



December 3, 2021

Tracyton Beach Road Sewer Improvements Technical Memorandum

To: City of Bremerton

From: Cameron Ross, PE, John Cartwright, EIT

Reviewed By: Jeff Foray, PE, Michael Lubovich, PE

Subject: Tracyton Beach Road Sewer Improvement Alternatives Evaluation
KJ 2197012*00



Introduction

The sanitary sewer along Tracyton Beach Road (TBR) was installed in the early 1990s and is experiencing ongoing maintenance issues. The sewer is a gravity-pressure main with the following characteristics: 4,000 lineal feet, 8-inch diameter, and constructed of ductile iron. The sewer main is located near the Port Washington Narrows, a water body that connects Sinclair Inlet and Dyes Inlet. An overflow resulting from a surcharge of the TBR sewer could discharge to these water bodies and impact the marine environment. The sewer main as it is currently constructed will require maintenance for the foreseeable future. The gravity sewer main was installed to serve residential development occurring on the hillside located above TBR and upland collection systems discharge into the main at several locations. The design uses a siphon concept to convey upstream flow to the downstream location near Sheridan Road. The sewer main is always under pressure since the elevation of the upstream and downstream end are similar, and upstream pressure is required to force the sewage through the sewer main. There are cleanouts located along the main that are always under pressure, and not currently used for cleaning. The pipe slope is low and reverse slopes at two locations, creating local low points. Figure 1 shows the existing system layout.

The flow velocity in the pipe is low, as there is low sewage flow from the upland collection systems draining into the pipe and the low pipe slope used for design. Because of the low flow velocity, solid deposition occurs and there is no scouring of the pipe. Current peak flows are likely between 100 gpm and 200 gpm which is below the minimum velocity to achieve scouring in an 8-inch pipe. Upland sewage could potentially back up and surcharge, which could lead to a sanitary sewer overflow (SSO) with the current flows.

To keep sewage moving through the pipe and to prevent an SSO, the gravity sewer main requires ongoing weekly maintenance, which is expensive and prevents the City's operation and maintenance (O&M) staff from performing other urgent maintenance work. Currently four (4) members of the sewer O&M crews dedicate Friday mornings to maintaining this main using jetting and vactor equipment. The crew of 4 includes 2 vactor truck operators, 2 flaggers, and a vactor truck. Maintenance is performed at two locations. At the downstream end where the main

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transitions to gravity flow the crew inserts a vactor jet hose up to 900 feet (maximum length) into the sewer from the downstream gravity manhole. The addition of the water and the jetting action will loosen and liquify the material and cause it to flow downstream. After they observe the flow gaining velocity and solids moving through the downstream manhole, they will go to the approximate mid-point of the pipe (Alta Drive), which is a local high point. Sewage backs up to the gravity manhole at Alta Drive but does not surcharge at this location, so the city is able to insert the jet into this manhole and run it down to the main, where they can jet the main and get the material liquified and moving.

The City's proposed solution to improve flow in the gravity main utilizes pumps to increase the velocity so that solids will not settle out and scour velocity can be achieved. There are connections points from upland collection systems that drain into this main, and since the pressure in the main will be increased by the pumps the City will need to address these connections using a combination of check valves and smaller pumping systems.

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Figure 1: Existing Pressurized Gravity Main Layout on Tracyton Beach Road



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Existing Pressurized Gravity Sewer Condition and Capacity

The existing 8-inch ductile iron pipe was installed in 1991 and current conditions of the pipe are unknown. The sewer line has been in service for 30 years and potholing or a CCTV inspection of the system would help identify any potential areas where the pipe may need to be replaced. The existing gravity sewer line's flow and low slope causes the system to back up and create blockages due to solids deposition, See Attachment A. In order to meet a scouring velocity of 3 feet per second through an 8-inch pipe, a minimum flow of 450 gallons is required.

The Washington State Department of Ecology *Criteria for Sewage Works Design* (Orange Book) states that the velocity in the pipe should not exceed 8 feet per second (fps) or drop below 2 fps. Accordingly, the Department of Ecology recommends an optimum pipe velocity between 3.5 and 5 fps for reduced maintenance costs and to prevent the accumulation of solids.

Existing Site Constraints and Impacts to Residents

There are two alternatives being examined for this project which involve varying levels of construction. For each improvement alternative there are minor modifications to the current sewer alignment to tie into proposed lift station(s). The sewer alignment adjustments, to tie the existing sewer line into the proposed lift station, will allow O&M staff to perform maintenance safely out of the roadway. This includes saw cutting the road, adding manholes and new lengths of 8-inch HDPE pipe, utility crossings, and possible land acquisition for the lift station(s). There is also anticipated to be roadway construction, so adequate traffic controls will be necessary. There are several properties along TBR whose only ingress and egress from their homes is on TBR. This will need to be properly managed so that impacts to residents are minimized. During the construction of the lift station(s) it is anticipated that temporary easements will be required to build the lift station(s). The construction along TBR is also next to waterways and proper construction Best Management Practices will need to be implemented to reduce any risk of spill into the waters. There is water line on east side of road which needs 10-feet of horizontal separation and 1.5-feet of vertical separation from any sanitary sewer services.

Geotechnical Considerations

It is not known if a geotechnical report has been prepared for the area. Further investigation will be needed in the areas where the lift station(s) are anticipated to be installed to better understand the soil capacity and any buoyancy restrictions due to the proximity to the water.

System Conditions

Currently an estimated 250 properties, zoned as low density residential in the City's and the Kitsap County's 2016 Comprehensive Plans, discharge to this main and the total number of residences is expected to increase over time. The City and Kennedy Jenks evaluated future capacity requirements by looking at the potential for growth in the area. Reviewing information provided by the City, it was determined five areas have potential for additional build out. Following evaluation of current flows, provided in Chapter 4 of the City's 2014 Wastewater Comprehensive Plan, an estimated 71 gpd per resident, with approximately 2.5 residents per

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household, was used to estimate average flow of the collection area. The average flow was estimated to be 47,038 gpd or 33 gpm. Applying a peaking factor of 4 to the average flow, and an infiltration and inflow factor of 3,000 gallons per day per acre, the peak hour flow at build out is projected to be 564,650 gpd or 392 gpm. Lastly, a growth factor of 20% was applied to reflect future growth in the area. The resulting design capacity is 470 gpm, as shown in Table 1 below. Stormwater flows are collected and conveyed in a separate system and not included in the projections.

Table 1: Lift Station Capacity Projections

	gpd	gpm
Average Flow (gpm)	47,038	33
Peaking Factor		4
Peak Flow	188,150	131
Infiltration and Inflow (I/I)	3,000 (gpd/acre)	
Peak Flow + I/I	564,650	392
Growth Factor		20%
Pump Design Capacity	677,580	471

Wet well sizing is based on the below formula, found in Section C2-1.2.5 of the Orange Book:

$$V = tQ/4$$

V = minimum volume (gallons)

t = minimum time between pump starts

Q = pump capacity (gallons/minute)

This formula identifies the minimum wet-well volume required to prevent a fixed speed pump motor from overheating due to an excessive number of cycles (starts and stops) in a given period of time. The wet well should be designed with a capacity large enough that excessive cycling is minimized and small enough to avoid prolonged detention time. The United States Environmental Protection Agency (EPA) recommends a maximum detention time of 20 to 30 minutes when using constant speed pumps. The detention time can be reduced to 5 to 15 minutes with the use of variable frequency drives. Assuming a maximum of 6 starts per hour, corresponding with a 10-minute pump cycle time, and using the Pump Design Flow of 471 gpm, the required wet well operating volume is 1,175 gallons. An 8-foot diameter wet well with a 3.5-foot operating range should meet the calculated operating volume requirements of 1,316 gallons. The response time, or the time to fill the wet well, for the 8-foot diameter option is 96.8 minutes at a 33-gpm flow rate and 6 minutes at a 471-gpm flow rate.

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Improvement Alternatives

The following sewer alternatives were developed for consideration as part of this evaluation:

Status Quo: No changes to the current operation.

Alternative 1: Two lift stations and new gravity sewer for intercepting gravity lines.

Alternative 2: One lift station with two packaged pump stations at intercepting gravity lines.

The two alternatives are discussed below in terms of how each alternative would address the operational and maintenance issues for the sewer system that the City has identified for improvement. Each alternative includes an Opinion of Probable Construction Cost (OPCC) Class 5 estimate that includes construction costs, engineering design contingency, and construction management costs. Figures 2 and 3 below provide a location map for the two alternatives.

No Action - Status Quo

In the status quo alternative there would be no changes to the current operation and maintenance of the system. This would involve maintenance staff continuing weekly flushing of the gravity sewer line and significant use of O&M staff time. This alternative has a potential risk of spilling into Puget Sound if an overflow occurs due to blockage in the gravity sewer line, and proximity to the water.

Improvement Alternative 1

The first alternative includes the construction of two new lift stations and new gravity sewer lines and manholes to redirect the sewer lateral flows to one of the two new lift stations. The approach for this alternative is to separate the proposed force main from the gravity sewer. The first lift station would be located on Tracyton Beach Road and north of NW Carter Farms Ct at an unnamed intersection. Currently, there does not appear to be enough City owned property for building the lift station, so a permanent easement would be required on the corner lot property. The existing gravity sewer would be re-routed to the proposed lift station and force main redirected to the existing line with a water crossing on the eastside of the road. The second lift station would be located at Pat Vista Park, with most of the same requirements and features of the first lift station. Proposed lift stations will include a wet well, submersible pumps, above grade control panel and emergency backup power. Odor control is not included in the design as the wastewater will have a low residence time through the system.

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Alternative 1 also includes installing a new gravity sewer line to redirect flow from NE 31st St to the first proposed lift station on Tracyton Beach Road and the unnamed intersection. There would need to be approximately 860 feet of 8" HDPE that would run from NE 31st St to the proposed lift station along with four new manholes. See Figure 2 for a layout of the proposed alternative. Alternatively, there are few homes served from Alta Drive, and these homes could be served via residential simplex grinder pump stations that tie into the force main.

The total construction cost estimate for Alternative 1 is estimated to range between \$4,965,000 and \$2,317,000 for the class 5 estimate. A breakdown of the cost can be found in Attachment B.

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Figure 2: Alternative 1 Plan View Layout



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Improvement Alternative 2

This second alternative includes the construction of a new lift station located on Tracyton Beach Road and north of NW Carter Farms Ct at an unnamed intersection. Currently, it is anticipated there will not be enough City owned property for building the lift station, so a permanent easement would be required on the corner lot property. Excavation of the road near the proposed location would be required to access the existing sanitary sewer to re-route the line to the new lift station and back to the existing line. The existing 8-inch ductile iron line will serve as the new force main. There are two connections along Tracyton Beach Road that would require 100 gpm packaged pump stations in the system laterals. The packaged pump stations would be proposed at NE 31st St, and near Gerard Place and Pat Carey Vista Park on the east side of Tracyton Beach Road. See Figure 3 for a layout and proposed location. The proposed lift station, located along Tracyton Beach Road, will consist of a wet well, submersible pumps, above grade control panel and emergency backup power.

The total construction cost estimate for Alternative 2 is estimated to range between \$4,425,000 and \$2,065,000 for the class 5 estimate. A breakdown of the cost can be found in Attachment B.

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Figure 3: Alternative 2 Plan View Layout



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Comparison of Alternatives

The two improvement alternatives plus a status quo alternative were evaluated using evaluation criteria developed with City staff. The criteria included:

1. **Opinion of Probable Construction Cost (OPCC):** This criterion is based on the improvements described in the forementioned alternatives and is a Class 5 estimate for construction cost. See Attachment B for a breakdown.
2. **Annual O&M Expected Labor Hours:** This criterion is based on the improvements described in the forementioned alternatives and the anticipated amount of labor hours required for each alternative.
3. **Maintenance Staff Demand:** This criterion is based on the ease of O&M activities and design conformation to the City Standard and the strain on O&M staff time.
4. **Safety:** This criterion is based on the safety of the given alternative in terms of O&M activities, site security, accessibility, and location.
5. **All Site Issues Addressed:** This criterion is based on whether the sewer system adequately addresses the current site issues which include resolving the high and low spots along the sewer alignment.
6. **Total Lifecycle Cost:** This criterion is based on the improvements described in the forementioned alternatives and the Class 5 estimates for total cost for the corresponding alternatives. See Attachment C for a breakdown.

The above six criteria were scored for each alternative using a Best-Average-Worst scale.

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Table 2: Alternatives Analysis Selection Criteria Scoring

Parameter	Units	ALTERNATIVES		
		Status Quo	Alternative 1	Alternative 2
OPCC	\$	\$	\$4,965,000 - \$2,317,000	\$4,425,000 - \$2,065,000
O&M Labor Hours	Hrs/Yr	832	285	438
Maintenance Staff Demand	High/Low	High	Low	Medium
Safety	Yes/No	No	Yes	Yes
Site Issues Addressed	Yes/No	No	Yes	Yes
20 Yr. Life Cycle Cost Estimate (Total Capital plus 20 Yr. Present Worth O&M)	\$	\$1,423,000	\$5,430,000 - \$2,782,000	\$5,054,000 - \$2,694,000

Notes:

1. Scoring:
 - a. Green = Best
 - b. Yellow = Average
 - c. Pink = Worst
2. See Attachment C for breakdown of Life Cycle Cost.
3. O&M labor hours include sewer staff and WWTP plant staff O&M time

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Evaluation Results

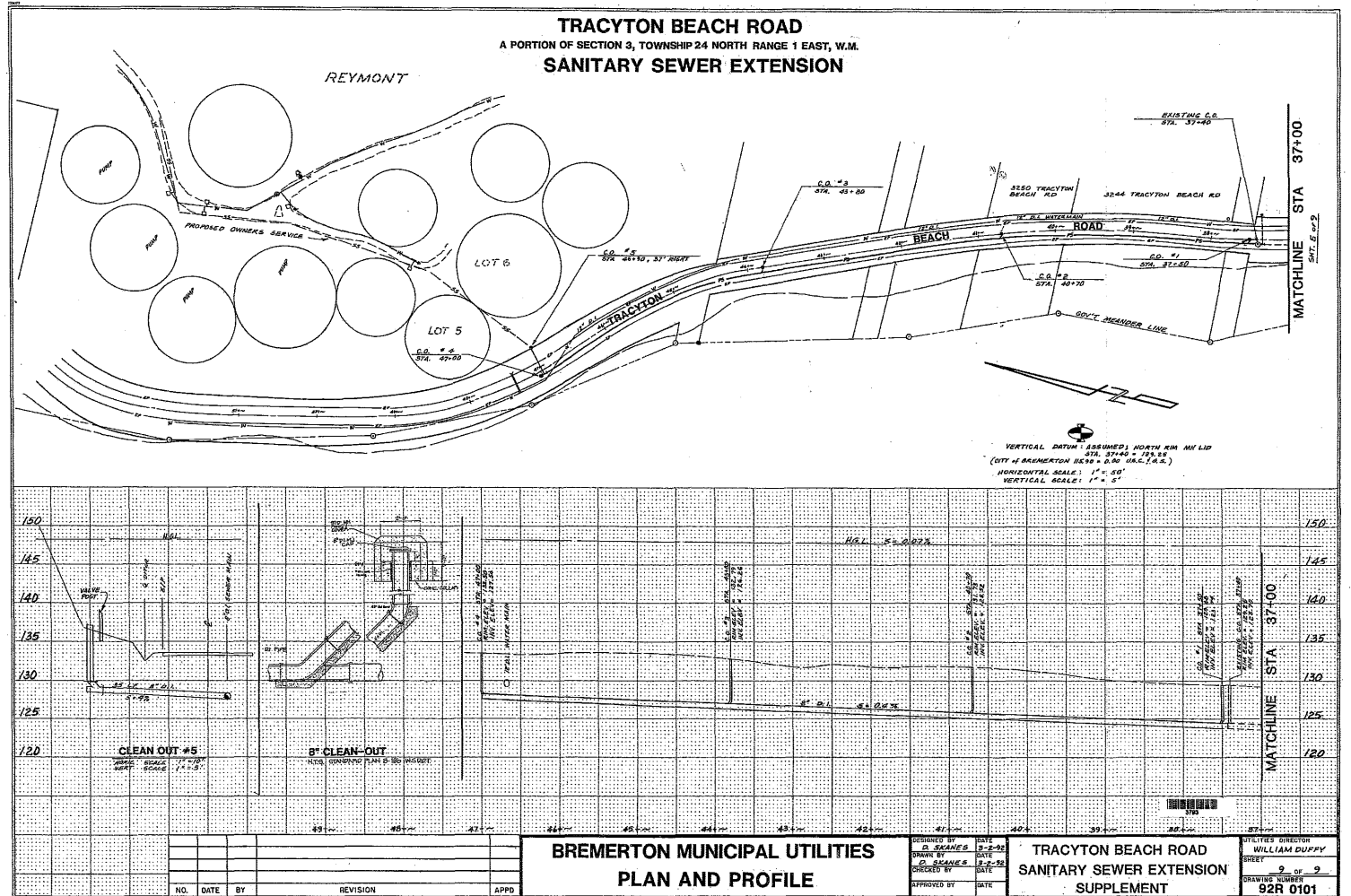
The alternative analysis above suggests both Alternatives provide adequate results that meet the system needs. Alternative 1 is the most conservative design by separating the gravity sewer line installed for system laterals from the force main; however, it requires a longer design and construction schedule, higher engineering and construction costs and larger impact to the community. Alternative 2 is the recommended selection to resolve the low spots in the sewer profile and provide a long-term solution for the City and residents. Further investigation of the alternatives is needed to evaluate pressure in the laterals to confirm proposed packaged pump station locations will operate effectively and drain during or after pump operation. Ultimately, size constraints, space limitations and utility interactions need to be evaluated before a definitive selection can be made.

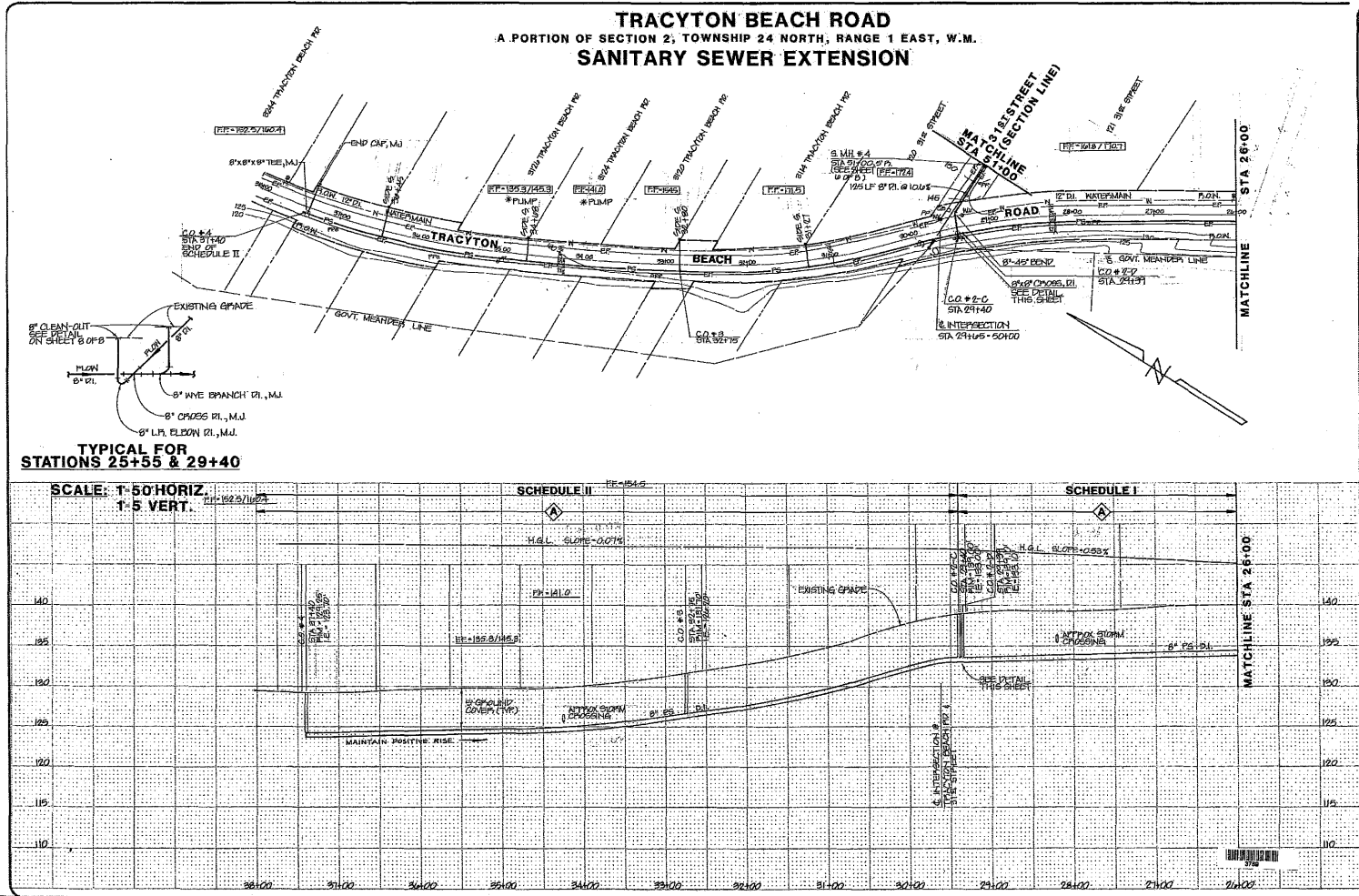
Attachments:

Attachment A: Plan and Profile of Tracyton Beach Road Sewer System
Attachment B: Opinion of Probable Construction Cost
Attachment C: Life Cycle Cost

Attachment A

Plan and Profile of Tracyton Beach Road Sewer System





REVISIONS

NO.	DATE	DESCRIPTION
1	5/21/20	ISSUED FOR PERMITS
2	5/21/20	REVISED PER CITY REQUEST

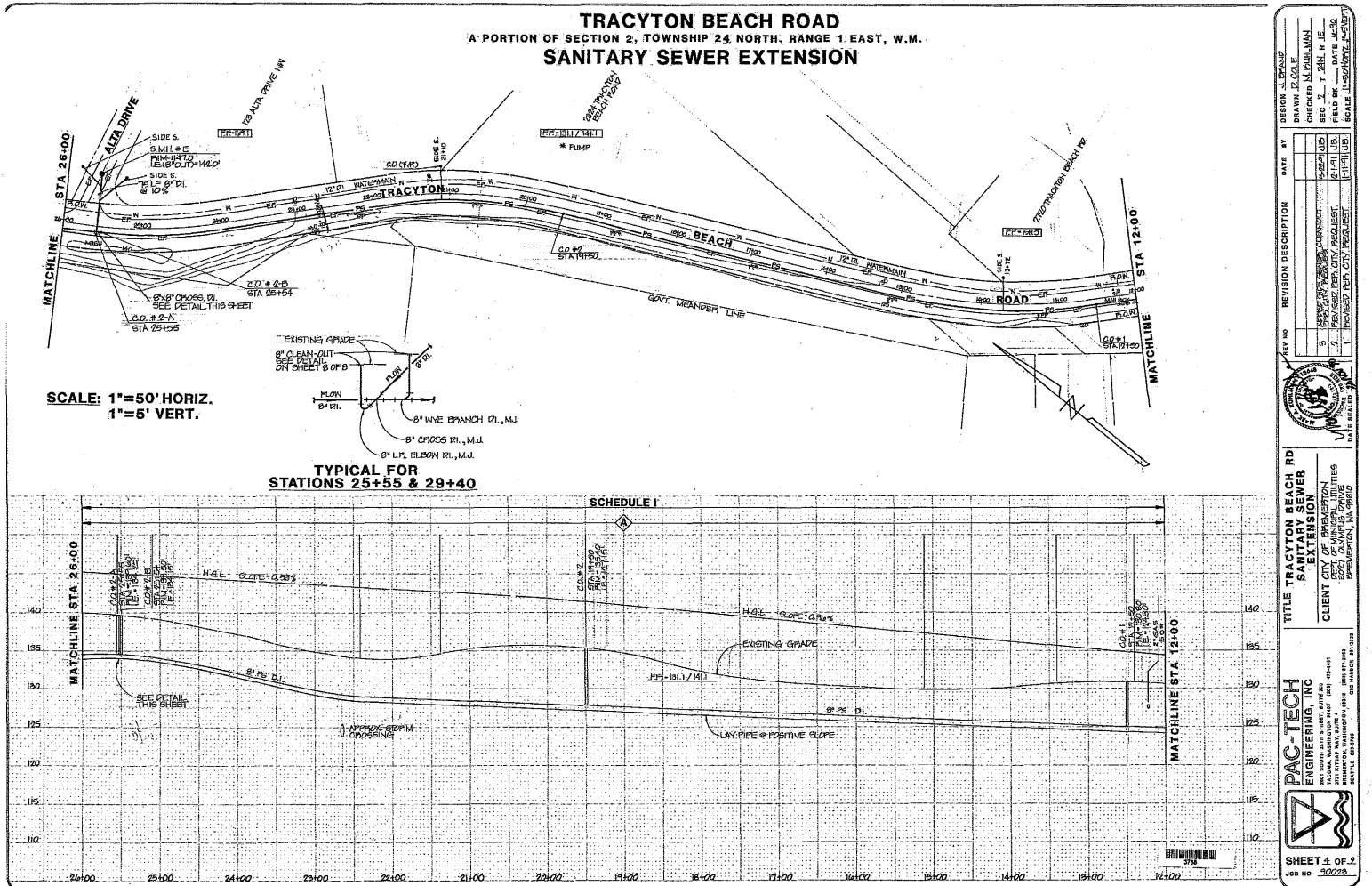
DESIGNER J. S. BROWN
DRAWN M. S. SHAWMAN
CHECKED T. W. B. B.
SCALE 1"=50' HORIZ. 1"=5' VERT.

PAC-TECH ENGINEERING INC.
1000 W. 10TH STREET, SUITE 100
BREMERTON, WA 98512
PH: 360-871-1111
WWW.PAC-TECH-ENGINEERING.COM

TITLE TRACYTON BEACH RD
SANITARY SEWER
EXTENSION

CLIENT CITY OF BREMERTON
5000 QUINCY DRIVE
BREMERTON, WA 98512

SHEET 5 OF 2
JOB NO. 30229



Attachment B

Opinion of Probable Construction Cost

OPINION OF PROBABLE CONSTRUCTION COST - ALTERNATIVE 1

KENNEDY/JENKS CONSULTANTS

Client: City of Bremerton
 Project: Tracyton Beach Sewer
 Location: Bremerton, WA
 Estimate Type: **Conceptual**

Prepared By: JMC
 Date Prepared: 12/2/2021
 K/J Proj. No.: 2197012*00

SUMMARY BY DIVISION

DIV. No.	ITEM DESCRIPTION	MATERIALS	EQUIPMENT & INSTALLATION	SUB-CONTRACTOR	TOTAL
1	General Requirements				see below
2	Existing Conditions	6,166	6,166	95,270	107,602
3	Concrete/ Manholes	261,010	59,230		320,240
5	Metals	2,128	1,024		3,152
6	FRP	6,820	4,520		11,340
9	Finishes	1,000	1,000	37,680	39,680
10	Specialties	500	1,000		1,500
22	Plumbing	29,081	48,106		77,187
26-28	Electrical /Instrumentation/ Communications	295,932	2,500	120,270	418,702
31	Earthwork	34,560	59,320	100,000	193,880
32	Exterior Improvements		243,437	26,720	270,157
33	Utilities	52,932	118,856	9,030	180,819
41	Water & Wastewater Equipment		106,110		106,110
	Subtotal Direct Cost	690,129	651,270	388,971	1,730,369
	Site Overhead/ General Conditions 8%				138,430
	Design/Estimating Contingency 25%				432,592
	Escalate to Midpt of Const. @ 10.0%				432,592
	Subtotals				2,733,984
	Bonds & Insurance 2.5%				68,350
	Contractors Fee @ 15%				410,098
	Subtotals				3,212,431
	Estimated Bid Price				3,212,431
	WA State Sales Tax 10.1%				324,456
	Total Estimate				3,540,000

*Does not include utility service connection fees

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
\$5,310,000	\$3,540,000	\$2,478,000

OPINION OF PROBABLE CONSTRUCTION COST - ALTERNATIVE 2

KENNEDY/JENKS CONSULTANTS

Client: City of Bremerton
 Project: Tracyton Beach Sewer
 Location: Bremerton, WA
 Estimate Type: **Conceptual**

Prepared By: JMC
 Date Prepared: 12/2/2021
 K/J Proj. No.: 2197012*00

SUMMARY BY DIVISION

DIV. No.	ITEM DESCRIPTION	MATERIALS	EQUIPMENT & INSTALLATION	SUB-CONTRACTOR	TOTAL
1	General Requirements				see below
2	Existing Conditions	6,166	6,166	83,230	95,562
3	Concrete/ Manholes	90,505	31,715		122,220
5	Metals	1,064	512		1,576
6	FRP	3,410	2,260		5,670
9	Finishes	500	500	18,840	19,840
10	Specialties	250	500		750
22	Plumbing	8,737	436,247		444,984
26-28	Electrical /Instrumentation/ Communications	147,966	1,250	60,135	209,351
31	Earthwork	17,280	30,660	50,000	97,940
32	Exterior Improvements		18,323	13,360	31,683
33	Utilities	9,147	11,862	680	21,689
41	Water & Wastewater Equipment		448,030		448,030
	Subtotal Direct Cost	285,025	988,026	226,245	1,499,295
	Site Overhead/ General Conditions 8%				119,944
	Design/Estimating Contingency 25%				374,824
	Escalate to Midpt of Const. @ 10.0%				374,824
	Subtotals				2,368,886
	Bonds & Insurance 2.5%				59,222
	Contractors Fee @ 15%				355,333
	Subtotals				2,783,441
	Estimated Bid Price				2,783,441
	WA State Sales Tax 10.1%				281,128
	Total Estimate				3,060,000

*Does not include utility service connection fees

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
\$4,590,000	\$3,060,000	\$2,142,000

Attachment C

Life Cycle Cost

Lift Station Pump Comparison - Present Worth Cost

Design Criteria		Alternatives		
Parameter	Units	Status Quo	Alternative 1 - two pump station w/ gravity sewer	Alternative 2 - One pump station with 2 package pump stations
Costs¹				
Operations & Maintenance				
Operations - Power Calculations				
Power Requirement	HP	0.0	58.0	31.3
Daily Runtime	hrs/day	0	3	3
Power Use	kWh/day	0	130	70
Power Cost	\$/kWh	0.0946	0.0946	0.0946
Annual Power Cost ²	\$/year	\$0	\$4,500	\$2,400
Operations and Maintenance Cost Calculations				
Annual Operational Labor Cost ^{8,11}	\$	\$49,920	\$11,520	\$17,280
Annual Scheduled Maintenance Labor Cost ⁹	\$		\$3,840	\$5,760
Annual Repair Labor Cost	\$		\$1,689	\$3,223
Annual Parts/Supplies Cost ⁷	\$	\$23,070	\$2,267	\$3,589
Annual Maintenance Cost ¹⁰	\$	\$72,990	\$19,316	\$29,852
Annual O&M Cost Estimate (Inclusive of Power ²)	\$/year	\$72,990	\$23,816	\$32,252
O&M Present Worth (20-years, 0.25%) ^{3,4}	\$	\$1,423,000	\$465,000	\$629,000
Capital Cost Calculations ⁵				
Lift Station Capital Cost ⁶	\$		\$3,540,000	\$3,060,000
20 Yr. Life Cycle Cost Estimate (Total Capital plus 20 Yr. Present Worth O&M)	\$	\$1,423,000	\$4,005,000	\$3,689,000

Notes:

1. All costs are in 2021 dollars.
2. Industrial electricity rates in Bremerton assumed at \$0.0946/kWh using local areas
3. Federal Real Discount Rate is assumed at 0.25%.
4. O&M values include maintenance (labor at \$60/hr and parts) and power.
5. Capital cost estimates are for two pumps (one duty; one standby) per wetwell.
6. Includes pumps, local controls, accessories, shipping, and startup
7. Assume 450 GPM for 4 hours on status quo to clean line
8. Assumed \$60/hr for labor, half Day, once a month per pump, crew of 2. Status quo refer to Ecology Submittal
9. Assumed \$60/hr for labor, full Day, twice year per pump, crew of 2; Status quo refer to Ecology Submittal
10. From vendor: 500 for parts per pump and 30% of pump cost every 10 years in maintenance.
11. 60/hr x half day x once per week x 4 people for status quo only

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