			
				32		26			
						27			
						28		SM	
						29			
						30			
						31			
						32			
						33			**SILTY SAND** - dark gray/green, wet, medium dense, fine to coarse sand
						34		SM	
						35			
				15		36			**SILTY CLAY** - dark gray-olive with slight gray-brown mottling, moist, stiff to very stiff, moderately plastic
						37			
						38			
						39		CH	
						40			
						41			
						42			
						43			
						44			**SANDY CLAY** - dark olive-gray, moist, very stiff, fine to coarse sand, small sand lenses, moderately plastic
						45			
108	22.0	1.5		20		46			
						47			
						48			
						49			
						50			

* Converted to equivalent standard penetration blow counts.

** Existing ground surface at time of drilling

SURFACE ELEVATION: **feet ****
TOTAL DEPTH: **126.4 feet**
GROUND WATER DEPTH: ▽ **22.0 feet at time of drilling**
▼ **feet**

LOGGED BY: **JCR**
EQUIPMENT: **Mud Rotary**
DIAMETER of BORING: **inches**
DATE DRILLED: **7-24-00**

KLEINFELDER

PROJECT NUMBER **41-7596-01/001** DATE **SEP 2000**

LOG OF EXPLORATION BORING K-1
RIVERFRONT PROJECT
Petaluma, California

PLATE **A-3**

LABORATORY				FIELD						
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/ft. *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
						51–62		CL/CH	continuation of SANDY CLAY, as above
				23					visable rootlets, sand lenses slightly larger in thickness
87	30.8			22		63–75		SM	SILTY SAND - dark gray-olive, wet to moist, medium dense, fine sand, small clay lenses, trace rootlets
104	22.2			44		76		CH	CLAY - dark gray, moist, hard, plastic
						77–83		ML	CLAYEY SILT WITH SAND - dark gray, moist, hard, fine sand, shell fragments
				56		84–87		SP	SAND WITH OCCASIONAL GRAVEL - wet, very dense, fine to medium sand, subrounded to rounded gravel to 1/4"
						88–89		GP	SANDY GRAVEL - gray with white, red-yellow and brown mottling, wet, very dense, subrounded to rounded gravel to 1/2"
						90–93		SM	SILTY SAND - gray, wet, very dense, fine to medium sand
						94		CH	CLAY WITH SILT AND SAND - gray, wet, hard, fine sand, plastic
				52/ 11"		95–100			SANDY CLAY - gray with red-brown mottling, moist, hard, fine to medium sand, occasional thin lenses of subrounded to rounded gravel to 1/4"

* Converted to equivalent standard penetration blow counts.

** Existing ground surface at time of drilling

SURFACE ELEVATION: **feet ****
TOTAL DEPTH: **126.4 feet**
GROUND WATER DEPTH: ▽ **22.0 feet at time of drilling**
▼ **feet**

LOGGED BY: **JCR**
EQUIPMENT: **Mud Rotary**
DIAMETER of BORING: **inches**
DATE DRILLED: **7-24-00**

KLEINFELDER

LOG OF EXPLORATION BORING K-1

RIVERFRONT PROJECT

Petaluma, California

PLATE **A-4**

PROJECT NUMBER **41-7596-01/001** DATE **SEP 2000**

LABORATORY				FIELD					
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/ft. *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
						101		CL	continuation of SANDY CLAY, as above
						102			
						103			
						104			
						105			**SAND WITH SILT** - gray and gray-brown, moist, very dense, fine to medium sand
				89/ 11"		106		SP/SM	
						107			
						108			
						109		CL/CH	**SILTY CLAY** - gray and olive-brown, moist, hard, moderately plastic (completely weathered claystone)
						110			**CLAYSTONE** - olive-gray, highly weathered, friable, small discontinuous polished pressure planes, harder drilling at 109'
						111			
						112			
						113			
						114			
						115			
				61/ 10.5"		116			
						117			
						118			
						119			
						120			
						121			
						122			
						123			
						124			
						125			
				56/ 11"		126			grades to olive-brown, moderately weathered with depth
						127			BOTTOM OF BORING K-1 @ 126.4 FEET
						128			
						129			
						130			
						131			
						132			
						133			
						134			
						135			
						136			
						137			
						138			
						139			
						140			
						141			
						142			
						143			
						144			
						145			
						146			
						147			
						148			
						149			
						150			

* Converted to equivalent standard penetration blow counts.

** Existing ground surface at time of drilling

SURFACE ELEVATION: **feet ****
TOTAL DEPTH: **126.4 feet**
GROUND WATER DEPTH: ▽ **22.0 feet at time of drilling**
▼ **feet**

LOGGED BY: **JCR**
EQUIPMENT: **Mud Rotary**
DIAMETER of BORING: **inches**
DATE DRILLED: **7-24-00**

KLEINFELDER

PROJECT NUMBER **41-7596-01/001** DATE **SEP 2000**

LOG OF EXPLORATION BORING K-1
RIVERFRONT PROJECT
Petaluma, California

PLATE **A-5**

LABORATORY				FIELD						
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/ft. *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
						1			**SILTY SAND WITH OCCASIONAL GRAVEL** - light gray-brown, dry, loose, fine to coarse sand, subrounded gravel to 1/2" (Fill)
				8		2			
						3			
				9		4			grades to fine silty sand, light yellow gray-brown, moist (Fill)
						5			
88	26.3			11		6			**SILTY SAND WITH CLAY** - yellow-brown with olive-gray mottling, moist, loose (Fill)
						7			
						8			
						9			
				6		10			**CLAY** - olive-gray, moist, firm, moderately to highly plastic, black discoloration (organics), scattered gravel
				Push		11			
						12			
						13			
				6		14			decrease in organic content, discoloration, firm
						15			
						16		OH	
						17			
						18			
						19			high organic layer (plant material), soft to firm, moist, rootlets
69	37.0			4		20			
						21			
						22			
						23			**SILTY CLAY WITH SAND** - light gray-olive, moist, stiff, small yellow-brown sand lenses, rootlets, moderately plastic
				12		24			
						25		CL/CH	▽
						26			
						27			
						28			**SANDY CLAY** - light olive, moist to wet (pockets), very stiff, fine to moderately coarse sand, trace red-brown mottling, well installed, moved north 5' switched to mud rotary loss of drill mud at 30'
						29			
				24		30			
106	21.8	2.0				31		CL	
						32			
						33			
						34			occasional subrounded to subangular gravel to 1/2", increase in sand content
						35			
						36			**SILTY SAND WITH GRAVEL AND CLAY** - yellow-brown, moist, medium dense, subrounded gravel to 1/2"
						37		SM/SC	
						38			
						39			
						40			**SILTY CLAYEY SAND** - olive-gray-brown, moist, stiff, fine to medium sand
						41			
						42			
						43		SM/SC	
						44			
						45			
						46			
						47			**SILTY CLAY** - light gray-olive, moist, stiff, trace rootlets, moderately plastic
						48			
						49			
						50			

* Converted to equivalent standard penetration blow counts.

** Existing ground surface at time of drilling

SURFACE ELEVATION: **feet ****
TOTAL DEPTH: **110.3 feet**
GROUND WATER DEPTH: ▽ **25.0 feet at time of drilling**
▽ **feet**

LOGGED BY: **JCR**
EQUIPMENT: **Mud Rotary**
DIAMETER of BORING: **inches**
DATE DRILLED: **7-26-00**

KLEINFELDER

PROJECT NUMBER **41-7596-01/001** DATE **SEP 2000**

LOG OF EXPLORATION BORING K-6
RIVERFRONT PROJECT
Petaluma, California

PLATE **A-11**

LABORATORY				FIELD					SOIL DESCRIPTION
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/ft. *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	
				19		51-57		CL/CH	continuation of SILTY CLAY, as above
						57-64		CL	**SILTY SANDY CLAY** - yellow-brown, moist, firm, fine to medium sand increase in sand content, trace subangular to subrounded gravel to 1/2" grades to light gray/olive, comparable composition
						64-68		CH	**CLAY WITH TRACE SAND** - light olive, moist, very stiff, fine sand
110	19.7	2.5		28		69-89		CL	**SANDY SILTY CLAY WITH GRAVEL** - light gray-olive, with yellow-olive and brown mottling, moist, very stiff, fine sand, coarse gravel, subangular gravel to 1/2", veins of black discoloration (possible roots), poorly sorted, low to moderate plasticity
						82-89		SM/SC	**SILTY SAND WITH GRAVEL** - trace clay, yellow-olive-brown with gray clasts, moist, dense, subangular to subrounded gravel to 1/2", fine to coarse sand
				33		89-98		SC	**CLAYEY SAND WITH GRAVEL** - light gray-olive, with dark gray gravel, moist to wet, dense, fine sand, fine to coarse gravel, subangular to subrounded gravel to 1/2", coarsening downward
						98-100			hard drilling at 98' **SERPENTINITE** - see next page

* Converted to equivalent standard penetration blow counts.

** Existing ground surface at time of drilling

SURFACE ELEVATION: **feet ****
TOTAL DEPTH: **110.3 feet**
GROUND WATER DEPTH: ▽ **25.0 feet at time of drilling**
▼ **feet**

LOGGED BY: **JCR**
EQUIPMENT: **Mud Rotary**
DIAMETER of BORING: **inches**
DATE DRILLED: **7-26-00**

KLEINFELDER

PROJECT NUMBER **41-7596-01/001** DATE **SEP 2000**

LOG OF EXPLORATION BORING K-6
RIVERFRONT PROJECT
Petaluma, California

PLATE **A-12**

LABORATORY				FIELD						
Dry Density (pcf)	Moisture Content (%)	Shear Strength (ksf)	Other Tests	Blows/ft. *	Sample	Depth (feet)	Lithology Symbol	U.S.C.S. Designation	SOIL DESCRIPTION
106	24.9	3.0		61 9"		101 102 103 104 105 106 107 108 109			**SERPENTINITE** - dark brown, light green, blue-gray, completely weathered, weak grades to moderately weathered dark gray-blue black, slightly weathered, moderately strong
				55/3"		110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150			BOTTOM OF BORING K-6 @ 110.3 FEET

* Converted to equivalent standard penetration blow counts.

** Existing ground surface at time of drilling

SURFACE ELEVATION: **feet ****
TOTAL DEPTH: **110.3 feet**
GROUND WATER DEPTH: ▽ **25.0 feet at time of drilling**
▼ **feet**

LOGGED BY: **JCR**
EQUIPMENT: **Mud Rotary**
DIAMETER of BORING: **inches**
DATE DRILLED: **7-26-00**

KLEINFELDER

LOG OF EXPLORATION BORING K-6
RIVERFRONT PROJECT
Petaluma, California

PLATE **A-13**

PROJECT NUMBER **41-7596-01/001** DATE **SEP 2000**

LOGGED BY	BEGIN DATE	COMPLETION DATE	BOREHOLE LOCATION (Lat/Long or North/East and Datum)	HOLE ID
S.Mano/C.Rambo	6-11-09	6-12-09	2278308.1 ft / 5953435.2 ft	R-09-013
DRILLING CONTRACTOR			BOREHOLE LOCATION (Offset, Station, Line)	SURFACE ELEVATION
WDC Exploration & Wells			14' Rt Sta 191+80 A	10 ft
DRILLING METHOD			DRILL RIG	BOREHOLE DIAMETER
Rotary Wash			CME 85	4-7/8 inch
SAMPLER TYPE(S) AND SIZE(S) (ID)			SPT HAMMER TYPE	HAMMER EFFICIENCY, ERi
Modified CA (1.96"), SPT (1.44")			Auto Hammer 140lb/30in	85%
BOREHOLE BACKFILL AND COMPLETION			GROUNDWATER READINGS DURING DRILLING	AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING
Cement			Dry to 19'	N/A	86.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	0		CLAYEY SAND with GRAVEL (SC); light brown; moist.												
	1				1	6 7 7	14	35							8 inch hollow stem auger to 21.5 feet
8.00	2		CLAYEY GRAVEL with SAND (GC); grayish brown; moist.												
	3														
6.00	4				2	3 11 3	14	35							
	5		Lean to fat CLAY with SAND (CL/CH/CH); stiff; dark gray; moist.												
4.00	6														Drilling fluid measured at 5.5 feet on 6/11/09
	7														Stabilization fabric at 6 feet
2.00	8														
	9		Fat CLAY (CH); medium stiff; gray; moist.		3	1 2 3	5	100							
0.00	10														
	11				4	1 2 4	6	100		28	94	UC = 0.42			
-2.00	12		At EL. -2.0 ft, with Clayey Sand lenses with some black speckling.												
	13														
-4.00	14		At EL. -4.0 ft, becomes very stiff; mottled with brown.		5	2 4 9	13	80		28	95	UC = 1.14			LL=67 PI=45 PI
	15														
-6.00	16														
	17														
-8.00	18														
	19		At EL. -9.0 ft, becomes stiff.		6	2 7 9	16	90		26	97	UC = 0.87			
-10.00	20														
	21		SILTY SAND (SM); medium dense; gray; moist.												
-12.00	22														Began rotary wash
	23		SANDY lean CLAY (CL); soft; grayish brown; moist.												
-14.00	24														
	25														

(continued)

URS BORING RECORD 200802 28645040_MSNB4PETRIVER.GPJ SNJ_CT.GLB 2/2/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				R-09-013
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	Sonoma	101	0.9/2.9	04-28645045
PROJECT OR BRIDGE NAME				
U.S. 101/ SR 116 SOH				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		6-17-09	1 of 4

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	25		SANDY lean CLAY (CL) *(continued)*.		7	2 3 5	8	100		25	100	UC = 0.21			
-16.00	26		SILTY SAND (SM); loose; greenish gray; moist.							23	103				+#4=0 -#200=41% PA
-18.00	27 28														
	29		Lean CLAY with SAND (CL); medium stiff; bluish gray; moist to wet.		8	1 2 3	5	100							
-20.00	30														
-22.00	31 32														
	33														
-24.00	34		At EL. -24.0 ft, becomes stiff; moist.		9	3 4 7	11	60		25	101	UC = 0.61			
-26.00	35 36														
-28.00	37 38														
	39		SANDY lean CLAY (CL); stiff; very dark greenish gray; moist.		10	3 7 7	14	80		22	104	UC = 0.86			
-30.00	40														
-32.00	41 42														
	43														
-34.00	44		Fat CLAY (CH); stiff; dark bluish gray; moist.		11	4 5 6	11	90		31	91	UC = 0.69			
-36.00	45 46														
	47														
-38.00	48		SANDY lean CLAY (CL); stiff; very dark greenish gray; moist.												
	49				12	3 9 9	18	90							
-40.00	50		Lean CLAY (CL); stiff; very dark greenish gray; moist.							23	103	UC = 0.71			
-42.00	51 52														
	53		SANDY lean CLAY with GRAVEL (CL); greenish gray; moist; weathered rock.												
-44.00	54				13		35	25							
	55														

(continued)

URS BORING RECORD 200802 28645040_MSNB4PETRIVER.GPJ SNJ_CT.GLB 2/2/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE: **BORING RECORD**

HOLE ID: **R-09-013**

DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Sonoma**	**101**	**0.9/2.9**	**04-28645045**

PROJECT OR BRIDGE NAME: **U.S. 101/ SR 116 SOH**

BRIDGE NUMBER	PREPARED BY	DATE	SHEET
	L.Phillips	**6-17-09**	**2 of 4**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method / Casing Depth	Remarks
	55		SANDY lean CLAY with GRAVEL (CL) *(continued)*.			12 20 15								
-46.00	56													
	57													
-48.00	58													
	59		METAMORPHIC ROCK (SERPENTINITE), dark greenish gray, intensely weathered, Lean Clay (CL).		14	3 4 6	10	100						
-50.00	60													
	61													
-52.00	62													
	63													
-54.00	64				15	16 10 41	51	80						
	65													
-56.00	66		At EL. -55.5 ft, with trace of white talc.											
	67													
-58.00	68													
	69				16	26 50/1"	50/ 1"	60						
-60.00	70													Sampler advanced 7 in.
	71													Stop drilling 06/11/09 Resume drilling 06/12/09
-62.00	72													
	73													
-64.00	74													
	75				17	50 50/1"	50/ 1"	40						
-66.00	76													Sampler advanced 7 in.
	77													
-68.00	78													
	79													
-70.00	80													
	81													
-72.00	82													
	83													
-74.00	84													
	85													

(continued)

URS BORING RECORD 200802 28645040_MSNB4PETRIVER.GPJ SNJ_CT.GLB 2/2/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**R-09-013**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Sonoma**	**101**	**0.9/2.9**	**04-28645045**
PROJECT OR BRIDGE NAME				
U.S. 101/ SR 116 SOH				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		**6-17-09**	**3 of 4**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample Location	Sample Number	Blows per 6 in.	Blows per Foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (tsf)	Drilling Method	Casing Depth	Remarks
	85		METAMORPHIC ROCK (Serpentinite) *(continued)*.		18	42 77 87/4"	164/ 10"								
-76.00	86														Sampler advanced 16 in.
	87		Bottom of Borehole at 86.5 ft.												
-78.00	88														
	89														
-80.00	90														
	91														
-82.00	92														
	93														
-84.00	94														
	95														
-86.00	96														
	97														
-88.00	98														
	99														
-90.00	100														
	101														
-92.00	102														
	103														
-94.00	104														
	105														
-96.00	106														
	107														
-98.00	108														
	109														
-100.00	110														
	111														
-102.00	112														
	113														
-104.00	114														
	115														

URS BORING RECORD 200802 28645040_MSNB4PETRIVER.GPJ SNJ_CT.GLB 2/2/10

URS

San Jose Office

55 S. Market St, Ste 1500
San Jose, CA 95113

REPORT TITLE				HOLE ID
BORING RECORD				**R-09-013**
DIST.	COUNTY	ROUTE	POSTMILE	EA
04	**Sonoma**	**101**	**0.9/2.9**	**04-28645045**
PROJECT OR BRIDGE NAME				
U.S. 101/ SR 116 SOH				
BRIDGE NUMBER	PREPARED BY		DATE	SHEET
	L.Phillips		**6-17-09**	**4 of 4**

BORING 1

EQUIPMENT: Truck-Mounted Mobile B-53 with 6-Inch Hollow Stem Augers

DATE: 3/27/15

ELEVATION: 12-Feet*

*REFERENCE: Google Earth, 2015

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	
						0 – 0			Sandy CLAY with Gravel (CH) Medium to dark gray-brown, slightly moist, medium stiff, medium to high plasticity clay, ~30% fine sand, ~10-15% fine gravel. [Fill]
PI=44 LL=63		650 UC	10	23.7	96	– 1			
		125 UC	10	22.8	93	5			SAND with Clay (SP-SC) Medium brown, slightly moist, loose, fine sand, ~5-10% fines. [Fill]
						– 2			SILT with Clay and Sand (MH) Medium gray, moist to wet, soft, high to very high plasticity silt and clay, ~5-15% sand. [Bay Mud]
						3 ▽ 10			
		500 UC		31.9	93				
						– 4			CLAY with Sand (CH) Medium to dark gray, moist, medium stiff to stiff, high plasticity clay, ~10% sand. [Alluvium] Grades medium brown with black and light gray mottling at 15.5 feet.
						15			
		1850 UC	14	27.4	98	– 5			
						– 6 20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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FILE: 1130.112 BL.dwg

BORING LOG

Basin Street Properties
Marina Apartments
Petaluma, California

Project No. 1130.112 Date: 4/22/15

Drawn NGK
Checked

A-2
FIGURE

BORING 1 (CONTINUED)

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	
		2775 UC	16	25.9	100	20 / 7			CLAY with Sand (CH) Medium brown with black and light gray mottling, moist, medium stiff to stiff, high plasticity clay, ~10% sand. [Alluvium] Grades blue-gray at 21.0 feet.
	P200 37.7%	110 UC	10	24.1	102	25 / 8			Clayey SAND/SAND with Clay (SC/SP) Medium blue-gray, saturated, medium dense to dense, fine to coarse sand, ~30-40% low to medium plasticity clay. [Alluvium]
	P200 15.7%		31	11.3		9			Grades with ~15-20% low to medium plasticity clay.
	P200 8.2%		18	14.6		30 / 10			
	P200 21.5%		14	19.7		35 / 11			Grades with ~20-25% low to medium plasticity clay.
						12			CLAY with Sand (CH) Dark gray, moist, medium stiff, high plasticity clay, ~10% fine sand. [Alluvium]
	P200 92.5%		11	32.9	94	40			Bottom of boring at 41.5 feet. Groundwater observed at 10.0 feet immediately after drilling.

NOTES:
(1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
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BORING LOG

Basin Street Properties
Marina Apartments
Petaluma, California

Project No. 1130.112 Date: 4/22/15

Drawn NGK
Checked

A-3
FIGURE

BORING 2

EQUIPMENT: Truck-Mounted Mobile B-53 with 6-Inch Hollow Stem Augers

DATE: 3/27/15

ELEVATION: 12-Feet*

*REFERENCE: Google Earth, 2015

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	
						0 – 0			2-Inches Asphalt Concrete
									11-Inches Aggregate Baserock
PI=40 LL=64		675 UC	11	23.7	90	– 1			Sandy CLAY with Gravel (CH) Dark gray-brown, slightly moist, medium stiff, medium to high plasticity clay, ~40% fine sand, ~10% fine gravel. [Fill]
		625 UC	14	19.0	103	5			SAND with Clay (SP-SC) Medium blue-gray, moist, loose to medium dense, fine sand, ~10% fines. [Fill]
						– 2			SILT with Clay and Sand (MH) Medium gray, moist, soft, high plasticity silt and clay, ~10% sand. [Bay Mud]
						– 3 10 ▽			Grades with ~20% gravel up to 1" Ø.
						– 4			CLAY with Sand (CH) Medium brown, slightly moist, stiff, high plasticity clay, ~10-15% fine sand. [Alluvium]
		1425 UC	17	31.1	92	15 – 5			
						– 6 20			

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
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BORING LOG

Basin Street Properties
Marina Apartments
Petaluma, California

Project No. 1130.112 Date: 4/22/15

Drawn NGK
Checked

A-4
FIGURE

BORING 2 (CONTINUED)

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	meters / feet DEPTH	SAMPLE	SYMBOL (3)	
		900 UC	8	34.5	86	20 – 7			CLAY with Sand (CH) Medium brown, slightly moist, stiff, high plasticity clay, ~10-15% fine sand. [Alluvium]
	P200 42.8%		9	21.8		25 – 8			Clayey SAND (SC) Medium brown, moist, loose, fine sand, ~40-50% low plasticity clay. [Alluvium]
	P200 6.9%		26	11.7		30 – 9 – 10			SAND with Clay (SP) Medium brown with light gray, dark gray, red and orange mottling, saturated, medium dense, fine to coarse sand, ~5-10% clay, trace gravel. [Alluvium]
	P200 83.2%		5	33.2	90	35 – 11			Sandy CLAY (CH) Medium gray, moist, medium stiff, high plasticity clay, ~20-30% fine sand. [Alluvium]
						– 12 – 40			Bottom of boring at 36.5 feet. Groundwater observed at 10.5 feet immediately after drilling.

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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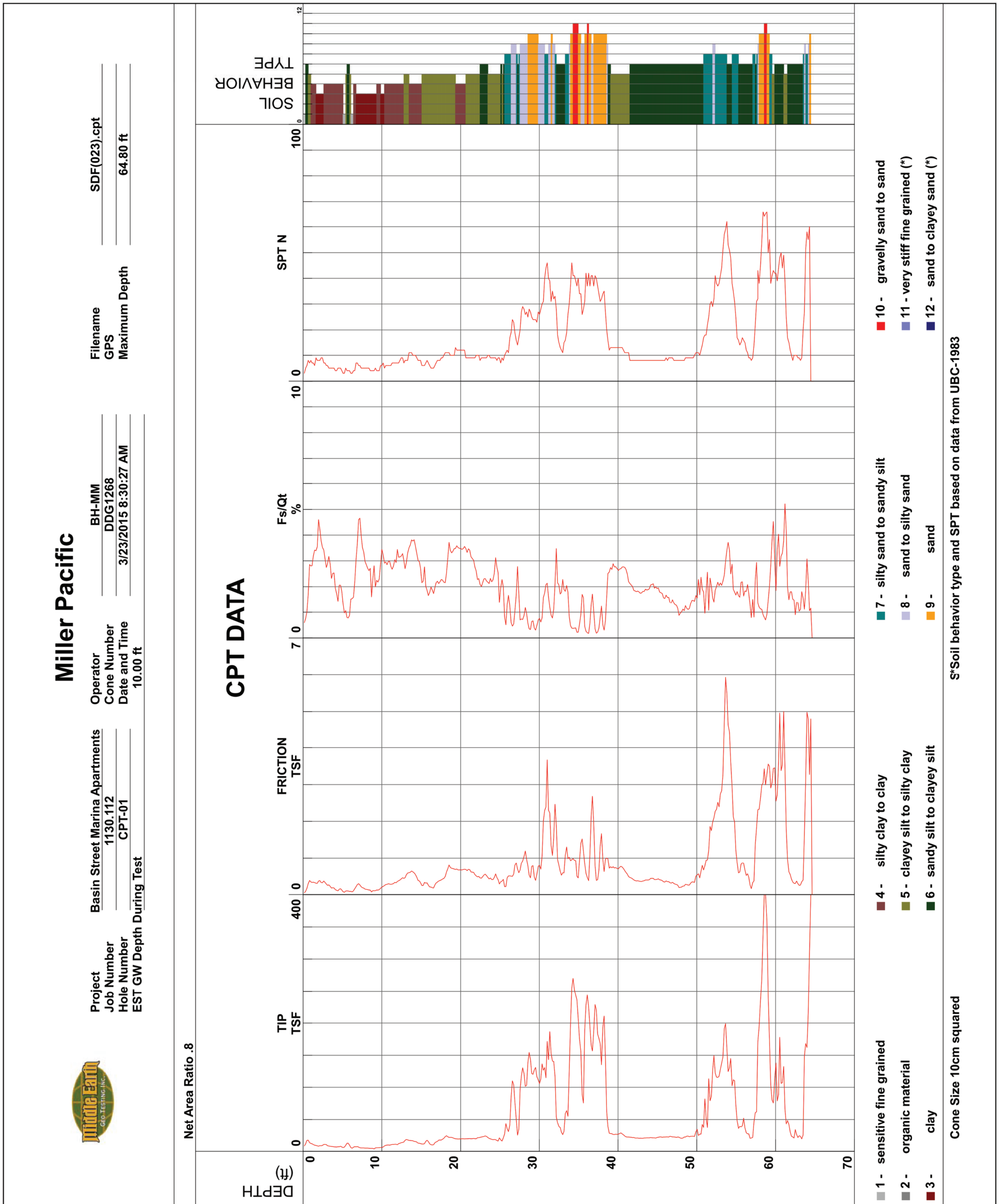
BORING LOG

Basin Street Properties
Marina Apartments
Petaluma, California

Project No. 1130.112 Date: 4/22/15

Drawn NGK
Checked

A-5
FIGURE



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FILE: 1130.112 CPTs.dwg

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CPT-1: PLOT & INTERPRETATION

Basin Street Properties
Marina Apartments
Petaluma, California

Project No. 1130.112 Date: 4/30/15

Drawn NGK
Checked

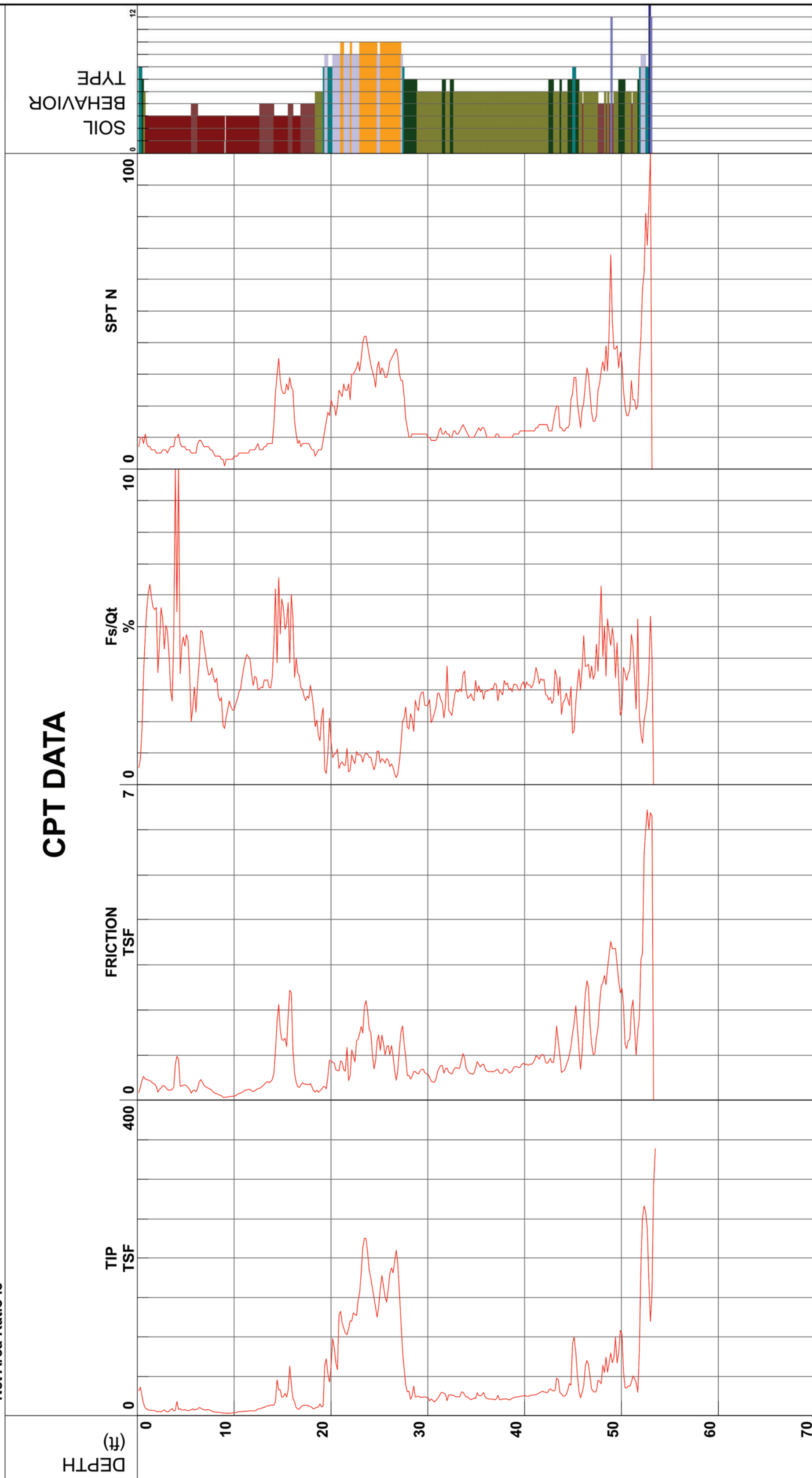
A-10
FIGURE

Miller Pacific

Project	Basin Street Marina Apartments	Operator	BH-MM	Filename	SDF(027).cpt
Job Number	1130.112	Cone Number	DDG1298	GPS	
Hole Number	CPT-04	Date and Time	3/23/2015 11:39:29 AM	Maximum Depth	53.48 ft
EST GW Depth During Test		10.00 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 10cm squared

S*Soil behavior type and SPT based on data from UBC-1983

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FILE: 1130.112 CPTs.dwg

CPT-4: PLOT & INTERPRETATION

Basin Street Properties
Marina Apartments
Petaluma, California

Project No. 1130.112 Date: 4/30/15

Drawn NGK
Checked

A-13
FIGURE

EBA Engineering
825 Sonoma Avenue
Santa Rosa, CA 95404
Telephone: 707-544-0784
Fax: 707-544-0866

WELL NUMBER MW-11

CLIENT Skoff Trucking
PROJECT NAME Skoff Trucking
PROJECT NUMBER 99-723
PROJECT LOCATION 1 Casa Grande Road, Petaluma, California
DATE STARTED 8/8/06 **COMPLETED** 8/8/06
GROUND ELEVATION 7.85 ft **HOLE SIZE** 8"
DRILLING CONTRACTOR Clear Heart Drilling
GROUND WATER LEVELS:
DRILLING METHOD Rotary Auger Drilling
▽ **AT TIME OF DRILLING** 13.0 ft / Elev -5.2 ft
LOGGED BY Ben Melosh **CHECKED BY** Paul Nelson
▼ **AT END OF DRILLING** 11.0 ft / Elev -3.2 ft
NOTES Sunny and warm
▼ **168hrs AFTER DRILLING** 2.1 ft / Elev 5.8 ft

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	TESTS	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)	WELL DIAGRAM
0							CLAY; black (Gley 1 2.5/N), slighly moist, <10% fine sand, low plasticity, low estimated k		Well box
5					CL				Grout slurry Schedule 40 Blank PVC Bentonite
							8.0 -0.2		
	SS	67	5-8-9 (17)	Lab Sample (13:52)			SANDY CLAY; greenish grey (Gley 1 5/10YG), 20% mottled (2.5Y 5/3), slightly moist, 15% fine grain sand, 85% low plasticity fines, low estimated k, HC odor	1382	
10					CL				# 2/12 Sand Schedule 40 Screen PVC (0.01-inch slotted)
							13.0 ▽ -5.2		
	SS	83	6-4-6 (10)		SW-SC		CLAYEY SAND; light olive brown (2.5Y 5/3), saturated, 85% well graded sand, 15% fines, high estimated k	0.0	
15							16.0 -8.2		
							Bottom of hole at 16.0 feet.		

BORING NUMBER BLDG-2

AEI Consultants

Environmental & Engineering Services

CLIENT DeNova Homes
PROJECT NAME Lakeville Petaluma PHII
PROJECT NUMBER 327703
PROJECT LOCATION 2592 Lakeville Highway, Petaluma, California
DATE STARTED 6/19/14 **COMPLETED** 6/19/14
GROUND ELEVATION _____ **HOLE SIZE** 2.25 inches
DRILLING CONTRACTOR Environmental Control Associates, Inc.
GROUND WATER LEVELS:
DRILLING METHOD Direct Push
▽ **AT TIME OF DRILLING** 13.00 ft
LOGGED BY Diego Gonzalez **CHECKED BY** David Provance
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS	PID DATA (ppm)	GRAPHIC LOG	MATERIAL DESCRIPTION	COMPLETION
0					(Stockpile) Sandy Gravelly Silt, dark brown (3/3 10YR), loose, dry, debris (brick, glass, asphalt). Note: gravel and cobble size pieces as depth increases up to 12 feet bgs	
	SP-11-2.5'		0			
5	SP-11-5.5'		0			
	SP-11-8.5'		0			
10	SP-11-11.5'		0		12.0 ▽ (ML) Clayey Silt, black (2/1 10YR), soft, moist, low plasticity, trace organics	
15	BLDG-2-15.5		0		15.0 (SW-SM) Silty Sand with clay, gray (5/1 10YR), soft/loose, wet, medium to coarse sand, well graded 16.0 (CH) Sandy Clay, olive brown (4/3 2.5Y), hard, high plasticity, very fine sand	
20	BLDG-2-19.5		0			
	BLDG-2-23.5		0		24.0	

Bottom of borehole at 24.0 feet.

BORING 1

EQUIPMENT: Track-mounted Hydraulic Drill Rig with 6-inch Hollow Stem Auger
DATE: 03/14/19
ELEVATION: 17 feet*
*REFERENCE: DGA, Existing Utility and Topographic Survey, dated 1/31/19

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0			SILT with Sand (MH) dark brown to black, moist, medium stiff, high plasticity, occasional brick fragment						
	1				11	83	34.6			
	5			Sandy CLAY (CH) brown to black, moist, stiff, medium to high plasticity						
	2				13	96	26.7	1500 UC		
3	10			Clayey SILT with Sand (ML) tan, moist, very stiff, low to medium plasticity						
					37	90	31.8	2575 UC		
4										
	15									
5					25	94	28.4			
6	20			SAND with Clay and Gravel (SW-SC)						

▽ Water level encountered during drilling
▼ Water level measured after drilling

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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FILENAME: 595.138 BL.dwg

BORING LOG

BioMarin Development
Lakeville Business Park
Petaluma, California

Project No. 595.138 Date: 4/1/2019

Drawn EIC
Checked

A-2
FIGURE

BORING 1 (CONTINUED)

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			SAND with Clay and Gravel (SW-SC) tan, wet, medium dense to dense, fine- to coarse-grained	47	121	14.5			
				CLAY with Sand (CH) brown, moist, medium stiff, medium to high plasticity	7					
7	25				10	86	34.3	825 UC		
8										
9	30			grades stiff	25	101	23.4	2000 UC		
10										
	35									
11										
12	40									

Water level encountered during drilling

Water level measured after drilling

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
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FILENAME: 595.138 BL.dwg

BORING LOG

BioMarin Development
Lakeville Business Park
Petaluma, California

Project No. 595.138 Date: 4/1/2019

Drawn EIC
Checked

A-3
FIGURE

BORING 1 (CONTINUED)

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
12	40			CLAY with Sand (CH) brown, moist, stiff, medium to high plasticity	22	96	26.8			
13										
14	45			SAND with Clay (SC) brown, wet, medium dense, fine- to coarse-grained	36	100	24.7			
15	50			Bottom of boring at 48 feet Groundwater measured at 7 feet upon completion	21					
16										
17	55									
18	60									

▽ Water level encountered during drilling

▼ Water level measured after drilling

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
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FILENAME: 595.138 BL.dwg

BORING LOG

BioMarin Development
Lakeville Business Park
Petaluma, California

Project No. 595.138 Date: 4/1/2019

Drawn EIC
Checked

A-4
FIGURE

BORING 2

EQUIPMENT: Track-mounted Hydraulic Drill Rig with 4-inch Solid Flight Auger
DATE: 03/15/19
ELEVATION: 15 feet*
*REFERENCE: DGA, Existing Utility and Topographic Survey, dated 1/31/19

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
0	0			SILT with Sand (MH) dark brown to brown-gray, moist, medium stiff, high plasticity,contains very fine brick fragments	8	76	40.6		PL:40 LL:74 PI:34	EI:139
1	5			grades stiff, no brick fragments	16	91	28.3	1950 UC		
2										
3	10			Sandy CLAY (CL) brown-gray, moist, very stiff, low plasticity	33	98	24.8	3675 UC		
4										
5	15			Silty CLAY (CH) tan, moist, very stiff, medium to high plasticity	28	89	33.6			
6	20									

▽ Water level encountered during drilling
▼ Water level measured after drilling

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
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FILENAME: 595.138 BL.dwg

BORING LOG

BioMarin Development
Lakeville Business Park
Petaluma, California

Project No. 595.138 Date: 4/1/2019

Drawn EIC
Checked

A-5
FIGURE

BORING 2 (CONTINUED)

DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (4)		BLOWS / FOOT (1)	DRY UNIT WEIGHT pcf (2)	MOISTURE CONTENT (%)	SHEAR STRENGTH psf (3)	OTHER TEST DATA	OTHER TEST DATA
	20			Silty CLAY (CH) tan, moist, very stiff, medium to high plasticity						
				SAND with Clay and Gravel (SC) tan, wet, dense, fine- to coarse-grained	91	117	15.9			
	7			Silty CLAY (CL) light tan, moist, very stiff, medium to high plasticity	38					
	25									
	8									
				Clayey SAND (SC) tan, wet, dense, medium- to coarse-grained						
	9				56		18.6		P200 21.6	
	30			Clay (CH) brown, moist, very stiff, medium to high plasticity, trace very fine-grained sand						
	10									
	35									
	11									
					37	89	33.2			
	12									
	40			Bottom of boring at 39.5 feet. Groundwater measured at 6.5 feet upon completion						

▽ Water level encountered during drilling

▼ Water level measured after drilling

NOTES: (1) UNCORRECTED FIELD BLOW COUNTS
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(4) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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FILENAME: 595.138 BL.dwg

BORING LOG

BioMarin Development
Lakeville Business Park
Petaluma, California

Project No. 595.138 Date: 4/1/2019

Drawn EIC
Checked

A-6
FIGURE

MILLER PACIFIC ENGINEERING GROUP
A CALIFORNIA CORPORATION

FILENAME: 595.138 CPT.dwg

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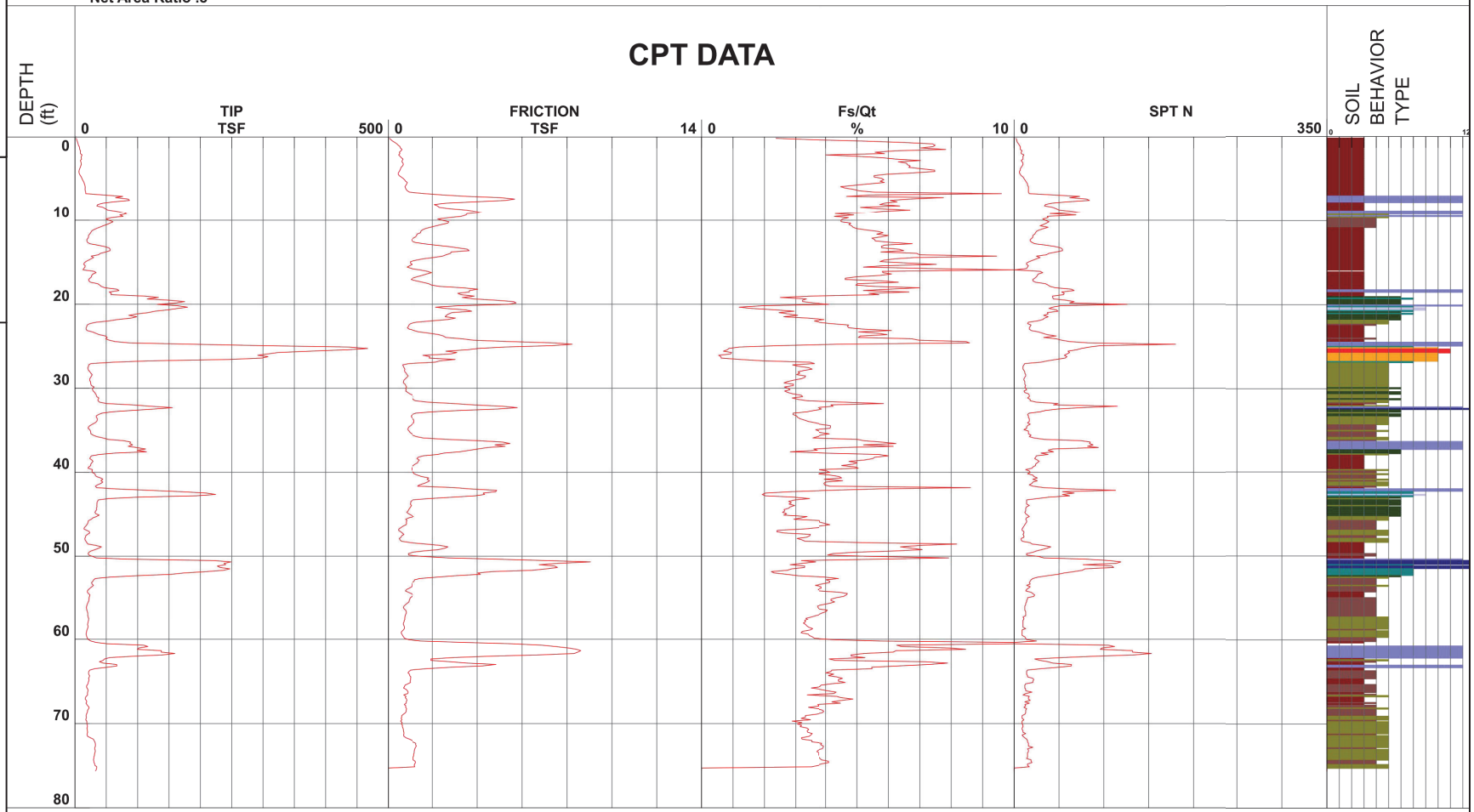
Miller Pacific Engineering

Middle Earth GEO TESTING INC.

Project	BioMarin Lakeville Business Park	Operator	BH-JM	Filename	SDF(166).cpt
Job Number	595.138	Cone Number	DDG1448	GPS	
Hole Number	CPT-01	Date and Time	3/12/2019 2:19:12 PM	Maximum Depth	75.62 ft
EST GW Depth During Test		5.80 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained
2 - organic material
3 - clay
4 - silty clay to clay
5 - clayey silt to silty clay
6 - sandy silt to clayey silt
7 - silty sand to sandy silt
8 - sand to silty sand
9 - sand
10 - gravelly sand to sand
11 - very stiff fine grained (*)
12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

BioMarin Development
Lakeville Business Park
Petaluma, California

Project No. 595.138
Date: 4/9/2019

Drawn RCA
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CPT-01 LOG

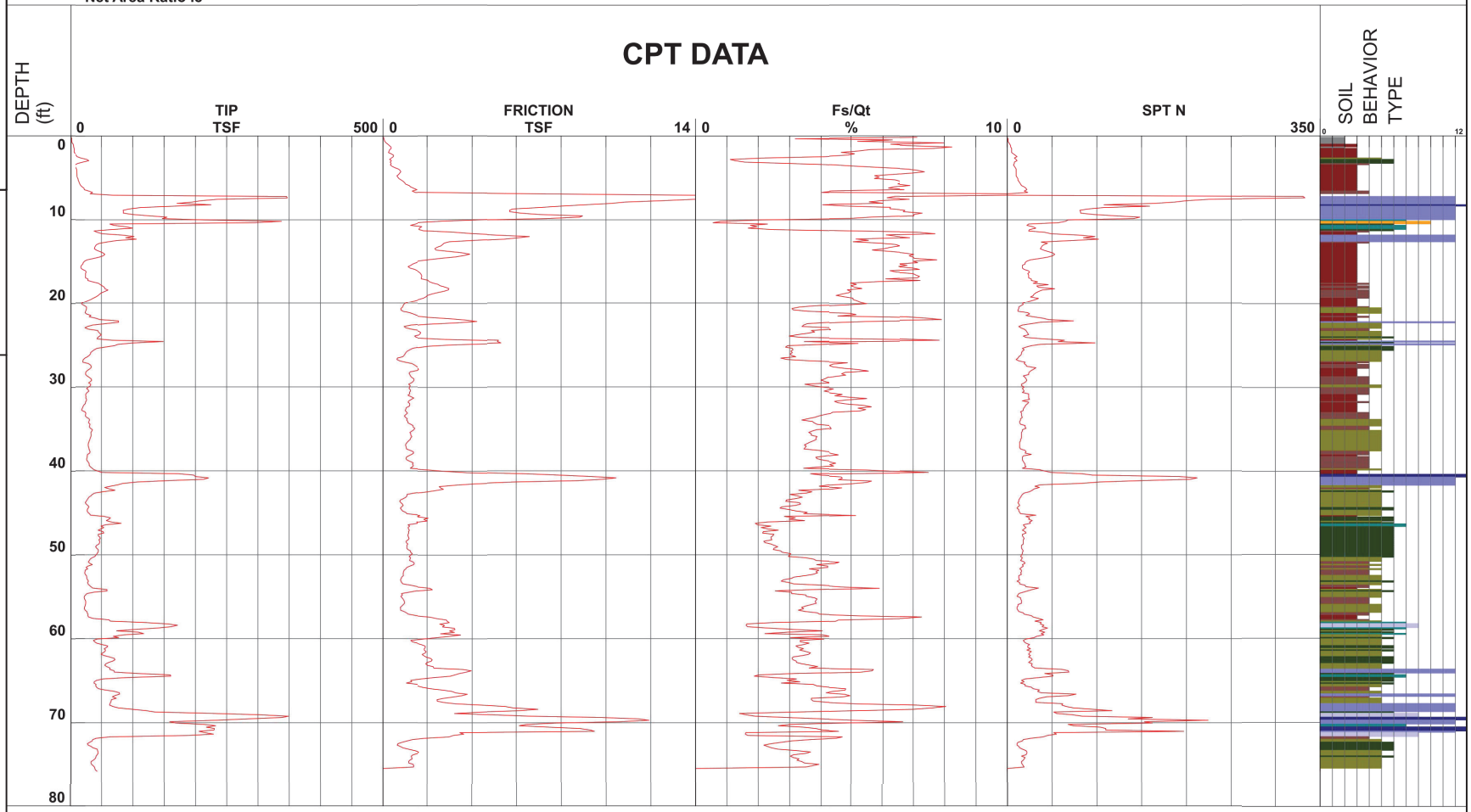
FIGURE B-2

Miller Pacific Engineering

Project	BioMarin Lakeville Business Park	Operator	BH-JM	Filename	SDF(164).cpt
Job Number	595.138	Cone Number	DDG1448	GPS	
Hole Number	CPT-02	Date and Time	3/12/2019 11:29:53 AM	Maximum Depth	75.79 ft
EST GW Depth During Test		4.90 ft			

Net Area Ratio .8

CPT DATA



1 - sensitive fine grained	4 - silty clay to clay	7 - silty sand to sandy silt	10 - gravelly sand to sand
2 - organic material	5 - clayey silt to silty clay	8 - sand to silty sand	11 - very stiff fine grained (*)
3 - clay	6 - sandy silt to clayey silt	9 - sand	12 - sand to clayey sand (*)

Cone Size 15cm squared

S*Soil behavior type and SPT based on data from UBC-1983

CPT-02 LOG

BioMarin Development
Lakeville Business Park
Petaluma, California

Project No. 595.138

Date: 4/9/2019

Drawn RCA
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B-3
FIGURE

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FILENAME: 595.138 CPT.dwg

BORING 1

EQUIPMENT: Portable Hydraulic Drill Rig
4-Inch Solid Flight Augers

DATE: 1/22/09

ELEVATION: 000-Feet*

*REFERENCE: Topo Map used for Elevation

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT*	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters	DEPTH feet	SAMPLE	SYMBOL (3)	
						0	0			CLAYEY SILT (MH) dark brown, moist to saturated, medium stiff, high plasticity, roots present (lime-treated)
EI			18							
		1450 UC		38.1	81					
			13							SILTY CLAY (CH) dark brown, moist to saturated, medium stiff to stiff, high plasticity
EI						1				
			14							
		1300 UC		39.4	81		5			
			16							
						2				
						3	10			SANDY CLAY (CL) olive-green, moist to saturated, very stiff, low plasticity
	78.1% P200	2000 UC	25	35.9	85					
						4				CLAYEY SAND (SC) tan-olive green, saturated, very loose, fine-grained sand, contains lenses of coarse rounded sand
	38.1% P200			38.0	83		15			
			3			5				
						6	20			GRAVELLY SAND (SW) tan-brown, saturated, loose, ~60% fine to coarse-grained sand, ~40% coarse to fine-grained rounded gravel

* 0.65x conversion for Modified California to SPT sampler

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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FILE: 1320.02BL.dwg

BORING LOG

3925 Cypress Drive
Petaluma, California

Project No. 1320.02 Date: 3/19/09

Designed N/A
Drawn NRS
Checked

A-2
FIGURE

BORING 1 (CONTINUED)

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT*	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	DEPTH meters / feet	SAMPLE	SYMBOL (3)	
	5.9% P200		9	13.7		20 / 7			GRAVELLY SAND (SW) tan-brown, saturated, loose, ~60% fine to coarse-grained sand, ~40% coarse to fine-grained rounded gravel
	67.1% P200		17	28.1		25 / 8			SANDY CLAY (CL) tan-olive green, saturated, very stiff, low plasticity
	28.6% P200		65	15.9		30 / 9			CLAYEY SAND (SC) tan, saturated, very dense, medium-grained sand
						35 / 10			Bottom of boring at 31.5 feet Groundwater measured at 8.0 feet 24 hours after drilling
						40 / 11			
						12			

* 0.65x conversion for Modified California to SPT sampler

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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FILE: 1320.02BL.dwg

BORING LOG

3925 Cypress Drive
Petaluma, California

Project No. 1320.02 Date: 3/19/09

Designed N/A
Drawn NRS
Checked

A-3
FIGURE

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