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PTP Recycled Water Connection Laguna Road Pipeline Project Preliminary Design Report (Final Draft)

25 January 2023

Prepared for

United Water Conservation District
1701 North Lombard Street, Suite 200
Oxnard, CA 93030

KJ Project No. 2244204*00

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Section 1: Introduction

The United Water Conservation District (District) is preparing and planning for potential pipeline connections to the Pumping Trough Pipeline (PTP) System for the delivery of recycled water. The potential recycled water sources include the following:

1. **The City of Oxnard's Advanced Water Purification Facility (AWPF),** which can currently produce up to 7,000 acre-feet per year (AFY) of advanced treated recycled water and may produce more in the future.
2. **Camrosa Water District's (Camrosa) Conejo Creek Diversion**, with a permitted surface water diversion capacity of up to 15,683 AFY, which is mostly comprised of City of Thousand Oaks Hill Canyon Wastewater Treatment Plant (HCTP) disinfected tertiary recycled water during dry weather periods.
3. **Camrosa' s Water Reclamation Facility (WRF),** which produces approximately 1,450 AFY of disinfected tertiary recycled water, and
4. **Camarillo's Water Reclamation Facility (WRF),** which produces approximately 4,450 AFY of disinfected tertiary recycled water.

The proposed Laguna Road Pipeline will support the District's mission of reducing groundwater pumping in the PTP service area and the Oxnard Plain by delivering recycled water. The PTP system includes five (5) Lower Aquifer System (LAS) wells that are operated to supply non-potable irrigation water during periods of drought when there is insufficient surface water supply from the Santa Clara River or to maintain pipeline pressure during periods of high demand. Recycled water will reduce the need to operate LAS wells.

In August 2016, the District entered into the "Full Advanced Treatment Recycled Water Management and Use agreement ("Agreement" with the City of Oxnard for the delivery of recycled water from the City's AWPF to the PTP system. The Agreement includes a provision that the City of Oxnard will design, permit, construct, and finance one Point of Delivery (POD) to the PTP system. Initially, the proposed POD was to extend to the PTP system along Nauman Road. In the late summer and fall of 2020, the District engaged in a series of meetings and workshops with the Fox Canyon Groundwater Management Agency (FCGMA) and Oxnard Pleasant Valley Core Stakeholder Group (OPV Group). The potential use of recycled water from the Camrosa WRF and Camarillo WRF was considered and an alternate point of connection (POC) between the PVCWD and PTP system along Laguna Road was discussed between the District, PVCWD, Camrosa Water District, and City of Camarillo.

The PTP system and Pleasant Valley County Water District (PVCWD or PV) system are located within approximately 3,500 feet of each other along Laguna Road, as shown by the red box in Figure 1-1. Constructing a pipe along Laguna Road to connect the PTP system (blue) to the PV system (green) would enable water supplies from the Oxnard AWPF, via the Hueneme Rd Pipeline (purple), as well as supplies from Camrosa Water District's Conejo Creek Diversion and Camrosa and Camarillo's Water Reclamation Facility (WRF), to be conveyed to the PTP system, via the PV system. PV is also in the process of designing a pipeline along Laguna Rd. (yellow).

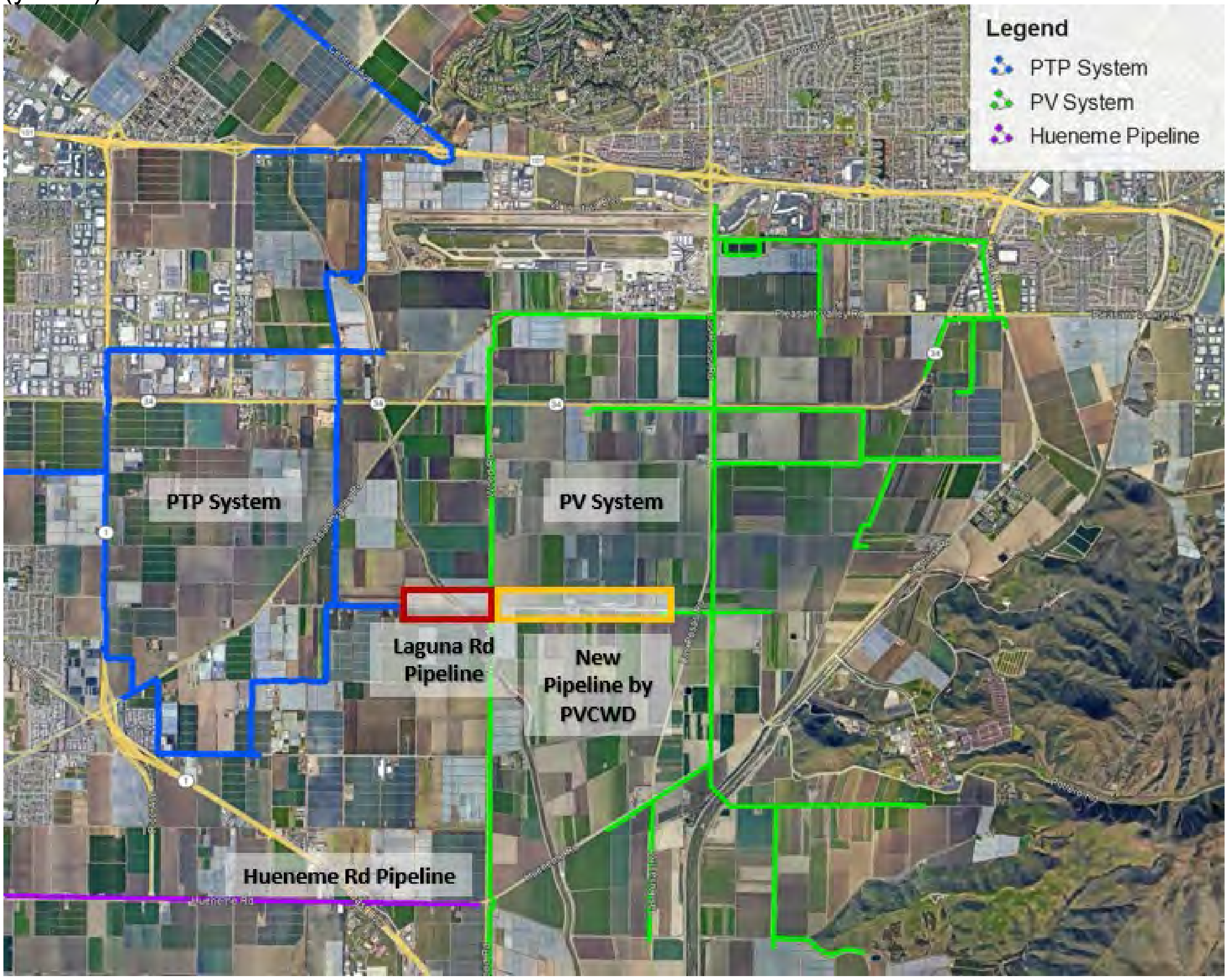


Figure 1-1: Location of Proposed Laguna Rd Pipeline

This preliminary design report for the construction of the pipeline along Laguna Rd to connect the PV and PTP systems provides the following:

- Water Quality Analysis
- Hydraulic Analysis of the PV – PTP system connection
- Flow Control
- Pipeline Design including materials, alignment, and Revolon Slough crossing
- Permitting and grant requirements
- Cost Estimate
- Project Options Evaluation
- Recommendations

Section 2: Water Quality

As part of this Preliminary Design Report, a water quality analysis was conducted to summarize the water quality for the existing PTP and PV systems' supplies that would potentially enter the PTP system via the Laguna Rd pipeline. An assessment of agriculture-based water quality objectives and monitoring requirements was also analyzed. This desktop water quality analysis provides an initial assessment of the water quality constraints and considerations for the project.

2.1 Agricultural Water Quality Objectives

The PTP system is used for irrigation of agricultural crops and does not need to adhere to drinking water standards and regulations. The water quality objectives for the PTP system are based on agricultural goals for the crops grown in the region by the District's customers. Row crops, strawberries, avocados, and lemons are crops commonly grown in the area, as shown by Figure 2-1.

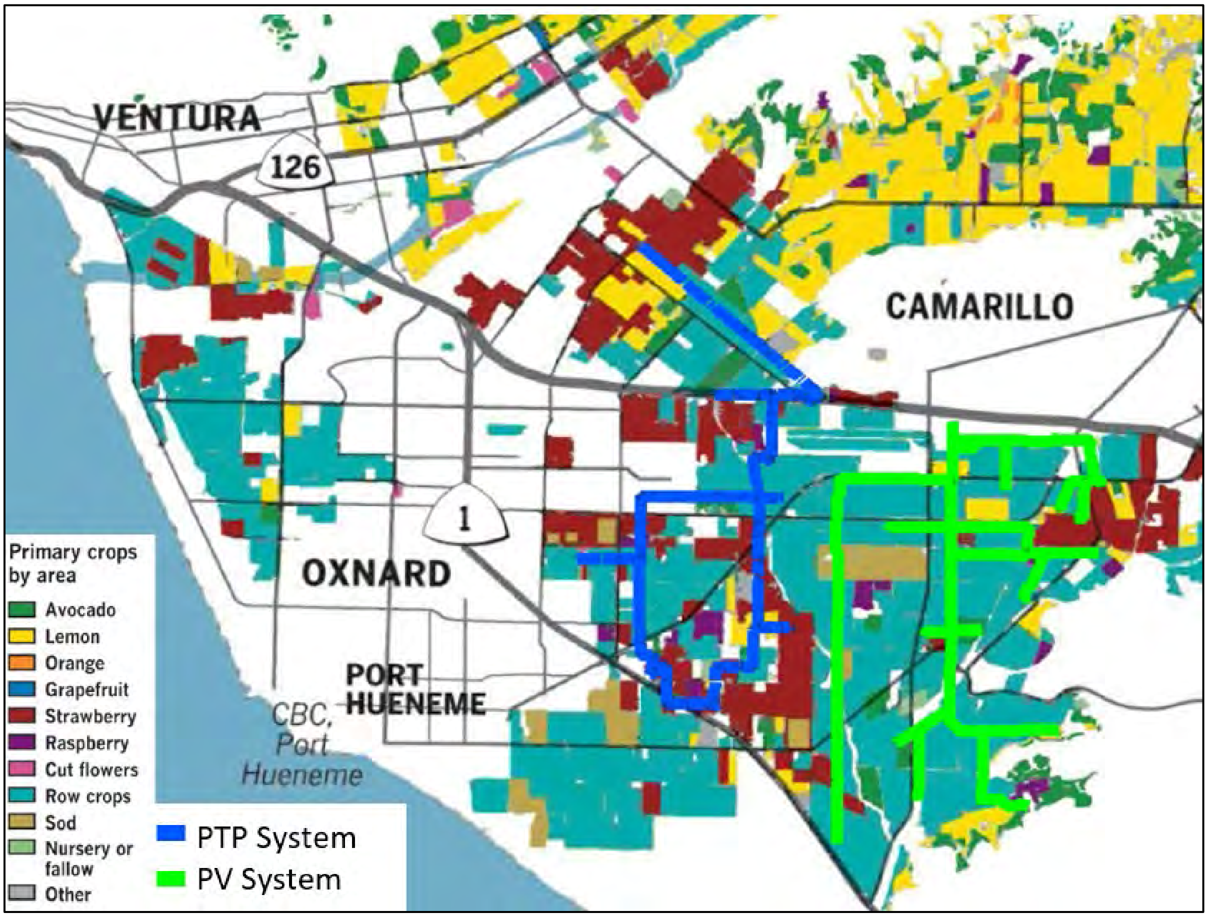


Figure 2-1: Primary Crops in PTP and PV Systems (Adapted from Farm Bureau of Ventura County, 2020)

Salinity is an important measurement of water quality for plants and can be represented by several parameters such as total dissolved solids (TDS) or electrical conductivity (ECw). TDS and ECw are lumped parameters influenced by ions in water. Specific ions such as chloride, sodium, and boron are also potentially harmful to plants at high concentrations. Water with elevated concentrations of chloride (>100 mg/L), sodium (>70 mg/L), and boron (>0.5 mg/L) can damage or injure sensitive plants. TDS and chloride were identified by the District as the primary constituents of concern for agricultural customers in the region.

A guide produced by The Water Reuse Foundation "Designing and Managing Landscapes Irrigated with Recycled Water" has identified four categories of water quality for irrigation, with Category 1 representing 'good water quality with no restrictions, and Category 4 representing poor water quality only for plants tolerant of salt and boron. The four categories and their corresponding water quality constituent parameters are shown in Table 2-1.

Table 2-1: Water Quality Constituent Parameters by Category (Adapted from Water Reuse, 2021)

Constituent	**Units**	**Category 1** Good water quality with no restrictions for use	**Category 2** Moderate water quality that is appropriate for nearly all landscapes	**Category 3** Fair water quality for plants with some salt tolerance	**Category 4** Poor water quality only for plants tolerant of salt and boron
TDS	mg/L	<640 (1)	640 – 830	830 – 1,600	>1,600
Chloride	mg/L	<100	100 – 200	200 – 350	>350
Boron	mg/L	<0.5	0.5 - 1.0	1.0 – 2.0	>2.0
EC_w	dS/m	< 1.0	1.0 – 1.3	1.3 – 2.5	>2.5
Sodium	mg/L	<70	70 – 150	150 – 200	>200
Sodium adsorption ratio (SAR)	-	<3	3 – 6	6 – 9	>9
Bicarbonate	mg/L	< 90	90 – 200	200 – 500	>500
Residual Chlorine	mg/L	< 1.0	1 – 2.5	2.5 – 5.0	>5.0

Note:

(1) Based on the finding that strawberries, a common crop in this region, can be sensitive to TDS >500 mg/L, 500 mg/L was used for the subsequent analysis.

While TDS less than 640 was designated as Category 1, strawberries are sensitive to TDS and a TDS goal of 500 mg/L was identified. Thus, the water quality goals listed in category 1 with a modified TDS of less than 500 was used to compare the water quality of existing and potential future supplies.

2.2 Existing PTP System Source Water Quality

The existing water quality for the District's PTP water supplies were analyzed and summarized in Table 2-2 below based on available published water quality data from the Engineering Report for Recycled Water Distribution and Use in the Pumping Trough Pipeline System Draft (March 2017). These sources included surface water, the Saticoy Wells, and PTP groundwater wells.

Table 2-2: PTP Existing Sources Water Quality for TDS & Chloride

	TDS (mg/L)			Chloride (mg/L)		
Water Source	**Minimum**	**Maximum**	**Average**	**Minimum**	**Maximum**	**Average**
Surface Water	699	1480	1134	22	102	61
Saticoy Wells	713	2040	1082	27	120	60
PTP Wells	645	1020	879	36	69	45

In addition to the TDS and chloride data, boron data was also available. These showed a range of boron measurements from 0.2 mg/L to 1.0 mg/L. The boron measurements are summarized in Table 2-3.

Table 2-3: PTP Existing Sources Water Quality for Boron

	Boron (mg/L)		
Water Source	**Minimum**	**Maximum**	**Average**
Surface Water	0.3	1	0.7
Saticoy Wells	0.5	0.9	0.6
PTP Wells	0.2	0.6	0.4

The average water quality in the PTP system was classified into categories (Table 2-1) and summarized in Table 2-4. All the District's water sources were classified as Category 3 based on TDS and Category 1 based on chloride. The boron was classified as Category 2 for both Surface Water and Saticoy Wells and Category 1 for the PTP wells.

Table 2-4: Water Quality Category for Existing Water Sources in the PTP System (Average)

Water Source	Category Based on TDS	Category Based on Chloride	Category Based on Boron
Surface Water	Category 3	Category 1	Category 2
Saticoy Wells	Category 3	Category 1	Category 2
PTP Wells	Category 3	Category 1	Category 1

2.3 Potential Future PTP System Source Water Quality

The District is also working on the design of the Extraction Barrier and Brackish Water (EBB) Treatment Project which is a potential future water source that could enter the PTP system. The EBB plant is anticipated to produce between 4,500-6,400 AFY of anticipated RO product water. Table 2-5 summarizes the projected water quality data from the Extended Desktop Modeling Evaluation (Trussell Tech, December 2011). A range of projected water qualities are provided as the water quality may be impacted by the type of post stabilization treatment that is chosen to treat the RO permeate as well as the duration of the pumping impacting the ratio of freshwater and seawater pumped.

Table 2-5: Projected Water Quality for EBB Project

Constituent	EBB-Water (1)
Annual Production (AFY)	4,500 -6,374
TDS (mg/L)	111-202
Chloride (mg/L)	38 - 47.5
Boron (mg/L)	0.3
SAR	1.05- 1.60

Note:
(1) Values are projected

The water quality from the EBB water is anticipated to be highly purified water with water quality constituents falling in Category 1. This EBB water is a potential alternative that could be used to blend and improve the quality of the PTP supply sources.

2.4 PV System Source Water Quality

The PV system currently receives water from Camrosa Conejo Creek Diversion, Camarillo’s WRF, and Camrosa’s WRF. Additionally, the PV system receives surface water from the District when it is available. The PV system uses groundwater wells to supplement water supplies. The existing available water quality data for the PV system is summarized in Table 2-6. This includes the projected water quality for the City of Oxnard’s AWPF which is anticipated to soon be delivered to the PV system via the Hueneme pipeline.

Averaged water quality data for existing or planned water sources are classified into categories (Table 2-1) and summarized in Table 2-7. PV’s water sources are a combination of water quality categories, and the overall water quality of the PV system is dependent on the ratio of the different available water supplies.

Table 2-6: PV System Existing Water Quality

Water Source	TDS (mg/L)			Chloride (mg/L)			Boron (mg/L)
	Min.	Max.	Avg.	Min.	Max.	Avg.	Avg.
City of Oxnard's AWPF		230 (1)			70.3 (1)		0.5
Camrosa Conejo Creek Diversion	580	1078	775.8	115	219	163.5	0.5
Camrosa's & Camarillo's Combined WRF	880	1227	1073.5	203	300	226.1	N/A
PV Groundwater(2)	700	984	807.1	50	144	87.1	0.39

Note:
(1) Values are projected
(2) Groundwater was based on available Well No. 7 water as this is in closest proximity to the connection point.

Table 2-7: Water Quality Category for Existing Water Sources in the PV System (Average)

Water Source	Category Based on TDS	Category Based on Chloride	Category Based on Boron
City of Oxnard's AWPF	Category 1	Category 1	Category 1
Camrosa Conejo Creek Diversion	Category 2	Category 2	Category 1
Camrosa's & Camarillo's Combined WRF	Category 3	Category 3	Unknown
PV Groundwater	Category 2	Category 1	Category 1
UWCD Surface Water	Category 2	Category 1	Category 2

2.4.1 Potential Water Qualities Under Various Source Water Proportions

It is desired that the water quality improves once the connection to the PTP system is made. Based on TDS, the current water quality is Category 3. The percentage of water for each source was evaluated to achieve a Category 1 or Category 2 level water quality for TDS when introducing the PV water (Oxnard AWPF, Camrosa Conejo Creek, and Camrosa/Camarillo WRF), as well as the potential future EBB water into the PTP system. Range and average TDS by source is shown in Figure 2-2.

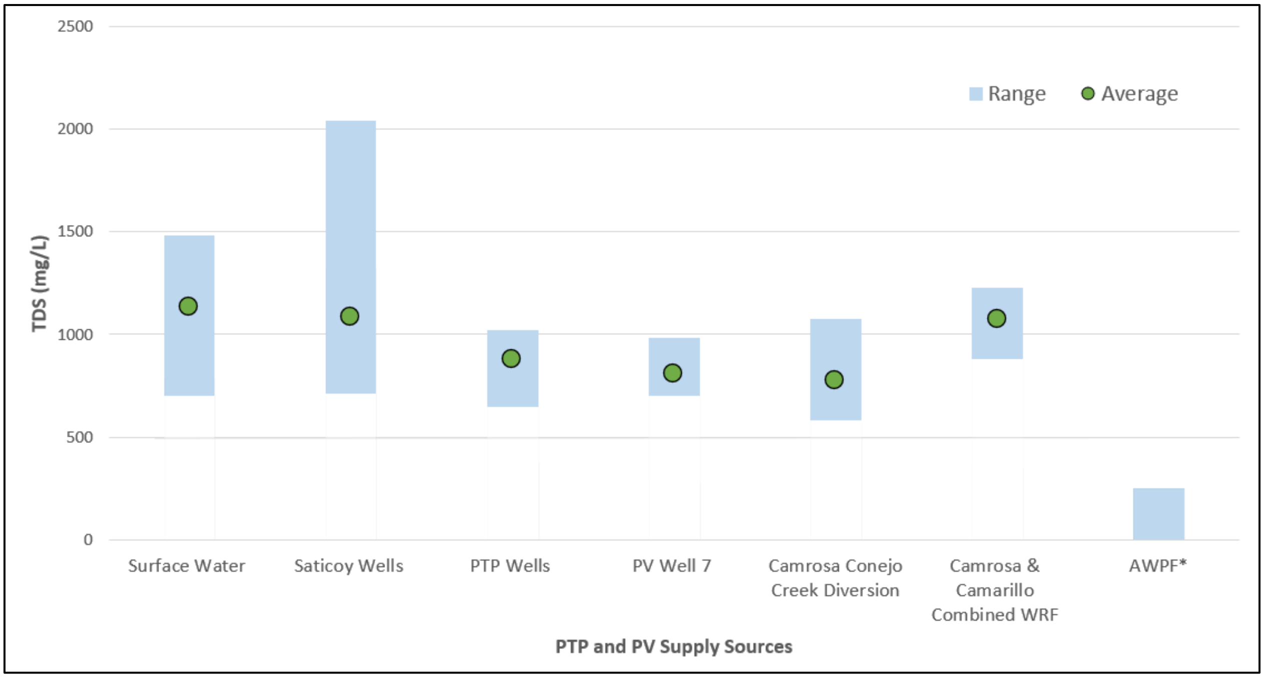


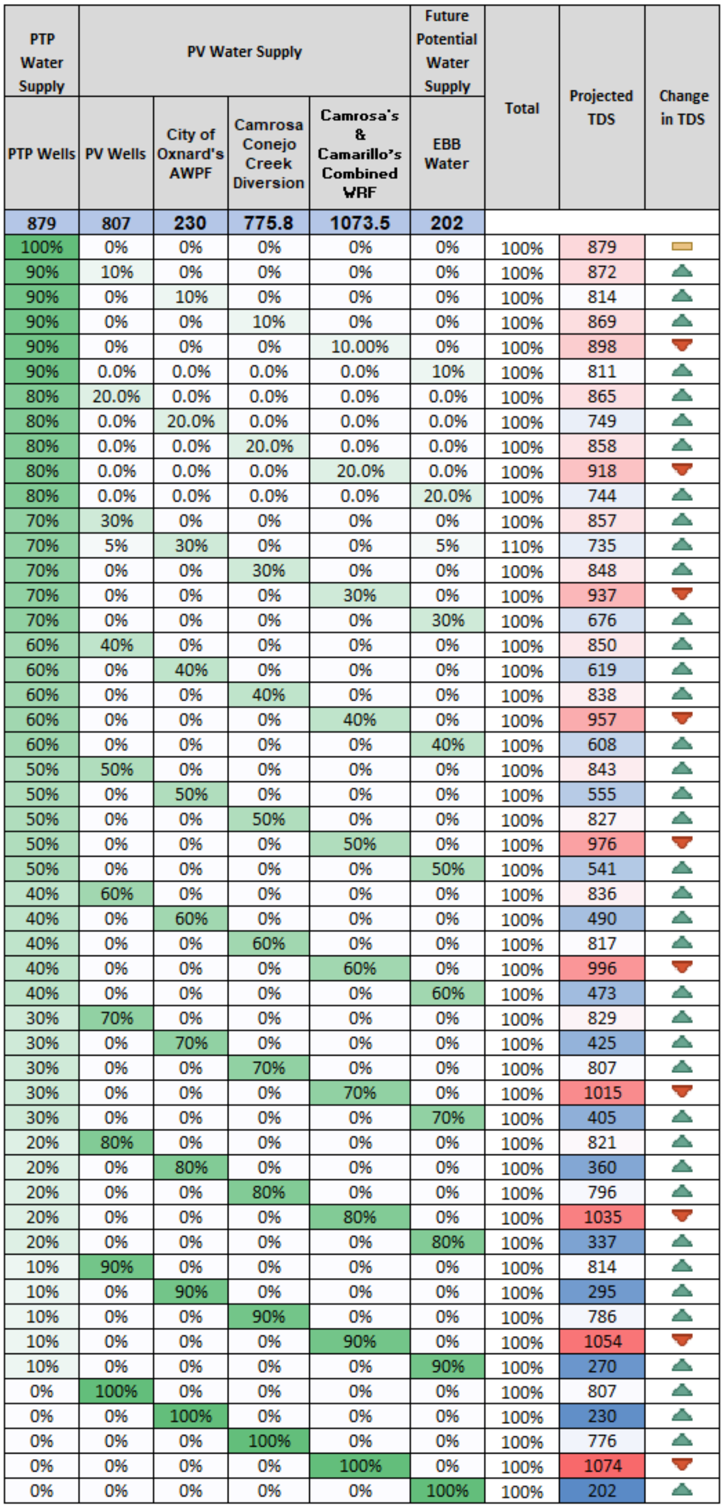
Figure 2-2: Range and Average TDS Water Quality by Source

Since the water qualities will be a mix of water qualities existing in both the PV and PTP systems, additional evaluation of different potential scenario combinations of TDS water qualities were evaluated based on the average TDS. This was a statistical analysis and did not include chemical transport modeling. Transport modeling would be required to better understand the different water quality throughout the distribution system. Table 2-8 and Table 2-9 demonstrate the change in TDS when the PTP system is either surface water (Table 2-8) or groundwater (Table 2-9) with one additional new supply type including PV groundwater wells, City of Oxnard's AWPF, Camrosa Conejo Creek Diversion, Camrosa's & Camarillo's Combined WRF, or EBB water. Table 2-8 demonstrates that when the PTP system is dominated by surface water, the introduction of any type of PV water in any ratio will improve TDS. However, when the PTP system is dominated by PTP groundwater, TDS will improve with all water types except for Camrosa's and Camarillo's Combined WRF. Similar results were observed in Table 2-10 when an even proportion of PTP groundwater and surface water was considered.

Table 2-8. TDS Scenarios for PTP Surface Water with One Additional New Water Supply

PTP Water Supply	PV Water Supply				Future Potential Water Supply	Total	Projected TDS	Change in TDS
Surface Water	PV Wells	City of Oxnard's AWPF	Camrosa Conejo Creek Diversion	Camrosa's & Camarillo's Combined WRF	EBB Water			
1134	**807**	**230**	**775.8**	**1073.5**	**202**			
100%	0%	0%	0%	0%	0%	100%	1134	▬
90%	10%	0%	0%	0%	0%	100%	1101	▲
90%	0%	10%	0%	0%	0%	100%	1044	▲
90%	0%	0%	10%	0%	0%	100%	1098	▲
90%	0%	0%	0%	10.00%	0%	100%	1128	▲
90%	0.0%	0.0%	0.0%	0.0%	10%	100%	1041	▲
80%	20.0%	0.0%	0.0%	0.0%	0.0%	100%	1069	▲
80%	0.0%	20.0%	0.0%	0.0%	0.0%	100%	953	▲
80%	0.0%	0.0%	20.0%	0.0%	0.0%	100%	1062	▲
80%	0.0%	0.0%	0.0%	20.0%	0.0%	100%	1122	▲
80%	0.0%	0.0%	0.0%	0.0%	20.0%	100%	948	▲
70%	30%	0%	0%	0%	0%	100%	1036	▲
70%	5%	30%	0%	0%	5%	110%	913	▲
70%	0%	0%	30%	0%	0%	100%	1027	▲
70%	0%	0%	0%	30%	0%	100%	1116	▲
70%	0%	0%	0%	0%	30%	100%	854	▲
60%	40%	0%	0%	0%	0%	100%	1003	▲
60%	0%	40%	0%	0%	0%	100%	772	▲
60%	0%	0%	40%	0%	0%	100%	991	▲
60%	0%	0%	0%	40%	0%	100%	1110	▲
60%	0%	0%	0%	0%	40%	100%	761	▲
50%	50%	0%	0%	0%	0%	100%	971	▲
50%	0%	50%	0%	0%	0%	100%	682	▲
50%	0%	0%	50%	0%	0%	100%	955	▲
50%	0%	0%	0%	50%	0%	100%	1104	▲
50%	0%	0%	0%	0%	50%	100%	668	▲
40%	60%	0%	0%	0%	0%	100%	938	▲
40%	0%	60%	0%	0%	0%	100%	592	▲
40%	0%	0%	60%	0%	0%	100%	919	▲
40%	0%	0%	0%	60%	0%	100%	1098	▲
40%	0%	0%	0%	0%	60%	100%	575	▲
30%	70%	0%	0%	0%	0%	100%	905	▲
30%	0%	70%	0%	0%	0%	100%	501	▲
30%	0%	0%	70%	0%	0%	100%	883	▲
30%	0%	0%	0%	70%	0%	100%	1092	▲
30%	0%	0%	0%	0%	70%	100%	482	▲
20%	80%	0%	0%	0%	0%	100%	872	▲
20%	0%	80%	0%	0%	0%	100%	411	▲
20%	0%	0%	80%	0%	0%	100%	847	▲
20%	0%	0%	0%	80%	0%	100%	1086	▲
20%	0%	0%	0%	0%	80%	100%	388	▲
10%	90%	0%	0%	0%	0%	100%	840	▲
10%	0%	90%	0%	0%	0%	100%	320	▲
10%	0%	0%	90%	0%	0%	100%	812	▲
10%	0%	0%	0%	90%	0%	100%	1080	▲
10%	0%	0%	0%	0%	90%	100%	295	▲
0%	100%	0%	0%	0%	0%	100%	807	▲
0%	0%	100%	0%	0%	0%	100%	230	▲
0%	0%	0%	100%	0%	0%	100%	776	▲
0%	0%	0%	0%	100%	0%	100%	1074	▲
0%	0%	0%	0%	0%	100%	100%	202	▲

Table 2-9. TDS Scenarios for PTP Groundwater with One Additional New Water Supply



PTP Water Supply	PV Water Supply				Future Potential Water Supply	Total	Projected TDS	Change in TDS
PTP Wells	PV Wells	City of Oxnard's AWPF	Camrosa Conejo Creek Diversion	Camrosa's & Camarillo's Combined WRF	EBB Water			
879	807	230	775.8	1073.5	202			
100%	0%	0%	0%	0%	0%	100%	879	▬
90%	10%	0%	0%	0%	0%	100%	872	▲
90%	0%	10%	0%	0%	0%	100%	814	▲
90%	0%	0%	10%	0%	0%	100%	869	▲
90%	0%	0%	0%	10.00%	0%	100%	898	▼
90%	0.0%	0.0%	0.0%	0.0%	10%	100%	811	▲
80%	20.0%	0.0%	0.0%	0.0%	0.0%	100%	865	▲
80%	0.0%	20.0%	0.0%	0.0%	0.0%	100%	749	▲
80%	0.0%	0.0%	20.0%	0.0%	0.0%	100%	858	▲
80%	0.0%	0.0%	0.0%	20.0%	0.0%	100%	918	▼
80%	0.0%	0.0%	0.0%	0.0%	20.0%	100%	744	▲
70%	30%	0%	0%	0%	0%	100%	857	▲
70%	5%	30%	0%	0%	5%	110%	735	▲
70%	0%	0%	30%	0%	0%	100%	848	▲
70%	0%	0%	0%	30%	0%	100%	937	▼
70%	0%	0%	0%	0%	30%	100%	676	▲
60%	40%	0%	0%	0%	0%	100%	850	▲
60%	0%	40%	0%	0%	0%	100%	619	▲
60%	0%	0%	40%	0%	0%	100%	838	▲
60%	0%	0%	0%	40%	0%	100%	957	▼
60%	0%	0%	0%	0%	40%	100%	608	▲
50%	50%	0%	0%	0%	0%	100%	843	▲
50%	0%	50%	0%	0%	0%	100%	555	▲
50%	0%	0%	50%	0%	0%	100%	827	▲
50%	0%	0%	0%	50%	0%	100%	976	▼
50%	0%	0%	0%	0%	50%	100%	541	▲
40%	60%	0%	0%	0%	0%	100%	836	▲
40%	0%	60%	0%	0%	0%	100%	490	▲
40%	0%	0%	60%	0%	0%	100%	817	▲
40%	0%	0%	0%	60%	0%	100%	996	▼
40%	0%	0%	0%	0%	60%	100%	473	▲
30%	70%	0%	0%	0%	0%	100%	829	▲
30%	0%	70%	0%	0%	0%	100%	425	▲
30%	0%	0%	70%	0%	0%	100%	807	▲
30%	0%	0%	0%	70%	0%	100%	1015	▼
30%	0%	0%	0%	0%	70%	100%	405	▲
20%	80%	0%	0%	0%	0%	100%	821	▲
20%	0%	80%	0%	0%	0%	100%	360	▲
20%	0%	0%	80%	0%	0%	100%	796	▲
20%	0%	0%	0%	80%	0%	100%	1035	▼
20%	0%	0%	0%	0%	80%	100%	337	▲
10%	90%	0%	0%	0%	0%	100%	814	▲
10%	0%	90%	0%	0%	0%	100%	295	▲
10%	0%	0%	90%	0%	0%	100%	786	▲
10%	0%	0%	0%	90%	0%	100%	1054	▼
10%	0%	0%	0%	0%	90%	100%	270	▲
0%	100%	0%	0%	0%	0%	100%	807	▲
0%	0%	100%	0%	0%	0%	100%	230	▲
0%	0%	0%	100%	0%	0%	100%	776	▲
0%	0%	0%	0%	100%	0%	100%	1074	▼
0%	0%	0%	0%	0%	100%	100%	202	▲

Table 2-10. TDS Scenarios for PTP Equal Groundwater and Surface Water with One Additional New Water Supply

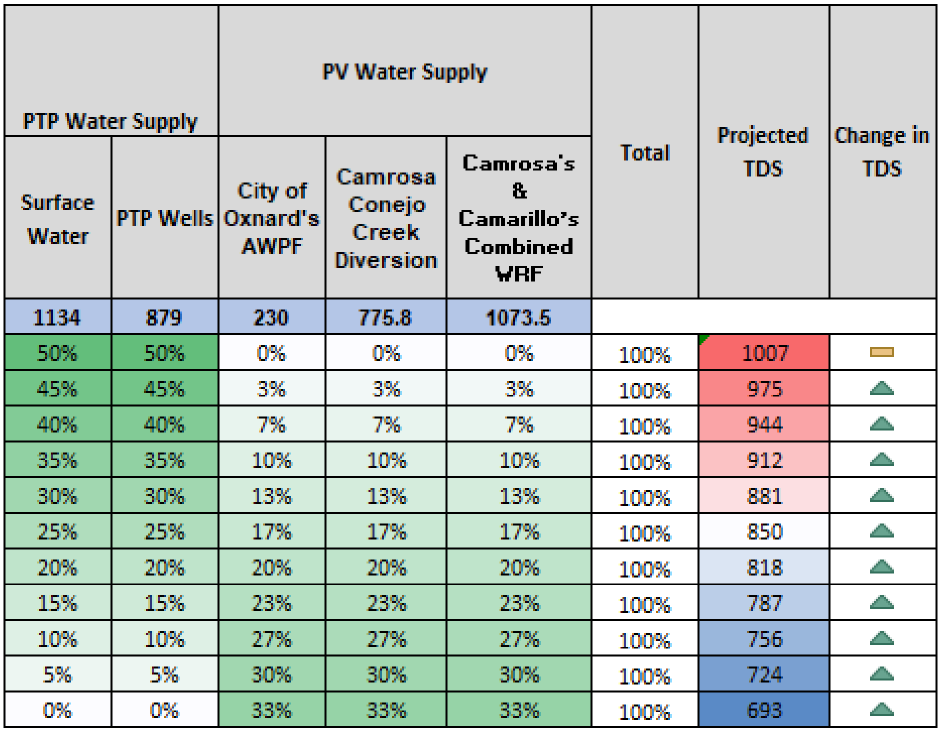
PTP Water Supply		PV Water Supply				Future Potential Water Supply	Total	Projected TDS	Change in TDS
Surface Water	PTP Wells	PV Wells	City of Oxnard's AWPF	Camrosa Conejo Creek Diversion	Camrosa's & Camarillo's Combined WRF	EBB Water			
1134	879	807	230	775.8	1073.5	202			
50%	50%	0%	0%	0%	0%	0%	100%	1007	▬
45%	45%	10%	0%	0%	0%	0%	100%	987	▲
45%	45%	0%	10%	0%	0%	0%	100%	929	▲
45%	45%	0%	0%	10%	0%	0%	100%	983	▲
45%	45%	0%	0%	0%	10.00%	0%	100%	1013	▼
45%	45%	0.0%	0.0%	0.0%	0.0%	10%	100%	926	▲
40%	40%	20.0%	0.0%	0.0%	0.0%	0.0%	100%	967	▲
40%	40%	0.0%	20.0%	0.0%	0.0%	0.0%	100%	851	▲
40%	40%	0.0%	0.0%	20.0%	0.0%	0.0%	100%	960	▲
40%	40%	0.0%	0.0%	0.0%	20.0%	0.0%	100%	1020	▼
40%	40%	0.0%	0.0%	0.0%	0.0%	20.0%	100%	846	▲
35%	35%	30%	0%	0%	0%	0%	100%	947	▲
35%	35%	5%	30%	0%	0%	5%	110%	824	▲
35%	35%	0%	0%	30%	0%	0%	100%	937	▲
35%	35%	0%	0%	0%	30%	0%	100%	1027	▼
35%	35%	0%	0%	0%	0%	30%	100%	765	▲
30%	30%	40%	0%	0%	0%	0%	100%	927	▲
30%	30%	0%	40%	0%	0%	0%	100%	696	▲
30%	30%	0%	0%	40%	0%	0%	100%	914	▲
30%	30%	0%	0%	0%	40%	0%	100%	1033	▼
30%	30%	0%	0%	0%	0%	40%	100%	685	▲
25%	25%	50%	0%	0%	0%	0%	100%	907	▲
25%	25%	0%	50%	0%	0%	0%	100%	618	▲
25%	25%	0%	0%	50%	0%	0%	100%	891	▲
25%	25%	0%	0%	0%	50%	0%	100%	1040	▼
25%	25%	0%	0%	0%	0%	50%	100%	604	▲
20%	20%	60%	0%	0%	0%	0%	100%	887	▲
20%	20%	0%	60%	0%	0%	0%	100%	541	▲
20%	20%	0%	0%	60%	0%	0%	100%	868	▲
20%	20%	0%	0%	0%	60%	0%	100%	1047	▼
20%	20%	0%	0%	0%	0%	60%	100%	524	▲
15%	15%	70%	0%	0%	0%	0%	100%	867	▲
15%	15%	0%	70%	0%	0%	0%	100%	463	▲
15%	15%	0%	0%	70%	0%	0%	100%	845	▲
15%	15%	0%	0%	0%	70%	0%	100%	1053	▼
15%	15%	0%	0%	0%	0%	70%	100%	443	▲
10%	10%	80%	0%	0%	0%	0%	100%	847	▲
10%	10%	0%	80%	0%	0%	0%	100%	385	▲
10%	10%	0%	0%	80%	0%	0%	100%	822	▲
10%	10%	0%	0%	0%	80%	0%	100%	1060	▼
10%	10%	0%	0%	0%	0%	80%	100%	363	▲
5%	5%	90%	0%	0%	0%	0%	100%	827	▲
5%	5%	0%	90%	0%	0%	0%	100%	308	▲
5%	5%	0%	0%	90%	0%	0%	100%	799	▲
5%	5%	0%	0%	0%	90%	0%	100%	1067	▼
5%	5%	0%	0%	0%	0%	90%	100%	282	▲
0%	0%	100%	0%	0%	0%	0%	100%	807	▲
0%	0%	0%	100%	0%	0%	0%	100%	230	▲
0%	0%	0%	0%	100%	0%	0%	100%	776	▲
0%	0%	0%	0%	0%	100%	0%	100%	1074	▼
0%	0%	0%	0%	0%	0%	100%	100%	202	▲

Combinations of PV water types were then evaluated. These water sources included the city of Oxnard’s AWPF, Camrosa Conejo Creek Diversion and Camrosa’s and Camarillo’s combined WRF. It is anticipated that a portion of the system’s water may originate from PV groundwater wells. These wells have similar TDS values to PTP wells. Physical infrastructure modifications are being considered to limit the amount of PV groundwater conveyed to the PTP system, however the proportion of PV groundwater is unknown at this time. This is further discussed in Chapter 6 Point of Connection. Since the PV and PTP groundwater wells have similar TDS values, future TDS analyses can consider the PTP and PV well proportions combined.

Table 2-11 evaluates TDS scenarios under equal PTP groundwater and surface water, with an equal distribution of PV supplies. This demonstrates the benefit of PV water quality at equal proportions to the PTP system. This was similarly observed with the PV groundwater and surface water individually, as shown in Table 2-12 and Table 2-13.

Since Camrosa’s & Camarillo’s Combined WRF had the most adverse impacts on PTP water quality, as demonstrated by the previous TDS water quality scenarios, additional evaluation was conducted to understand the potential water quality scenarios with this supply. Table 2-14 demonstrates that with an equal supply of Oxnard AWPF water and the combined WRF there is no adverse impact to TDS when the PTP system is groundwater supplies. Table 2-15 demonstrates that approximately 60% of the supply can be combined WRF with 20% Oxnard AWPF and 20% PTP groundwater to not have an adverse impact on TDS in the PTP system.

Table 2-11. TDS Scenarios for PTP Equal Groundwater and Surface Water with Equal Distribution of 3 PV Water Types



PTP Water Supply		PV Water Supply			Total	Projected TDS	Change in TDS
Surface Water	PTP Wells	City of Oxnard's AWPF	Camrosa Conejo Creek Diversion	Camrosa's & Camarillo's Combined WRF			
1134	879	230	775.8	1073.5			
50%	50%	0%	0%	0%	100%	1007	▬
45%	45%	3%	3%	3%	100%	975	▲
40%	40%	7%	7%	7%	100%	944	▲
35%	35%	10%	10%	10%	100%	912	▲
30%	30%	13%	13%	13%	100%	881	▲
25%	25%	17%	17%	17%	100%	850	▲
20%	20%	20%	20%	20%	100%	818	▲
15%	15%	23%	23%	23%	100%	787	▲
10%	10%	27%	27%	27%	100%	756	▲
5%	5%	30%	30%	30%	100%	724	▲
0%	0%	33%	33%	33%	100%	693	▲

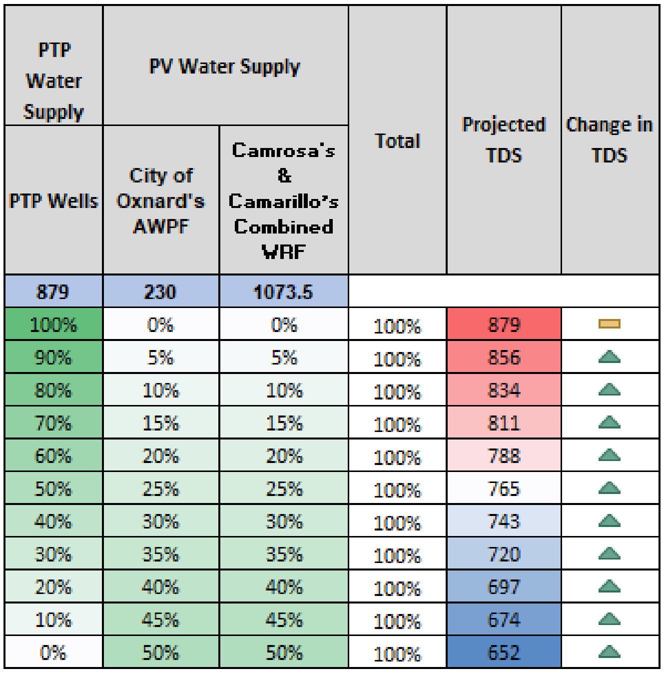
Table 2-12. TDS Scenarios for PTP Equal Groundwater with Equal Distribution of 3 PV Water Types

PTP Water Supply	PV Water Supply			Total	Projected TDS	Change in TDS
PTP Wells	City of Oxnard's AWPF	Camrosa Conejo Creek Diversion	Camrosa's & Camarillo's Combined WRF			
879	230	775.8	1073.5			
100%	0%	0%	0%	100%	879	▲
90%	3%	3%	3%	100%	860	▲
80%	7%	7%	7%	100%	842	▲
70%	10%	10%	10%	100%	823	▲
60%	13%	13%	13%	100%	805	▲
50%	17%	17%	17%	100%	786	▲
40%	20%	20%	20%	100%	767	▲
30%	23%	23%	23%	100%	749	▲
20%	27%	27%	27%	100%	730	▲
10%	30%	30%	30%	100%	712	▲
0%	33%	33%	33%	100%	693	▲

Table 2-13. TDS Scenarios for PTP Surface Water with Equal Distribution of 3 PV Water Types

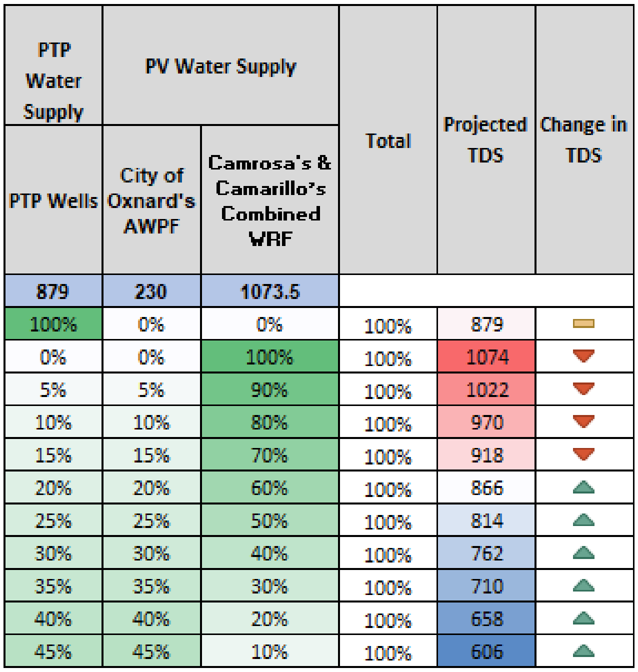
PTP Water Supply	PV Water Supply			Total	Projected TDS	Change in TDS
Surface Water	City of Oxnard's AWPF	Camrosa Conejo Creek Diversion	Camrosa's & Camarillo's Combined WRF			
1134	230	775.8	1073.5			
100%	0%	0%	0%	100%	1134	▬
90%	3%	3%	3%	100%	1090	▲
80%	7%	7%	7%	100%	1046	▲
70%	10%	10%	10%	100%	1002	▲
60%	13%	13%	13%	100%	958	▲
50%	17%	17%	17%	100%	914	▲
40%	20%	20%	20%	100%	869	▲
30%	23%	23%	23%	100%	825	▲
20%	27%	27%	27%	100%	781	▲
10%	30%	30%	30%	100%	737	▲
0%	33%	33%	33%	100%	693	▲

Table 2-14. TDS Scenarios for PTP Groundwater with Oxnard AWPF and Camrosa’s & Camarillo’s Combined WRF



PTP Water Supply	PV Water Supply		Total	Projected TDS	Change in TDS
PTP Wells	City of Oxnard's AWPF	Camrosa's & Camarillo's Combined WRF			
879	230	1073.5			
100%	0%	0%	100%	879	▬
90%	5%	5%	100%	856	▲
80%	10%	10%	100%	834	▲
70%	15%	15%	100%	811	▲
60%	20%	20%	100%	788	▲
50%	25%	25%	100%	765	▲
40%	30%	30%	100%	743	▲
30%	35%	35%	100%	720	▲
20%	40%	40%	100%	697	▲
10%	45%	45%	100%	674	▲
0%	50%	50%	100%	652	▲

Table 2-15. TDS Scenarios for Camrosa’s & Camarillo’s Combined WRF with Even PTP Groundwater and Oxnard AWPF Supply



PTP Water Supply	PV Water Supply		Total	Projected TDS	Change in TDS
PTP Wells	City of Oxnard's AWPF	Camrosa's & Camarillo's Combined WRF			
879	230	1073.5			
100%	0%	0%	100%	879	▬
0%	0%	100%	100%	1074	▼
5%	5%	90%	100%	1022	▼
10%	10%	80%	100%	970	▼
15%	15%	70%	100%	918	▼
20%	20%	60%	100%	866	▲
25%	25%	50%	100%	814	▲
30%	30%	40%	100%	762	▲
35%	35%	30%	100%	710	▲
40%	40%	20%	100%	658	▲
45%	45%	10%	100%	606	▲

2.5 PTP System Water Quality with Laguna Rd Pipeline

The water quality that will be conveyed from the PV system to the PTP system may be dependent on the following:

1) **Flow conveyance:** The total amount of flow that is conveyed from the PV to PTP system as well as the timing of the flow will impact the water quality.

2) **Location of the PV water sources:** The proximity of the Laguna Road pipeline to the source waters in the PV system as well as how they are hydraulically connected will impact the water quality. Water sources closer and with a higher HGL near the intersection of Wood and Laguna Rd. (such as Well No.7 when in service) will have a higher impact on water quality.

3) **Available water supplies:** The proportion of the various water supplies in both the PV and PTP systems will impact the overall water quality.

2.5.1 Flow Conveyance

The total amount of flow and the timing of that conveyance in relationship to the influent water sources to the PV system will impact the water quality. If water is taken when water in the PV system is primarily City of Oxnard's AWPF source water, water quality in the PTP system will benefit. However, if water is primarily Camrosa's and Camarillo's WRF source water, water quality in the PTP system will be similar or lower water quality than it currently is based on TDS and chloride. While conveyance of PV groundwater would have minimal impact on water quality in the PTP system, it would not be desirable for either the PV or PTP system to convey water through the Laguna Rd pipeline when groundwater wells provide the primary water supply in the PV system.

2.5.2 Location of Water Sources

The proximity of the Laguna Road pipeline to the source waters in the PV system as well as how they are hydraulically connected will impact the water quality.

2.5.2.1 Oxnard's AWPF

The Oxnard's AWPF enters the PV system at the intersection of Hueneme Rd and Wood Rd. The connection point is approximately 11,000 feet (approximately 2 miles) from the Laguna Road pipeline. Demand along Wood Road as well as system hydraulics will impact the total amount of Oxnard AWPF flow that is conveyed from the PV to PTP system.

2.5.2.2 Groundwater Wells

The PV system operates groundwater wells to supplement water supplies. PV Wells No. 3, 7, and 11 are in close proximity to the Laguna Rd Pipeline, as shown in Figure 2-3. Well No. 7 is located the closest to the Laguna Rd Pipeline. When Well No.7 is operating and the pipeline is open for the PTP system to receive flows from the PV system, flow conveyed will primarily be groundwater and will have the water quality profile of the groundwater in the PV system. This scenario should be avoided due to the transfer of water between groundwater basins, as regulated by the FCGMA. Avoidance of transferring groundwater to the PTP system from the PV system can be achieved by either operational changes or design modifications.

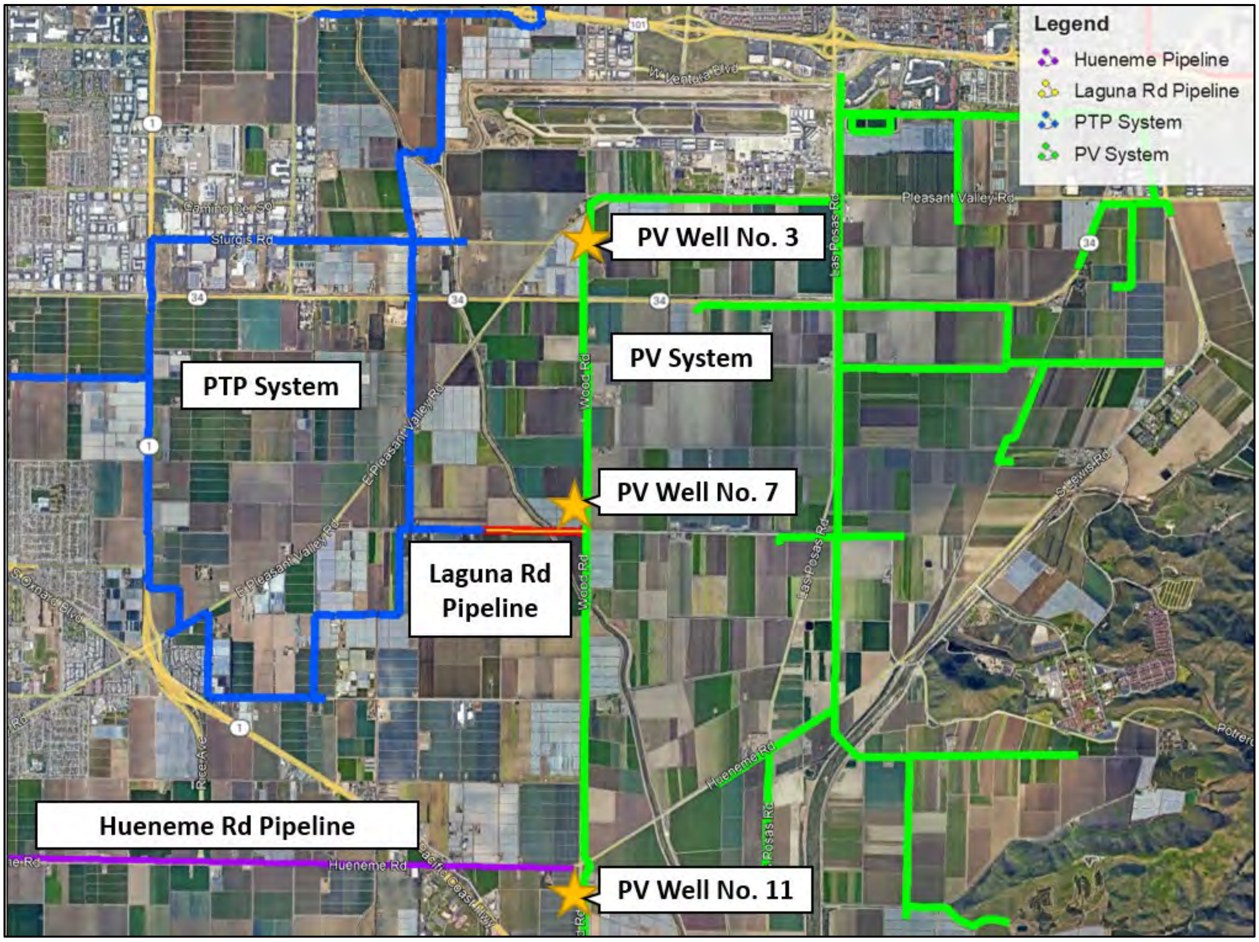


Figure 2-3: Location of PV Groundwater Wells Near Laguna Rd Pipeline

2.5.2.3 Camrosa Water Supplies

There are three different water sources from Camrosa that enter the PVCWD system, which fall into two classes of nonpotable water which are non potable surface water and Title 22 recycled water. These Camrosa water sources include:

1. **Conjeo Creek Diversion:** This water is comprised of Conejo Creek surface water as well as Title 22 disinfected tertiary-treated recycled water from the Camrosa Water Reclamation Facility (CWRF) – Title 22 disinfected tertiary-treated recycled water. Based on Camrosa's Urban Water Management Plan the majority of this water is comprised of Conejo Creek Diversion water.

2. **Camarillo Sanitary District (CamSan) Water Reclamation Facility (WRF):** – This is comprised of Title 22 disinfected tertiary-treated recycled water. This source began conveyance to the PV system in 2019.
3. **Camrosa Water Reclamation Facility (CWRF):** This is comprised of Title 22 disinfected tertiary-treated recycled water

Based on the approximate location of the Camrosa system to the PV system, water from this source would need to travel over 6.5 miles to reach the Laguna Rd pipeline. If looping is added to the PV system by PVCWD, where a connection is added along Laguna Rd between the existing PV system, a shorter conveyance system would exist, reducing the distance to approximately 2.5 miles.

2.6 Water Quality Requirements & Recommendations

Based on this analysis the following next steps are recommended to continue assessing how receiving flows from the PV system via the Laguna Road pipeline may impact water quality in the PTP system. These next steps include:

- Conduct hydraulic modeling using a water quality tracer with the PV system model (currently being designed by MKN) to understand how different water sources are hydraulically connected and may impact water quality conveyed through the Laguna Road Pipeline.

- Consider conducting surveys and/or gathering information from farmers on water quality observations and requirements to better inform water quality goals and objectives.

- Evaluate any other water quality constituents that may be of concern to farmers including boron, EC_w, sodium, SAR, bicarbonate, and residual chlorine.

- Identifying any potential changes in the PV system that may impact the operation of the PV system and have water quality impacts on the connection point as a result (such as looping connections, anticipated water delivery schedules, etc.)

Based on the various water sources and water qualities within the PV system, it is recommended that the District monitor the water quality and the flowrate of the water into the PTP system at the Laguna Rd Pipeline. This would include turbidity, chlorine, and potentially chloride and boron monitors. It is recommended that a flow meter be installed to monitor the flowrate. These are further discussed in Section 4.

Section 3: Hydraulic Analysis of PV – PTP Connection

A hydraulic analysis was conducted to evaluate the ability to convey flow from the PV system to the PTP system. This hydraulic analysis included evaluation of historical SCADA data, the development of a simplified hydraulic model using Innovyze's InfoWater software of the PV and PTP system connection and an investigation into potential future pressure conditions.

3.1 Analysis of Existing System Conditions Near Laguna Rd

Historical system pressure data from March 1, 2021 through March 31, 2022 was evaluated for the PTP and PV systems, representing multiple seasons and crop rotations for both systems. The PTP pressure data, recorded continuously, and sampled at 5-minute intervals and the PV metering data sampled in 1-minute intervals was used for the analysis.

Pressure readings are taken at the discharge side of groundwater wells within the PTP and PV systems, even when the wells are not operating. The closest wells in the PTP and PV systems to the proposed system interconnection were identified. These wells are PTP Well No. 1 and PV Well No. 7. The location of these wells is shown in Figure 3-1.

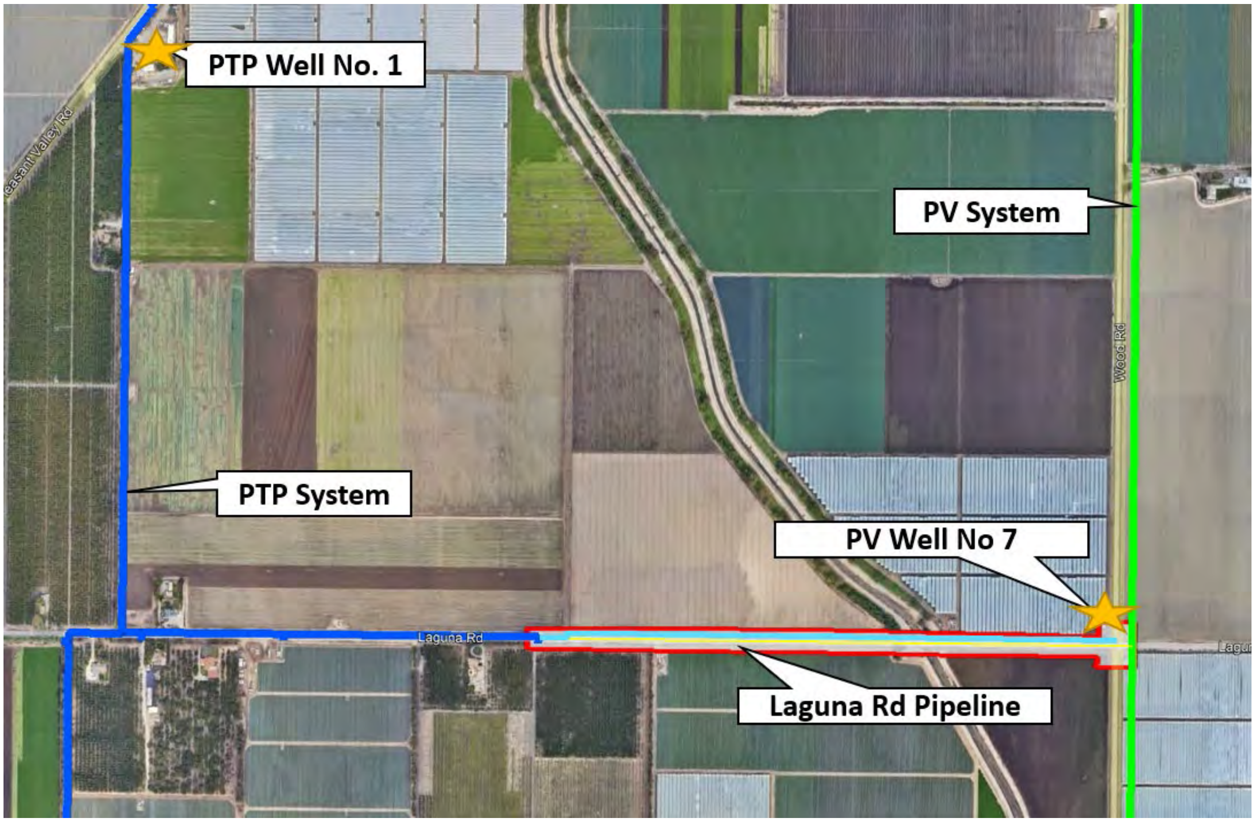


Figure 3-1: Map of Well Locations with SCADA Pressure Sensors

The SCADA data was evaluated for the full period available and data anomalies were excluded. The pressure for the closest PTP and PV wells to the proposed pipeline is summarized in Table 3-1. This data demonstrates that the PV and PTP systems have operational pressures within 1 psi of each other, on average.

Table 3-1: PTP and PV Measured SCADA Pressure Conditions at Nearest Groundwater Well (March 1, 2021 to March 31, 2022)

	PTP Well No. 1			PV Well No. 7		
	Pressure (psi)	**Head (ft)**	**HGL at Well (ft)**	**Pressure (psi)**	**Head (ft)**	**HGL at Well (ft)**
Average	33	76	106	32	74	103
High	46	106	136	40	92	117
Low	15	35	64	20	46	70

3.2 Hydraulic Modeling

The District recently built a hydraulic model using Innovyze InfoWater software for the Extraction Barrier and Brackish Water Treatment Project (EBB-Water) Alternatives Analysis, in which a high-level screening analysis was conducted to evaluate five potential projects for the distribution of treated coastal brackish groundwater. The PTP system portion of the EBB-Water model was designed using the District's existing EPANET model and was updated based on available record drawings and information. For the PV system, a portion of the system was modeled with available record drawings, which included pipeline diameters. Digital elevation model (DEM) data was used to estimate the inverts of pipelines with missing data.

3.2.1 Hydraulic Modeling Assumptions

A simplified version of this recently developed hydraulic model was used to simulate flows and evaluate the system under varying pressure conditions with the addition of the Laguna Rd pipeline that connects the PTP and PV systems. Since the pressure was being constantly measured in the PTP and PV systems at the wells near the proposed pipeline, these were used as the boundary conditions of the model and modeled as fixed head reservoirs. The pressures were converted into HGL conditions using the measured pressure (converted to feet of head) and the ground elevation of the well. A combination of head conditions based on the observed range of pressures from the metering data was used to evaluate the anticipated performance of the pipeline.

The following assumptions were made for the model:

- 2,920 feet of new 24-inch pipe will be added, connecting the PTP and PV systems.
- The operating pressure conditions of the PV system will not significantly change because of the new connection to the Hueneme pipeline to import water from Oxnard.
- Flow will only be allowed from the PV to PTP system. Reverse flow to the PV system was not evaluated.

- All model runs were evaluated under steady state conditions.
- The existing butterfly valve on Laguna Road was assumed to be completely open with a minor loss value (K value) of 0.4. A check valve is not included and will be considered as part of final design for any headlosses.
- The model assumes no demands between the PV Well No. 7 and PTP Well No. 1.

3.2.2 Hydraulic Model Scenarios

The model was used to simulate a variety of head conditions in both the PTP and PV systems accounting for a range of potential pressure conditions based on the observed historical SCADA data and anticipated pressure changes in the PV system.

These scenarios included evaluating the PV system at three different pressure conditions:

1. **Existing Average:** This reflected the current average PV operating pressure of 32 psi (98 feet of head) at PV Well No. 7.
2. **Above Average:** This reflected the operation of the PV system at 45 psi (128 feet of head), which is above the existing average system pressure. This reflects a potential system change that would raise the HGL of the PV system, such as the connection to Hueneme Rd pipeline, but is also below the desired pressure condition by PV for infrastructure protection.
3. **Above Current Operating:** This reflected if the system were to have a boosted pressure condition to 55 psi. This reflects a potentially larger hydraulic change in the PV system. The above average head condition was modeled as it is uncertain what pressure conditions will be in the PV system in the future. During recent Hueneme Rd Pipeline startup-testing, the pressure leaving the Oxnard AWPF was approximately 65 psi, which is much higher than the existing pressure in the PV system. PVCWD uses a PRV to reduce the pressure to be below 50 psi at the connection of the Hueneme pipeline to protect the existing infrastructure and maintain their current operating strategy. However, if the pressure were to be throttled less, there is a possibility that the system could potentially operate at a higher pressure.

Using the three PV pressure conditions, the PTP system pressure was modified from 0 to 60 psi (29.55 to 168 feet of head) at 5 psi (11.55 feet of head) intervals at PTP Well No. 1. This was done to evaluate how the conveyance would be impacted at a range of operating pressures of both the PV and PTP system.

3.2.3 Hydraulic Model Results

The hydraulic modeling results demonstrated that the amount of flow that can be conveyed through the proposed pipeline is limited by the head differential between the PTP and PV systems. For water to be conveyed through the proposed pipeline to the PTP system, the pressure in the PV system must be higher than in the PTP system.

The higher the PV pressure is in comparison to the pressure condition in the PTP system, the more flow that can be conveyed. If the pressure in the PTP system is higher than the pressure in the PV systems, flow cannot be conveyed to the PTP system.

The model was used to simulate a variety of head conditions in both the PTP and PV systems, with the results presented in the graph in Figure 3-2. The blue box on Figure 3-2 demonstrates the measured pressure range in the PTP system and the potential flow that could be conveyed under the different PV system head conditions. When both systems are operating at their average conditions (33 psi in the PTP system and 32 psi in the PV system) little to no flow can be conveyed. At the lowest observed PTP system pressure of approximately 15 psi (64 feet of head) and under existing PV pressure conditions, approximately 3,500 gpm could be conveyed to the PTP system. However, the typical pressure range for the PTP system is much narrower, with values between 30 and 38 psi. When both systems are operating at their average conditions (33 psi in the PTP system and 32 psi in the PV system) little to no flow can be conveyed. A maximum flow of approximately 6,500 gpm can be conveyed when the PV has an above average head condition of 55 psi and the PTP has a low head condition of 5 psi. This pressure condition, however, is unlikely to occur due to the required system pressure for water delivery to PTP customers and infrastructure protection within the PV system.

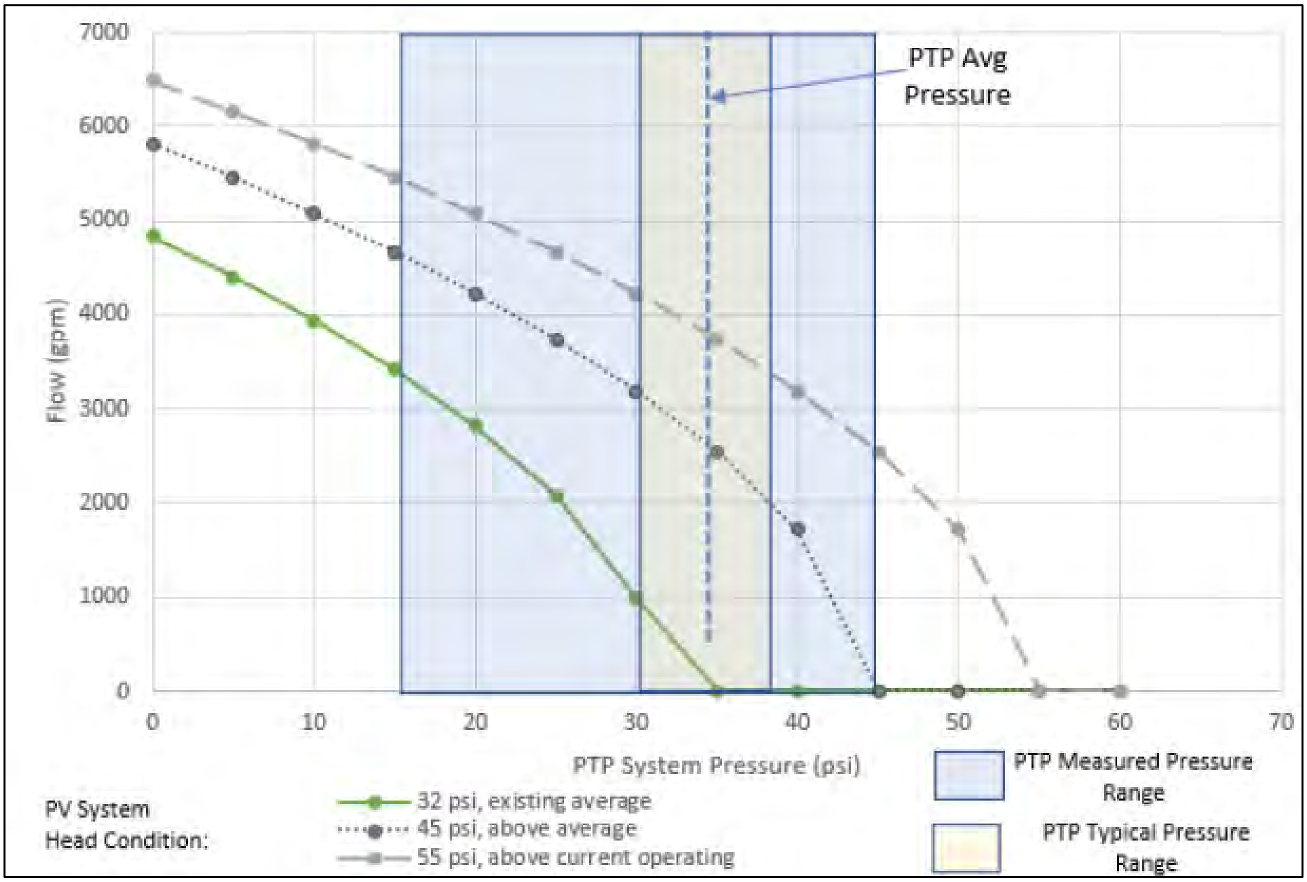


Figure 3-2: Modeled Flow through Laguna Pipeline Under Varied PV and PTP Head Conditions

3.3 Hydraulic Limitations & Considerations

Based on the findings of this analysis the amount of flow that can be conveyed through the new pipeline is limited by the pressure of the PV system. When both the PV and PTP system are operating at their average pressures little to no flow can be conveyed through the pipeline. When the PV system is operating at a higher pressure of 45 or 55 psi, the pipeline can convey approximately 2,500 or 3,700 gpm, respectively.

These results suggest that to convey flow from the PV to PTP system either additional head needs to be added to the system through a booster pump station or the PV system must operate at a higher HGL.

Based on the hydraulic analysis the following next steps are recommended:

- **PVCWD Coordination**: Coordinate with PVCWD to gain a better understanding of the existing and planned hydraulic modifications, especially in regard to the operation of the Hueneme Rd Pipeline.
- **Extended Period Simulations with Combined PV/PTP Model:** Conduct extended period simulations with combined PV/PTP models to understand the operational complexity and decision optimization for operation of the pipeline.
- **Surge Analysis:** Once both systems are interconnected transient pressures from one system can potentially impact the other system. Surge analysis modeling would provide insight on potential surge conditions and their impacts. This analysis would inform if/what surge protect near the interconnect is required.
- **Water Quality Modeling with Hydraulic Model:** Integrate the hydraulic modeling and water quality analyses to understand the impacts of Wells No. 3, 7, and 11, as well as the other existing water qualities in the PV system.

Section 4: Flow Control Station

This section discusses the required analyzers, initial valve selection considerations, and flow metering. The flow control strategy and electrical requirements will need to be further defined during the next phase of design.

4.1 Required Analyzers

Per discussion and District input, and based on water quality concerns from Section 2, chlorine residual, from tertiary water, and TDS introduced from the PV system into the PTP system are the constituents that require monitoring.

Chlorine residual can be monitored either through a colorimetric analyzer that uses a chemical reagent to determine the residual in the water or an amperometric analyzer that uses a membrane and electrical sensors to determine the residual. A significant difference in the analyzers is that the colorimetric analyzer requires a reagent for analysis which results in a water waste stream that needs to be discharged to a sewer. Since the flow control station will be located at a remote site, the District therefore prefers the amperometric analyzer. KJ recommends the HACH CL-10 amperometric analyzer from the HACH company.

TDS residual can be monitored either through an independent analyzer that uses electrodes to measure the voltage and determine the TDS, like the Hanna model Panel Mounted Conductivity and TDS controller, or by an Endress+Houser (E+H) Proline Promag W400 Magnetic Flowmeter that has the option to detect TDS. Since a flowmeter will be required for this project, and independent analyzers will require more maintenance with required cleaning of the electrical probes over time, KJ recommends the E+H Promag W400 Magnetic Flowmeter, which is already used by the District for flow measurements.

4.2 Valve Selection

The valve selection will be dependent on the flow control strategy. If the system is designed without a pump station, two types of valves should be considered during the next phase of design: a butterfly valve with a check valve to prevent backflow, or Cla-Val's Flow Control Valve with built in check-valve. In the case that a pump station is used for flow conveyance only an isolation valve, such as a gate valve would be considered. The butterfly valve will require an open/close or modulating electronic actuator that will be controlled by the District's SCADA system and the analyzers listed above. The minimum pressure differential between the two system needs to be at least 10 psi, but preferably 15 psi to allow flow. This pressure differential is based on the use of a Cla-Val or check valve, which based on manufacturer's requirements need a minimum differential of 5 psi. If this minimum pressure differential is not achieved the valve will remain closed.

4.3 Flowmeter

The District currently uses Endress+Houser Proline Promag W400 Magnetic Flowmeter in other parts of the PTP system, therefore KJ recommends the E+H Promag W400 Magnetic Flowmeter for this system. The magnetic flowmeter can be set for either single direction or bi-directional, and has an option to detect TDS.

4.4 Flow Control Strategy

The flow control strategy will be based on the following:

- Type of connection
- Customer demands
- Water quality
- Pressure requirements
- Agreements between PVWD and UWCD

These requirements will be defined during the next phase of design.

4.5 Electrical Requirements

Electrical requirements will be based on the flow control strategy. At a minimum, power will be required for the flowmeter, analyzers, and control valve. These requirements will be defined during the next phase of design.

Section 5: Pipeline Design

5.1 Pipeline Materials Analysis

The purpose of this section is to determine the most appropriate pipe material for the underground pipeline facilities install by cut and cover construction techniques. Based on the hydraulic modeling completed in Section 3, the required diameter of the Laguna Road Pipeline is 24-inches. In accordance with the District's standard specifications, allowable materials for a 24-inch diameter water pipeline include polyvinyl chloride pipe (AWWA C900 PVC DR 25, Class 165), high-density polyethylene pipe (HDPE DR 17), and cement mortar lined and coated (CML&C) steel pipe (8 Gauge/0.135", minimum).

The proposed pipe materials will be evaluated based on following criteria:

- Life Expectancy
- Corrosion Protection
- Flow Characteristics
- Structural Integrity
- Joint Tightness
- Availability
- Handling/Installation
- Material Costs

5.1.1 Life Expectancy

The life expectancy for a water pipeline constructed of any material is difficult to measure. Poor pipe manufacture, poor installation practices, corrosion, water chemistry, pressure surges, and unforeseen surcharge loading on the pipe all play a role in potentially reducing the useful life of the pipe. The useful life of HDPE and PVC pipe is 50 years according to HDPE and PVC manufacturers, and both HDPE and PVC pipe have been in service for that length of time. While steel pipe manufacturers claim a lifespan of 100 years, and there are some instances where the pipe has been in service for that long, in most cases steel pipe appears to have closer to a 50-year life span based on empirical evidence from local agencies. PVC may be more susceptible to damage during installation compared to the more robust alternatives.

5.1.2 Corrosion Protection

Corrosion is one of the main causes of pipe failure and can occur internally or externally.

Internal Corrosion Protection

Water is normally neutral in nature with a pH of 7. Impurities dissolved in the water and chemicals added to the water can affect the pH, causing the pH to range from 6 (slightly acidic) to 8 (slightly alkaline). Slightly acid water can affect ferrous pipe by chemically attacking the pipe. Certain chemicals used to treat potable water, including but not limited to chlorine, chloramines, and other disinfectants can also chemically attack bare ferrous metal. Cement mortar lining is normally used to protect steel pipe from internal corrosion by increasing the alkalinity of the water next to the lining, protecting the ferrous metal from chemical attack.

HDPE and PVC are chemically inert materials and are not vulnerable to most forms of chemical attack normally found in water. Note that AWWA C900 PVC pipe uses ductile iron fittings, which are ferrous metal, and will need to be lined with cement mortar or epoxy to protect the pipe from internal corrosion.

External Corrosion Protection

Steel pipe below grade needs to be protected from the surrounding soil and groundwater as the soil can attack the pipe chemically, and this pipe type also needs to be protected from galvanic corrosion. Steel pipe is normally protected from corrosive soil and groundwater by coating with ¾-inch cement mortar per AWWA C205. The mortar acts as a passivating material by increasing the alkalinity of the soil and water touching the pipe. Additional protection of ferrous pipe may include pipe bonding, poly bagging, and installing cathodic test stations (CTS) to measure corrosive effects on the pipe over time. If corrosion is detected by the CTS, a passive corrosion protection system such as sacrificial anodes or an active system such as induced current can be installed.

A geotechnical investigation was conducted for the project and included an analysis of the corrosivity of surrounding soils and the depth of groundwater. The report data noted the following data with values based on Caltrans' standard of corrosivity for ferrous metals and concrete:

- Soil pH of 7.3 to 8.3, which is alkaline, and not considered corrosive
- Soil resistivity of 180 to 583 ohm-centimeters, which is considered severely corrosive
- Soluble sulfates at borings from 790 ppm to 8,315 ppm, which varies between slightly corrosive for 790 ppm to severely corrosive for 8,315 ppm
- Soluble chlorides between 35 to 156 ppm, which is considered slightly corrosive

Based on the severity of corrosive soils in the area, KJ recommends the use of HDPE or PVC pipe for buried conditions, since HDPE and PVC are resistant to most chemical attacks in the soil. Note that fittings for PVC pipe will be ductile iron and will require polyethylene bagging or other measures to protect them from soil corrosion. Steel pipe could be used, but will require cathodic test stations along the alignment, and review by a corrosion engineer to determine if cement mortar coating or tape wrap coating would be suitable for protection.

In addition to soil corrosion, galvanic corrosion can occur when dissimilar metals are joined to each other without some form of insulation to prevent metal to metal contact. Galvanic corrosion for ferrous metal pipes can be reduced by using insulated flanges, bushings, or unions between dissimilar metals to prevent the start of a galvanic cell. HDPE and PVC are immune to galvanic corrosion as they are chemically inert and electrically insulated.

Exposed Weathering Protection

Steel pipe above grade needs to be protected from atmospheric weathering due to rain and other damp conditions to protect the exterior of the pipe from corrosion. Steel pipe should be blasted to bare steel and then coated with a primer followed by a zinc-rich coating with a urethane finish. The coating should last 10 to 20 years, depending on the weather conditions, before requiring recoating of the pipe. Exposed PVC pipe is vulnerable to damage from ultraviolet light and is usually used in only small diameters and/or painted with an acrylic (latex) paint that needs to be applied every five years to protect from sunlight. Exposed HDPE pipe that has carbon black added to the resin is resistant to UV exposure, however, it can be very sensitive to temperature changes at grade, expanding or contracting with temperature increase or decrease. KJ recommends steel pipe for above grade use due to its durability to weather, vandalism and accidental damage compared to HDPE and PVC.

5.1.3 Flow Characteristics and Abrasion Resistance

Most commonly used pressure pipe materials have similar flow characteristics and all typically have a Hazen-Williams design coefficient (C factor) ranging from 120 to 150. However, the inner surface of pressure pipe materials such as cement mortar can wear over time, experience sedimentation, be damaged by chemical attacks, and allow the growth of algae and other biological organisms which can increase the friction loss and reduce flow capacity. The PTP and PV system pipelines in particular have had the presence of clam shells, resulting from surface water inflows from the Santa Clara River. HDPE and PVC are chemically inert, fairly resistant to biological growth, and have been empirically shown to have excellent flow characteristics, with a C factor of 150 when new and 140 when aged.

Steel pipe should maintain decent flow characteristics throughout the life of the pipe as long as pipe maintenance is performed, including pipe flushing, disinfection, and protecting the pipe from internal corrosion. Steel pipe typically has a C factor of 140 when new and 120 when aged.

Abrasion of the cement mortar pipe lining can occur when velocities inside the pipe exceed 10 to 13 feet per second (fps) for extended durations of time (greater than 4 hours for multiple days at a time). To minimize the chance for abrasion, steel pipe needs to be sized so that velocities are less than 10 fps during peak demands. The Laguna Road Pipeline has been sized for peak velocities of 5 fps in order to avoid significant head loss and abrasion in the pipe. PVC and HDPE pipe have significant abrasion resistance, even at velocities higher than 10 fps.

For PVC and CML&C steel pipe, we can assume that the nominal diameter and inside diameter of the pipe are approximately equal, especially considering the friction coefficient. HDPE is unique and can be specified in Iron Pipe Size (IPS) or Ductile Iron Pipe Size (DIPS), however IPS is much more common and is considered here. IPS is based on the pipe OD. Since the pipe wall thickness is significantly thicker compared to even PVC pipe, a larger HDPE pipe diameter will need to be specified to get an equivalent inside diameter. For example, 24-inch DR 17 HDPE has an ID of 21.1 inches, 26-inch DR 17 HDPE has an ID of 22.76 inches and 28-inch DR 17 HDPE has an ID of 24.51 inches. Kennedy Jenks recommends using 28-inch DR 17 HDPE unless hydraulics shows the smaller ID of the 26-inch HDPE is acceptable.

5.1.4 Structural Integrity

External Loading

Pipe strength and the specified bedding foundation work together to withstand the trench or backfill load and any superimposed or live loads. Trench load is a function of the soil material and trench width. For preliminary design purposes, a unit weight of 120 pcf, a minimum of 4 feet of cover and a maximum cover of 10 feet will be used. The pipeline will be installed at the 4-foot minimum cover throughout most of the alignment to minimize the potential for loose sands to slough into the trench since most contractors use trench shields for pipe installation. Deeper depths will only be used when required to cross existing utilities. Since there is the possibility that a trenchless crossing may be required at the Revolon Slough, loading will also be checked at 25 feet of cover, and will require tight sheet and shoring to minimize sand sloughing into the trench and minimize dewatering from groundwater. Live loads of 16,000 lbs., based on AASHTO H20, will be applied to pipes with less than 8 feet of cover; adjusted for the depth of cover over the pipe.

The Marston Equation is used to determine the vertical external load on the pipe due to the fill material. The equation is:

$$W_e = C_d w B_d^2$$

Where:

W_e = The vertical load on the pipe (lb./ft of length)

C_d = Load calculation coefficient for conduits completely buried in ditches

w = The unit weight of fill materials (pcf)

B_d = Horizontal breadth of ditch at top of conduit (ft)

The Marston equation shows that the load on the pipe increases in relation to the square of the trench width. The trench width is equal to the outside diameter of the pipe plus the sidewall clearance from the outside edge of the pipe to the edge of the trench wall. A sidewall clearance of 12-inches on each side of the pipe allows for the proper installation of the trench bedding and pipe while minimizing the load on the pipe.

CML&C steel pipe, HDPE, and PVC are designed as flexible conduits. The pipe wall thickness is required to resist the bending stress and deflection due to the trench load, and the pipe also gains support from the undisturbed trench walls. Table 5-1 provides the deflection of the 24-inch diameter pipe, assuming an modulus of soil reaction E' of 1000 for the pipe bedding, at 4-feet of cover, the minimum cover required per the District's Standards, and also at 10-feet of cover, which is the anticipated deepest cover for the replacement pipe. The calculated pipe deflections are within the manufacturer's recommended maximum allowable deflection.

Table 5-1 24-inch Pipe Deflection Calculations

Pipe Material	Pipe Deflection (4' Cover)	Pipe Deflection (10' Cover)	Max. Allowable Deflection
HDPE (SDR 17)*	1.41%	1.87%	5%
PVC (SDR 25 PC 100)	1.11%	1.52%	5%
CML&C (0.135" wall thickness)	1.11%	1.43%	2%

*28-inch nominal diameter for HDPE to match equivalent 24-inch inside diameter

A check was also made at 25-feet of cover in anticipation of a possible trenchless crossing of the Revolon Slough. Deflections of 4.30% and 3.50% were calculated for the HDPE and PVC pipe respectively and are within the allowable deflection of the pipe. For CML&C steel pipe, a depth of 25 feet would require the steel pipe wall thickness to be increased to 0.375 inches to fall within allowable pipe deflection. Changing the pipe bedding from sand to either ¾" crushed rock or a 1- or 2-sack cement slurry could reduce the wall thickness to 0.1875 inches.

5.1.5 Internal Pressure

The pipe wall must be designed thick enough to handle two types of internal pressure: working pressure and surge pressure. Wall thickness for working and surge pressures are determined based on the Hydrostatic Design Basis (HDB) for PVC and HDPE and hoop strength for CML&C steel pipe. The HDB of 4,000 psi for PVC pipes and 1,600 psi for HDPE pipes was determined from empirical testing of the pipe's short term and long term bursting pressure. PVC and HDPE use the surge pressure wave equation to add surge pressure to the working pressure before determining the minimum thickness. In all cases, a minimum safety factor of 2 is applied to the wall thickness for surge plus working pressures.

Wall thickness for CML&C steel pipe was determined based on a conservative maximum internal hoop strength of 33,000 psi for low grade steel pipe. Steel pipe is assumed to be able to take a design surge pressure based upon 75% of the internal hoop strength.

The proposed pipeline is assumed to have a maximum working pressure of 60 psi based on working pressures along the PTP pipeline and the proposed connection to the PV Wood Road Pipeline. All pipe materials selected for this project are suitable to withstand this internal pressure.

5.1.6 Joint Tightness

The pipe joint serves two purposes: First, it must be watertight to prevent infiltration and exfiltration. Second, the joint must be flexible to accommodate earth movement, thereby preventing pipe fractures. Push-on joints will be used for PVC based on ASTM Standard A746 and AWWA C900, respectively. CML&C steel pipe will use either welded lap joints or rubber gasketed joints per AWWA C200. HDPE pipe will use fused joints using a McElroy Fusion Machine that can record pressure, temperature, and time of the fusion. To account for earth settlement, PVC joints provide the necessary flexibility while welded steel pipe and HDPE joints provide stiffness to resist any settlement. All three joint types are effective in preventing infiltration/exfiltration.

Thrust restraint will be required for pressure pipe where horizontal or vertical changes in the alignment occur. Externally installed mechanical restrained joints are recommended for PVC pipe to allow the weight of the pipe and the soil above the pipe to resist movement. CML&C steel pipe will require welded lap joints where thrust restraint is required so the weight of the pipe and soil will resist movement. HDPE pipe will not require any additional thrust restraint as all the pipe joints are welded, so the joints will not separate. Concrete thrust blocks are not recommended as the size and location of the blocks can be problematic during and after installation, with the potential for utility interference or the potential for soil behind the thrust block to be disturbed, especially for large diameter pipes (24" +).

5.1.7 Availability

Kennedy/Jenks has contacted the pipe suppliers to determine the estimated delivery time for the pipe. The estimated delivery time for 2,900 feet of 24-inch diameter PVC is approximately 45 calendar days. The estimated delivery time for 24-inch CML&C steel pipe is approximately 60 calendar days. The estimated delivery time for 2,900 feet of 28-inch diameter HDPE pipe is approximately 45 calendar days. This availability is affected by the existing material shortages for petroleum products and steel, due to high demand, energy concerns, and weather conditions at the material fabricators' locations.

5.1.8 Handling/Installation

Handling and installation of the pipe will be similar for two of the three types of pipe material (PVC and CML&C). A crane, trackhoe or front-end loader with a pipe sling will be required to unload the pipe and install in the trench. Then a hairpin sling, pipe clamp, or ratchet lever will guide the spigot end into place. PVC pipe would be significantly easier for the contractor to handle, since it is significantly lighter than CML&C steel as summarized in Table 5-2. PVC pipe is vulnerable to UV light above grade. Both CML&C Steel pipe and PVC pipe are recommended for below grade installations, and CML&C Steel pipe is recommended for above grade installations.

For HDPE pipe, the pipe is usually strung out on the ground and fused above grade; which requires a large work area. This area should be available along the shoulder of Laguna Road. After the fusion process is complete, the pipe is then rolled or pulled into the trench. Since HDPE has a high coefficient of thermal expansion compared to most other pipe materials, care must be taken during design to account for temperature fluctuations when stored, making connections or installed above grade. HDPE is recommended for below grade installations.

Table 5-2: Pipe Weight and Standard Lengths

	24-inch Equivalent Diameter
Pipe Material	**Weight (lb./ft)**
HDPE (DR 17)*	59.87
PVC (DR 25, Class 165)	56.00
CML&C Steel (0.135")	123.00

<u>Note:</u>
*28-inch diameter used for HDPE to match IDs

5.1.9 Material Costs

Material costs are based on a 24-inch nominal/inside diameter for the pipe, and a length of 2,900 feet. The costs provided by the suppliers contacted are provided in Table 5-3. The costs <u>do not include</u> installation or taxes. Installation costs for steel pipe is assumed to be higher due to the heavier weight of the ferrous pipe compared to plastic pipe. Additionally, the cost of installing steel pipe can be higher if welded joints are used compared to rubber gasketed joints.

The cost is also affected by the existing material shortages for petroleum products and steel due to high demand, energy concerns, and weather conditions at the material fabricators' locations.

Table 5-3 24-inch Pipeline Supply Costs

PVC (DR 25)		CML&C Steel		HDPE*	
Unit Cost ($/LF)	**Total Cost ($)**	**Unit Cost ($/LF)**	**Total Cost ($)**	**Unit Cost ($/LF)**	**Total Cost ($)**
$123.90	$360,000	$131.46	$381,000	$107.43	$312,000

Note:
*Based on 28-inch DR 17 HDPE

5.1.10 Materials Evaluation Summary

The pipe materials were evaluated based on the above-described criteria. Each category was rated from 1 to 5, with 1 being a low rating and 5 being a high rating. Each category was weighted based on the importance of the category, and then multiplied by the rating to determine the weighted value of each rating. The ratings were then added together to determine which material had the best overall characteristics for the project. Table 5-4 represents the general comparisons of the pipe materials.

Table 5-4: Pipe Material Ratings

Category		PVC		HDPE		CML&C Steel	
	Weight (%)	Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating
Life Expectancy	15	5	0.75	5	0.75	5	0.75
Corrosion Protection	15	4	0.60	5	0.75	4	0.60
Flow Characteristics	10	5	0.50	5	0.50	4	0.40
Structural Integrity	10	5	0.50	5	0.50	5	0.50
Joint Tightness	10	4	0.40	5	0.50	5	0.50
Availability	10	5	0.50	5	0.50	4	0.40
Handling & Installation	15	5	0.75	5	0.75	3	0.45
Material Cost	15	4	0.60	5	0.75	4	0.60
TOTAL	**-**	**-**	**4.60**		**5.0**	**-**	**4.20**

5.1.11 Materials Recommendation

All three pipe materials are technically feasible for this project, though HDPE and PVC rank the highest. Based on the criteria evaluated in Table 5-4, HDPE and PVC are preferred materials for the buried pipe. If an above grade installation is selected, steel would be the most appropriate materials for its UV resistance, durability, ability to span distances unsupported and minimal thermal movement.

It should be noted that for an HDD trenchless crossing of the Revolon Slough, at least one vertical curve in the alignment will be necessary. Comparing the bend radius of fusible PVC, steel and HDPE, the bend radius of fusible PVC and steel is much greater and would require a longer and deeper alignment length. This depth could cause deep service connections, if necessary, along Laguna Road. Therefore, if HDD is the selected installation method, HDPE would be the recommended material over fusible PVC or steel.

5.2 Alternative Alignments

The proposed Laguna Road Pipeline is located within the Oxnard Plain along Laguna Road and starts at the connection to the PV system near the intersection of Laguna Road and Wood Road and heads west for approximately 3,500 linear feet to the connection with the PTP System. Laguna Road is a 2-lane paved road with a 24-foot-wide travelled way and a 50-foot wide right-of way.

Three alternative alignments, the North, Center, and South Alignments were initially assessed, as shown by Figure 5-1. The North Alignment is north of the public right-of-way (blue), Center Alignment is within the public right of way (yellow), and the South Alignment is south of the public right-of-way (orange). The South Alignment was eliminated due to a cell tower located within the alignment. Further analysis of the North and Center Alignments is provided in Section 5.2.6 Alignment Analysis.

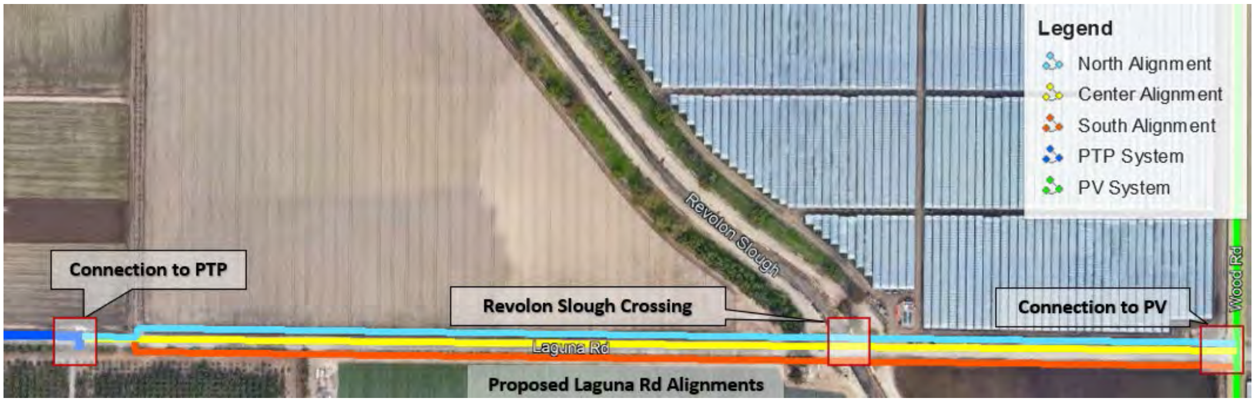


Figure 5-1: Three Proposed Alignments on Laguna Rd.

5.2.1 Utility Research

Preliminary utility research was conducted using Digalert for the alignments. The utilities identified in the area include: Airtouch Cellular—Verizon Wireless (CO Motive), AT&T, Frontier, Pleasant Valley Water District, SCE, and SoCal Gas. Overhead telephone and electrical lines are located along the right-of-way of Laguna Road along the north side of Laguna Road. A 4-inch irrigation line parallels Laguna Road in a farmer's parcel between the Revolon Slough and the connection to the existing 16-inch PTP line on the west side. The line is approximately 4 feet north of the north right-of-way line. A gas line is located on the north side of Laguna Road approximately 12 feet north of the street centerline. A Verizon telecommunication line starts at the intersection of Wood Road and Laguna Road and travels along Laguna Road approximately 4 feet north of the street centerline to just past the Revolon Slough, were it joins a Verizon Telecommunication Tower to the south of Laguna Road. A parcel on the northwest corner of the intersection of Laguna Road and Wood Road contains Pleasant valley's Well No. 7 and a 12-inch waterline from the well to the existing 27-inch Pleasant Valley waterline in the east side of Wood Road.

Table 5-5. Summary of Existing Utilities

Utility	Contact	Number
Airtouch Cellular—Verizon Wireless	John Crosse	(818) 898-2352
AT&T	John Vierra	(209) 604-9679
Frontier	Betty Tenorio	(310) 264-5100
Pleasant Valley Water District	Jared Bouchard	(805) 482-2119
SCE	Paul Vega	(805) 654-7480
SoCal Gas	Sergio Rodriguez	N/A

5.2.2 Utility Corridor Requirements

The utility corridor width varies based on the diameter of the pipeline. The following table anticipates the minimum utility corridor width under ideal conditions to construct the proposed pipeline.

Nominal Pipe Diameter Size (inches)	Minimum Utility Corridor Width Required (feet)
24-inch	10.3-ft

The utility corridor widths are based on the following:

- 28-inch OD HDPE pipe
- A construction trench width of the OD of the pipe plus 12-inches on each side of the pipe
- A minimum 3-feet clearance between the outside of the utility corridor trench width and the outside of an adjacent utility.
- A minimum of 4-feet depth of cover of the pipe, requiring a 7-foot deep trench for pipeline installation requiring a 4-foot wide trench at the top. If the pipeline needs to be uncovered without shoring during maintenance and repairs, a 6-foot deep trench at a 1:1 slope would be 14 feet wide at the top, while with shoring, a 4-foot wide trench would be required.

A 10-foot horizontal separation and 1-foot vertical separation between potable water pipelines and existing sewer or recycled water lines is required in accordance with the California Code of Regulations, Title 22, 64572. However, this separation requirement can be reduced to four feet by utilizing special construction techniques and materials and obtaining DDW approval. Since this waterline is a non-potable waterline that will be converted to a recycled waterline, a 4-foot horizontal separation and 1-foot separation between recycled water pipelines and other recycled water pipelines or sewers is required in accordance with the California Code of Regulations, Title 22, 64572.

Consideration should also be given to allow for a minimum 10-foot horizontal clearance between overhead electric lines and the outside of the trench per California Department of Industrial Relations Electric Safety Orders.

Based on a review of the location of existing utilities, there is enough room for a utility corridor in either of the two alternative alignments; in the farm just north of the Laguna Road right-of-way (North Alignment), or within Laguna Road (Center Alignment).

5.2.3 Temporary and Permanent Easement Requirements

Per discussions with the District, if the Laguna Road Pipeline is installed in the farmer’s property just north of Laguna Road, a 15-foot permanent easement will be required for the District’s use to maintain and access the line as needed. This 15-foot easement will also minimize impacts to the farmer’s property and operation.

The contractor needs a minimum construction work area along the project to be able to work at a minimum level of efficiency. This width needs to allow for excavation of the pipe trench, equipment, trench spoil, backfill and bedding, and pipe stringing.

Installation of a 28-inch diameter pipeline will require an approximate 4-foot-wide trench to install the pipe and shoring and 12-foot-wide work area on both sides of the pipe trench for a minimum width of 28 feet. If the construction work is being done on the Center Alignment (in Laguna Road Right-of-Way), there should be enough room to construct the pipeline and potentially leave one lane open for traffic with a flagman required. If construction is for the North Alignment (the dirt farm road north of Laguna Road), a 10-foot temporary easement to the north of the permanent easement should be requested from the farmer to help with construction purposes. As an option, to help speed up construction for the contractor, an encroachment permit should be filed with the County of Ventura to allow the use of 10-20 feet width of Laguna Road just south of the proposed permanent easement with traffic control that would allow extra room for the contractor to move equipment and materials around the pipe and trench.

5.2.4 Required Valves and Appurtenances

Combination Air and Vacuum Valves (CAVs) will be required along the new pipeline alignment. CAVs will be installed at all high points along the pipeline, at local high points that could occur when valves are closed and spaced a maximum of 2,500 lineal feet on straight pipeline runs. The CAVs are preliminary sized at 2-inches based on the general rule that every one-foot diameter of pipeline requires 1-inch of CAV. The size of the CAVs will be confirmed during final design.

Isolation valves shall be 24-inch gate valves per the District’s standards and will be installed at maximum intervals of 2,500 feet. Locations shall be at the connections with other pipelines where possible to maximize operational flexibility and to maintain service to all customers. The crossing of the Revolon Slough may be another location where valves should be considered, and KJ will confirm with VCWPD if these valves are required, or if valves at either end of the pipeline are sufficient. In the event the pipe is damaged, the valves could be closed to allow repair work and minimize service interruption. Because 24-inch gate valves have the actuator on top of the pipe, and the distance from the top of the pipe to the top of the valve nut is approximately 40-inches, a minimum of 48-inches cover should be maintained for the pipeline so that the valve nut doesn’t stick out above grade.

Blow-off facilities will be required along the new pipeline alignment and will be provided at low points of the pipeline. District standards require blow-offs at the end of waterlines or between two valves where a low point exists. Since there is no local sewer in proximity of the blowoff for discharge, the District will need to treat the water once recycled water is accepted into the system before water from the blowoff can be discharged into a storm drain or storm channel. It may be feasible to discharge to the Revolon Slough, however, this will require a permit from the County and the LA Regional Water Quality Control Board.

5.2.5 Geotechnical Concerns

A geotechnical investigation and subsequent report (Appendix A) was conducted and prepared by Yeh and Associates and included 4 bores along Laguna Road between the proposed start of the pipeline and the intersection of Laguna Road and Wood Road. Borings were located along the north side of the road. Two borings were drilled at each end of the alignment approximately 12 feet deep, while the other two borings were drilled next to the Revolon Slough and were 30 feet and 50 feet deep respectively. The 50-foot deep boring was converted into a monitoring well to measure fluctuations in the ground water between wet and dry seasons, take groundwater samples to determine if there are any constituents that would require treatment before discharging into the Revolon Slough, and if needed, pump testing to determine dewatering requirements for both trenching and trenchless installations.

Material from the borings varied from silty clay with sand, to clay with sand to poorly graded sand with silt, with an OSHA soil classification of Type B to Type C soil, which requires either trench shields, shoring or temporary excavation slopes of 1.5:1 H:V to 2:1 H:V in soils above ground water. Groundwater varied between 7-9 feet below ground surface (bgs) at the two borings furthest from the Revolon Slough to 10-17 feet bgs in the borings near the slough. In soils below groundwater, tight shoring systems such as sheet piles, braced excavations, secant pile walls, or soldier pipe/lagging walls should be provided to reduce the flow of water into the excavation, allow dewatering within the shoring area, and reduce seepage. Trench shields/boxes are not recommended for excavations in loose/unconsolidated soils or in excavations below the groundwater table.

Where necessary, dewatering should lower the groundwater elevation to at least 2 feet below the depth of the excavation and provide a stable subgrade for construction. Dewatering in excavations below approximately 10 feet deep could produce significant amounts of water that will need proper disposal according to regulatory discharge requirements. Dewatering could result in ground settlement, and monitoring of groundwater flow from pumps and piezometers, as well as surveying and monitoring settlement of existing structures should be performed to evaluate the impacts of dewatering near existing structures.

5.2.6 Alignment Analysis

The two alignments, North Alignment and Center Alignment were analyzed with the utility information, easement information, and other considerations. This section provides the advantages and disadvantages for each alignment.

5.2.6.1 Alternative 1 - North Alignment

Alternative 1 is located in a proposed 15-foot-wide permanent easement to the north of Laguna Road. The pipeline is set 10 feet off the north right-or-way line with Laguna Road. This alternative offers the following advantages:

- The proposed pipeline will be open-cut construction in dirt and will not require asphalt pavement replacement, providing cost and time savings.
- Minimizes traffic impacts by providing the ability to leave one lane open for traffic.
- The alignment has minimal buried utilities.

The alternative has the following disadvantages:

- The 15-foot-wide permanent easement would not be enough for construction. The Contractor would either need to get about 25 more feet of temporary easement from the farmer or get an encroachment permit and use half of Laguna Road for construction purposes.
    - Getting the easement from the farmer would potentially affect the farmer’s crops and operations depending on the location of irrigation lines along the property line and the time in which the work is undertaken.

  - Getting the encroachment permit would require one lane to be closed and requiring a flagman during construction hours. Any damage to the road during construction would also need to be repaired.

- The Contractor would need to navigate and be cautious with the existing telephone and electrical overhead wires along the north edge of Laguna Road, including a 10-foot separation between the edge of the trench and the power lines, and the farmer's 4-inch irrigation line that parallels the road.

- Construction of a bridge, microtunnel or auger bore crossing the Revolon Slough could interfere with the farmer's operations on either side of the slough.

- A flagman will be necessary for traffic control, as one lane will be closed to traffic.

5.2.6.2 Alternative 2 – Center Alignment

Alternative 2 is located north of the centerline within Laguna Road. The proposed pipeline could shift between 5 feet north from street centerline to 5 feet south of the street centerline depending on the existing utilities and Right-of-Way dimensions. This alternative offers the following advantages:

- Pipeline would stay within one section of the street utility corridor and appears to have minimal interference with utilities

- The road right-of-way is wide enough for the contractor to construct the pipeline without taking any additional temporary easement from the private landowners next to the road.

- A private easement is not required and coordination with the landowner is not required.

- Laguna Road is not in Ventura County's 2022-2026 Multi-year Pavement Plan for road rehabilitation.

The alternative has the following disadvantages:

- Traffic control measures will require closing at least one lane within the 2-lane street sections and may require both lanes closed. If both lanes are closed with detours, the Contractor may be able to install the pipeline faster than trying to maneuver construction equipment around a one lane closure with the trench, strung out pipeline, and spoil pile of dirt. However, this may not be practical due to the need for farmers to access their property from the road.

- Trenching in the road will require pavement repair/replacement which will increase costs.

- Existing power lines on the north side of the right of way will require a minimum of 10 feet distance between the trench and the power poles based on the voltage of the line. The alignment will be adjusted based on the confirmed voltage of the lines.

- If a trenchless crossing needs to be placed within the road, the road will require a shutdown for the trenchless work, which could take up to two months depending on the trenchless method used. If a trenchless crossing needs to be added north of the road then it would impact the farmer's operations.

5.3 Revolon Slough Crossing Analysis

KJ requested and received the record drawings from Ventura County Watershed Protection District (VCWPD) for the Laguna Road Bridge crossing the Revolon Slough. Based on the record drawings, the existing Revolon Slough is a 55-foot wide, 16-foot deep concrete channel that crosses at a 60 degree skew to the Laguna Road. The actual bridge itself is a large double box reinforced concrete culvert that has a 10-inch wide, 30-foot long, and 14-foot high pier wall that splits the channel for water to go into the RCB. The top slab thickness of the RCB is 18-inches and the RCB has a railing extension above that of 15-inches, for a total of 33-inches. It would be difficult to hang a 24-inch diameter steel pipe on the north side of the bridge within that space. The south side of the bridge has an existing walkway and a 12-inch pipe hanging on the side already, so there is no room to hang the pipe on the south side. Since there is no room to hang the pipe on the bridge, two options are available for crossing the Revolon Slough; extending the pipe across the channel on its own bridge, or a trenchless crossing underneath the channel.

5.3.1 Above Grade (Bridge Crossing)

5.3.1.1 Technical Issues

For above grade crossings, the maximum allowable span of the 24-inch steel pipe is critical for determining the number of pipe supports required to cross the channel. A 55-foot wide channel crossed at a 60 degree skew presents an approximate total of 64 feet of span that needs to be crossed with the potential for one pipe support in the middle of the channel. In accordance with the AWWA M11 design guidelines for steel pipe, and the Steel Pipe Fabricator's guide, and assuming a simple beam equation with a maximum beam deflection of 2% of the pipe diameter, a 24-inch diameter pipe with a ¼" thick wall steel thickness can practically span up to 48-feet, while the same pipe with a 5/8" steel wall thickness can practically span up to 60-feet in length. The pipe crossings will require pipe saddles on each side of the bridge to help support the pipe, and a 2-inch combination air and vacuum valve will need to be installed on the pipe since it will be a local high point in the line that could trap air.

KJ reviewed both possible pipe thickness alternatives based on feasibility of construction, environmental issues, and costs. The first option (see Figure 5-2, Bridge Crossing Option 1), utilizing the existing 10-inch wide pier wall as a pipe support for the ¼" thick wall steel pipe had several disadvantage related to the construction of the bridge:

- The existing pier wall is too small to handle the required pipe support, the wall would need to be modified to handle the larger support.
- Increasing the pier wall for the support could significantly affect the hydraulics in the channel, which VCWPD would most likely not approve unless the change in hydraulics is mitigated.

- Modifying the pier wall would require the channel and modification to occur during the dry season and will need the contractor performing the modification to be aware of the weather to protect workers and construction if an unexpected storm occurs.

- Since the pipe is exposed, the pipe should be painted every 10-20 years to protect the pipe from corrosion and remove graffiti.

- Pipe will be visible to the public and could be a target for vandalism, but could be painted a color that would help it blend into the background except if it's used to carry recycled water, it will need markings to delineate that it is a recycled water line. Fencing may be required to protect the pipeline.

- Would be difficult to repair the pipe in the event of damage to it, and there is potential for recycled water to enter the creek in the event of damage.

- Final Design will need to include seismic design and wind loading of the bridge to confirm it will meet seismic and wind standards, which could result in addition costs for additional wall thickness to the pipe, an additional expansion joint, or other items to improve the safety of the bridge.

- Any cost savings in minimizing the steel wall is lost in the required pier modification.

- Final Design will include additional costs, including additional costs for seismic design.

Based on the disadvantages, KJ does not recommend using the first option for bridge crossing.

The second option (see Figure 5-3, Bridge Crossing Option 2) utilizes a 26-inch diameter steel pipe with a 5/8" thick wall to allow the pipe to span the whole length of the Revolon Slough without the need for a support in the middle of the channel. This option has the following advantages:

- Does not require modification of the existing pier wall in the channel, or affect the hydraulics of the channel.

- Can be installed as one approximate 60-foot piece or as two pieces welded together.

- The 5/8-inch wall thickness of the steel pipe will help resist corrosion and vandalism.

Disadvantage of this alignment include:

- Since the pipe is exposed, the pipe should be painted every 10-20 years to protect the pipe from corrosion and remove graffiti over time.

- Pipe will be visible to the public and could be a target for vandalism but could be painted a color that would help it blend into the background, except if it's used to carry recycled water, it will need markings to delineate that it is a recycled water line. Fencing may be required to protect the pipeline.

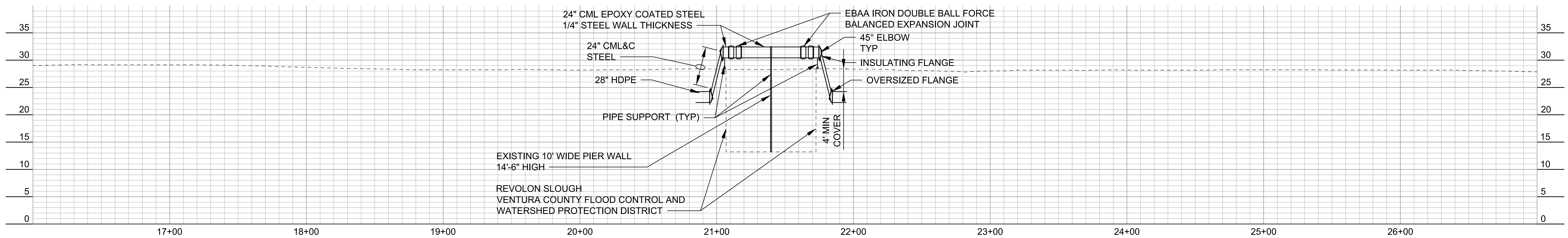
- Would be difficult to repair the pipe in the event of damage to it, and there is potential for recycled water to enter the creek in the event of damage.

- Final Design will need to include seismic design and wind loading of the bridge to confirm it will meet seismic and wind standards, which could result in addition costs for additional wall thickness to the pipe, an additional expansion joint, or other items to improve the safety of the bridge.

KJ recommends the second bridge crossing option based on the comparison of the advantages and disadvantages of the two alternatives.

5.3.1.2 Cost

A Conceptual cost estimate for Option 2 was developed based on the cost of the steel pipe, fittings, pipe supports and other items required for construction of the pipe bridge. The estimated cost of the Bridge is $400,000 and will be updated in final design if selected as the recommended crossing method.



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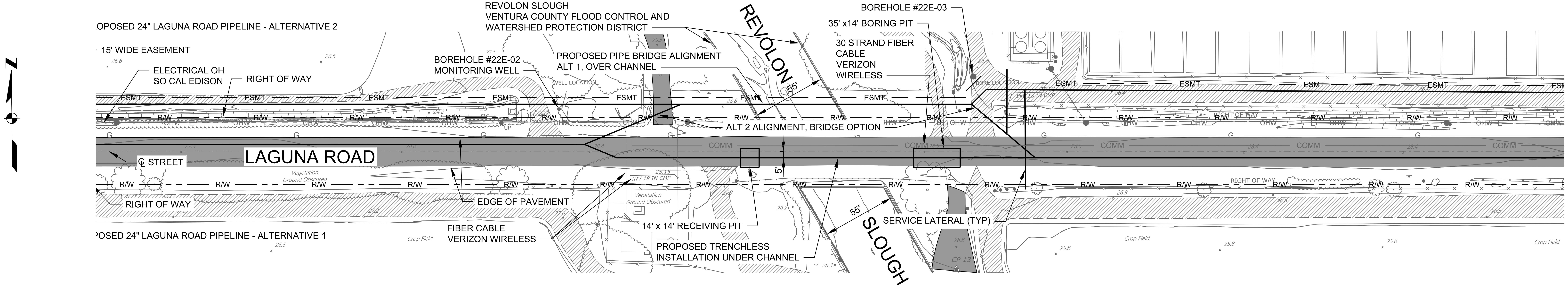

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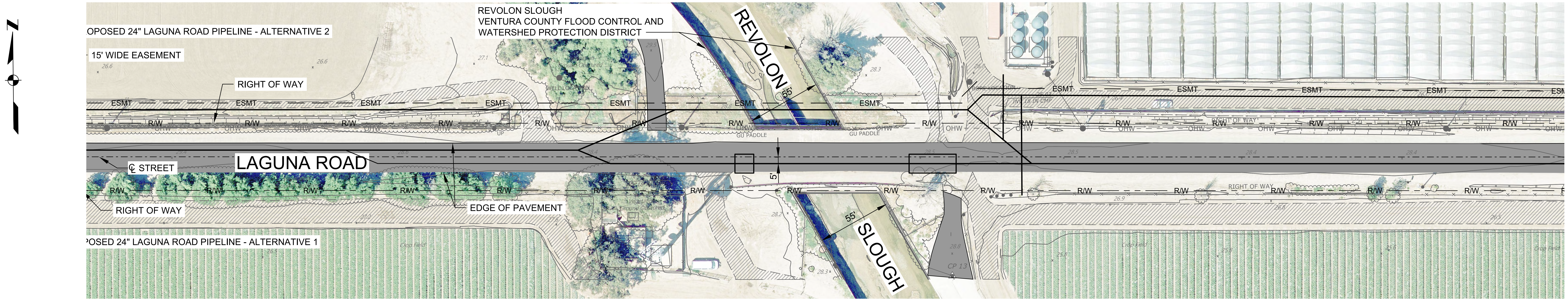

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United Water
CONSERVATION DISTRICT

CHIEF ENGINEER
PROJECT MANAGER

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UNITED WATER CONSERVATION DISTRICT
1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030
PTP RECYCLED WATER CONNECTION
LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT

Kennedy Jenks

BRIDGE CROSSING OPTION 1

FIGURE 5-2

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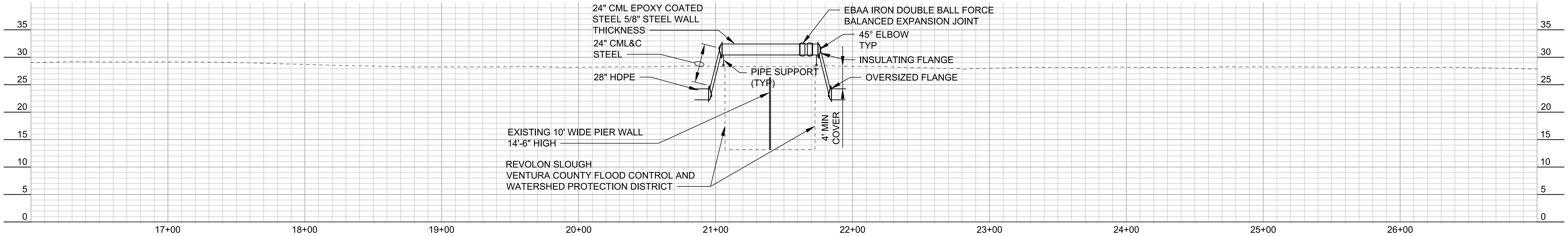

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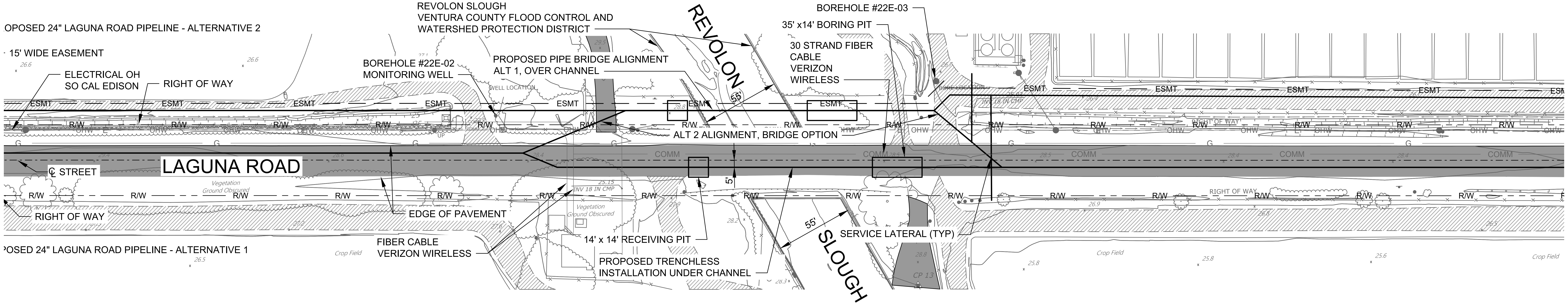

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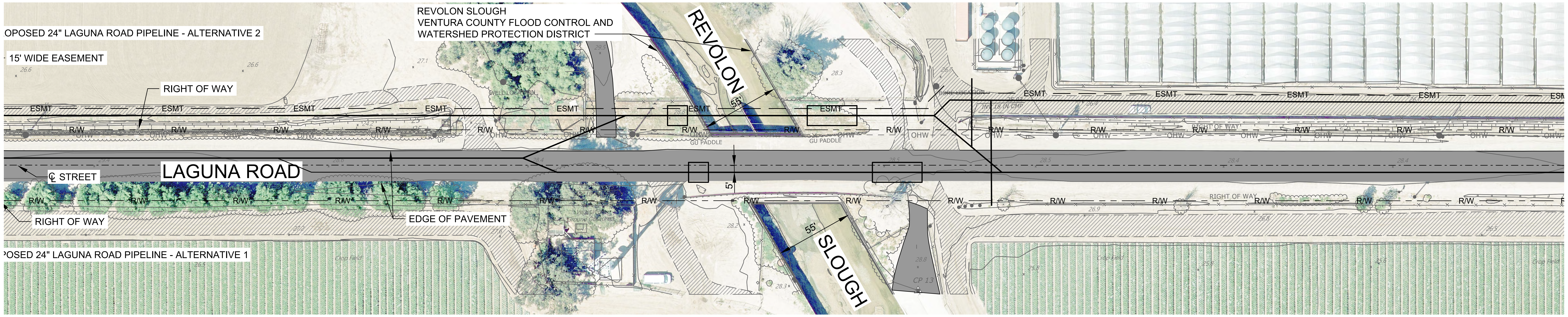

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Kennedy Jenks

BRIDGE CROSSING OPTION 2

FIGURE 5-3

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5.3.2 Below Grade Crossings

The purpose of this section is to review several different trenchless alternatives for the proposed Revolon Slough crossings based on the geotechnical investigation conducted by Yeh and Associates. The trenchless methods that will be evaluated will include Auger Boring, Microtunneling, Open Shield Pipe Jacking, Pilot Tube Guided Auger Boring, Pipe Ramming and Horizontal Directional Drilling.

5.3.2.1 Technical and Geotechnical Considerations

Yeh and Associates' draft Geotechnical report identifies two borings closest to the trenchless crossing. Boring 22E-02 is on the west side of Revolon Slough and Boring 22E-03 is on the east side of the slough. The report characterized the soils in the borings as follows:

- The top 7 feet of soil was artificial fill, of loose to medium dense silty and clayey sand with varying amounts of gravel
- The next 10 feet of soil consisted of unconsolidated sand, silt, and gravel
- Below that point, soil consisted of unconsolidated poorly sorted clayey sand with some gravel

Groundwater in the area varied from 9 feet below ground surface (bgs) at boring 22E-02 to 17 feet bgs at boring 22E-03.

The top of the Revolon Slough is at an elevation of 27 feet above mean sea level (msl). The flowline of the concrete channel is 15 feet below the top of the channel, for an elevation of 12 feet, msl. Per existing plans, the concrete bottom is 18-inches thick and there is 27-inches of filter material below the concrete bottom. Based on VCWPD standards for minimum clearance of five feet between the top of the new pipe or casing and the bottom of the channel's filter material, the trenchless crossing will need a minimum of 22 feet of cover (elevation of 6 feet msl) for the crossing.

5.3.2.2 Trenchless Crossing Selections

Based on the minimum cover of the trenchless crossing and the groundwater levels identified in the geotechnical report, dewatering groundwater will be required or a trenchless technology will need to be selected that does not require dewatering except at the shafts. Groundwater will need to be discharged into the Revolon Slough using a NPDES permit, and water samples should be taken prior to bid so contractors will know if any water treatment is required before discharge. For purposes of this study, KJ will focus on three trenchless technologies that are designed to handle construction in high groundwater conditions, Horizontal Directional Drilling (HDD), Microtunneling, and auger boring. Feasibility of trenchless methods which require dewatering will be determined during final design when pump tests on the monitoring well installed at boring 22E-02 will be conducted. The advantages and disadvantages of these technologies will be discussed in the next subsections.

5.3.2.3 Horizontal Directional Drilling (HDD)

HDD is a surface-to-surface (no shafts required) pipeline installation technique, using downhole drill rigs, and is typically comprised of three phases (see Figure 5-4). During the first phase, high-pressure drilling fluid (drilling mud) is pumped through a guided/steerable pilot bore from an entry location to an exit location along a designed or pre-determined alignment and profile. The HDD equipment is only able to be steered during the pilot bore, so it is important that the pilot bore is constructed correctly to ensure the success of the bore alignment and grade. Locating and tracking the drilling equipment during the pilot bore stage is commonly achieved using surface equipment that receives a signal from a down-hole sonde at the head of the drill stem. The drill locator uses the information received from the signal of the sonde to calculate the azimuth, pitch, depth, roll, and other parameters to determine the location of the drill head. The locator analyzes this data and relays this information to the drill rig operator who then makes adjustment to the steering of the pilot bore to meet the design. This locating/steering process continues on a real-time basis through completion of the pilot bore. Overall accuracy of plus or minus 2-5% of bore depth could be expected, or approximately 1.25 feet maximum error horizontally or vertically. The pilot bore is often thought to be the stage with the highest drilling mud pressures. If the drilling mud pressures exceed the overburden (above ground) pressure, the pressurized drilling fluid can escape to the surface. This is called “hydrofracture” or “inadvertent returns.” These risks can be minimized by real-time monitoring of annular pressures behind the drill bit, and frequent testing of drilling fluids for comparison with annular pressure calculations.

The second phase of the HDD process is referred to as the reaming phase where the bore diameter is enlarged by pushing or pulling reamers through the bore to enlarge the borehole. As the reamers are pushed or pulled, soil is excavated and removed from the borehole with circulating drilling mud. The drilling mud that circulates to the open ends of the bore is pumped to a soil separation system to allow the mud to be cleaned and the excavated material to be removed from the borehole. Multiple passes with reamers of increasing diameters are typically required to ream the bore to its final diameter. Final bore diameters are usually 1.5 times the size of the outer diameter of the product pipe or 12-inches larger, whichever is smaller. The risk of hydrofracture during the reaming process is typically small, unless the upsize from the pilot bore diameter to the reamed diameter is very large. In this case, the drilling fluid pressures can become very large and the risk of hydrofracture increases.

The third phase of the HDD process involves pulling the carrier pipe into the prepared borehole. Often, a barrel reamer that is slightly larger than the diameter of the pipe precedes the final pipe as it is being pulled into the borehole, to remove any collapsed material in the borehole. Drilling mud is circulated during the pull to reduce friction as drilling mud within the hole is displaced by the pipe; therefore, it is critical to be prepared to manage a large volume of drilling mud during the pipe pull-back phase. In cases where there is a large differential elevation between entry and exit elevations, a mud seal is necessary to control and regulate drilling fluid release . General guidelines on required HDD entry work area suggest dimensions of 80 to 100 feet wide and 200 feet in length.

HDD for construction of a new 28-inch HDPE waterline presents a number of challenges. Issues to be addressed include:

- General Geological Conditions- as noted above regarding potential for hydrofracture, if a high percentage of the soil is gravel with a low amount of fine or course sand, or clay, there is a high likelihood of hydrofracture, as the drilling fluid will not stay in the borehole and will follow the voids along the gravels, which would make boring difficult at best, and may even cause failure. Unconsolidated soils and gravel have a tendency to influence the potential for hydrofracture. Confirming the gravel percentage of the borehole samples and the level of consolidation of soils and gravel will help to determine a proper mix of mud to carry the bore.

- Depth of existing waterline – For the Revolon Slough crossing, the proposed waterline is approximately 6 feet below the existing Slough invert). The slough was built with an 18" thick concrete base on a filter bed of gravel approximately 27-inches thick. During final design, calculations will need to be developed to determine if there is a potential for the slurry to not stay confined in the borehole and break through to the ground (hydrofracture), especially in cases where there is a significant amount of gravel in the area with low amounts of fine or course sand to help keep the fluid in the borehole. The necessary pressure to keep the mud in the borehole will be critical as to high a pressure will cause hydrofracture while too low a pressure will make boring difficult.

- Bore Size – For a 28-inch diameter pipe, the bore size pulling the pipe through after reaming the hole would be approximately 42-inches in diameter, to the next standard reamer size. This bore size will need to be used for determining potential interference with existing utilities and the slough crossing.

Figure 5-4 shows a preliminary HDD design for crossing underneath the Revolon Slough. The HDD will be approximately 600 feet in length. The HDD entrance and exit will have angles about 10 degrees from horizontal and the vertical curves in the bore will have a radius of approximately 1440 feet and lengths of 250 feet. An approximate 98-foot-long straight bore will be underneath the slough. Based on initial calculations, the 28-inch diameter HDPE will need to have a minimum SDR of 13.5 to handle the bending radius for the entrance and exit as well as pull back stresses on the pipe.

Requirements for HDD:

1) Minimum carrier pipe diameter: 24 inches inside diameter
2) Carrier pipe materials: HDPE
3) Pilot hole minimum bend radius: 1,440 feet
4) HDPE minimum bend radius: 1,440 feet *(bend radius is governed by pilot hole drill steel or allowable pull loads, whichever results in the longer radius)*
5) Borehole diameter: Minimum 12 inches larger in diameter than outside diameter of carrier pipe
6) Conductor casing: Dependent on geotechnical conditions at profile and resulting borehole stability

7) Profile depth: Top of borehole minimum 5 feet below bottom of slough *(dependent upon site-specific geotechnical conditions and future hydrofracture analysis)*

The horizontal directional drilling concept is shown in Figure 5-4 includes:

1) 20,000 square foot entry side work area

2) 600 feet of 24-inch ID HDPE carrier pipe

3) 600 feet of exit side staging for HDD pipe pullback

5.3.2.4 Microtunneling

Microtunneling is a laser-guided and steered trenchless construction method that does not require manned entry. Microtunneling was originally designed as a soft ground tunneling method capable of direct jacking of the carrier pipe to line and grade using a highly automated and mechanized tunnel boring machine called a microtunnel boring machine (MTBM). The MTBM is advanced through the ground using the pipe jacking method. Excavated spoils are removed from the tunnel face through slurry pipes and separated at the ground surface through mechanical means. Other features of the method include earth and hydrostatic counter balancing methods to minimize ground movement due to construction. Microtunneling has changed over time to include increased capability for rock, longer drives, and curved drives. Microtunneling machines have the ability to pressure balance the force against water, allowing Microtunneling machines to be one of the few trenchless methods able to be used below the groundwater table. Most other trenchless methods required that the groundwater to be below the invert of the casing prior to start of the trenchless work.

Microtunneling for construction of a new 24-inch waterline presents a number of challenges. Issues to be addressed include:

- Depth of existing waterline – For the Revolon Slough crossing, the proposed waterline is approximately 6 feet deep below the existing Slough invert. The slough was built with an 18” thick concrete base on a filter bed of gravel approximately 27-inches thick. The depths of clearance will be evaluated during final design to confirm we have adequate spacing for installation of the casing. Note that since the carrier pipeline is 28-inches compared to a standard 36-inch diameter microtunnel machine, the microtunnel pipe will act as a casing and the carrier pipe will be installed at tunnel completion within the casing.

- Maximum tunnel distance between shafts – A standard 36-inch microtunneling machine is limited to an approximate 800-foot maximum distance between shafts depending on the soils. The Revolon Slough crossing has a horizontal distance significantly shorter than the maximum 800 feet distance.

- Jacking and receiving shafts need to be carefully placed – Jacking and receiving shafts will need to be placed to minimize impacts on traffic and utilities. Jacking shafts for microtunneling are generally large, approximately 40 feet long by 20 feet wide, to accommodate the machine, the pipe to be jacked, and the jacking reaction wall.

Receiving shafts, while smaller, still require approximately 20 feet by 20 feet dimension to remove the machine. There will also need to be a large laydown area behind the jacking shaft to allow the Contractor to set up the microtunnel equipment and install the steel casing. The depths of the shafts could be up to 30 feet deep and will require sheet piles for shoring to minimize groundwater infiltration, and to prevent unconsolidated soil from sliding into the shaft.

- Groundwater above the tunnel soffit – Microtunneling is usually the preferred option for tunnels below the groundwater table. When microtunneling is used above the groundwater table and at a shallow depth there is the potential for hydrofracture (frac-out) of the drilling fluid to the surface, which is to be avoided. Groundwater is anticipated to be between 9 and 17 feet bgs. Encountering groundwater is possible, but not certain and using an MTBM machine when above the groundwater is both very expensive and can lead to other problems, such as loss of drilling mud into the formation. Gathering groundwater depths from the monitoring wells on a periodic basis should help determine when the microtunnel machine will be working in groundwater. We anticipate that groundwater will normally be high during the winter and spring, when most of the rainfall occurs, but summer and fall data will be useful to determine if the groundwater depth will allow construction during the dry months. Groundwater levels should be measured monthly and included as an addendum to the Geotechnical Report for review by the Engineer and the bidding contractors. As a potential option, if the groundwater is deep, and the area is dry or can be easily dewatered, either jack and bore installation or a pilot tube microtunnel can be used to install the casing and pipe.

- Presence of hard materials in the soil– When cobbles or hard soil are anticipated, the approach is to grind the material with the microtunneling machine to a size that allows their removal in the slurry. Microtunneling machines typically start at a minimum 36-inch diameter and get larger from there. The minimum tunnel size for manned entry to remove an obstruction at the face of the machine is 54- to 60-inches in diameter. At this diameter, an air lock can be incorporated into the machine allowing workers to access the face in a controlled air environment. At this size, the casing will need to be designed so that a minimum of five (5) feet of separation occurs between the top of the casing and the bottom of the concrete channel. More separation may be required to protect the channel from potential settlement.

- Potential for Settlement – With unconsolidated soils and gravels, there is the risk of settlement during or after the bore as voids form due to soil and gravel consolidation and settlement. This settlement can be tracked during construction by using settlement monitoring stations above grade along the track of the bore. Voids can be filled by installing grout ports on the microtunnel casing so that grout can be pushed into potential voids after the casing is installed, but before the pipeline is installed inside the casing.

- Require a Rescue Shaft – If a larger microtunnel is not used to reduce capital costs and based on the small size of the pipe to be installed, an allowance for one rescue shaft, to remove hard soil materials or obstructions from the face of the microtunnel machine, should be included in the cost estimate. A rescue shaft should be considered during the final design.

Based on the potential for dealing with groundwater throughout the bore, this alternative is deemed feasible. Depth of cover over the casing can be mitigated through the use of the smallest size microtunnel machine available, setting the top of casing just below the required minimum cover and adjusting the water carrier pipe in the casing. Figure 5-5 shows what microtunnel construction would look like for the waterline.

Summary of requirements for Microtunneling:

1) Minimum carrier pipe diameter: 24 inches inside diameter
2) Carrier pipe materials: HDPE
3) Casing material: Welded steel
4) Steel casing diameter: 42 inches *(minimum 12 inches in diameter larger than outside diameter of carrier pipe upsized to the minimum machine size)*
5) Casing spacers: Required
6) Annular space fill: Assumed fill with grout or sand (between casing and carrier)
7) Profile depth: Top of steel casing minimum 5 feet below bottom of Slough

The microtunneling concept includes:

1) 12,000 square foot launch side work area
2) 5,000 square foot reception side work area
3) 40-foot long by 20-foot wide by 30-foot deep microtunnel launch shaft
4) 20-foot long by 20-foot wide by 30-foot deep microtunnel reception shaft
5) 100 feet of 36-inch steel casing

5.3.2.5 Auger Boring (Jack and Bore)

Auger boring involves jacking steel casing segments forward while removing the spoils within the casing via a rotating auger. Auger boring has been in use for over 50 years and is a reliable technology for trenchless installation in stable soils that are above the groundwater table or soils that can be dewatered so that the casing invert is installed above the dewatered groundwater table. Dense soils can be better for auger boring due to increased soil stability when the casing is bored, minimizing the potential for subsidence. Once the casing is installed, the carrier pipe is then placed inside, supported by casing spacers.

Auger Boring for construction of a new 24-inch waterline presents a number of challenges. Issues to be addressed include:

- Depth of existing waterline – For the Revolon Slough crossing, the proposed waterline is approximately 6 feet deep below the existing Slough invert. The slough was built with an 18” thick concrete base on a fliter bed of gravel approximately 27-inches thick. The depths of clearance will be evaluated during final design to confirm we have adequate spacing for installation of the casing. A 36-inch diameter steel casing will be jacked below the channel and the carrier pipe will be installed at tunnel completion within the casing.

- Maximum tunnel distance between shafts – A 36-inch auger boring machine is limited to an 300-foot maximum distance between shafts. The Revolon Slough crossing has a horizontal distance significantly shorter than the maximum 300 feet distance.

- Jacking and receiving shafts need to be carefully placed – Jacking and receiving shafts will need to be placed to minimize impacts on traffic and utilities. Jacking shafts for microtunneling are generally large, approximately 35 feet long by 14 feet wide, to accommodate the machine, the pipe to be jacked, and the jacking reaction wall. Receiving shafts, while smaller, still require approximately 10 feet by 10 feet dimension to remove the cutting head. There will also need to be a laydown area behind the jacking shaft to allow the Contractor to set up the auger boring equipment and install the steel casing. The depths of the shafts could be up to 30 feet deep and will require sheet piles for shoring to minimize groundwater infiltration, and to prevent unconsolidated soil from sliding into the shaft.

- Groundwater above the tunnel soffit –Groundwater is anticipated to be between 9 and 17 feet bgs. Gathering groundwater depths from the monitoring wells on a periodic basis, as well as doing a pump test on the well should help determine how much dewatering will be required for the project. We anticipate that groundwater will normally be high during the winter and spring, when most of the rainfall occurs, but summer and fall data will be useful to determine if the groundwater depth will allow construction during the dry months considering the close location to farms. Groundwater levels should be measured monthly and included as an addendum to the Geotechnical Report for review by the Engineer and the bidding contractors.

- Presence of hard materials in the soil– When cobbles or hard soil are anticipated, the approach is to grind the material with the auger boring machine to a size that allows their removal. Auger boring machines typically start at a minimum 12-inch diameter and get larger from there. The minimum tunnel size for manned entry to remove an obstruction at the face is 54- to 60-inches in diameter. At this size, the casing will need to be designed so that a minimum of five (5) feet of separation occurs between the top of the casing and the bottom of the concrete channel. More separation may be required to protect the channel from potential settlement.

- Potential for Settlement – With unconsolidated soils and gravels, there is the risk of settlement during or after the bore as voids form due to soil and gravel consolidation and settlement. This settlement can be tracked during construction by using settlement monitoring stations above grade along the track of the boring. Voids can be filled by installing grout ports on the microtunnel casing so that grout can be pushed into potential voids after the casing is installed, but before the pipeline is installed inside the casing.

- Require a Rescue Shaft – If a larger auger bore is not used to reduce capital costs and based on the small size of the pipe to be installed, an allowance for one rescue shaft, to remove hard soil materials or obstructions from the face of the auger boring machine, should be included in the cost estimate. A rescue shaft should be considered during final design.

Based on the potential for dewatering groundwater throughout the bore, this alternative is deemed feasible. Depth of cover over the casing can be mitigated through the use of a 36-inch casing. Figure 5-5 shows what auger boring construction would look like for the waterline.

Summary of requirements for Auger Boring:

1) Minimum carrier pipe diameter: 24 inches inside diameter
2) Carrier pipe materials: HDPE
3) Casing material: Welded steel
4) Steel casing diameter: 36 inches *(minimum 12 inches in diameter larger than outside diameter of carrier pipe)*
5) Casing spacers: Required
6) Annular space fill: Assumed fill with grout or sand (between casing and carrier)
7) Profile depth: Top of steel casing minimum 5 feet below bottom of Slough

The Auger Boring concept includes:

1) 1,500 square foot launch side work area
2) 400 square foot reception side work area
3) 35-foot long by 14-foot wide by 30-foot deep microtunnel launch shaft
4) 10-foot long by 10-foot wide by 30-foot deep microtunnel reception shaft
5) 100 feet of 36-inch steel casing

5.3.2.6 Cost Evaluation

Table 5-6 below shows the cost evaluation for the three trenchless alternatives discussed. Note that these costs are conceptual level costs only and will be updated if selected for final design.

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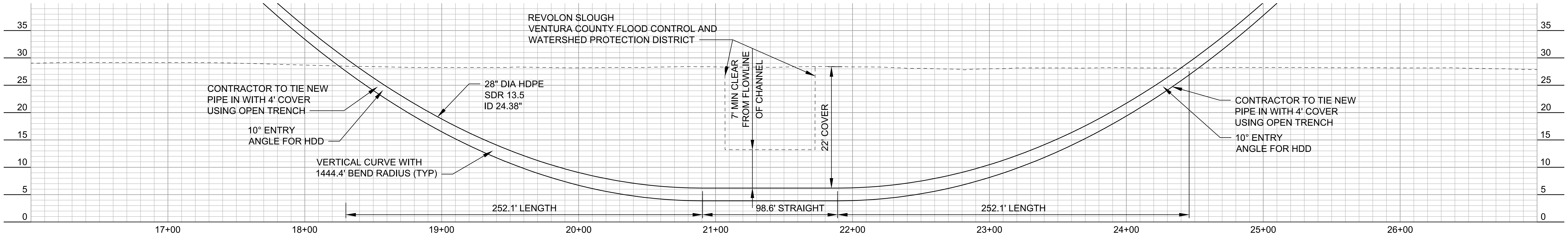

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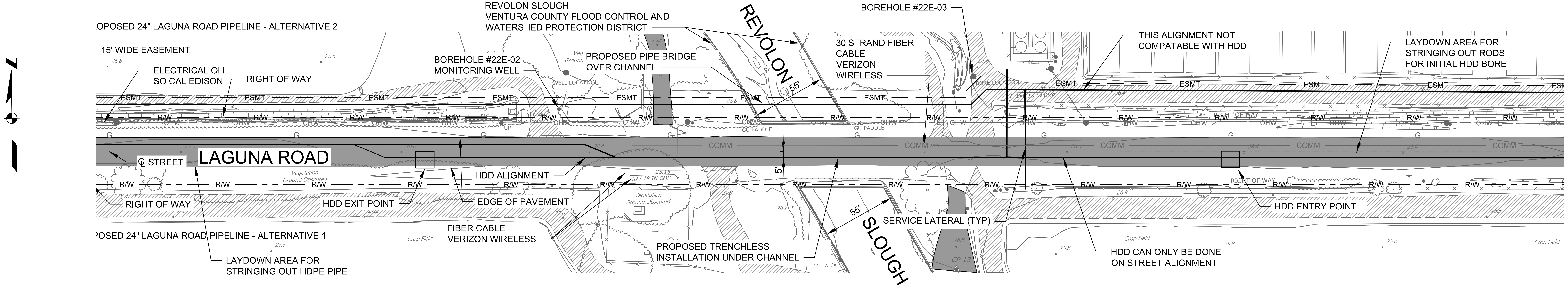

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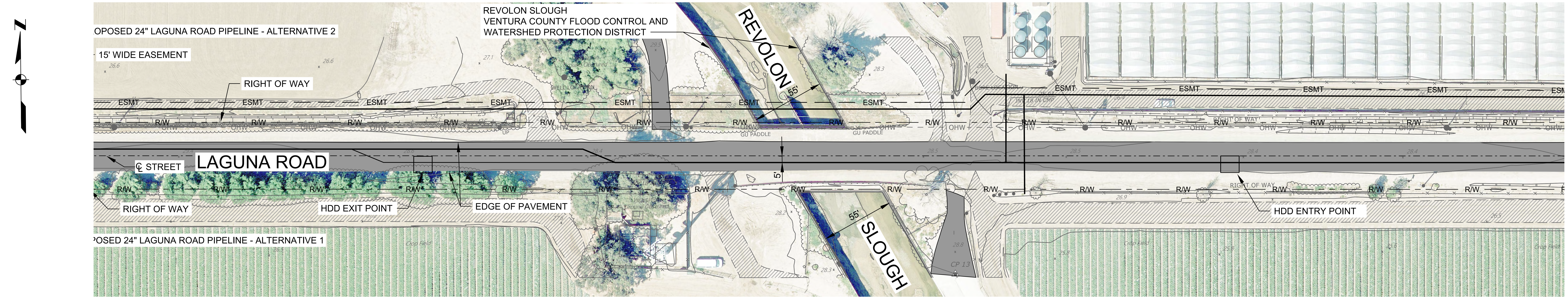

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PROJECT MANAGER			
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UNITED WATER CONSERVATION DISTRICT
1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030
PTP RECYCLED WATER CONNECTION
LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT

Kennedy Jenks

HDD CROSSING

FIGURE 5-4

SCALE

JOB NO
2244204.00

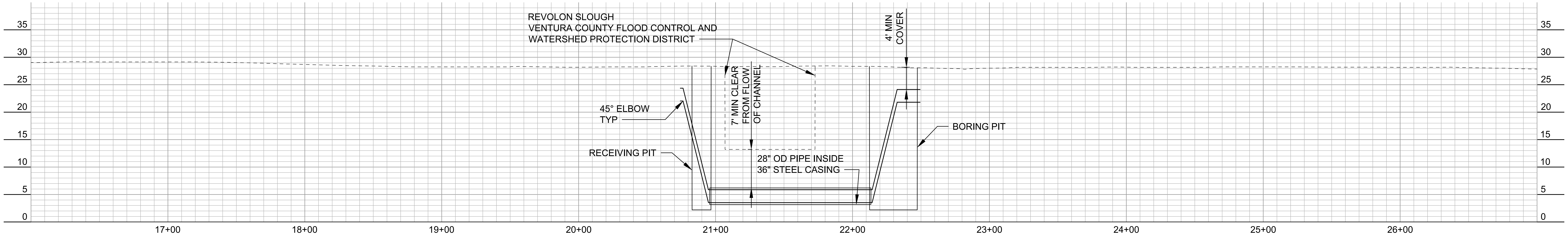
DATE
2022

SHEET OF ---
H-003

Plot Date: 11/10/2022 2:46 PM

User: CHERYL LOVE

pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\United Water Conservation District\Projects\PTP Recycled Water Connection - Laguna Rd Pipeline_2244204.00\010-Design\10.06-Drawings\Civil\2244204.00-C-004



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PROFILE

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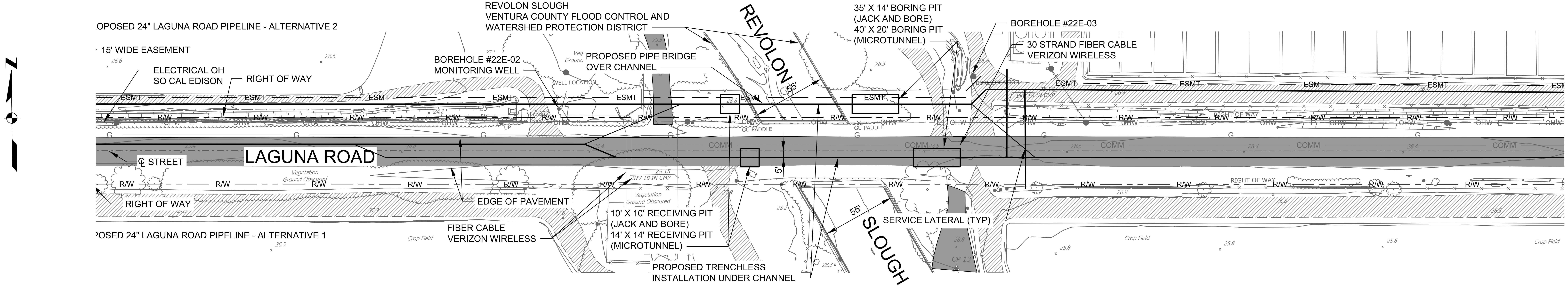

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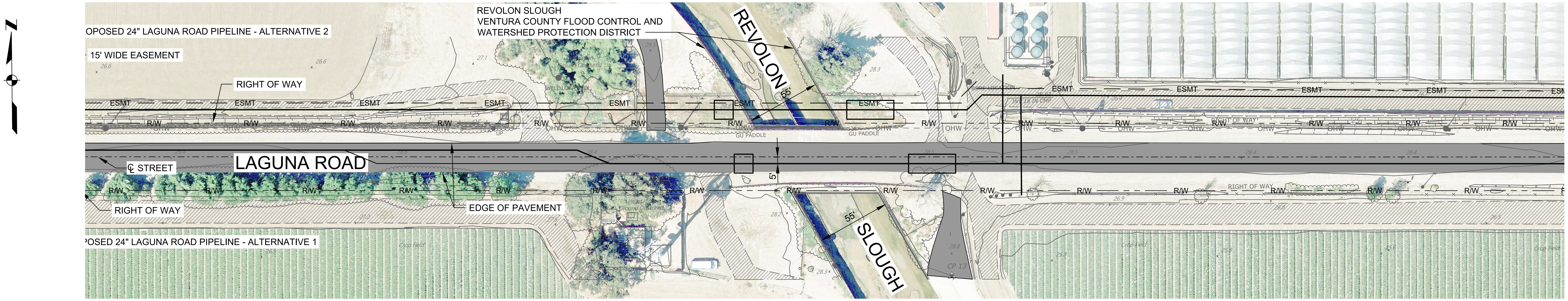
PLAN



##/##/#### - 30% SUBMITTAL

CHIEF ENGINEER
PROJECT MANAGER

NO	REVISION	DATE	BY

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Kennedy Jenks

MICROTUNNEL AND
AUGER BORING OPTIONS

FIGURE 5-5

SCALE
JOB NO 2244204.00
DATE 2022
SHEET OF ---
H-004

Table 5-6: Cost Evaluation

Microtunneling (with one segment and two shafts)

Shaft Dimensions

Description	Length, ft	Width, ft	Depth, ft	Qty	Unit Cost	Cost
Microtunneling (36-inch steel casing)				100 LF	$4,500	$450,000
Launch Shaft	40	20	30	1	$480,000	$480,000
Reception Shaft	20	20	30	1	$240,000	$240,000
MT TOTAL (Conceptual Level)						**$1,170,000**

Horizontal Directional Drilling

Description	Length, ft	Width, ft	Depth, ft	Qty	Unit Cost	Cost
Horizontal Directional Drill				600 LF	$3,000	$1,800,000
(Assumes 24-inch ID carrier pipe)	n/a	n/a	n/a			
HDD TOTAL (Conceptual Level)						**$1,800,000**

Auger Bore (with one segment and two shafts)

Shaft Dimensions

Description	Length, ft	Width, ft	Depth, ft	Qty	Unit Cost	Cost
Auger Bore (36-inch steel casing)				100 LF	$2,000	$200,000
Launch Shaft	35	15	30	1	$360,000	$360,000
Reception Shaft	10	10	30	1	$120,000	$120,000
Dewatering (estimate only)					$100,000	$100,000
MT TOTAL (Conceptual Level)						**$780,000**

5.3.2.7 Crossing Recommendation

The Bridge Crossing option using 5/8" thick steel wall for the pipe was the least expensive of the crossing options with an estimated cost of $400,000, followed by Auger Bore at $780,000. The Bridge Crossing has the lowest capital cost of any of the options, at the cost of vulnerabilities to potential earthquake damage, vandalism, and a higher operation and maintenance cost to repaint the pipeline every 10-20 years, plus any additional costs to repair potential vandalism. The Bridge Crossing option also does not include additional costs for seismic design and wind loading, which could increase the cost of the crossing. The Auger Bore crossing, while having a higher capital cost, will require minimal operational and maintenance costs as the HDPE pipeline inside the casing is resistant to corrosion and will have minimal vulnerabilities to either earthquake damage or vandalism due to being buried and having a material that is resistant to earthquake damage. However, the auger bore potentially risks additional costs during construction for groundwater dewatering during construction. KJ recommends the bridge crossing alternative as the preferred alternative to crossing the Revolon Slough based on cost and constructability. If the District elects not to use the bridge option, then during final design a pump test should be conducted to determine the practicality of dewatering during construction of the Auger Bore method. If dewatering costs appear to be minimal ($100,000 was the estimated cost in the preliminary design), then the auger boring method should be selected, however, if excessive dewatering is required, then the microtunnel option should be selected. Horizontal Directional Drilling, while not requiring dewatering, was the least preferred option based on the length of drilling required, costs, and additional work room required for construction of this trenchless method.

Section 6: Point of Connection

The recommended point of connection based on the findings from the hydraulic and water quality analysis and discussions with the PVWD are summarized in this section.

6.1 Point of Connection Limitations

Hydraulic and water quality analyses identified that a simple pipe to pipe connection point to the PV system would not be feasible without operational modifications. The PTP and PV systems are both low pressure systems at similar hydraulic heads and there is not adequate pressure in the PV system to convey flows to the PTP system, as discussed in Section 3. Additionally, the proximity of Well No.7 and PVWD's reliance on this well through its well optimization plan would primarily result in the conveyance of groundwater to the PTP system, which is not the overall intent of the project. As a result, several potential options for the operational modifications were identified and evaluated as potential point of connection solutions. These point of connection options are summarized in Table 6-1.

Table 6-1. Options for Point of Connection

Option Identified	Description of Option
Option A: Add a new Booster PS (+)	Address hydraulic issues by adding a new booster pump station on the Laguna Road Pipeline near the intersection of Wood Rd and Laguna Rd to increase pressure and allow flow from PV to PTP system.
Option B: PV Operational Changes (+)	Increase hydraulic grade line (HGL) in PV system by modifying the operation of the recently installed pressure reducing valve (PRV) at Hueneme Rd to increase pressure for deliveries of advanced treated recycled water (RW) from Oxnard to the PTP system.
(+) Add-on for Options A or B: New valve vault on PV System North of Laguna Rd	Add a valve vault on PV System at the intersection of Wood Rd and Laguna Rd to avoid conveyance of Well 7 GW to PTP System. The valve would be added to the 27-inch PV pipeline north of Laguna Rd.
Option C: Wood Road Pipeline Isolation	Add two new motor operated valves on PV Wood Road Alignment – (1) near Well 7 and (1) near the Hueneme Road pipeline connection to allow for isolation of a portion of the PV system to have a dominance of AWPF water delivered to the PTP system by isolating Well 7 and Well 3.

Appendix B provides a Technical Memorandum that further outlines the details of the point of connection and potential alternatives that were evaluated as options.

6.2 Analysis of Point of Connection Options

The benefits of each of the four options for the point of connection were analyzed. The limitations identified for the four options are summarized in Table 6-2.

Table 6-2. Limitations of Point of Connection Options

Option	Limitations
Option A: Add a new Booster PS (+)	• Requires more space in an already constricted area at the intersection of Wood and Laguna Rd; land owned by PVWD. • Significant additional capital and O&M costs • When Well 7 is in operation, flows from PV to PTP would be dominated by local groundwater unless an additional vault was added (see add-on below)
Option B: PV Operational Changes (+)	• Potential risks to PV system if operating at higher pressures: (1) leakage/damage to existing infrastructure, (2) loss of groundwater well capacity, (3) modification to multiple groundwater pumps and (4) impacts to customers directly served. • UWCD would have limited control over pressure condition of RW deliveries. • When Well 7 is in operation, flows from PV to PTP would be dominated by local groundwater unless an additional vault was added (see add-on below)
(+) Add-on for Options A or B: New valve vault on PV System North of Laguna Rd	• Requires installation of new infrastructure directly on PV system • Requires additional O&M costs, for energy, maintenance and repairs. • Vault likely required, especially if valve is motor operated, which would require more space in already constricted area; land owned by PV. • Long lead times for large diameter valves (up to a year)
Option C: Wood Road Pipeline Isolation	• Potential risks to isolated segment of PV system if operating at higher pressures: (1) leakage/damage to existing infrastructure, (2) loss of groundwater well capacity, (3) modification to multiple groundwater pumps and (4) impacts to customers directly served. • Requires direct modifications to the PV system and potentially for customer connections along this segment (e.g., install PRVs) • Requires land and infrastructure for new vaults for motor operated valves. • Long lead time for large diameter valves (up to a year).

6.3 Recommended Point of Connection

Based on further analysis of the options and discussions with PVWD it is recommended that the point of connection include a pump station to convey flows into the PTP system, as well as an isolation valve within the PV line on Wood Road that would divert flows from Well No. 7 to the north part of the that system to avoid conveyance to the PTP system.

Benefits of this option are that it provides adequate head to convey flows from the PV to PTP system and allows for the mitigation of groundwater from Well No. 7 being conveyed into the PTP system.

PVWD currently owns a plot of land at the intersection of Wood and Laguna Roads. This plot of land is used for Well No. 7, but has adequate land available for the construction of a new pump station. Based on initial evaluation of the land, a portion of the parcel is being used by the neighboring farmer.

Figure 6-1 identifies a high-level preliminary layout of a potential pump station layout within the existing PVWD parcel. Based on the parcel information and known requirements, there is adequate space to install a pump station within the parcel. The crops that are within the parcel owned by PVWD may be impacted for creating an access route for pump maintenance work, however, this will depend on further analysis and design of the proposed pump station and valve.

This initial concept identified two potential limiting factors on the site. The first is the existing 12” ACP line which may be located slightly farther north than what is shown in the layout. The available system drawings show the connection to the pump station at the south center portion of the pump station, however, based on Google Earth Street view it appears that the groundwater pump discharge line is located further north. This will need to be further evaluated in the next phase of design. The second limitation is the overhead electrical wires which require a 10-foot clearance from the pump station or a waiver by the electrical company.

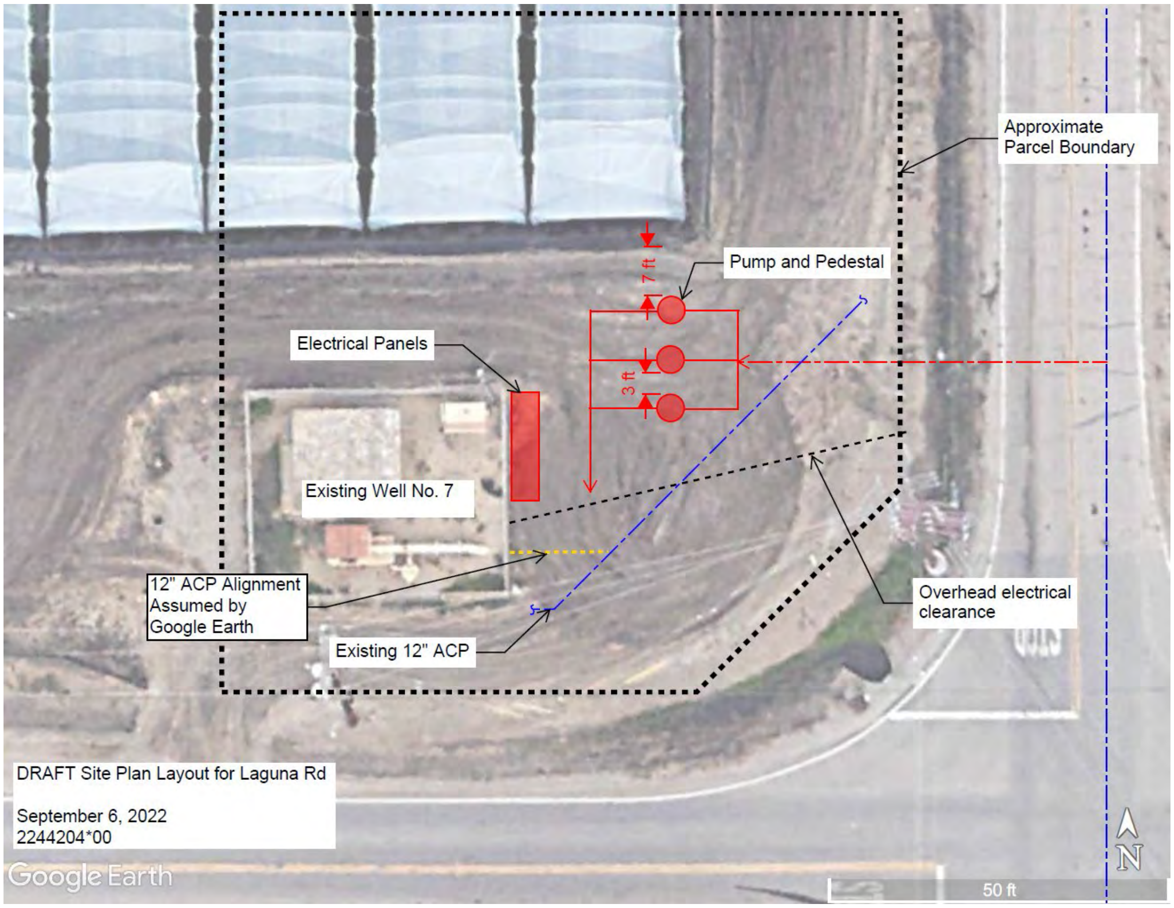

Figure 6-1. Preliminary Layout of Potential Pump Station Connection

Further evaluation of the feasibility of this design is required and discussions with PVWD would be required since this involves development of a pump station on their property as well as the addition of a valve on their existing pipe. The point of connection with their system may also impact the PV system hydraulics and must be further considered in collaboration with PVWD.

Section 7: Permitting

Table 7-1 summarizes the permitting that is anticipated to be required to construct the pipeline based on its alignment. It also includes the estimated cost of the alignment. Copies of permit applications and instructions are included in Appendix C. Each permit is discussed in further detail below.

Table 7-1. Summary of Permits Required

Permit	Estimated Cost	Permit Required for Alignment Alternative	
		North Alignment	Center Alignment
County of Ventura Public Works Agency Roads and Transportation Encroachment Permit	$750 + an additional inspection fee deposit	Yes	Yes
Ventura County Publics Work Agency Watershed Protection District Encroachment & Watercourse Permit	$2000 ($395 application fee + 1605 trust account deposit)	Yes	Yes
Los Angeles Regional Water Quality Control Board	$250	Yes	Yes
Ventura County Air Quality Control District	$0 – Contactor responsible for equipment	Yes	Yes
Cal-OSHA – Trenching	$0 – Contractor responsible	Yes	Yes
Cal-OSHA – Tunnel Classification	$0 – Contractor will pay a $50 fee if they require a diesel generator in the tunnel	Yes	Yes

- **County of Ventura Publics Work Agency Roads and Transportation Encroachment Permit:** This permit is required since the project will be in the public right-of-way. A traffic control plan is required when applying for this permit.

- **Ventura County Publics Work Agency Watershed Protection District Encroachment & Watercourse Permit:** This permit is required since the project is in the vicinity of the Revolon Slough and within the VCWPD right-of-way. There may also be discharge of water into the Revolon Slough which would also need to be covered by this permit and a discharge permit from RWQCB below.

- **Los Angeles Regional Water Quality Control Board (RWQCB)** - National Pollutant Discharge Elimination System (NPDES) Construction Storm Water Pollution Prevention Plan (SWPPP) Permit, pursuant to Section 402 of the CWA, and a Water Quality Certification (or a waiver thereof), pursuant to Section 401C of the Clean Water Act. The District would be required to complete and submit an NPDES/SWPPP Permit application, Water Quality Certification, and associated fees before beginning construction dewatering (if applicable) or pressure testing discharges. Since this is a linear pipeline project that would disturb more than 1 acre of land, the Contractor would be responsible for following the District's general permit and submitting the Notice of Intent (NOI) and developing the SWPPP per the District's Special Conditions.

- **Ventura County Air Quality Control District (VCAQCD) –** Implementation of BMPs for dust control and construction equipment emissions is expected to be required by the VCAQCD. Mitigation measures outlined from the approved CEQA document will be incorporated into Contract Documents.

- **California Occupational Safety and Health Administration (Cal-OSHA)** – The contractor is required to have a Trenching/ Shoring permit for any portion of the project involving trenching, demolition, and excavation greater than 5 feet in depth. A tunnel classification permit will also be required for any jack and bore or Microtunnel with a casing diameter of 30-inches or greater. Note that Horizontal Directional Drilling (HDD) does not require a tunnel classification permit.

Section 8: Grant Requirements

In September 2020, the District received a $343,000 grant from the Natural Resources Conservation Service (NRCS) which supports water supply efficiency to growers. The grant will pay per weight of pipeline, which needs to be considered further based on an anticipated requirement of a pump station near the point of connection.

Section 9: Summary of Agreements

The connection to the PV system will allow for the conveyance of water from sources including Oxnard, Camrosa, and Camarillo, however, it will require agreements with several agencies. These agencies are anticipated to include Pleasant Valley Water District, the City of Oxnard, the Fox Canyon Groundwater Management Agency, and PTP Customers.

9.1 Pleasant Valley Water District

The District and PVWD will need to develop a mutually beneficial agreement that addresses operations controls, costs, available land for the pump station construction, and other existing PVWD agreements with other agencies. An agreement will be required between the District and PVWD for the conveyance of water from the PV to PTP system. Two significant components of this agreement are anticipated to be the operational controls and cost of water. PVWD will need to consider the potential impact of this connection to their existing agreements with other entities. The agreement must begin during design and be further refined as the design progresses.

9.1.1 Operational Agreement

An operational control agreement with PVWD will be required. This agreement is important for the overall success of the project and protection of existing infrastructure. The operational agreement should consider the following:

- **Water Deliveries Timing:** Identify anticipated times (seasonally/ daily/ duration) of water deliveries from the PV to PTP system. This would consider the available water supplies from other sources and the timing of the District pulling water from the PV system.

- **Operation Limits:** An agreement of allowable pressures, flowrates, and other system parameters/conditions that would impact both the infrastructure and functionality of the PV and PTP systems.

- **Maintenance Plans:** An agreement of maintenance, especially if a portion of it is directly on the PV system must be considered.

- **Emergency Connection:** During design it may be possible to develop a bypass system that in the case of an emergency or excess surface water delivery that the District could convey flows if the normal surface water delivery route from El Rio is out of service.

- **Data Sharing:** Transparent and mutually accessible data for decision making for both agencies on system operation.

9.1.2 Cost Agreement

A cost agreement must also be identified with PVWD for the water that is imported from the PV to the PTP system. It is recommended that the cost agreement consider the various types of water qualities that may exist in the system and the willingness of PTP system users to pay for the higher quality water. Agreements on cost of land use, construction costs, and operation and maintenance will be necessary. It is anticipated that the District will own, operate, and maintain most, if not all, of the infrastructure for the point of connection.

9.1.3 Existing PVWD Agreements with Other Entities

PVWD has existing agreements such as the agreements with the City of Oxnard, Camrosa, and Camarillo. These and the connection of the PTP system to the PV system must be considered in the agreement. PVWD currently has a 2-year agreement with the City of Oxnard for advanced purified water deliveries through the Hueneme Rd pipeline. The City of Oxnard may consider using a portion of their available advanced purified water for groundwater recharge. This may impact the future agreement and availability of water supplies for the PV/PTP systems.

9.2 Fox Canyon Groundwater Management Agency

The FCGMA is responsible for management of groundwater resources in the region. The groundwater pumps in the PV system extract water from the Pleasant Valley groundwater basin, while the groundwater pumps in the PTP system extracts from the Oxnard groundwater basin. Existing agreements with FCGMA, the District, and PVWD require the conveyance of a portion of surface water to benefit the Pleasant Valley basin. Since the conveyance of water from the PV to PTP system may include a portion of groundwater, this may require approval from the FCGMA.

9.3 PTP Customers

The anticipated water quality from the connection to the PV system would improve. This would result in a higher quality water being delivered to customers, however, at a higher cost per unit. Since the water is of a higher quality, less water is anticipated to be required. It is anticipated that a rate agreement would need to be negotiated with PTP customers to account for the improved water quality and additional costs to deliver that higher quality water.

Section 10: Cost Estimate

A preliminary opinion of probable construction costs for the water pipeline have been prepared and is provided in Appendix D. The construction costs include a 25% contingency and are based on information available at the time of preparation.

The opinion of probable construction cost for the preferred alternative of the 24-inch diameter water pipeline is approximately $2.46 Million. This cost is based on the 30% design drawings and an average cover of 4 feet over the 28-inch HDPE DR 17 Pipe. The cost includes installation in a 15-foot wide easement north of Laguna Road, Four 6-inch service connections to farmers including pavement sawcutting, removal, and replacement, one 2-inch air and vacuum valves, 24-inch gate valves on each side of the pipeline, and auger boring across the Revolon Slough with a 36-inch casing. Auger boring (jack and bore) was included in the cost estimate for the Revolon Slough crossing as it is more conservative of the two potential Revolon Slough crossing options. There is a potential for cost savings if the bridge crossing option is chosen. Costs do not include the pump station connection and related analyzers and flow control for the pump station, traffic control, pressure testing, disinfection, restrained joints or potholing, but some of these costs are assumed to be included in the 25% contingency. Division 1 Costs such as mobilization, demobilization, bonds, submittals, and similar items have been assumed to be 10% of the construction cost.

Section 11: Summary of Findings, Recommendations, & Next Steps

The following section provides a summary of the findings from the project and provides a recommendation on the next steps to further advance the design of the Laguna Rd pipeline and connection to the PV system.

11.1 Summary of Findings

Based on the work conducted as part of the PDR the following were identified:

- **Water Quality:** By connecting to the PV system there is the opportunity for improved water quality, especially when water from the Oxnard AWPF is available.

- **System Hydraulics:** The available HGL of the PV system is not sufficient to convey the desired flow to the PTP system. Additional head or operational controls will be required for the Laguna Rd pipeline connection to be successful. This can be achieved through the addition of a pump station at the intersection of Wood and Laguna Rds.

- **Pipeline Design:** 28-inch Diameter HDPE DR 17 is recommended for buried pipe due to its light weight, cost competitiveness, durability, and resistance to corrosive soils. Pipeline should have a minimum of 4-feet of cover and be designed for AASHTO H20 loading. Assume a maximum working pressure of 60 psi, and a design pressure of 100 psi.

- **Pipeline Alignment:** The proposed easement to the north of Laguna Road is recommended to minimize costs for removing and replacing the existing AC pavement within Laguna Road, and easier access to the pipe for operation and maintenance.

- **Revolon Slough Crossing:** KJ recommends a bridge crossing over the Revolon Slough using 26-inch diameter welded steel pipe with a minimum 5/8” steel wall thickness. An alternative crossing method could be an auger bore underneath the Revolon Slough. However, this is anticipated to be more expensive and pump tests would be required to determine the amount of dewatering required for the crossing.

- **Point of Connection:** Based on preliminary evaluation, the implementation of a pump station on PV owned land is feasible and would provide adequate head to convey flow to the PTP system. Additional considerations such as additional apparatus or operational controls will need to be considered for minimizing the movement of groundwater from the PV to PTP system, primarily from Well No. 7.

11.2 Recommendations

Based on the findings of this PDR, the following is recommended for the pipeline, point of connection, and water quality monitoring.

Pipeline Design

Based on the findings of this analysis the highlighted alignment in the 30% Design Drawings (Appendix E) is recommended, using the alignment in the private easement to the north, with willingness of the landowner to provide an easement. It is also recommended that a new turnout be added to the landowner's property. The pipeline is recommended to be 28-inch DR 17 HDPE pipe for buried pipe. Any exposed pipe should be epoxy coated and cement mortar lined steel pipe. The crossing of the Revolon Slough based on available information should be an auger bore, however, if dewatering costs are excessive then a bridge crossing should be considered.

Point of Connection

At the point of connection to the PV system, it is recommended that a pump station is used to convey flows from the PV system to the PTP system since the systems operate at similar head conditions. The pump station is recommended to be placed on the PV owned land through coordination with PV. It is also recommended that a vault on the PV system be installed at the intersection of Wood Rd and Laguna Rd to avoid conveyance of Well No. 7 groundwater to the PTP system. The valve would be added to the 27-inch PV pipeline north of Laguna Rd. Flow control and backflow prevention should be considered in the next phase of design, as well as an emergency by-pass connection, if this is of interest to PV.

Water Quality Monitoring

Monitoring of water quality will be important to identify the type of water that is entering the PTP system. Since it is anticipated that the Oxnard AWPF water will be a higher cost per unit than the existing water supplies in the PTP system, it is recommended that further coordination be conducted with farmers to understand the desired water quality impacts to their current operations and primary water quality objectives. This will also help inform the District of preferred timings of water deliveries of higher quality water when available. It is recommended that chlorine and TDS be monitored, using HACH 10 and the E+H Promag 400W, respectively.

11.3 Next Steps

The following next steps are recommended to advance the design of the project:

1) **MOU with PV:** Develop a MOU with PV to establish the basis of design for the connection point. This will serve as an initial agreement of design parameters that will be used for the design of the pump station and advancing the design of the pipeline. This agreement will be critical for advancing the design and meeting the schedule of the grant.

2) **Farmer Water Quality:** Establish a greater understanding of the agricultural water quality constraints and benefits through coordination with the farmers in the PTP system. This can be achieved through farmer surveys and/or coordination with the Farm Bureau of Ventura County.

3) **Dewatering Parameters:** Conduct a pump test of the monitoring well next to the Revolon Slough to determine the required dewatering parameters.

4) **Coordination with Permitting Agencies:** Coordinate with permitting agencies including the DDW, FCGMA, private landowner, CEQA, and other permitting agencies including Ventura County and LA RQQCB.

5) **Additional Hydraulic Analyses:** Conduct additional hydraulic analyses that will form the basis of design for the pump station and operational controls, including surge analysis.

6) **Begin 30% Pump Station Design:** Based on the conceptual design established as part of this technical memorandum and with the design parameters identified in the MOU with PV, the 30% pump station will need to be designed. This would then be progressed through final design.

7) **Advance 60% Pipeline Design:** Based on the findings from this preliminary design and the MOU with PV the pipeline design will be advanced to 60% through final design.

8) **MOA with PV:** Once the design is progressed develop a MOA with PV for the operation of the system prior to construction.

Appendix A: Geotechnical Report

Preliminary Geotechnical Report

United Water Conservation District

PTP Recycled Water Connection, Laguna Road Pipeline Project

Oxnard, California

Yeh Project No.: 221-500

October 28, 2022

Prepared for:

Kennedy Jenks Consultants
2775 North Ventura Road, Suite 202
Oxnard, California 93036
Attn: Mr. Ray Lyons, PE

Prepared by:

Yeh and Associates, Inc.
56 E. Main Street, Suite 104
Ventura, California 93001
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October 28, 2022

Project No. 221-500

Kennedy Jenks Consultants
2775 North Ventura Road, Suite 202
Oxnard, California 93036

Attn: Mr. Ray Lyons, PE

Subject: **Preliminary Geotechnical Report, United Water Conservation District, PTP Recycled Water Connection, Laguna Road Pipeline Project, Oxnard, California**

Dear Mr. Lyons:

Yeh and Associates, Inc. is pleased to submit this draft Geotechnical Report for preliminary design of United Water Conservation District PTP Recycled Water Connection, Laguna Road Pipeline project along Laguna Road west of Wood Road in Oxnard, California. This report was prepared in accordance with our agreement for professional services, dated February 18, 2022 and Amendment No. 1 dated May 9, 2022. Recommendations and geotechnical considerations are provided for pipe installation, pipe connections and trench details, earthwork, corrosion test data, seismicity, and liquefaction. Preliminary design considerations for trenchless installation using HDD or design considerations for foundations to support the pipe above ground is also provided.

The geotechnical evaluation consisted of a program of data review, field exploration with drilling and installation of a temporary monitoring well, laboratory testing, and analyses. Field and laboratory data collected for this study are attached to the report. Graphics showing the locations of the field explorations, and an interpreted subsurface profile are also provided.

A summary of the key geotechnical considerations for the design of the pipeline replacement is as follows:

- The field exploration program consisted of drilling four borings and installing one groundwater monitoring well as well as reviewing previous geotechnical data available in the site vicinity. Explorations along the proposed pipeline alignment extended to depths of 11.5 to 51.5 feet below the existing ground surface. The subsurface conditions encountered consisted of up to approximately 8.5 feet of artificial fill that has been placed and re-worked as part of agricultural activities. Alluvium was encountered below the artificial fill. The alluvium consisted predominantly of soft to stiff clay with interlayers of loose to medium dense sand. More sand was present in the borings west of the Revolon Slough.

- The new pipe is anticipated to be constructed between 7 and 12 feet below the invert of the channel using horizontal directional drilling (HDD) or supported at grade adjacent to the bridge on foundation supports. Geotechnical considerations that could impact the HDD below Revolon Slough are groundwater, caving and slumping ground, permeable sand and gravel lenses and layers, and relatively soft and variable subsurface conditions within the alluvium. The same considerations could impact a bridge alternative. Additional considerations for a bridge alternative are consolidation settlement for shallow foundations, the need for relatively long, deep foundations to obtain the capacity to resist the loads within the soft and wet fine-grained soil.

- Granular soil layers encountered within the alluvium in the borings is potentially liquefiable considering the design earthquake. The horizontal portion of an HDD alternative is below within these depths. The consequences of liquefaction are estimated to be approximately 1.5 inches of vertical settlement within the identified soil layers. Mitigation for liquefaction could consist of ground improvement, supporting the pipe on deep foundations, or managing the hazard as part of the operations and maintenance plan for the pipeline and water system with an emergency response plan. Yeh can provide additional information or services to address liquefaction for the design of the pipeline if requested.

We appreciate the opportunity to be of service. Please contact Loree Berry at 805-481-9590 or lberry@yeh-eng.com if you have questions or require additional information.

Sincerely,
YEH AND ASSOCIATES, INC.

Loree A. Berry, P.E.
Senior Project Manager

REGISTERED PROFESSIONAL ENGINEER
LOREE A. BERRY
No. 73221
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CIVIL
STATE OF CALIFORNIA

Nick Simon, GIT
Project Geologist

Colter Stopka
Staff Geologist

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1. PURPOSE AND SCOPE OF STUDY

Yeh and Associates was retained by Kennedy Jenks to provide geotechnical recommendations for the design of the United Water Conservation District (UWCD) Laguna Road recycled water pipeline project in Oxnard, California. The location of the site is shown on Figure 1.

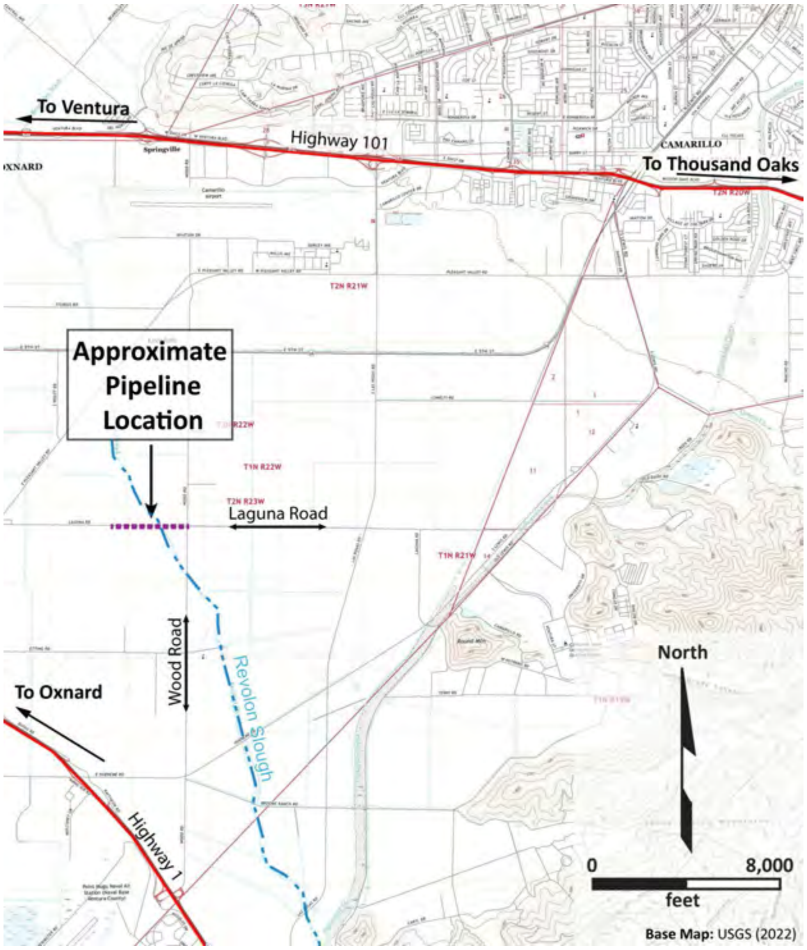


Figure 1: Project Location Map

The geotechnical evaluation consisted of a program of project coordination, field exploration with drilling, installation of a temporary groundwater well, laboratory testing, and engineering analyses as a basis for providing the preliminary recommendations in this report. This report provides field and laboratory data collected for the project, an assessment of key geologic hazards that could impact the project, and geotechnical considerations and recommendations for earthwork, the cut and cover portions of the new pipeline, and considerations for the proposed trenchless and above ground alternatives across the Revolon Slough.

2. PROJECT UNDERSTANDING

The project generally consists of constructing a new recycled water connection between the United Water Conservation District (UWCD) Pumping Trough Pipeline (PTP) and the Pleasant Valley County Water District (PV) system. The pipeline will consist of 24-inch diameter HDPE and extend approximately 2,700 linear feet. The majority of the new pipeline will be trenched with a minimum four feet of cover; however, the pipeline crosses the Revolon Slough, a 60-foot-wide concrete-lined flood control channel operated and maintained by Ventura County Public Works Department – Watershed Protection. Preliminary design is considering either an above ground option to support the pipe on the existing culvert or on above ground pipe footings where Laguna Road crosses the slough or to design a trenchless crossing below the channel. A trenchless crossing would be approximately 600 feet long.

2.1 SITE DESCRIPTION

The site of the new pipeline is within the Oxnard Plain. The terrain in the project vicinity is relatively flat and gently slopes to the west and the east from the Revolon Slough at an average grade of less than 1 percent. Existing site grades are near elevation 27 feet and flow in the channel flows southerly through the project limits. The Revolon Slough is a rectangular shaped concrete lined flood control channel approximately 60 feet wide and with 15-foot-high channel walls at the project location.

The pipeline alignment runs along Laguna Road from near Wood Road at the eastern end and extending approximately 2,700 feet west. The alignment is bordered by active agricultural uses on the north and south side of Laguna Road. Several overhead utility lines are present along the north side of Laguna Road.

2.2 PROPOSED PROJECT IMPROVEMENTS

The project limits and preliminary layout of the site were provided on drawings and written descriptions from Kennedy Jenks in July 2022. The project generally consists of constructing a new 24-inch diameter recycled water pipeline below Laguna Road. The majority of pipe will be installed less than 5 feet deep using trenching methods. A portion of the pipeline will cross the Revolon Slough. Preliminary design concepts include installation using trenchless construction below the channel or by supporting the pipeline above ground on foundations. The most likely trenchless concept consists of approximately 600 linear feet of 24-inch diameter fused HDPE pipe installed below the flood control channel using horizontal directional drilling. The concept indicates the invert of the new pipe will be approximately 7 to 12 feet below the bottom of the channel. The new pipe will rise in elevation to the trenched portion of the pipe with an approximately 1400-foot bend radius outside the limits of the channel, resulting in a total drilled length of approximately 600 feet (measured horizontally). An alternative concept for the pipeline crossing is to support the pipeline above the ground surface on the existing or a retrofitted culvert or new pipe footings. The invert of the pipe beyond the crossing segment is anticipated to have approximately 3 to 4 feet of cover.

3. FIELD EXPLORATION AND TESTING

The field exploration program consisted of drilling four borings adjacent to the project alignment. One of the borings was converted to a temporary groundwater monitoring well at the completion of drilling. The locations of the borings and well are shown on Plate 1. The logs of the borings including remarks on well completion are presented in Appendix A.

3.1 DRILLING

The drilling subcontractor for this project was 2R Drilling from Chino, California. 2R Drilling used a CME75 truck-mounted rig equipped with 8-inch-diameter hollow-stem augers to drill four borings to depths ranging between 11.5 and 51.5 feet deep on April 28 and 29, 2022. Yeh personnel logged the subsurface conditions encountered during the drilling, secured soil samples for subsequent laboratory testing and classified the soil encountered. The samples intervals, a description of the subsurface conditions encountered, field tests, blow counts (N-Values) recorded during drive sampling, percent recovery, and selected laboratory test data are presented on the log.

Sampling was performed by driving either a modified California or standard penetration test (SPT) split spoon sampler at typical 2.5-foot intervals to approximately 20 feet below the ground surface, and at 5-foot intervals below 20 feet. The SPT sampler has a 2-inch outside diameter, 1-3/8-inch inside diameter and is equipped for but was used without liners. The modified California sampler has a 3-inch outside diameter, 2-3/8-inch inside diameter and was used with 1-inch-high brass liners. Drive samples were collected using a 140-pound automatic trip hammer in accordance with ASTM D-1586 (the Standard Penetration Test) procedures.

Upon completion, borings 22E-01, 22E-03, and 22E-04 were backfilled with bentonite chips mixed with approved native fill material collected from the auger cuttings to the ground surface. Boring 22E-02 was completed as a temporary 2-inch PVC monitoring well with a flush mount well cover. The well was constructed according to Ventura County Well Permit GWP-08653.

3.1 WATER LEVEL MONITORING

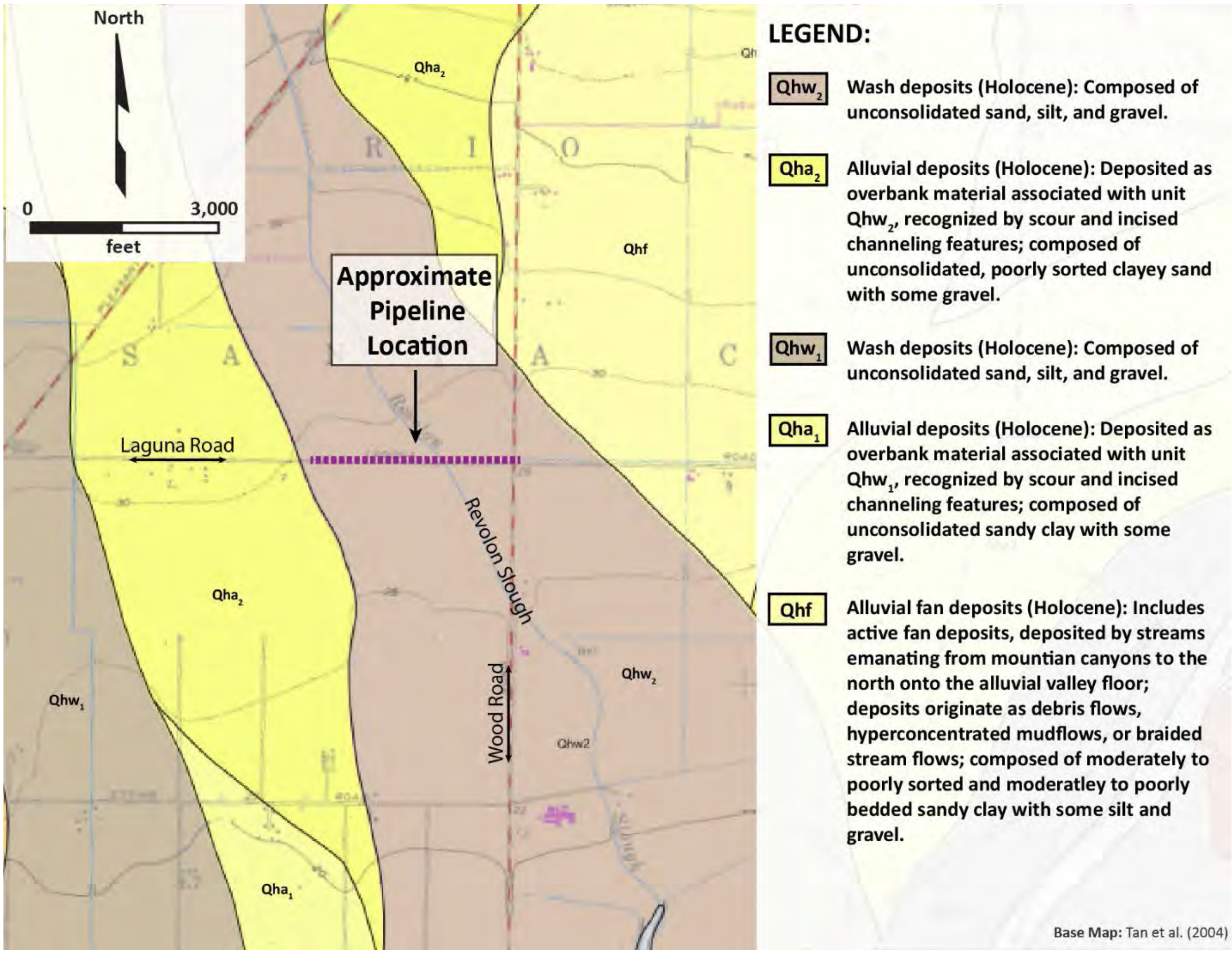
Yeh has measured the depth to groundwater in the monitoring well on April 29 and July 15, 2022 and the values are reported in the Section 4.3. A pressure transducer/datalogger (TD-Diver) will be installed in the well during October/November 2022 to obtain 1-hour groundwater measurements through approximately April 30, 2023. This will provide nearly continuous groundwater level data and the ability to track fluctuations, response to rain events, irrigation, or other. Yeh will periodically visit the well to download the collected data and manually measure water levels. Groundwater measurements subsequent to this report will be incorporated with the final Geotechnical Report.

3.2 LABORATORY TESTING

Laboratory testing was performed on selected samples recovered from the borings. Tests for moisture content, unit weight, percent passing the 200 sieve, Atterberg limits, and particle size distribution by sieve analysis were performed at our laboratory in Ventura, California. Union Materials Laboratory in Oxnard, California performed a test for unit weight versus moisture content relation by the modified Proctor test and sand equivalent. Cooper Testing of Palo Alto, California performed corrosion tests for soluble sulfates and soluble chlorides. A test for incremental consolidation, unconsolidated undrained shear, and consolidated undrained triaxial shear strength were performed at Cal Poly Geo-E laboratory in San Luis Obispo. Testing was performed in accordance with applicable ASTM procedures. After the completion of the laboratory testing, the field descriptions were confirmed or modified as necessary and boring logs were prepared. The laboratory test results are presented in Appendix B.

4. SUBSURFACE CONDITIONS

4.1 GEOLOGIC SETTING



Base Map: Tan et al. (2004)

Figure 2: Regional Geologic Map
Third Printing, 2010

The project site is located on the Oxnard Plain and within the Western Transverse Ranges Geomorphic Province of California. The Western Transverse Ranges are a regional deformation belt characterized by a northeast-southwest trending structural grain and corresponding geomorphic features that extend from the Santa Barbara Channel to the Mojave section of the San Andreas Fault. The Oxnard Plain is an alluvial fan that is bordered to the east by the Santa Monica Mountains, to the west by the Santa Clara River and to the north by the Camarillo and the Las Posas Hills. The project site is located within the western portion of Oxnard Plain, proximal to the Santa Clara River.

The regional geology as mapped by Tan et al (2004) is shown on Figure 2. Tan maps the surface geology in the site vicinity as Holocene-age alluvial deposits (Qha).

4.2 GEOLOGIC UNITS

The borings encountered units of existing artificial fill (Af) and alluvium (Qa). An interpreted subsurface profile of the conditions encountered along the crossing segment is shown on Plate 2. A description of the units encountered and shown on the boring logs and profile are summarized below.

Artificial Fill (Af). Artificial fill was encountered in each of the explorations. The fill was encountered between 7.5 and 8.5 feet deep at the 2 borings closest to the Channel (22E-02 and 22E-03). That fill appears to have been placed by previous site grading associated with construction of the channel and other utilities, irrigation, and drainage pipes that traverse near the crossing. The fill was predominately composed of medium stiff to stiff silty and sandy clay. Trash, wood, and construction debris were noted within the artificial fill in boring 22E-02.

The fill encountered in borings 22E-01 and 22E-04 at the outer ends of the alignment was 3 to 5 feet thick. Those borings were completed within existing agricultural roads and the encountered fill appears to be re-worked alluvium that has been disturbed and moved and altered over the years as part of the farming operations. The fill was predominantly composed of loose clayey sand and medium stiff sandy clay. The fill was underlain by alluvium.

Alluvium (Qa). Alluvial deposits were encountered in each of the explorations below the artificial fill. The alluvium consisted of the two predominant units shown on Plate 1 and 2 and described below:

> Qa_1: This unit was encountered in each of the borings explorations and predominantly consisted of an soft to medium stiff sandy lean clay and very loose to loose clayey sand with interlayers up to 4 feet thick consisting of loose to medium dense poorly graded sand. The bottom of the unit is interpreted to be approximately 20 feet below the ground surface, near elevation 7 feet.
>
> Qa_2: This unit was encountered below Qa_1 in borings 22E-02 and 22E-03 and predominantly consisted of soft to stiff lean clay and sandy lean clay to the explored depth of 51.5 feet.

A summary of the laboratory test results for the various units shown on Plate 1 is presented in Table 1 below:

Table 1: Geotechnical Properties Test Summary[1]

Geologic Unit	Locations Encountered	Dry Unit Wt. (pcf)	Moisture Content (%)	Particle Size Analyses (%G, %S, %F)	Atterberg Limits LL, PI	Corrosion pH, ρ (Ω-cm)	Strength Parameters
Artificial Fill (Af)	22E-01*, 22E-02, 22E-03, 22E-04	87-101	19-27	0 G 26 S 73 F	--	pH 7.3-8.3 ρ = 180-583 SO_4^{2-} = 3,412-8,315 *SO_4^{2-} = 790 at 22E-01 CL^- = 35-156	S_{pp} = 1.75-3.75
Alluvium (Qa_1)	22E-01, 22E-02, 22E-03, 22E-04	90-103	18-50	0 G 20-81 S 19-80 F	LL 48 PI 26	--	S_{pp} = 0.5-0.75 ϕ'_{cu} = 37° c'_{cu}= 0 ksf
Alluvium (Qa_2)	22E-02, 22E-03	77-96	26-44	0 G 16 S 84 F	LL 32-40 PI 17-21	--	S_{pp} = 0.75-2.5 S_{uu} = 1.0

4.3 GROUNDWATER CONDITIONS

The interpreted groundwater elevation as extrapolated from the field explorations is shown on Plate 2, at approximately elevation 17 feet in the vicinity of Revolon Slough. Borings 22E-01 and 22E-04 were drilled near or within active irrigation areas and groundwater was encountered slightly higher, at approximately elevation 19 to 22 feet. Measurements from the groundwater well were taken April 29, 2022 at 10.9 feet and on July 15, 2022 at 11.3 feet deep. Groundwater conditions within the Oxnard Plain are typically associated with multiple aquifers. The groundwater conditions at the site are likely associated with the shallow aquifer and groundwater perching on clay layers that form aquitards below the site. The groundwater encountered in the field explorations appears to be perched above clay zones within the Qal1 unit shown on Plate 1. Soil moisture and groundwater conditions will vary seasonally in response to rainfall, irrigation, and pumping from local groundwater wells.

5. SEISMIC HAZARDS

Seismic hazards that could impact the pipeline design are associated with seismic shaking; liquefaction of the alluvium encountered in response to an earthquake. Neither faults or landslides were mapped within the project limits, and we did not observe evidence of those hazards within the project limits. A summary of our seismic hazard and liquefaction analysis of the soil conditions encountered is summarized below:

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[1] Geotechnical properties are noted for dry unit weight (γ_d) and moisture content (w_o); particle size as percent gravel (G), sand size (S) and fines content (F); electrical resistivity (ρ) in ohm-centimeters (Ω-cm), soluble sulfates (SO_4^{2-}) and soluble chorides (CL^-) in parts per million; Atterberg liquid limit (LL) and plasticity index (PI); shear strength (S) in kips per square foot (ksf) measured by pocket penetrometer (pp), torvane (tv), cone penetration test (cp) or unconsolidated undrained (uu) tests; friction angle (ϕ) or cohesion (c) in kips per square foot measured from direct shear (ds) or consolidated undrained (cu) tests, uniaxial compressive strength (σ_a) in kip per square inch (ksi).

5.1 SEISMIC DATA

The pipeline should be designed to resist lateral forces generated by earthquake shaking in accordance with the current building code and applicable design practice. The design earthquake for the project is an event having a 2 percent probably of exceedance in 50 years. The U.S. Geological Survey's online Unified Hazard Tool (accessed August 19, 2022) was used to estimate seismic data for liquefaction analysis. The site location was specified as 34.1765 degrees latitude by -119.1005 degrees longitude. Liquefaction analyses was performed using ground motions estimated using a Site Class D. The design earthquake is estimated to be a magnitude 7.0 earthquake occurring at a mean distance of approximately 11 kilometers from the site and resulting in a peak ground acceleration of approximately 0.75g. The design earthquake magnitude and distance correspond to the deaggregated mean magnitudes for the peak ground acceleration. Sources that contribute to the probabilistic seismic hazard are the Simi-Santa Rosa, Oak Ridge (onshore), Malibu Coast and Ventura-Pitas Point fault systems.

5.2 LIQUEFACTION

Liquefaction is the loss of soil strength that typically occurs in loose to medium dense granular soil that is below the water table in response to seismic shaking. The extent and severity of liquefaction is dependent upon the intensity and duration of the strong ground motion. Yeh assessed liquefaction potential using the methods and procedures described in Seed et al. (2003). The analysis considered corrected SPT blow counts from boring 22E-02 and 22E-03 and a design ground water depth of 5 feet. The seismic inputs were the peak ground acceleration and earthquake magnitude listed in Section 5.1. The estimated total seismic settlement is approximately 1.5 inches to occur within the loose to medium dense sand encountered between at 7 to 10 feet, 13.5 to 16 feet, and 18.5 to 20.5 feet.

The impact to the project site could be manifested as vertical settlement, horizontal ground displacement of unlined channels, strength loss within potentially liquefiable layers, cracking at the ground surface, and sand boils.

6. CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations of this report are intended for use with the UWCD's standard plans and specifications and are based on our project understanding and the subsurface conditions described in this report.

6.1 EARTHWORK – GENERAL

6.1.1 CLEARING AND GRUBBING

Clearing and grubbing should be performed to remove existing vegetation and objectionable material from improvement areas that will be graded, receive fill, or serve as borrow sources. Grubbing should include removing stumps, roots and buried vegetation. Care should be taken not to injure trees, plants or existing improvements outside of the clearing limits. Soil containing pavement, debris, organics, unsuitable, loose or disturbed materials should be removed prior to placing fill. Demolition areas should be cleared of old foundations, existing fill, pavement, abandoned utilities, and soil disturbed during clearing and grubbing. Depressions or disturbed material left from the removal or demolition of materials should be replaced with compacted fill.

6.1.2 COMPACTION

Table 2 provides a summary of the recommended minimum levels of compaction for locations where fill will be placed. Relative compaction should be assessed according to the latest approved edition of ASTM Standard Test Method D1557.

Table 2: Recommended Compaction

Location of Fill Placement	Recommended Minimum Relative Compaction
General	90% U.O.N.[2]
Utility trench bedding, pipe zone or backfill	90% U.O.N.
Fill or backfill placed within 3 feet of finished grade in pavement areas	95%
Asphalt concrete, aggregate base, or subbase	95%
Foundation areas and within 5 feet horizontal of foundations	95%

6.1.3 FILL PLACEMENT

Fill should be mechanically compacted. Jetting or ponding should not be permitted for placement or compaction of fill materials. Fill materials should be moisture conditioned and spread in lifts that are suitable for compaction with the equipment being used. Control of compaction layer thickness will be necessary to achieve compaction throughout the material being placed. Fill should typically be spread in loose lifts of approximately 8 inches or less, and within 2 percent of the optimum moisture content, to achieve the recommended compaction.

The moisture content of the material should be such that the specified compaction can be achieved in a firm and stable condition. Each layer should be spread evenly, bladed and mixed to provide relative uniformity of material within each layer, and be moisture conditioned by adding water or drying the material to provide a moisture content suitable for compaction, and be thoroughly mixed during the spreading to provide relative uniformity of material within each layer. Soft or yielding materials should be removed and replaced with properly compacted fill material prior to placing the

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[2] U.O.N. – unless otherwise noted

next layer of fill. Fill and backfill materials may need to be placed in thinner lifts to achieve the recommended compaction with the equipment being used.

Particles greater than half the compacted lift thickness can limit compactive effort. The fill should not contain rocks, gravel or other solid particles larger than 3 inches in the greatest dimension. Deleterious materials, such as soft rock particles, concrete or pavement rubble, metal, glass or sharp objects should not be placed within the fill material being placed. Recycled or reused materials should only be used and placed within the fill when specifically permitted by the project specifications. Rocks should not be nested, and voids should be filled with compacted fill material.

6.1.4 SUGGESTED MATERIAL SPECIFICATIONS

Pipeline construction and materials should generally conform to the latest approved edition of the United Water Conservation District (UWCD) Design and Construction Standards (Standards). Materials may also be referenced to the 2018 edition Caltrans Standard Specifications. The following specifications are suggested for materials referenced in various sections of this report.

Asphalt Concrete. Asphalt concrete consists of Type A Hot Mix Asphalt Concrete that complies with Section 39-2 of the Caltrans *Standard Specifications* with PG 64-16 asphalt binder.

Aggregate Base. Aggregate base consists of imported aggregate that complies with the grading and quality requirements for ¾-inch Class 2 aggregate base per Section 26-1.02B of the Caltrans *Standard Specifications*.

Compacted Fill to be placed as backfill of jacking and receiving pits, trench backfill, or general fill consists of on-site material free of organics, oversize rock (greater than 3 inches), trash, debris, corrosive, and other deleterious materials. Do not place drilling fluids or boring muck in the fill. Engineer will review fill and borrow sources before being imported to the site. Furnish fill materials that comply with all specified material requirements for the designated placement location as placed at the site.

Gravel. Aggregate for gravel drains or pipe bedding consists of imported gravel or crushed rock that is free of clay, organic, corrosive, trash, debris, recycled or reclaimed material, and other deleterious substances. Gravel will have a durability index of at least 40 when tested according to ASTM D3744. The gradation of the gravel shall conform to ASTM C-33 Number 8 aggregate (3/8-inch gravel). Gravel shall be fully encased in a geotextile fabric for separation.

Geotextile for Separation (Filter Fabric). Geotextile for separation consists of Class C filter fabric conforming to Section 96-1.02B of the Caltrans *Standard Specifications*.

Pipe Bedding - Sand consists of imported material conforming to Sections 3.13A of the Caltrans *Standard Specifications*.

Pipe Bedding - Gravel. see Gravel.

Pipe Zone Material. Bedding and Pipe Zone Material consist of imported material conforming to Sections 3.13A of the Standards.

Two-sack Slurry Backfill. Slurry cement backfill can be used as Trench Backfill and consists of 2-sack sand-cement slurry conforming to Section 19-3.02G of the Caltrans *Standard Specifications*. Aggregate will be imported sand conforming to the gradation and quality requirements of the *Standard Specifications*. Provide slurry cement backfill as a stable flowable mix and that can be consolidated using vibration during placement. Subsequent backfill or compacted material can be placed above slurry cement backfill once the slurry cement can support foot-traffic without more than ¼-inch indentation.

Trench Backfill. Trench backfill placed in overland areas consists of imported or onsite soil conforming to Compacted Fill. Trench backfill placed below pavement areas consists of imported sand conforming to Pipe Zone Material or Two-sack Slurry Backfill when required by the Engineer.

6.2 SEISMIC CONSIDERATIONS

Alluvial soil encountered in the borings is potentially liquefiable considering the design earthquake (analysis is discussed in Section 5.2 of this report). The potentially liquefiable soil layers are interbedded within the Qal_1 units shown on Plate 2. As previously discussed in this report, the consequences of liquefaction are estimated to be approximately 1.5 inches of vertical settlement The impacts to the pipe could be loss of ground support, differential settlement and ground movement along the alignment, and shear forces associated with horizontal displacement due to instability of layers of liquefiable soil. The potential for liquefaction to impact the new pipeline is similar to the hazard that already exists for the surrounding infrastructure. The location and specific impacts that seismic shaking and liquefaction could have on pipelines cannot be estimated using readily available methods, and the potential hazard should therefore be considered in a general sense relative to the pipeline design and operation.

Mitigation for liquefaction could consist of ground improvement to reduce the potential for the soil around the pipe to liquefy during the design earthquake, supporting the pipe on deep foundations above the creek to avoid liquefaction hazards and design the pile foundation to resist forces associated with liquefaction, or to manage the hazard to the waterline and associated water distribution system with the operations and maintenance guidelines for the pipe. Management typically consists of planning inspections of the pipeline(s) following a major earthquake or catastrophic event, having a response plan in place to repair or bypass damaged sections of pipe, and having personnel trained to respond to those scenarios in preparation for a damaging earthquake. The latter management approach is commonly used for pipelines and pipe networks because of the complexity and uncertainty in the ability to predict the specific response of pipelines to earthquakes and where damage may occur. Yeh can provide additional information or services to address liquefaction for the design of the pipeline if requested.

6.3 SHALLOW PIPELINE DESIGN

A summary of trench backfill recommendations is presented on Figure 3. The portions of the pipe outside the limits of the Revolon Slough Crossing will be installed in a trench using conventional trench excavation and backfill. Suggested Material Specifications for bedding material, pipe zone material and trench backfill are described in Section 6.1.4 of this report. Bedding, pipe zone, and trench backfill should be compacted to 90 percent relative compaction unless a higher degree of compaction is recommended for the area where the material is being placed.

Bedding and Foundation Support. Bedding is initial backfill placed between the trench subgrade and the bottom of the pipe. At least 4 inches of Pipe Bedding should be provided below the pipe. The pipe should be placed on the bedding such that the middle third of the pipe ($D_0/3$ on Figure 4) is in contact with the bedding prior to placing initial backfill within the pipe zone. The bedding may be loosened along the invert of the pipe, if necessary, to help form the cradle. Pipe bedding should be compacted to at least 90 percent relative compaction.

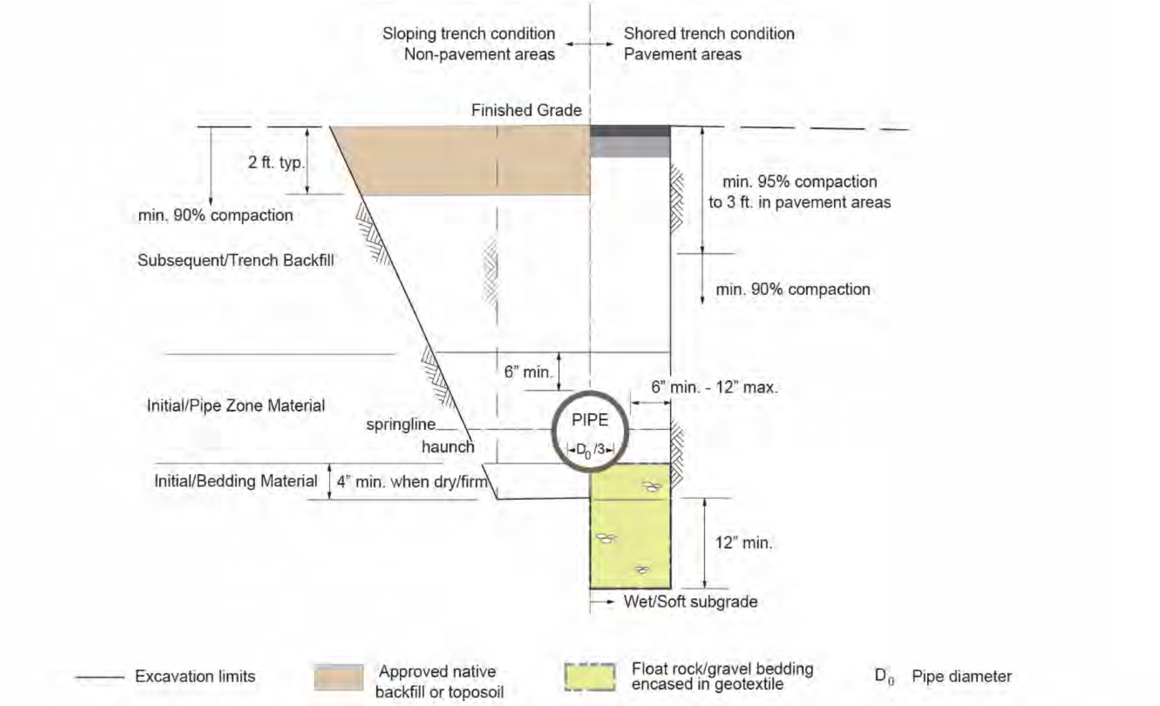

Figure 3: Typical Trench Detail

The bedding can be placed on firm subgrade material at the bottom of the trench, unless stabilization of the trench foundation is needed. If yielding subgrade conditions are encountered at the bottom of the trench, we recommend that at least 12 inches of gravel bedding encased in a filter fabric be provided below the pipe. The actual limits and need for subgrade stabilization should be evaluated based on the conditions encountered during construction. The project specifications should provide for varying the limits of the stabilization and the thickness of the gravel, if needed, based on the conditions encountered during construction.

Pipe Zone Material. Pipe zone material is fill placed from the top of the bedding to at least 12 inches above the top of the pipe. Compaction within the pipe zone should be performed such that the pipe is fully supported during compaction, and such that excessive deformation or damage to the pipe does not occur. Compaction above the springline or top of the pipe should not be performed until the fill placed below that elevation has been properly compacted.

Trench Backfill. Trench backfill is fill placed above the pipe zone to the finished grade or to the bottom of the base of other specified backfill materials (such as the pavement structural section or trench patch). Trench backfill can consist of either select on-site soil or imported fill material conforming to the recommendations of this report, and any other requirements for the area where the trench backfill is being placed.

6.4 GEOTECHNICAL CONSIDERATIONS FOR DESIGN OF CROSSING AT REVOLON SLOUGH

6.4.1 SUBSURFACE CONDITIONS

Subsurface conditions should be considered in final alterative design selection for the pipeline crossing. Geotechnical considerations are provided below for a trenchless installation, or an above ground alternative supported on foundations. Yeh will provide additional design input to final alternative design and present it in a revised draft or final Geotechnical report. The subsurface conditions encountered at the project site were discussed previously in this report, on logs in Appendix A, and are summarized on Plate 2.

6.4.2 TRENCHLESS INSTALLATION CONSIDERATIONS

Trenchless pipeline construction methods being reviewed are horizontal directional drilling (HDD), jack and bore, or microtunnel. Jack and bore methods will require dewatering within temporary entry and exit pits within encountered soft clay and loose sand soil below the groundwater table. Additional hydrogeologic testing and analyses may be needed to evaluate the potential to dewater not only the pits but the jack and bore crossing. Microtunnel would require the installation of a minimum 42-inch diameter casing and also require dewatering within the entry and exit pits. Horizontal directional drilling (HDD) is the likely preferred alternative for a trenchless option. HDD is generally best suited for relatively uniform firm ground without permeable layers or boulders. HDD entry/exit pits and its curved drill path can be designed to pass beneath the channel structure but will be below groundwater. The HDD bore should pass below the channel at a minimum depth of two bore diameters below the bottom of the channel. Temporary or permanent casing is recommended to support the HDD bore through the loose and soft layers of fill, sand and clay encountered within the Qa_1 layer shown on Plate 2 and to reduce the potential for soil fracturing and drill fluid loss in those zones. Factors that may adversely influence the drilling, rates of drilling, or the ability to guide the drilling on the planned alignment are the presence of gravel or cobble, caving soil conditions, permeable layers that may be prone to fluid losses, and weak soil layers that are prone to failure or squeezing under the fluid pressures needed to advance the drilling.

6.4.3 ABOVE GROUND FOUNDATION SUPPORT CONSIDERATIONS

The encountered artificial fill, soft clay and loose sand layers (Qa_1) is likely to produce static settlement as a result of foundation loads typical of pipeline bridges and also seismic settlement. The estimated amount of vertical settlement from soil liquefaction triggered by the design earthquake is approximately 1.5 inches. Foundations will need to be designed to resist the result of differential settlement between pipe supports. The flood zone elevation and depth to design level groundwater elevations will need to be considered in design. The foundation type and design approach will depend on the anticipated design loads and the estimated soil capacity to resist static and seismic conditions. Both a shallow and deep foundation approach are feasible and should be compared and considered. Shallow foundations will require removal of unsuitable soil and replacement with several feet of structure fill below the footings to achieve the required capacity. The amount of recommended removal and replacement will be dependant on the load conditions and allowable settlement tolerance at the proposed support locations. The advantage of a shallow foundation is the potential to generally maintain excavations above groundwater. A drilled shaft foundation could be designed to resist static loads and potential downdrag loads from liquefiable soil layers during a seismic event. Drilled shaft foundations would develop capacity from soil friction developed along the caisson sidewalls that resist foundation loads. End bearing is not generally included for soil conditions encountered. Drilled shafts construction will extend below the groundwater table and shaft stability within the af and Qa_1 unit is a consideration without the use of casing or drill slurry.

A drilling plan should be required to be submitted by the Contractor and reviewed and approved by the design team prior to construction for the selected construction method.

6.5 CORROSION DATA

Selected samples from the field exploration programs were tested for pH, resistivity, soluble sulfates and soluble chlorides. Results are presented in Appendix B. The results of the testing of four soil samples collected from the borings at depths ranging from 3 to 7.5 feet below the ground surface are summarized as follows:

- pH: 7.3 to 8.3
- Resistivity: 180 to 583 ohm-centimeters
- Soluble sulfates at borings 22E-02 to 22E-04): 3,412 to 8,315 ppm
- Soluble sulfates at boring 22E-01: 790 ppm
- Soluble chlorides: 35 to 156 ppm

The resistivity and pH suggest that site soils tested are corrosive to ferrous metals and reinforced concrete based on the test results. Design of the project should consider corrosivity test results using appropriate design standards including the American Concrete Institute (ACI) and the American Water Works Association (AWWA). Corrosion protection could consider installing sacrificial anodes on the pipeline or other corrosion protection measures depending on the chosen pipe material type and connectors.

6.6 CONSTRUCTION CONSIDERATIONS

6.6.1 EXCAVATIONS AND SHORING

The soil anticipated to be encountered in excavations vary from Type B to Type C depending on the location based on Cal OSHA guidelines for the design of temporary slopes and shoring systems. The contractor is responsible for job site safety and should provide a competent person at the time of construction to review the excavation and select the proper sloping and/or shoring systems needed for the conditions being encountered. Dewatering in advance of excavations may be needed at various locations to provide stable slope conditions during excavation. Slopes should not be considered stable when excavated below the groundwater table or there is seepage daylighting on slopes.

Tight shoring systems such as sheet piles, braced excavations, secant pile walls, soldier pile/lagging walls should be provided where groundwater will be encountered within the excavation. The selected shoring system should reduce the flow of water into the excavation and allow for dewatering within the shoring to provide a work area for construction. Sheet piles, if used, should be embedded below the bottom of the excavation to help cutoff seepage and reduce uplift seepage forces and unstable conditions at the excavation depth. Alternatively, sheet piles can be shortened and a concrete plug could be placed over the bottom of the excavation to form a seal that would resist seepage pressures and allow for dewatering within the shored excavation.

Trench shields/boxes or slide-rail shoring systems are not considered suitable for excavations in loose soil or below the groundwater table. Trench shields or shoring jacks could likely be used in excavations where the soil type is appropriate for the shoring system and the excavation is above groundwater.

6.6.2 DEWATERING

When necessary, dewatering should lower the groundwater elevation to at least 2 feet below the depth of the excavation and provide a stable subgrade for construction. Groundwater is expected to be about 10 feet deep. Seepage may be found in shallower excavations and may be addressed using localized dewatering procedures such as gravel wells with sump pumps. Construction dewatering in excavations below approximately 10 feet deep could produce significant amounts of water that will need proper disposal relative to regulatory discharge requirements.

Dewatering can result in nearby ground settlement within soft compressible soils as pore water is removed and the soil skeleton compresses from self-weight and/or surcharge loads. Monitoring of the groundwater flow from pumps and piezometers, as well as surveying and monitoring settlement of existing structures can be performed to evaluate the impacts dewatering near existing structures. The necessary extents of monitoring will depend on pump system siting/depth, pumping rates, and soil types.

The contractor should submit a detailed excavation and dewatering plan for review by the geotechnical professional before beginning the excavation. Excavation and dewatering plans should be designed by a qualified professional civil engineer registered in the State of California engineer familiar with design of excavations, shoring, and dewatering in similar subsurface conditions. The plan should detail the dewatering plans, shoring, support of adjacent structures and adjacent utilities, and an appropriate monitoring program for the anticipated subsurface conditions.

6.7 SUBGRADE EVALUATION

A qualified geotechnical professional should observe the bottom of excavations to evaluate if the exposed subgrade is suitable for fill placement. The project specifications should provide for stabilization of the subgrade according to the recommendations of this report, if needed, to address soft or yielding subgrade conditions if encountered.

6.8 GRADING OBSERVATION

A qualified geotechnical professional should observe backfill operations during construction on behalf of the owner to have reasonable certainty that fill placement and compaction is being performed according to the recommendations of this report. Field density testing should be performed to help evaluate the compaction and moisture content of the materials being placed. Fill and aggregates delivered to the site and excavated onsite soil that will be reused as fill or backfill, should be sampled and tested for conformance with gradation and quality requirements for the project or submittals reviewed for conformance. The frequency and locations of the tests should be at the discretion of the geotechnical professional. The project specifications should include provisions for the contractor to allow for testing and to provide any shoring, ingress-egress, or traffic control needed to safely perform the testing at the locations and depths needed.

7. LIMITATIONS

This study has been conducted in general accordance with currently accepted geotechnical practices in this area for use by the client for design purposes. The conclusions and recommendations submitted in this report are based upon the data obtained from field reconnaissance, subsurface exploration and sampling, and our understanding of the proposed project and type of construction described in this report. If there are any changes in the project or site conditions, Yeh should review those changes and provide additional recommendations, if needed. Any modifications to the recommendations of this report or approval of changes made to the project should not be considered valid unless they are made in writing. The report and drawings contained in this report are intended for design-input; and are not intended to act as construction drawings or specifications.

Site conditions will vary between points of observation or sampling, seasonally, and with time. The nature and extent of subsurface variations across the site may not become evident until excavation is performed. If during construction, fill, soil, or water conditions appear to be different from those described herein, Yeh should be advised and provided the opportunity to evaluate those conditions and provide additional recommendations, if necessary. The geotechnical professional should observe portions of the construction and site conditions, such as excavations, exposed subgrades and earthwork, to evaluate whether or not the conditions encountered are consistent with those assumed for design, and to provide additional recommendations during construction, if needed.

8. REFERENCES

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▬ ▬ ▬ Approximate Alignment of 24-Inch Recycled Water Pipeline

🟥 Approximate Location of 8" Hollow Stem Auger Boring

● Approximate Location of 2-inch temporary monitoring well

Base Map: Google Earth, 2022

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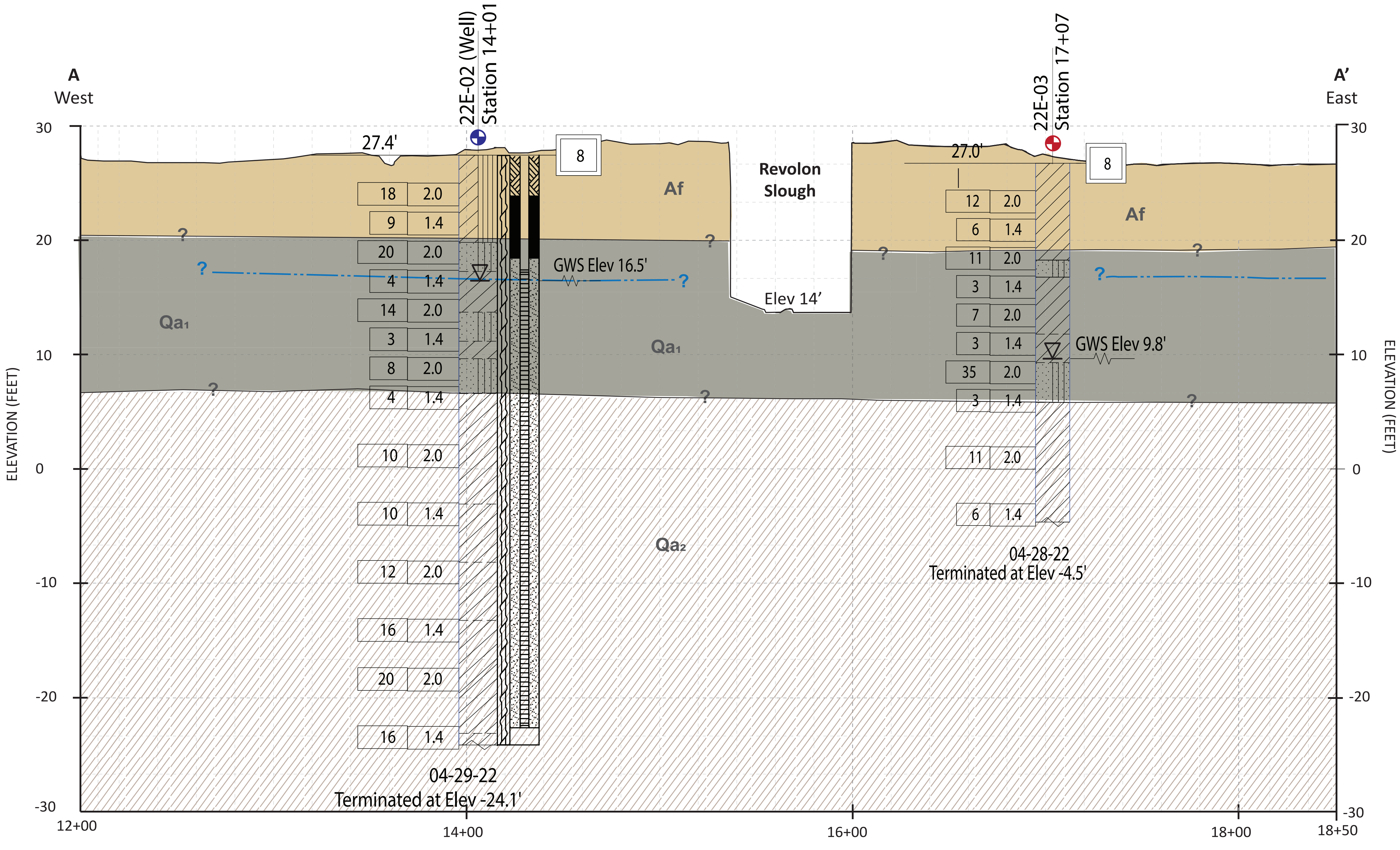
FIELD EXPLORATION PLAN

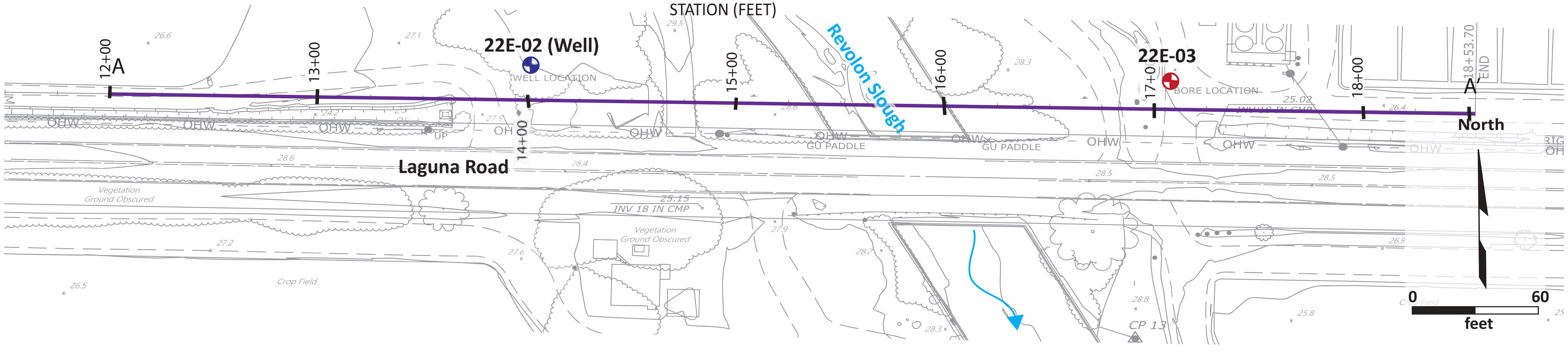
PROJECT NAME:
Laguna Road Recycled Water Pipeline
United Water Conservation District
Oxnard, CA

PLATE
1

PROJECT NUMBER:
221-500

REVISION DATE:
7/13/2022





LEGEND:

Af Artificial Fill: medium stiff to stiff silty and sandy clay and loose clayey sand

Qa₁ Alluvial deposits (Holocene): soft to medium stiff sandy lean clay and very loose to loose clayey sand with interlayers of up to 4 feet thick containing loose to medium dense poorly graded sand.

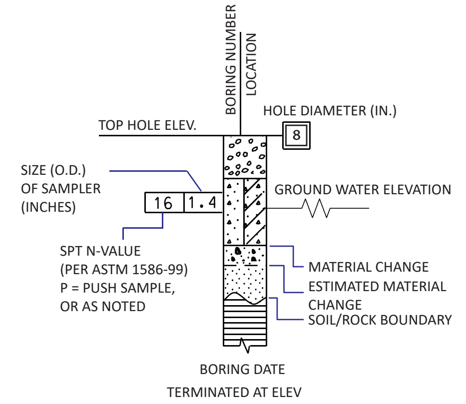
Qa₂ Alluvial deposits (Holocene): soft to stiff lean clay and sandy lean clay

—?— Geologic contact, queried where uncertain

—?·— Interpreted groundwater surface during drilling, queried where uncertain

▽ Groundwater level encountered during drilling

See text and logs of exploration for description of subsurface conditions. All boundaries and locations are approximate.



PROFILE

1 in. = 10 ft. vertical
1 in. = 60 ft. horizontal

PLAN VIEW

Scale: 1” = 60’

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PLAN AND INTERPRETED SUBSURFACE PROFILE

PROJECT NAME: Laguna Road Recycled Water Pipeline United Water Conservation District Oxnard, CA	**PLATE** 2
PROJECT NUMBER: 221-500	**REVISION DATE:** 8/20/22

APPENDIX A - FIELD EXPLORATION

GROUP SYMBOLS AND NAMES

Graphic / Symbol		Group Names
▨	**GW**	Well-graded GRAVEL Well-graded GRAVEL with SAND
▨	**GP**	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
▨	**GW-GM**	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
▨	**GW-GC**	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
▨	**GP-GM**	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
▨	**GP-GC**	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
▨	**GM**	SILTY GRAVEL SILTY GRAVEL with SAND
▨	**GC**	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
▨	**GC-GM**	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
▨	**SW**	Well-graded SAND Well-graded SAND with GRAVEL
▨	**SP**	Poorly graded SAND Poorly graded SAND with GRAVEL
▨	**SW-SM**	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
▨	**SW-SC**	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
▨	**SP-SM**	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
▨	**SP-SC**	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
▨	**SM**	SILTY SAND SILTY SAND with GRAVEL
▨	**SC**	CLAYEY SAND CLAYEY SAND with GRAVEL
▨	**SC-SM**	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
▨	**PT**	PEAT
▨		COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol		Group Names
▨	**CL**	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
▨	**CL-ML**	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
▨	**ML**	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
▨	**OL**	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
▨	**OL**	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
▨	**CH**	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
▨	**MH**	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
▨	**OH**	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
▨	**OH**	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
▨	**OL/OH**	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation (ASTM D2435)
CL	Collapse Potential (ASTM D5333)
CP	Compaction Curve (ASTM D1557)
CR	Corrosion, Sulfates, Chlorides (CTM 643; ASTM D4972, ASTM G187, ASTM D4327)
CU	Consolidated Undrained Triaxial (ASTM D4767)
DS	Direct Shear (ASTM D3080)
EI	Expansion Index (ASTM D4829)
M	Moisture Content (ASTM D2216)
OC	Organic Content (ASTM D2974)
P	Permeability (ASTM 5084)
PA	Particle Size Analysis (ASTM D422-63 [2007])
PI	Liquid Limit, Plastic Limit, Plasticity Index (ASTM D4318)
PL	Point Load Index (ASTM D5731)
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value (CTM 301)
RS	Torsional Ring Shear (ASTM D6467)
SE	Sand Equivalent (CTM 217)
SG	Specific Gravity (AASHTO T 100)
SL	Shrinkage Limit (ASTM D427)
SW	Swell Potential (ASTM D4546)
TV	Pocket Torvane
UC	Unconfined Compression - Soil (ASTM D2166) Unconfined Compression - Rock (ASTM D7012)
UU	Unconsolidated Undrained Triaxial (ASTM D2850)
UW	Unit Weight (ASTM D4767, ASTM D7263)
VS	Vane Shear (AASHTO T 223-96 [2004])
-200	200 Wash (ASTM D1140)

SAMPLER GRAPHIC SYMBOLS

- ☒ Standard Penetration Test (SPT) (2" O.D.)
- ⧗ Standard California Sampler (2.5" O.D.)
- ⧗ Modified California Sampler (3" O.D.)
- ▯ Shelby Tube
- ▯ Piston Sampler
- ▯ Rock Core
- ⁞ Grab Sample
- ▩ Bulk Sample
- ◩ Other (see remarks)

DRILLING METHOD SYMBOLS

- ▯ Auger Drilling
- ▯ Rotary Drilling
- ▯ Dynamic Cone or Hand Driven
- ☒ Diamond Core

WATER LEVEL SYMBOLS

- ∇ First Water Level Reading (during drilling)
- ▼ Static Water Level Reading (short-term)
- ▼ Static Water Level Reading (long-term)

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REPORT TITLE
LEGEND FOR SOIL CLASSIFICATION

PROJECT NAME
UWCD Laguna Road Pipeline

DATE	SHEET
5/17/2022	**1 of 2**

LOGGED BY **C. Stopka**	BEGIN DATE **4/28/22**	COMPLETION DATE **4/28/22**	HAMMER TYPE **140-lb automatic trip**	BORING NUMBER **22E-01**
FINAL BY **L. Berry**			BOREHOLE LOCATION (Lat/Long or North/East and Datum) **N 6227432/E 1888424**	SURFACE ELEVATION **27.8 ft**
DRILLING METHOD **Hollow-Stem Auger**			BOREHOLE LOCATION (Offset, Station, Line) **--**	WEATHER NOTES **Warm, Breezy**
DRILLER **2R Drilling**			LOCATION DESCRIPTION **Farm road, ~2700ft west of Wood Rd, ~30ft north of Laguna Rd**	BACKFILLED WITH **Cuttings**
DRILL RIG **CME-75**			GROUNDWATER READINGS / DURING DRILLING **8.8 ft** / AFTER DRILLING (DATE)	TOTAL DEPTH OF BORING **11.5 ft**

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample or Run Location	Sample or Run Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (ksf)	Drilling Method	Well Diagram	Well Description	Remarks
	0		CLAYEY SAND (SC); loose; brown; moist; (ALLUVIUM).		A											10:45 - Drilling Started CR (pH = 7.80, r = 583 ohm-cm, SO_4^{2-} = 790 mg/kg, Cl^- = 76 mg/kg)
	1															
26	2															
	3				1	3 3 5	8	100		22	99					SE
24	4															
	5		Very loose.		2	2 2 2	4	75								-200 (0% G, 35% S, 65% F)
22	6		Wet.													
	7															
20	8		Medium dense.		3	8 10 9	19	100		24	100					
	9															∇
18	10		Very loose; olive brown.		4	1 1 1	2	100								
	11															
16	12		Bottom of borehole at 11.5 ft bgs													11:35 - Drilling Completed
	13		This Boring Record was developed in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010) except as noted on the Soil or Rock Legend or below.													
14	14															
	15															
12	16															
	17															
10	18															
	19															
8	20															
	21															
6	22															
	23															
4	24															
	25															

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PROJECT NAME **UWCD Laguna Road Pipeline**	
PROJECT NUMBER **221-500**	
BORING NUMBER **22E-01**	
REVISION DATE **5/17/2022**	SHEET **1 of 1**

LOGGED BY **C. Stopka**	BEGIN DATE **4/29/22**	COMPLETION DATE **4/29/22**	
HAMMER TYPE **140-lb automatic trip**			BORING NUMBER **22E-02**
FINAL BY **L. Berry**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **N 6228811/E 1888423**	SURFACE ELEVATION **27.4 ft**	
DRILLING METHOD **Hollow-Stem Auger**	BOREHOLE LOCATION (Offset, Station, Line) **--**	WEATHER NOTES **Warm, Breezy**	
DRILLER **2R Drilling**	LOCATION DESCRIPTION **Pullout, ~1250ft west of Wood Rd, ~60ft north of Laguna Rd**	BACKFILLED WITH **Monitoring Well**	
DRILL RIG **CME-75**	GROUNDWATER READINGS — DURING DRILLING — AFTER DRILLING (DATE) **10.9 ft on 4-29-22**	TOTAL DEPTH OF BORING **51.5 ft**	

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample or Run Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (ksf)	Well Description	Remarks
	0	SILTY CLAY with SAND (CL-ML); stiff; brown; moist; white mineralization (calcite?); wood debris; (ARTIFICIAL FILL).	A								Flush mount traffic rated vault Concrete surface seal 2 in. Schedule 40 PVC Bentonite seal	
	1											
25	2											
	3		1	6 8 10	18	100		20	101			
23	4											
	5	Chunk of concrete in sampler shoe.	2	4 4 5	9	25		19				Sample #2 was disturbed
21	6											
	7											
19	8	Poorly graded SAND with SILT (SP-SM); medium dense; light brown; moist; (ALLUVIUM).	3	6 8 12	20	100		25	87	3.75PP		-200 (0% G, 26% S, 73% F) CR (pH = 8.31, r = 180 ohm-cm, SO_4^{2-} = 8,315 mg/kg, Cl^- = 61 mg/kg)
	9										#3 Monterey sand 2 in. Schedule 40 PVC, 0.02 in. slot size	
17	10	Lean CLAY with SAND (CL); soft; brown; moist to wet.	4	1 2 2	4	100		27		0.75PP		PA (0% G, 25% S, 75% F)
	11											▼
15	12											
	13		5	4 6 8	14	100		23	103			
13	14	Poorly graded SAND with SILT (SP-SM); loose; light olive brown; moist to wet.										
	15		6	1 1 2	3	100		41				
11	16	Lean CLAY (CL); soft; dark grayish brown; moist.										
	17											
9	18	Poorly graded SAND with SILT (SP-SM); loose; brown; wet.	7	3 4 4	8	100						-200 (0% G, 81% S, 19% F)
	19											
7	20		8	1 2 2	4	100		33		0.75PP		
	21	Lean CLAY (CL); soft; dark grayish brown; moist to wet.										
5	22											
	23											
3	24											
	25											

(continued)

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PROJECT NAME
UWCD Laguna Road Pipeline
PROJECT NUMBER
221-500
BORING NUMBER
22E-02
REVISION DATE
5/17/2022
SHEET
1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample or Run Location	Sample or Run Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (ksf)	Drilling Method	Well Diagram	Well Description	Remarks
	25	▨	Medium stiff. Lean CLAY (CL) *(continued)*.	⧗	9	3 4 6	10	100		38	83	0.75PP				C
1	26	▨														
	27	▨														
-1	28	▨														
	29	▨														
-3	30	▨	Lean CLAY with SAND (CL); stiff; light olive brown; moist; fine SAND.	⧖	10	5 5 5	10	50				0.75PP				-200 (0% G, 16% S, 84% F)
	31	▨														
-5	32	▨														
	33	▨														
-7	34	▨														
	35	▨	Lean CLAY with SAND (CL); medium stiff; dark grayish brown; moist.	⧗	11	4 6 6	12	100		41	87	1.0PP				PI (40 LL, 23 PL, 17 PI) UU
-9	36	▨														
	37	▨														
-11	38	▨														
	39	▨														
-13	40	▨	Lean CLAY with SAND (CL); very stiff; olive brown; moist to wet.	⧖	12	3 6 10	16	75				0.75PP				
	41	▨														
-15	42	▨														
	43	▨														
-17	44	▨														
	45	▨	Stiff.	⧗	13	6 9 11	20	100		26	96	2.5PP				
-19	46	▨														
	47	▨														
-21	48	▨														
	49	▨														
-23	50	▨		⧖	14	2 5 11	16	83				1.5PP				
	51	▨	Lean CLAY (CL); very stiff; dark grayish brown; moist.													
-25	52		Bottom of borehole at 51.5 ft bgs													
	53															
-27	54		This Boring Record was developed in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010) except as noted on the Soil or Rock Legend or below.													
	55															

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PROJECT NAME
UWCD Laguna Road Pipeline
PROJECT NUMBER
221-500
BORING NUMBER
22E-02
REVISION DATE
5/17/2022
SHEET
2 of 2

LOGGED BY
C. Stopka

BEGIN DATE
4/28/22

COMPLETION DATE
4/28/22

HAMMER TYPE
140-lb automatic trip

BORING NUMBER
22E-03

FINAL BY
L. Berry

BOREHOLE LOCATION (Lat/Long or North/East and Datum)
N 6229116/E 1888413

SURFACE ELEVATION
27.0 ft

DRILLING METHOD
Hollow-Stem Auger

BOREHOLE LOCATION (Offset, Station, Line)
--

WEATHER NOTES
Warm, Breezy

DRILLER
2R Drilling

LOCATION DESCRIPTION
Farm road, ~960ft west of Wood Rd, ~50ft north of Laguna Rd

BACKFILLED WITH
Bentonite Chips and Cuttin

DRILL RIG
CME-75

GROUNDWATER READINGS — DURING DRILLING **17.0 ft** — AFTER DRILLING (DATE) **17.2 ft on 4-28-22**

TOTAL DEPTH OF BORING
31.5 ft

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample or Run Location	Sample or Run Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (ksf)	Drilling Method	Well Diagram	Well Description	Remarks
	0		SANDY lean CLAY (CL); medium stiff; strong brown; moist; (ARTIFICIAL FILL).		A					20						11:45 - Drilling Started CP ($\gamma_{D, MAX}$ = 123 pcf, w_{OPT} = 10%)
	1															
25	2															
	3				1	4 5 7	12	100		24	89	1.75PP				
23	4															
	5				2	2 3 3	6	100		23						CR (pH = 7.72, r = 507 ohm-cm, SO_4^{2-} = 5,061 mg/kg, Cl^- = 35 mg/kg)
21	6															
	7															
19	8				3	9 7 4	11	100		18	90					
	9		Poorly graded SAND with SILT (SP-SM); loose; brown; moist; (ALLUVIUM).													
17	10		SANDY lean CLAY (CL); soft; brown; mosit to wet.		4	2 2 1	3	100		34		0.75PP				PI (48 LL, 22 PL, 26 PI)
	11															
15	12															
	13		Mosit.		5	3 3 4	7	100				0.75PP				CU
13	14															
	15		Lean CLAY with SAND (CL); soft; light olive brown; moist; fine SAND.		6	1 1 2	3	100		50						
11	16															
	17															▼
9	18		Poorly graded SAND with SILT (SP-SM); medium dense; light olive brown; wet.		7	13 20 15	35	100		23	102					PA (0% G, 47% S, 53% F)
	19															
7	20				8	1 1 2	3	100		35		0.5PP				
	21		Lean CLAY (CL); medium stiff; very dark grayish brown; moist.													
5	22															
	23															
3	24															
	25															

(continued)

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PROJECT NAME
UWCD Laguna Road Pipeline

PROJECT NUMBER
221-500

BORING NUMBER
22E-03

REVISION DATE
5/17/2022

SHEET
1 of 2

ELEVATION (ft)	DEPTH (ft)	Material Graphics	DESCRIPTION	Sample or Run Location	Sample or Run Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (ksf)	Drilling Method	Well Diagram	Well Description	Remarks
	25		Lean CLAY (CL) *(continued)*.		9	4 5 6	11	100		44	77	1.5PP				PI (32 LL, 11 PL, 21 PI)
1	26															
	27															
-1	28															
	29															
-3	30				10	3 3 3	6	100		30		1.0PP				
	31															
-5	32		Bottom of borehole at 31.5 ft bgs													13:00 - Drilling Completed
	33		This Boring Record was developed in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010) except as noted on the Soil or Rock Legend or below.													
-7	34															
	35															
-9	36															
	37															
-11	38															
	39															
-13	40															
	41															
-15	42															
	43															
-17	44															
	45															
-19	46															
	47															
-21	48															
	49															
-23	50															
	51															
-25	52															
	53															
-27	54															
	55															

5 BR - STANDARD WITH MONITORING WELL 221-500 BORING LOGS.GPJ CALIFORNIA YEH LIBRARY (YEH V3 APRIL 2020).GLB 22/8/21

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PROJECT NAME
UWCD Laguna Road Pipeline
PROJECT NUMBER
221-500
BORING NUMBER
22E-03
REVISION DATE
5/17/2022
SHEET
2 of 2

LOGGED BY **C. Stopka**	BEGIN DATE **4/28/22**	COMPLETION DATE **4/28/22**	HAMMER TYPE **140-lb automatic trip**
BORING NUMBER **22E-04**			
FINAL BY **L. Berry**	BOREHOLE LOCATION (Lat/Long or North/East and Datum) **N 6229649/E 1888388**	SURFACE ELEVATION **26.2 ft**	
DRILLING METHOD **Hollow-Stem Auger**	BOREHOLE LOCATION (Offset, Station, Line) **--**	WEATHER NOTES **Warm, Breezy**	
DRILLER **2R Drilling**	LOCATION DESCRIPTION **Farm road, ~300ft west of Wood Rd, ~50ft north of Laguna Rd**	BACKFILLED WITH **Bentonite Chips and Cutting**	
DRILL RIG **CME-75**	GROUNDWATER READINGS	DURING DRILLING **10.0 ft**	AFTER DRILLING (DATE) **7.2 ft on 4-28-22**
TOTAL DEPTH OF BORING **11.5 ft**			

ELEVATION (ft)	DEPTH (ft)	DESCRIPTION	Sample or Run Number	Blows per 6 in.	Blows per foot	Recovery (%)	RQD (%)	Moisture Content (%)	Dry Unit Weight (pcf)	Shear Strength (ksf)	Remarks
	0	SANDY lean CLAY (CL); medium stiff; dark brown; moist; with pockets of SILTY SAND with GRAVEL (SM); brown; slightly moist; (ARTIFICIAL FILL).	A					27			13:10 - Drilling Started CR (pH = 7.33, r = 385 ohm-cm, SO_4^{2-} = 3,412 mg/kg, Cl^- = 156 mg/kg)
	1										
24	2										
	3		1	4 4 5	9	33					Sample #1 was disturbed SE
22	4										
	5	SANDY lean CLAY (CL); medium stiff; brown; moist; fine SAND; (ALLUVIUM). Strong brown.	2	2 3 3	6	100				0.75PP	-200 (0% G, 20% S, 80% F)
20	6										
	7										▼
18	8	Lean CLAY (CL); soft; olive brown; moist; trace fine SAND.	3	2 2 3	5	100		36	84		
	9										
16	10	Lean CLAY with SAND (CL); medium stiff; strong brown; moist to wet; fine SAND.	4	2 3 3	6	100					▽
	11										
14	12	Bottom of borehole at 11.5 ft bgs									13:40 - Drilling Completed
	13	This Boring Record was developed in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010) except as noted on the Soil or Rock Legend or below.									
12	14										
	15										
10	16										
	17										
8	18										
	19										
6	20										
	21										
4	22										
	23										
2	24										
	25										

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PROJECT NAME
UWCD Laguna Road Pipeline
PROJECT NUMBER
221-500
BORING NUMBER
22E-04
REVISION DATE
5/17/2022
SHEET
1 of 1

APPENDIX B - RESULTS OF LABORATORY TESTING

SUMMARY OF LABORATORY TEST RESULTS

Sample Information							Gradation			Atterberg		Corrosion				Compaction					
Boring No.	Sample No.	Depth (ft)	Sample Type	Total Unit Weight, γ_t, (pcf)	Dry Unit Weight, γ_d, (pcf)	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)	Plasticity Index (PI)	Liquid Limit (LL)	pH	Resistivity (Ω - cm)	$SO_4^{\ 2-}$ (mg/kg)	Cl^- (mg/kg)	Max. Dry Unit Weight, $\gamma_{d, MAX}$, (pcf)	Optimum Moisture Content (%)	R-Value	Expansion Index	Additional Testing	USCS Classification
22E-01	A	0.0	BULK	--	--	--	--	--	--	--	--	7.80	583	790	76	--	--	--	--	--	CLAYEY SAND (SC)
22E-01	1	2.5	MCAL	120	99	22	--	--	--	--	--	--	--	--	--	--	--	--	--	SE	CLAYEY SAND (SC)
22E-01	2	5.0	SPT	--	--	--	0	35	65	--	--	--	--	--	--	--	--	--	--	--	CLAYEY SAND (SC)
22E-01	3	7.5	MCAL	124	100	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	CLAYEY SAND (SC)
22E-01	4	10.0	SPT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	CLAYEY SAND (SC)
22E-02	A	0.0	BULK	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SILTY CLAY with SAND (CL-ML)
22E-02	1	2.5	MCAL	122	101	20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SILTY CLAY with SAND (CL-ML)
22E-02	2	5.0	SPT	--	--	19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SILTY CLAY with SAND (CL-ML)
22E-02	3	7.5	MCAL	109	87	25	0	26	73	--	--	8.31	180	8,315	61	--	--	--	--	--	Poorly graded SAND with SILT (SP-SM)
22E-02	4	10.0	SPT	--	--	27	0	25	75	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY with SAND (CL)
22E-02	5	12.5	MCAL	126	103	23	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY with SAND (CL)
22E-02	6	15.0	SPT	--	--	41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Poorly graded SAND with SILT (SP-SM)
22E-02	7	17.5	MCAL	123	--	--	0	81	19	--	--	--	--	--	--	--	--	--	--	--	Poorly graded SAND with SILT (SP-SM)
22E-02	8	20.0	SPT	--	--	33	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY (CL)
22E-02	9	25.0	MCAL	115	83	38	--	--	--	--	--	--	--	--	--	--	--	--	--	C	Lean CLAY (CL)
22E-02	10	30.0	SPT	--	--	--	0	16	84	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY with SAND (CL)
22E-02	11	35.0	MCAL	122	87	41	--	--	--	17	40	--	--	--	--	--	--	--	--	UU	Lean CLAY with SAND (CL)
22E-02	12	40.0	SPT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY with SAND (CL)
22E-02	13	45.0	MCAL	121	96	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY with SAND (CL)
22E-02	14	50.0	SPT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY (CL)

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PROJECT NAME **UWCD Laguna Road Pipeline**	
PROJECT NO. **221-500**	REVISION DATE **5-17-22**
PROJECT MANAGER **L. Berry**	PREPARED BY **C. Stopka**
CHECKED BY **L. Berry**	SHEET **1 of 2**

SUMMARY OF LABORATORY TEST RESULTS

Sample Information							Gradation			Atterberg		Corrosion				Compaction					
Boring No.	Sample No.	Depth (ft)	Sample Type	Total Unit Weight, γ_t, (pcf)	Dry Unit Weight, γ_d, (pcf)	Moisture Content (%)	Gravel (%)	Sand (%)	Fines (%)	Plasticity Index (PI)	Liquid Limit (LL)	pH	Resistivity (Ω - cm)	SO_4^{2-} (mg/kg)	Cl^- (mg/kg)	Max. Dry Unit Weight, $\gamma_{d, MAX}$, (pcf)	Optimum Moisture Content (%)	R-Value	Expansion Index	Additional Testing	USCS Classification
22E-03	A	0.0	BULK	--	--	20	--	--	--	--	--	--	--	--	--	123	10	--	--	--	SANDY lean CLAY (CL)
22E-03	1	2.5	MCAL	111	89	24	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SANDY lean CLAY (CL)
22E-03	2	5.0	SPT	--	--	23	--	--	--	--	--	7.72	507	5,061	35	--	--	--	--	--	SANDY lean CLAY (CL)
22E-03	3	7.5	MCAL	107	90	18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Poorly graded SAND with SILT (SP-SM)
22E-03	4	10.0	SPT	--	--	34	--	--	--	26	48	--	--	--	--	--	--	--	--	--	SANDY lean CLAY (CL)
22E-03	5	12.5	MCAL	124	98	26	--	--	--	--	--	--	--	--	--	--	--	--	--	CU	SANDY lean CLAY (CL)
22E-03	6	15.0	SPT	--	--	50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY with SAND (CL)
22E-03	7	17.5	MCAL	126	102	23	0	47	53	--	--	--	--	--	--	--	--	--	--	--	Poorly graded SAND with SILT (SP-SM)
22E-03	8	20.0	SPT	--	--	35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Poorly graded SAND with SILT (SP-SM)
22E-03	9	25.0	MCAL	111	77	44	--	--	--	21	32	--	--	--	--	--	--	--	--	--	Lean CLAY (CL)
22E-03	10	30.0	SPT	--	--	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY (CL)
22E-04	A	0.0	BULK	--	--	27	--	--	--	--	--	7.33	385	3,412	156	--	--	--	--	--	SANDY lean CLAY (CL)
22E-04	1	2.5	MCAL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	SE	SANDY lean CLAY (CL)
22E-04	2	5.0	SPT	--	--	--	0	20	80	--	--	--	--	--	--	--	--	--	--	--	SANDY lean CLAY (CL)
22E-04	3	7.5	MCAL	114	84	36	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY (CL)
22E-04	4	10.0	SPT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	Lean CLAY with SAND (CL)

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PROJECT NAME
UWCD Laguna Road Pipeline

PROJECT NO.
221-500

REVISION DATE
5-17-22

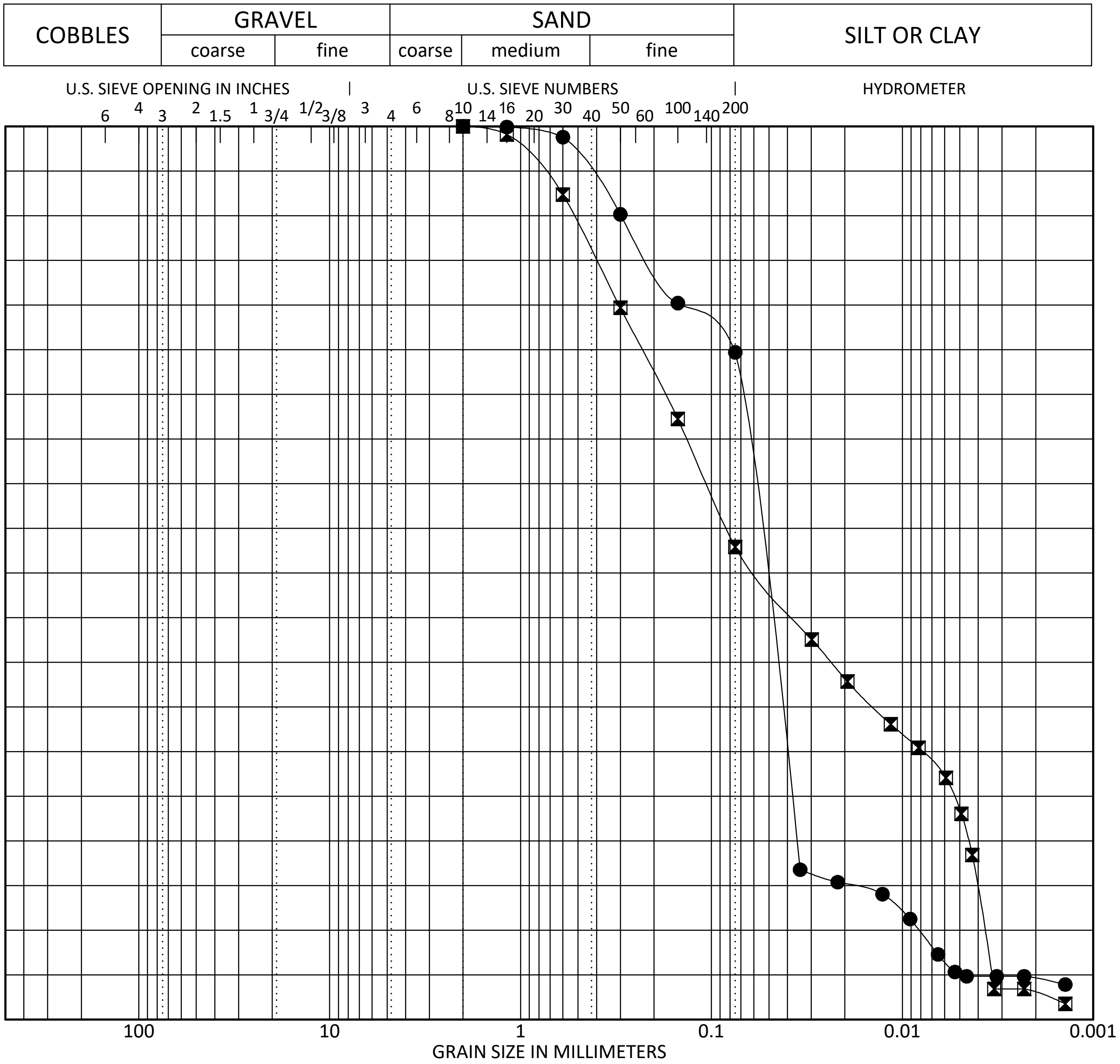
PROJECT MANAGER
L. Berry

PREPARED BY
C. Stopka

CHECKED BY
L. Berry

SHEET
2 of 2

YEH SUMMARY OF TEST RESULTS 221-500 BORING LOGS.GPJ CALIFORNIA YEH LIBRARY (YEH V3 APRIL 2020).GLB 22/8/21



Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	22E-02	10.0 ft	Lean CLAY with SAND (CL)	--	--	--	3.34	7.52
☒	22E-03	17.5 ft	Poorly graded SAND with SILT (SP-SM)	--	--	--	0.16	28.51

Specimen Identification			D100	D60	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	22E-02	10.0 ft	2	0.061	0.054	0.041	0.008	0.0	25.3	69.6	5.1
☒	22E-03	17.5 ft	2	0.106	0.058	0.008	0.004	0.0	47.1	29.4	23.5

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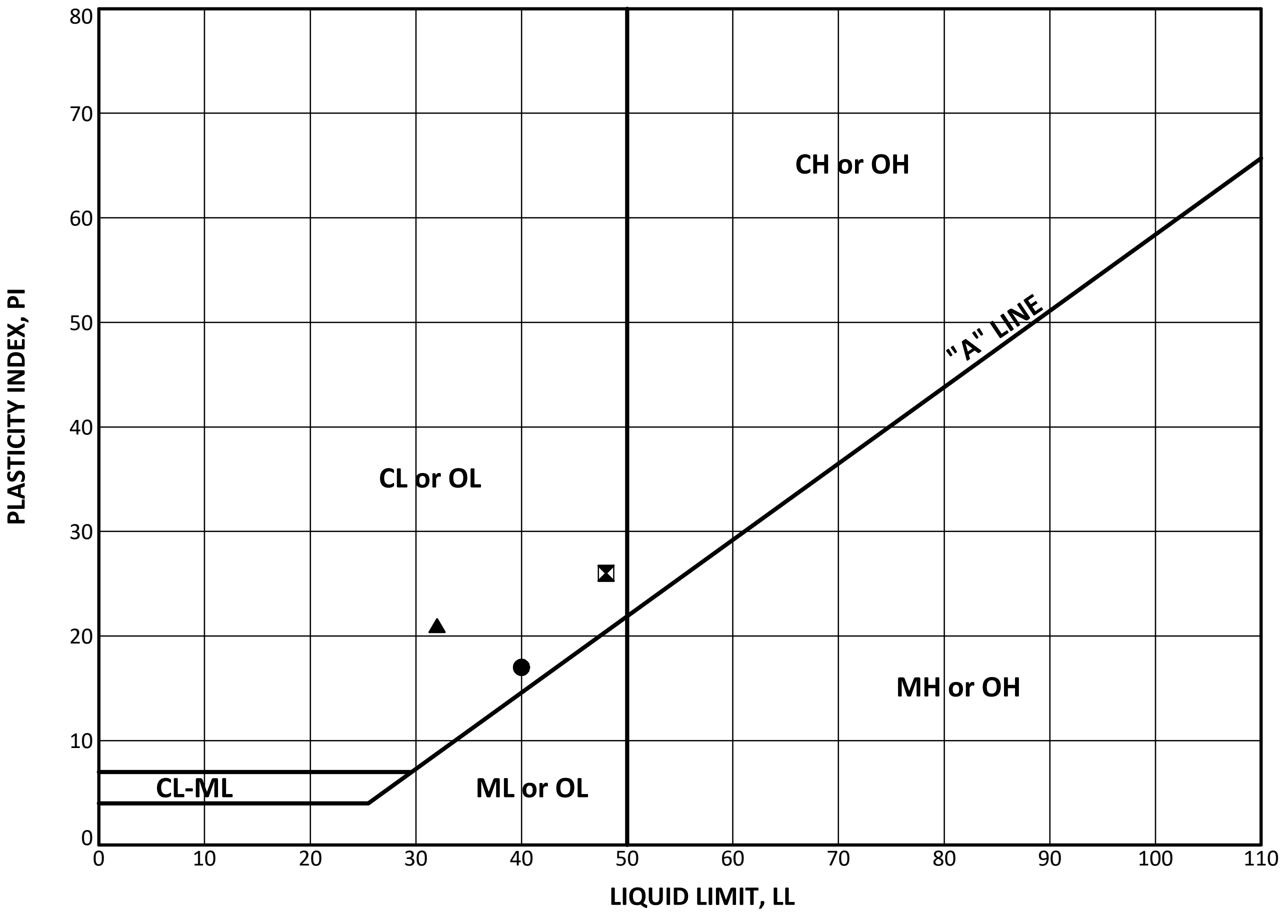
GRAIN SIZE DISTRIBUTION

PROJECT NAME **UWCD Laguna Road Pipeline**	PROJECT NO. **221-500**
REVISION DATE **5-17-22**	PROJECT MANAGER **L. Berry**

PREPARED BY **C. Stopka**	CHECKED BY **L. Berry**	SHEET **1 of 1**

YEH SIEVE 221-500 BORING LOGS.GPJ CALIFORNIA YEH LIBRARY (YEH V3 APRIL 2020).GLB 22/8/21



Boring Number	Sample ID	Depth (ft)	Test Symbol	MC (%)	Fines (%)	LL	PL	PI	Classification
22E-02	11	35.0	●	41	--	40	23	17	Lean CLAY with SAND (CL)
22E-03	4	10.0	⊠	34	--	48	22	26	SANDY lean CLAY (CL)
22E-03	9	25.0	▲	44	--	32	11	21	Lean CLAY (CL)

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ATTERBERG LIMITS

PROJECT NAME
UWCD Laguna Road Pipeline

PROJECT NO.
221-500

REVISION DATE
5-17-22

PROJECT MANAGER
L. Berry

PREPARED BY
C. Stopka

CHECKED BY
L. Berry

SHEET
1 of 1

YEH ATTERBERG 221-500 BORING LOGS.GPJ CALIFORNIA YEH LIBRARY (YEH V3 APRIL 2020).GLB 22/8/21

COOPER
TESTING LABORATORY

Corrosivity Tests Summary

CTL # 687-158 **Date:** 5/31/2022 **Tested By:** PJ **Checked:** PJ

Client: Yeh and Associates **Project:** Laguna Road Pipeline **Proj. No:** 221-500

Remarks:

Sample Location or ID			Resistivity @ 15.5 °C (Ohm-cm)			Chloride	Sulfate		pH	ORP		Sulfide	Moisture	Soil Visual Description
			As Rec.	Min	Sat.	mg/kg	mg/kg	%		(Redox)		Qualitative	At Test	
						Dry Wt.	Dry Wt.	Dry Wt.		E_H (mv)	At Test	by Lead	%	
Boring	Sample, No.	Depth, ft.	ASTM G57	Cal 643	ASTM G57	ASTM D4327	ASTM D4327	ASTM D4327	ASTM G51	ASTM G200	Temp °C	Acetate Paper	ASTM D2216	
22E-01	A	0-5	-	-	-	76	790	0.0790	-	-	-	-	17.5	Dark Brown CLAY w/ Sand
22E-02	8	20	-	-	-	61	8,315	0.8315	-	-	-	-	32.3	Brown CLAY
22E-03	2	5	-	-	-	35	5,061	0.5061	-	-	-	-	27.2	Brown CLAY w/ Sand
22-04	A	0-45	-	-	-	156	3,412	0.3412	-	-	-	-	21.8	Brown Clayey SAND

5/26/2022

Yeh and Associates, Inc.
56 E. Main Street
Suite 104
Ventura CA, 93001

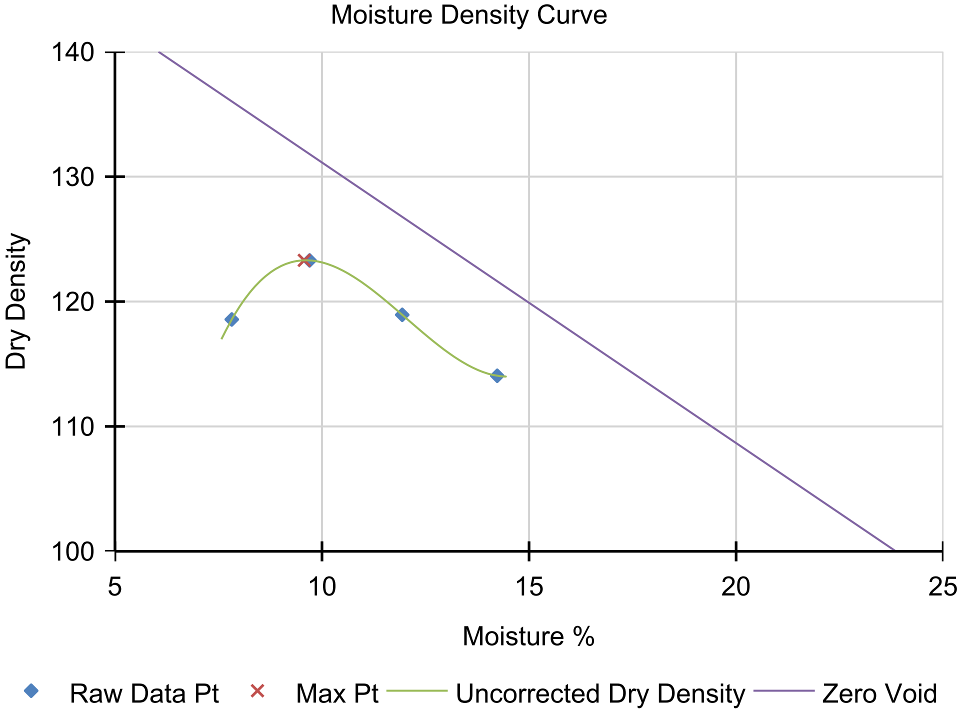
LABORATORY COMPACTION CHARACTERISTICS OF SOIL

Project No 0107
Client Reference No
Sample ID/Barcode 058
Material Criteria
Material Source
Material Description Clay with sand (CL-CH); olive brown, wet
Project Yeh - On-Call Master Agreement
Location Detail Yeh 221-500; 22E-03 #A @0'-5'

Date Sampled 5/16/2022
Date Tested 5/19/2022
Sampled By Client

Test Standard ASTM D1557
Compaction Method B
Rock Correction No
Rock Replacement No
Rock Specific Gravity
Specific Gravity Determination

Method of Sample Preparation Used Wet
Type of Compaction Rammer Used Automatic
Type of Rammer Face 2" Round
Optimum Moisture 9.6
Maximum Dry Dens 123.3



Sieve Analysis

Sieve Size	%Retained
+3/4"	0.0
+3/8"	2.0
+#4	3.0
Minus #4	
Total	5.0

Data Pt	Moisture %	Dry Density
1	7.8	118.6
2	9.7	123.3
3	11.9	118.9
4	14.2	114.1

Tested By Adam Sinutko

Manager Evan Folk

Lab Address PO Box 52506 OXNARD CA, 93031
System Link http://umt.vahalo.com/assignments/4887E93F-0D6C-4E57-5DE1-85D724E0C4F6
System Path Yeh - On-Call Master Agreement / SOILS / AGGREGATE LAB / 0107 Proctor AS220519-1; Lab ID - 058

5/26/2022

Sand Equivalent Value of Soils and Fine Aggregate

AASHTO T176

Client Yeh and Associates, Inc.

Address Yeh and Associates, Inc.
56 E. Main Street
Suite 104
Ventura CA, 93001

Project No	0107	**Date Tested**	5/20/2022
Client Reference No		**Sample Rec Date**	
Material Source		**Date Sampled**	5/16/2022
Material Description	Clay (CL-CH); dark olive brown, wet	**Sampled By**	Client
Project	Yeh - On-Call Master Agreement		
Location Detail	Yeh #221-500; 22E-01 #1 @ 2.5'		

Prep Method Dry

Shaker Method Mechanical Shaker

		Specification
Sand Reading Average	0.5	
Clay Reading Average	13.5	
Sand Equivalent Value	5.0	

Remarks

Technician Adam Sinutko
Digital Signature By User Login

Manager Evan Folk
Digital Signature By User Login

Lab Address PO Box 52506 OXNARD CA, 93031
System Link http://umt.vahalo.com/assignments/BE5A3B28-87D0-41D6-C776-24D0D2B5A9C6
System Path Yeh - On-Call Master Agreement / SOILS / AGGREGATE LAB / 0107 SandEquiv AS220519-1

5/26/2022

Sand Equivalent Value of Soils and Fine Aggregate

AASHTO T176

Client Yeh and Associates, Inc.

Address Yeh and Associates, Inc.
56 E. Main Street
Suite 104
Ventura CA, 93001

Project No 0107

Client Reference No

Material Source

Material Description Clay (CL-CH); dark olive brown, wet

Project Yeh - On-Call Master Agreement

Location Detail Yeh #221-500; 22E-04 #A @ 0-5'

Date Tested 5/20/2022

Sample Rec Date

Date Sampled 5/16/2022

Sampled By Client

Prep Method

Shaker Method Mechanical Shaker

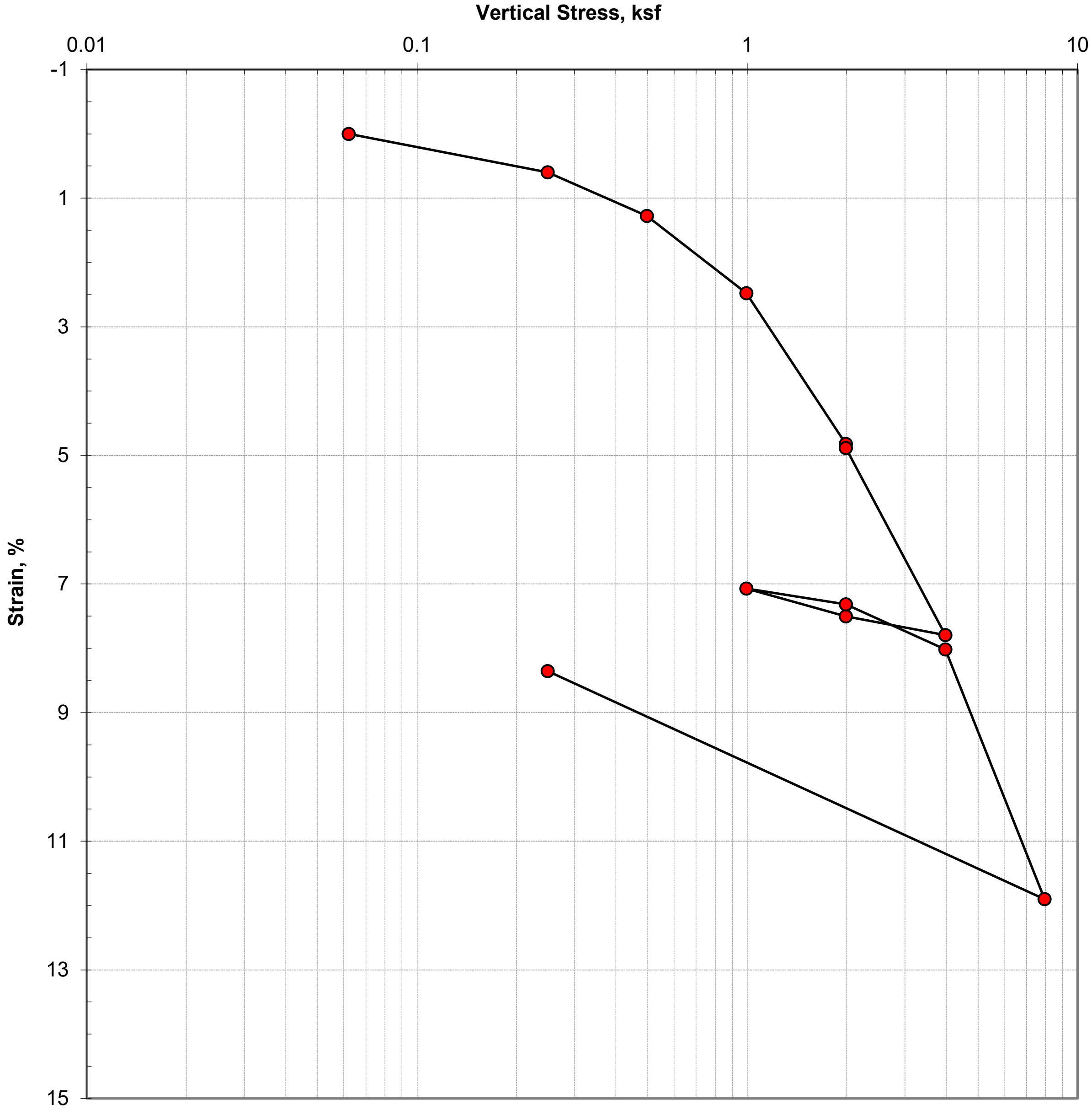
		Specification
Sand Reading Average	0.4	
Clay Reading Average	13.3	
Sand Equivalent Value	4.0	

Remarks

Technician Adam Sinutko
Digital Signature By User Login

Manager Evan Folk
Digital Signature By User Login

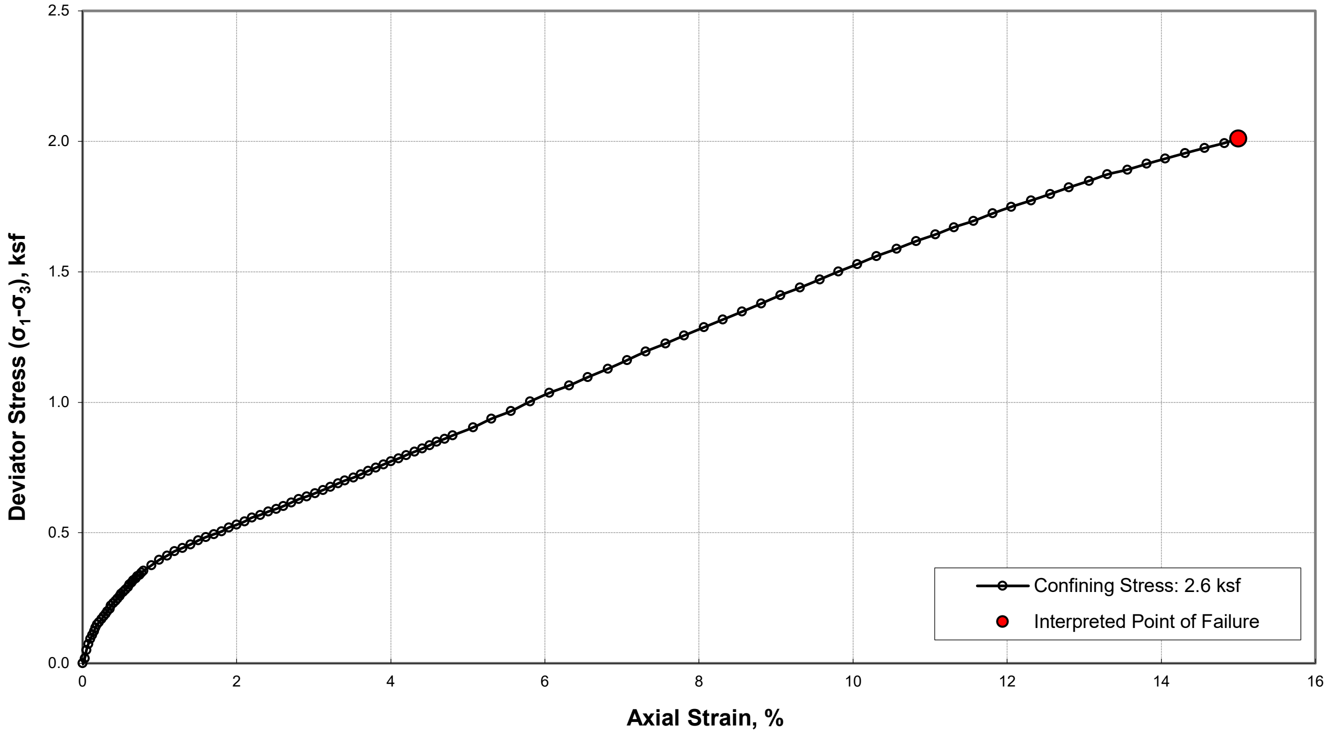
Lab Address PO Box 52506 OXNARD CA, 93031
System Link http://umt.vahalo.com/assignments/5DA9270A-3425-4724-89D4-8AFF2E2CD5EA
System Path Yeh - On-Call Master Agreement / SOILS / AGGREGATE LAB / 0107 SandEquiv AS220519-2; 05B



SAMPLE ID	Boring, Sample $^{\#}$, Depth	22E-02 , #9 , 25.0 ft	
	USCS Classification:	Lean Clay (CL)	
PROPERTIES		Initial	Final
	Water Content, %	38.2%	32.5%
	Dry Unit Weight, pcf	82.9	90.5
	Saturation, %	98%	100%
	Void Ratio	1.07	0.90
	Diameter, in	2.42	2.42
	Height, in	0.82	0.75

SUMMARY	Preconsolidation Pressure, ksf	---
	Inundation Increment, ksf	--
	Liquid Limit	---
	Plastic Limit	---
	Plasticity Index	---
	Passing $^{\#}$200	---
	Estimated Gs	2.75
REMARKS	Test Method: ASTM D2435	
	Project: Laguna Road Pipeline	
	Test Performed by CalPoly GEO-E Lab	
	Checked by L.Berry, Yeh 8-19-22	

INCREMENTAL CONSOLIDATION TEST



SAMPLE ID	Boring Number:	22E-02
	Sample Number:	11
	Sample Depth:	35.0 ft
	USCS Classification:	Lean CLAY with sand (CL): gray brown, moist
PROPERTIES	Water Content, %	34.2%
	Dry Unit Weight, pcf	86.5
	Saturation, %	96%
	Void Ratio	0.98
	Diameter, in	2.42
	Height, in	5.00

SAMPLE IMAGES

CLASSIFICATION	Sieve Size	% Passing	Other Parameters	
	3/8-in. (9.5mm)	---	Liquid Limit	---
	#4 (4.75mm)	---	Plastic Limit	---
	#16 (1.18mm)	---	Plasticity Index	---
	#30 (0.6mm)	---	Estimated Gs	2.75
	#100 (0.150mm)	---	S_u from T_v, ksf	---
	#200 (0.075mm)	---	S_u from PP, ksf	---

TEST SUMMARY	Maximum Deviator Stress, ksf	2.0
	Undrained Shear Strength, ksf	1.0
	Axial Strain at Failure, %	15.0
	Strain Rate, %/min	1.0
	Cell Pressure, ksf	2.6
	Tested By:	GF
	Date Tested:	5/27/22

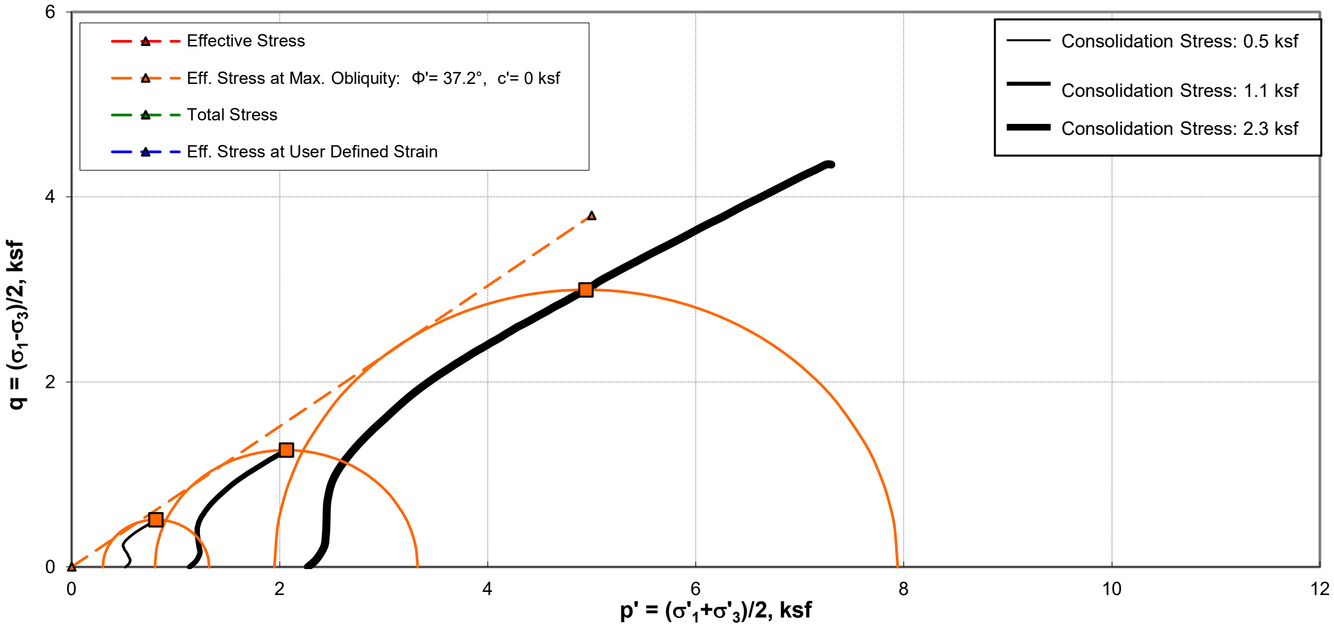
REMARKS

Test Method: ASTM 2850

Project: Laguna Road Pipeline

Tested by the CalPoly Geo-E Laboratory. Checked by L. Berry, Y

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST REPORT



SAMPLE ID

Boring Number	22E-03
Sample Number	5
Specimen Depth	12.5 ft
USCS Classification	Clayey SAND (SC): gray olive brown, wet

INITIAL

Trial ID	A	B	C
Water Content, %	28.1%	25.9%	24.9%
Dry Unit Weight, pcf	95.3	99.1	100.7
Saturation, %	99%	100%	100%
Void Ratio	0.77	0.70	0.67
Diameter, in	2.42	2.42	2.42
Height, in	5.00	4.83	4.72

PRE-SHEAR

Water Content, %	25.9%	24.9%	24.0%
Dry Unit Weight, pcf	99.1	100.7	102.3
Saturation, %	100%	100%	100%
Void Ratio	0.70	0.67	0.65

REMARKS

Test Method: ASTM 4767 (modified for staged testing)
Project: Laguna Road Pipeline

Tested by CalPOLY Geo-E Laboratory.
Checked by L. Berry, Yeh and Associates, 8-19-22

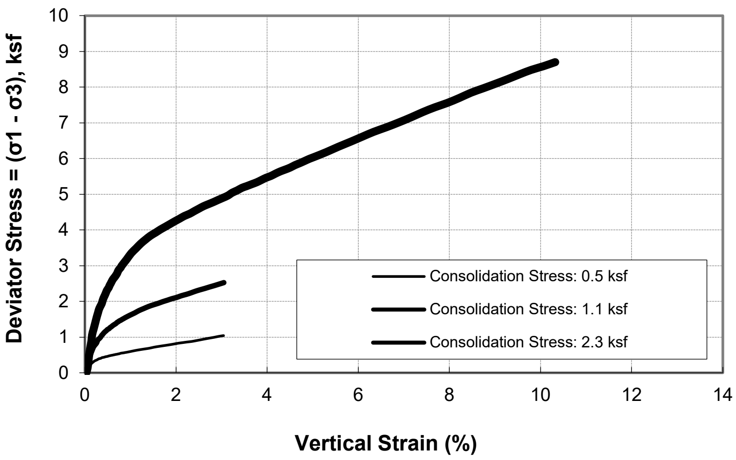
CLASSIFICATION

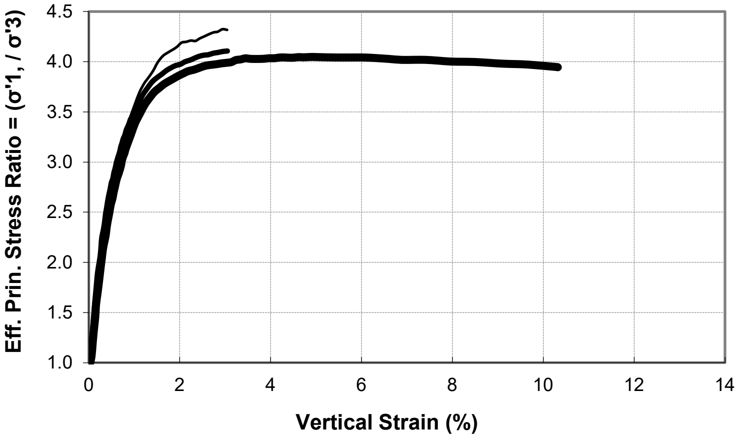
Trial ID	A	B	C
Liquid Limit	---	---	---
Plastic Limit	---	---	---
Plastic Index	---	---	---
Passing #4 (4.75 mm)	---	---	---
Passing #200 (0.075 mm)	---	---	---
Estimated Gs	2.70	2.70	2.70

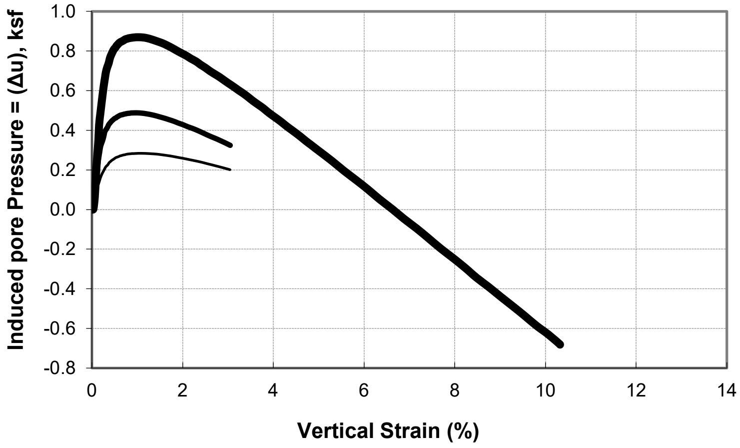
TEST SUMMARY

Trial ID	A	B	C
B-Parameter	0.98	0.98	0.98
t_{50}, minutes	N/A	N/A	N/A
Strain Rate, %/min	0.02	0.02	0.02
Cell Pressure, ksf	9.2	9.8	11.0
Back Pressure, ksf	8.7	8.7	8.7
Consolidation Stress, ksf	0.5	1.1	2.3
Deviator Stress @ Failure, ksf	1.0	2.5	5.9
Axial Strain @ Failure, %	2.9	3.0	4.9
σ'_{1F}, ksf	1.3	3.3	7.9
σ'_{3F}, ksf	0.3	0.8	1.9
Tested By:	ND	ND	ND
Date Tested:	5/29/22	5/30/22	5/31/22

CONSOLIDATED UNDRAINED TRIAXIAL TEST







A	22E-03	#5	12.5 ft	Clayey SAND (SC): gray olive brown, wet
B	22E-03	#5	12.5 ft	
C	22E-03	#5	12.5 ft	

CONSOLIDATED UNDRAINED TRIAXIAL TEST

Appendix B: Technical Memorandum

09 August 2022

Technical Memorandum (TM)

To: Michel Kadah, PE, United Water Conservation District (UWCD)
Robert Richardson, PE, UWCD
Maryam Bral, PhD, PE, UWCD

From: Ray Lyons, PE, Kennedy Jenks
Evelyn Choudhary, EIT , Kennedy Jenks

Reviewers: Paul Chau, PE, Kennedy Jenks
Dawn Taffler, PE, LEED^{AP}, Kennedy Jenks

Subject: Laguna Road Pipeline PDR Options to Address Hydraulic and Operational Constraints

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1. Overview

Based on recent modeling results, discussions during the 7 July 2022 status meeting, information from the Pleasant Valley Water Conservation District (PV or PVWCD), and follow-up considerations by the Kennedy Jenks team, this technical memorandum (TM) describes options to modify the Laguna Rd Pipeline Preliminary Design Report (PDR) efforts to address hydraulic and operational constraints identified as part of the preliminary design process.

2. Hydraulic Modeling Findings

Two significant hydraulic challenges were identified:

1. **PTP/PV Hydraulic Grade:** SCADA data for the PTP and PV systems near the proposed new pipeline at Laguna Rd indicated that both systems operate at similar average pressures. ***For adequate flow to be conveyed from the PTP to the PV system, the PV system must be at a higher HGL.***

2. **PV Well No. 7:** United intends to convey recycled water (RW) from Oxnard's AWPF facility through the PV system, however, PV's Well No. 7 is located directly next to the proposed pipeline. During the coordination meeting with PVCWD, this well station pump was identified as a preferred pump for PV system operation based on their pump efficiency program. SCADA data indicates that this pump is frequently operating. ***To avoid groundwater from Well No. 7 dominating transfers to the PTP system, the following infrastructure modifications or operational adjustments could be made:***

- **a.** Take water from the PV system only when Well No.7 is not operating. This would require coordinating with PV to utilize Well No. 7 less frequently and potentially negotiate a schedule for use of this well to optimize United's ability to receive recycled water from Oxnard.
- **b.** Add an additional valve vault onto the 27-inch PV pipeline north of the intersection of Wood and Laguna Rd to restrict flow from Well No. 7 to the PTP system.
- **c.** Well No. 11, located south of the AWPF connection point may also impact water qualities conveyed to the PTP system.

3. Hueneme Road Pipeline Challenges

Kennedy Jenks is providing construction management (CM) services for the Hueneme Rd Pipeline, which now connects Oxnard's RW system to the PV system. The pipeline will subsequently provide deliveries of RW from Oxnard to the PTP system, via the PV system. ***PVWCD has requested that the pressure be maintained at 50 psi or lower, with the intention of protecting the infrastructure in the PV system.*** A PRV has been installed at the connection point from the Hueneme Rd Pipeline into the PV system.

Based on discussion with this Kennedy Jenks CM team, start-up activities have included:.

- An initial startup test for the AWPF to deliver flows to the PV system. The discharge pressure was measured at approximately 65 psi leaving the facility, and the PRV at the intersection of Hueneme and the PV system reduced the pressure to 50 psi on the PV side of the connection. During this initial test, flow was unable to be conveyed to the PV system at the anticipated flowrate.
- A second startup test (on July 13th) to flush the line. At this time, flows were successfully conveyed into the PV system. The flowrate averaged approximately 2,500 gpm. The pressure at Wood Rd varied from approximately 42 to 48 psi, however the accuracy of this pressure reader is unknown.

4. Potential Options for Consideration

Given the potential impact of these findings, **Table 1** presents three potential options to modify the Laguna Road Pipeline design to address hydraulic and operational constraints. Each option is described and elements to be confirmed, benefits and limitations are highlighted. The next step is to discuss potential options and constraints with PVWCD.

Table 1 – Potential Options to Modify Laguna Road Pipeline Design to Address Hydraulic and Operational Issues

Option	Description	Benefits	Limitations
Option A: Add a new Booster PS (+)	Address hydraulic issues by adding a new booster pump station at the intersection of Wood Rd and Laguna Rd to increase pressure to allow flow from PV to PTP system. <u>To be Confirmed:</u> ✓ Confirm that a control strategy or valve system can be implemented with PV that minimizes Well 7 water from being conveyed to PTP system. ✓ Confirm that the PTP system can receive the higher-pressure flows and understand potential impacts to the PTP system operation.	• United would have more control over system hydraulics. • Installation of variable speed drives enhance flow control and energy efficiencies. • Minimizes impacts to the PV system caused by high pressure deliveries (see Option B).	• Requires more space in already constricted area at intersection of Wood and Laguna Rd; land owned by PV. • Significant additional capital cost (Est at $2-3 million). • Higher O&M costs (energy, maintenance and repairs). • When Well 7 is in operation, flows from PV to PTP would be dominated by local groundwater. • Additional vault on PV System would be required to avoid conveyance of Well 7 groundwater to PTP System - see (+) add-on below. • Potential for high operational complexity and significant ongoing coordination with PV. • Source water will be Oxnard recycled water blended with other PV supplies. • United and PV negotiations may impact project schedule.
Option B: PV Operational Changes (+)	Increase hydraulic grade line (HGL) in PV system by modifying the operation of the recently installed pressure reducing valve (PRV) at Hueneme Rd to increase pressure for deliveries of advanced treated recycled water (RW) from Oxnard to the PTP system. <u>To be Confirmed:</u> ✓ Once the Hueneme Rd connection to PV system is operational it the new operating HGL for the system should be evaluated. ✓ Confirm if PV system can be operated at a higher HGL.	• Minimal infrastructure requirements if existing pressure from the Hueneme Rd pipeline can be maintained. • Low project capital cost option.	• Potential risks to PV system if operating at higher pressures: (1) leakage/damage to existing infrastructure, (2) loss of groundwater well capacity, (3) modification to multiple groundwater pumps and (4) impacts to customers directly served. • United would have limited control over pressure condition of RW deliveries. • United and PV negotiations may impact project schedule. • When Well 7 is in operation, flows from PV to PTP would be dominated by local GW. • Additional vault on PV System would be required to avoid conveyance of Well 7 GW to PTP System - see (+) • Potential for high operational complexity and significant ongoing coordination with PV. • Source water will be Oxnard RW blended with other PV supplies
(+) Add-on for Options A or B: New valve vault on PV System North of Laguna Rd	Add a valve vault on PV System at the intersection of Wood Rd and Laguna Rd to avoid conveyance of Well 7 GW to PTP System. The valve would be added to the 27-inch PV pipeline north of Laguna Rd.	• Prevents Well 7 water from directly going into PTP system. • United would have more control over water quality and quantity transferred through the PV system. • Minimal infrastructure requirements. • Medium-low capital cost option in addition to cost of option A or B.	• Requires installation of new infrastructure directly on PV system • Requires additional O&M costs, for energy, maintenance and repairs. • Vault likely required, especially if valve is motor operated, which would require more space in already constricted area; land owned by PV. • Long lead times for large diameter valves (up to 1 year)
Option C: Wood Road Pipeline Isolation	Add two new motor operated valves on PV Wood Road Alignment – (1) near well 7 and (2) near Hueneme Road pipeline connection to allow for isolation of a portion of the PV system to have a dominance of AWPF water by isolating Well 7 and Well 3. <u>To be Confirmed:</u> ✓ Verify that this segment of the Wood Road pipeline and customers directly served can handle higher pressure deliveries. ✓ Confirm RW flow deliveries at RW transmission HGL (without PRV pressure reduction).	• United would have more control over system hydraulics. • Minimal infrastructure requirements if existing pressure from the Hueneme Rd pipeline can be maintained. • Provides a more direct connection to Oxnard's RW. • Low cost option	• Potential risks to isolated segment of PV system if operating at higher pressures: (1) leakage/damage to existing infrastructure, (2) loss of groundwater well capacity, (3) modification to multiple groundwater pumps and (4) impacts to customers directly served. • Requires direct modifications to the PV system and potentially for customer connections along this segment (e.g., install PRVs) • Requires land and infrastructure for new vaults for motor operated valves. • Long Lead time for large diameter valves (up to a year). • United and PV negotiations may also impact project schedule.

Appendix C: Permit Information

VENTURA COUNTY
PUBLIC WORKS AGENCY
WATERSHED PROTECTION DISTRICT

800 SOUTH VICTORIA AVENUE, VENTURA, CA 93009-1610
(805) 650-4060

ENCROACHMENT & WATERCOURSE PERMITS

A permit is required when:

- You want to do work or an activity in, on, over, under, or across the bed and banks of a channel in VCWPD jurisdiction.
- You want to construct something in, perform an activity in, or make any kind of use of VCWPD right-of-way (easement or property).

For most permits, the minimum requirements for applying are:

1. a completed application
2. a trust deposit of $2000 ($370 is non-refundable application fee and the remaining $1,630 is put in trust account for permit staff charges)
3. plans and a location map showing the activity or proposed construction

Below are the rates charged to your trust account for various staff:

Deputy Director	$219.45/hour
Engineer Manager II	$184.01/hour
Engineer III	$139.91/hour
Engineer IV	$162.77/hour
Hydrologist IV	$152.69/hour
Senior Public Works Inspector	$122.78/hour
Public Works Inspector III	$111.64/hour
Engineering Technician IV	$104.83/hour
Supervising Contract Support Specialist	$80.82/hour
Management Assistant II	$67.07/hour
Student Worker III - Extra Help	$21.28/hour

See page 2 for the “Application Form”.

For more complete information go to www.vcwatershed.org

APPLICATION FOR PERMIT

CHECK ONE: WATERCOURSE PERMIT ☐ ENCROACHMENT PERMIT ☐

PUBLIC WORKS AGENCY
VENTURA COUNTY WATERSHED PROTECTION DISTRICT
800 SOUTH VICTORIA AVE. VENTURA CA 93009-1610
(805) 650-4060

APPLICANT’S NAME: ______________________________

PHONE NO: ______________ EMAIL: ______________________

APPLICANT'S ADDRESS (OR NAME & ADDRESS OF AUTHORIZED SIGNATORY IF APPLICANT IS A CORPORATION):

____

IS THE PERMITTEE THE SAME AS THE APPLICANT? YES ☐ NO ☐ PHONE NO: ______________

PERMITTEE: ______________________ EMAIL: ______________

ADDRESS: ______________________________

PRINCIPAL CONTACT: ______________________________

CONTACT'S PHONE NO: ______________ EMAIL: ______________________

ASSESSOR PARCEL NUMBER OF SITE (s): ______________________

LOCATION DESCRIPTION OF PROPOSED WORK:

____

____

____

____

PURPOSE OF PERMIT OR DESCRIPTION OF WORK TO BE DONE AND MATERIALS TO BE USED:

____

____

____

____

____

DATE REQUESTED FOR COMMENCEMENT OF WORK: __________ ESTIMATED COMPLETION DATE: __________

TOTAL ESTIMATED COST OF PROPOSED CONSTRUCTION: $ ______________

****

IF THE PERMIT IS ISSUED, I AGREE THAT ALL WORK SPECIFIED WILL COMMENCE WITHIN SIXTY (60) DAYS AFTER THE PERMIT IS ISSUED, OR BY THE DATE SET FORTH IN THE PERMIT, WHICHEVER IS EARLIER, AND THAT ALL WORK WILL BE PURSUED TO ITS COMPLETION WITH REASONABLE DILIGENCE: AFTER SIX (6) MONTHS OF INACTIVITY FROM OUR LAST WRITTEN CORRESPONDENCE, THIS APPLICATION SHALL BE CONSIDERED EXPIRED AND A NEW APPLICATION & FEE WILL BE REQUIRED.

DATE: __________ APPLICANT SIGNATURE: ______________________________

APPLICANT (PRINT NAME): ______________________________

APPLICANT (NAME OF COMPANY, PRINT): ______________________________

STANDARD CONDITIONS

1. Permittee shall maintain Ventura County Watershed Protection District's (District's) right-of-way free from any and all debris resulting from the exercise of this permit.

2. Activities and uses authorized under this permit are subject to any instructions of the Engineer-Manager or his representative. All instructions must be strictly observed.

3. Any work performed under this permit prior to notification of District as to start of work will be subject to whatever action, including restoration to condition existing before work was begun, that the Watershed Protection District deems necessary to inspect, correct and/or approve said work.

4. Any damage cause to District structures by reason of exercise of this permit shall be repaired at the cost of Permittee to the satisfaction of this District.

5. This permit is valid only to the extent of District jurisdiction. Permits required by other interested agencies and consent of other interested agencies and consent of underlying fee owner of District easement lands shall be the responsibility of the Permittee. Nothing contained in this permit shall be construed as a relinquishment of any rights now held by the District.

6. Permittee shall indemnify, defend and hold District, its officers, agents and employees harmless from any and all claims, costs, expenses, liabilities, defense and legal costs and judgments for damages arising out of, or in any way connected with, the exercise of this permit by Permittee or its contractor, agents, employees and invitees.

7. Unless otherwise specified herein, this permit is subject to all prior unexpired permits, agreements, or easements, privileges or other rights, whether recorded or unrecorded, in the area specified in this permit. Permittee shall make his own arrangements with holders of such prior rights.

8. Any structures or portions thereof placed upon District rights-of-way, or which affect District structures, must be removed, revised, and/or relocated by Permittee without cost to the District, should future activities of the District so require, unless otherwise specified by the District.

9. If the property subject to this permit changes ownership, the Permittee must advise the new owner to contact the District concerning the need for a transfer of the permit.

10. If conditions change or new facts are discerned concerning the effects of the activities and uses authorized under this permit, or for other good cause, the District may modify the permit in order to protect life and property.

11. The Permittee shall provide the District with a record drawing depicting the accurate location of the subsurface encroachment authorized by the permit within 30 days after installation. Furnishing the record drawing shall not relieve the Permittee of the obligation to maintain permanent location records and accurately locate the subsurface encroachment to facilitate District work. The Permittee shall be liable for all costs incurred by the District as a result of inaccurate location data provided by the Permittee.

12. Permittee shall cause any bond, if required by the permit, to remain in effect to guarantee all the work to be performed and all the materials to be furnished under this permit against defects in materials or workmanship for a period of one (1) year from the date of final acceptance of the completed work by the District. Permittee shall, within reasonable time after receipt of written notice thereof, make good (at his own expense or at his surety's expense) and without cost to District, any defects in materials or workmanship which may develop during said one-year period and damage to other work caused by such defects or repairing of same.

13. A pre-construction meeting and final inspection are required with the Watershed Protection District Permit Engineer for all construction projects. Call for meeting and inspection schedules at least 48 hours prior to meetings.

14. **Permittee shall comply with the requirements of the Ventura Countywide Stormwater Quality Management Program (VCSQMP), as well as other state and federal requirements of the Clean Water Act.**

SPECIAL PROVISION

Attention is directed to Standard Condition No. 5 regarding the permittee's responsibility for obtaining other required permits. As one example, neither the issuance of a watercourse permit nor an encroachment permit precludes the need for the Permittee to comply with the provisions of Section 1603 of the Fish and Game Code of the State of California. In connection therewith, the Department of Fish and Wildlife may determine the project to be subject to the requirements of the California Environmental Quality Act (CEQA), notwithstanding that issuance of Watercourse or Encroachment permits by the Ventura County Watershed Protection District is a ministerial act and exempt from the provisions of the CEQA, as provided in Section 4.3.2(a) of the County of Ventura Administrative Supplement to the State CEQA Guidelines (which has been adopted for the Ventura County Watershed Protection District).

County of Ventura - Public Works Agency
ROADS & TRANSPORTATION

ENCROACHMENT PERMIT APPLICATION

800 South Victoria Avenue L#1620, Ventura, CA 93009
(805) 654-2055 / Fax.(805) 654-5169
email: pwa.transpermits@ventura.org / https://vcpublicworks.org/

Permit No: ____________
Date Applied: ____________
Project No: ____________

An incomplete application will not be processed. If fields are not applicable, please insert N/A.

"The undersigned hereby applies for permission to encroach on the following described County Right of Way or other property"

LOCATION OF WORK:

Street No: __________ Street Name: ______________________________ City: ________________________ Zip code: __________

Road Limits from Road Inventory: ____ Click link for Road Inventory List

Nearest Cross Street: ______________________________________ Distance from nearest Cross Street (FT): __________________

DESCRIPTION OF WORK:

____

____

____

____

Excavation Length: _________ Excavation Width: _________ Excavation Depth: _________ Excavation Surface: ______________

Number of Driveways : __________ Width of Driveway/sidewalk : ______________ Length of Sidewalk: ____________________

Start Date: ____________________________________ Estimated Completion Date: ____________________________________

APPLICANT INFORMATION:

Permittee: ____ Phone: _______________ Email: ______________________________

Address Street No: _________ Street Name: ______________________________ City: __________________ Zip code: _________

Primary Contact: ___________________________________ Phone: _______________ Email: ______________________________

Contractor:_______________________________________ Phone: _______________ Email: ______________________________

Address Street No: _________ Street Name: ______________________________ City: __________________ Zip code: _________

Field Contact Person: _____________________________________ Phone: ____

ATTACHMENTS INCLUDED:

☐Plans ☐Traffic Control Plan ☐Insurance Certificate Estimated Construction Cost ($): _____________ Other: _______________

Working in the road right of way without an approved permit is a misdemeanor and may be subject to double fees and other penalties.

ACKNOWLEDGEMENT

I understand that any permit that may be granted as a result of this request may be revoked by County at any time. In consideration for issuance of this permit, I agree, and by use hereof, my agents, employees, contractors and invitees agree to be bound by all of the provisions of California Vehicle Code Sections 35780, 35782, Division 12 of the Ventura County Ordinance Code, the Standard Conditions included with this permit and any special conditions hereupon, or attached hereto.

I agree to hold the County, its officials, officers, employees and agents harmless from any claims, defense and legal costs, judgments for damages, or other relief against the County as a result of acts, or omissions, by me or my representatives, in the performance of any activities permitted hereunder, whether the condition giving rise to the claim or judgment was created in whole, or in part, by me or my representatives.

I understand that a violation of the conditions would constitute a violation of the encroachment ordinance which is a misdemeanor per section 12301 and is guilty of separate offenses for every day and part thereof which such violation remains. I agree to comply with all conditions of approval for the permit. I further agree to continually maintain all encroachments authorized by this permit in a condition acceptable to the County.

By:____ Date: ______________________________
SIGNATURE OF PERMITTEE

Name: ____ Title: ______________________________
PRINT NAME

ATTACHMENT C – NOTICE OF INTENT & INSTRUCTIONS FOR COMPLETING THE NOTICE OF INTENT

CALIFORNIA
Water Boards

Edmund G. Brown Jr.
Governor

Matthew Rodriquez
Secretary for Environmental Protection

Los Angeles Regional Water Quality Control Board

NOTICE OF INTENT

TO COMPLY WITH GENERAL WASTE DISCHARGE REQUIREMENTS
AND
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

Check only one item.
A. New Discharge ☐ B. Material Change ☐ C. Existing Discharge ☐ CI # ______________

SECTION II. OWNER/OPERATOR & FACILITY INFORMATION

A. OWNER

Name/Agency		Contact Person		Title of Contact Person
Mailing Address		Email Address		
City	County	State	ZIP	Phone

B. OPERATOR (*If different from owner)*

Name/Agency		Contact Person		Title of Contact Person
Mailing Address		Email Address		
City	County	State	ZIP	Phone

C. FACILITY

Name of Facility		Owner Type (check one) 1. ☐City 2.☐ County 3.☐ State 4. ☐Fed 5. ☐ Private		
Address		Contact email address		
City	County	State	ZIP	Phone

D. STANDARD INDUSTRIAL CLASSIFICATION CODE (SIC) (4 digit code in order of priority)

1.)	(specify)	2.)	(specify)

Nature of Business (provide a brief description)

SECTION III. APPLICABLE GENERAL PERMIT FOR DISCHARGE (Check only one item)

- ☐ Volatile Organic Compounds Contaminated Groundwater (Order No. R4-2018-0087), Include Supplemental Analysis
- ☐ Wastewaters from Investigation and/or Cleanup of Petroleum Fuel Pollution (Order No. R4-2018-0086), Include Supplemental Analysis
- ☐ Discharges of Groundwater from Construction and Project Dewatering (Order No. R4-2018-0125), Include Supplemental Analysis
- ☐ Discharge of Nonprocess Wastewater (Order No. R4-2014-0060), Include Supplemental Analysis
- ☐ Hydrostatic Test Water (Order No. R4-2009-0068), Include Attachment A – Screening Levels
- ☐ Discharges of Groundwater from San Gabriel Valley Groundwater Basin (Order No. R4-2014-0141)

SECTION IV. EXISTING REQUIREMENTS/PERMITS (Skip if not applicable)

List any active Orders or Permits adopted by this Regional Water Board for the facility.

A. Order No. ______ ______ ______

B. NPDES Permit(s) ______ ______ ______

SECTION V. OUTFALL AND RECEIVING WATER INFORMATION

Outfall Number	**Latitude**			**Longitude**			**Receiving Waterbody** (River, Stream, Channel, Lake, Coastal, etc.)
	Deg.	**Min.**	**Sec.**	**Deg.**	**Min.**	**Sec.**	

SECTION VI. PROJECT INFORMATION (attach additional sheets, if necessary)

1). Description of project and discharge

2). Description of treatment process (Attach diagram showing the treatment process, if applicable)

3). Summary of feasibility study on conservation, reuse, and/or alternative disposal methods of the wastewater. Where full or partial reuse is not possible, provide reasons why reuse cannot be achieved.

4). Description of additive's composition	
5). Proposed Maximum Discharge Flow	
6). Proposed discharge startup date	
7). Estimated discharge duration	

SECTION VII. DISCHARGE QUALITY INFORMATION

This NOI requires that you obtain and analyze representative influent wastewater sample for the pollutants listed on **Attachment E**.

For Discharges Hydrostatic Test:

Have you included a completed Attachment A – **Screening for Potential Pollutants of Concern in Potable Water**?
(Applies only to potable water related discharges.) ☐ Yes ☐ No

For Discharges from all other sources:

Have you included a completed **Supplemental Pollutants Analysis/Measurements Form**?
(Complete the Quantitation Level column and attach laboratory analytical data) …… ☐ Yes ☐ No

If **No**, explain:

SECTION VIII. OTHER REQUIRED INFORMATION

Provide a 7.5' USGS Quadrangle Map (Scale 1:24,000) showing the project location and identifying surface water to which you propose to discharge.

Fees: Have you included appropriate filing fee with this submittal? (Applicable to new enrollees only)
Make checks payable to the Water Resources Control Board

SECTION IX. CERTIFICATION AND SIGNATURE (see appendix on who is authorized to sign)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Printed Name of Person Signing Date

Signature

Title

SECTION X. FORM SUBMITTAL

Send this completed Notice of Intent to:

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD, LOS ANGELES REGION
320 W. 4th Street, Suite 200
Los Angeles, CA 90013
Attention: General Permit Unit

Assistance with this form may be obtained by contacting the Regional Water Board at:

Phone	(213) 576-6600
Fax	(213) 576-6660

INSTRUCTIONS

FOR COMPLETING THE NOTICE OF INTENT FOR THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) GENERAL PERMITS FOR DISCHARGE OF WASTEWATERS TO SURFACE WATERS

These instructions are intended to help you, the Discharger, complete the Notice of Intent (NOI) form for general permits. Please type or print clearly when completing the NOI form and the vicinity map(s).

One NOI should be submitted by each owner/operator to cover all proposed discharges within the boundaries of this Regional Water Board.

Section I. Discharge Status

Please check appropriate box indicating whether this application is for new discharge, material change, or existing discharge. If it is an existing discharge, indicate four digit CI #.

Section II. Facility/Discharge Information

A. Section II.A. Owner

Name/Agency – The name (first and last)of the owner/operator of the facility. If the owner/operator is a company, corporation, etc., please put the name of the company, corporation, etc., in this space.
Contact Person – Please list the name (first and last) of the contact person for the owner/operator (agency, corporation, private business, etc.) listed above.
Mailing Address – The street number and street name where mail and correspondence should be sent (P.O. Box is acceptable).
E-mail Address – Please list the e-mail address of the contact person for the owner (agency, corporation, private business, etc.) listed above.
City, County, State, Zip Code – The city, county, state, Zip code that apply to the mailing address given.
Title of Contact Person – The official company title of the contact person.
Phone – The daytime telephone number of the contact person.

B. Section II.B. Operator (if different from owner)

Name/Agency – The name (first and last)of the owner/operator of the facility. If the owner/operator is a company, corporation, etc., please put the name of the company, corporation, etc., in this space.
Contact Person – Please list the name (first and last) of the contact person for the owner/operator (agency, corporation, private business, etc.) listed above.
Mailing Address – The street number and street name where mail and correspondence should be sent (P.O. Box is acceptable).
E-mail Address – Please list the e-mail address of the contact person for the owner or operator (agency, corporation, private business, etc.) listed above.
City, County, State, Zip Code – The city, county, state, Zip code that apply to the mailing address given.
Title of Contact Person – The official company title of the contact person.
Phone – The daytime telephone number of the contact person

C. Section II.C. Facility

Name – The name (first and last) of the person responsible for this facility.

Address – The street number and street name where the facility or actual discharge is located. Check the most appropriate ownership, City, County, State, Federal or Private.
E-mail Address – Please list the e-mail address of the contact person for the owner/operator (agency, corporation, private business, etc.) listed above.
City, County, State, Zip Code – The city, county, state, Zip code that apply to the facility address.
Phone – The daytime telephone number of the person responsible for this facility.

Section II.D. Standard Industrial Classification (SIC) (4 digit code in order of priority)

List, in descending order of significance, the 4—digit standard industrial classification (SIC) codes which best describe your facility in terms of the principal products or services you produce or provide. Also, specify each classification in words. These classification may differ from the SIC codes describing the operations generating discharge, air emissions, or hazardous wastes.

SIC code numbers are descriptions which may be found in the "Standard Industrial Classification Manual" prepared by the Executive Office of the President, Office of Management and Budget, which is available from the Government Printing Office, Washington, D. C.. Use current edition of the manual. If you have any question concerning the appropriate SIC code for your facility the NPDES Permitting Units of the Regional Water Quality Control Board.

Section III. Type of Discharge

Check the appropriate box indicating the type of discharge for this facility. Check only one box.

Section IV. Existing Requirements/Permits

If this facility has no existing permits or orders, skip this section. If the facility has any existing permits or orders, list it in the appropriate space provided.

Section V. Outfall and Receiving Water Information

If the facility discharges into a storm drain, indicate the immediate receiving waterbody (listed in the Basin Plan) where the discharge drains into.

Section VI. Project Information

Provide summary description of the project. Also describe the general characteristic of the discharge. If required, indicate the treatment process that would be needed to bring the discharge into compliance. Demonstrate that options of discharging to the sanitary sewer, conservation, reuse, and infiltration have been considered and found infeasible or that potential reuse is feasible. If additives are used in the project and/or treatment, briefly describe their compositions and provide corresponding Material Safety Data Sheet (MSDS) Form. Provide estimate of maximum discharge flow rate, proposed discharge startup date, and estimated discharge duration.

Section VII. Discharge Quality

This NOI requires that you obtain and analyze for the pollutants listed on the *Supplemental Pollutants Analysis/Measurements* or*, Attachment E – Screening Levels for Potential Pollutants of Concern in Potable Water (applies to potable water related discharges only)*. Check the YES box if analytical result is attached. If not, provide reasons why it was not included. Note that processing of your NOI application may be delayed until this required information is provided.

Section VIII. Other Required Information

Attach to this application a topographic map (7.5' USGS Quadrangle Map, Scale 1:24,000) of the area. The map must show the outline of the facility.

Section IX. Certification and Signature

Printed Name of Person Signing – Please type or print legibly. This section should be filled out by the responsible person as defined by 40 CFR section 122.22.
Signature and Date – Signature of name printed above and the date signed.
Title – The professional title of the person signing the NOI.

Required signatories per 40 CFR section 122.22

1. For a corporation
   By responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (I) A president, secretary, treasurer or vice president of the corporation in charge of a principal business function, or any other person who performs similar policy-or decision-making functions for the corporation, or (ii) the manager of one or more manufacturing, production, or operating facilities, provided, the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental laws and regulations; the manager can assure that the necessary systems are established or action taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

2. For a partnership or sole proprietorship
   By a general partner or the proprietor, respectively; or

3. For a municipality, State, Federal or public agency
   By either a principal executive officer or ranking elected official. For the purposes of this section, a principal executive officer of a Federal agency includes: (I) The chief executive officer of the agency, or (ii) a senior executive officer having responsibility for the overall operation of a principal geographic unit of the agency.

Appendix D: Cost Estimate

Kennedy Jenks

OPINION OF PROBABLE CONSTRUCTION COST
BASIS OF ESTIMATE
PROJECT INFORMATION

Client:	United Water Conservation District
Project:	Laguna Road Pipeline
KJ Job No.:	2244204*00
Estimate Date:	11/25/2022
Prepared By:	RJL
Reviewed By:	JLH
Estimate Type:	30% Design
AACEI Class Level Estimate :	4

PROJECT DESCRIPTION:

Project scope is construction of . Project includes :

- 28" HDPE raw water transmission main including Air Relief and Blowoff assemblies, valves.
- Jack and Bored Steel casings at one location.
- Connections to existing farmers.
- Paving removal and replacement at trenches.

ESTIMATE DOCUMENTS:

DRAWINGS: 30% Draft Submittal Drawings Dated October 2022

DOCUMENTS: Geotechnical Investigation Report

COSTS PROVIDED BY OTHERS: N/A

SOURCE OF COST DATA:

RS Means CostWorks 2022 Qtr 3 data

Similar recently bid projects.

HDPE Pipe Material supplier quotes as of April 2022

ESTIMATE ASSUMPTIONS:

The followings assumptions were made in the preparation of this estimate:

Regular working hours will be allowed.

Assumes native material will be suitable for backfill above the bedding zone.

SPECIFIC INCLUSIONS:

N/A

SPECIFIC EXCLUSIONS:

The estimate does not include the following:

Pump station connection

Contaminated Soils Removal or Disposal

Owner's Construction Management Expenses or Facilities

Independent or Special Inspections

Archeological or Paleontological surveys or mitigation

OPINION OF PROBABLE CONSTRUCTION COST **KENNEDY/JENKS CONSULTANTS**

Project: Laguna Road Pipeline

Building, Area: Laguna Road

Prepared By: RJL
Date Prepared: 1-Oct-22
K/J Proj. No. 2044222*00

Current at ENR 13,175
Escalated to ENR
Months to Midpoint of Construct 15

Estimate Type:
☐ **Conceptual Preliminary**
☐ **Construction Change Order**
☒ **Design Development @ 30% Complete**

			Materials		Installation		Sub-contractor		
Description	**Qty**	**Units**	**$/Unit**	**Total**	**$/Unit**	**Total**	**$/Unit**	**Total**	**Total**
Pipeline Work - 28" SDR 17 HDPE									
28-inch SDR 17 HDPE	2,786	LF	75.35	209,925	41.00	114,226			324,151
Excavation	34,147	cy			6.00	204,882			204,882
Bedding	1,282	cy	24.98	32,024	17.08	21,897			53,921
Backfill	1,651	cy			10.96	18,095			18,095
Spoil	1,496	cy			8.03	12,013			12,013
Pavement Removal - 6" deep (Trench)		sy			9.41				
Pavement Disposal (Trench)		cy			13.87				
Pavement Replacement - 7" thick (Trench)		sy					37		
Aggregate Base Replacement 6"		sy	4.80		1.65				
2" Grind and Overlay for Lane Width		sy					12		
Sawcut pavement		LF	0.55		6.95				
Locate Wire/ ID Tape	2,786	LF	0.50	1,393	0.50	1,393			2,786
Traffic Striping		LF					3		
6-inch Blowoff or 6" Lateral	6	EA							
Fire Hydrant	2	EA	3,315.65	6,631	321.51	643	75	150	7,424
24" x 6-inch HDPE Tee	6	EA	2,282.00	13,692	597.02	3,582			17,274
6" gate valve	6	EA	1,753.50	10,521	378.26	2,270			12,791
6" 90 elbow DI	6	EA	283.00	1,698	190.07	1,140			2,838
6" PVC Pipe	240	LF	8.27	1,984	7.09	1,701			3,685
Valve cap and riser (B-668)	6	EA	624.78	3,749	365.34	2,192			5,941
Excavation	87	cy			6.00	522			522
Bedding	33	cy	24.98	824	17.08	564			1,388
Backfill	53	cy			10.96	581			581
Spoil	34	cy			8.03	273			273
Pavement Removal - 6" deep (Trench)	107	sy			9.41	1,007			1,007
Pavement Disposal (Trench)	12	cy			13.87	166			166
Pavement Replacement - 7" thick (Trench)	107	sy					37	3,959	3,959
Aggregate Base Replacement 12" Thick	107	sy	4.80	514	1.65	177			690
2" Grind and Overlay for Lane Width	107	sy					12	1,284	1,284
Sawcut pavement	480	LF	0.55	264	6.95	3,336			3,600
Guard posts	12	EA	250.00	3,000	250.00	3,000			6,000
2" Air Vac Valve Assembly (B-367)	2	EA							
2" Air Valve	2	EA	1,144.72	2,289	108.22	216			2,506
2" saddle tap	12	EA	468.01	5,616	672.87	8,074			13,691
2" copper tubing	80	LF	32.11	2,569	7.60	608			3,177
2" brass nipple (pipe)	32	EA	14.70	470	70.97	2,271			2,741
2" brass 90 elbow	4	EA	28.35	113	84.46	338			451
2" brass valve	2	EA	433.98	868	83.05	166			1,034
corporation ball stop valve	2	EA	433.98	868	83.05	166			1,034
valve enclosure	2	EA	624.78	1,250	365.34	731			1,980
10" valve box	2	EA	53.50	107	65.48	131			238
concrete base	2	SF	300.00	600	300.00	600			1,200
Excavation	76	cy			6.00	456			456
Bedding	22	cy	24.98	550	17.08	376			925
Backfill	53	cy			10.96	581			581
Spoil	22	cy			8.03	177			177
Pavement Removal - 6" deep (Trench)	160	sy			9.41	1,506			1,506
Pavement Disposal (Trench)	18	cy			13.87	250			250
Pavement Replacement - 7" thick (Trench)	160	sy					37	5,920	5,920
Aggregate Base Replacement 12" Thick	160	sy	4.80	768	1.65	264			1,032
2" Grind and Overlay for Lane Width	160	sy					12	1,920	1,920
Sawcut pavement	160	LF	0.55	88	6.95	1,112			1,200
24-inch Gate Valve Assembly	2	EA							
24-inch Gate Valve, Class 200, flanged	2	EA	22,750.00	45,500	1,415.00	2,830			48,330
Valve cap and riser (B-668)	2	EA	116.00	232	120.83	242			474
24" Flange Adapter	4	EA	1,181.00	4,724	427.95	1,712			6,436
Jack and Bores									
J&B - RCFC&WCD Channel & Caltrans									
Excavation	635	cy			20.00	12,700			12,700
Bedding	530	cy	24.98	13,239	17.08	9,052			22,292
Backfill	102	cy	28.00	2,856					2,856
Spoil	534	cy			321.51	171,688			171,688
Shoring, Steel install & extract, 25'	3,850	SF	13.28	51,128	14.00	53,900			105,028
Steel Casing, 36-inch Diameter	125	LF					700	87,500	87,500
Casing Spacers for 26" Pipe	19	EA	159.51	2,991	16.16	303			3,294
Mobilization for Jack and Bore	1	LS			10,000.00	10,000			10,000
Pavement Removal - 6" thick (Trench)		sy			9.41				
Pavement Disposal (Trench)		cy			597.02				
Pavement Replacement -6" thick (Trench)		sy			70.97				

			Materials		Installation		Sub-contractor		
Description	**Qty**	**Units**	**$/Unit**	**Total**	**$/Unit**	**Total**	**$/Unit**	**Total**	**Total**
Aggregate Base Replacement 6"		sy	4.80		84.46				
Sawcut pavement		LF	0.55		83.05				
Other Work									
Dewatering at Jack and Bore Pit		LS			5,000.00				
CDF Backfill for Utilities		CY	150.00		150.00				
Potholing	20	EA					1,200	24,000	24,000
Pressure Testing/Chlor/Dechlor	1	LS					40,000	40,000	40,000
Traffic Control	1	LS					63,094	63,094	63,094
Project signs	2	EA	300.00	600	200.00	400			1,000
Sign R/R		EA	250.00		250.00				
Traffic Loop R/R		EA					3,000		
Subtotals				423645.39		674508.35		227827.34	1,325,981
Division 1 Costs	@	10%		42364.54		67450.83		22782.73	132,598
Subtotals				466009.93		741959.18		250610.07	1,458,579
Taxes - Materials Costs	@	7.75%		36115.77					36,116
Subtotals				502125.70		741959.18		250610.07	1,494,695
Taxes - Labor Costs									
Subtotals				502125.70		741959.18		250610.07	1,494,695
Contractor Markup for Sub	@	12%						30073.21	30,073
Subtotals				502125.70		741959.18		280683.28	1,524,768
Contractor OH&P	@	15%		75318.86		111293.88			186,613
Subtotals				577444.56		853253.06		280683.28	1,711,381
Estimate Contingency	@	25%							427,845
Subtotals									2,139,226
Escalate to Midpoint of Construct	@	4%							93,591
Estimated Bid Cost									2,232,817
Market Conditions Contingency	@	10%							223,282
Estimated Bid Cost									2,456,099
Total Estimate									**2,460,000**

Estimate Accuracy	
+25%	-15%

Estimated Range of Probable Cost		
+25%	Total Est.	-15%
$3,075,000	**$2,460,000**	**$2,091,000**

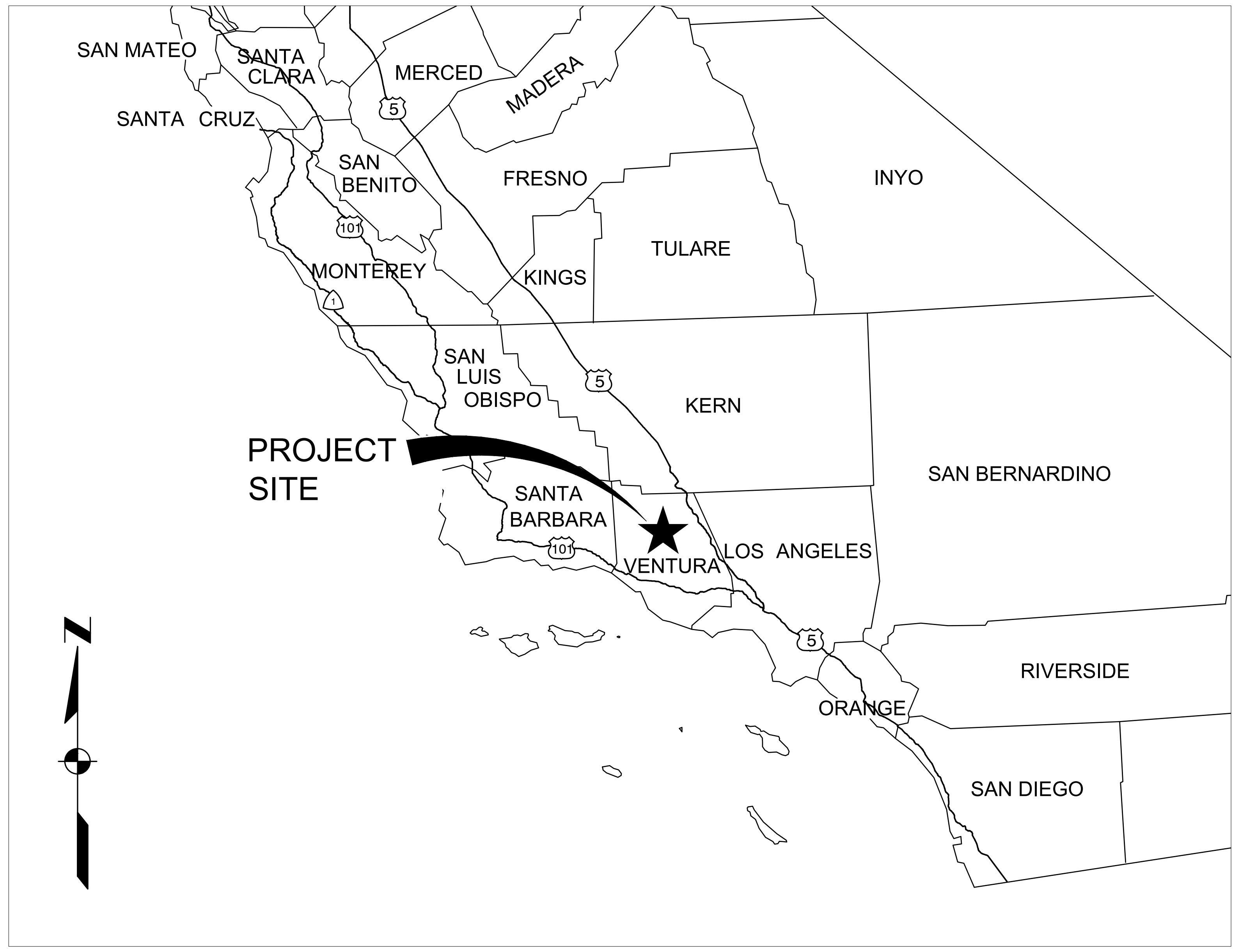
Appendix E: Design Drawings

UNITED WATER CONSERVATION DISTRICT

VENTURA COUNTY, CA

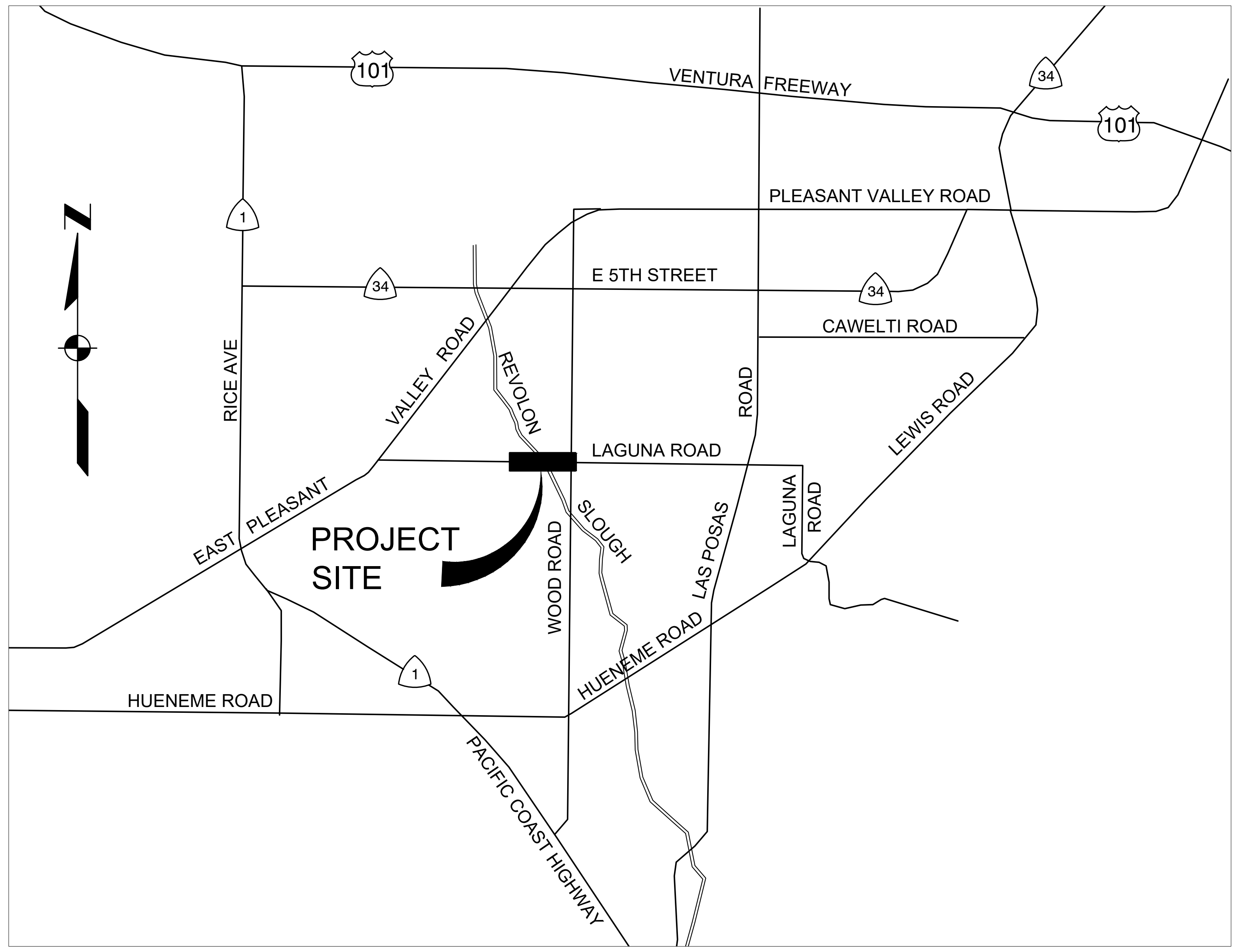
PTP RECYCLED WATER CONNECTION

LAGUNA ROAD PIPELINE PRELIMINARY DESIGN



GENERAL LOCATION MAP

SCALE: NTS



VICINITY MAP

SCALE: NTS

BOARD OF DIRECTORS

BRUCE E. DANDY, PRESIDENT
SHELDON G. BERGER, VICE PRESIDENT
LYNN E. MAULHARDT, SECRETARY/TREASURER
CATHERINE P. KEELING
MOHAMMED A. HASAN
GORDON KIMBALL
DANIEL C. NAUMANN

GENERAL MANAGER

MAURICIO E. GUARDADO, JR.

CHIEF ENGINEER

MARYAM A. BRAL

PROJECT MANAGER

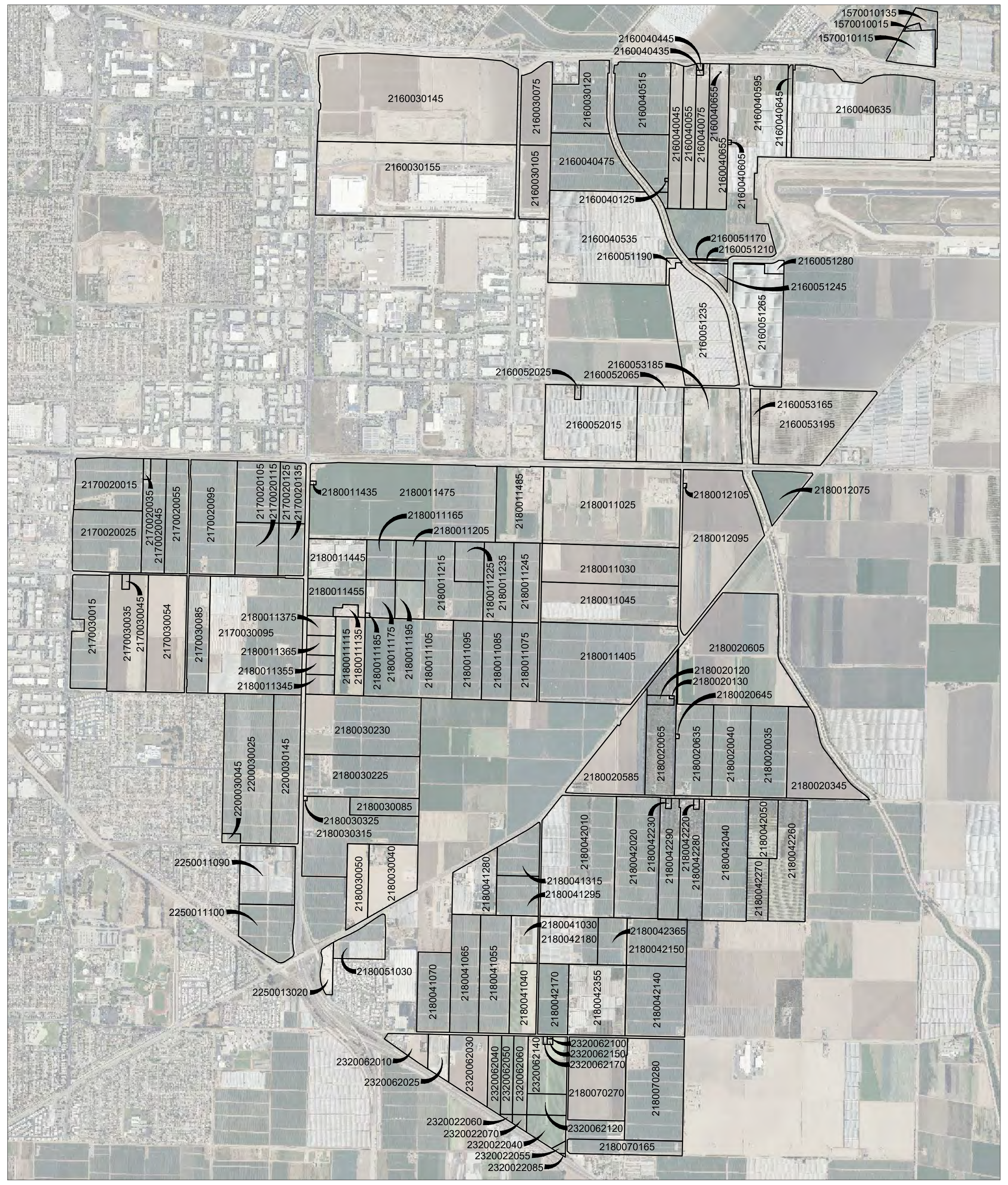
MICHEL KADAH

Kennedy Jenks

DRAWING INDEX

DWG NO.	SHEET NO.	DESCRIPTION
		GENERAL
1	G-001	COVER SHEET, VICINITY MAP, LOCATION MAP, AND DRAWING INDEX
2	G-002	GENERAL ABBREVIATIONS
3	G-003	GENERAL NOTES AND LEGEND
4	G-004	GENERAL EQUIPMENT DESIGNATIONS AND PROCESS IDENTIFICATION CODES
5	G-005	GENERAL PROCESS SYMBOLS
6	G-006	HYDRAULIC FLOW SCHEMATIC
		CIVIL
7	C-001	GENERAL KEYMAP AND NOTES
8	C-002	GENERAL CIVIL LEGEND
9	C-003	PLAN AND PROFILE - I
10	C-004	PLAN AND PROFILE - II
11	C-005	PLAN AND PROFILE - III
* 12	C-006	DETAIL SHEET (SLOUGH CROSSING, MISC. DETAILS)
* 13	C-007	DETAIL SHEET (MISC. DETAILS)

* NOT INCLUDED IN THE 30% DESIGN SET



PROPOSED RECYCLED WATER SYSTEM AND CONNECTIONS

SCALE: NTS

##/##/#### - 30% SUBMITTAL	CHIEF ENGINEER PROJECT MANAGER	SCALES 0 — 1" 0 — 25mm IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.	PRELIMINARY NOT FOR CONSTRUCTION	DESIGNED RJL DRAWN CLL CHECKED WCY	UNITED WATER CONSERVATION DISTRICT 1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030 PTP RECYCLED WATER CONNECTION LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT Kennedy Jenks	SCALE JOB NO 2244204.00 DATE 2023
United Water CONSERVATION DISTRICT	NO | REVISION | DATE | BY				COVER SHEET, VICINITY MAP, LOCATION MAP, AND DRAWING INDEX DWG: XX-###-###	SHEET OF --- G-001

Plot Date: 1/6/2023 2:17 PM

User: CHERYL LOVE

pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\United Water Conservation District\Projects\PTP Recycled Water Connection – Laguna Rd Pipeline_2244204.00\10-Design\10.06-Drawings\General\2244204 00-G-001

ABBREVIATIONS

'	FOOT, FEET
"	INCH, INCHES
#	POUND, NUMBER
%	PERCENT
&	AND
(SH)	SHIELDED
@	AT
℄	CENTERLINE
PL	PLATE
±	APPROXIMATELY
<	LESS THAN
=	EQUALS
>	GREATER THAN
Δ	DEFLECTION
∠	ANGLE
°	DEGREE(-S) (ANGULAR)
A	AMPERE(-S)
A/C	AIR CONDITIONING
A/D	ANALOG TO DIGITAL
A/M	AUTO/MANUAL
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS
AB	AGGREGATE BASE, ANCHOR BOLT(-S)
ABAN(-D)	ABANDON(-ED)
ABS	ABSOLUTE, ACRYLONITRILE-BUTADIENE-STYRENE
AC	ASPHALTIC CONCRETE, ALTERNATING CURRENT
ACH	AIR CHANGES PER HOUR
ACI	AMERICAN CONCRETE INSTITUTE
ACK	ACKNOWLEDGE
ACOUS	ACOUSTIC(-AL)
ACP	ASBESTOS CEMENT PIPE
ADA	AMERICANS WITH DISABILITIES ACT
ADDIT	ADDITIONAL
ADJ	ADJUST(-ED,-MENT,-ABLE)
ADJT	ADJACENT
ADWF	AVERAGE DRY WEATHER FLOW
AF	ACRE-FEET, AMPERE FRAME
AFCI	ARC-FAULT CIRCUIT INTERRUPTER
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AGG	AGGREGATE
AI	ANALOG INPUT
AIC	AMPERES INTERRUPTING CAPACITY
AISC	AMERICAN INSTITUTE OF STEEL CONSTRUCTION
AISI	AMERICAN IRON AND STEEL INSTITUTE
AITC	AMERICAN INSTITUTE OF TIMBER CONSTRUCTION
ALT	ALTERNAT(-E, -OR)
ALTD	ALTITUDE
ALUM	ALUMINUM
AMB	AMBIENT
ANC	ANCHOR
ANN	ANNUNCIATOR
ANSI	AMERICAN NATIONAL STANDARDS INSTITUTE
ANT	ANTENNA
AO	ANALOG OUTPUT
APA	AMERICAN PLYWOOD ASSOCIATION
APPROX	APPROXIMATE(-LY)
ARCH	ARCHITECT(-URAL)
AS	AMMETER SWITCH
ASB	ASBESTOS
ASCE	AMERICAN SOCIETY OF CIVIL ENGINEERS
ASD	ADJUSTABLE SPEED DRIVE (DC)
ASHRAE	AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASPH	ASPHALT
ASSY	ASSEMBLY
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AT	AMPERE TRIP
ATM	ATMOSPHERE (14.7 LB/IN2)
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AUX	AUXILIARY
AVE	AVENUE
AVG	AVERAGE
AWG	AMERICAN WIRE GAGE
AWS	AMERICAN WELDING SOCIETY
AWT	ADVANCED WATER TREATMENT
AWWA	AMERICAN WATER WORKS ASSOCIATION
B/W	BOTTOM OF WALL
BARM	BARMINUTOR
BATT	BATTERY
BB(S)	BEARING BAR(-S)
BC	BEGINNING OF HORIZONTAL CURVE, BARE COPPER
BCR	BEGIN CURB RETURN
BD	BOARD, BELT DRIVE
BDD	BACKDRAFT DAMPER
BF	BLIND FLANGE
BFP	BELT FILTER PRESS, BACKFLOW PREVENTER
BHP	BRAKE HORSEPOWER
BITUM	BITUMINOUS
BKR	BREAKER
BL	BUILDING LINE
BLDG	BUILDING
BLK	BLOCK(-S)
BLKG	BLOCKING
BM	BEAM, BENCH MARK
BM-1	BEAM MEMBER 1
BN	BOUNDARY NAILING
BO	BLOWOFF
BOC	BACK OF CURB
BOD 5	BIOCHEMICAL OXYGEN DEMAND (5 DAY)
BOT	BOTTOM
BP	BASE PLATE
BRG	BEARING
BS	BLACK STEEL, BOTH SIDES
BSMT	BASEMENT
BTU	BRITISH THERMAL UNIT
BTWN	BETWEEN
BVC	BEGINNING OF VERTICAL CURVE
C	CURVE, CONDUCTOR, CONTACT
C/C	CENTER-TO-CENTER
C/S	CONSTANT SPEED
CAB	CABINET
CALC(S)	CALCULATION(S)
CAT	CATEGORY
CATV	CABLE TV
CB	CATCH BASIN, CIRCUIT BREAKER
CC	CUBIC CENTIMETER(-S)
CCT	CHLORINE CONTACT TANK
CCTV	CLOSED-CIRCUIT TELEVISION
CD	CONTROL DAMPER
CEM	CEMENT
CEN	CENTRAL
CENT	CENTRIFUGAL
CER	CEILING EXHAUST RETURN
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CH	CHAMBER
CHAN	CHANNEL
CHEM	CHEMI(-CAL, -STRY)
CHK	CHECK
CHKD	CHECKERED
CI	CAST IRON
CID1	CLASSIFICATION I, DIVISION 1
CID2	CLASSIFICATION I, DIVISION 2
CIP	CAST IRON PIPE, CAST IN PLACE, CLEAN IN PLACE
CIRC	CIRCULA(-R, -TION)
CIRCUM	CIRCUMFERENCE
CISP	CAST IRON SOIL PIPE
CJ	CONSTRUCTION JOINT
CJP	COMPLETE JOINT PENETRATION
CKT	CIRCUIT
CL2	CHLORINE
CLASS	CLASSIFICATION
CLG	CEILING
CLOS	CLOSET
CLR	CLEAR(-ANCE)
CLSM	CONTROLLED LOW STRENGTH MATERIAL
CM	CENTIMETERS
CMC	CEMENT MORTAR COATED
CML	CEMENT MORTAR LINED
CML&C	CEMENT MORTAR LINED AND COATED
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CNJ	CONTROL JOINT
CNTR	CENTER
CNTRSK	COUNTERSUNK
CO	CLEANOUT, CONDUIT ONLY
CO2	CARBON DIOXIDE
COAX	COAXIAL
COD	CHEMICAL OXYGEN DEMAND
COL	COLUMN
COM	COMMON
COMM	COMMUNICATION
COMP	COMPRESSOR
CONC	CONCRETE
COND	CONDENSATE, CONDUIT
CONN	CONNECT (-ED, -S, -ION)
CONST	CONSTRUCTION
CONT	CONTINU(-ED, -OUS, -ATION)
COORD	COORDINATE
COP	COEFFICIENT OF PERFORMANCE
COR	CORNER
CORP	CORPORATION
CORR	CORRUGATED
COTG	CLEANOUT TO GRADE
CP	CONTROL POINT, CATHODIC PROTECTION
CPLG	COUPLING
CPT	CONTROL POWER TRANSFORMER
CPVC	CHLORINATED POLYVINYL CHLORIDE
CR	CONTROL RELAY, CRUSHED ROCK
CSD	CEILING SUPPLY DIFFUSER
CT	COURT, CURRENT TRANSFORMER, COOLING TOWER
CTRL	CONTROL
CTS	CATHODIC TEST STATION
CU FT	CUBIC FOOT, CUBIC FEET
CU IN	CUBIC INCH(-ES)
CU M	CUBIC METER(-S)
CU YD	CUBIC YARD(-S)
CUR	CURRENT
CV	VALVE FLOW COEFFICIENT
CWT	ONE HUNDRED POUNDS
DB	DRY BULB
DBL	DOUBLE
DC	DIRECT CURRENT
DCA	DOUBLE CHECK ASSEMBLY (TWIN ELEMENT CHECK VALVE)
DCS	DISTRIBUTED CONTROL SYSTEM
DEFL	DEFLECTION
DEG	DEGREE(-S)
DEG C	DEGREES CELSIUS
DEG F	DEGREES FARENHEIT
DEMO	DEMOLISH
DEPT	DEPARTMENT
DH	HEAD LOSS (IN FEET), DOWNHOLE
DI	DUCTILE IRON, DROP INLET, DISCRETE INPUT
DIA	DIAMETER
DIAG	DIAGONAL, DIAGRAM
DIAPH	DIAPHRAGM
DIM(-S)	DIMENSION(-S)
DIP	DUCTILE IRON PIPE
DIR	DIRECTION
DISC	DISCONNECT
DISCH	DISCHARGE
DISTR	DISTRIBUTION
DL	DEAD LOAD
DN	DOWN
DO	DISSOLVED OXYGEN, DISCRETE OUTPUT
DPDT	DOUBLE POLE, DOUBLE THROW
DPST	DOUBLE POLE, SINGLE THROW
DR	DOOR, DRAIN, DRYER
DRG	DOUBLE RUBBER GASKET JOINT
DS	DOWN SPOUT
DTL(-S)	DETAIL(-S)
DUP	DUPLEX
DWG(-S)	DRAWING(-S)
E	EAST
EA	EACH, EXHAUST AIR
EC	END OF HORIZONTAL CURVE
ECC	ECCENTRIC
ECD	EPOXY COATED
ECR	END CURB RETURN
EER	ENERGY EFFICIENCY RATIO
EF	EACH FACE
EFFIC	EFFICIENCY
EFFL	EFFLUENT
EG	EXISTING GRADE
EGL	ENERGY GRADE LINE
EL	ELEVATION, EPOXY LINED
EL&C	EPOXY LINED AND COATED
ELEC	ELECTRIC(-AL)
ELEM	ELEMENTARY
ELL	ELBOW
EMBED	EMBEDMENT
EMERG	EMERGENCY
EN	EDGE NAILING
ENCL	ENCLOSURE
ENET	ETHERNET
ENGR	ENGINEER
ENTR	ENTRANCE
EP	EDGE OF PAVEMENT
EPA	ENVIRONMENTAL PROTECTION AGENCY
EQ	EQUAL (-LY, -IZATION)
EQPM	EQUIPMENT
ES	EACH SIDE
ES/EW	EMERGENCY SHOWER/EYE WASH
ESP	EXTERNAL STATIC PRESSURE
EST	ESTIMATE(-D)
E-STOP	EMERGENCY STOP
ETC	ET CETERA
ETM	ELAPSED TIME METER
ETS	ELECTROLYSIS TEST STATION
EUSERC	ELECTRIC UTILITY SERVICE EQUIPMENT REQUIREMENTS COMMITTEE
EVC	END OF VERTICAL CURVE
EW	EACH WAY
EWT	ENTERING WATER TEMPERATURE
EXC	EXCAVATE
EXH	EXHAUST
EXIST	EXISTING
EXP	EXPANSION
EXT	EXTERNAL, EXTERIOR
FA	FIRE ALARM
FAB	FABRICATE(-D)
FAC	FACTORY
FACIL	FACILIT(-Y, -IES)
FAI	FRESH AIR INTAKE
FB	FLAT BAR
FC	FLEXIBLE COUPLING
FCA	FLANGE COUPLING ADAPTER
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN, FIRE DAMPER
FDC	FIRE DEPARTMENT CONNECTION
FDR	FEEDER
FE	FIRE EXTINGUISHER
FF	FAR FACE, FINISHED FLOOR
FFE	FINISHED FLOOR ELEVATION
FG	FINISHED GRADE
FH	FIRE HYDRANT
FIG	FIGURE
FIN	FINISH(-ED)
FL	FLOW LINE
FLA	FIRE/SMOKE DAMPER
FLASH	FLASHING
FLEX	FLEXIBLE
FLG	FLANGE(-D)
FLOC	FLOCCULATION
FLR	FLOOR
FM	FLOW METER
FN	FIELD NAILING
FNDN	FOUNDATION
FO	FIBER OPTIC
FOS	FACE OF STUD
FPS	FEET PER SECOND
FREQ	FREQUENCY
FRP	FIBERGLASS REINFORCED PLASTIC
FRT	FIRE-RETARDANT FLOOR
FS	FINISHED SURFACE, FAR SIDE
FSD	FIRE/SMOKE DAMPER
FT	FOOT, FEET
FTG	FOOTING
FU	FUSE
FURN	FURNITURE, FURNISHINGS
FURR	FURRING
FUT	FUTURE
FVNR	FULL VOLTAGE, NON REVERSING
FVR	FULL VOLTAGE, REVERSING
FWD	FORWARD
G	GRAMS, GROUND (ELECTRICAL)
GA	GAUGE
GAC	GRANULAR ACTIVATED CARBON
GAL	GALLON(-S)
GALV	GALVANIZED
GAS	GASOLINE
GB	GRADE BREAK
GC	GROOVED COUPLING
GDL	GROUND LEVEL
GFCI	GROUND-FAULT CIRCUIT INTERRUPTER
GI	GALVANIZED IRON
GL	GLASS
GLAZ	GLAZING
GLB	GLULAM BEAM
GLL	GLASS LINED
GND	GROUND
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GPR	GROUND PENETRATING RADAR
GR	GRATE
GRL	GUARDRAIL
GRS	GALVANIZED RIGID STEEL
GS	GALVANIZED STEEL
GYP (BD)	GYPSUM (BOARD)
H	HIGH, HEIGHT
H2O2	HYDROGEN PEROXIDE
H2S	HYDROGEN SULFIDE
H2SO4	SULFURIC ACID
HB	HOSE BIB
HD	HEAVY DUTY, HEAT DETECTOR
HDG	HOT DIP GALVANIZE(-D)
HDPE	HIGH DENSITY POLYETHYLENE
HDWD	HARDWOOD
HGL	HYDRAULIC GRADE LINE
HGR	HANGER
HH	HANDHOLE
HI	HYDRAULIC INSTITUTE
HM	HOLLOW METAL
HMI	HUMAN MACHINE INTERFACE
HOA	HAND-OFF-AUTOMATIC
HOR	HAND-OFF-REMOTE
HORZ	HORIZONTAL
HP	HORSEPOWER
H-P	HINGE POINT
HPT	HIGH POINT
HR(S)	HOUR(-S)
HRL	HANDRAIL
HSPF	HEATING SEASONAL PROFICIENCY FACTOR
HSS	HOLLOW STRUCTURAL SECTION
HST	HOIST
HT	HEIGHT
HTG	HEATING
HTR	HEATER
HVAC	HEATING, VENTILATING, AND AIR CONDITIONING
HVY	HEAVY
HWL	HIGH WATER LEVEL
HWY	HIGHWAY
HYD	HYDRAULIC
HZ	HERTZ (CYCLES PER SECOND)
I&C	INSTRUMENTATION AND CONTROL
I/O	INPUT/OUTPUT
IBC	INTERNATIONAL BUILDING CODE
ICC	INTERNATIONAL CODE COUNCIL
ID	INSIDE DIAMETER
IE	INVERT ELEVATION
IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS
IEER	INTEGRATED ENERGY EFFICIENCY RATIO
IF	INSIDE FACE
IL	INDICATING LIGHT
IN	INCH(-ES)
INFL	INFLUENT
INST	INSTANTANEOUS
INSTR	INSTRUMENT(-ATION)
INSUL	INSULATION
INT	INTERIOR, INTERNAL
INV	INVERT
IP	INTERNET PROTOCOL
IPS	INTERNATIONAL PIPE STANDARD, INCHES PER SECOND, IRON PIPE SIZE
IR	INFRARED
IRRG	IRRIGATION
IS	INTRINSICALLY SAFE
ISA	INTERNATIONAL SOCIETY OF AUTOMATION
ISO	ISOLAT(-E, -ION), ISOMETRIC
ISR	INTRINSICALLY SAFE RELAY
IW	INDUSTRIAL WASTE
IX	ION EXCHANGE
JB	JUNCTION BOX
JST	JOIST
JT	JOINT
KA	KILOAMPERE(-S)
KCMIL	THOUSANDS OF CIRCULAR MILS
KG	KNIFE GATE, KILOGRAM(-S)
KHZ	KILOHERTZ
KIP	ONE THOUSAND POUNDS
KM	KILOMETER(-S)
KSI	KIPS PER SQUARE INCH
KV	KILOVOLT(-S)
KVA	KILOVOLT-AMPERE(-S)
KVAR	KILOVOLT-AMPERE(-S) REACTIVE
KVARH	KILOVOLT-AMPERE REACTIVE HOUR(-S)
KW	KILOWATT(-S)
KWH	KILOWATT HOUR(-S)
L	LITER(-S), LENGTH, LINE
L/D	LITERS PER DAY
LA	LIGHTNING ARRESTER
LAB	LABORATORY
LAM	LAMINATE
LAN	LOCAL AREA NETWORK
LAT	LATERAL
LAV	LAVATORY
LB(-S)	POUND(-S)
LB(-S)/SF	POUND(-S) PER SQUARE FOOT
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
LD	DEVELOPMENT LENGTH
LDG	LANDING
LE	LIFTING EYE
LEED	LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN
LEL	LOWER EXPLOSIVE LIMIT
LF	LINEAR FEET
LG	LONG
LH	LEFT HAND
LIP	LIP OF GUTTER
LIQ	LIQUID
LL	LIVE LOAD
LLBB	LONG LEG BACK-TO-BACK
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LO	LOW
LOC	LOCATION
LONGIT	LONGITUDINAL
LOR	LOCAL-OFF-REMOTE
LOTO	LOCK-OUT, TAG-OUT
LP	LOW POINT, LIGHTING PANELBOARD
LPG	LIQUIFIED PETROLEUM GAS (PROPANE OR BUTANE AS NOTED)
LR	LONG RADIUS
L-R	LOCAL-REMOTE
LS	LIMIT SWITCH
LT	LEFT, LIGHT, LEFT TURN
LTG	LIGHTING
LV	LOW VOLTAGE
LW	LIGHT WEIGHT
LWL	LOW WATER LEVEL
LWT	LEAVING WATER TEMPERATURE
M	METER(-S)
mA	MILLIAMPERE(-S)
MACH	MACHINE
MATL	MATERIAL
MAX	MAXIMUM
MB	MACHINE BOLT
MBH	BTU PER HOUR (THOUSANDS)
MBR	MEMBRANE BIOREACTOR
MC	MOISTURE CONTENT, MISCELLANEOUS CHANNEL
MCA	MINIMUM CIRCUIT AMPACITY
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MCP	MOTOR CIRCUIT PROTECTOR
MECH	MECHANICAL
MF	MICROFILTRATION
MFR	MANUFACTURER
MFRD	MANUFACTURED
MG	MILLIGRAM(-S), MILLION GALLON(-S)
MG/L	MILLIGRAMS PER LITER
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MHZ	MEGAHERTZ
MIL(-S)	ONE-THOUSANDTH OF AN INCH
MIN	MINIMUM, MINUTE(-S)
MISC	MISCELLANEOUS
MJ	MECHANICAL JOINT
ML	MILLILITER(-S)
MLO	MAIN LUGS ONLY
MM	MILLIMETER(-S), MULTIMODE (FIBER)
MMBH	BTU PER HOUR (MILLIONS)
MOCP	MAXIMUM OVERCURRENT PROTECTION
MOD(-S)	MODIF(-Y, -ICATIONS)
MON	MONUMENT
MOV	MOTOR OPERATED VALVE
MPH	MILES PER HOUR
MR	MOISTURE-RESISTANT
MSE	MECHANICALLY STABILIZED EARTH
MT(-D, -G)	MOUNT(-ED, -ING)
MTL	METAL
MTR	MOTOR
MTS	MANUAL TRANSFER SWITCH
MUL	MULLION
MV	MEDIUM VOLTAGE
N	NORTH, NEUTRAL (ELECTRICAL)
N/A	NOT APPLICABLE
NAD	NORTH AMERICAN DATUM
NAOCL	SODIUM HYPOCHLORITE
NAOH	SODIUM HYDROXIDE
NAVD	NORTH AMERICAN VERTICAL DATUM
NC	NORMALLY CLOSED
NDT	NON-DESTRUCTIVE TEST(ING)
NE	NORTHEAST
NEC	NATIONAL ELECTRICAL CODE (NFPA 70)
NECA	NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION
NEMA	NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION
NETA	INTERNATIONAL ELECTRICAL TESTING ASSOCIATION
NF	NEAR FACE, NANOFILTRATION
NFC	NOT FOR CONSTRUCTION
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NG	NATURAL GAS
NH3	AMMONIA
NIC	NOT IN CONTRACT
NO	NORMALLY OPEN, NUMBER
NOM	NOMINAL
NORM	NORMAL
NPT	NATIONAL PIPE THREAD
NRS	NON-RISING STEM GATE VALVE
NS	NEAR SIDE
NSG	NON-SHRINK GROUT
NT	NORMALLY THROTTLED
NTS	NOT TO SCALE
NW	NORTHWEST
NWL	NORMAL WATER LEVEL
O/C	OPEN/CLOSE
O3	OZONE
OA	OVERALL
OBD	OPPOSED BLADE DAMPER
OC	ON CENTER
OD	OUTSIDE DIAMETER
ODP	OPEN DRIP PROOF
OF	OVERFLOW, OUTSIDE FACE
OFCI	OWNER FURNISHED, CONTRACTOR INSTALLED
OFS	OUTSIDE FACE OF STUD
OG	ORIGINAL GROUND
OH	OPPOSITE HAND, OVERHEAD
OIT	OPERATOR INTERFACE TERMINAL
OL	THERMAL OVERLOAD RELAY
OPNG(-S)	OPENING(-S)
OPP	OPPOSITE
ORIG	ORIGINAL
OS&Y	OUTSIDE SCREW AND YOKE (RISING STEM GATE VALVE)
OSA	OUTSIDE AIR
OSC	OPEN/STOP/CLOSE
OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
OT	OVER TEMPERATURE
OZ	OUNCE(-S)
P	PNEUMATIC, PIPE, POLE
P/L	PROPERTY LINE
PA	PUBLIC ADDRESS
PACP	PERFORATED ASBESTOS CEMENT PIPE
PAF	POWDER/POWER ACTUATED FASTENER
PB	PULLBOX, PUSHBUTTON
PC(-S)	PIECE(-S), PHOTOCELL, POINT OF CURVE (BEGIN CURVE), PROGRESSIVE CAVITY
PCC	POINT OF COMPOUND CURVE, POINT OF COMMON COUPLING
PCCP	PRETENSIONED CONCRETE CYLINDER PIPE
PCF	POUNDS PER CUBIC FOOT
PCO	PRESSURE CLEANOUT
PCOTG	PRESSURIZED CLEANOUT TO GRADE
PD	PRESSURE DROP, POSITIVE DISPLACEMENT
PE	PHOTOELECTRIC, PLAIN END, POLYETHYLENE
PEMB	PRE-ENGINEERED METAL BUILDING
PEN	PENETRAT(-E, -ION)
PER	PERIODIC
PERC	PERCOLAT(-E, -ION)
PERF	PERFORAT(-E, -ED, -ES, -ATION)
PF	POWER FACTOR, PROFILE
PFAS	PER- AND POLYFLUOROALKYL SUBSTANCES
PFOA	PERFLUOROOCTANOIC ACID
PFOS	PERFLUOROOCTANESULFONATE
PFR	POWER FACTOR RELAY
PH	PIPE HANGER, PHASE
pH	MEASURE OF ACIDITY OR ALKALINITY
PHMS	PAN HEAD MACHINE SCREW
PHSMS	PAN HEAD SHEET METAL SCREW
PI	POINT OF INTERSECTION
PID	PROPORTIONAL-INTEGRAL-DERIVATIVE
PIV	POST INDICATOR VALVE
PLAS	PLASTER
PLC	PROGRAMMABLE LOGIC CONTROLLER
PLF	POUND PER LINEAL FOOT
PM	PROJECT MANAGER, POWER MONITOR
PNL	PANEL
PNLBD	PANELBOARD
POE	POWER OVER ETHERNET
POT	POTABLE
PP	PARTIAL PENETRATION, POWER POLE, PAGES
PPB	PARTS PER BILLION
PPE	PERSONAL PROTECTIVE EQUIPMENT
PPM	PARTS PER MILLION
PR	PAIR
PRE-ENG	PRE-ENGINEERED
PRESS	PRESSURE
PRI	PRIMARY
PROJ	PROJECT(-ION)
PROP	PROPERTY, PROPOSED, PROPELLER
PROT	PROTECT(-OR)
PRS	PRESSURE SNUBBER
PRV	PRESSURE RELIEF VALVE, PRESSURE REDUCING VALVE
PS	PIPE SUPPORT, POWER SUPPLY
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE (PRESSURE ABOVE VACUUM)
PSIG	POUNDS PER SQUARE INCH GAUGE (PRESSURE ABOVE ATMOSPHERE)
PSL	PIPE SLEEVE
PSTA	PUMP STATION
PSV	PRESSURE SUSTAINING VALVE
PT(-S)	POINT OF TANGENT (END CURVE), PRESSURE-TREATED, POTENTIAL TRANSFORMER, POINT(-S)
PU	POLYURETHANE
PVC	POLYVINYL CHLORIDE, POINT OF VERTICAL CURVE
PVI	POINT OF VERTICAL INTERSECTION
PVMT	PAVEMENT
PVT	POINT OF VERTICAL TANGENCY
PW	POTABLE WATER
PWR	POWER
PWWF	PEAK WET WEATHER FLOW
Q	FLOW OR DISCHARGE
R, RAD	RADIUS
R/W	RIGHT OF WAY
RA	RETURN AIR
RAS	RETURN ACTIVATED SLUDGE
RC	REINFORCED CONCRETE
RCCP	REINFORCED CONCRETE CYLINDER PIPE
RCP	REINFORCED CONCRETE PIPE
RCPT	RECEPTACLE
RCT	REPEAT CYCLE TIMER
RD	ROAD
REC	RECEIVING
RECIRC	RECIRCULAT(-E, -ION)
RECT	RECTANG(-LE, -ULAR)
RED	REDUCE(-R)
REF	REFERENCE
REFR	REFRIGERATOR
REG	REGULAT(-E, -OR, -ION, -ING)
REINF	REINFORC(-E, -ED, -ING, -EMENT)
REL	RELATIVE
REQD	REQUIRED
REQT	REQUIREMENT
RESIL	RESILIENT
RESV	RESERVOIR
REV	REVISION
RH	RIGHT HAND
RIO	REMOTE INPUT/OUTPUT
RM	ROOM
RMT	REMOTE
RND	ROUND
RO	REVERSE OSMOSIS
RPM	REVOLUTIONS PER MINUTE
RPP	REDUCED PRESSURE PRINCIPLE
RPS	REVOLUTIONS PER SECOND
RR	RAILROAD
RST	RESET
RT	RIGHT TURN, RESET TIMER
RTE	ROUTE
RTN	RETURN
RTU	ROOF TOP UNIT, REMOTE TELEMETRY UNIT
RVSS	REDUCED VOLTAGE, SOLID STATE
S	SEWER, SOUTH
S/S	START/STOP
S/W	SIDEWALK
SA	SUPPLY AIR
SAN	SANITARY
SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
SCFM	STANDARD CUBIC FEET PER MINUTE
SCH	SCHEDULE
SCR	SILICON CONTROLLED RECTIFIER
SD	STORM DRAIN, SMOKE DETECTOR
SDMH	STORM DRAIN MANHOLE
SE	SOUTHEAST
SEC	SECONDARY, SECOND(-S)
SECT	SECTION
SED	SEDIMENTATION
SEER	SEASONAL ENERGY EFFICIENCY RATIO
SER	SERVICE ENTRANCE RATED
SGNL	SIGNAL
SH	SHOWER
SHT	SHEET
SI	SIDE INLET
SIM	SIMILAR
SK	SINK
SL	SLUDGE
SLBB	SHORT LEGS BACK-TO-BACK
SLH	SHORT LEG HORIZONTAL
SLV	SHORT LEG VERTICAL
SM	SINGLEMODE (FIBER)
SMACNA	SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
SMS	SHEET METAL SCREW
SO2	SULFUR DIOXIDE
SP	STATIC PRESSURE, SET POINT
SP GR	SPECIFIC GRAVITY
SPC(-S, -D)	SPACE(-S, -D)
SPD	SURGE PROTECTIVE DEVICE
SPDT	SINGLE POLE, DOUBLE THROW
SPEC(-S)	SPECIFICATION(-S)
SQ	SQUARE
SQ CM	SQUARE CENTIMETERS
SQ FT	SQUARE FEET
SQ IN	SQUARE INCHES
SQ M	SQUARE METER(-S)
SQ MI	SQUARE MILES
SQ YD	SQUARE YARD(-S)
SRG	SINGLE RUBBER GASKET JOINT
SS	STAINLESS STEEL, SANITARY SEWER, SOLID STATE
SSD	SATURATED SURFACE DRY
ST	STREET
STA	STATION
STAG	STAGGER
STB	SHORTING TERMINAL BLOCK
STD(-S)	STANDARD(-S)
STIFF	STIFFEN(-ER)
STL	STEEL
STM	STEAM
STOR	STORAGE
STP	SHIELDED TWISTED PAIR
STRC	STRUCTUR(-E, -AL)
SUB	SUBNATANT
SUBM	SUBMISSION, SUBMIT
SUP	SUPERNATANT
SUPP	SUPPORT(-S)
SURF	SURFACE
SUSP	SUSPEND(-ED)
SW	SOUTHWEST, SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
SYM	SYMMETRICAL
SYNC	SYNCHRONIZING
SYS	SYSTEM
T	TIME(-R)
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
T/C	TOP OF CONCRETE
T/P	TOP OF PAVEMENT
T/S	TOP OF STEEL
T/W	TOP OF WALL
T-_-P	TYPE ______ PIPE
T-_-S	TYPE ______ SUPPORT
TA	TRANSFER AIR
TAN	TANGENT(-IAL)
TB	THRUST BLOCK, TERMINAL BLOCK
TBM	TEMPORARY BENCHMARK, TUNNEL BORING MACHINE
TC	TRAY CABLE
TCP	TRANSMISSION CONTROL PROTOCOL
TDH	TOTAL DYNAMIC HEAD
TDS	TOTAL DISSOLVED SOLIDS
TEFC	TOTALLY ENCLOSED FAN COOLED
TEL	TELEPHONE
TEMP	TEMPERATURE, TEMPORARY
TMPTNK	TEMPERING TANK
TENV	TOTALLY ENCLOSED NON-VENTILATED
THK	THICK(-ENED, -ENER, -NESS)
THRU	THROUGH
TMV	THERMOSTATIC MIXING VALVE
TNK	TANK
TOD	TOTAL OXYGEN DEMAND
TOPO	TOPOGRAPHY
TOT	TOTAL, TOTALIZE(R)
TP	TEST PIT
TR	TREAD(-S)
T-R	THROUGH ROOF
TRTMT	TREATMENT
TS	STRUCTURAL TUBING
TSS	TOTAL SUSPENDED SOLIDS
TSTAT	THERMOSTAT
TURB	TURBIDITY
TYP	TYPICAL
U	URINAL
UBC	UNIFORM BUILDING CODE
UD	UNDERDRAIN
UF	ULTRAFILTRATION
UG	UNDERGROUND
UL	UNDERWRITERS LABORATORIES
UNKN	UNKNOWN
UON	UNLESS OTHERWISE NOTED
UPS	UNINTERRUPTIBLE POWER SUPPLY
USGBC	UNITED STATES GREEN BUILDING COUNCIL
UT	ULTRASONIC TESTING
UTP	UNSHIELDED TWISTED PAIR
UV	ULTRAVIOLET
V	VOLTS
V/S	VARIABLE SPEED
VA	VOLT-AMPERES
VAC	VACUUM
VAR	VARIES, VARIABLE, VOLT-AMPERES REACTIVE
VAT	VINYL ASBESTOS TILE
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE, VENDOR CONTROL PANEL
VD	VOLUME DAMPER
VEL	VELOCITY
VERT	VERTICAL
VERTS	VERTICAL BARS
VFD	VARIABLE FREQUENCY DRIVE (AC)
VFI	VACUUM FAULT INTERRUPTER
VIF	VERIFY IN FIELD
VOL	VOLUME
VPI	VERTICAL POINT OF INTERSECTION
VS	VOLTMETER SWITCH
VT	VENT
VTP	VERTICAL TURBINE PUMP
VTR	VENT TO ROOF
VVT	VARIABLE VOLUME/TEMPERATURE
W	WIDE, WIDTH, WIRE, WATTS, WELDED, WEST
W/	WITH
W/O	WITHOUT
WAN	WIDE AREA NETWORK
WAS	WASTE ACTIVATED SLUDGE
WB	WATER BAR, WET BULB
WC	WATER CLOSET, WATER COLUMN
WCLIB	WEST COAST LUMBER INSPECTION BUREAU
WCO	WALL CLEANOUT
WD	WOOD
WEF	WATER ENVIRONMENT FEDERATION
WER	WALL EXHAUST OR RETURN
WF	WIDE FLANGE
WG	WATER GAUGE
WH	WATER HEATER
WHDM	WATT-HOUR DEMAND METER
WHM	WATT-HOUR METER
WM	WATER METER
WMH	WATER MANHOLE
WNDW	WINDOW
WP	WEATHERPROOF, WATERPROOF, WORK POINT, WEATHER PROTECTED
WR	WEATHER RESISTANT
WS	WELDED STEEL, WATER SURFACE
WSD	WALL SUPPLY DIFFUSER
WSP	WELDED STEEL PIPE
WSTP	WATERSTOP
WT	WEIGHT, WALL THICKNESS
WTP	WATER TREATMENT PLANT
WTR	WATER
WV	WATER VALVE
WW	WASTEWATER
WWF	WELDED WIRE FABRIC
WWM	WELDED WIRE MESH
WWTP	WASTEWATER TREATMENT PLANT
XFMR	TRANSFORMER
XP	EXPLOSION PROOF
YD	YARD
YR	YEAR

PROJECT-SPECIFIC

##/##/#### - 30% SUBMITTAL

CHIEF ENGINEER

PROJECT MANAGER

NO	REVISION	DATE	BY

United Water
CONSERVATION DISTRICT

SCALES
0 1"
0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY
NOT FOR
CONSTRUCTION

DESIGNED RJL
DRAWN CLL
CHECKED WCY

UNITED WATER CONSERVATION DISTRICT
1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030

PTP RECYCLED WATER CONNECTION
LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT

KJ Kennedy Jenks

GENERAL ABBREVIATIONS

DWG: XX-###-###

SCALE

JOB NO 2244204.00

DATE 2023

SHEET OF ---

G-002

Plot Date: 1/6/2023 2:12 PM
User: CHERYL LOVE
pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\United Water Conservation District\Projects\PTP Recycled Water Connection – Laguna Rd Pipeline_2244204.00\10-Design\10.06-Drawings\General\2244204.00-G-002

NOTES

GENERAL

1. THIS PROJECT IS WITHIN CITY OF _____ RIGHT OF WAY. CONTRACTOR SHALL CONFORM TO CITY OF _____ ENCROACHMENT PERMIT AND REQUIREMENTS.
2. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH _____ STANDARDS AND APPLICABLE AWWA STANDARDS.
3. A PRE-EXISTING SITE CONDITION VIDEO SHALL BE PROVIDED BY THE CONTRACTOR AND SHALL SHOW EXISTING CONDITIONS OF ALL CONCRETE, ASPHALT, LANDSCAPED AREAS, BUILDING EXTERIOR, ETC. SURROUNDING THE CONSTRUCTION AREAS. VIDEO SHALL BE SUBMITTED TO THE OWNER PRIOR TO BREAKING GROUND. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE FROM DAMAGE. ALL IMPROVEMENTS DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE EXPEDITIOUSLY REPAIRED OR RECONSTRUCTED AT THE CONTRACTOR'S EXPENSE WITHOUT ADDITIONAL COMPENSATION.
4. ALL BUILDING COORDINATES ARE TO OUTSIDE CORNER OF COLUMN OR BUILDING.
5. CONTRACTOR SHALL RESTORE ALL SURVEY MONUMENTS THAT ARE DAMAGED OR DESTROYED DURING CONSTRUCTION.
6. OBSERVATIONS OF WORK IN PROGRESS DURING SITE VISITS SHALL NOT ALTER THE REQUIREMENTS OF THE CONTRACT DOCUMENTS.

UTILITIES

1. LOCATIONS OF UNDERGROUND UTILITIES SHOWN ON THE DRAWINGS WERE OBTAINED FROM AVAILABLE RECORDS AND ARE SHOWN IN THEIR APPROXIMATE LOCATION. THERE IS NO GUARANTEE THAT ALL EXISTING PIPELINES AND OBSTRUCTIONS ARE SHOWN OR THAT LOCATIONS INDICATED ARE ACCURATE. PRIOR TO THE START OF CONSTRUCTION, THE CONTRACTOR SHALL POTHOLE TO DETERMINE ACTUAL LOCATION AND ELEVATION OF ALL EXISTING UTILITIES IN AND AROUND THE AREAS OF NEW CONSTRUCTION.
2. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT ALL REMAINING EXISTING UTILITIES WHETHER SHOWN OR NOT SHOWN.
3. PRIOR TO ANY CONNECTION TO AN EXISTING UTILITY, THE CONTRACTOR SHALL COORDINATE WITH THE UTILITY OWNER.
4. PRIOR TO ANY EXCAVATION IN THE VICINITY OF ANY EXISTING UNDERGROUND FACILITIES, INCLUDING ALL WATER, SEWER, STORM DRAIN, GAS, PETROLEUM PRODUCTS, OR OTHER PIPELINES; ALL BURIED ELECTRIC POWER, COMMUNICATIONS, OR TELEVISION CABLES; ALL TRAFFIC SIGNAL AND STREET LIGHTING FACILITIES; AND ALL ROADWAY, STATE HIGHWAY, AND RAILROAD RIGHTS-OF-WAY, THE CONTRACTOR SHALL NOTIFY THE RESPECTIVE AUTHORITIES REPRESENTING THE OWNERS OR AGENCIES RESPONSIBLE FOR SUCH FACILITIES TO FACILITATE A TIMELY MANNER OF WORK SO THAT A REPRESENTATIVE OF SAID OWNERS OR AGENCIES CAN BE PRESENT DURING SUCH WORK IF THEY SO DESIRE. IN THE CASE OF THE UNDERGROUND UTILITY SERVICE ALERT CENTER, THIS NOTICE WILL GIVE THEM TIME TO MARK THE LOCATION OF THE UTILITIES. THE CONTRACTOR SHALL ALSO NOTIFY UNDERGROUND SERVICES ALERT (USA) AT (811) IN ACCORDANCE WITH THE SPECIFICATIONS TO FACILITATE A TIMELY MANNER OF WORK, PRIOR TO SUCH EXCAVATION.

NOTES (CONTINUED)

PERMITTING

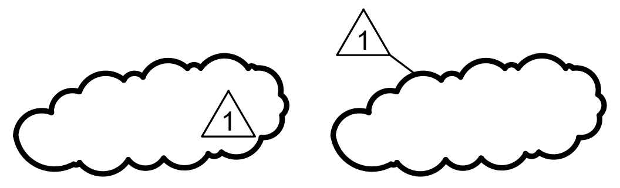
XXXXXX
XXXX

XXXXXX
XXXX

CALLOUTS AND SHORTHAND SYMBOLS

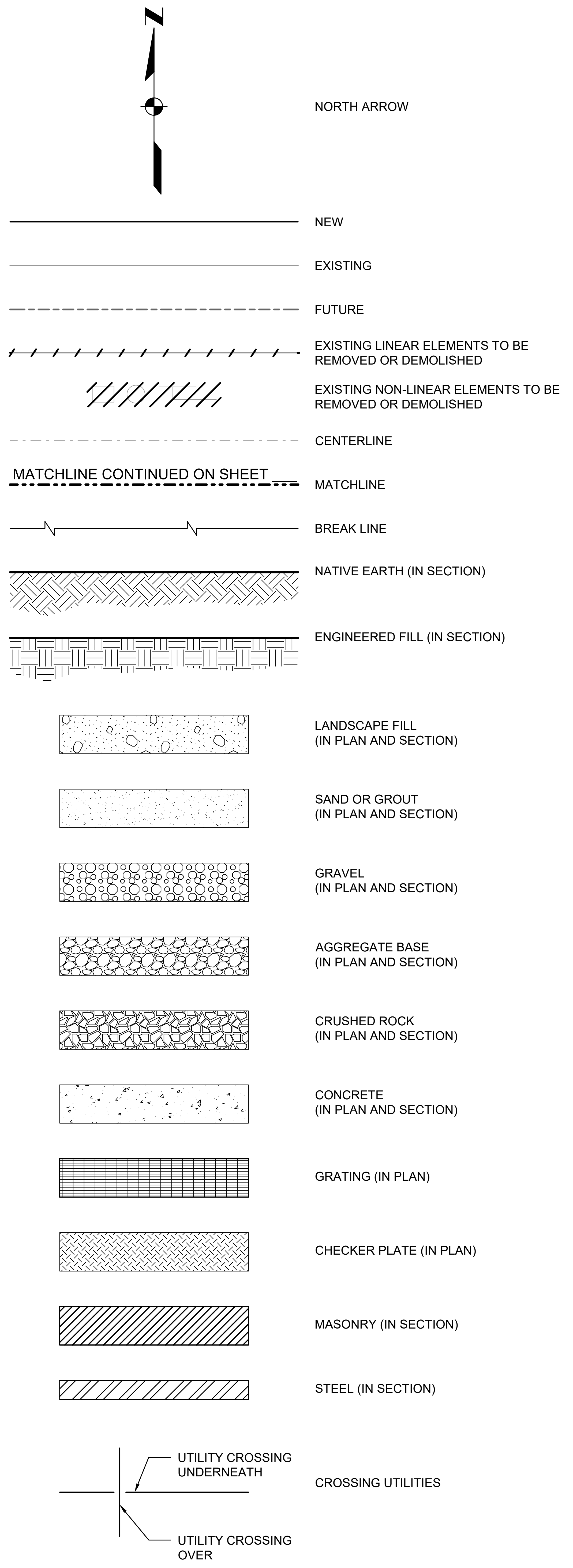
Ⓐ	SHEET KEYNOTE
℄	CENTERLINE
⅊	PLATE
Ø	DIAMETER
±	APPROXIMATELY
∠	ANGLE
▼	WATER/FLUID SURFACE
①	BUILDING GRID LABEL OR ACCESSORY NUMBER
##-##	DOOR
XXX	ROOM
##	WALL
##-##	WINDOW

REVISION SYMBOLS

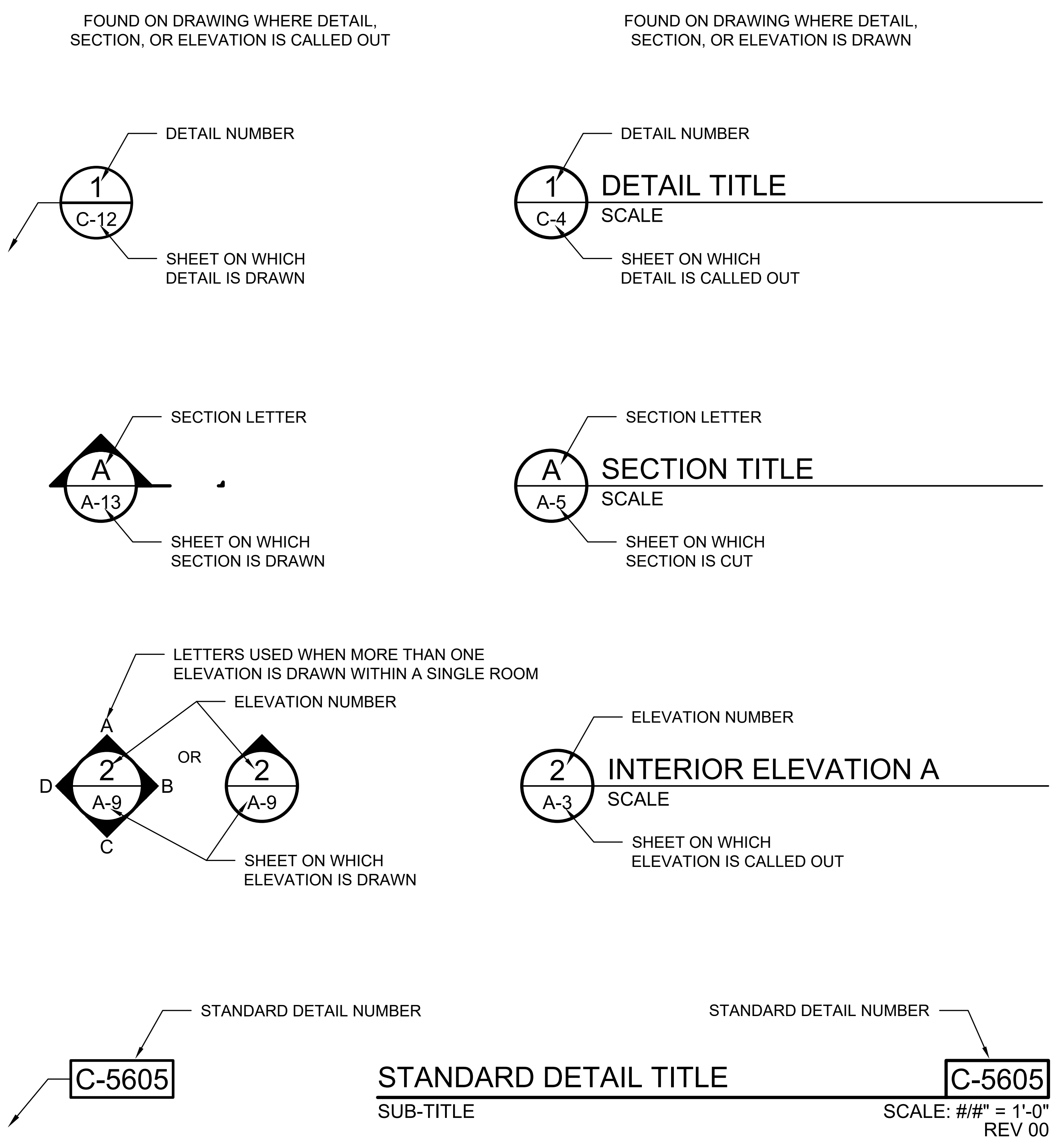


CLOUDED AREA INDICATES CHANGED INFORMATION; NUMBER IN TRIANGLE INDICATES THE DRAWING VERSION AND MATCHES WITH REVISION INFORMATION IN THE REVISION BLOCK WITHIN THE DRAWING BORDER

SYMBOLOGY



CROSS-REFERENCING SYMBOLS



NOTE
STANDARD DETAILS ARE LOCATED WITHIN THEIR RESPECTIVE DISCIPLINE, IMMEDIATELY FOLLOWING THE GENERAL ABBREVIATIONS, NOTES, AND LEGEND SHEETS.

##/##/#### - 30% SUBMITTAL

United Water
CONSERVATION DISTRICT

CHIEF ENGINEER
PROJECT MANAGER

NO	REVISION	DATE	BY

SCALES
0 1"
0 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY
NOT FOR
CONSTRUCTION

DESIGNED RJL
DRAWN CLL
CHECKED WCY

UNITED WATER CONSERVATION DISTRICT
1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030
PTP RECYCLED WATER CONNECTION
LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT

Kennedy Jenks

GENERAL NOTES
AND LEGEND

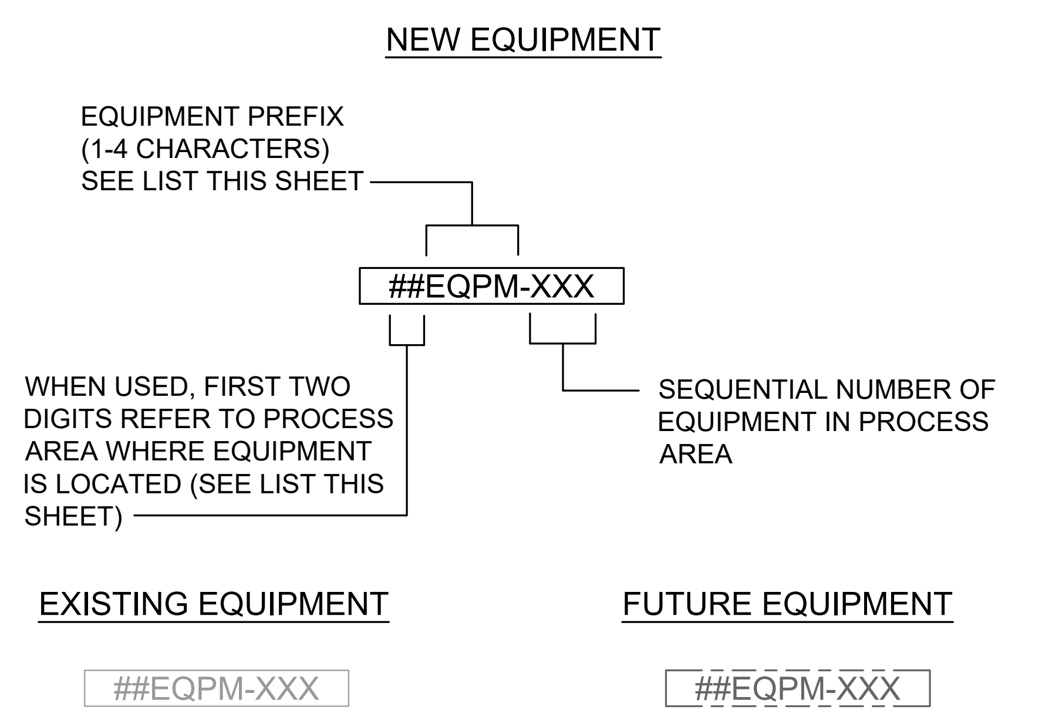
DWG: XX-###-###

SCALE
JOB NO 2244204.00
DATE 2023
SHEET OF ---
G-003

Plot Date: 1/6/2023 2:12 PM
User: CHERYL LOVE
pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\United Water Conservation District\Projects\PTP Recycled Water Connection – Laguna Rd Pipeline_2244204.00\10-Design\10.06-Drawings\General\2244204.00-G-003

Plot Date: 1/6/2023 2:13 PM
User: CHERYL LOVE
pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\United Water Conservation District\Projects\PTP Recycled Water Connection – Laguna Rd Pipeline_2244204.00\10-Design\10.06-Drawings\General\2244204.00-G-004

EQUIPMENT DESIGNATIONS



EQUIPMENT PREFIXES

ACU	HVAC AIR CONDITIONING UNIT (SELF-CONTAINED)
AF	HVAC AIR FILTER
AGT	AGITATOR
AHU	HVAC AIR HANDLER UNIT
ASD	ADJUSTABLE SPEED DRIVE (DC)
ATS	AUTOMATIC TRANSFER SWITCH
BATT	BATTERY SYSTEM
BFP	BELT FILTER PRESS
BLWR	BLOWER
BOIL	HVAC BOILER
BP	BACKFLOW PREVENTER
CAP	CAPACITOR
CDU	HVAC CONDENSING UNIT
CH	HVAC CHILLER
CNV	CONVEYOR
COM	COMMINUTOR
COMP	AIR/GAS COMPRESSOR
COVR	COVER (FLOATING)
CPT	COMPACTOR (SCREENINGS, ETC.)
CPU	COMPUTER
CRAN	CRANE
CRCP	HVAC RECIRCULATING PUMP
CSTR*	COMBINATION MOTOR STARTER - SEE NOTES
CTFG	CENTRIFUGE
DCSW	DISCONNECT SWITCH
DHMD	HVAC DEHUMIDIFIER
DIS	DISTRIBUTOR (ARM TYPE, EDUCTOR, EJECTOR, DIFFUSER, ETC.)
DMPR	HVAC CONTROL DAMPER
DP	DISTRIBUTION PANELBOARD
DR	DRYER
DU	DRIVE UNIT
ECU	HVAC EVAPORATIVE COOLING UNIT
EEW	EMERGENCY EYEWASH
ENG	ENGINE
EWS	EMERGENCY EYEWASH/SHOWER
EXF	HVAC FAN (EXHAUST)
FACP	FIRE ALARM CONTROL PANEL
FAN	HVAC FAN (RECIRCULATING)
FCU	HVAC FAN COIL UNIT
FILT	FILTER
FLAR	FLARE
FLOC	FLOCCULATOR
FURN	HVAC FURNACE
GATE*	GATE - SEE NOTES
GBT	GRAVITY BELT THICKENER
GEN	GENERATOR
GR	GRINDER
HC	HEATING COIL
HF	HARMONIC FILTER
HH	HANDHOLE
HPU	HEAT PUMP UNIT
HST	HOIST
HX	HEAT EXCHANGER
INJ	INJECTOR (INDUCTOR, EDUCTOR)
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
LVR	HVAC LOUVER
LP	LIGHTING PANELBOARD
M	MOTOR
MAU	MAKE-UP AIR UNIT
MCC	MOTOR CONTROL CENTER
MH	MANHOLE
MME	MISCELLANEOUS MECHANICAL EQUIPMENT
MOV	MOTORIZED VALVE OPERATOR
MTS	MANUAL TRANSFER SWITCH
MUX	MULTIPLEXER
MX*	MIXER - SEE NOTES
OCU	ODOR CONTROL UNIT
OIT	OPERATOR INTERFACE TERMINAL
P*	PUMP - SEE NOTES
POL	POLYMER DILUTION SYSTEM
PLC	PROGRAMMABLE LOGIC CONTROLLER
POV	PNEUMATIC VALVE OPERATOR
RH	ROOF HOOD
RIO	REMOTE INPUT/OUTPUT
RVAT	REDUCED VOLTAGE, AUTO TRANSFORMER MOTOR STARTER

EQUIPMENT PREFIXES (CONT)

RVPW	REDUCED VOLTAGE, PART WINDING MOTOR STARTER
RVSS	REDUCED VOLTAGE, SOLID STATE MOTOR STARTER
SC	SCREW COMPRESSOR
SCAL	WEIGHT SCALE
SCRN	SCREEN (BAR, ROTARY, ETC.)
SEP	SEPARATOR (SEDIMENTATION, TRAP, DRIP TRAP, CYCLONE, STRAINER, ETC.)
SLGR	SLUDGE GRINDER
SIL	SILENCER
SMP	SAMPLER
SEPT	SEPTAGE RECEIVING TANK
SUF	HVAC FAN (SUPPLY)
SV	SOLENOID VALVE OPERATOR
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
T*	TANK - SEE NOTES
TP	TRAP PRIMER
UH	HVAC UNIT HEATER
UPS	UNINTERRUPTIBLE POWER SUPPLY
UV	ULTRAVIOLET DISINFECTION UNIT
V*	VALVE - SEE NOTES
VCP	VENDOR CONTROL PANEL
VFD	VARIABLE FREQUENCY DRIVE (AC)
WH	WATER HEATER
XFMR	TRANSFORMER

NOTES

THE EQUIPMENT PREFIXES LISTED ABOVE ARE USED TO UNIQUELY IDENTIFY EACH PIECE OF EQUIPMENT. PREFIXES SHOWN WITH AN ASTERISK (*) MAY BE FURTHER REFINED BY SYMBOL, AND IDENTIFIED IN GREATER DETAIL IN EQUIPMENT SCHEDULES AND SPECIFICATIONS WITH THE ABBREVIATIONS SHOWN BELOW.

COMBINATION MOTOR STARTERS

FVNR	FULL VOLTAGE, NON-REVERSING
FVR	FULL VOLTAGE, REVERSING

GATES

SLID	SLIDE
FLAP	FLAP
TILT	TILTING WEIR

MIXERS

MECH	MECHANICAL
STATIC	STATIC
TANK	IN TANK (MOTORIZED)

PUMPS

CHOP	CHOPPER
DPHM	DIAPHRAGM
HOSE	HOSE
LOBE	LOBE (ROTARY LOBE)
PC	PROGRESSIVE CAVITY
PD	POSITIVE DISPLACEMENT
PERI	PERISTALTIC
SUBM	SUBMERSIBLE
SUMP	SUBMERSIBLE SUMP
VT	VERTICAL TURBINE
WELL	SUBMERSIBLE WELL

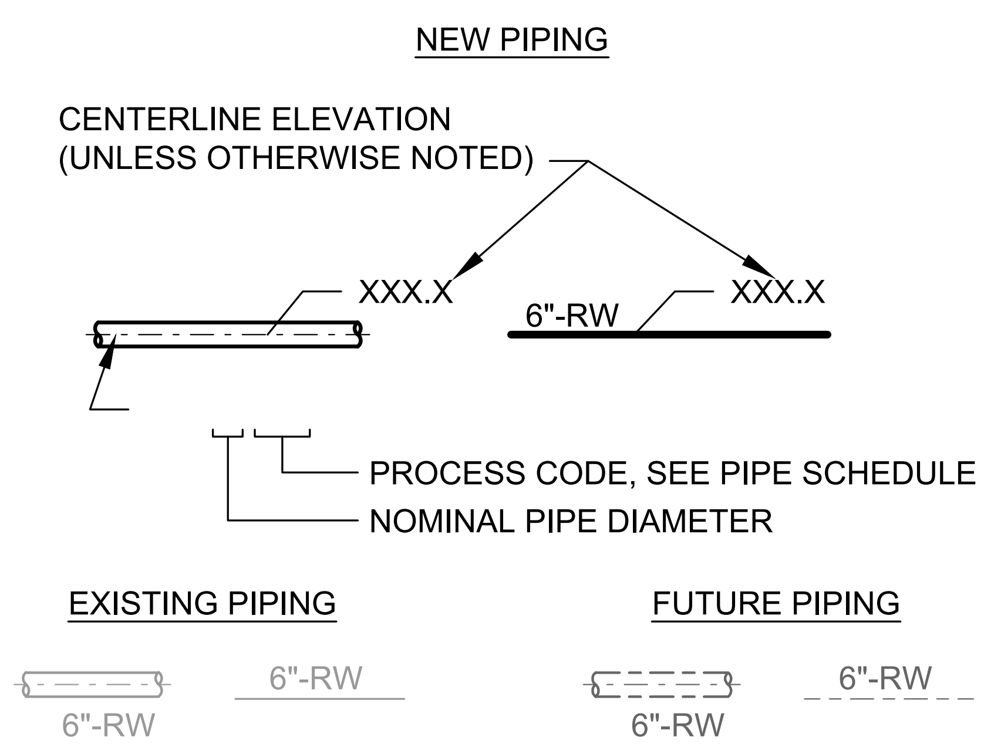
TANKS

NPRS	NON-PRESSURIZED (DIGESTER, STORAGE, ETC.)
PRS	PRESSURE VESSEL (AIR RECEIVER, ETC.)

VALVES

ALTD	ALTITUDE
AR	AIR RELEASE
ARVR	AIR RELEASE VACUUM RELIEF
AV	VACUUM RELIEF/AIR INLET
BALL	BALL
BFLY	BUTTERFLY
CA	COMBINATION AIR/VACUUM
CHK	CHECK
FCTL	FLOW CONTROL
GATE	GATE
GLOB	GLOBE
NEDL	NEEDLE
PCTL	PUMP CONTROL
PINC	PINCH
PLUG	PLUG
PRED	PRESSURE REDUCING
PREL	PRESSURE RELIEF
PSUS	PRESSURE SUSTAINING
SOL	SOLENOID

PIPING DESIGNATIONS



PROCESS CODES

AA	AERATION AIR
ALUM	LIQUID ALUM
AM	AMMONIA
AS	ACTIVATED SILICA
BA	BUBBLER AIR
BWS	BACKWASH SUPPLY
BWW	BACKWASH WASTE
CA	COMPRESSED AIR
CEN	CENTRATE
CHWR	HVAC CHILLED WATER RETURN
CHWS	HVAC CHILLED WATER SUPPLY
CLG	CHLORINE - GAS
CLL	CHLORINE - LIQUID
CLS	CHLORINE SOLUTION
CLV	CHLORINE GAS UNDER VACUUM
CLVD	CHLORINATOR VENT & DETECTION
CND	CONDENSATE
CNDD	HVAC CONDENSATE DRAIN
CRD	CHEMICAL RESISTANT DRAIN
CRV	CORROSION RESISTANT VENT
CS	CIRCULATED SLUDGE
CTS	CALCIUM THIOSULFATE
CWR	CHILLED WATER RETURN
CWS	CHILLED WATER SUPPLY
D	PLUMBING SANITARY DRAIN & VENT
DCNT	DECANT
DHWR	PLUMBING DOMESTIC HOT WATER RETURN
DHWS	PLUMBING DOMESTIC HOT WATER SUPPLY
DR	PROCESS DRAIN
DS	DIGESTED SLUDGE
DW	DEMINERALIZED WATER
EBS	ENGINEERED BIOSOLIDS
EEX	ENGINE EXHAUST
EWR	ENGINE COOLING WATER RETURN
EWS	ENGINE COOLING WATER SUPPLY
FA	FOUL AIR
FAW	FILTER AIR WASH
FC	FERRIC CHLORIDE
FE	FINAL EFFLUENT
FI	FILTER INFLUENT
FM	FORCE MAIN
FOG	FATS, OILS, AND GREASE
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
FSP	FIRE PROTECTION SPRINKLER
FSW	FILTER SURFACE WASHWATER
FTW	FILTER TO WASTE
FW	FILTERED WATER
FWS	FOOD WASTE SLURRY
FWW	FILTER WASTE WASHWATER
GR	GRIT
H2O2	HYDROGEN PEROXIDE
HCA	HYDROCHLORIC ACID
HFA	HYDROFLUOSILICIC ACID
HHWR	HVAC HEATING WATER RETURN
HHWS	HVAC HEATING WATER SUPPLY
HWR	HEATING WATER RETURN
HWS	HEATING WATER SUPPLY
HYPO	SODIUM HYPOCHLORITE
IA	INSTRUMENT AIR
INJ	INJECTOR WATER
IRR	LANDSCAPING SPRINKLER SYSTEM
IXE	ION EXCHANGE EFFLUENT
LAS	LIQUID AMMONIUM SULFATE
LO	LUBE OIL
LOX	LIQUID OXYGEN
LPG	LIQUIFIED PETROLEUM GAS
LS	LIME SLURRY

PROCESS CODES (CONT)

MC	MEMBRANE CONCENTRATE SUPPLY
MCCR	MEMBRANE CONCENTRATE RETURN
MCP	MEMBRANE CLEANING PERMEATE SUPPLY
MCPR	MEMBRANE CLEANING PERMEATE RETURN
MCR	MEMBRANE CLEANING RETURN
MCS	MEMBRANE CLEANING SUPPLY
MCW	MEMBRANE CLEANING WASTE
METH	METHANOL
MF	MEMBRANE FEED WATER
MGOH	MAGNESIUM HYDROXIDE
ML	MIXED LIQUOR
MP	MEMBRANE PERMEATE
MUA	MURIATIC ACID
NAOH	SODIUM HYDROXIDE
NG	NATURAL GAS
NPW	NON-POTABLE WATER
OF	OVERFLOW
OG	OFF GAS
OXG	GASEOUS OXYGEN
OZ	OZONE
OZW	OZONATED WATER
PA	PLANT AIR
PAC	POLYALUMINUM CHLORIDE
PD	PLANT DRAIN
PEFF	PRIMARY EFFLUENT
PHOS	PHOSPHATE
POL	POLYMER
PP	POTASSIUM PERMANGANATE
PSL	PRIMARY SLUDGE
PW	POTABLE WATER
RAS	RETURN ACTIVATED SLUDGE
REW	RECLAIMED WATER
REF	REFRIGERANT
RS	RAW SEWAGE
RSL	RAW SLUDGE
RW	RAW WATER
SA	SAMPLE LINE
SBS	SODIUM BUSULTFITE
SCI	SCALE INHIBITOR
SCM	SCUM
SD	STORM DRAIN
SEFF	SECONDARY EFFLUENT
SG	SLUDGE GAS
SH	SODIUM HYDROXIDE/CAUSTIC SODA
SI	SODIUM SILICATE
SL	SLUDGE
SN	SUPERNATANT
SO	SULFUR DIOXIDE
SO2	SULFUR DIOXIDE SOLUTION
SO2V	SULFUR DIOXIDE GAS UNDER VACUUM
SOA	SULFURIC ACID
SPD	SUMP PUMP DISCHARGE
SS	SANITARY SEWER
ST	STEAM (LOW PRESSURE <10 PSI)
SW	SETTLED WATER
TE	TERTIARY EFFLUENT
TPW	PLUMBING TEMPERED WATER
TS	THICKENED SUPERNATANT
TSL	THICKENED SLUDGE
TW	TREATED WATER
TWAS	THICKENED WAS
UW	UTILITY WATER
VE	VENT
VTR	PLUMBING VENT TO ROOF
WAS	WASTE ACTIVATED SLUDGE
WLO	WASTE LUBE OIL
WW	WASTE WASHWATER
WWR	WASHWATER RETURN

UTILITY CONTACT INFORMATION

AT&T
ATT DAMAGE PREVENTION HOTLINE
510-645-2929

CROWN CASTLE
FIBER DIG
800-634-3110

PLEASANT VALLEY COUNTY WATER DISTRICT
154 S. LAS POSAS ROAD, CAMARILLO CA, 93010
JARED BOUCHARD
805-482-2119

SOUTHERN CALIFORNIA GAS
SHARON CARDIEL
805-385-4845

AIR TOUCH CELLULAR
JOHN CROSSE
818-923-9298

SOUTHERN CALIFORNIA EDISON DISTRIBUTION
SC EDISON PERSONNEL
800-611-1911

SOUTHERN CALIFORNIA EDISON TELECOM
800-655-8844

FRONTIER COMMUNICATIONS
678-831-2444

##/##/#### - 30% SUBMITTAL

United Water
CONSERVATION DISTRICT

CHIEF ENGINEER
PROJECT MANAGER

NO	REVISION	DATE	BY

SCALES
0 1"
0 25mm
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PRELIMINARY
NOT FOR
CONSTRUCTION

DESIGNED RJL
DRAWN CLL
CHECKED WCY

UNITED WATER CONSERVATION DISTRICT
1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030
PTP RECYCLED WATER CONNECTION
LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT

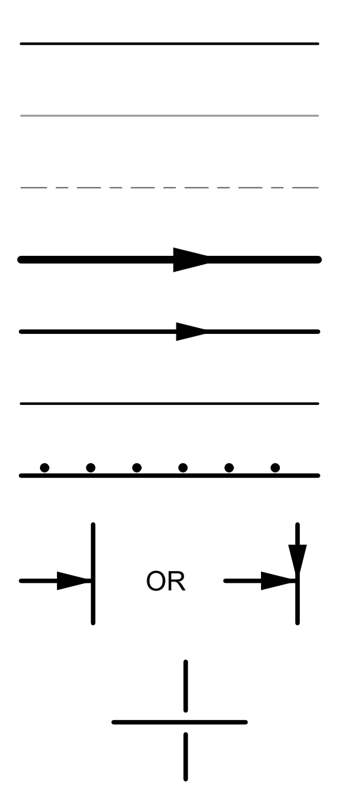
Kennedy Jenks

GENERAL EQUIPMENT DESIGNATIONS
AND PROCESS IDENTIFICATION CODES

DWG: XX-###-###

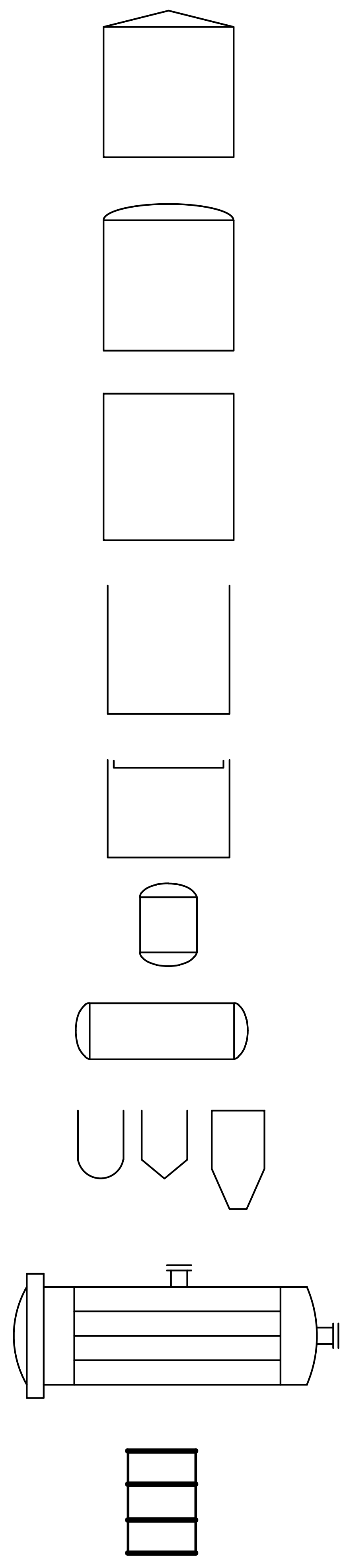
SCALE
JOB NO 2244204.00
DATE 2023
SHEET OF ---
G-004

PIPING - SINGLE LINE



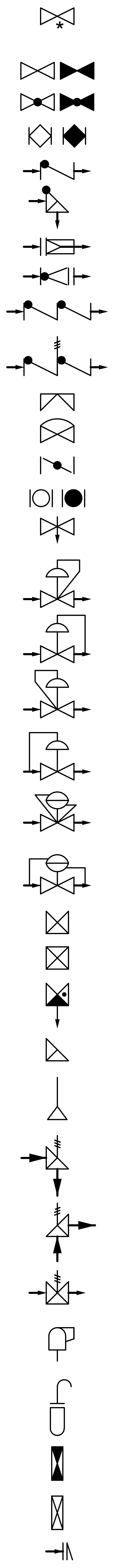
- NEW WORK (NOT SCREENED)
- EXISTING (SCREENED)
- FUTURE (LONG DASH, SHORT DASH)
- PROCESS - PRIMARY
- PROCESS - SECONDARY
- PROCESS - DRAIN
- PROCESS - HEAT TRACED
- CONNECTED
- NOT CONNECTED

TANKS AND VESSELS



- TANK WITH CONICAL ROOF
- TANK WITH DOMED ROOF
- TANK WITH FLAT ROOF
- OPEN TOP TANK
- TANK WITH FLOATING COVER
- PRESSURE VESSEL - VERTICAL
- PRESSURE VESSEL - HORIZONTAL
- HOPPER, VESSEL, OR BIN
- FILTER VESSEL
- STORAGE DRUM

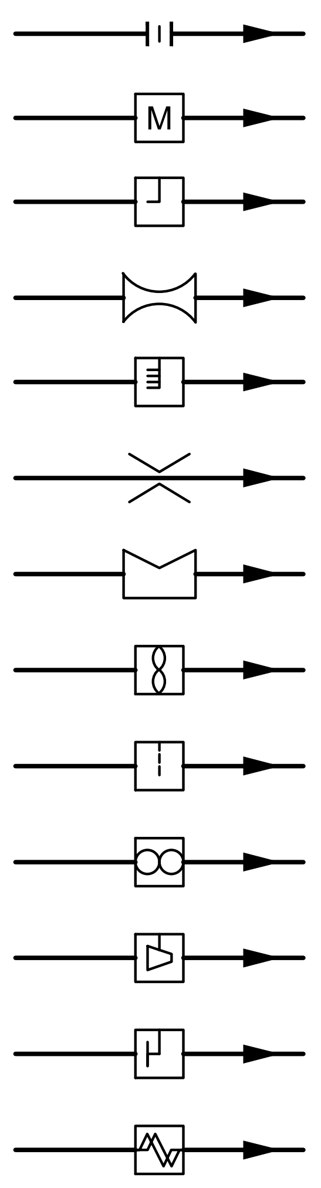
VALVES AND GATES



* FC = FAIL CLOSED
FO = FAIL OPEN
FL = FAIL LOCKED IN LAST

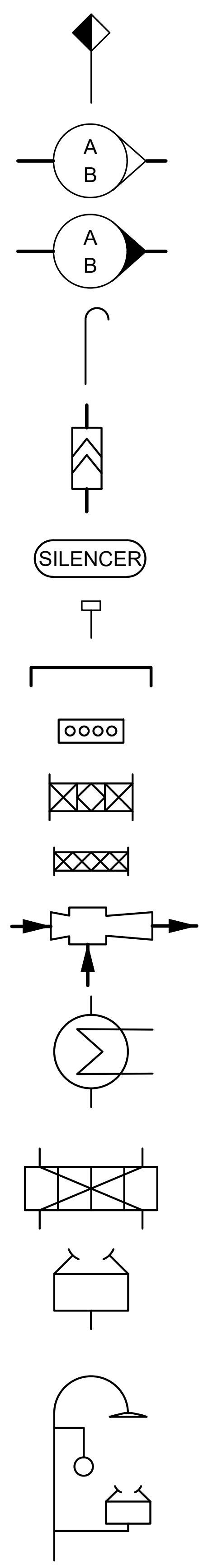
- GATE VALVE (NORMALLY OPEN, NORMALLY CLOSED)
- GLOBE VALVE (NORMALLY OPEN, NORMALLY CLOSED)
- PLUG VALVE (NORMALLY OPEN, NORMALLY CLOSED)
- CHECK VALVE
- ANGLED CHECK VALVE
- DUCKBILL CHECK VALVE
- BALL CHECK VALVE
- BACKFLOW PREVENTER (DOUBLE CHECK ASSEMBLY)
- BACKFLOW PREVENTER (REDUCED PRESSURE PRINCIPLE)
- PINCH VALVE
- DIAPHRAGM VALVE
- BUTTERFLY VALVE
- BALL VALVE (NORMALLY OPEN, NORMALLY CLOSED)
- NEEDLE VALVE
- PRESSURE REDUCING VALVE, SELF-CONTAINED
- PRESSURE REDUCING VALVE WITH EXTERNAL PRESSURE TAP
- PRESSURE SUSTAINING VALVE, SELF-CONTAINED
- PRESSURE SUSTAINING VALVE WITH EXTERNAL PRESSURE TAP
- DIFFERENTIAL PRESSURE REGULATING VALVE, SELF-CONTAINED
- DIFFERENTIAL PRESSURE REGULATING VALVE WITH EXTERNAL PRESSURE TAP
- 3-WAY VALVE
- 4-WAY VALVE
- SHADING INDICATES PORT TO BE CLOSED DURING NORMAL OPERATION. DOT INDICATES PORT TO BE CLOSED DURING ALTERNATE OPERATION.
- ANGLE VALVE
- FOOT VALVE
- VACUUM RELIEF/AIR INLET VALVE (AV)
- PRESSURE RELIEF VALVE (PREL)
- AIR RELEASE/VACUUM RELIEF VALVE (ARVR)
- COMBINATION AIR/VACUUM VALVE (CA)
- AIR RELEASE VALVE (AR)
- GATE - NORMALLY CLOSED
- GATE - NORMALLY OPEN
- FLAP GATE

PRIMARY INLINE ELEMENTS



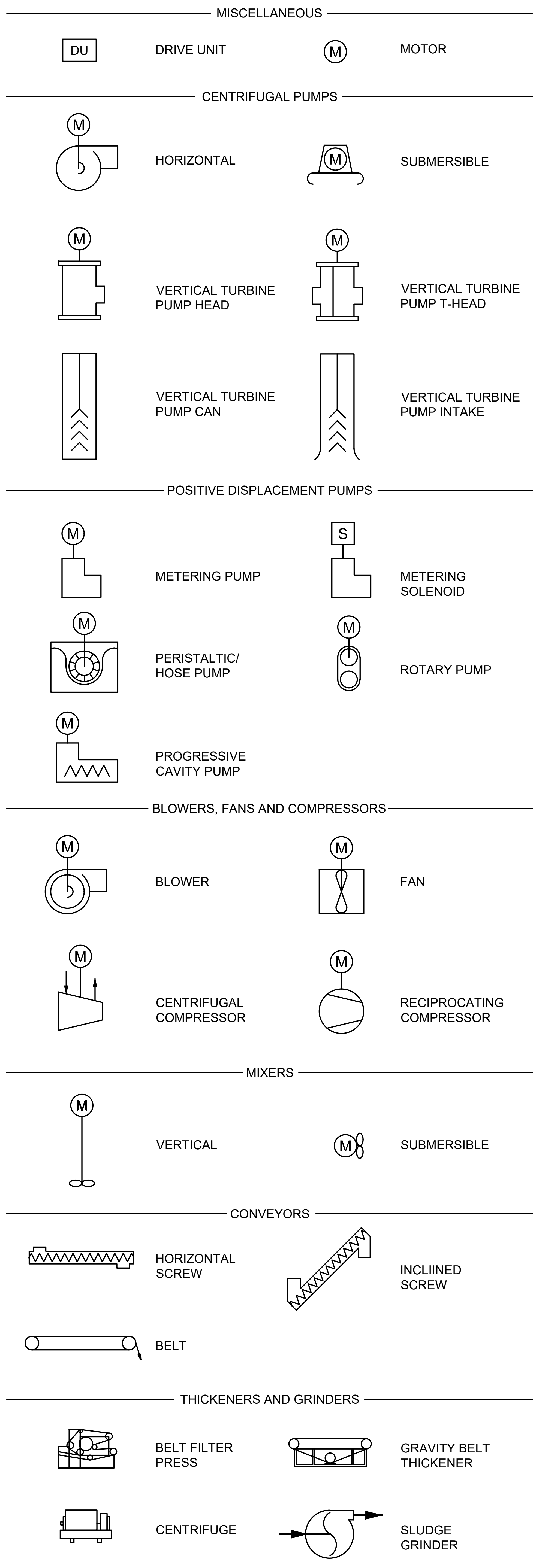
- ORIFICE PLATE
- MAGNETIC FLOW TUBE
- SINGLE PORT PITOT TUBE OR PITOT-VENTURI TUBE
- VENTURI TUBE
- AVERAGING PITOT TUBE
- FLUME
- WEIR
- TURBINE OR PROPELLER-TYPE PRIMARY ELEMENT
- THERMAL MASS FLOWMETER
- POSITIVE DISPLACEMENT TYPE FLOW TOTALIZING INDICATOR
- VORTEX SENSOR
- TARGET TYPE SENSOR
- CORIOLIS EFFECT SENSOR

MISCELLANEOUS



- PIPE MATERIAL CHANGE
- ROTAMETER
- ROTAMETER WITH INTEGRAL VALVE
- VENT
- FLAME ARRESTOR
- SILENCER
- SNUBBER
- WEIGH SCALE
- CHEMICAL DIFFUSER
- INJECTION MIXER
- STATIC MIXER
- EDUCTOR/INJECTOR
- SHELL AND TUBE HEAT EXCHANGER
- PLATE AND FRAME HEAT EXCHANGER
- EYEWASH
- EYEWASH AND SHOWER

EQUIPMENT



MISCELLANEOUS

- DRIVE UNIT
- MOTOR

CENTRIFUGAL PUMPS

- HORIZONTAL
- SUBMERSIBLE
- VERTICAL TURBINE PUMP HEAD
- VERTICAL TURBINE PUMP T-HEAD
- VERTICAL TURBINE PUMP CAN
- VERTICAL TURBINE PUMP INTAKE

POSITIVE DISPLACEMENT PUMPS

- METERING PUMP
- METERING SOLENOID
- PERISTALTIC/ HOSE PUMP
- ROTARY PUMP
- PROGRESSIVE CAVITY PUMP

BLOWERS, FANS AND COMPRESSORS

- BLOWER
- FAN
- CENTRIFUGAL COMPRESSOR
- RECIPROCATING COMPRESSOR

MIXERS

- VERTICAL
- SUBMERSIBLE

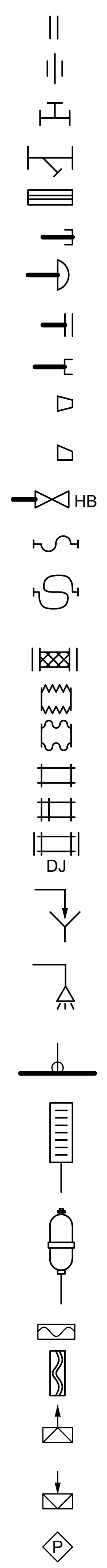
CONVEYORS

- HORIZONTAL SCREW
- INCLIINED SCREW
- BELT

THICKENERS AND GRINDERS

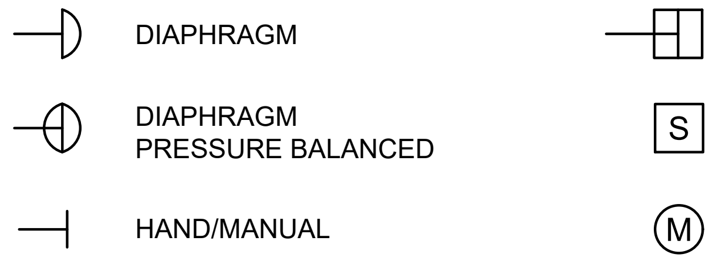
- BELT FILTER PRESS
- GRAVITY BELT THICKENER
- CENTRIFUGE
- SLUDGE GRINDER

PIPING ACCESSORIES AND FITTINGS



- FLANGE
- UNION
- TEE
- Y STRAINER
- FLOW STRAIGHTENING VANE
- SCREWED CAP
- WELDED CAP
- BLIND FLANGE
- QUICK DISCONNECT
- REDUCER (CONCENTRIC)
- REDUCER (ECCENTRIC)
- HOSE BIBB CONNECTION
- CHEMICAL PIPING FLEXIBLE CONNECTION/ FLEXIBLE HOSE
- FLEXIBLE TANK CONNECTION
- BRAIDED METAL HOSE
- METAL BELLOWS
- EXPANSION JOINT
- FLEXIBLE COUPLING
- FLANGED COUPLING ADAPTER
- DISASSEMBLING JOINT
- DRAIN
- SPRAY NOZZLE
- THERMOWELL
- CALIBRATION CYLINDER
- PULSATION DAMPER
- DIAPHRAGM SEAL
- ANNULAR SEAL
- RUPTURE DISK, PRESSURE
- RUPTURE DISK, VACUUM
- PURGE

VALVE AND GATE OPERATORS



- DIAPHRAGM
- DIAPHRAGM PRESSURE BALANCED
- HAND/MANUAL
- CYLINDER OPERATOR
- SOLENOID
- MOTOR

NOTES

1. SEE THE PRECEDING DRAWING FOR EQUIPMENT DESIGNATIONS AND PROCESS IDENTIFICATION CODES.
2. THIS IS A GENERALIZED LEGEND SHEET. SEE ALSO ISA S5.1, S5.3 AND S7.3.

##/##/#### - 30% SUBMITTAL

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NO	REVISION	DATE	BY

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GENERAL PROCESS SYMBOLS

DWG: XX-###-###

SCALE
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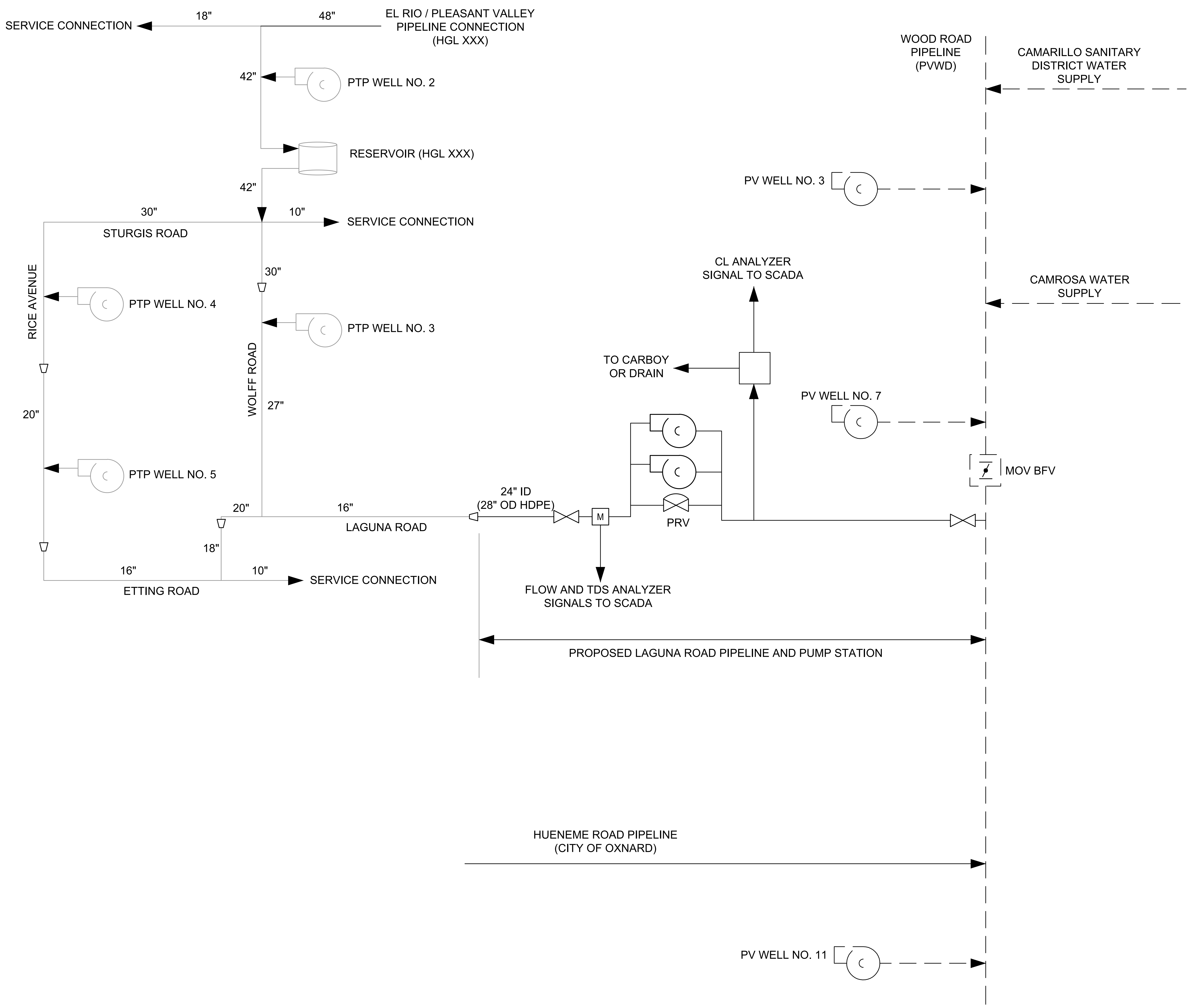
G-005

Plot Date: 1/6/2023 2:13 PM

User: CHERYL LOVE

pw:\\kjce-pw.bentley.com:kjce-pw\Documents\Clients\United Water Conservation District\Projects\PTP Recycled Water Connection – Laguna Rd Pipeline_2244204.00\10-Design\10.06-Drawings\General\2244204 00-G-006



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Kennedy Jenks

HYDRAULIC FLOW SCHEMATIC

DWG: XX-###-###

SCALE

JOB NO 2244204.00

DATE 2023

SHEET OF ---

G-006

Plot Date: 1/6/2023 2:13 PM

User: CHERYL LOVE

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CIVIL NOTES

GENERAL

1. PROTECT ALL EXISTING AND CONSTRUCTED ITEMS:
   1.1. ON SITE
   1.2. ADJACENT TO SITE
   1.3. ALONG ROUTE TO CONSTRUCTION SITE.
   ANY DAMAGE SHALL BE IDENTIFIED TO OWNER AND REPAIRED PER OWNERS REQUIREMENTS.
2. OBTAIN PERMITS NECESSARY TO COMPLETE FEATURES WITHIN EASEMENTS, DEDICATIONS AND PUBLIC RIGHT-OF-WAY.
3. COORDINATES ARE PROVIDED AS FOLLOWS UNLESS NOTED OTHERWISE ON DRAWINGS:
   3.1. FACE OF WALL
   3.2. FACE OF CURB
   3.3. CORNER OF EQUIPMENT PADS AND VAULTS
4. SURFACE FEATURES SHALL BE ORIENTED PARALLEL TO CURB/GUTTER OR WALLS UNLESS OTHERWISE NOTED.
5. PROTECT ALL SURVEY MONUMENTS.
6. SHOULD THE CONTRACTOR DISCOVER ANY DISCREPANCIES BETWEEN THE CONDITIONS EXISTING IN THE FIELD AND THE INFORMATION SHOWN ON THESE DRAWINGS, CONTRACTOR SHALL NOTIFY THE OWNER PRIOR TO PROCEEDING WITH CONSTRUCTION.
7. THE CONTRACTOR SHALL MAINTAIN A COPY OF AN APPROVED SET OF PLANS ON THE CONSTRUCTION SITE AT ALL TIMES.
8. PROVIDE TEMPORARY TRAFFIC SIGNAGE IN ACCORDANCE WITH STATE AND LOCAL AGENCIES DURING THE COURSE OF CONSTRUCTION.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TRAFFIC CONTROL WITHIN THE PUBLIC RIGHT OF WAY IN ACCORDANCE WITH LOCAL ORDINANCES. NO WORK SHALL COMMENCE UNTIL ALL REQUIRED TRAFFIC CONTROL MEASURES ARE IN PLACE.

GRADING

1. ADJUST VALVE BOXES, PULL BOXES, VAULTS, AND MAHOLES TO FINISHED GRADES AND SLOPES SHOWN ON CIVIL GRADING DRAWINGS UNLESS OTHERWISE SHOWN OR SPECIFIED. MANHOLES IN OPEN FIELDS SHALL BE SET ONE FOOT ABOVE GRADE. APPROXIMATE RIM ELEVATIONS ARE SHOWN ON DRAWINGS.
2. GRADES SHOWN ARE TO TO OF THE FINISHED SURFACE UNLESS NOTED OTHERWISE.
3. EXISTING FEATURES SHOWN OUTSIDE OF PROJECT SURVEY ARE FOR REFERENCE ONLY.

DEMOLITION

1. DEMOLITION SHOWN ON DRAWINGS IS THE MINIMAL AMOUNT REQUIRED TO COMPLETE DESIGN. ADJUST THE EXTENT OF DEMOLITION PER MEANS AND METHODS. COORDINATE ADDITIONAL DEMOLITION REQUIRED WITH THE ENGINEER.
2. SUBMIT AS-BUILTS OF UTILITIES ABANDONED IN PLACE AS PART OF THE WORK.

PIPING

1. THESE NOTES ARE GENERIC IN NATURE. PROJECT SPECIFIC NOTES ON FOLLOWING DRAWINGS TAKE PRECEDENCE.
2. THE CONTRACTOR SHALL COMPLY WITH THE STATE DEPARTMENT OF HEALTH SERVICES CRITERIA FOR THE SEPARATION BETWEEN WATER MAINS, NON-POTABLE WATER UTILITIES, AND SEWER.
3. WATER, STORM AND SEWER PIPELINES SHALL BE INSTALLED WITH A MINIMUM OF 36 INCHES OF COVER, UNLESS OTHERWISE NOTED.
4. PRIOR TO SUBMITTAL OF PIPE SHOP DRAWINGS, VERIFY THE INVERT ELEVATIONS, ALIGNMENT, OUTSIDE DIAMETER, LOCATION, AND MATERIAL OF ALL EXISTING PIPELINES TO WHICH NEW PIPELINES WILL BE CONNECTED.
5. PIPE STATIONING REPRESENTS THE HORIZONTAL PROJECTION OF THE PIPE CENTERLINE BETWEEN MANHOLES, POINTS OF INFLECTION, AND/OR CENTER OF FITTINGS.
6. RESTRAIN ALL PIPE, FITTINGS, FLEXIBLE CONNECTORS, AND/OR FLANGED COUPLING ADAPTERS UNLESS OTHERWISE NOTED. THRUST PROTECTION SHALL BE ADEQUATE FOR TEST PRESSURES SPECIFIED.
7. LOCATION OF EXISTING UTILITIES ARE APPROXIMATE. CONTRACTOR SHALL EXPOSE EXISTING PIPE(S) OR STRUCTURE(S) TO WHICH NEW PIPE(S) IS/ARE CONNECTING. VERIFY EXACT LOCATION, SIZE, MATERIALS, AND INVERT ELEVATIONS PRIOR TO SUBMITTING PIPE DRAWINGS.
8. PROTECT EXISTING UTILITIES UNLESS OTHERWISE NOTED.
9. CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING IN PROXIMITY TO GAS. CONTRACTOR SHALL NOTIFY UTILITY COMPANY WHEN WORKING WITHIN THE VICINITY AND SHALL FOLLOW UTILITY SAFETY GUIDELINES AND OSHA REQUIREMENTS. ALL CONSTRUCTION WITHIN 5 FEET HORIZONTALLY OF ANY GAS MAIN SHALL BE HAND DUG.
10. CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING IN PROXIMITY TO OVERHEAD ELECTRICAL LINES. CONTRACTOR SHALL FOLLOW ELECTRICAL UTILITY SAFETY GUIDELINES AND OSHA REQUIREMENTS.
11. CROSSING PIPELINES SHOWN IN PROFILE REPRESENT OUTSIDE DIAMETER UNLESS OTHERWISE NOTED.
12. ORIENT ECCENTRIC MANHOLE(S) SUCH THAT THE LID IS OUTSIDE OF WHEEL PATH.
13. COORDINATES LOCATING MANHOLES ARE TO THE CENTER OF THE STRUCTURE.
14. SIZE OF FITTING SHOWN ON THE DRAWINGS SHALL CORRESPOND TO THE ADJACENT STRAIGHT RUN OF PIPE, UNLESS OTHERWISE INDICATED. TYPE OF JOINT AND FITTING MATERIAL SHALL MATCH AS SHOWN FOR ADJACENT STRAIGHT RUN OF PIPE, UNLESS OTHERWISE NOTED.
15. PIPE HANGERS AND SUPPORTS SHOWN ARE APPROXIMATE. FINAL PIPE SUPPORT SHALL BE APPROVED BY THE ENGINEER PRIOR TO INSTALLATION.
16. NUMBER AND LOCATION OF UNIONS SHOWN ON DRAWINGS ARE APPROXIMATE. PROVIDE UNIONS NECESSARY TO FACILITATE CONVENIENT REMOVAL OF VALVES AND MECHANICAL EQUIPMENT.
17. CONTRACTOR SHALL PROVIDE AS-BUILT PIPELINE PLAN AND PROFILES IN ACCORDANCE WITH THE GENERAL CONDITIONS.
18. CONTRACTOR SHALL COORDINATE AND PERFORM PIPE CONNECTIONS TO APPURTENANCES, EXISTING PIPING, FACILITIES, AND TO THE WORK OF OTHER CONTRACTORS, IF APPLICABLE.

SURVEY NOTES

BASIS OF COORDINATES

THE BASIS OF BEARINGS FOR THIS SURVEY IS THE CALIFORNIA COORDINATE SYSTEM NAD83, ZONE 5, EPOCH 2017.50 AS DETERMINED LOCALLY BY A LINE BETWEEN CONTINUOUS GLOBAL POSITIONING STATIONS (CGPS) AND/OR CONTINUOUS OPERATING REFERENCE STATIONS (CORS) CSCI & TOST BEING NORTH 65°12'25.61" EAST AS DERIVED FROM GEODETIC VALUES PUBLISHED BY THE CALIFORNIA SPATIAL REFERENCE CENTER (CSRC).

BENCHMARK

THE VERTICAL DATUM OF THIS SURVEY IS THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88), PER GPS TIES & GEOID MODELING (GEOID12B) TO CGPS STATION VNCO. ELLIPSOID HEIGHTS ARE CONSTRAINED PER CSRC. NO COUNTY BENCHMARKS WERE MEASURED IN THIS SURVEY.

SURVEYOR

AEROTECH MAPPING, INC.

CONTROL POINTS

XXXXXX
XXXX
XXXXXX
XXXX

KEY MAP

##/##/#### - 30% SUBMITTAL

United Water
CONSERVATION DISTRICT

CHIEF ENGINEER
PROJECT MANAGER

NO	REVISION	DATE	BY

SCALES
0 — 1"
0 — 25mm
IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY.

PRELIMINARY
NOT FOR
CONSTRUCTION

DESIGNED: RJL
DRAWN: CLL
CHECKED: WCY

UNITED WATER CONSERVATION DISTRICT
1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030
PTP RECYCLED WATER CONNECTION
LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT

Kennedy Jenks

GENERAL CIVIL
KEYMAP AND NOTES

DWG: XX-###-###

SCALE: NO SCALE
JOB NO: 2244204.00
DATE: 2023
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C-001

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GEOTECHNICAL SYMBOLS

#	SOIL BORING LOCATION
TP-#	TEST PIT LOCATION
MW	MONITORING WELL

CORROSION CONTROL SYMBOLS

ETS	ELECTROLYSIS TEST STATION
T	CATHODIC TEST STATION
CTS	CORROSION TEST STATION
CATS	CASING TEST STATION
IJTS	INSULATING JOINT TEST STATION
FPTS	FOREIGN PIPELINE TEST STATION
CSTS	CURRENT SPAN TEST STATION

EROSION CONTROL SYMBOLS

	RIPRAP
	HAY BALE/STRAW WATTLE
	SILT FENCE

GENERAL CIVIL SYMBOLS

S=0.012	SLOPE ON PAVED SURFACE OR PIPE
3:1	BERM SLOPE (HORZ TO VERT)
	SURFACE FLOW DIRECTION

TOPOGRAPHY AND MAPPING SYMBOLS

125	MAJOR CONTOURS
124	MINOR CONTOURS
	TOP OF SLOPE
	TOE OF SLOPE
P/L P/L	PROPERTY LINE
R/W R/W	RIGHT-OF-WAY LINE
	GRADE BREAK
R	RIDGE LINE
ESMT	EASEMENT LINE
ESMT TEMPORARY	TEMPORARY EASEMENT LINE
	TRAIL OR DIRT ROAD
	FLOW LINE
	FLOOD HAZARD AREA
	EDGE OF WETLANDS
	RAILROAD
	SITE OR RETAINING WALL
	GUARDRAIL (PERMANENT)
	LIMITS OF GRADING
	LIMITS OF EXCAVATION

EXISTING UTILITIES

G	NATURAL GAS
HPG	HIGH PRESSURE GAS
LPG	LIQUID PETROLEUM
W	WATER LINE
PW	POTABLE WATER
FIRE	FIRE SUPPLY WATER
REW	RECLAIMED WATER
UW	UTILITY/NON-POTABLE WATER
IRR	IRRIGATION WATER
SD	STORM DRAIN
SS	SANITARY SEWER
STM	STEAM
TEL	TELEPHONE
COMM	COMMUNICATIONS LINE
FOC	FIBER OPTIC CABLE
CATV	CABLE TV
E	POWER
UNK	UNIDENTIFIED
ABND	ABANDONED UTILITY

EXISTING FEATURES

	VEGETATION
	TREE (SIZE AND TYPE)
	WELL
	POWER POLE
	GUY LINE AND ANCHOR
M B	MAILBOX
☒	TRAFFIC SIGNAL BOX OR POLE
	SIGN
T	TELEPHONE BOX
C	COMMUNICATION/CATV BOX
	HOSE BIBB
HR	HOSE RACK
W	WATER BOX/METER
BFP	BACKFLOW PREVENTER
MH LID MH LID	MANHOLE OR VAULT
FH	FIRE HYDRANT

PROPOSED FEATURES

	DROP INLET CATCH BASIN
	FLARED END SECTION

PIPING AND UTILITIES

	AV/AR VALVE (IN PLAN) LOCATE ON SIDE SHOWN
	AV/AR VALVE (IN PROFILE)
	BLOWOFF (IN PLAN) LOCATE ON SIDE SHOWN
	BLOWOFF (IN PROFILE)
FH	FIRE HYDRANT (IN PLAN)
MH LID	MANHOLE (IN PLAN)
CO CO	CLEANOUT TO GRADE (IN PLAN)

ROADWORK AND PAVING

NOTES:

1. PAVING PATTERNS MAY ONLY APPEAR IN PORTIONS OF PAVED AREAS TO DEFINE LIMITS OF PAVING.
2. SEE ALSO GENERAL LEGEND FOR ADDITIONAL PAVING PATTERNS.

	ASPHALT (IN PLAN AND SECTION)
	CONCRETE CURB
	CONCRETE CURB AND GUTTER
	DRIVEWAY/ACCESS RAMP
x x x x x x x x x	WELDED WIRE FABRIC (IN SECTION)

CONTROL SYMBOLS

BM-XX	BENCH MARK
#	SITE COORDINATES (SEE TABLE ON DRAWINGS)
DESCRIPTION N XXXXXX.XX E XXXXXX.XX	SITE COORDINATES
	CONTROL POINT
	MONUMENT
FG XXX.XX	FINISHED ELEVATION/GRADE
EG XXX.X ±	EXISTING ELEVATION/GRADE
X	CURVE DATA (SEE TABLE ON DRAWINGS)

STRUCTURES

x x x	FENCE (CHAIN LINK)
	FENCE (WOOD)
	FENCE (SWING GATE)
	PROTECTIVE BARRIER
	PROTECTIVE BARRIER (REMOVABLE)
	STRUCTURE
	STRUCTURE (BELOW GRADE)

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United Water
CONSERVATION DISTRICT

CHIEF ENGINEER

PROJECT MANAGER

NO	REVISION	DATE	BY

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0 1"
0 25mm
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PRELIMINARY
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DESIGNED RJL
DRAWN CLL
CHECKED WCY

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1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030
PTP RECYCLED WATER CONNECTION
LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT

Kennedy Jenks

GENERAL CIVIL LEGEND

DWG: XX-###-###

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C-002

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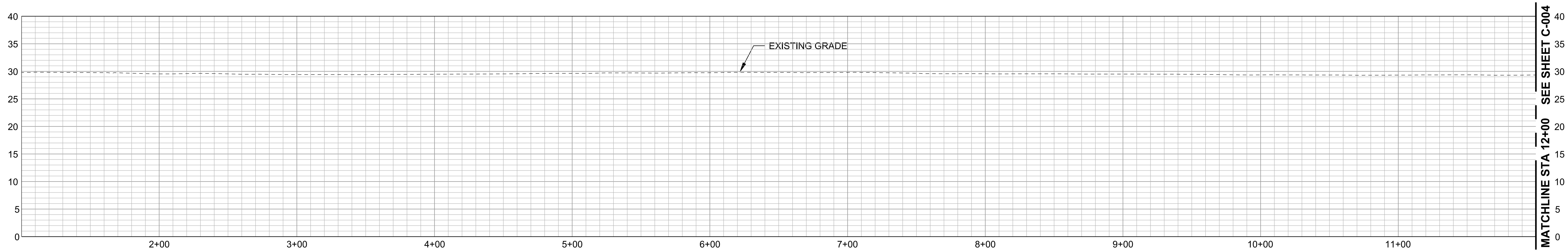
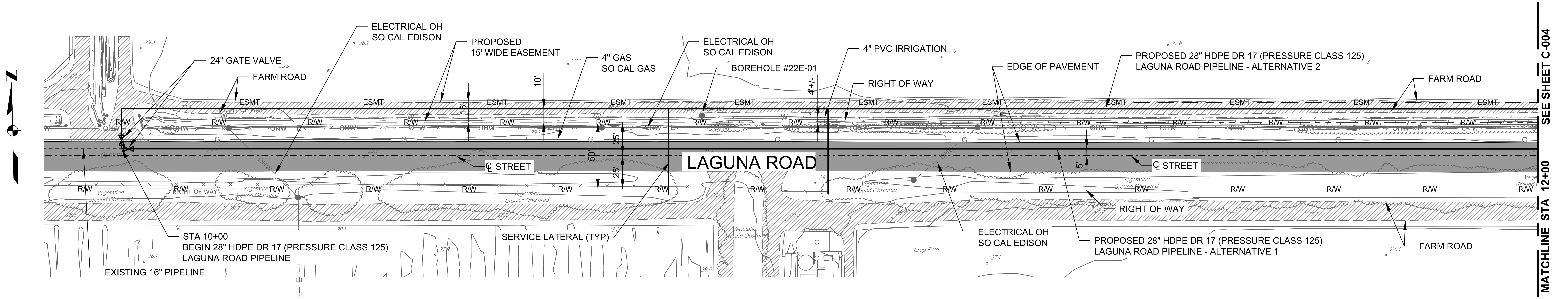


0 20 40 60
1"=40'

PROFILE

0 5 10 15
1"=10' VERT



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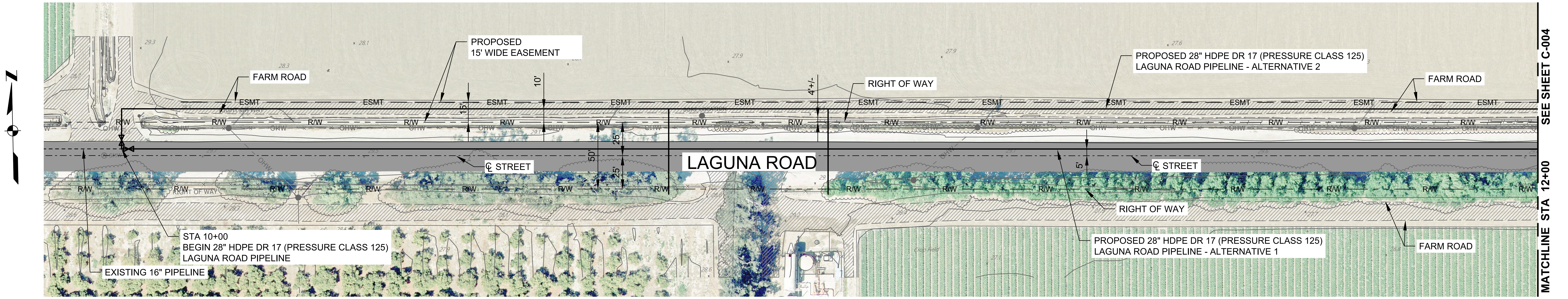
PLAN



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PLAN AND PROFILE - I

DWG: XX-###-###

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DATE 2023
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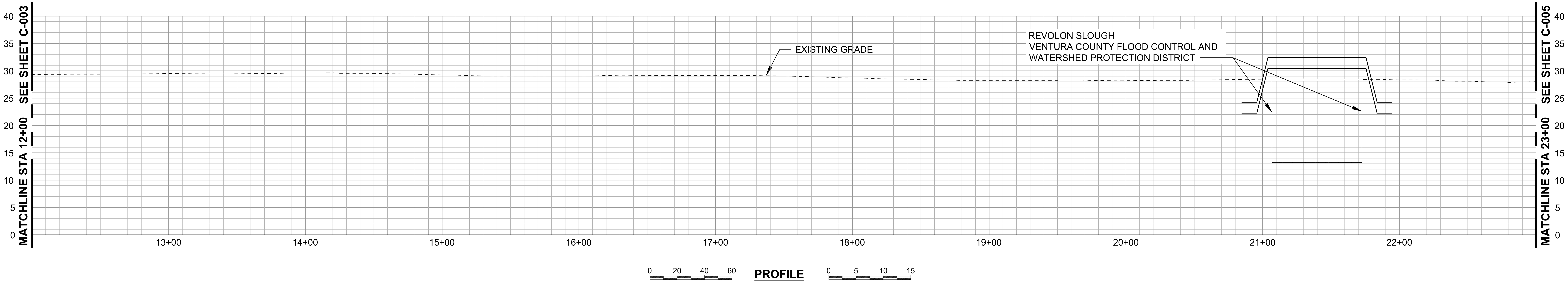
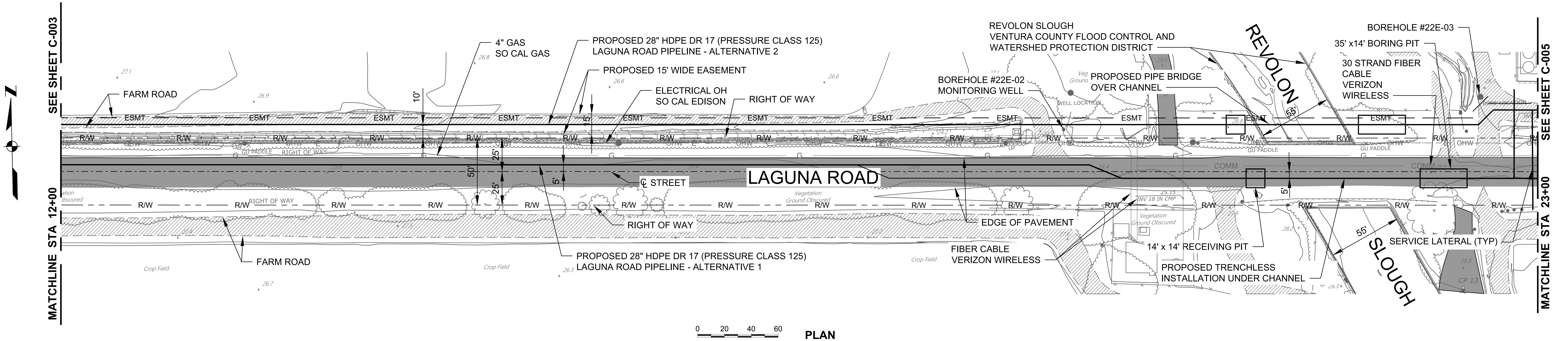


PROFILE



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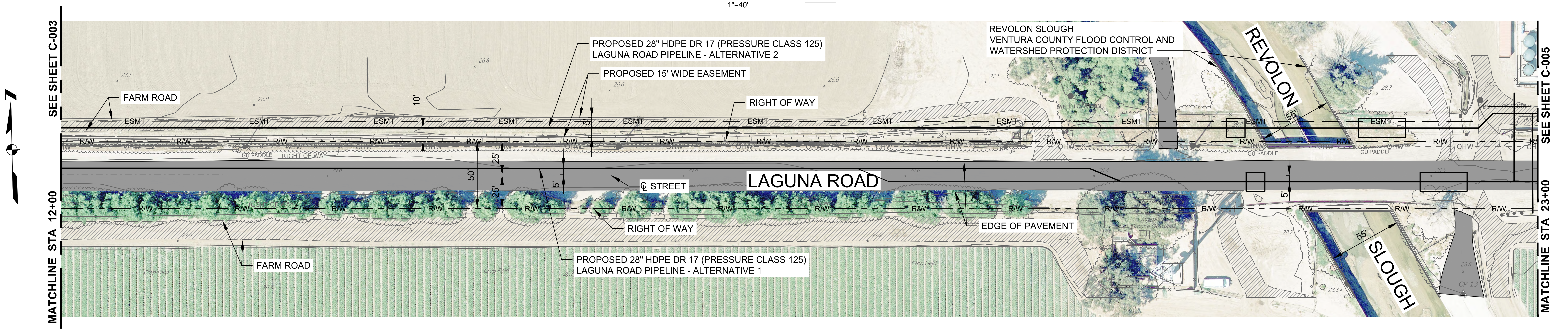

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United Water CONSERVATION DISTRICT

CHIEF ENGINEER

PROJECT MANAGER

NO	REVISION	DATE	BY

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0 25mm

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PRELIMINARY NOT FOR CONSTRUCTION

DESIGNED	RJL
DRAWN	CLL
CHECKED	WCY

UNITED WATER CONSERVATION DISTRICT
1701 NORTH LOMBARD STREET, SUITE 200, OXNARD, CA 93030

PTP RECYCLED WATER CONNECTION
LAGUNA RD PIPELINE PRELIMINARY DESIGN REPORT

Kennedy Jenks

PLAN AND PROFILE - II

DWG: XX-###-###

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2023

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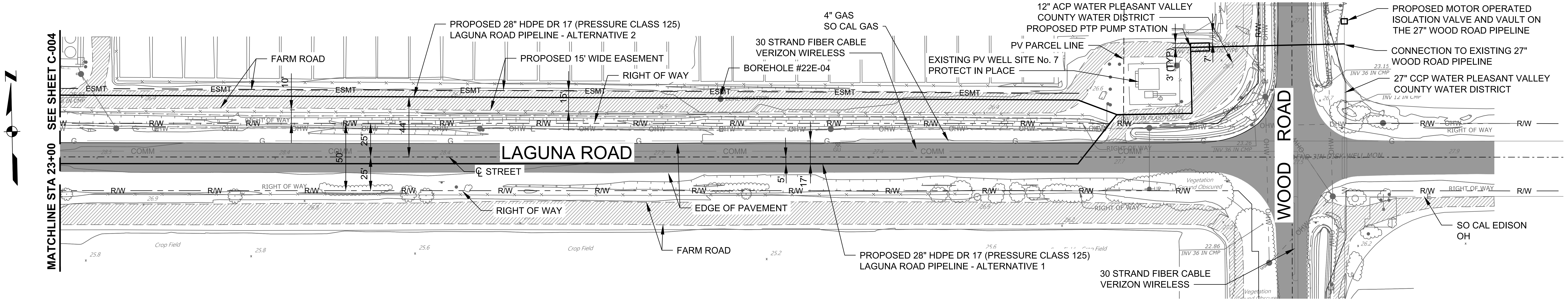
0 20 40 60
1"=40'

PROFILE

0 5 10 15
1"=10' VERT



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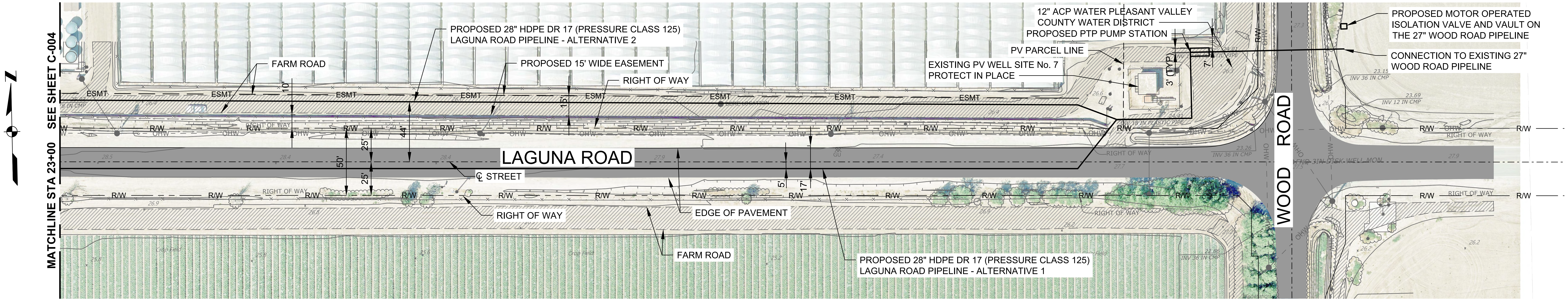
1"=40'

PLAN



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CONSERVATION DISTRICT

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Kennedy Jenks

PLAN AND PROFILE - III

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DATE 2023
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