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Nipomo Waterline Intertie Project

CONCEPT DESIGN REPORT APPENDICES

Volume 2 of 3

April 2009

Nipomo Waterline Intertie Project

Concept Design Report Appendices
Volume 2 of 3

Nipomo Community Community Services District

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General Manager	Bruce Buel
District Engineer	Peter Sevcik, PE
Utilities Superintendent	Tina Grietens

Nipomo Community Community Services District

Board of Directors

President	Jim Harrison
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Project Engineers	Josh Reynolds, PE
	Jon Hanlon, PE
	Cesar Romero, PE
	Kirk Gonzalez, PE
	Eileen Shields, EIT

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AECOM Subconsultants

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Wallace Group	Joe Morris, RLS

Horizontal Directional Drilling

Jacobs Associates	Craig Camp, PE

AECOM Subconsultants

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Firma	David Foote, ASLA

Permitting Support

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Appendix A
Technical Memorandum #9: System Pressure Reduction Study

Boyle Engineering
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Memorandum

Date:	September 23, 2008
To:	Peter Sevcik, PE
	Bruce Buel, General Manager
From:	Josh Reynolds, PE
	Eileen Shields, EIT
Subject:	NCSD Waterline Intertie Project Technical Memorandum No. 9: System Pressure Reduction Study

Introduction

The Waterline Intertie Project Preliminary Engineering Memorandum (PEM) (Boyle, May 2008) evaluates project alternatives for the transport and delivery of supplemental water from the City of Santa Maria to Nipomo's water distribution system. Two improvement phases were developed based on supplemental water inflow rates. Phase I improvements provide capacity for 1,300 gpm, and Phase II improvements were developed for 1,860 gpm (the maximum allowance from the City of Santa Maria per the 2005 Memo of Understanding).

Figure 1 displays the recommended Phase I and Phase II improvements as presented in the PEM. These improvements will afford the system capacity to handle 1,860 gpm. However, the introduction of supplemental water at the recommended point-of-connection (POC) (Orchard Road and Southland Street) increases already high pressures in the area.

To improve capacity and reduce pressures in the NCSD system, the PEM recommends improvements including upgrading the following water lines to a 12-inch diameter line: Southland Street, Orchard Street from Southland to Division, and Frontage Road from Southland to Tefft. To isolate customers from increased pressures, pressure regulators on individual service connections in the southern portion of Nipomo's water distribution system (Area A) are also recommended. For the purposes of this memorandum, this set of recommended improvements will be referred to as Option 1 (Figure 2).

Alternative Improvement Plan for NCSD System

As requested, Boyle has performed a preliminary hydraulic analysis to investigate an alternative improvement approach for reducing pressures in Area A. A separate pressure zone was evaluated instead of individual pressure regulators on the Area A service connections and the pipeline improvements recommended in the PEM were reevaluated with the new pressure zone in place. The same NCSD WaterCAD model as used for the Preliminary Engineering Memorandum was utilized to evaluate the feasibility of the new pressure zone. Two alternative boundaries for the pressure zone were developed and modeled separately as Option 2 and Option 3. Two additional alternatives, Options 4 and 5, utilize dedicated pipelines in addition to a new pressure zone.

Option 2. A parallel waterline along Orchard Road from Southland to Division Streets and four valves were added to the model to isolate Area B (Figure 3). An isolation valve was placed on Orchard and Southland to close the connection between the parallel and existing waterline. Two pressure reducing valve (PRV) stations were positioned: 1) on Frontage Road between Division Street and Martita Place, and 2) on the existing Orchard Road waterline between Story and Grande. Both PRV stations were set at a hydraulic grade of 520 ft (83 psi and 87 psi, respectively). A closed isolation valve was placed along the 6-inch waterline that runs across Belanger Dr. and Avenida Montecito Verde between Division and Story Streets.

Option 3. This option uses a parallel waterline along Orchard Road, running from Southland to Grande Avenue, with three PRV stations and three isolation valves to isolate Area C (Figure 4). The PRV stations were placed in the following locations: 1) on the existing Orchard Road waterline, north of Division Street 2) on Frontage Road South of Grande, and 3) on South Oakglen, between Darby Lane and Amado Street. The PRV stations were set to a hydraulic grade of 532 feet (78, 82, and 82 psi, respectively). Isolation valves were placed in the following positions: 1) at Orchard and Southland to close the connection between the parallel and existing waterline, 2) on Nopal Way, between Harrier Lane and Fir Place, and 3) on Avenida de Amigos.

Option 4. Option 4 utilizes the same improvements as Option 3, along with two 12-inch dedicated pipelines, a waterline improvement along Frontage Road from Grande to Tefft, and a fourth PRV station (Figure 5). One dedicated 12-inch pipeline runs parallel to the existing waterline in Southland Street. The second dedicated pipeline runs parallel to the existing Frontage Road waterline and ties in to the system at Grande Avenue. Both new pipelines were modeled to operate outside the new pressure zone (Area C). An existing 8-inch waterline in Frontage Road between Hill St and Tefft St will be replaced with a 12-inch pipeline, extending to Grande Avenue. A PRV station was added between the existing and dedicated lines along Southland, between Drumm Lane and Honey Grove Lane. All PRV stations were modeled at a hydraulic grade setting of 532 feet (78, 82, 82, and 94 psi, respectively).

Option 5a. Option 5a is similar to Option 4, but uses a different route to tie into the Tefft St waterline (Figure 6) and delays the Frontage Street waterline replacement from Grande Ave to Tefft St. Instead, dedicated lines will run along Southland and Frontage Rd to Grande. From the intersection of Division and Frontage a dedicated line crosses Highway 101 to Amado Street, runs along Amado St to South Oakglen and follows South Oakglen to the 16-inch waterline in Tefft Street. PRV stations and isolation valves are modeled in the same locations and settings as in Option 4 to create the Area C pressure zone.

Option 5b. Option 5b is the same as 5a, but takes a different route between Frontage Road and South Oakglen (Figure 7). Instead of crossing Highway 101 at Division, the alignment crosses at the intersection of Grande Ave and Frontage Rd and runs along Darby Lane to South Oakglen. It then follows South Oakglen to the 16-inch waterline in Tefft.

Model Conditions

All system improvement options were modeled under steady-state conditions with all wells off and tanks 75 % full. Two demand scenarios were run: average day demands[1] (2.67 mgd) for typical conditions, and 10 % of average day demands (0.27 mgd) to mimic low flow periods when pressures in the system are highest. Since NCSD system pressures are typically lower during times of higher demands, maximum and peak demand scenarios were not evaluated for this study. Based on recent correspondence between NCSD and the City of Santa Maria, a supplemental water inflow rate of 2,000-gpm was modeled. All Options were modeled with the existing water system infrastructure, except for the addition of the improvements discussed (i.e., no Master-planned improvements were added).

Model Results

The improvement options were evaluated based on resultant pressures in the PRV Zone and near Joshua and Orchard which is where the supplemental water pipeline from the pump station would connect to the existing line in Orchard Road. Pressure at Joshua and Orchard is indicative of the pressure required at the Waterline Intertie Project pump station.

For Option 1, service-side pressures in Area A will be dictated by the settings on the individual service pressure regulators. Options 2, 3, and 4 provide the advantage of also protecting pipelines within the separate pressure zones from elevated pressures.

Results indicate that Options 2 and 3 required higher pressures at Joshua and Orchard to deliver flow into the system than required for Option 1. The existing 12-inch pipeline - along Orchard Road between Joshua and Southland Streets - was designed to be constructed with Pressure Class 150 AWWA C900 PVC pipe. Option 2 increased the required pressure at Joshua and Orchard from 146 to 153 psi. In addition, Option 2 increased pressures in the residential area between Division Street, Jessica Place, and Beverly Drive by approximately 10 psi to levels between 96 and 105 psi. Option 3 reduced the pressures in the residential area, but required 160 psi at Joshua and Orchard to deliver flow into the system. The additional dedicated pipelines in Option 4 cause a reduction in pressure at Joshua and Orchard to 144 psi, near what is required in Option 1, and maintained residential area pressures to levels near or below existing. Options 5a and 5b provide similar residential pressures as with Option 4, and a slightly higher pressure requirement at Joshua and Orchard (147 instead of 144 psi). Table 1 summarizes the model results for each improvement scenario under ADD conditions and Table 2 summarizes results for 10 % ADD conditions. Resultant pressures are the same for Options 5a and 5b.

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[1] Average day demands as defined in the Water and Sewer Master Plan Update (Cannon, December 2007).

Table 1. Comparison of Pressure Ranges (psi)
for NCSD Water System Improvement Options under existing ADD

	Existing (Static Pressures)	Option 1 Individual pressure regulators	Option 2 PRV Zone B	Option 3 PRV Zone C	Option 4 PRV Zone C + dedicated lines & 4th sta.	Options 5a & 5b PRV Zone C + 4th sta. & dedicated lines to Tefft
Area A	93 – 100	98 – 107	–	–	–	–
Area B	85 – 100	–	77 – 91	–	–	–
Area C	64 – 100	–	–	61 – 97	61 – 97	61 – 97
Joshua & Orchard	105	146	153	160	144	147

Notes:

Option 1: Service-side pressures would be dictated by individual pressure regulator settings.
Option 2: Pressures calculated with PRVs set at hydraulic grade of 520 ft (83 & 87 psi).
Option 3: Pressures calculated with PRVs set at hydraulic grade of 532 ft (78, 82, & 82 psi).
Options 4 & 5: Pressures calculated with PRVs set at hydraulic grade of 532 ft (78, 82, 82, & 94 psi).

Table 2. Comparison of Pressure Ranges (psi)
for NCSD Water System Improvement Options under 10% existing ADD

	Existing Static Pressures	Option 1 Individual pressure regulators	Option 2 PRV Zone B	Option 3 PRV Zone C	Option 4 PRV Zone C + dedicated lines	Options 5a & 5b PRV Zone C + 4th sta. & dedicated lines to Tefft
Area A	96 – 103	100 – 109	–	–	–	–
Area B	88 – 103	–	77 – 91	–	–	–
Area C	66 – 103	–	–	61 – 98	61 – 98	61 – 98
Joshua & Orchard	107	148	158	165	150	151

Notes:

Option 1: Service-side pressures would be dictated by individual pressure regulator settings.
Option 2: Pressures calculated with PRVs set at hydraulic grade of 520 ft (83 & 87 psi).
Option 3: Pressures calculated with PRVs set at hydraulic grade of 532 ft (78, 82, & 82 psi).
Options 4 & 5: Pressures calculated with PRVs set at hydraulic grade of 532 ft (78, 82, 82, & 94 psi).

Fire Flow Analysis

A fire flow analysis was run to compare the fire flow availability under the preferred improvement options (Option 1, Option 4, and Option 5), with existing fire flow availability, and with the availability under improvements as recommended in the Water and Sewer Master Plan Update (Cannon Associates, December 2007). The analysis was conducted on the nodes contained in the new pressure zone created in Options 4 and 5 (Area C). The minimum required fire flow for the area is 1,500 gpm. A minimum residual pressure criterion of 20 psi was applied to the entire system except the nodes immediately adjacent to the Quad Tanks. Each scenario was modeled under steady-state conditions with maximum day demands[2] (4.53 mgd), all wells off, no supplemental water inflow, and tanks 75% full.

Fire Flow Results

The fire flow analysis indicated that during existing conditions 7 out of the 128 nodes tested in Area C fail to meet fire flow criteria. Under the Master-planned improvement scenario, one node failed to meet fire flow criteria. Under Option 1, three nodes failed. Under Options 4 and 5a, five nodes failed, and 4 nodes failed under Option 5b. Since available fire flows were within a few percentage points for 5a and 5b, they are considered to be equivalent within the expected accuracy of the model. These results are summarized in Table 3, below. All nodes failing fire flow criteria are at dead-ends.

Table 3. Summary of Fire Flow Availability for Nodes Failing to meet Fire Flow Criteria

Nodes with Fire Flow Availability Under 1500 gpm		Fire Flow Availability (gpm)					
		NCSD Water Distribution System Improvement Scenario					
WaterCAD Node Label	Location	Existing System	Master-Planned	Option 1	Option 4	Option 5a	Option 5b
J-610	January St & Juno Ct	**1,497**	1,637	1,521	**1,485**	**1,487**	1,501
J-1325	Ashland Ln	**1,348**	1,646	1,628	**1,451**	**1,459**	**1,464**
J-1586	End of Drumm Ln	**1,446**	1,966	1,992	1,791	1,809	1,811
J-4457	End of Juno Ct	**1,383**	1,503	**1,403**	**1,373**	**1,375**	**1,387**
J-5200	Division St @ January St	**1,391**	1,508	**1,411**	**1,381**	**1,383**	**1,395**
J-5277	End of Ashland Ln	**1,252**	**1,484**	**1,464**	**1,333**	**1,340**	**1,344**
J-6138	End of Widow Ln	**1,488**	2,059	2,076	1,833	1,851	1,854

[2] Maximum day demands as defined in the Water and Sewer Master Plan Update (Cannon, December 2007).

Conclusions

The introduction of supplemental water to the southern region of NCSD water distribution system increases already high pressures. One mitigation option is to add pressure regulators to approximately 200 individual services, as recommended in the Preliminary Engineering Memorandum. Another option is to isolate the high pressure area using valves and create a separate pressure zone. Though Option 2 effectively reduces pressures within the separate pressure zone, it causes an increase in pressures (to levels greater than 100 psi) between the northern zone boundary and Division Street. Therefore Option 3 was investigated as an expanded pressure zone to include Area B and the influenced area to the north. Because Options 2 and 3 require higher pump discharge pressures at Orchard and Joshua, the fourth Option included two dedicated waterlines along Southland and Frontage and an additional PRV station. Option 5a was investigated as a means to delay improvements along the section of Frontage between Division and Tefft, until plans to realign Frontage Road are formalized. Option 5b requires less new pipeline along South Oakglen Avenue.

The modeling indicates that a separate pressure zone is feasible and has the potential to protect infrastructure from increased pressures due to the inflow of supplemental water at Orchard and Southland. Under Option 1, the pressure at Orchard and Joshua ranges from 146 - 148 (when modeled with conditions as described). Pressures at Orchard and Joshua are increased with Options 2 and 3 (153 – 165 psi), causing increased electricity requirements at the pump station and high pressures for the existing Orchard Road waterline, which is rated for 150 psi[3]. The improvements modeled as Options 4 and 5 reduce pressures at Orchard and Joshua (144 – 151 psi) and protect services from high pressures, similar to the Option 1 improvements recommended in the PEM. However, the fire flow analysis indicates a higher number of nodes failing fire flow criteria under Options 4 and 5 improvements, than under Master-planned or Option 1 improvements. Five nodes under Options 4 and 5a, and four nodes under Option 5b have less than 1,500 gpm fire flow available, as opposed to three nodes under Option 1, or one node under master-planned improvements. All of these nodes are located at the ends of 6-inch water lines. When 8-inch pipe is added to the model to loop these dead ends, results indicate that all nodes in Area C meet minimum fire flow criteria for Options 1, 4, 5a, and 5b. Less than 800-feet total of 8-inch pipe to loop these dead ends would be required, but is not included in the cost opinion. Since the nodes are close to meeting the fire flow requirements, the District needs to determine if the projects are warranted. An opinion of probable construction cost for improvements under Options 1, 4, 5a, and 5b is summarized in Table 4, attached. Life-cycle costs would be similar because of the similar pressure conditions experienced at the pump station under all four Options (Tables 1 and 2).

Attachments:
- Figure 1. Project Components and Phasing (Preliminary Engineering Memorandum)
- Figure 2. NCSD System Improvements Option 1
- Figure 3. NCSD System Improvements Option 2
- Figure 4. NCSD System Improvements Option 3
- Figure 5. NCSD System Improvements Option 4
- Figure 6. NCSD System Improvements Option 5a
- Figure 7. NCSD System Improvements Option 5b
- Table 4. Opinion of Probable Construction Cost

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[3] The Orchard Road waterline pressure rating is based on Record Drawings for Orchard Road and Santa Maria Vista Waterlines (12-12-05). The pressure rating should be reevaluated, and perhaps tested, to ensure the Orchard Road waterline can sustain increased pressures from the supplemental water.

DWG: W:\Nipomo CSD (19996)\Waterline Intertie Project 19996.12\Phase 4 – UPDATE to Draft Prelim Engr Memo\CAD\Exhibits\Figure ES-1-rev.dwg USER: eshields
DATE: Aug 26, 2008 3:08pm XREFS: IMAGES: img20600389 Aerial Photo-LITE-SMALL.jpg

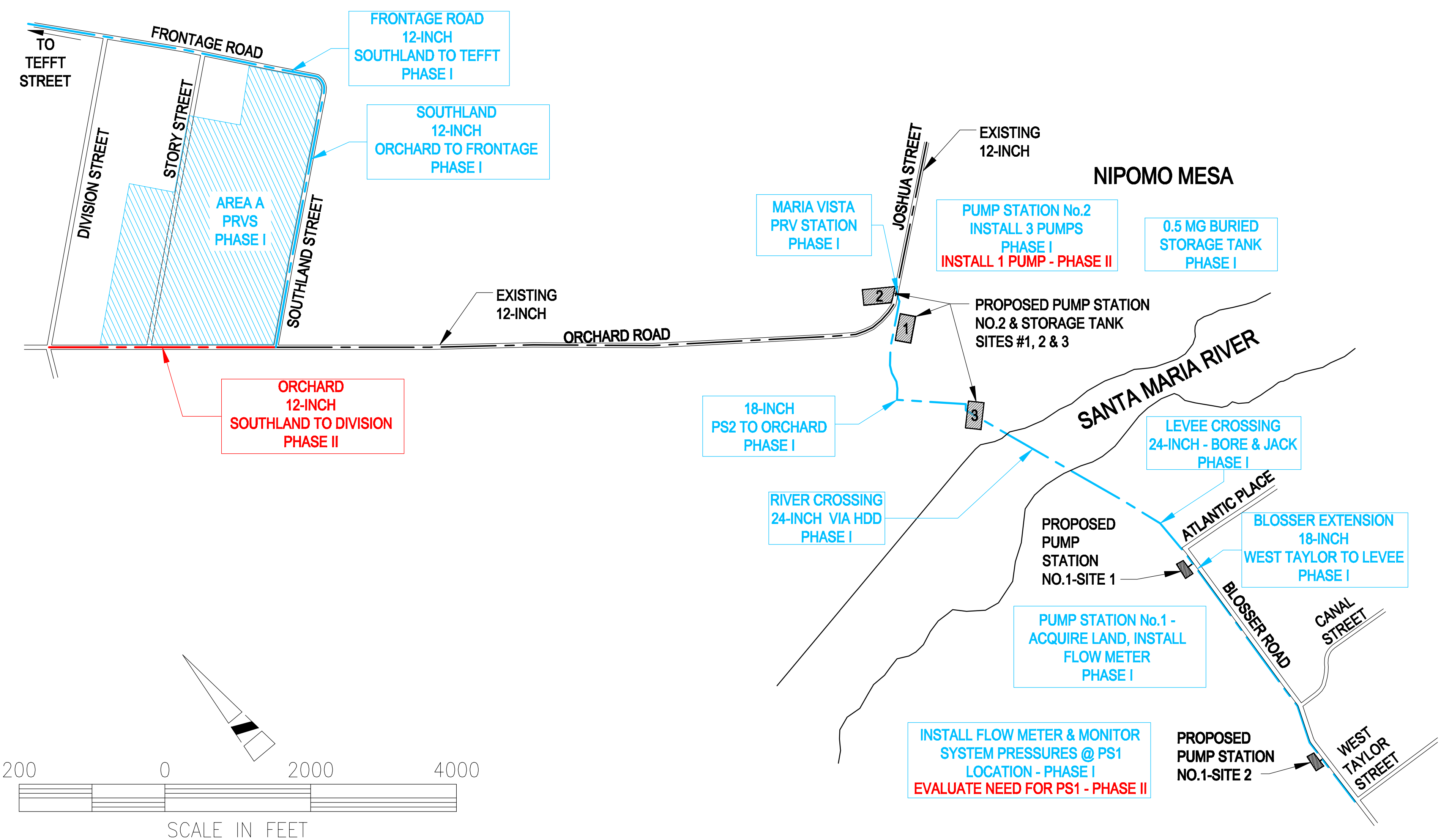


FIGURE 1	NCSD WATERLINE INTERTIE PROJECT COMPONENTS AND PHASING	BEC PROJECT NO. 19996.12	BOYLE ENGINEERING CORPORATION

Figure 2: NCSD System Improvements Option 1

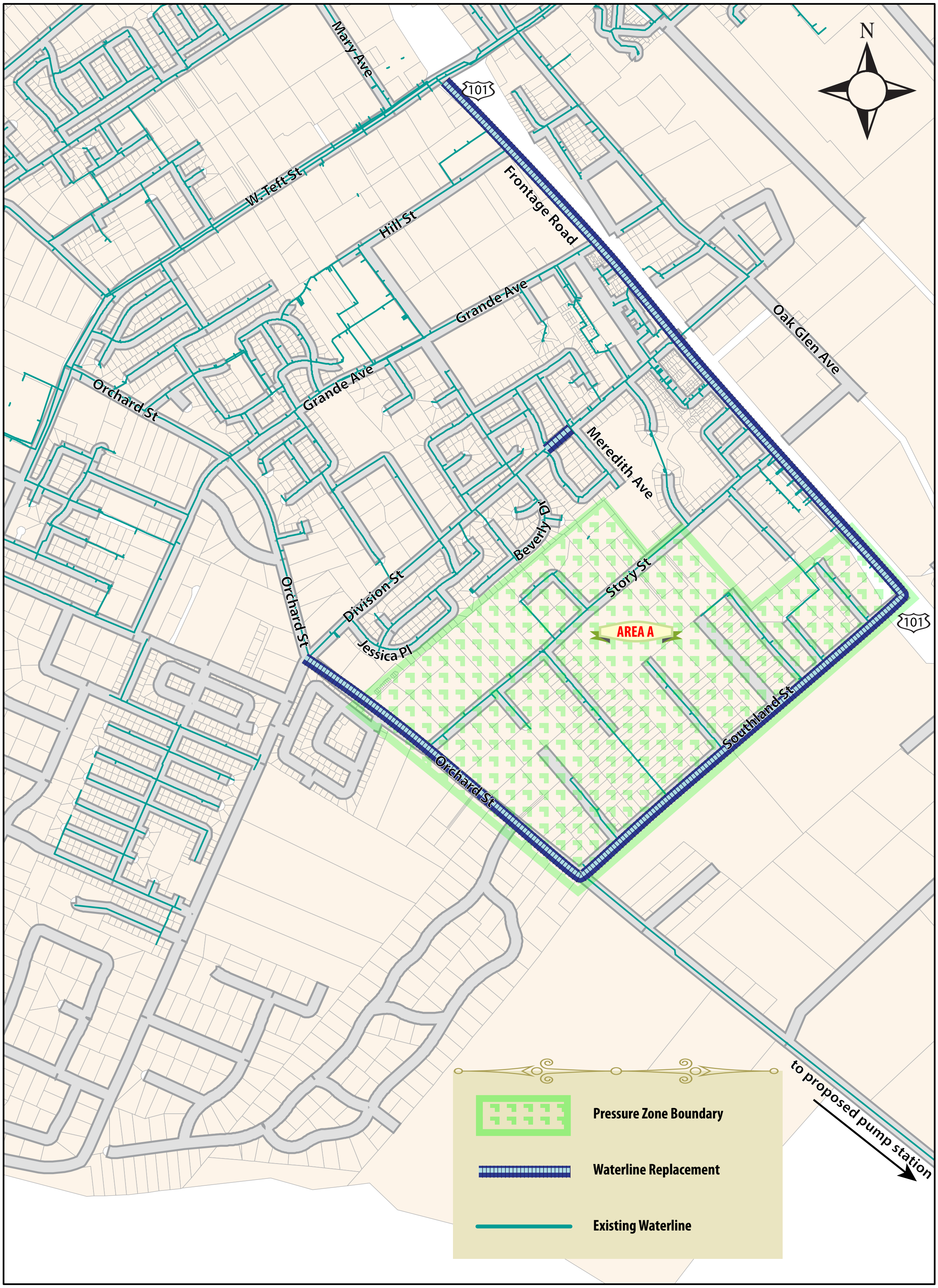


Figure 3: NCSD System Improvements Option 2

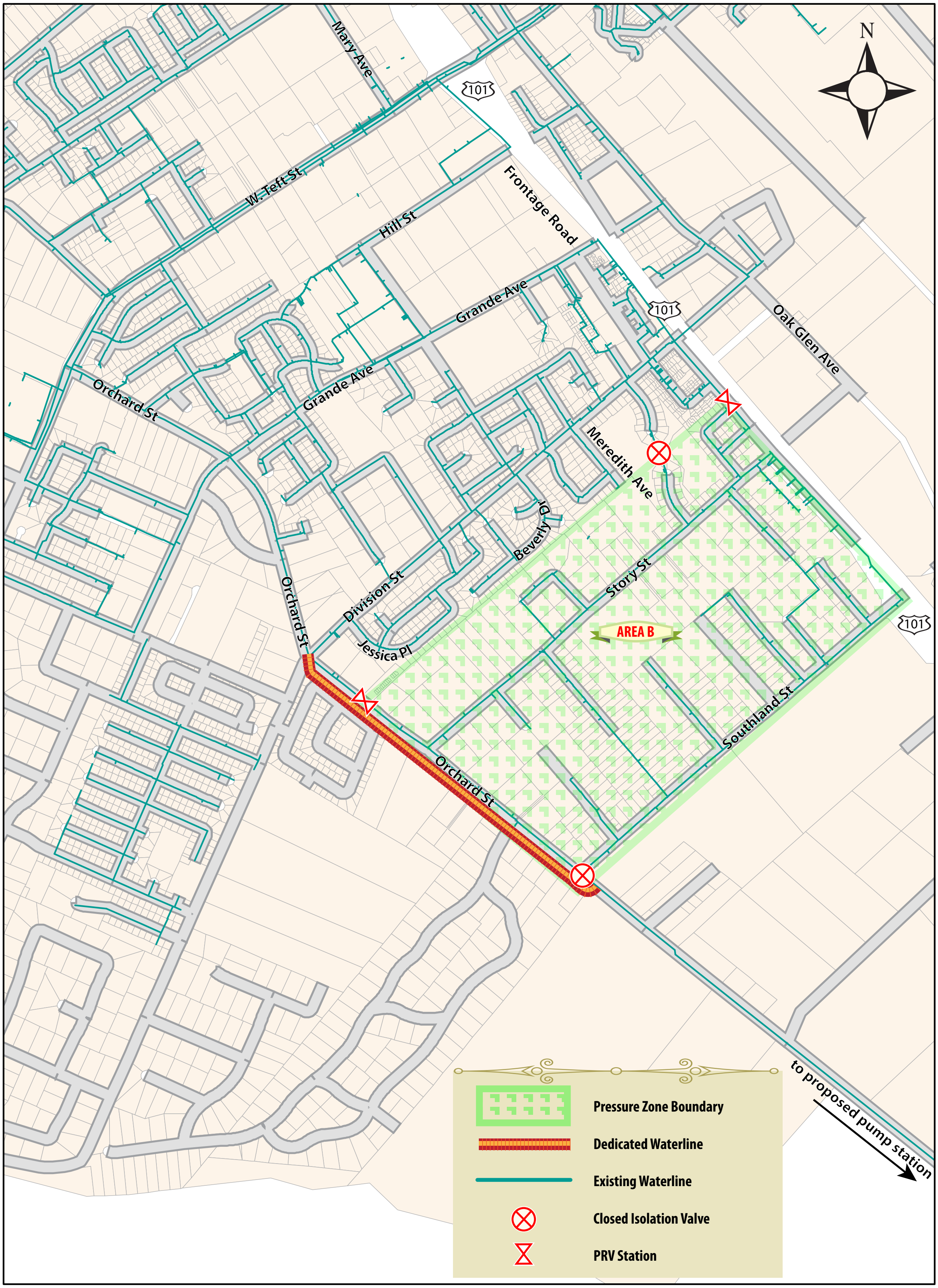


Figure 4: NCSD System Improvements Option 3

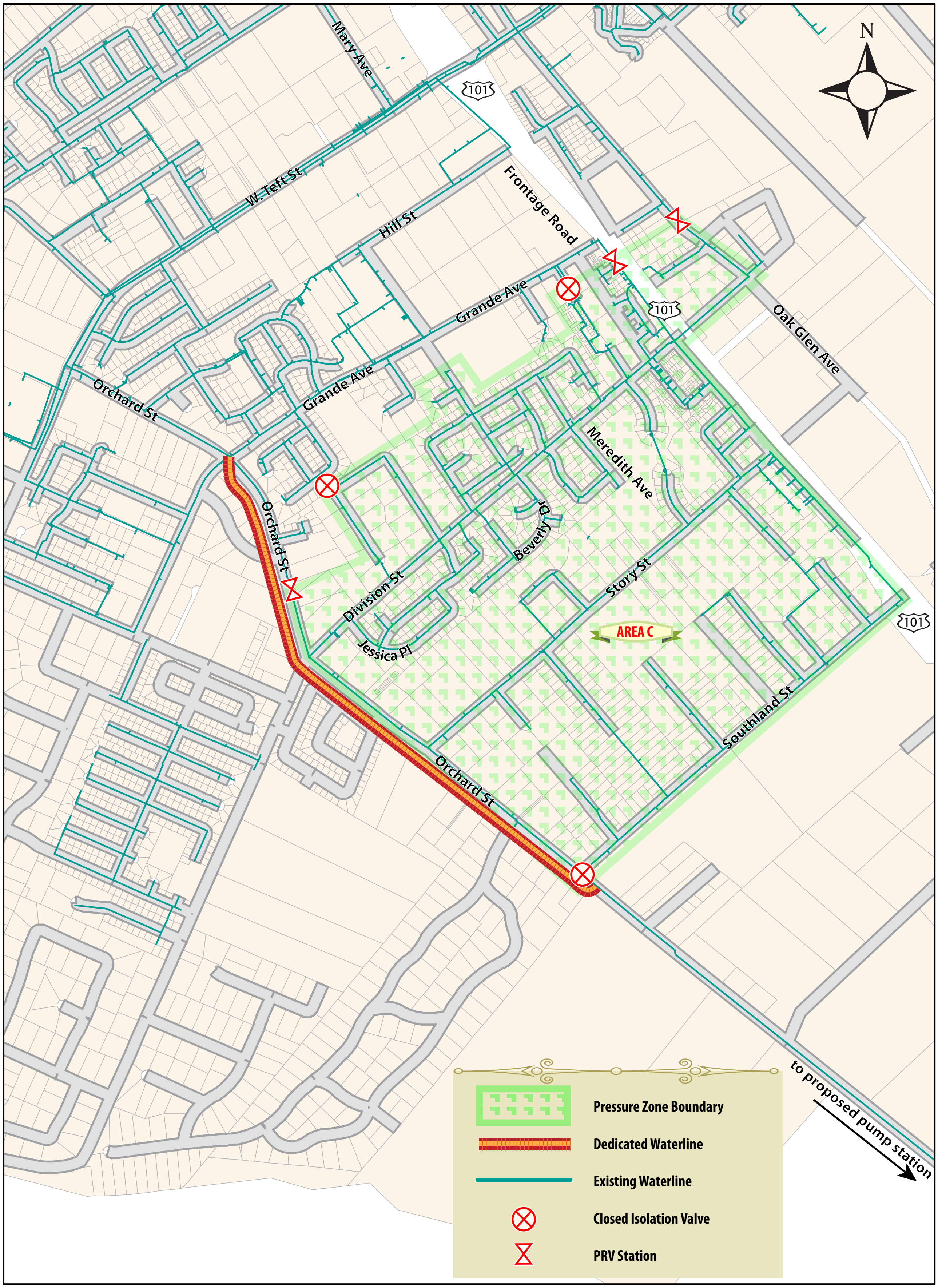


Figure 5: NCSD System Improvements Option 4

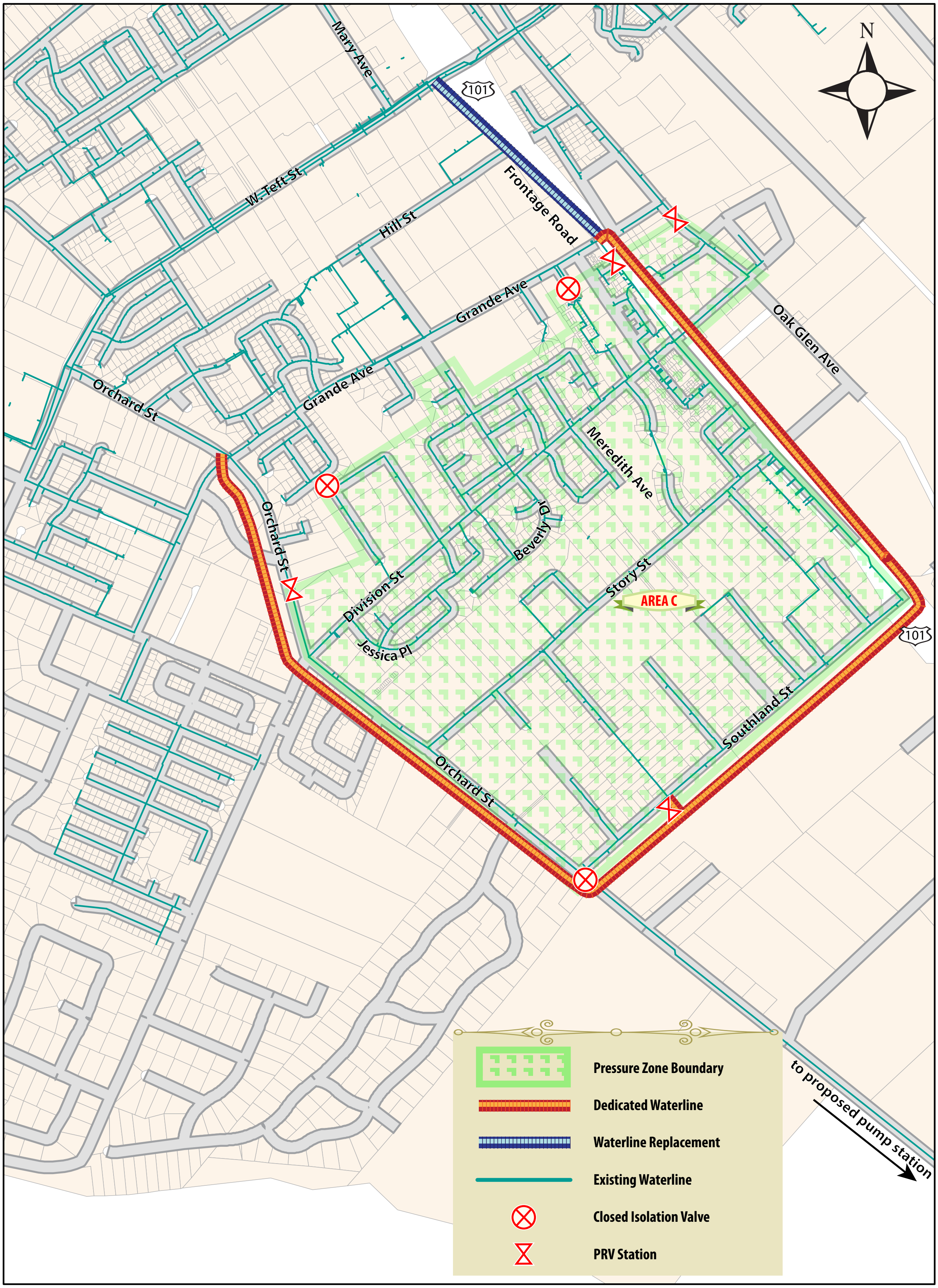


Figure 6: NCSD System Improvements Option 5a

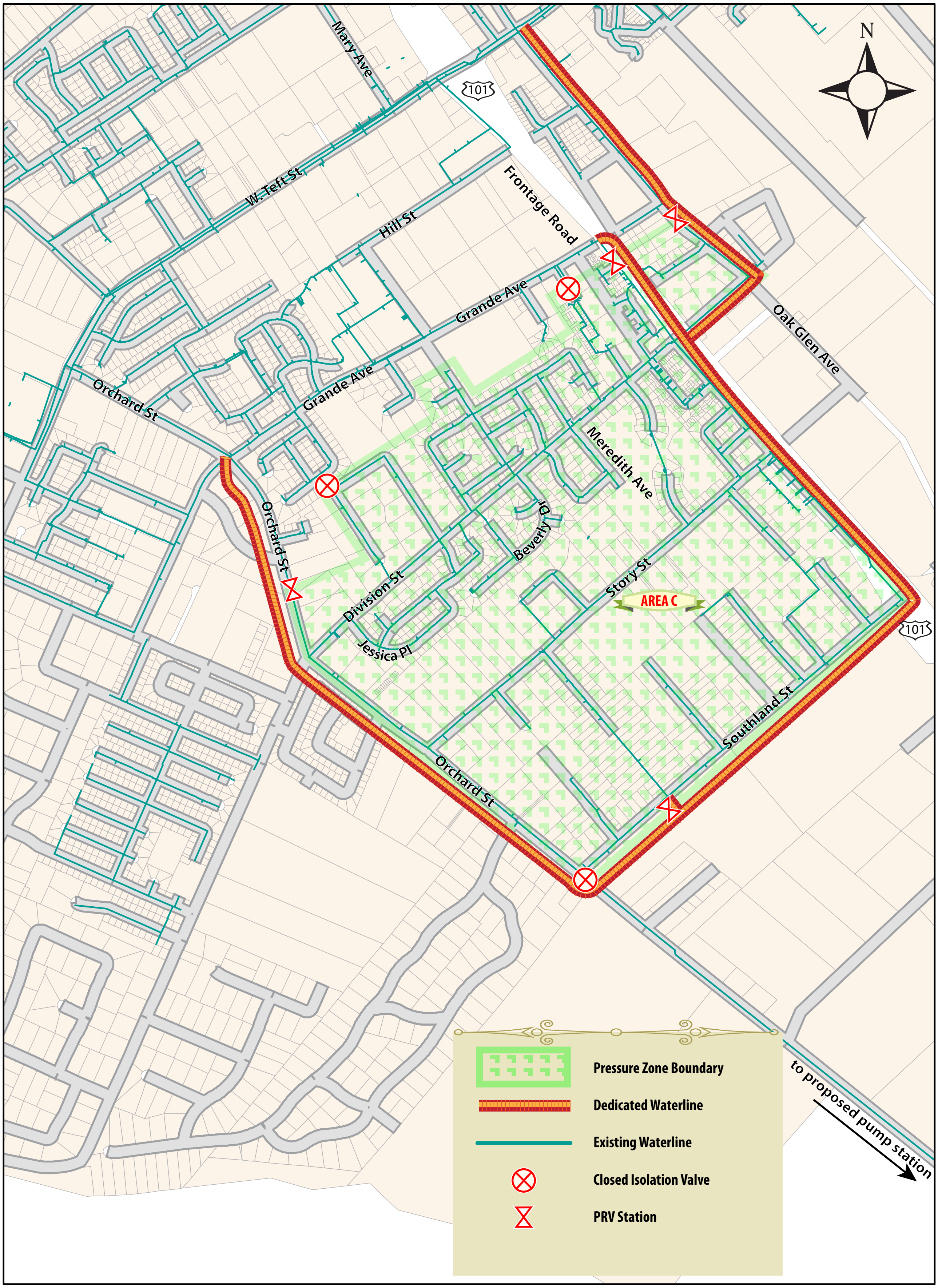


Figure 7: NCSD System Improvements Option 5b

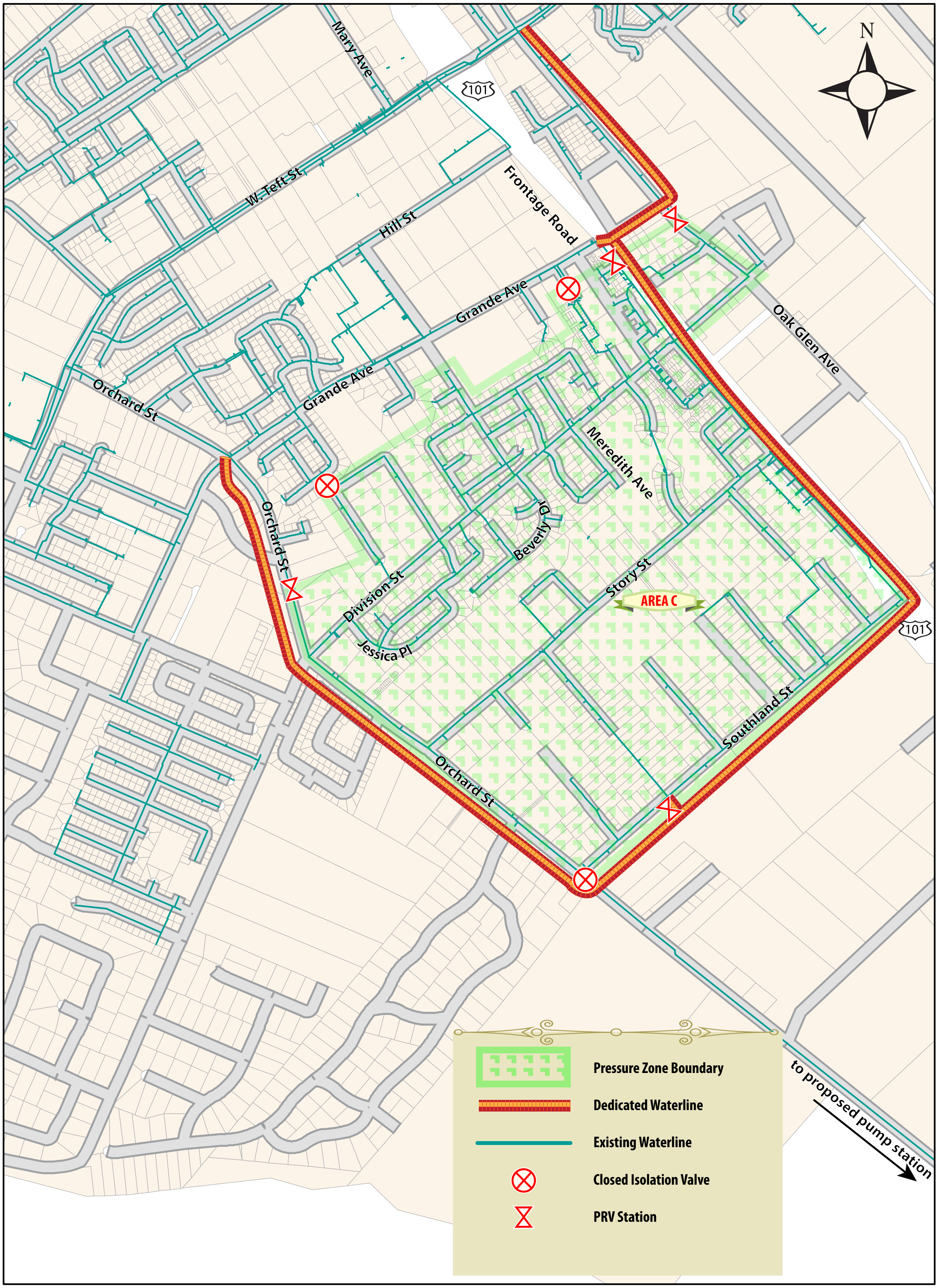


Table 4
Nipomo Community Services District
WATERLINE INTERTIE PROJECT
NCSD Water Distribution System Improvements
OPINION OF PROBABLE CONSTRUCTION COST

Supplemental Inflow Rate = 2,000 gpm

Item	Description	Quantity	Unit	Unit Price	Amount
	Option 1. As recommended in Preliminary Engineering Memorandum (Boyle, May 2008)				
1	Pressure regulators on individual services in Area A	200	EA	$200	$40,000
2	Southland St Incremental Upgrade 10" to 12"	3900	LF	$40	$156,000
3	Orchard Rd 12" Upgrade (Southland to Division)	3200	LF	$145	$464,000
4	Traffic Control for Orchard Rd	3200	LF	$7	$22,400
5	AC Pavement Overlay on Orchard Rd (assume 12-ft lane)	4267	YD^2	$36	$153,600
	Option 1 Subtotal				$836,000
	Master Planned Improvements *				
7	Southland St 10" Upgrade (Frontage to Orchard) *	3900	LF	$160	$624,000
8	Frontage Rd 12" Upgrade (Southland to Tefft) *	6470	LF	$200	$1,294,000
	Master planned Improvements Subtotal				$1,918,000
	Option 1 Adjusted Subtotal				$2,754,000
	Contingency	30%			$826,200
	Option 1 Total				$3,580,200

Item	Description	Quantity	Unit	Unit Price	Amount
	Option 4. PRV Zone with Dedicated Lines and Frontage Rd Improvements				
1	Parallel Orchard Rd waterline 12" (Southland to Grande)	5200	LF	$145	$754,000
2	Traffic Control	5200	LF	$7	$36,400
3	AC Pavement Overlay (assume 12-ft lane)	6933	YD^2	$36	$249,600
4	Parallel Southland St waterline 12"	3900	LF	$145	$565,500
5	Traffic Control	3900	LF	$7	$27,300
6	AC Pavement Overlay (assume 12-ft lane)	5200	YD^2	$36	$187,200
7	Parallel Frontage Rd waterline 12" (Southland to Tefft)	6470	LF	$145	$938,150
8	Traffic Control	6470	LF	$7	$45,290
9	AC Pavement Overlay (assume 12-ft lane)	8627	YD^2	$36	$310,560
10	Pressure Reducing Valve Station to isolate zone	4	EA	$18,000	$72,000
11	Isolation Valves to isolate zone	3	EA	$4,000	$12,000
	Option 4 Subtotal				$3,198,000
	Contingency	30%			$959,400
	Option 4 Total				$4,157,400

Notes:
Costs not included: Engineering and administration, mobililzation, pipeline to loop dead-end waterlines
Division Street upgrade (from Preliminary Engineering Memorandum) removed from Option 1, as determined already complete
* The Master Planned project costs presented in this table have been modified from the Master Plan and the Preliminary Engineering Memorandum to reflect Boyle's opinion of costs and to be consistent with the unit costs used in this comparative analysis. These unit costs include traffic control and pavement overlay for these Master Plan projects, whereas these items are separate in the other opinions.

Table 4
Nipomo Community Services District
WATERLINE INTERTIE PROJECT
NCSD Water Distribution System Improvements
OPINION OF PROBABLE CONSTRUCTION COST

Supplemental Inflow Rate = 2,000 gpm

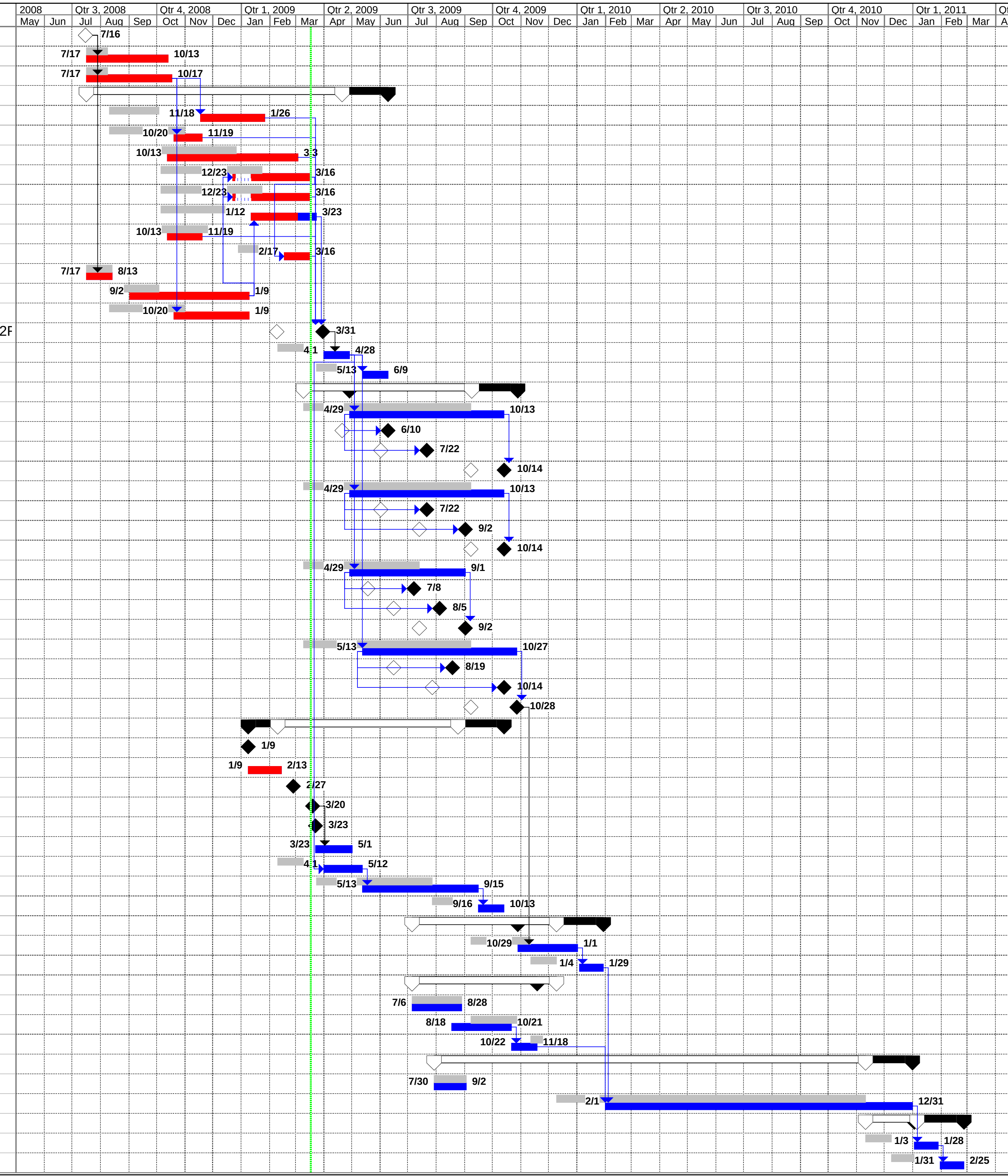
Item	Description	Quantity	Unit	Unit Price	Amount
Option 5a. PRV Zone with Dedicated Lines (limited Frontage Rd. Improvements, cross Hwy 101 @ Amado)					
1	Parallel Orchard Rd waterline 12" (Southland to Grande)	5200	LF	$145	$754,000
2	Traffic Control	5200	LF	$7	$36,400
3	AC Pavement Overlay (assume 12-ft lane)	6933	YD^2	$36	$249,600
4	Parallel Southland St waterline 12"	3900	LF	$145	$565,500
5	Traffic Control	3900	LF	$7	$27,300
6	AC Pavement Overlay (assume 12-ft lane)	5200	YD^2	$36	$187,200
7	Parallel Frontage Rd waterline 12" (Southland to Grande)	4400	LF	$145	$638,000
8	Traffic Control	4400	LF	$7	$30,800
9	AC Pavement Overlay (assume 12-ft lane)	5867	YD^2	$36	$211,200
10	Highway crossed with jacked casing & 12" carrier pipe	220	LF	$600	$132,000
11	Parallel Amado (cross Hwy 101) waterline 12"	680	LF	$145	$98,600
12	Traffic Control	680	LF	$7	$4,760
13	AC Pavement Overlay (assume 12-ft lane)	907	YD^2	$36	$32,640
14	Parallel S. Oakglen Ave waterline 12"	3200	LF	$145	$464,000
15	Traffic Control	3200	LF	$7	$22,400
16	AC Pavement Overlay (assume 12-ft lane)	4267	YD^2	$36	$153,600
17	Pressure Reducing Valve Station to isolate zone	4	EA	$18,000	$72,000
18	Isolation Valves to isolate zone	3	EA	$4,000	$12,000
	Option 5a Subtotal				$3,692,000
	Contingency	30%			$1,107,600
	Option 5a Total				$4,799,600
Option 5b. PRV Zone with Dedicated Lines (limited Frontage Rd. Improvements, cross Hwy 101 @ Darby)					
1	Parallel Orchard Rd waterline 12" (Southland to Grande)	5200	LF	$145	$754,000
2	Traffic Control	5200	LF	$7	$36,400
3	AC Pavement Overlay (assume 12-ft lane)	6933	YD^2	$36	$249,600
4	Parallel Southland St waterline 12"	3900	LF	$145	$565,500
5	Traffic Control	3900	LF	$7	$27,300
6	AC Pavement Overlay (assume 12-ft lane)	5200	YD^2	$36	$187,200
7	Parallel Frontage Rd waterline 12" (Southland to Grande)	4400	LF	$145	$638,000
8	Traffic Control	4400	LF	$7	$30,800
9	AC Pavement Overlay (assume 12-ft lane)	5867	YD^2	$36	$211,200
10	Highway crossed with jacked casing & 12" carrier pipe	220	LF	$600	$132,000
11	Parallel Darby (cross Hwy 101) waterline 12"	500	LF	$145	$72,500
12	Traffic Control	500	LF	$7	$3,500
13	AC Pavement Overlay (assume 12-ft lane)	667	YD^2	$36	$24,000
14	Parallel S. Oakglen Ave waterline 12"	2100	LF	$145	$304,500
15	Traffic Control	2100	LF	$7	$14,700
16	AC Pavement Overlay (assume 12-ft lane)	2800	YD^2	$36	$100,800
17	Pressure Reducing Valve Station to isolate zone	4	EA	$18,000	$72,000
18	Isolation Valves to isolate zone	3	EA	$4,000	$12,000
	Option 5b Subtotal				$3,436,000
	Contingency	30%			$1,030,800
	Option 5b Total				$4,466,800

Notes:
Costs not included: Engineering and administration, mobililzation, pipeline to loop dead-end waterlines
Division Street upgrade (from Preliminary Engineering Memorandum) removed from Option 1, as determined already complete
* The Master Planned project costs presented in this table have been modified from the Master Plan and the Preliminary Engineering Memorandum to reflect Boyle's opinion of costs and to be consistent with the unit costs used in this comparative analysis. These unit costs include traffic control and pavement overlay for these Master Plan projects, whereas these items are separate in the other opinions.

Appendix B
Project Schedule
(3/17/09)

NCSD WATERLINE INTERTIE PROJECT - Tue 3/17/09

ID	Task Name	Duration	Start	Finish	Predecessors
1	Kickoff meeting	1 day	Wed 7/16/08	Wed 7/16/08	
2	Right of Entry Agreements and Coordination	63 days	Thu 7/17/08	Mon 10/13/08	1
3	Permitting and Approvals for Field Work at River	67 days	Thu 7/17/08	Fri 10/17/08	1
4	**Concept Design Report**	**234 days**	**Thu 7/17/08**	**Tue 6/9/09**	
5	101 - Geotechnical Report for HDD Technical Memorandum	2.5 mons	Tue 11/18/08	Mon 1/26/09	3
6	102 - Project Bidding Strategy Technical Memorandum	1.15 mons	Mon 10/20/08	Wed 11/19/08	3
7	103 - Pipeline Alignment Technical Memorandum	102 days	Mon 10/13/08	Tue 3/3/09	
8	104 - Pump Station Design Technical Memorandum	2.45 mons	Tue 12/23/08	Mon 3/16/09	14
9	105 - Reservoir Design Technical Memorandum	2.45 mons	Tue 12/23/08	Mon 3/16/09	14
10	106 - Permitting Strategy Technical Memorandum	2.55 mons	Mon 1/12/09	Mon 3/23/09	14
11	107 - Chloramination Systems Technical Memorandum	1.4 mons	Mon 10/13/08	Wed 11/19/08	
12	108 - Back-up Power, Controls, and Instrumentation Technical Memorandum	1 mon	Tue 2/17/09	Mon 3/16/09	8FS-20 days
13	109 - Pressure Reduction Study	1 mon	Thu 7/17/08	Wed 8/13/08	1
14	110 - Survey and Base Map (by Wallace Group)	4.7 mons	Tue 9/2/08	Fri 1/9/09	
15	111 - Geotechnical Report (by Fugro)	3 mons	Mon 10/20/08	Fri 1/9/09	3
16	Draft Concept Report	1 day	Tue 3/31/09	Tue 3/31/09	5,6,7,8,9,10,11,12F
17	113 Review and Finalize Concept Design Report	1 mon	Wed 4/1/09	Tue 4/28/09	16
18	114 - Narrative Report	1 mon	Wed 5/13/09	Tue 6/9/09	17FS+10 days
19	**Construction Plans and Specifications**	**131 days**	**Wed 4/29/09**	**Wed 10/28/09**	
20	Bid Package 1 - HDD	6 mons	Wed 4/29/09	Tue 10/13/09	17
21	60% Submittal	1 day	Wed 6/10/09	Wed 6/10/09	20SS+1.5 mons
22	90% Submittal	1 day	Wed 7/22/09	Wed 7/22/09	20SS+3 mons
23	100% Submittal	1 day	Wed 10/14/09	Wed 10/14/09	20
24	Bid Package 2 - NCSD System Pipeline Improvements	6 mons	Wed 4/29/09	Tue 10/13/09	17
25	60% Submittal	1 day	Wed 7/22/09	Wed 7/22/09	24SS+3 mons
26	90% Submittal	1 day	Wed 9/2/09	Wed 9/2/09	24SS+4.5 mons
27	100% Submittal	1 day	Wed 10/14/09	Wed 10/14/09	24
28	Bid Package 3 - Blosser Road Water Main and Flow Meter	4.5 mons	Wed 4/29/09	Tue 9/1/09	17
29	60% Submittal	1 day	Wed 7/8/09	Wed 7/8/09	28SS+2.5 mons
30	90% Submittal	1 day	Wed 8/5/09	Wed 8/5/09	28SS+3.5 mons
31	100% Submittal	1 day	Wed 9/2/09	Wed 9/2/09	28
32	Bid Package 4 - Pump Station, Reservoir, and Chloramination Systems	6 mons	Wed 5/13/09	Tue 10/27/09	17
33	60% Submittal	1 day	Wed 8/19/09	Wed 8/19/09	32SS+3.5 mons
34	90% Submittal	1 day	Wed 10/14/09	Wed 10/14/09	32SS+5 mons
35	100% Submittal	1 day	Wed 10/28/09	Wed 10/28/09	32
36	**Permitting**	**198 days**	**Fri 1/9/09**	**Tue 10/13/09**	
37	End of EIR Public Review Period	1 day	Fri 1/9/09	Fri 1/9/09	
38	Preparation of Administrative Final EIR/Responses to Comments	1.3 mons	Fri 1/9/09	Fri 2/13/09	
39	Receipt of Comments from District on Final EIR	1 day	Fri 2/27/09	Fri 2/27/09	
40	Completion of Final EIR	1 day	Fri 3/20/09	Fri 3/20/09	
41	Completion of Findings of Fact	1 day	Mon 3/23/09	Mon 3/23/09	
42	Public Hearings/EIR Certification	1.5 mons	Mon 3/23/09	Fri 5/1/09	40
43	Complete and submit permit applications	30 days	Wed 4/1/09	Tue 5/12/09	17FS-1 mon
44	Coordinate with regulatory agencies	90 days	Wed 5/13/09	Tue 9/15/09	43
45	Acquire permits and incorporate in final design plans	20 days	Wed 9/16/09	Tue 10/13/09	44
46	**Standard Bid-Construct Process for Underground/Storage Work**	**67 days**	**Thu 10/29/09**	**Fri 1/29/10**	
47	Solicit Bids	2.35 mons	Thu 10/29/09	Fri 1/1/10	35
48	Award Bids	1 mon	Mon 1/4/10	Fri 1/29/10	47
49	**Turnkey Design-Build Process for HDD Work**	**98 days**	**Mon 7/6/09**	**Wed 11/18/09**	
50	Pre-Qualify Contractors	2 mons	Mon 7/6/09	Fri 8/28/09	
51	Solicit Bids	2.35 mons	Tue 8/18/09	Wed 10/21/09	
52	Award Bids	1 mon	Thu 10/22/09	Wed 11/18/09	51
53	**Construction**	**372 days**	**Thu 7/30/09**	**Fri 12/31/10**	
54	Retain Design Firm to Perform Engineering Services During Construction	5 wks	Thu 7/30/09	Wed 9/2/09	
55	Construct	12 mons	Mon 2/1/10	Fri 12/31/10	48,52
56	**Startup and Testing**	**40 days**	**Mon 1/3/11**	**Fri 2/25/11**	
57	Startup	1 mon	Mon 1/3/11	Fri 1/28/11	55
58	Testing	1 mon	Mon 1/31/11	Fri 2/25/11	57



Project: WIP Design Schedule
Date: Tue 3/17/09

Task	Milestone	Rolled Up Task	Rolled Up Baseline	Split	Project Summary
Progress	Baseline Milestone	Rolled Up Milestone	Rolled Up Baseline Milestone	Baseline Split	Group By Summary
Baseline	Summary	Baseline Summary	Rolled Up Progress	External Tasks	Deadline

AECOM

Appendix C
Example Request for Qualifications:
RFQ for Inverted Siphon No. 7 Replacement Project

RFQ for Inverted Siphon No. 7 Replacement Project

Ojai Sanitary District (AECOM, 2005)

Notice Inviting Pre-Qualification

Notice is hereby given that pre-qualification questionnaires to "pre-qualify" for the right to bid the Inverted Siphon No. 7 Replacement Project will be received by the Ojai Valley Sanitary District at their office located at 1072 Tico Road, Ojai, California before September 23, 2005, 4:00 p.m. The Inverted Siphon No. 7 Replacement Project includes construction of an inverted siphon beneath the San Antonio Creek to replace the previous siphon that was damaged/destroyed during the winter storms of 2005. The construction of the crossing will consist of Horizontal Directional Drilling (HDD) approximately 1650-feet across the San Antonio Creek and along Old Creek Road. The pipeline will be approximately 100-feet deep at the low point in the siphon. The estimate project cost is in the $2-3 M range. The anticipated schedule includes bids in mid-October 2005, award in October 2005, commence construction in early November 2005, and complete construction before January 1, 2006.

Pre-qualification questionnaires can be obtained from the District. Pre-qualification questionnaires shall be completed and enclosed in an envelope, sealed and clearly labeled with project title and name of contractor. Contractors seeking "pre-qualification" shall be Class A licensed within the state of California and shall be qualified with a minimum of 10 years experience in the installation of pipelines using Horizontal Directional Drilling as the method of installation. In order to be considered for "pre-qualification" on this project, contractors shall include the following information within the pre-qualification questionnaires:

- A list of at least five (5) Horizontal Directional Drilling Projects, each with a minimum length of 1000 L. F. of installed pipe with a minimum bore diameter of 24 inches using HDD as the method of installation.
- Said reference projects shall have been completed by the proposed contractor within the last ten (10) years.
- One of the referenced projects shall have utilized driven steel casing material.
- One of the referenced projects shall have been in comparable ground conditions to those anticipated on the project (gravelly alluvium between 25 and 75 feet deep and bedrock below 75 feet deep).
- The proposed project superintendent shall have at least 10 years of HDD experience and shall have managed at least 3 HDD projects in similar ground with drill lengths of 1000 feet of more.
- The proposed HDD operator and locator instrument operator shall have at least 10 years experience in the installation of pipelines using HDD as the method of installation. The operators shall have successfully completed a minimum of 5 pipeline projects each with a minimum of 1000 feet of installed pipe with a minimum bore diameter of 24 inches.
- The list of projects shall include:
    - The name and location of the project, the owner's name, address, contact person and telephone number.
    - The Architect and/or Engineer's name, address, contact person and telephone number.
    - The Construction Manager's name, address, contact person and telephone number.
    - A description of the project, scope of work performed, total value of construction, total value of change orders, construction duration, time extensions granted.
    - The name of the proposed project superintendent and proposed HDD operator and locator instrument operator and their resumes.

The District will apply a uniform system of rating pre-qualification respondents on objective criteria consistent with Department of Industrial Relations recommendations, on the basis of the completed questionnaires and financial statements to determine the qualified bidders list.

The District may refuse to grant pre-qualification where the requested information is incomplete or not received by September 23, 2005, 4:00 p.m. There is no appeal from a refusal for an incomplete or late application.

Where a timely and completed application results in a rating below that necessary to pre-qualify, an appeal can be made. An appeal is begun by the Contractor delivering notice to the District of its appeal of the decision with respect to its pre-qualification rating, no later than ten business days after the Notice of Determination is issued. Without a timely appeal, the Contractor waives any and all rights to challenge to decision of the District, whether by administrative process, judicial process, or any other legal process or proceeding.

If the Contractor gives the required notice of appeal and requests a hearing, the hearing shall be conducted so that it is concluded within fourteen business days after the District's receipt of the notice of appeal. The hearing shall be an informal process conducted by a panel to which the District has delegated responsibility to hear such appeals (the "Appeals Panel"). At or prior to the hearing, the Contractor will be advised of the basis for the District's pre-qualification determination. The Contractor will be given the opportunity to present information and present reasons in opposition to the rating. After the conclusion of the hearing, the Appeals Panel will render its decision. It is the intention of the District that the date for the submission and opening of bids will not be delayed or postponed to allow for completion of an appeal process.

The questionnaires and financial statements shall not be public records and shall not be open to public inspection; however, records of the names of the contractors applying for pre-qualification status shall be public records subject to disclosure.

The information given by contractors seeking pre-qualification is provided with the understanding that the intentional providing of false information is grounds for disqualification.

To request a Pre-Qualification questionnaire, contact Bob Stein of Boyle Engineering Corporation at (805) 644-9704.

Dated this 1st day of September 2005.

Ojai Valley Sanitary District, California

John K Correa

John K. Correa, General Manager

C:\Documents and Settings\CorreaJ\Local Settings\Temporary Internet Files\OLK1\Notice Inviting Pre-Qual.doc

Ojai Valley Sanitary District
Inverted Siphon No. 7 Replacement

Project Information

Ojai Valley Sanitary District owns and operates the wastewater collection system for the Ojai Valley and adjacent areas. During the heavy winter storms of 2005 portions of the sewer system were severely damaged. On January 9, 2005 portions of pipeline downstream of Siphon No. 7 were washed out or severely damaged due to flooding on San Antonio Creek. This pipeline conveys essentially all of the sewage from the Town of Ojai. Within a short time, temporary pipelines were installed and service was restored. Currently, a temporary pipeline is buried on the east side of Old Creek Road, replacing the pipelines that were damaged or destroyed in the flooding.

The Ojai Valley Sanitary District (OVSD) plans to replace the damaged and destroyed portions of pipeline, and construct a new inverted siphon beneath the creek, installing the facilities at sufficient depth and with other protective measures to protect it from future flood events. Siphon No. 7 (prior to damage) conveyed sewer flows from Manhole 26 to Manhole 25; the new siphon will transmit sewer flows a greater distance.

The start point is just downstream of existing Manhole 27 and will convey flows under the creek and return to gravity flow near Manhole 22 (see Exhibit 2). The total project, including both siphon and gravity-flow pipelines, will extend for approximately 1800 feet starting from existing Manhole 27 (located on Creek Road, approximately 3200 feet northeast of the Creek Road/Hwy 33 intersection) to just downstream of existing Manhole 22 (located in Old Creek Road to the south-southwest).

Construction of the siphon portion of the project will be performed using the horizontal directional drilling (HDD) process. At the low point, the pipeline may be more than 100 feet deep, founded in the bedrock of the Monterey Foundation. On the southern end of the siphon, loose sandy-gravelly material will be encountered, which may necessitate the driving of a larger casing to prevent the HDD from caving and to prevent the excess loss of drilling fluid.

At the upstream side of the siphon, there will be a hydraulic structure capable of diverting flows to the various carrier pipes. This structure will also include provisions for launching cleaning "pigs" into the siphon pipes from inside the structure.

At the downstream side of the siphon, another hydraulic structure will be used to channel the flows from the various carrier pipes into a single gravity flow pipe.

The anticipated project schedule is completion of design in September 2005, bid in mid October 2005, commence construction November 1, 2005, and complete construction prior to January 1, 2006.

HDD contractors interested in the project will need to complete the District's prequalification requirements to become eligible to submit a bid for the project.

Subsurface Conditions

Materials encountered by the drill holes advanced at the OVSD Siphon No. 7 site consisted of artificial fill materials, alluvial sediments, and bedrock of the Monterey Formation.

Artificial Fill (af)

The artificial fill materials observed in the vicinity of the proposed crossing project consisted of asphalt concrete and base materials along Old Creek Road and loose fine- to coarse-grained soil materials with cobbles, rock fragments, organics, and construction debris associated with backfill of low areas eroded by storm flows south and east of San Antonio Creek. The fill materials appeared to have been dumped and loosely spread about the site. Also, OVSD has indicated that a buried rock-filled gabion structure is located creek-side of Old Creek Road.

Artificial fill materials were encountered in all of the drill holes advanced for the Siphon No. 7 crossing study south of San Antonio Creek (DH-1 through DH-3, DH-5, and DH-6). Artificial fill materials were not encountered by DH-4 advanced on the northern side of the creek. The artificial fill materials encountered in the drill holes consisted of about 3 to 7 feet of loose silty sand with gravel and sand with gravel with varying amounts of cobbles, rocks, organic material, and debris.

Alluvium (Qal)

The alluvial sediments encountered by the drill holes consisted predominately of loose granular sediments that caved readily during open-hole (mud-rotary) drilling. ODEX (casing advance) drilling techniques were subsequently employed to alleviate caving alluvial soil conditions.

Thickness of the alluvium interpreted from the drill holes and geophysical survey data ranges from less than 10 feet near the valley walls to about 70 feet (+/- 20%) near the active channel. The granular materials sampled and interpreted from the drill cuttings and drilling characteristics consisted of sand, clayey sand, silty sand, sandy silt, gravel, cobbles, and boulders. Alluvial sediments observed in the creek channel consisted of sand with gravel and cobbles to greater than 3 feet in diameter.

Monterey Formation (Tm)

The Monterey Formation bedrock consists of highly weathered, highly to extensively fractured, thinly interbedded siltstone and diatomaceous siltstone with lesser amounts of siliceous (well indurated) siltstone and sandstone. The project vicinity is characterized by north to northeast-trending geologic structure (synclines, anticlines, and faults) with bedrock that dips primarily to the southeast at about 30 to 65 degrees.

The Monterey Formation is a hydrocarbon-bearing/producing formation. Hydrocarbon and sulfur odors were noted and oil staining/seeps were observed in samples recovered during drilling.

Groundwater

San Antonio Creek was flowing at the time of the August 2005 field exploration. Groundwater was encountered in each of the 6 drill holes advanced for the study at depths of between about 7 to 10 feet. The creek level and groundwater conditions will vary seasonally due to changes in runoff, storm conditions, rainfall and other factors. Groundwater should be anticipated during construction of the project.

Ojai Valley Sanitary District

Inverted Siphon No. 7 Replacement

Pre-Qualification Questionnaire
For Horizontal Directional Drilling Specialty Contractors

CONTACT INFORMATION

Firm Name: ______________________ Check One: ☐ Corporation
(as it appears on license) ☐ Partnership
☐ Sole Prop.

Contact Person: ____

Address: ____

Phone: ____________________ Fax: ____________________

If firm is a sole proprietor or partnership:

Owner(s) of Company: ____

Contractor's License Number(s):

____

____

____

PART I. ESSENTIAL REQUIREMENTS FOR PRE-QUALIFICATION

1. Contractor possesses a valid and current California Contractor's license for the project or projects for which it intends to submit a bid.
   ☐ Yes ☐ No

2. Contractor has a liability insurance with a combined single policy limit per occurrence of $2,000,000 for both Comprehensive and Broad Form General Liability.
   ☐ Yes ☐ No

3. Contractor has current workers' compensation insurance policy as required by the Labor Code or is legally self-insured pursuant to Labor Code section 3700 et. seq.
   ☐ Yes ☐ No ☐ Contractor is exempt from this requirement, because it has no employees

4. Have you attached your latest copy of a <u>reviewed</u> or <u>audited</u> financial statement with accompanying notes and supplemental information. [1 3]
   ☐ Yes ☐ No

   NOTE: A financial statement that is not either reviewed or audited is not acceptable. A letter verifying availability of a line of credit may also be attached; however, it will be considered as supplemental information only, and is not a substitute for the required financial statement.

5. Have you attached a notarized statement from an admitted surety insurer (approved by the California Department of Insurance) and authorized to issue bonds in the State of California, which states: (a) that your current bonding capacity is sufficient for the project for which you seek pre-qualification if you are seeking pre-qualification for a single project; or (if you are seeking pre-qualification valid for a year) (b) your current available bonding capacity? [4]
   ☐ Yes ☐ No

   NOTE: Notarized statement must be from the surety company, not an agent or broker.

6. Has your contractor's license been revoked at any time in the last five years? [2]
   ☐ Yes ☐ No

---

[1] A "no" answer to question 4 will not be disqualifying if the contractor is exempt from complying with question 4, for reasons explained in footnote 3.

[2] A contractor disqualified solely because of a "yes" answer given to question 6, 7, or 9 may appeal the disqualification and provide an explanation for the relevant circumstances during the appeal procedure.

[3] Public contract Code section 20101(3) exempts from this requirement a contractor who has qualified as a small business pursuant to Government Code section 14837(d)(1), if the bid is "no more than 25 percent of the qualifying amount provided in section 14837(d)(1)." As of January 1, 2001, the qualifying amount is $10 million, and 25 percent of that amount, therefore, is $2.5 million.

[4] An additional notarized statement from the surety may be requested by *Public Entity* at the time of submission of a bid, if this pre-qualification package is submitted more than 60 days prior to submission of the bid.

7. Has a surety firm completed a contract on your behalf, or paid for completion because your firm was default terminated by the project owner within the last five (5) years? [2]
☐ Yes ☐ No

8. At the time of submitting this pre-qualification form, is your firm ineligible to bid on or be awarded a public works contract, or perform as a subcontractor on a public works contract, pursuant to either Labor Code section 1777.1 or Labor Code section 1777.7?
☐ Yes ☐ No
If the answer is "Yes," state the beginning and ending dates of the period of debarment:

____

9. At any time during the last five years, has your firm, or any of its owners or officers been convicted of a crime involving the awarding of a contract of a government construction project, or the bidding or performance of a government contract? [2]
☐ Yes ☐ No

[2] A contractor disqualified solely because of a "yes" answer given to question 6, 7, or 9 may appeal the disqualification and provide an explanation for the relevant circumstances during the appeal procedure.

PART II PRE-QUALIFICATION QUESTIONS

<u>Questions about History of the Business and Organizational Performance</u>
(16 questions)

1. How many years has your organization been in business in California as a contractor under your present business name and license number? ______ Years

2. Is your firm currently the debtor in a bankruptcy case?
☐ Yes ☐ No

3. Was your firm in bankruptcy any time during the last five years? (This question refers only to a bankruptcy action that was not described in answer to question 7, above).
☐ Yes ☐ No

4. Has any CSLB license held by your firm or its Responsible Managing Employee (RME) or Responsible Managing Officer (RMO) been suspended within the last five years?
☐ Yes ☐ No

5. At any time in the last five years, has your firm been assessed and paid liquidated damages after completion of a project, under a construction contract with either a public or private owner?
☐ Yes ☐ No

6. In the last five years has your firm, or any firm with which any of your company's owners, officers or partners was associated, been debarred, disqualified, removed or otherwise prevented from bidding on, or completing, any government agency or public works project for any reason?
☐ Yes ☐ No

NOTE: "Associated with" refers to another construction firm in which an owner, partner or officer of your firm held a similar position, and which is listed in response to question 1c or 1d on this form.

7. In the last five years, has your firm been denied an award of a public works contract based on a finding by a public agency that your company was not a responsible bidder?
☐ Yes ☐ No

NOTE: The following two questions refer only to disputes between your firm and the owner of a project. You need not include information about disputes between your firm and a supplier, another contractor, or subcontractor. You need not include information about "pass-through" disputes in which the actual dispute is between a sub-contractor and a project owner. Also, you may omit reference to all disputes about amounts of less than $50,000.

8. In the past five years, has any claim **<u>against</u>** your firm concerning your firm's work on a construction project, been **<u>filed in court or arbitration</u>**?
☐ Yes ☐ No

9. In the past five years, has your firm made any claim against a project owner concerning work on a project or payment for a contract, and **filed that claim in court or arbitration**?
☐ Yes ☐ No

10. At any time during the past five years, has any surety company made any payments on your firm's behalf as a result of a default, to satisfy any claims made against a performance or payment bond issued on your firm's behalf in connection with a construction project, either public or private?
☐ Yes ☐ No

11. In the last five years, has any insurance carrier, for any form of insurance, refused to renew the insurance policy for your firm?
☐ Yes ☐ No

12. Has your firm, or any of its owners, officers, or partners ever been found liable in a civil suit, or found guilty in a criminal action, for making any false claim or material misrepresentation to any public agency or entity?
☐ Yes ☐ No

13. Has your firm, or any of its owners, officers or partners ever been convicted of a crime involving any federal, state, or local law related to construction?
☐ Yes ☐ No

14. Has your firm or any of its owners, officers or partners ever been convicted of a federal or state crime of fraud, theft, or any other act of dishonesty?
☐ Yes ☐ No

15. If your firm was required to pay a premium of more than one per cent for a performance and payment bond on any project(s) on which your firm worked at any time during the last three years, state the percentage that your firm was required to pay. You may provide an explanation for a percentage rate higher than one per cent, if you wish to do so.
__________________%

16. During the last five years, has your firm ever been denied bond credit by a surety company, or has there ever been a period of time when your firm had no surety bond in place during a public construction project when one was required?
☐ Yes ☐ No

Questions about compliance with safety, workers compensation, prevailing wage and apprenticeship laws.
(11 questions)

1. Has CAL OSHA cited and assessed penalties against your firm for any "serious," "willful" or "repeat" violations of its safety or health regulations in the past five years?
☐ Yes ☐ No

Note: If you have filed an appeal of a citation and the Occupational Safety and Health Appeals Board has not yet ruled on your appeal, you need not include information about it.

2. Has the federal Occupational Safety and Health Administration cited and assessed penalties against your firm in the past five years?
☐ Yes ☐ No
If yes, attach a separate signed page describing each citation.

Note: If you have filed an appeal of a citation and the appropriate appeals Board has not yet ruled on your appeal, you need not include information about it.

3. Has the EPA or any Air Quality Management District or any Regional Water Quality Control Board cited and assessed penalties against either your firm or the owner of a project on which your firm was the contractor, in the past five years?
☐ Yes ☐ No

NOTE: If you have filed an appeal of a citation and the Appeals Board has not yet ruled on your appeal, or if there is a court appeal pending, you need not include information about the citation.

4. How often do you require documented safety meetings to be held for construction employees and field supervisors during the course of a project?

____

5. List your firm's Experience Modification Rate (EMR) (California workers' compensation insurance) for each of the past three premium years:

Current year: ___________________
Previous year: ___________________
Year prior to previous year: ___________________
If your EMR for any of these three years is or was 1.00 or higher, you may, if you wish, attach a letter of explanation.

NOTE: An Experience Modification Rate is issued to your firm annually by your workers' compensation insurance carrier.

6. Within the last five years, has there ever been a period when your firm had employees but was without workers' compensation insurance or state-approved self-insurance?
☐ Yes ☐ No

7. Has there been more than one occasion during the last five years on which your firm was required to pay either back wages or penalties for your own firm's failure to comply with the **state's** prevailing wage laws?
☐ Yes ☐ No

NOTE: This question refers only to your own firm's violation of prevailing wage laws, not to violations of the prevailing wage laws by a subcontractor.

8. During the last five years, has there been more than one occasion on which your own firm has been penalized or required to pay back wages for failure to comply with the **federal** Davis-Bacon prevailing wage requirements?

☐ Yes ☐ No

9. Provide the **name, address and telephone number** of the apprenticeship program sponsor(s) (approved by the California Division of Apprenticeship Standards) that will provide apprentices to your company for use on any public work project for which you are awarded a contract by *[Public Entity]*.

____

____

10. If your firm operates its own State-approved apprenticeship program:

a. Identify the craft or crafts in which your firm provided apprenticeship training in the past year.

b. State the year in which each such apprenticeship program was approved, and attach evidence of the most recent California Apprenticeship Council approval(s) of your apprenticeship program(s).

c. State the number of individuals who were employed by your firm as apprentices at any time during the past three years in each apprenticeship and the number of persons who, during the past three years, completed apprenticeships in each craft while employed by your firm.

11. At any time during the last five years, has your firm been found to have violated any provision of California apprenticeship laws or regulations, or the laws pertaining to use of apprentices on public works?.

☐ Yes ☐ No.

If yes, provide the date(s) of such findings, and attach copies of the Department's final decision(s).

NOTE: You may omit reference to any incident that occurred prior to January 1, 1998 if the violation was by a subcontractor and your firm, as general contractor on a project, had no knowledge of the subcontractor's violation at the time they occurred

Part III **PROJECT EXPERIENCE (Project 1)**

Questions concerning recent construction projects completed:

1. Contractor shall provide information about five (5) Horizontal Directional Drilling projects completed within the last 10 years, each of which shall incorporate a minimum drilling length of 1000-feet and a minimum diameter of 24-inches. Names and references must be current and verifiable. Use separate sheets of paper that contain all of the following information:

Project Name: ______________________________

Location: ______________________________

Owner:

Owner Contact (name and current phone number):

____

____

Architect or Engineer: ______________________________

____

____

Architect or Engineer Contact (name and current phone number):

____

____

Construction Manager (name and current phone number):

____

____

Total Value of Construction: ______________________________

Total Value of Change Orders: ______________________________

Original Construction Contract Duration: ______________________________

Original Contract Completion Date: ______________________________

Actual Date of Completion: ______________________________

Scope of Work Performed:

Provide a description of the work performed including the following work items. Include equipment manufacturers and suppliers, sub-contractors, special construction methods, etc.

Horizontal Directional Drilling Length:

____

____

____

Horizontal Directional Drilling Diameter

____

Casing Material

Ground Conditions

Superintendent

HDD Operator

Part III PROJECT EXPERIENCE (Project 2)

Questions concerning recent construction projects completed:

1. Contractor shall provide information about five (5) Horizontal Directional Drilling projects completed within the last 10 years, each of which shall incorporate a minimum drilling length of 1000-feet and a minimum diameter of 24-inches. Names and references must be current and verifiable. Use separate sheets of paper that contain all of the following information:

Project Name: ______________________________

Location: ______________________________

Owner:

Owner Contact (name and current phone number):

____

____

Architect or Engineer: ______________________________

____

____

Architect or Engineer Contact (name and current phone number):

____

____

Construction Manager (name and current phone number):

____

____

Total Value of Construction: ______________________________

Total Value of Change Orders: ______________________________

Original Construction Contract Duration: ______________________________

Original Contract Completion Date: ______________________________

Actual Date of Completion: ______________________________

Scope of Work Performed:

Provide a description of the work performed including the following work items. Include equipment manufacturers and suppliers, sub-contractors, special construction methods, etc.

Horizontal Directional Drilling Length:

____

____

____

Horizontal Directional Drilling Diameter

Casing Material

Ground Conditions

Superintendent

HDD Operator

Part III PROJECT EXPERIENCE (Project 3)

Questions concerning recent construction projects completed:

1. Contractor shall provide information about five (5) Horizontal Directional Drilling projects completed within the last 10 years, each of which shall incorporate a minimum drilling length of 1000-feet and a minimum diameter of 24-inches. Names and references must be current and verifiable. Use separate sheets of paper that contain all of the following information:

Project Name: ____________________

Location: ____________________

Owner:

Owner Contact (name and current phone number):

____

____

Architect or Engineer: ____________________

____

____

Architect or Engineer Contact (name and current phone number):

____

____

Construction Manager (name and current phone number):

____

____

Total Value of Construction: ____________________

Total Value of Change Orders: ____________________

Original Construction Contract Duration: ____________________

Original Contract Completion Date: ____________________

Actual Date of Completion: ____________________

Scope of Work Performed:

Provide a description of the work performed including the following work items. Include equipment manufacturers and suppliers, sub-contractors, special construction methods, etc.

Horizontal Directional Drilling Length:

____

____

____

Horizontal Directional Drilling Diameter

Casing Material

Ground Conditions

Superintendent

HDD Operator

Part III **PROJECT EXPERIENCE (Project 4)**

Questions concerning recent construction projects completed:

1. Contractor shall provide information about five (5) Horizontal Directional Drilling projects completed within the last 10 years, each of which shall incorporate a minimum drilling length of 1000-feet and a minimum diameter of 24-inches. Names and references must be current and verifiable. Use separate sheets of paper that contain all of the following information:

Project Name: ______________________________
Location: ______________________________
Owner:
Owner Contact (name and current phone number):

____
____

Architect or Engineer: ______________________________
____
____

Architect or Engineer Contact (name and current phone number):

____
____

Construction Manager (name and current phone number):

____
____

Total Value of Construction: ______________

Total Value of Change Orders: ______________

Original Construction Contract Duration: ______________

Original Contract Completion Date: ______________

Actual Date of Completion: ______________

Scope of Work Performed:

Provide a description of the work performed including the following work items. Include equipment manufacturers and suppliers, sub-contractors, special construction methods, etc.

Horizontal Directional Drilling Length:

____
____
____

Horizontal Directional Drilling Diameter

Casing Material

Ground Conditions

Superintendent

HDD Operator

Part III PROJECT EXPERIENCE (Project 5)

Questions concerning recent construction projects completed:

1. Contractor shall provide information about five (5) Horizontal Directional Drilling projects completed within the last 10 years, each of which shall incorporate a minimum drilling length of 1000-feet and a minimum diameter of 24-inches. Names and references must be current and verifiable. Use separate sheets of paper that contain all of the following information:

Project Name: ____________________
Location: ____________________
Owner:
Owner Contact (name and current phone number):

____
____

Architect or Engineer: ____________________
____
____

Architect or Engineer Contact (name and current phone number):

____
____

Construction Manager (name and current phone number):

____
____

Total Value of Construction: ____________________

Total Value of Change Orders: ____________________

Original Construction Contract Duration: ____________________

Original Contract Completion Date: ____________________

Actual Date of Completion: ____________________

Scope of Work Performed:

Provide a description of the work performed including the following work items. Include equipment manufacturers and suppliers, sub-contractors, special construction methods, etc.

Horizontal Directional Drilling Length:

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____
____

Horizontal Directional Drilling Diameter

Casing Material

Ground Conditions

Superintendent

HDD Operator

EXHIBIT-2

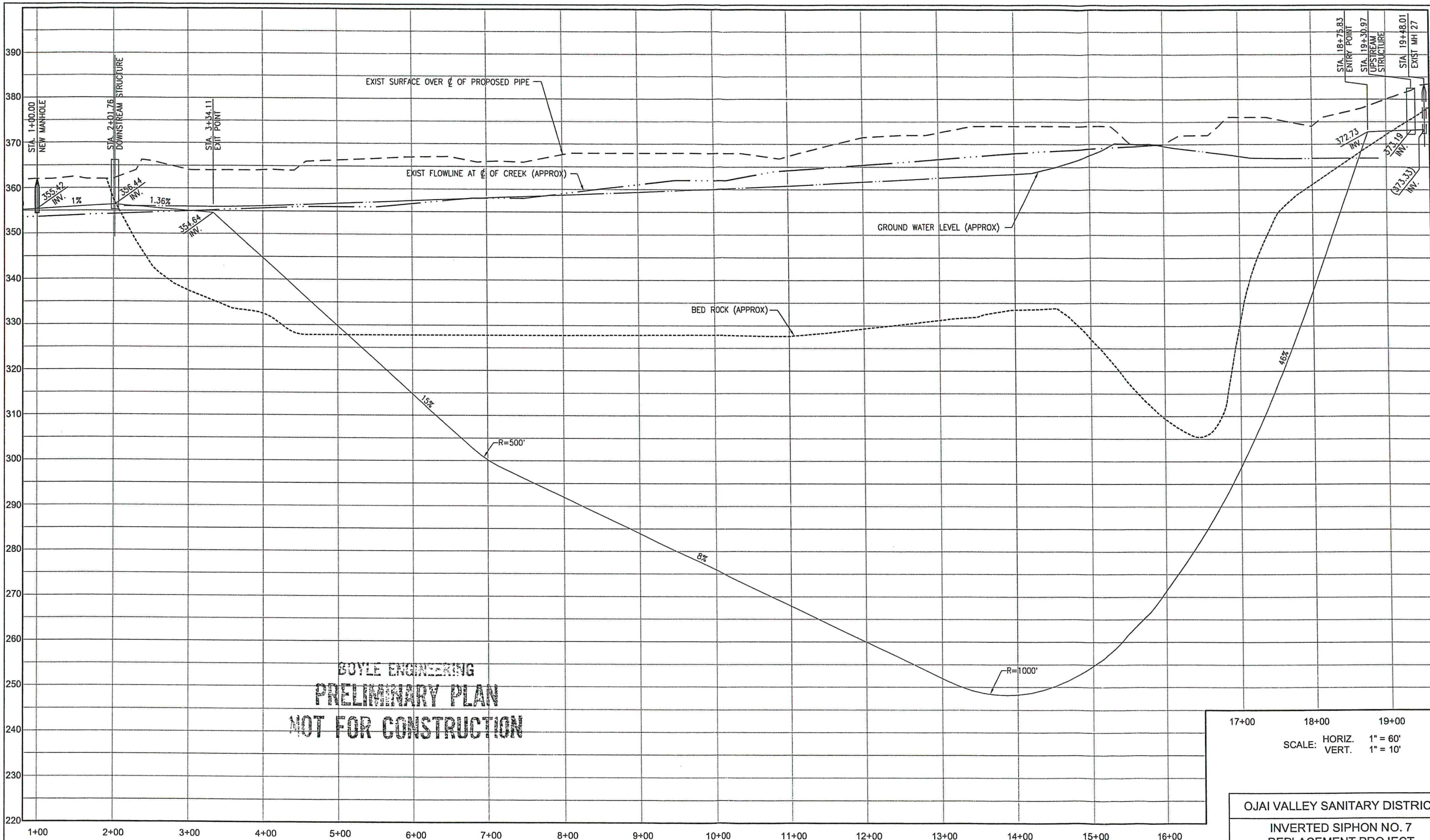
OJAI VALLEY SANITARY DISTRICT

"INVERTED SIPHON #7 REPLACEMENT"

BOYLE

BOYLE ENGINEERING
PRELIMINARY PLAN
NOT FOR CONSTRUCTION

9-1-05



SCALE: HORIZ. 1" = 60'
VERT. 1" = 10'

DWG: F:\ellison\00510101 Inverted Siphon\CAD\Planset\C-002 PROF.dwg USER: frizzo
DATE: Sep 01, 2005 10:27am XREFS: C-BD IMAGES: OVSD_new2003.jpg

REGISTERED PROFESSIONAL ENGINEER ROBERT D. ELLISON NO. C 38094 EXP. 3/31/07 CIVIL STATE OF CALIFORNIA

BOYLE ENGINEERING CORPORATION
5851 Thille St. Suite 201
Ventura, California 93003
805-644-9704
WWW.BOYLEENGINEERING.COM

OJAI VALLEY SANITARY DISTRICT

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

REV	DATE	DESCRIPTION	APPROVED
1	9-1-05		

OJAI VALLEY SANITARY DISTRICT

INVERTED SIPHON NO. 7 REPLACEMENT PROJECT

SIPHON PROFILE

DESIGN	DRAWN	CHECKED	C.A. NO.	DRAWING NO.	SHEET
RDE	AJR	R.C.E.		DATE	C-2

Appendix D
Santa Maria River Crossing
Preliminary Design Report (Jacobs)

JACOBS ASSOCIATES

Engineers/Consultants

April 24, 2009

Cesar Romero, PE
AECOM
11194 Pacific Street, Suite 204
San Luis Obispo, CA 93401

SUBJECT: Nipomo Community Services District (CSD) Pipeline
Santa Maria River Crossing
Final Preliminary Design Report

Dear Mr. Nunley:

The attached final report is our deliverable for the preliminary design of the Nipomo Community Services District (CSD) Pipeline Santa Maria River Crossing as stated in Task 3 of our contract dated December 23, 2008. The final report incorporates the comments received and updates our design and construction recommendations for the river crossing utilizing horizontal directional drilling (HDD) and discusses potential issues that may arise during design or construction in order to assist the Owner in making informed decisions.

If you have any questions or comments, please give us a call at 619-528-2292.

Very truly yours,

JACOBS ASSOCIATES

Glenn M Boyce

Glenn M. Boyce, PhD, PE
Senior Associate

Craig Camp / GMB

Craig Camp
Senior Trenchless Engineer

Enclosure: Final Preliminary Design Report dated 04/24/2009
JA Project #4003.1

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Attachment:

A: Tunnelman's Ground Classification

List of Drawings:

1: Vicinity and Location Map, 1 of 11

2: HDD Plan, C-101 and 102

3: HDD Profile, C-201 and 202 and G-002

4: HDD Laydown Area Arrangement

1. OVERVIEW

The Nipomo Community Services District (NCSD) is planning to construct a new 24-in. inside diameter potable water interconnect with the City of Santa Maria to create a second source of water and handle anticipated growth. The pipeline needs to connect with an existing pipeline on the north side of Santa Maria, immediately south of the Santa Maria River and west of Highway 101, and within the Blosser Road right-of-way. The pipeline crosses the river and gains approximately 100 ft in elevation as it rises to the Nipomo Mesa. The Santa Maria River, at the time of the site visit, was dry. It is understood that the river carries water within a subterranean riverbed with surface flows only during large storm events. The river channel falls under the jurisdiction of the U.S. Army Corps of Engineers (USACOE).

This preliminary design report presents an evaluation of horizontal directional drilling (HDD) requirements for the crossing. It also sets forth key design criteria, staging area considerations, and construction impacts.

2. PROJECT LOCATION

The project is located between the community of Nipomo in San Luis Obispo County and the City of Santa Maria in Santa Barbara County (Drawing 1). The crossing (Drawing 2) of the Santa Maria River is approximately 2,615 ft long. The horizontal directional drilled (HDD) crossing makes an entrance north of the field that lies within the Santa Maria River levy and approximately one mile west of Highway 101. The HDD exit point is approximately 100 ft higher than the HDD entrance and within an area dominated with agricultural fields. This HDD reach, as currently anticipated, is straight and does not include a horizontal curve.

3. TOPOGRAHY AND SURFACE FEATURES

3.1 Surface Conditions

The general topography in the vicinity of the HDD crossing includes a broad river valley south of the Nipomo Mesa. The City of Santa Maria lies on this broad river valley. The levee crests are approximately 8 ft higher than the ground on either side of the levy. The Nipomo Mesa is approximately 100 ft above the river valley.

The Santa Maria River levy is bordered by residential properties on the southeast and by vacant farmland on the southwest. The dry riverbed is either agricultural fields or unimproved land. The land north of the river and on the mesa is sparsely populated farmland.

3.2 Pipeline Cover Requirements

Two HDD design criteria govern the vertical cover required over the pipeline crossing. First, a minimum of 40 ft of groundcover will be provided within the river channel. This dimension is critical at the toe of the north riverbank, where there is the least amount of cover over the profile. Currently, the design has a minimum of 43 ft of separation. The separation is a minimum dimension of elevation and horizontal distance.

The second criterion is to provide sufficient confinement against slurry pressure, which varies with distance along the drill hole from the entry point. The drilling of the pilot hole typically requires an increase in slurry pumping pressure of approximately 1 psi for every 30 ft of drill steel to push the drill cuttings through the borehole. This increase in slurry pressure holds true until the drill path attains an elevation above the entrance elevation. At that point, gravity will provide the energy for the slurry (referred to herein as “drilling mud”) to return to the entrance point. The risk of an inadvertent return, where the drilling mud flows to the surface or into a body of water (also known as a “frac-out”), is reduced. The risk of a frac-out remains low until the drill path exits the ground. The industry standard to approximate the hydrostatic head of the drilling mud at the point of excavation is as follows: half of the hydrostatic pressure is exerted on the outside of the drill steel at the point of excavation, and half of the hydrostatic pressure is frictional head loss inside the drill steel. Utilizing this relationship and a typical estimated soil unit weight of 125 lb/ft^3 for the alluvium, approximately 37 ft of ground cover is required at the toe of the north riverbank. Ground cover for confinement is a governing condition for the proposed profile. A “frac-out” could prevent the project from being completed because the HDD construction method requires the circulation of the fluid for excavation and hole stability.

Other design criteria to consider include scour depth and flood elevation. The pipeline is to be installed below the scour depth, which is anticipated to be approximately 25 ft below the existing river bottom surface. According to the latest FEMA Firm map No. 06079C1902F (date 8/28/08), the Santa Maria River is within Zone “A” of the 100-year flood zone where “No Base Flood Elevations are Determined.”. The drill path is discussed later in section 12.

4. SUBSURFACE CONDITIONS

The existing geotechnical information along the alignment indicates that the soils generally consist of alluvium derived from the Paso Robles Formation and dune sand. The geotechnical report also states that groundwater levels vary significantly seasonally and as such the HDD construction should take place during periods of low flow because the HDD entry point is within the active river bed.

The alluvium, stream channel deposits within the riverbed, appears to be clean sand. The alluvial stream channel deposit is anticipated to exhibit running behavior when dry, as defined in the Tunnelman's Ground Classification (Appendix A) and flowing behavior when wet. The ground will require the drilling mud to help stabilize the excavation. The alluvium will tend to have high frictional forces during carrier pipe installation due to the sand content and anticipated ground behavior. A surface casing or a shored pit may be required to stabilize the soils at the entry and exit points during drilling. The use of drilling mud will also reduce frictional forces during carrier pipe installation.

The alluvium, located outside of the river channel, appears to be sand with an increased silt and clay content. This alluvium is anticipated to exhibit raveling behavior when dry and flowing behavior when wet. The ground will require the drilling mud to help stabilize the excavation. The alluvium will tend to have moderate frictional forces during carrier pipe installation due to the sand content and anticipated ground behavior. The use of drilling mud will reduce fictional forces during carrier pipe installation.

The older alluvium that underlies the alluvium is similar to the alluvium located outside of the river channel. The older alluvium includes clay and silt and is distinguished from the alluvium by an increase in gravel and cobble frequency and increased density. There is a possibility of boulders within this deposit. The older alluvium is anticipated to exhibit raveling behavior when dry and flowing behavior when wet. The ground will require drilling mud to help stabilize the excavation. The older alluvium will tend to have high frictional forces during carrier pipe installation due to the sand content and anticipated ground behavior. The use of drilling mud will reduce frictional forces during carrier pipe installation.

The Paso Robles Formation is a formational rock comprised of weakly cemented clay, silt, and sand. The formation is anticipated to exhibit firm behavior and will tend to contain the drilling mud and provide stability to the excavation. The Paso Robles Formation will tend to have low frictional forces during carrier pipe installation due to the stability of the excavation when lubricated and higher frictional forces when the drilling mud is not in the excavation. The contact line between the riverbed alluvium and the Paso Robles Formation is anticipated to project downward at the same angle as the surface topography to an elevation of 95 ft and then transition into a gentle slope to the south.

The dune sand deposits that form the Nipomo Mesa are anticipated to exhibit running behavior when dry and flowing behavior when wet. The ground will require the drilling mud to help stabilize the excavation. Since this is at a higher elevation than the entrance point, a surface casing or a shored pit may be required to prevent over-excavation and to stabilize the hole as the drilling mud may not remain in the hole. The sand dune deposits will tend to have moderate frictional forces during carrier pipe installation due to the sand content and anticipated ground behavior. The drilling mud, if present, will reduce fictional forces during carrier pipe installation.

The drill path is anticipated to enter at 9 degrees at a surface elevation of 190 ft. The drill path then commences a 5,000-ft-radius vertical curve and passes from the relatively softer riverbed alluvium into older alluvium near El. +150. The drill path will enter the gentle sloping Paso Robles Formation near El. +80. The drill path attains its greatest depth of El. +78 in the Paso Robles Formation. The drill path then progresses towards the surface, where it transitions out of the Paso Robles Formation near El, +220 and into the sand dune deposits. The drill path then ends its radius and progresses to the surface near El. +300, where it exits at 14.5 degrees (Drawing 3).

5. HORIZONTAL DIRECTIONAL DRILLING (HDD) CROSSING

The Owner has tentatively selected a pipe size and material. This report assumes installation of a 30-in. OD 24-in. ID DR 9.0 fusion-bonded high-density polyethylene (HDPE) carrier pipe.

According to the preliminary hydraulic analysis provided by AECOM, the carrier pipe is anticipated to have a maximum operating pressure of 100 psi at the southern end near the HDD entry point, a maximum operating pressure of approximately 148 psi at the deepest point in the HDD alignment. The maximum change in pressure due to surge is estimated to be 70 psi, resulting in a total maximum pressure of 218 psi at the deepest point.

5.1 Horizontal Directional Drilling Method Description

HDD's distinguishing features include a guided and steerable drill tool used to excavate the ground. Spoils are typically washed to the surface through the excavated opening utilizing slurry (drilling mud). The process is completed from the surface in several passes to obtain the final constructed diameter, followed by the installation of a completed pipeline in one continuous operation. During this process, the excavated opening is filled with drilling mud to support the ground. The excavated opening is oversized approximately 50% by volume (30% by diameter) to accommodate the carrier pipe. The HDD method installs pipelines or conduits in an inverted arc profile.

HDD is typically a three-stage construction method with the first stage consisting of pilot hole excavation, the second stage consisting of reaming the hole to the required size, and the third stage consisting of pulling the pipe into the stabilized hole. The pilot hole is excavated using a steerable guided drilling method that follows a prescribed path. The pilot hole starts at the ground surface with an entry angle, most typically between 8 and 20 degrees. It traverses to depth following a large radius vertical curve. After completion of the vertical curve, the hole is drilled horizontally until the designed path progresses to the ground surface, at which time a second vertical curve commences and the drill path intercepts the surface. The drill path exit angle is most typically between 5 and 12 degrees. After the hole has been enlarged to the required size, the carrier pipeline is pulled into the hole. The annular space in the hole can be grouted with a cement grout, but it is more common with the HDD process to leave the drilling mud as the final backfill.

The use of a midpath intercept may reduce risk on this project. A midpath intercept is performed by drilling with two HDD rigs, one from each end. Table 1 summarizes the midpath intercept method as practiced by two contractors since 1999. For this project, one HDD rig would start from the Nipomo Mesa and one HDD rig would start from the dry Santa Maria Riverbed. The larger pull-back rig would be located on the Nipomo Mesa. The two HDD rigs advance the pilot hole along the same drill path from opposite ends until the drill tools are within feet of touching. From this point the HDD drill located in the dry Santa Maria Riverbed reverses direction or withdraws its drill steel while the rig located on the Nipomo Mesa continues to advance the pilot hole. The advancing drill steers to the withdrawing drill, and eventually the drill paths merge into one. The two rigs continue simultaneously withdrawing and advancing until the withdrawing rig’s drill steel exits the hole and the advancing rig’s drill steel exits at the dry Santa Maria Riverbed location. The Nipomo Mesa rig’s drill steel occupies the entire drill path, completing the pilot hole. The drill steel can be connected to both drill rigs and they can be operated in a push-pull arrangement, or one drill rig can perform the remaining operations. The push-pull arrangement allows the excavation to be advanced in either direction and the slurry to be processed at either or both ends. The midpath intercept method may reduce risk by allowing for the entire pilot hole to be drilled with drilling mud and increasing hole stability. Other advantages of the midpath intercept method are:

- Fluid pressures in each drilled hole are better controlled, reducing the risk of an inadvertent return (frac-out).
- Mud return line is not required as the mud is pumped across the reach within the drill steel.
- Drill steel continuously occupies the hole until the carrier pipe is installed. Having drill steel occupy the hole reduces the risk of losing the hole due to hole collapse.

Table 1
Summary of Projects Using the Midpath Intercept Method

California Projects					
Year	Project Owner	Contact	Pipe	Reach	Location
2007	PG&E (Pacific Gas & Electric)	ARB Contractors PG&E	24" Steel	6,779 Feet	Old River, Sacramento, CA
2007	PG&E	ARB Contractors PG&E	24" Steel	5,899 Feet	Middle River, Sacramento, CA
2007	PG&E	ARB Contractors PG&E	24" Steel	6,418 Feet	Latham Slough, Sacramento, CA
2007	City of Coronado, CA	City of Coronado	30" HDPE	3,086 Feet	San Diego Bay, San Diego, CA
2008	PG&E	Southwest Contractors	24" Steel	6,518 Feet	Stone Lakes NWR, Walnut Grove, CA

North American Projects					
Year	Project Owner	Contact	Pipe	Reach	Location
1999	Allinance Pipeline	Universal Ensco	24NPS 1,084.17M	3,557 Feet	Peace River 4&6, Taylor, BC, Canada
2000	North Carolina Gas	U.S. Pipeline	30" Steel	1,280 Feet	Rock Creek/Hendrix Swamp, Concord, NC
2002	Williams Gas Pipeline	Associated Pipeline	20" Steel	4,212 Feet	McClane Parks, Tumwater, WA
2003	WE Energies	WE Energies	30" Steel	2,070 Feet	Little Oconomowoc River, North Lake, WI
2003	WE Energies	WE Energies	30" Steel	2,391 Feet	Mason Creek, Waukesha, WI
2005	Gaz Metropolit	Michels Directional Crossings	20" Steel	7,455 Feet	ST. Lawrence Seaway, Trois-Rivieies, Quebec, Canada
2006	Okaloosa Gas District	Patterson & Wilder Construction	10" Steel	8,400 Feet	Walton County, Okaloosa, FL
2006	Conoco Phillips	Same	18" Steel	4,585 Feet	Wapiti River & hill, Beaver Lodge, Alberta, Canada
2006	Conoco Phillips	Same	18" Steel	2,700 Feet	Wapiti River & hill, Beaver Lodge, Alberta, Canada
2006	Dominion Pow	UTEC Constructors Corp.	10" Steel	7,400 Feet	Elizabeth River, Norfolk Navy Base VA
2006	Dominion Pow	UTEC Constructors Corp.	8" Steel	7,400 Feet	Elizabeth River, Norfolk Navy Base VA
2006	Dominion Pow	UTEC Constructors Corp.	2" Steel	7,400 Feet	Elizabeth River, Norfolk Navy Base VA
2006	Duke Energy	Same	20" Steel	4,200 Feet	LaBiche River, Yukon,. Canada

2006	Keyera	Same	Two-6" Stee	7,218 Feet	Buckinghorse & Daniels, BC, Cana
2006	Keyera	Same	3" Steel	5,512 Feet	Buckinghorse & Daniels, BC, Cana
2007	King County Washington	King County	28" HDPE	3,947 Feet	High School SE6th St., Bellvue, WA
2007	King County Washington	King County	32" Steel	1,063 Feet	Interstate-405, Bellvue, WA
2007	Enbridge Pipeline	Global Pipeline Partne	20" Steel	2,280 Feet	Flambeau River, Ladysmith, WV
2007	Niu Valley	Michels Corporation	20" HDPE	3,250 Feet	Niu Stream/Kalaniaaole Hwy, Honolulu, Oahu, HI
2008	Enbridge Pipeline		42" Steel	2,564 Feet	Kishwaukee River Belvidere, IL
2008	Brunswick Pipeline	Louisbourg Pipelines	30" Steel	4,272 Feet	St. Johns River, St. Johns, New Brunswick, Canada
2008	Gulfstream Natural Gas	Sheehan Pipeline Construction	30" Steel	2,739 Feet	Couse Midden, Port Mayaca, FL
2008	Guardian Pipeline	Price Gregory	20" Steel	2,407 Feet	Fox River Wrightstown, WI
2008	Guardian Pipeline	Price Gregory	30" Steel	3,078 Feet	Rock River, Dodge County, WI
2008	EXXONMOBI	Sheehan Pipeline Construction	42" Steel	4,975 Feet	Indian Bayou, Port Arthur, TX
2008	EXXONMOBI	Sheehan Pipeline Construction	42" Steel	6,017 Feet	Old River Port Arthur, TX
2008	EXXONMOBI	Sheehan Pipeline Construction	42" Steel	4,378 Feet	Taylor Bayou, Port Arthur, TX
2009	PSE&G (Public Service Electric & Gas)	Napp Grecco	16" Steel	6,230 Feet	Newark Bay, Elizabeth, NJ
2009	Florida Power & Light	Same	9" Steel	5,821 Feet	Miami, FL
2009	Florida Power & Light	Same	9" Steel	5,200 Feet	Miami, FL
2009	Florida Power & Light	Same	9" Steel	5,200 Feet	Miami, FL

5.2 HDD Tracking Methods

Guiding the drill tool over the length, depth, and through the anticipated subsurface conditions is likely to require the use of an electromagnetic guidance system. The guidance system utilizes a source on the surface comprised of a loop, single wire, or solenoid antenna to establish the magnetic field. A walk-over unit is not capable of providing accurate information at the depths required for this project. The field-generating source is surveyed and the location(s) and field strength provided to the processing computer. The sonde, which is a specialized receiver and positional sensor system, is located approximately 10 ft behind the drill tool and receives the magnetic signal. The signal is transmitted to the surface through an insulated wire within the hollow center of the drill steel. A computer on the surface analyzes the information and provides three-dimensional positional information to the HDD operator, who reads the information and directs the steering action. Steering is accomplished by the drill tool, which has a designed bend in the drill tool, known as a bent sub. Steering is accomplished by aligning the bent sub to the desired direction and pushing without rotation. Once the direction has been established, the drill tool is advanced by rotating the drill steel. The maximum steering deflection is limited by the drill tool, drill steel, carrier pipe, ground conditions, and measurement tolerances. Steering tolerances are discussed later in section 12. Line and grade tolerance is typically a function of the contractor's selected guidance system, depth, ground conditions, and drill path, and is typically expressed as a percentage of the drill path depth. The line and grade tolerance for this project is expected to be on the order of 10%, or 10 ft at depth of 100 ft. It may be necessary to pull back and redrill a portion of the hole to achieve this tolerance.

It may not be possible to monitor the location of the drill tool over the full length of the alignment due to environmental considerations. While it is possible to use field generators for water crossings, doing so requires that the field generator be located and secured in the riverbed. If this is not permissible, the directional control system must be established on both banks of the river, thereby limiting the ability to track the location of the drill tool while drilling under the river.

The contractor will require access over the entire length of the drill path to lay out and survey the field generator wire and to inspect for frac-outs. The width of the easement needs to be at least 100 ft wide, centered over the drive to accommodate the field generator wire. The width of the field generator wire centered over the drill path is the same as the depth of the drill path, or for a 100-ft-deep drill path, 50 ft on either side of the drill path. The contractor needs to be able to clear and grub the path so as to survey the field generator wire and ensure the field generator wire is in close contact with the ground.

5.3 <u>Drilling Mud</u>

Drilling mud is an engineered fluid that consists of water and bentonite, a naturally occurring clay. The mud may include additives that are used to modify specific engineering properties. The bentonite, when mixed with water, becomes a dense fluid with properties that help support the ground, reduce friction, and transport the spoils out to the surface. The drilling mud is pumped through the hollow center of the drill steel to the drill tool. Once the fluid exits the drill tool, it mixes with the excavated materials and is transported back to the drill rig through the annular space of the drilled hole.

The hydraulic pressure required for the drill path varies in proportion to the excavated opening length and depth, and the elevation change. As depth increases, the ground load increases and confines the fluid. Care must be taken to avoid the loss of fluid (an inadvertent return), which may result from fracturing of the ground by the fluid pressure or upon encountering more permeable ground. In the case of the former, the construction of an exit pit may assist in channeling the fluid loss.

Drilling mud is used during pilot-hole excavation, reaming, swabbing, and pullback operations. These HDD operations are defined later in section 5.7.

5.4 Drilling Fluid Management

A shallow drilling pit, approximately 8 ft wide by 20 ft long and sloping downward along the drill path to an 8-ft depth, will be required at each end of the drill path. This pit may need to be shored to prevent collapse due to the existing soil conditions. The drill pit will be used for launching the surface casing, if required, and the pilot and reaming tools, and for the collection of slurry. On this project, the exit point is approximately 100 ft higher than the entry point. The drilling fluids containment pit on the south side needs to be sized to accommodate slurry flowing to the low side once the enlarged hole breaks through during the reaming process. The contractor will be required to capture and contain the excess slurry in Baker tanks. Slurry pits to capture the excess fluids are not permitted. The contractor may also elect to perform forward reaming, pushing the reamer from the entrance to exit side. The contractor is unlikely to perform forward reaming because of the weak cementation anticipated in the Paso Robles Formation and pulling the reamer provides for more efficient excavation. The use of a midpath intercept may reduce the risk of an inadvertent return occurring at the point of minimum cover, reduce the risk of hole collapse as the hole is filled with drilling mud, and improve the ground conditioning on the uphill portion of the reach.

Displaced drilling fluid will flow into the entry drill pit. The simplest method for handling the drilling mud at the exit pit is to run a mud return line back to the entry pit. In the absence of a mud return line, the slurry can be pumped from the exit pit and transported back to the entry pit in vacuum tanker trucks. Another alternative is to set up an additional HDD rig at the exit pit to handle the slurry. A mud return line would require permission from the USACOE and the landowners. The USACOE would likely require a double containment wall if it were to grant permission.

The HDD rig is anticipated to pull the carrier pipe in from south to north from the Nipomo Mesa and displace the drilling mud to the exit pit. The contractor will need to capture and process this displaced drilling mud and may elect to use Baker tanks or vacuum trucks to capture the excess fluids.

5.5 Slurry Separation

The drilling mud is returned to the surface containing suspended solids. The solids are removed through the use of screening plants, desanding cones, and desilting cones, with the cleaned drilling mud being reused in the excavation process. A centrifuge may be required to remove fine silt and clay particles. If a slurry separation plant is not used, then the spoils are typically loaded into a vacuum truck and hauled off-site for dewatering and drying before disposal in order to reduce disposal costs.

For this project, the primary spoils-handling operation is anticipated to be located within the existing construction right-of-way in the Santa Maria River. The volume of drilling mud will vary depending on its formulation, contractor's method, and physical properties of the excavated ground.

5.6 Typical HDD Profile

For this project, the drill path comprises a broadly sweeping inverted vertical arc. A separate sweeping arc in the horizontal plane or a compound curve is not anticipated.

5.7 HDD Installation Process

HDD is a multistep process. Some of the following steps may not be required on this project, and are noted as optional:

Step 1: Install surface casing (Optional)

A surface casing may be used to support the near-surface soils so as to prevent hole collapse and may be used to insure against inadvertent returns at drilling startup or exiting. A surface casing, comprising a steel casing, may be set into a trench excavation at the predetermined entry angle and then backfilled, pipe rammed into the soil at a predetermined entry angle, or a combination of the two. A surface casing is typically used when the ground is anticipated to have flowing, raveling, or running behavior (see table in Appendix A). The surface casing may also be required by a property owner such as the USACOE.

When the surface casing is installed by pipe ramming, the spoils inside the casing are typically removed with an auger mounted on the HDD drill rig after the ramming has been completed or stopped. The auger is rotated into the casing until the auger is full; rotation is then stopped and the auger extracted. Once the auger section is retrieved to the top of the surface casing, the auger is rotated to remove the spoils. The auger extraction of spoils is repeated until the surface casing is cleared of spoils. The ramming of the casing and spoil removal steps are repeated until the surface casing is installed to the required depth. Surface casings have been installed to lengths of 200 ft. If the surface casing seizes, the normal process is to stop, remove the hammer, clear some of the spoils, replace the hammer, and resume the driving of the casing.

Once the casing is installed and free of spoils, a smaller diameter pipe with centralizers is installed in the casing to hold the drill steel in the center of the casing. This pipe is later removed, after the pilot-hole excavation has been completed, to permit the hole reamer to be inserted or extracted.

Step 2: Drill pilot hole

The HDD drill rig is set up aboveground and the platform inclined between 8 and 15 degrees from horizontal. A 4-to-12-in. diameter hollow steel pipe drill string with a drill tool at the lead end is pushed forward along the designed pilot bore path. Drilling mud is pumped into the drill steel under pressure. The drilling mud exits through the cutting nozzles or through the mud motor on the drill tool, assisting with the excavation of the pilot hole. The drilling mud under pressure returns to the surface and in doing so carries earth spoils back to the drill rig through the annular space of the excavated pilot hole. The pilot hole is extended to the “exit side” or “pipe side” of the HDD installation.

During pilot-hole excavation, the drill path may have difficulty maintaining line and grade when encountering the relatively shallow contacts between softer and harder materials, specifically when transitioning into the weathered and unweathered Paso Robles Formation from the older alluvium. The transition is anticipated to be located below the riverbed near the bottom of the HDD curve.

Step 3: Ream pilot hole

Assuming the slurry is recycled, Step 3 will require the use of a slurry return line or vacuum trucks if only one HDD rig is used. A slurry line would be routed from the exit pit to the HDD rig within the Santa Maria River. If a permit can be obtained for routing the return slurry line across the river, the permitting agency will likely require that the slurry return line be double-contained over its entire length.

Once the pilot hole excavation exits the ground at the intended location, a reamer is attached to the drill string. Drilling mud is again pumped to jets on the reamer from the drill-rig side. As the reamer is pulled back to the drill rig, additional pieces of drill string may be added to the tail end of the reamer on the exit (pipe) side of the installation, or the excavated opening is left without drill steel. The number of reaming passes is dependant on the size of the opening and ground characteristics. For this project, it is expected that it will take a maximum of four reaming passes to accommodate the carrier pipe.

Table 2 summarizes the maximum anticipated excavation based upon pipe dimensions.

Table 2
HDPE Pipe Diameters

Pipe ID Inches nominal	Dimensional Ratio (DR)	AWWA C906-07 Pressure Class PSI	HDPE ID Inches	HDPE OD Inches	Pounds per Linear Foot	Maximum Excavation Diameter Inches
24	9.0	200	22.934	30.0	121.62	45.0

Step 4: Swab reamed hole (Optional)

The reamed hole opening may be “swabbed” using a tool that transports large soil particles out of the opening while encouraging “caking” of the sidewalls by forcing mud into and against the excavated sidewall.

Step 5: Build-up of pipeline

During steps 1 through 4, a separate crew assembles the entire length of carrier pipe that is to be pulled back into the excavated hole. It is assembled and left on rollers or blocks until needed. The pipe handling and assembly are completed in one location, and the pipeline is not pulled until completely assembled. The pipe is anticipated to be laid out along the Blosser Road right-of-way within the City of Santa Maria.

The fusion process creates a small double bead at the joint on the inside and outside of the pipe. The bead protrudes approximately 3/16-in. from the sidewall. The internal bead may affect pipe hydraulics, and the external bead may affect the pipe installation process. Therefore, if the bead must be removed, it needs to be done as part of the fusion process while the pipe is hot; otherwise, subsequent bead removal will likely cause damage to the pipe.

Step 6: Pullback

The pipe string is attached with a swivel head to the drill string and a swab optionally placed in front of the swivel and pipe string. The pipe is then pulled from the pipe side to the drill side in one continuous smooth operation. The swivel head minimizes the rotational forces on the carrier pipe, reducing friction stresses. In some cases, the carrier pipe cannot be laid out in one continuous string, and the pullback must be stopped until the next section is added. The longer and more frequent the shutdown, the more unfavorable for completion of the pullback. The carrier pipe will be filled with water in order for the pipeline to approximate neutral buoyancy in the ground and reduce the installation frictional stress on the pipeline. Since this project is for potable water, the pipe should be filled with potable water.

For this project, the pullback of a single continuous pipe string could be completed within eight hours. However, it would be prudent to allow a longer period, on the order of 24 hours, in the event that problems occur in the field.

Borehole instability is a risk factor for this project due to the excavated diameter, clean sand in the river channel, and dune sands on the Nipomo Mesa. This risk can be minimized by using proper drilling fluid design and continuous quality and quantity monitoring of the fluid. In addition, special reaming tools can be used to help maintain the stability of the borehole. An example of a special reamer is a combination fly cutter and barrel reamer. The fly-cutter component cuts and mixes the ground with the drilling mud, and the barrel component helps pack bentonite into the wall of the borehole to stabilize the hole and reduce the flow of drilling mud from the uphill side (the Nipomo Mesa) to the downhill side (the Santa Maria River).

Pipe friction is a risk factor due to the presence of sand, weight of the pipe, and a potentially dry hole. The risk can be minimized by:

- Reducing friction through the use of pipe rollers on the surface,
- Approximating neutral buoyancy during pullback by incrementally filling the pipe with water during pullback,
- Allowing air to enter the leading end of the pipe string, and
- Performing the pullback in one continuous pull without stopping for incremental welds.

An air line that allows air to flow to the leading edge of the carrier pipe needs to be installed inside the carrier pipe during pullback to avoid creating a vacuum and lifting the water filled carrier pipe above the river elevation.

Upon completion of the pullback, both ends of the carrier should be capped and the pipe filled with water and left to relax and rebound from the installation process at least 24 hours before any additional work is performed.

6. SURFACE CONSTRUCTION REQUIREMENTS

The HDD process creates temporary construction impacts at both ends of the alignment due to access and construction lay-down area requirements. The minimum component area dimensions given exclude truck turnaround areas. Allowing the contractor to use the entire width of the right-of-way and to extend the work areas may allow for a more efficient work area. Lay-down areas are required at four locations:

1. Pipe lay down is anticipated to be in order of preference: 30 ft wide × 2,800 ft long for a continuous string, or 35 ft wide × 1,400 ft long for two strings with one weld during pullback. This area extends from the HDD lay-down area away from the drill path. If necessary, the area may include a slight bend to facilitate a continuous pipe string.
2. North side: approximately 75 ft wide × 250 ft long (Drawing 4).
3. South side: approximately 75 ft wide × 250 ft long (Drawing 4).
4. Equipment storage is anticipated to accommodate eight full tractor trailers with access for unloading select items, as needed, during the project.

Both sides of the proposed crossing require truck access to import equipment, pipe, supplies, and construction materials; and export spoils. Accommodations for workers to cross from one side of the river to the other may be required. Both ends need to accommodate the setup since the contractor should be allowed to select the entrance and exit ends of the drill path. The pullback is required to be from the Nipomo Mesa as there is no easement at this end for the pipe buildup and because of the steep exit angle. For the midpath intercept method, both sides will be continuously occupied for the duration of the project.

7. PIPE MATERIAL AND GEOMETRY

The proposed pipe material for the pressure pipeline is high-density polyethylene (HDPE). HDPE is a common pipe material that is compatible with the HDD installation method. As discussed above, HDPE for HDD applications is typically butt fusion welded. The ends of the pipe are trimmed, heated, and then pressed together. The entire process is measured and monitored to ensure a watertight bond that is structurally capable of withstanding the anticipated installation and operating forces. Once the operating requirements are determined and the alignment configuration and anticipated installation forces calculated, the pipe is checked for operating requirements.

Thrust blocks may be required at the connection of the HDD installed pipe with the open-trench pipeline.

8. HDD PIPE DESIGN CRITERIA

8.1 <u>Corrosion</u>

HDPE is inert to corrosive elements in water and soil and does not require corrosion protection.

8.2 Pipe Wall Thickness Determination

In HDD installations, the pipe strength and wall thickness requirements are determined by the installation and operation loads, which are discussed in more detail below.

8.2.1 Installation Design Evaluation

HDD pipelines differ from conventionally buried pipelines, mainly due to the high loads and stresses that it is subjected to during the installation. The installation process induces tension, bending, and external pressure stresses on the pipe. Jacobs Associates' will perform a preliminary evaluation and the Contractor's engineer will submit a design calculation package before commencing the work.

a. **Tension Stress** is composed of the following stresses (ASCE 2005):

- **Frictional drag between the pipe and the wall of the excavated opening**. The frictional coefficient between the pipe and soil is multiplied by the bearing force around the excavated opening induced by the pulling load.

- **Fluidic drag due to the drilling fluid around the pipe.** Fluidic drag is calculated by multiplying the surface area of the pipe by the frictional coefficient between the drilling fluid and the pipe.

- **Effective weight of the pipe**. The effective weight of the pipe is equal to the difference between the weight of the section of pipe being pulled and the weight of the drilling fluid displaced by the pipe. Note that the weight of the pull section includes the weight of the external coatings and the pipe contents as well as the weight of the product pipe itself. The effective weight is usually expressed in pounds per foot.

  Note that the frictional and fluidic drag always retards the pipe movement underground, thus increasing the tension stress. On the other hand, the effective weight may increase or reduce the tension stress, depending on the buoyancy and pulling direction of the pipe. There are additional factors that affect the pulling load, including drilling fluid, subsurface properties, and removal of cuttings (ASCE 2005). Since these factors are difficult to account for in design calculations, HDD design requires engineering judgment to interpret the numerical results. The maximum allowable tensile stress is based on Pipeline Research Committee (1995).

b. **Bending Stress** is induced as the pipe advances through the curved section of the drill path due to the rigidity of the HDPE pipe. It is a result of the pipe being forced to bend to the curvature of the excavated opening. The design limits for the tubular members in offshore structures are applied to the HDD pipe design. This is due to the similarities between these two loading cases (ANSI / API 1993).

c. **External Hoop Stress** is a result of the following factors:

- Hydrostatic pressure on the pipe due to the weight of the surrounding drilling fluid,
- Hydrokinetic pressure due to the flow of the drilling fluid within and out of the drilled path,
- Hydrokinetic pressure as a result of the pulling of the pipe in the excavated opening, and
- Bearing pressure of the pipe against the excavated opening wall as it is advanced through the curvatures of the drilled path (ASCE 2005).

Hydrostatic pressure equals the height of the drilling fluid column multiplied by the drilling fluid density. The hydrokinetic pressure due to drilling fluid flow can be estimated utilizing annular flow pressure loss formulas. No formulas exist to estimate the hydrokinetic pressure due to pulling of the pipe into the excavated opening and it is purely assessed based on engineering judgment. Similar to bending, external hoop stress design criteria for tubular members in offshore structures are valid for HDD pipe design (ANSI / API 1993).

d. **Combined Installation Stresses**. It is necessary to consider the locations along the HDD pipe, where tensile, bending, and external hoop stresses occur simultaneously. HDD pipe locations with tight radius of curvature, high tension, and high hydrostatic head are checked for serviceability. Design limitations are obtained from ANSI / API 1993.

8.2.2 HDPE Pipe Operating Design Evaluation

The design calculations used to evaluate the HDPE pipe are typically performed in accordance with AWWA M55. The pipe stresses caused by operating conditions on HDD are very similar to the pipe stresses for a conventional trench pipeline, with the addition of flexural stresses caused by elastic bending inherent in HDD pipe. The four sources of the operating load are:

a. **Internal Pressure.** The internal pressure is caused by the fluid within the pipe and results in circumferential tension stress (namely, the hoop stress). The minimum wall thickness is selected in accordance with AWWA M55 and ASME / ANSI 1986. In design, different hydraulic conditions, including static, operating, maximum surge, and transient, are considered.

b. **Bending.** The elastic bends caused during installation remain in the pipe during operation and thus induce flexural stress on the pipe. These bends are approximated as a circular curve with the same radius of curvature as in the pilot hole data. Calculations and limitations are the same as the bending stresses induced during installation.

c. **Thermal Effect.** The stress caused by thermal expansion is a result of varying temperatures during construction and operation while the pipe is fully restrained by the surrounding medium. Although the pipe is not restrained by the surrounding soil during construction, this calculation is based on the assumption that soil tends to return to its natural state after installation. The degree to which the pipe will be constrained by the soil depends on the subsurface conditions, and it is hard to predict. It is calculated in accordance with ASME / ANSI 1986.

d. **External Pressure.** The external pressure is the larger of the load applied by the height of the drilling fluid or the sum of the earth and groundwater load at the lowest elevation of the HDD. The earth load calculation is performed in accordance with ASTM F 1962–99 (ASTM 1999).

e. **Pipe Joint Design**: Butt-fusion weld joints will be utilized to connect segments of the HDPE pipe for the HDD pipe. A joint efficiency factor is used to lower the strength of the joint in order to account for the type of joint.

In pipe joint design, the combined effect of the stresses due to temperature change and Poisson’s effect are considered. The pipe undergoes temperature change since the temperature at which the joints are welded is higher than the temperature of the water as it starts flowing within the pipe. The temperature difference results in axial stress in the joint since the axially constrained pipe has a tendency to contract.

In addition to the stresses due to temperature change, Poisson’s effect of the hoop stress is taken into consideration for joint design due to internal pressure and restrained ends. It is our understanding that AECOM will perform this analysis.

9. SCOUR DEPTH CONSIDERATIONS

The design scour depth for the river crossing was not considered in the preliminary design of the river crossing, since scour depth is not considered a deciding factor in the selection of HDD construction methods. HDD construction is a flexible system, and the pipeline can be installed at a deeper depth if the scour analysis so dictates. Any adjustments to the HDD pipeline profile are anticipated to be addressed as the design progresses. Normally, for a deeper alignment, the changes may include increasing the entrance and exit angles or setting back the additional footage that permits the increased depth. This analysis is not included in Jacobs Associates’ scope.

10. PERMIT CONSIDERATIONS

Previous experience with HDD projects indicates that several permits may be required on this project. Permits likely to be required are the U.S. Army Corps of Engineers' (USACOE) stream alteration permit for the river crossings, the California Division of Occupational Safety and Health's (CalOSHA) underground classification as a result of the underground construction, a U.S. Environmental Protection Agency stormwater pollution prevention plan (SWPPP), and a regional air quality permit due to the use of diesel equipment. During construction, the contractor may request a permit from the regional air quality board for nongeneration classification of the slurry plant. The nongeneration classification is for equipment that does not generate air pollution through the use of engines and does not release fumes during its operation due to processing materials that contain odorous products. Obtaining this permit may prevent shutdowns during construction due to public complaints if odors are released during the slurry recycling process. Obtaining permits is not included in Jacobs Associates' scope.

11. ALTERNATIVE MATERIALS

Permitting the use of alternative pipe materials will tend to increase the competitiveness of bids. Alternative pipe materials that the Owner may include are:

- Welded steel pipe (WSP) with acceptable lining and coating,
- Permalok™ with T-7 joint for HDD applications with acceptable lining and coating, or
- Ductile iron pipe (DIP).

The current selected material is HDPE—PE 3408.

Permalok™ is a steel pipe with machined mechanical joints that provide thrust restraint without welding. The T-7 joint has two "O-rings" that provide a water-tight joint for pressure systems. The HDD variant provides more surface area for the transfer of tensile forces between pipe segments. Permalok™ joints also transfer thrust loads, which would allow thrust forces without damaging the pipe.

All pipe materials would need to be specifically designed and manufactured for HDD application. WSP would require every welded pipe joint to have the lining and coating patched across the welded joint. All linings would need to be approved for potable water and be flexible enough to accommodate the flexing of the pipe during installation. Possible lining products include fusion bonded epoxy (FBE) and polyurethane. FBE limits the pipe joint length to 20 ft due to the manufacturers not having ovens that can accommodate longer pipe segments. Polyurethane linings do not require ovens and can be supplied in 40-ft segments, reducing the number of welds and joint repair cost.

Permalok does not require welding or joint patching, further reducing the field welding and patching cost over WSP. All coatings would need to meet corrosion and abrasion-resistance requirements and be flexible enough to accommodate the flexing of the pipe during installation. Possible products include polymer concrete (Powercrete™).

12. CONSTRUCTION CONSIDERATIONS

12.1 Curvature Criteria

The minimum radius of curvature during installation for a 30-in. OD HDPE pipe is approximately 30 times the pipe outside diameter, or about 100 ft (based upon dimensional information only). The actual radius of curvature is determined using critical HDPE properties, operating pressure, static pressure, surge pressure, and external loads, in addition to the induced bending stresses from the curvature. The drill steel is also a factor determining the radius of curvature. The minimum drill steel diameter is anticipated to be at least 8 in. The safe minimum radius of curvature for the drill string is approximately 1,200 times the drill steel diameter, or 800 to 1,000 ft for this project. A tighter radius or significantly thicker drill steel would require the use of shorter lengths of drill steel.

The geometry dictated by the layout parameters for this project greatly exceeds the minimum radius of curvature established by constructability and pipe-material considerations.

12.2 Length

A pipe string of about 40 ft longer (20 ft on each end) than the drill path is needed to accommodate for the pipe shrinkage that occurs after the pipe is placed (the pipe is elongated approximately 10 ft due to pulling forces and temperature). The pipe shrinkage occurs as a result of cooler temperatures in the hole and the release of tension developed in the pipe (during pipe pullback) once the pullback is complete. Verification that the HDPE has shrunk will be made before the ends are cut and capped. A maximum HDPE length of about 2,655 ft is anticipated.

12.3 Pipeline Buildup

For this project, the pipeline is anticipated to be built up as one continuous string of pipe for pullback to mitigate risk of the excavation collapsing during pullback.

The HDPE joints will be welded by creating a bead on the inside and outside of each joint. The inner welded bead may need to be removed due to system hydraulic requirements. The outer bead may need to be removed to reduce skin friction and the probability of the pipe string becoming unable to be advanced during pullback.

12.4 Pipeline Design Summary

Table 3 summarizes the preliminary geometry of the HDD profile.

Table 3
General HDD Profile Geometry

Description	Measurement
Entry Angle: Santa Maria River	9 degrees
Entry Elevation	190 ft
Straight Length	277 ft
Vertical Bend Radius	5,000 ft
Curve Length	2123 ft
Invert Elevation	78 ft
Horizontal Bend Radius	N/A
Minimum Depth at River	110 ft
Exit Angle: Nipomo Mesa	14.5 degrees
Straight Length	216 ft
Exit Elevation	300 ft

12.5 Pipe Termination

It is anticipated that the crossing pipeline will be connected to open-cut sections at a later date since open trench construction should not be performed within 100 ft of a pipeline until after the HDD installation is completed. Each end of the pipeline will extend 10 to 20 ft beyond the entry and exit points. The ends will be laid flat in a trench and sealed with an end cap or blind flange. The trench will be backfilled with telltale post and trench tape in order to locate the ends of the pipe during follow-on open-cut construction.

12.6 Preliminary Pullback Calculations

Preliminary pullback calculations were performed utilizing the selected HDPE pipe sizes given in Table 2 and the profile given in Table 3. These calculations were based on the following assumptions: (1) during the installation process, the carrier pipe is backfilled with water as the carrier is pulled into the excavation, and (2) the portion of the carrier pipe that is below the entrance elevation is filled with water and remains filled with water for the life of the facility. Any changes to these will affect the calculations and, hence, the pullback forces, and may cause the carrier pipe to collapse. Table 4 summarizes the anticipated machine installation requirements.

12.7 HDD Rig Size

HDD rig size determination is based on two separate requirements. The first is the pullback force required to pull the carrier pipe into the excavation. The estimated pullback force is summarized in Table 4. The second is the torque required to complete the excavation in a timely and cost efficient manner. The minimum estimated machine torque is included in Table 4.

Table 4
Summary of Preliminary Machine Requirements

Description (unit)	**24-in. ID DR 9**
Safe Pullback Force (lb)	893,000
Factor of Safety	2.0
Allowable Pullback Force (lb)	446,000
Maximum Required Pullback Force (lb)	357,000
Minimum HDD Machine Pullback Capacity (lb)	700,000
Suggested HDD Machine Pullback Capacity (lb)	1,000,000
Suggested Torque (ft-lb)	100,000

In the event that a contractor elects to use a midpath intercept, the smaller rig would be located on the Santa Maria River side to excavate the pilot hole, recirculate the drilling mud, provide torque assistance during the reaming process, and assist with pullback. If two rigs are used, the pullback force needs to be met by the larger rig. The two machines are required to operate during reaming operations for this exception to apply. If two rigs are used, the combined torque needs to meet 110% of the minimum torque requirements. The smaller rig would need to supply the lesser of a maximum of 20% of the suggested torque or its rated capacity, and the larger rig would need to supply a minimum of 80% of the suggested torque. These requirements are the minimum unless the contractor can demonstrate otherwise.

13. ENGINEER’S ESTIMATE OF PROBABLE CONSTRUCTION COSTS

The Engineer’s estimate of probable construction costs with schedule will be submitted under separate cover. The cost estimate will be based upon using a 24-in. ID carrier pipe.

14. REFERENCES

ANSI / API (1993). *Recommended practice for planning, designing and constructing fixed offshore platforms – Working stress design.* 20th Ed. RP 2A-WSD-93, Washington, D.C.

ASCE (2005). *Pipeline design for installation by horizontal directional drilling.* ASCE, Reston, Va.

ASME / ANSI (1986). *Liquid transportation systems for hydrocarbons, liquid petroleum gas, anhydrous ammonia, and alcohols.* ANSI B31.4, New York.

ASTM (1999). *Standard guide for use of maxi-horizontal directional drilling for placement of polyethylene pipe or conduit under obstacles, including river crossings.* F 1962–99, ASTM, West Conshohocken, Pa.

AWWA (2005). *PE pipe – Design and installation.* M55, AWWA, Denver.

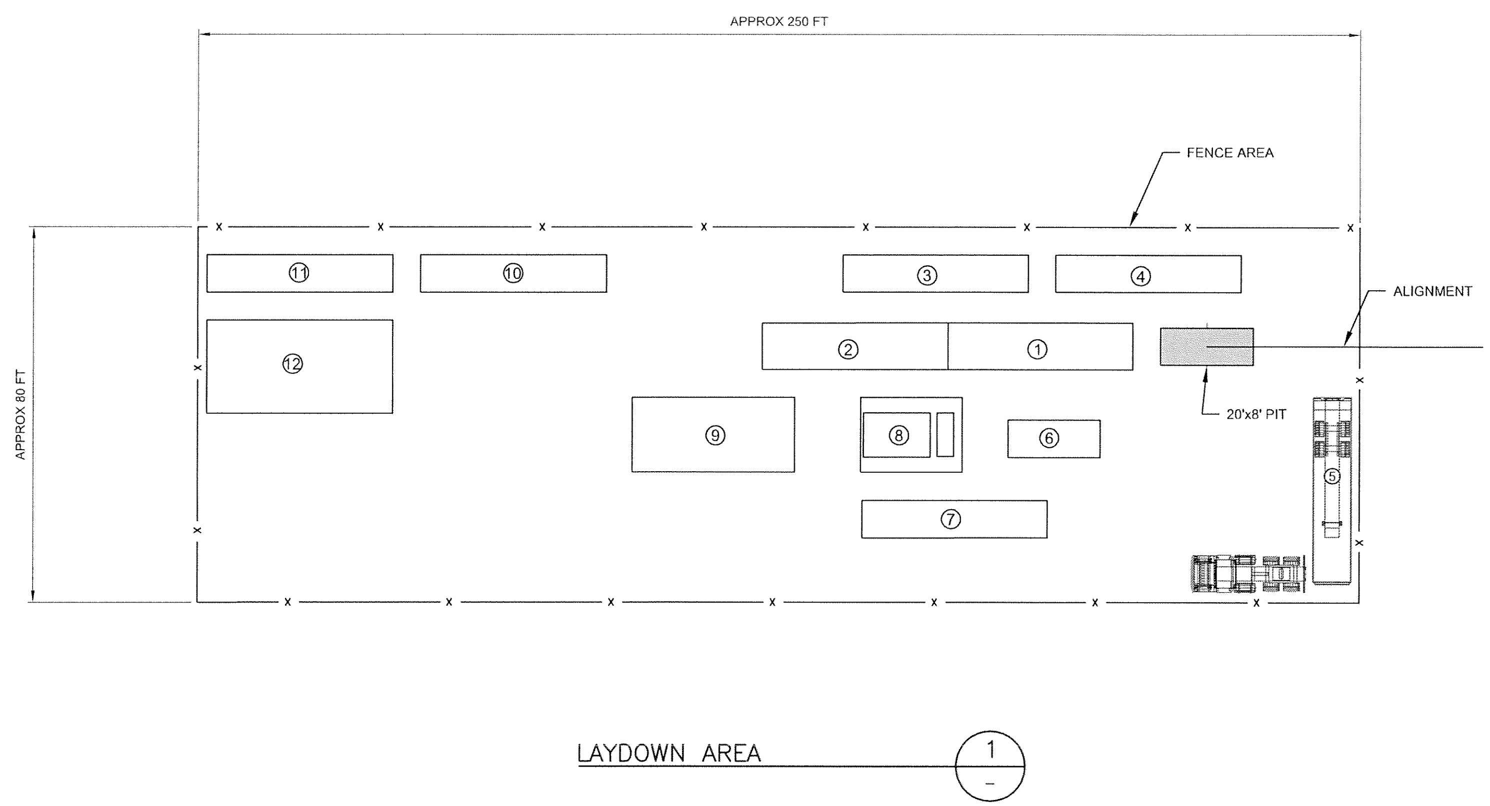
AWWA (2007). *Polyethylene (PE) pressure pipe and fittings, 4 in. (100 mm) through 63 in. (1,575 mm) for water distribution and transmission.* C906, AWWA, Denver.

Pipeline Research Committee (PRC). (1995). *Installation of pipelines by horizontal directional drilling, an engineer's design guide.* American Gas Association, Washington, D.C.

Tunnelman's Ground Classification for Soils
(after Heuer, 1974)

Classification		Behavior	Typical Soil Types
Firm		Heading can be advanced without initial support and final lining can be constructed before ground starts to move.	Loess above water table; hard clay, marl, cemented sand, and gravel when not highly overstressed.
Raveling	Slow Raveling Fast Raveling	Chunks or flakes of material begin to drop out of the arch or walls sometime after the ground has been exposed, due to loosening or to overstress and "brittle" fracture (ground separates or breaks along distinct surfaces, opposed to squeezing ground). In fast raveling ground, the process starts within a few minutes, otherwise the ground is slow raveling.	Residual soils or sand with small amounts of binder may be fast raveling below the water table; slow raveling above. Stiff fissured clays may be slow or fast raveling depending upon degree of overstress.
Squeezing		Ground squeezes or extrudes plastically into tunnel, without visible fracturing or loss of continuity, and without perceptible increase in water content. Ductile, plastic yield and flow due to overstress.	Ground with low frictional strength. Rate of squeeze depends on degree of overstress. Occurs at shallow to medium depth in clay of very soft to medium consistency. Stiff to hard clay under high cover may move in combination of raveling at execution surface and squeezing at depth behind surface.
Running	Cohesive Running Running	Granular materials without cohesion are unstable at a slope greater than their angle of repose (±30-35 degrees). When exposed at steeper slopes they run like granulated sugar or dune sand until the slope flattens to the angle of repose.	Clean, dry granular materials. Apparent cohesion in moist sand or weak cementation in any granular soil may allow the material to stand for a brief period of raveling before it breaks down and runs. Such behavior is cohesive-running.
Flowing		A mixture of soil and water flows into the tunnel like a viscous fluid. The material can enter the tunnel from the invert as well as from the face, crown, and walls, and can flow for great distances completely filling the tunnel in some cases.	Below the water table in silt, sand, or gravel without enough clay content to give significant cohesion and plasticity. May also occur in highly sensitive clay when such material is disturbed.
Swelling		Ground absorbs water, increases in volume, and expands slowly into the tunnel.	Highly preconsolidated clay with plasticity index in excess of about 30, generally containing significant percentages of montmorillonite clay.

Attachment A



NOTE:

1. THE LAYDOWN AREA SHOWN IS ARRANGED FOR THE WEST SIDE OF THE ALIGNMENT. FOR THE EAST SIDE, THE ARRANGEMENT CAN BE MIRRORED/REVERSED.

CONCEPTUAL MAJOR EQUIPMENT LIST

1	HORIZONTAL DIRECTION DRILL (HDD) RIG (2 PCS)
2	HORIZONTAL DIRECTION DRILL (HDD)
3	HYDRAULIC POWER PACK (2 REQD)
4	HYDRAULIC POWER PACK
5	VACUUM TRUCK
6	HDD CONTROL CABIN
7	DRILL STEEL TRUCK
8	EXCAVATOR
9	DRILL STEEL STORAGE
10	SPOILS SEPARATION PLANT (2 REQD)
11	SPOILS
12	SPOILS HANDLING AREA

JACOBS ASSOCIATES Engineers/Consultants 1843 Hotel Circle S., Suite 350 San Diego, CA 92108	NIPOMO COMMUNITY SERVICE DISTRICT CONCEPTUAL LAYDOWN AREA ARRANGEMENT	PROJECT NO. 4003 DATE: 06/01/06 FIGURE NO. 4	REV -

Appendix E
Frontage Road Sewer Replacement
Preliminary Hydraulic Calculations

AECOM

Frontage Road Sewer Replacement Preliminary Hydraulic Calculations

Gravity Sewer

Manhole	Design Sta.	Calc'd Inv. El on New Align	Invs.	Notes on Inv. Adj.	Rims
Southland **F.0 = ~6066**	-76.87 **-74.37** -71.87	297.20	297.15 **297.20** 297.25	Matching i	308.01
F.1	47.50 50.00 52.50		297.86418 **297.914** 297.96418		310.05
F.2	267.50 270.00 272.50		299.07038 **299.120** 299.17038		310.84
F.3	667.50 670.00 672.50		301.20272 **301.253** 301.30272		312.91
Luggage **F.4 = 486b**	1050.97 **1053.47** 1055.97	**303.30**	303.25 **303.30** 303.35	*303.25*	317.33
F.5	1279.12 1281.62 1284.12		304.68569 **304.736** 304.78569		321.35
Story **F.6 = 514b**	1679.12 **1681.62** 1684.12	**307.28**	307.15 **307.20** 307.25	*307.15* **Manually a**	327.01
Story **F.7 = 515b**	1692.10 **1694.60** 1697.10	**307.35**	307.3 **307.35** 307.4	Matching i	327.19
F.8	2114.58 2117.08 2119.58		311.12679 **311.177** 311.22679		328.07
Margie **F.9 = 533b**	2536.66 **2539.16** 2541.66	**318.095**	314.95 **315.0** 315.05	*314.95* **Manually d**	329.2
Near Division F.10	3034.66 3037.16 3039.66		318.49626 **318.546** 318.59626		329.72
Division **F.11 = 549**	3054.50 **3057.00** 3059.50	318.75	318.70 **318.75** 318.80	*318.70* Matching i	329.33

Segment Length	Critical MH ave slope	Design slope	Rise DS Inv to US Inv, ft	Check segment Slope	Replace. Diameter (in)	Diameter (ft)	n	Area (ft^2)	Velocity (fps)	Qave (gpd)[1]	Qave (cfs)	Peak Flow (gpd)	Peak Flow (cfs)	Max Capacity (50%)	Qfull (cfs)	Qavg/ Qfull	Qpeak/ Qfull	d/D avg flow	d (in) avg flow	d/D peak flow	d (in) peak flow	Velocity Avg Flow	Velocity Peak Flow
					Manning Velocity						**Capacity**												
119.37	0.00541	0.00515	0.614176235	0.00515	21	1.750	0.011	2.4053	5.599	Future: 1,590,000	2.3850	4,770,000	7.379	6.734	13.468	0.177	0.548	0.270	5.670	0.516	10.836	4.099	5.644
					21	1.750	0.011	2.4053	5.599	Current: 570,000	0.8550	1,710,000	2.645	6.734	13.468	0.063	0.196	0.163	3.423	0.290	6.090	2.979	4.278
215.00			1.106206672	0.00515	21	1.750	0.011	2.4053	5.599	Future: 1,590,000	2.3850	4,770,000	7.379	6.734	13.468	0.177	0.548	0.270	5.670	0.516	10.836	4.099	5.644
					21	1.750	0.011	2.4053	5.599	Current: 570,000	0.8550	1,710,000	2.645	6.734	13.468	0.063	0.196	0.163	3.423	0.290	6.090	2.979	4.278
395.00			2.032333189	0.00515	21	1.750	0.011	2.4053	5.599	Future: 1,590,000	2.3850	4,770,000	7.379	6.734	13.468	0.177	0.548	0.270	5.670	0.516	10.836	4.099	5.644
					21	1.750	0.011	2.4053	5.599	Current: 570,000	0.8550	1,710,000	2.645	6.734	13.468	0.063	0.196	0.163	3.423	0.290	6.090	2.979	4.278
378.47			*1.9472839*	0.00515	21	1.750	0.011	2.4053	5.599	Future: 1,590,000	2.3850	4,770,000	7.379	6.734	13.468	0.177	0.548	0.270	5.670	0.516	10.836	4.099	5.644
					21	1.750	0.011	2.4053	5.599	Current: 570,000	0.8550	1,710,000	2.645	6.734	13.468	0.063	0.196	0.163	3.423	0.290	6.090	2.979	4.278
223.15	0.00621	0.00599	1.335687131	0.00599	21	1.750	0.011	2.4053	6.039	Future: 1,590,000	2.3850	4,770,000	7.379	7.263	14.527	0.164	0.508	0.260	5.460	0.500	10.500	4.324	6.039
					21	1.750	0.011	2.4053	6.039	Current: 570,000	0.8550	1,710,000	2.645	7.263	14.527	0.059	0.182	0.150	3.150	0.280	5.880	3.080	4.421
395.00			*2.36431287*	0.00599	21	1.750	0.011	2.4053	6.039	Future: 1,590,000	2.3850	4,770,000	7.379	7.263	14.527	0.164	0.508	0.260	5.460	0.500	10.500	4.324	6.039
					21	1.750	0.011	2.4053	6.039	Current: 570,000	0.8550	1,710,000	2.645	7.263	14.527	0.059	0.182	0.150	3.150	0.280	5.880	3.080	4.421
7.98	0.01156	na	0.092218798	0.00627	21	1.750	0.011	2.4053	6.179	Future: 1,590,000	2.3850	4,770,000	7.379	7.431	14.863	0.160	0.496	0.260	5.460	0.494	10.374	4.424	6.117
					21	1.750	0.011	2.4053	6.179	Current: 570,000	0.8550	1,710,000	2.645	7.431	14.863	0.058	0.178	0.150	3.150	0.270	5.670	3.151	4.523
417.48	0.00906	0.00893	3.726785372	0.00893	21	1.750	0.011	2.4053	7.376	Future: 1,090,000	1.6350	3,270,000	5.059	8.870	17.740	0.092	0.285	0.202	4.242	0.364	7.644	4.573	6.284
					21	1.750	0.011	2.4053	7.376	Current: 360,000	0.5400	1,080,000	1.671	8.870	17.740	0.030	0.094	0.110	2.310	0.202	4.242	2.950	4.573
417.08			*3.72321463*	0.00893	21	1.750	0.011	2.4053	7.376	Future: 1,090,000	1.6350	3,270,000	5.059	8.870	17.740	0.092	0.285	0.202	4.242	0.364	7.644	4.573	6.284
					21	1.750	0.011	2.4053	7.376	Current: 360,000	0.5400	1,080,000	1.671	8.870	17.740	0.030	0.094	0.110	2.310	0.202	4.242	2.950	4.573
493.00	0.00724	0.00699	3.446262602	0.00699	21	1.750	0.011	2.4053	6.527	Future: 1,090,000	1.6350	3,270,000	5.059	7.849	15.699	0.104	0.322	0.215	4.515	0.392	8.232	4.151	5.796
					21	1.750	0.011	2.4053	6.527	Current: 360,000	0.5400	1,080,000	1.671	7.849	15.699	0.034	0.106	0.110	2.310	0.215	4.515	2.611	4.151
14.84			*0.1037374*	0.00699	21	1.750	0.011	2.4053	6.527	Future: 1,090,000	1.6350	3,270,000	5.059	7.849	15.699	0.104	0.322	0.215	4.515	0.392	8.232	4.151	5.796
					21	1.750	0.011	2.4053	6.527	Current: 360,000	0.5400	1,080,000	1.671	7.849	15.699	0.034	0.106	0.110	2.310	0.215	4.515	2.611	4.151

Manhole diameter, ft: 5	Drop across MHs, conservative: 0.1 ft	Flow multiplier: 1.00	Peak Factor 3.000	Conditional formating Criteria: Max peak d/D = 0.75; Max avg d/D = 0.5; v min (fps) = 2; v max (fps) = 10

(1) Current and future flows and distribution of flows to connecting mains are based on the Southland WWTF Master Plan (AECOM 2009) analysis.

Appendix F
Preliminary Outline of Technical Specifications

AECOM

Outline of Technical Specifications

This is a draft outline and is subject to change.

BID PACKAGE 1
SANTA MARIA RIVER CROSSING

007300 COORDINATION OF WORK, PERMITS, AND REGULATIONS
012000 MEASUREMENT AND PAYMENT
013300 SUBMITTALS
015100 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS
017410 CLEANING DURING CONSTRUCTION AND FINAL CLEANING
020120 PROTECTING EXISTING UNDERGROUND UTILITIES
030500 GENERAL CONCRETE CONSTRUCTION
099000 PAINTING AND COATING
311100 CLEARING, GRUBBING, AND STRIPPING
312300 EARTHWORK
312316 TRENCHING, BACKFILLING, AND COMPACTING
330521 PIPE RAMMING OF STEEL SURFACE CASING
330525 HORIZONTAL DIRECTIONAL DRILLING
330526 INSTALLATION OF CARRIER PIPE INTO HDD COMPLETED BOREHOLE
330527 ANNULAR BACKFILL GROUTING
331300 DISINFECTION OF PIPING
400515 PRESSURE TESTING OF PIPING
402097 HIGH DENSITY POLYETHYLENE (HDPE) CARRIER PIPE

BID PACKAGE 2
NIPOMO AREA PIPELINE IMPROVEMENTS & FRONTAGE ROAD SEWER REPLACEMENT

07300 SUPPLEMENT TO GENERAL PROVISIONS

011100 COORDINATION OF WORK, PERMITS, AND REGULATIONS

012000 MEASUREMENT AND PAYMENT

013216 CPM CONSTRUCTION SCHEDULE REQUIREMENTS

013233 PRECONSTRUCTION DIGITAL AUDIO-VIDEO DOCUMENTATION

013300 SUBMITTALS

015210 TEMPORARY FIELD OFFICE BUILDING

015526 TRAFFIC REGULATION

015725 STORM WATER RUNOFF CONTROL PROGRAM

017410 CLEANING DURING CONSTRUCTION AND FINAL CLEANING

019310 OPERATION AND MAINTENANCE MANUALS

020120 PROTECTING EXISTING UNDERGROUND UTILITIES

020130 CONNECTIONS TO EXISTING BURIED PIPELINES

023219 SUBSURFACE UTILITY LOCATING (POTHOLING)

033000 CONCRETE

034210 PRECAST CIRCULAR CONCRETE MANHOLES

260500 GENERAL ELECTRICAL REQUIREMENTS

260519 WIRES AND CABLES LESS THAN 600 VOLTS
260526 GROUNDING AND BONDING

260534 CONDUITS, BOXES, AND FITTINGS

260573 ARC-FLASH HAZARD ANALYSIS

099000 PAINTING AND COATING

099752 COLD-APPLIED WAX TAPE COATING

099754 POLYETHYLENE SHEET ENCASEMENT (AWWA C105)

311100 CLEARING, STRIPPING, AND GRUBBING

312300 EARTHWORK

312316 TRENCHING, BACKFILLING, AND COMPACTING

312323 GRAVEL AND CRUSHED ROCK BASE FOR STRUCTURES

313219 FILTER FABRIC

317216 JACKED STEEL CASING

321216 ASPHALT CONCRETE PAVING

321313 PORTLAND CEMENT CONCRETE PAVING

321540 GRAVEL ROADWAY CONSTRUCTION

321613 CONCRETE CURBS, GUTTERS, AND SIDEWALKS

321723 TRAFFIC SIGNING, STRIPING, AND MARKINGS

323112 STEEL CHAIN LINK FENCES AND GATES

330130 LEAKAGE AND INFILTRATION TESTING

330131 SANITARY SEWER SYSTEM TELEVISION INSPECTION

331300 DISINFECTION OF PIPING AND STRUCTURES

333112 PVC GRAVITY SEWER PIPE

344113 TRAFFIC SIGNALS AND INTERSECTION LIGHTING

400500 GENERAL PIPING REQUIREMENTS

400515 PRESSURE TESTING OF PIPING

400520 MANUAL, CHECK, AND PROCESS VALVES

400560 AIR-RELEASE AND VACUUM-RELIEF VALVES

402040 DUCTILE-IRON PIPE

402092 PVC DISTRIBUTION PIPE (AWWA C900)

099720 CHEMICAL-RESISTANT COATINGS FOR CONCRETE

099722 PLASTIC LINER SHEET FOR CONCRETE

BID PACKAGE 3
BLOSSER ROAD WATERLINE AND FLOW METER

07300 SUPPLEMENT TO GENERAL PROVISIONS

011100 COORDINATION OF WORK, PERMITS, AND REGULATIONS

012000 MEASUREMENT AND PAYMENT

013216 CPM CONSTRUCTION SCHEDULE REQUIREMENTS

013233 PRECONSTRUCTION DIGITAL AUDIO-VIDEO DOCUMENTATION

013300 SUBMITTALS

015210 TEMPORARY FIELD OFFICE BUILDING

015526 TRAFFIC REGULATION

015725 STORM WATER RUNOFF CONTROL PROGRAM

017410 CLEANING DURING CONSTRUCTION AND FINAL CLEANING

019310 OPERATION AND MAINTENANCE MANUALS

020120 PROTECTING EXISTING UNDERGROUND UTILITIES

020130 CONNECTIONS TO EXISTING BURIED PIPELINES

023219 SUBSURFACE UTILITY LOCATING (POTHOLING)

033000 CONCRETE

099000 PAINTING AND COATING

099752 COLD-APPLIED WAX TAPE COATING

099754 POLYETHYLENE SHEET ENCASEMENT (AWWA C105)

260500 GENERAL ELECTRICAL REQUIREMENTS

260519 WIRES AND CABLES LESS THAN 600 VOLTS

260526 GROUNDING AND BONDING

260534 CONDUITS, BOXES, AND FITTINGS

260573 ARC-FLASH HAZARD ANALYSIS

311100 CLEARING, STRIPPING, AND GRUBBING

312300 EARTHWORK

312316 TRENCHING, BACKFILLING, AND COMPACTING

312323 GRAVEL AND CRUSHED ROCK BASE FOR STRUCTURES

313219 FILTER FABRIC

317216 JACKED STEEL CASING

321216 ASPHALT CONCRETE PAVING

321313 PORTLAND CEMENT CONCRETE PAVING

321540 GRAVEL ROADWAY CONSTRUCTION

321613 CONCRETE CURBS, GUTTERS, AND SIDEWALKS

321723 TRAFFIC SIGNING, STRIPING, AND MARKINGS

323112 STEEL CHAIN LINK FENCES AND GATES

331300 DISINFECTION OF PIPING AND STRUCTURES

344113 TRAFFIC SIGNALS AND INTERSECTION LIGHTING

400500 GENERAL PIPING REQUIREMENTS

400515 PRESSURE TESTING OF PIPING

400520 MANUAL, CHECK, AND PROCESS VALVES

400560 AIR-RELEASE AND VACUUM-RELIEF VALVES

402040 DUCTILE-IRON PIPE

402092 PVC DISTRIBUTION PIPE (AWWA C900)

409115 MAGNETIC FLOWMETERS

BID PACKAGE 4
JOSHUA STREET PUMP STATION AND RESERVOIR, AND CHLORAMINATION SYSTEMS

07300 SUPPLEMENT TO GENERAL PROVISIONS

011100 COORDINATION OF WORK, PERMITS, AND REGULATIONS

012000 MEASUREMENT AND PAYMENT

013216 CPM CONSTRUCTION SCHEDULE REQUIREMENTS

013233 PRECONSTRUCTION DIGITAL AUDIO-VIDEO DOCUMENTATION

013300 SUBMITTALS

015210 TEMPORARY FIELD OFFICE BUILDING

015526 TRAFFIC REGULATION

015725 STORM WATER RUNOFF CONTROL PROGRAM

017410 CLEANING DURING CONSTRUCTION AND FINAL CLEANING

019310 OPERATION AND MAINTENANCE MANUALS

020120 PROTECTING EXISTING UNDERGROUND UTILITIES

020130 CONNECTIONS TO EXISTING BURIED PIPELINES

023219 SUBSURFACE UTILITY LOCATING (POTHOLING)

031510 CONCRETE JOINTS, WATER STOPS, AND SEALANTS

032100 CONCRETE REINFORCEMENT

033000 CONCRETE

033500 CONCRETE FINISHING AND CURING

042223 CONCRETE UNIT MASONRY

050520 BOLTS, WASHERS, ANCHORS, AND EYEBOLTS

055100 LADDERS, STAIRS, AND STAIR NOSINGS

055200 HANDRAILS AND SAFETY CHAINS

055300 GRATING, COVER PLATES, AND ACCESS HATCHES

081110 METAL DOORS AND FRAMES

099000 PAINTING AND COATING

099752 COLD-APPLIED WAX TAPE COATING

099754 POLYETHYLENE SHEET ENCASEMENT (AWWA C105)

099761 FUSION-BONDED EPOXY LININGS AND COATINGS

238110 HEATING AND AIR-CONDITIONING EQUIPMENT

260500 GENERAL ELECTRICAL REQUIREMENTS

260519 WIRES AND CABLES LESS THAN 600 VOLTS

260526 GROUNDING AND BONDING

260534 CONDUITS, BOXES, AND FITTINGS

260548 SEISMIC RESTRAINT FOR ELECTRICAL EQUIPMENT

260573 ARC-FLASH HAZARD ANALYSIS

261219 PAD-MOUNTED TRANSFORMERS

262650 ELECTRIC MOTORS

262923 VARIABLE FREQUENCY DRIVE (VFD)

263212 STANDBY ENGINE-GENERATORS (LARGER THAN 100 KW)

263710 GENERATOR CONTROL SWITCHGEAR

264213 CATHODIC PROTECTION AND JOINT BONDING

311100 CLEARING, STRIPPING, AND GRUBBING

312300 EARTHWORK

312316 TRENCHING, BACKFILLING, AND COMPACTING

312323 GRAVEL AND CRUSHED ROCK BASE FOR STRUCTURES

313219 FILTER FABRIC

317216 JACKED STEEL CASING

321216 ASPHALT CONCRETE PAVING

321313 PORTLAND CEMENT CONCRETE PAVING

321540 GRAVEL ROADWAY CONSTRUCTION

321613 CONCRETE CURBS, GUTTERS, AND SIDEWALKS

321723 TRAFFIC SIGNING, STRIPING, AND MARKINGS

323112 STEEL CHAIN LINK FENCES AND GATES

329010 LANDSCAPE PLANTING

331300 DISINFECTION OF PIPING AND STRUCTURES

331620 PRESTRESSED CIRCULAR CONCRETE RESERVOIRS

344113 TRAFFIC SIGNALS AND INTERSECTION LIGHTING

400500 GENERAL PIPING REQUIREMENTS

400515 PRESSURE TESTING OF PIPING

400520 MANUAL, CHECK, AND PROCESS VALVES

400560 AIR-RELEASE AND VACUUM-RELIEF VALVES

400722 FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

402040 DUCTILE-IRON PIPE

402057 FUSION EPOXY-LINED AND -COATED STEEL PIPE

402092 PVC DISTRIBUTION PIPE (AWWA C900)

409115 MAGNETIC FLOWMETERS

409715 PRESSURE GAUGES AND PRESSURE SWITCHES

432150 VERTICAL TURBINE PUMPS

433280 PACKAGED CHEMICAL FEED SYSTEM

434117 SURGE TANK SYSTEMS

434127 POLYETHYLENE STORAGE TANKS

444249 IN-LINE STATIC INJECTION RING MIXERS