OCSD - Pump Station Replacement

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Conveyance Bros. (W2)

Winter Design Review
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Project Description

The Orange County Sanitation District (OCSD) has identified two aging pump stations (PS), Westside (WS) and Seal Beach (SB), within the Los Alamitos and Seal Beach area. With the increasing sewage flow and odor complaints, the frequency for maintenance of the Westside PS has also increased. In collaboration with Conveyance Bros Inc, OCSD will be replacing the two PS with a new station that is to be built adjacent to the existing Seal Beach PS.

Figure 1: Project location map.

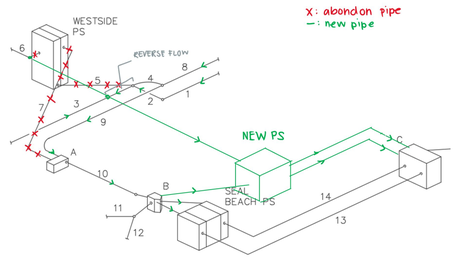

Figure 2: Process flow diagram of existing and proposed system.

Scope of Work

Task	% Completed
Review existing pump station data to validate projected maximum flows.	100%
Select and evaluate:	
2 profiles for upstream sanitary sewer.	100%
3 options for the number and individual capacity(s) of each set of pumps.	33.3%
1 profiles for station's downstream force main(s).	50%
Prepare a preliminary cost estimate.	60%
Draft plan and profile civil and mechanical drawings and develop a PDR.	5%

References

5700 Angleflow Pumps Performance. (2011, June). Retrieved March, 2019, from https://www.pentair.com/content/dam/extranet/flow/fairbanks-nijhuis/vertical-angleflow-solids-handling-pumps-5710-series/performance-data-sheets/Performance Data - 5700 Series.pdf

Ludwin, D. A., P.E. (2006). *Orange County Sanitation District: Design Guidelines*. CA

Mahoney, W. D., P.E. (2019). *Public Works Costbook* (26th ed.). Vista, CA: BNi Building News.

Upstream Sanitary Sewer

Design Approach:
Two upstream sanitary sewer alignments were proposed, figures 3 & 4. New pipe designs were calculated using Manning's Equation while considering constraints below. For both alternatives, the downstream invert elevations were approximately -13 feet. Additionally, a new sewer gravity to SB PS was considered. Alternative 1 proposed a new 48 in. pipe with the same slope as the existing line (0.0052). Alternative 2 also proposed a new 48 in. pipe but with a slope of 0.0062. Alternative 2 was chosen since its performance aligns closely with the existing gravity sewer which currently functions well for the District.

Table 1: Max and min flow speed calculations based on slope and pipe diameter.

Design	Diameter (in)	Slope	Elevation Difference (L=5621 ft)	Min Velocity (fps)	Minimum D/d	Max Velocity (fps)	Maximum D/d
Existing Pipe 10	51	-0.00052	2.92	1.67	0.2	3.07	0.95
Alternative 1	48	-0.00052	2.92	1.55	0.19	2.89	0.67
Alternative 2	48	-0.00062	3.46	1.65	0.18	3.1	0.63

Constraints:
- Max D/d ratio: 0.75
- Range of velocity in pipe: 2- 4 fps
- Minimize costs
- Minimize Depth
- Clearance from existing utilities

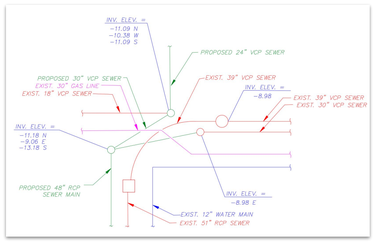

Figure 3: Upstream connection 1.

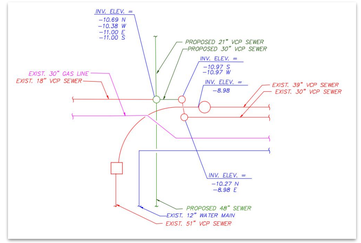

Figure 4: Upstream connection 2.

Downstream Force Mains

Design Approach
The pump station will be configured to have submersible dual wet well pits. The system curve values were calculated using Hazen-williams and designed according to the OCSD manual.

Design Constraint
All piping within the pump station will be standard steel. All underground force main piping will be HDPE. For the section above ground over the Bolsa Chica Channel the pipe will be steel.

Alternatives
1. Two force mains of same size
2. Two force mains of different sizes

V=Q/A	True ID		Nominal
5.33	23.25	Suction	24
9.68	17.25	Discharge	18
6.65	27.25	Manifold	28
13.33	19.25	Meter Run	20
5.06	31.25	FM STEEL	32
5.06	31.25	FM STEEL	32
4.98	31.50	FM HDPE	36
5.06	31.25	FM STEEL	32
4.98	31.50	FM HDPE	36
7.90	25.00	FM Lined VCP	27

Figure 5: Alternative 1 pipe configuration.

Pump Selection

Design Approach:
Due to the large difference in elevation of the two influent sources, two separate wet wells at different elevations was explored, each with different pump sets. Alternative 1 was chosen and the optimal pumps for each each wet well set is seen in table 2.

Design Constraint (OCSD Guidelines):
- Max Pump Speed: 1180 RPM
- NPSHA >= NPSHR + Margin
- Pump Efficiency within 70% of BEP

Alternatives:
1. 3 duty pumps 1 standby (same size each)
2. 4 duty pumps 1 standby (same size each)
3. 4 duty pumps 1 standby (differing size)

Table 2. Alternative 1 pump data

Three (3) Pump Configuration	Wet Well #1: Flow from 48" Line	Wet Well #2: Flow from 51" Line
Invert Elev:	- 16.75 ft	- 6.10 ft
Max Flow:	16.5(MGD)	17.4(MGD)
(3) Pumps:	3819.44 (gpm/p)	4027.78 (gpm/p)
Max Static Head:	40.62 ft	30.14 ft
Max TDH:	82 ft	72 ft
Pump Used:	14X16 (2 Vane)	16X18 (3 Vane)
Motor:	1180 RPM	880 RPM
Power (BHP):	180 HP	160 HP

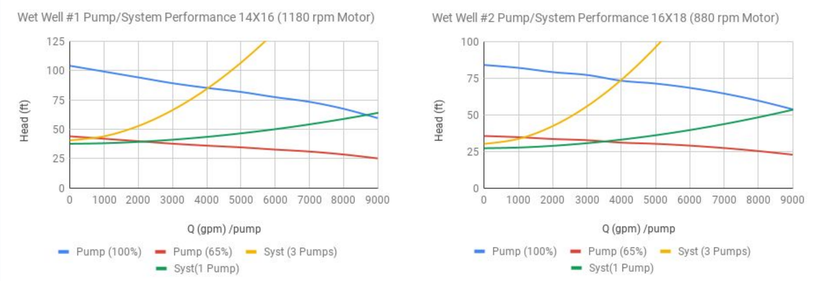

Figure 6. Alternative 1 performance curves

Preliminary Cost Estimate

Table 3. Cost Analysis Breakdown

Material	Quantity	Labor Hours	Labor Cost	M & CE	Total
Building & Components	4,973 SF	543	$37,494	$158,972	$196,466
Common Site Work		16,061	$996,943	$1,227,999	$2,224,942
Concrete	4,885 CF	31,381	$2,166,408	$1,099,678	$3,266,086
Electrical and I&C				$1,374,752	$1,374,752
Electrical and I&C Installation		3,355	$253,201	$492,119	$745,320
Finishes	20,027 SF	5,540	$362,308	$200,083	$562,391
General Conditions		4,050	$251,387	$866,100	$1,117,487
Mansory	9,061 SF	3,632	$255,162	$111,292	$366,454
Miscellaneous Metals	4.5 TONS			$77,533	$77,533
Miscellaneous Metals Installation		360	$24,342	$6,668	$31,010
Process & Mechanical				$1,075,377	$1,075,377
Process & Mechanical Installation		2,790	$196,621	$653,735	$850,356
Specialty Site Work		10,741	$666,687	$1,719,925	$2,386,612
			Contractor Direct Cost		$14,274,786
Other					
Installing Contractor Burden and Mark-Ups					$3,335,572
Estimator Gross Adjustments					$3,963,608
Prime Contractor Costs					$6,906,991
			Total Cost of Replacing One Pump		$28,480,957
Estimate for Scope of Project					
Pump 2					$29,519,043.00
Estimated Total Project Cost					$58,000,000.00

With the current progress of the project, Conveyance Bros compiled an estimated total cost of $58 million for turning the WS PS to a gravity system and replacing the SB PS with two new wet wells. The difference in cost between the two pump stations include, but not limited to:
- Depth of Wet Wells
- Depth of Force Mains
- Energy Consumption
- Materials
- Labor
- Insurance