Appendix G: Crosstown Pipeline Memorandum

Kennedy Jenks

32001 32nd Avenue South, Suite 300
Federal Way, WA 98001
(253) 835-6400

Crosstown Pipeline Alternatives Analysis

4 February 2025

Prepared for

City of Bremerton
345 6th Street
Bremerton, WA 98337

KJ Project No. 2397011*00

Table of Contents

Table of Contents (cont'd)

List of Tables

List of Figures

List of Appendices

Section 1: Introduction

The Crosstown Pipeline (CTP), originally constructed in 1984, plays a key role in the City of Bremerton's (City's) collection system infrastructure. The high-capacity pipeline extends from the northeast quadrant of West Bremerton approximately 20,000 linear feet (LF) to the Westside Wastewater Treatment Plant (Westside WWTP), also referred to as the Westside Treatment Plant (WTP). Starting at Sewage Pump Station CE-1, the pipeline is comprised of 24-inch cement-lined ductile iron pipe (DIP), 30-inch DIP (CIPP-lined in 2012), 36-inch HDPE (installed in 2012), 30-inch prestressed concrete cylinder pipe (PCCP), and 36-inch PCCP, which ends immediately upstream of the WTP headworks. The CTP receives flows from pump stations CE-1, CW-1, CW-4, CE-4 (via the Central Bremerton Force Main), WB-3, WB-6, WB-1 and WB-2 (both owned and managed by Kitsap County Sewer District No. 1), SB-1, SB-3, and SB-4. The CTP acts both as a gravity and pressure main. Approximately 11,000 LF of the initial section of the CTP starting at the WTP is lower than the headworks and therefore always pressurized. Moving further upstream from the WTP, the elevation of the CTP increases and flow occurs via gravity. However, these sections can become pressurized during high flow conditions caused by wet weather events. During these events, the pipeline is capable of safely conveying up to approximately 30 MGD to the Westside WWTP.

Kennedy/Jenks Consultants, Inc. (Kennedy Jenks) has been retained by the City to develop conceptual alternatives for increasing the capacity and reliability of the CTP. This analysis has been performed in conjunction with the 2024 update to the City's Wastewater Comprehensive Plan (WCP), for which Kennedy Jenks has also been retained. As such, the analyses herein consider collection system flows across the planning horizon of 2024-2044.

Kennedy Jenks has assessed each conceptual alternative with respect to select criteria developed collaboratively with City personnel, yielding an overall score for each alternative.

Section 2: Alternatives Analysis

Per discussions with the City held September 27, 2024, Kennedy Jenks progressed two pipeline alignments through conceptual design. The different alignments include options for sizing the pipeline, based on the intended use of the new pipeline. A total of three alternatives were developed that utilize two different pipeline alignments. Each alternative developed includes proposed alignment routing, approximate quantity and type of utility crossings, constructability considerations, potential risks and a Class 5 cost estimate per the Association for the Advancement of Cost Engineering (AACE) guidelines.

2.1 Alternative 1A – Larger Parallel Pipeline

2.1.1 General Description

Alternative 1A proposes to install a pipeline beginning near the intersection of 9th Street and Montgomery Avenue that runs predominantly parallel to the existing CTP to the Westside WWTP, approximately 11,500 LF. At the pipeline start, an existing blind flange at the intersection can be modified to convey upstream flow to either the existing CTP or the new, parallel CTP. A flow split structure or valving will be added at the junction of the CTP and the Central Bremerton Force Main (CBFM). Each pump station that conveys flow to the CTP downstream of the parallel pipeline origin will undergo pipeline connection improvements to allow for conveyance to the proposed parallel pipeline in addition to the existing connection to the existing CTP. Figure 2-1 below illustrates the alternative.

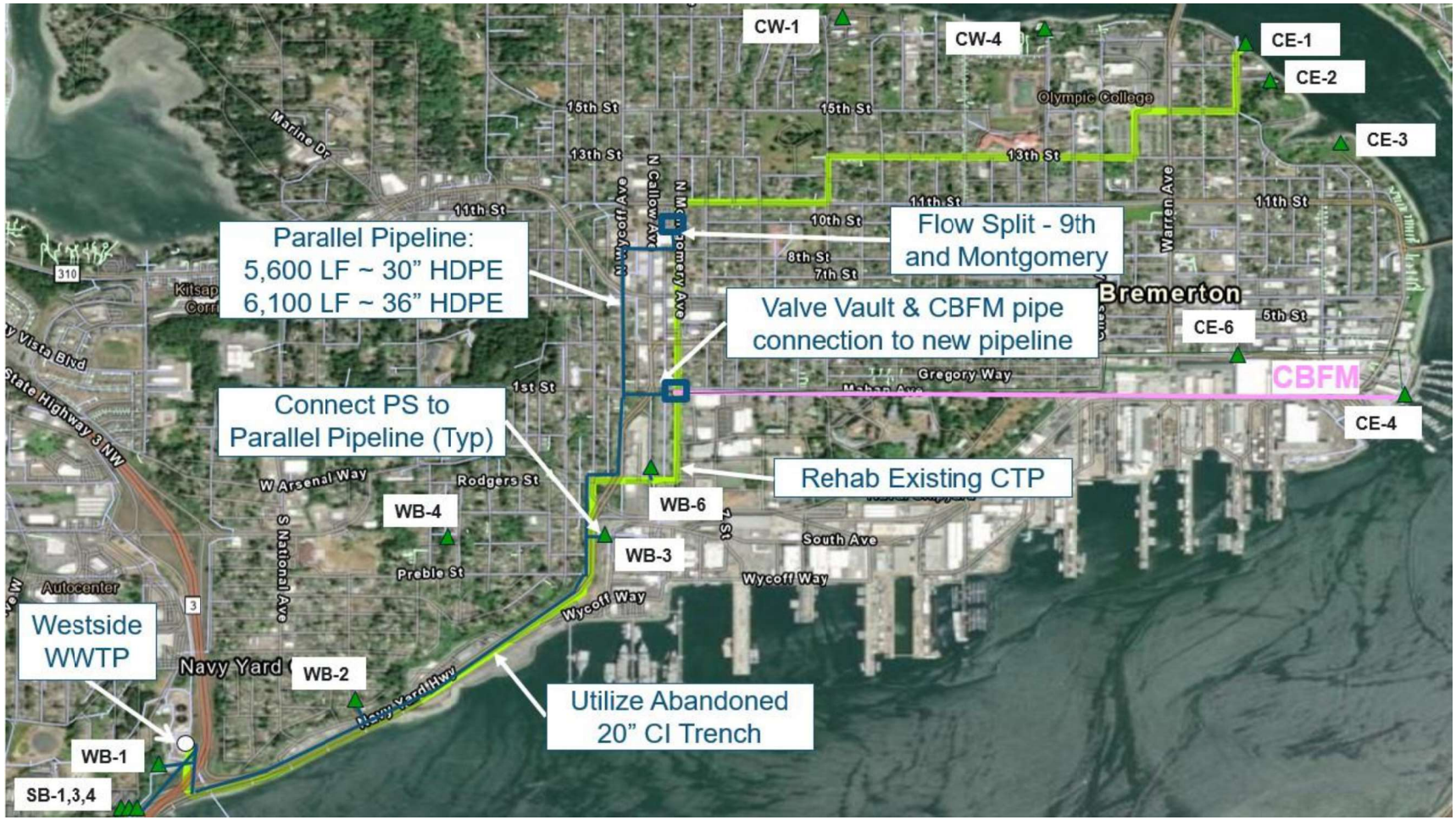

Figure 2-1: Alternative 1A - Larger Parallel Pipeline Concept

2.1.2 Pipeline Capacity

As part of the 2024 WCP Update (2024, Kennedy Jenks), the City's population growth and subsequent collection system loading were assessed across the planning horizon of 2024-2044 with respect to each sewer basin.

The proposed pipeline is sized as 30-inch and 36-inch, similar to the existing CTP, to allow for full redundancy and operational flexibility downstream of the origin point, with capacity for average dry weather and peak wet weather flows through 2044. Table 2-1 and Table 2-2 evaluate the proposed pipeline sizes for each segment against the projected 2024 and 2044 flows, respectively. Through the planning horizon, the velocity through the pipeline during the dry weather season is below two feet per second, the typical design standard for minimum flow through a sewer. Settling of solids within the pipeline may occur, which can cause odor control issues within the pipeline.

Table 2-1: Pipeline Capacity Servicing 2024 Flows

	Wet Weather			Dry Weather		
CTP Pipe Segment	**Cumulative PHF[1] (gpm)**	**Pipe Size (Inches)**	**Pipe Velocity (ft/s)**	**Cumulative ADWF[1] (gpm)**	**Pipe Size (Inches)**	**Pipe Velocity (ft/s)**
Origin to CE-4 (CBFM/CTP Junction)	11,685	30	5.8	1,107	30	0.9
CE-4 to WB-6	12,234	30	6.0	1,111	30	0.9
WB-6 to WB-3	17,869	36	6.2	1,113	36	0.6
WB-3 to WB-1[2]	24,798	36	8.5	1,693	36	0.8
WB-1[2] to WB-2[2]	25,028	36	8.6	1,722	36	0.8
WB-2[2] to SBFM[2,3]	25,808	36	8.9	1,819	36	0.9
SBFM[3] to WTP	27,788	36	9.6	2,067	36	1.0

Notes:

(1) Peak hourly flows (PHFs) and Average Dry Weather Flows (ADWFs) based on 2023 pump station data provided by City in gallons per minute (gpm).

(2) No current pump station data provided. Flows based on 2013 pump station data per 2014 Wastewater Comprehensive Plan Update report.

(3) Average dry weather flows (ADWFs) from SB-1, SB-3, and SB-4 conveyed via South Bremerton Force Main (SBFM)

Table 2-2: Pipeline Capacity Servicing 2044 Flows

CTP Pipe Segment	Wet Weather			Dry Weather		
	Cumulative PHF[1] (gpm)	Pipe Size (Inches)	Pipe Velocity (ft/s)	Cumulative ADWF[1] (gpm)	Pipe Size (Inches)	Pipe Velocity (ft/s)
Origin to CE-4 (CBFM/CTP Junction)	14,289	30	6.5	1,762	30	0.8
CE-4 to WB-6	15,037	30	6.8	1,790	30	0.8
WB-6 to WB-3	20,673	36	6.5	1,792	36	0.6
WB-3 to WB-1[2]	27,767	36	8.8	2,396	36	0.8
WB-1[2] to WB-2[2]	27,997	36	8.8	2,425	36	0.8
WB-2[2] to SBFM[2,3]	28,777	36	9.1	2,522	36	0.8
SBFM[3] to WTP	32,564	36	10.3	2,983	36	0.9

Notes:

(1) Peak hourly flows (PHFs) based on 2023 pump station data provided by City in gallons per minute (gpm).

(2) No current pump station data provided. Flows based on 2013 pump station data per 2014 Wastewater Comprehensive Plan Update report.

(3) Average dry weather flows (ADWFs) from SB-1, SB-3, and SB-4 conveyed via South Bremerton Force Main (SBFM)

Per conversations with the City in November 2024, there are concerns and unknowns about the condition of the existing CTP. The proposed pipeline in this alternative is sized for full capacity of the contributing flows to the CTP, thereby reducing the criticality of failure for the existing CTP.

2.1.3 Pipeline Alignment

The proposed alignment follows the existing CTP closely to limit the construction scope required to connect the downstream pump stations, Central Bremerton Force Main, and South Bremerton Force Main to the parallel pipeline. The connection points included in this alternative allow for the CE-4, WB-6, WB-3, WB-1, WB-2, and SB-1/3/4 (via SBFM) pump stations to convey into the existing CTP or the proposed parallel pipeline.

A significant portion of the proposed pipeline runs within a Washington State Department of Transportation (WSDOT) limited access-full control corridor along Charleston Boulevard. These types of corridors are historically difficult for contractually negotiating longitudinal pipeline access. The City already has two pipelines running longitudinally through this corridor: the existing CTP and an abandoned 20-inch cast iron pipeline. Per City GIS, the abandoned pipeline runs approximately from the connection point of WB-3 to the CTP to the Westside WWTP. The proposed alternative assumes WSDOT will accept the design intent to utilize the trench to remove the abandoned line and replace it with the proposed 36-inch pipeline.

The proposed parallel pipeline must cross State Route 3 to reach the Westside WWTP. This section of the State highway is also a WSDOT limited access-full control corridor. Per conversations with WSDOT personnel in September 2024, perpendicular crossings of these types of corridors are historically viable. The existing CTP makes such a crossing in the same area as the proposed parallel pipeline.

The proposed pipeline follows a similar alignment to the existing CTP but avoids several utility-congested intersections at the upstream portion. Specifically, the Montgomery Avenue right-of-way includes some large diameter water lines, therefore the proposed pipeline follows 9th Street further west of Montgomery to Wycoff Avenue. The pipeline then travels south down Wycoff Avenue, instead of Montgomery Avenue; this road has more available space for the new pipeline. The CBFM will also connect to the new pipeline on Wycoff Avenue to avoid the congested utilities in Montgomery Avenue. A valve vault located near 1st Street and Montgomery Ave will provide a connection between the existing CTP and CBFM and it will also connect to a new pipeline that travels west until it connects to the proposed pipeline at 1st Street and Wycoff. Table 2-3 summarizes the approximate number of utility crossings:

Table 2-3: Alternative 1A Utility Crossings

	Water Crossings[1]	Sewer Crossings[1]	Storm Crossings[1]	Gas/Electrical/Telecom Crossings (Each)[2]
Alternative 1A	18	7	30	14

Notes:

(1) Water/Sewer/Storm Crossings quantified per City GIS

(2) Gas/Electrical/Telecommunications Crossings estimated based on the number of road crossings

2.1.4 Construction Sequencing

A proposed sequence of constructing this alternative, to achieve the goals of increasing capacity and providing opportunity to assess the condition of and rehabilitate the existing CTP could be as follows:

1. Construct a means of flow splitting at 9th Street and Montgomery Avenue. An existing cross with a 30-inch blind flange can be utilized for the beginning of the parallel pipeline. Additional valving on the existing CTP to provide flow isolation would be required.

2. Construct the parallel pipeline, and construct pump station connections to the parallel pipeline, as well as the CBFM connection.

3. Perform condition assessments and execute rehabilitation of the existing Crosstown Pipeline. The parallel pipeline is sized for peak wet weather flows, so construction and condition assessments can take place in the dry weather or wet weather months if necessary. The existing CTP can be taken offline in full for the assessments and rehabilitation.

2.1.5 Alternative 1A Challenges

At the conceptual level, the following challenges have been identified for this alternative:

- Considerable WSDOT coordination will be required to obtain approval to construct or rehabilitate infrastructure in the limited access-full control corridor along Charleston Boulevard.
- Additional WSDOT coordination will be required for crossing under State Route 3 next to the WTP.
- The condition of the abandoned 20-inch cast iron pipe and trench is largely unknown. More investigation into the pipe's condition is needed to assess feasibility of removing and replacing this pipeline.
- All connection points to the CTP need to be investigated further to determine the constructability of select discharging into the existing CTP and the proposed parallel line. Such investigations include alignment routing, connection point condition assessment, nearby utility potholing, and permitting.

2.2 Alternative 1B – Smaller Parallel Pipeline

2.2.1 General Description

Alternative 1B is nearly identical to Alternative 1A, with the parallel pipeline sized for dry weather flows instead of wet weather flows. The reduction in pipeline capacity introduces the possibility to utilize the abandoned 20-inch CI pipe, instead of Alternative 1A's scope of removing the pipe and utilizing the trench for a larger pipe. The proposed flow splitting structures and the proposed pipeline connection improvements for each pump station will remain the same as Alternative 1A. Figure 2-2 below illustrates the alternative.

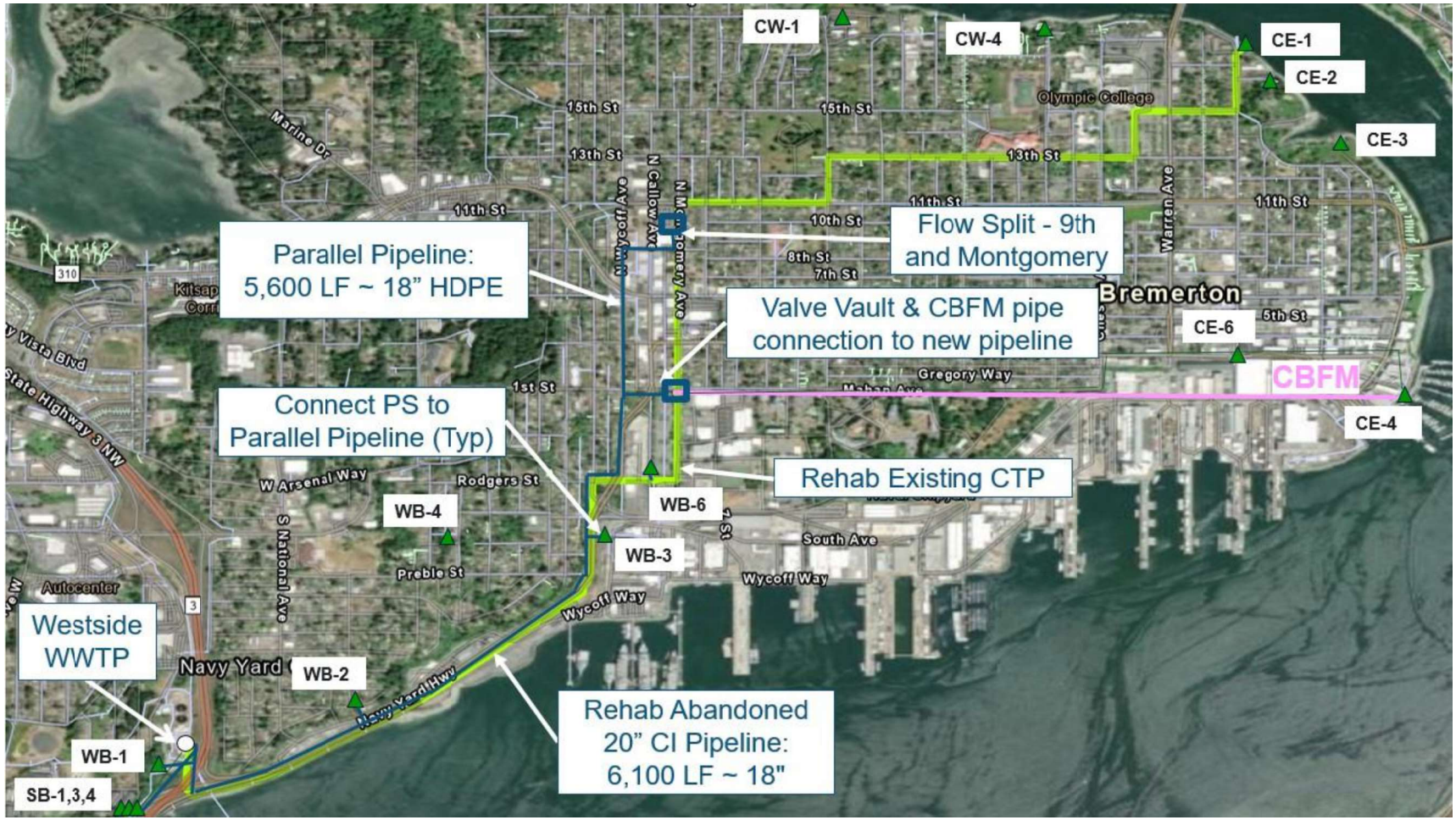

Figure 2-2: Alternative 1B - Smaller Parallel Pipeline Concept

2.2.2 Pipeline Capacity

Alternative 1B is sized for average dry weather flow. The proposed pipeline is 15-inches and 18-inches to meet minimum velocity standards in the 2024 flow regime and accommodate future increases in flow across the 20-year horizon. The pipeline capacity sizing across the 2024-2044 planning horizon is summarized in Table 2-4 below.

Table 2-4: Pipeline Capacity Servicing Dry Weather Flows

	2024			2044		
CTP Pipe Segment	**Cumulative ADWF[1] (gpm)**	**Pipe Size (Inches)**	**Pipe Velocity (ft/s)**	**Cumulative ADWF[1] (gpm)**	**Pipe Size (Inches)**	**Pipe Velocity (ft/s)**
Origin to CE-4 (CBFM/CTP Junction)	1,107	15	2.0	1,762	15	3.2
CE-4 to WB-6	1,111	15	2.0	1,790	15	3.2
WB-6 to WB-3	1,113	15	2.0	1,792	15	3.3
WB-3 to WB-1[2]	1,693	18	2.1	2,396	18	3.0
WB-1[2] to WB-2[2]	1,722	18	2.2	2,425	18	3.1
WB-2[2] to SBFM[2,3]	1,819	18	2.3	2,522	18	3.2
SBFM[3] to WTP	2,067	18	2.6	2,983	18	3.8

Notes:

(1) 2024 Average Dry Weather Flows (ADWFs) based on 2023 pump station data provided by City in gallons per minute (gpm).

(2) No current pump station data provided. 2024 flows based on 2013 pump station data per 2014 Wastewater Comprehensive Plan Update report.

(3) Average dry weather flows (ADWFs) from SB-1, SB-3, and SB-4 conveyed via South Bremerton Force Main (SBFM)

2.2.3 Pipeline Alignment

The proposed alignment for Alternative 1B follows that of Alternative 1A exactly. The first section of pipe will be brand new pipe, however the proposed alternative involves rehabilitating the abandoned 20-inch CI pipe within the WSDOT limit access-full control corridor. At WB-3, the abandoned 20-inch DI pipe will be rehabilitated and connected to new 18-inch pipe.

A significant portion of the proposed pipeline runs within a WSDOT limited access-full control corridor along Charleston Boulevard and the proposed parallel pipeline must cross State Route 3 to reach the Westside WWTP. Additionally, Alternative 1B will also install a valve vault that connects the existing CTP and CBFM at the same location as Alternative 1A. The approximate number of utility crossings from Table 2-3 above applies to both Alternatives 1A and 1B.

2.2.4 Construction Sequencing

A proposed sequence of constructing this alternative, to achieve the goals of increasing capacity and providing opportunity to assess the condition of and rehabilitate the existing CTP could be as follows:

1. Construct a means of flow splitting at 9th Street and Montgomery Avenue. An existing cross with a 30-inch blind flange can be utilized for the beginning of the parallel pipeline. Additional valving on the existing CTP to provide flow isolation would be required.

2. Construct the parallel pipeline, and construct pump station connections to the parallel pipeline, as well as the CBFM connection.

3. During the summer months, perform condition assessments and execute rehabilitation of the existing Crosstown Pipeline. The parallel pipeline is sized for average dry weather flows, therefore condition assessments and rehabilitation efforts should be timed around rain events. During the wet weather season, condition assessments and rehabilitation should not be conducted.

2.2.5 Alternative 1B Challenges

At the conceptual level, the following challenges have been identified for this alternative:

- Considerable WSDOT coordination will be required to obtain approval to construct or rehabilitate infrastructure in the limited access-full control corridor along Charleston Boulevard.

- Additional WSDOT coordination will be required for crossing State Route 3.

- The condition of the abandoned 20-inch cast iron pipe is largely unknown. This Alternative assumes the 20-inch pipe can be lined and rehabilitated with a less invasive method than open trench construction.

- All connection points to the CTP and the 20-inch abandoned cast-iron pipe need to be investigated further to determine the constructability of select discharging into the existing CTP and the proposed parallel line.

- There is always a risk of unplanned wet weather events which could dramatically increase the flow within the new pipeline that is sized only for conveying dry weather flows. The development of a standard operating procedure (SOP) to account for wet weather events while the smaller pipeline is in use is recommended.

2.3 Alternative 2 – Alternate Alignment

Alternative 2 proposes to install a pipeline beginning near the intersection of 9th Street and Montgomery Avenue that runs parallel to the existing CTP for approximately 3,500 linear feet before turning west along a new horizontal alignment, primarily along Preble Street, before crossing Route 3 and reaching the Westside WWTP, totaling approximately 11,500 linear feet. At the pipeline start, a flow splitting structure will be constructed with valving to convey flow from the upstream pump stations (CE-1 and CW-1) to either the existing CTP or the proposed pipeline. To convey wastewater uphill and into the Westside WWTP, a new pump station will be constructed, and the remaining pipeline will be pressurized force main. Figure 2-3 below summarizes the alternative.

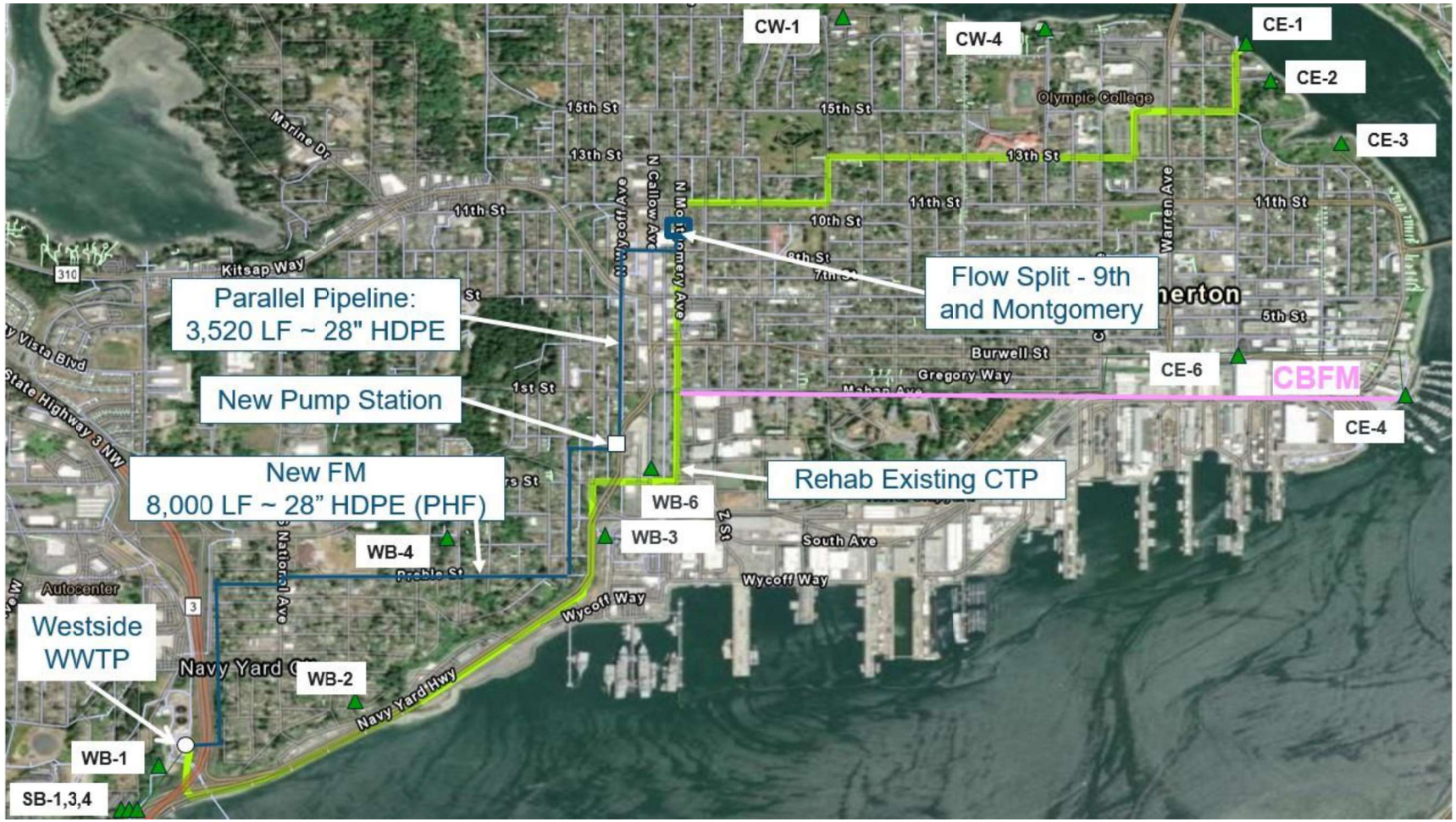

Figure 2-3: Alternative 2 – Alternative Alignment Concept

2.3.1 Pipeline Capacity

The proposed alternative will be capable of conveying flow from CE-1 and CW-1 to the WWTP without using the CTP; downstream pump station connections will continue to discharge to the existing CTP. The proposed pipeline is sized to handle peak hour wet weather flows of these upstream pump stations, as its primary function would be to reduce flow through the existing CTP during peak wet weather events. The pipeline capacity of the proposed alternative pipeline at both ends of the 20-year planning horizon is described in Table 2-5.

Table 2-5: Proposed Pipeline Capacity Servicing 2024-2044 Wet Weather Flows

	2024			2044		
Pipe Segment	**Cumulative PHF[1] (gpm)**	**Pipe Size (Inches)**	**Pipe Velocity (ft/s)**	**Cumulative PHF[2] (gpm)**	**Pipe Size (Inches)**	**Pipe Velocity (ft/s)**
Origin to New PS	11,685	30	5.3	16,590	30	7.5
New PS to WTP	11,685	28	6.1	16,590	28	8.6

Notes:
(1) Flows based on 2023 pump station data provided by City
(2) Flow based on population growth data per Kitsap County Planning Policies (2021).

With reduced flow necessary through the existing CTP during wet weather events, the existing Crosstown Pipeline will have sufficient capacity for 2024 and 2044 peak wet weather flows even with rehabilitation of the pipeline resulting in a reduction in capacity. A summary of the existing CTP capacity under this alternative is shown in Table 2-6.

Table 2-6: Existing CTP Servicing 2024-2044 Flows (excluding CE-1 and CW-4)

	2024			2044		
CTP Pipe Segment	**Cumulative PHF[1] (gpm)**	**Pipe Size (Inches)**	**Pipe Velocity (ft/s)**	**Cumulative PHF[2] (gpm)**	**Pipe Size (Inches)[3]**	**Pipe Velocity (ft/s)**
Origin to CE-4[4]	-	-	-	-	-	-
CE-4 to WB-6	549	30	0.3	2,404	26	1.5
WB-6 to WB-3	6,184	30	3.7	9,993	26	6.0
WB-3 to WB-1[5]	13,113	36	5.2	15,956	32	6.4
WB-1[5] to WB-2[5]	13,343	36	5.3	16,456	32	6.6
WB-2[5] to SBFM[5,6]	14,123	36	5.6	17,456	32	7.0
SBFM[6] to WTP	16,103	36	6.4	19,656	32	7.8

Notes:
(1) Flows based on 2023 pump station data provided by City
(2) Flow based on population growth data per Kitsap County Planning Policies (2021).
(3) Assuming rehabilitation results in reduction of pipeline diameter
(4) CE-4 contributes to the CTP via the CBFM
(5) No current pump station data provided. Flows based on 2013 pump station data per 2014 Wastewater Comprehensive Plan Update report.
(6) Flows from SB-1, SB-3, and SB-4 conveyed via South Bremerton Force Main (SBFM)

2.3.2 Pipeline Alignment

The proposed alignment follows the existing CTP along Montgomery Avenue, then deviates west before reaching a proposed new pump station. The pump station will convey flow to the Westside WWTP by way of Lafayette Avenue, Preble Street, and Bremerton Boulevard. Lafayette Avenue and Preble Street are residential in this area, with less congested underground utilities along the route. The City has existing infrastructure along Bremerton Boulevard, adjacent to State Route 3. The proposed alignment avoids the WSDOT limited access-full control corridor along Charleston Boulevard, reducing the permitting-related risks to construct the pipeline. A portion of the proposed new pipeline along Preble Street does enter Kitsap County right-of-way within the Navy Yard City neighborhood.

The connection points included in this alternative allow for the CE-1, CW-4, and CW-1 pump stations to convey into the existing CTP or the proposed parallel pipeline.

The proposed alignment must cross State Route 3 to reach the Westside WTP. This section of the State highway is also a WSDOT limited access-full control corridor. Per conversations with WSDOT personnel in September 2024, perpendicular crossings of these types of corridors are historically viable. The proposed alignment crosses State Route 3 near an existing City sewer crossing.

The proposed pipeline is expected to make several utility crossings along the proposed alignment. The Montgomery Avenue right-of-way includes some large diameter waterlines, but the sections along Lafayette Avenue, Preble Street, and Bremerton Boulevard are areas with less congested utility corridors and intersections. Table 2-7 below summarizes the approximate quantity of utility crossings related to the alternative.

Table 2-7: Alternative 2 Utility Crossings

	Water Crossings[1]	Sewer Crossings[1]	Storm Crossings[1]	Gas/Electrical/Telecom Crossings (Each)[2]
Alternative 2	30	8	36	24

Notes:

(1) The Water/Sewer/Storm Crossings were quantified utilizing the City's GIS

(2) The Gas/Electrical/Telecommunications Crossings were quantified by summating the number of road crossings in the City's GIS

2.3.3 Alternative 2 Challenges

At the conceptual level, the following risks and challenges have been identified for this alternative:

- Land acquisition will be required for locating the newly proposed pump station.
- WSDOT coordination will be required for crossing State Route 3.
- Coordination with Kitsap County will be required for crossing through Navy Yard City.

2.4 Alternative Costs

Project capital construction costs were developed for each alternative to gain an understanding of the potential costs for equipment and high-level construction requirements. Several markups were also applied to these estimates to provide a preliminary cost for ancillary project needs such as costs for electrical, instrumentation and controls and permitting. A summary of the ranges of costs is presented below in Table 2-8. The detailed estimates with assumed markups and taxes are included in Appendix A.

Table 2-8: Alternative Capital Costs

Alternative	Capital Cost	Cost Estimate Range[1]
1A - Parallel Pipeline (Larger Pipe)	$27.6M	$19.3M - $41.4M
1B - Parallel Pipeline (Smaller Pipe)	$20.9M	$14.6M - $31.4M
2 - Alternative Alignment	$29.2M	$20.4M - $43.8M

Notes:
(1) AACE Class 5 cost estimate range -30%/+50%

Section 3: Alternatives Evaluation

Each alternative was evaluated based on established weighted criteria relevant to the City's needs and priorities. The evaluation yielded a weighted score for each alternative.

3.1 Criteria Descriptions

A defined set of criteria was developed with the City to evaluate the alternatives, as follows:.

- Constructability
- Rehabilitation of CTP
- Capital Cost
- Operation & Maintenance
- Redundancy
- Ease of Permitting

3.1.1 Constructability

Each alternative has a unique layout and set of spatial constraints. With different layouts, there are a mix of utility crossings required for each alternative. The estimated quantity of required utility crossings was leveraged as a predictor of the level of effort required to install a new pipeline. Additionally, larger pipelines were scored lower than smaller pipelines, as they are more difficult to determine a viable location where all minimum utility offsets are met.

3.1.2 Capital Costs

For each project there are costs associated with rehabilitating the existing CTP and completing bypass pumping during the rehabilitation. The duration of bypass pumping required varies for each project depending on the proposed locations to tie-in the existing flow. One of the largest project costs is the amount of new piping required for the new pipeline. The newly proposed lines vary between 18-inch and 36-inch HDPE pipes. Each alternative also has costs associated with the amount of utility crossings, Route 3 crossing costs, land acquisition and traffic control costs. All alternatives also include at least one new flow split structure as well as reconnection costs to one or more existing pump stations. Each alternative was scored based on the estimated probable construction cost. The most expensive alternatives were scored the lowest and the least expensive were scored the highest.

3.1.3 Redundancy

Per conversations with the City describing each concept, redundancy was identified as one the City's top priorities. Redundancy in this application is defined as the amount of flow that can be received by each alternative, and whether the alternative can wet weather flows in addition to dry season flows.

3.1.4 Rehabilitation of the Existing CTP

The existing section of the CTP that the City is most concerned about and would like to rehabilitate is approximately 11,000 LF of PCCP. The current condition is largely unknown and there is no way to currently bypass or divert flow in order to perform a condition assessment.

Similar large pipes in the system have experienced pipe breaks and have identified major structural issues, therefore the City has prioritized rehabilitating the existing CTP since currently there is no redundancy for this section. Each alternative was scored by the ease of bypass pumping during rehabilitation and ability to receive flow during rehabilitation. Alternatives where excessive bypass piping was required scored lowest and alternatives where easy connections can be made during bypass pumping scored higher.

3.1.5 Operations & Maintenance

Adding a new pipeline to the current system introduces new operational opportunities and challenges. Alternatives that have more flexibility during operations can be useful but could also introduce complications if they are not managed correctly. More operationally complex alternatives were scored lower than simpler designs that do not require operational interference. Installing new pipelines and pump stations increases the amount of infrastructure the City is required to maintain. Alternatives with the most amount of additional piping or new construction elements (e.g., flow splitters, pump stations) scored lower than simpler designs.

3.1.6 Permitting

Securing the required permits and coordination are required before moving forward with any alternative, and the relative difficulty in obtaining approval from authorities having jurisdiction has been factored into evaluating each alternative. Part of the existing CTP is located parallel to the Puget Sound Naval Shipyard and a downstream section is within a WSDOT limited access-full control corridor, parallel to Charleston Boulevard and a railroad. All alternatives require crossing State Highway 3 is mandatory to reach the Westside WWTP. Furthermore, some alternatives may require land acquisition for any permanent fixtures outside of an already established right-of-way. Alternatives with less permitting complications were scored the highest.

3.2 Alternatives Criteria Matrix

Every alternative was scored utilizing the Criteria Evaluation Matrix in Table 3-1. The justification for each score is detailed for each criterion, and the criterion weight is also denoted. The criterion weights were collaboratively determined with City Operations and Project Management staff during workshops preceding the finalization of this memorandum.

Table 3-1: Criteria Evaluation Matrix

	Scoring			
Criteria	3	2	1	1
Cost (20%)	Total cost <$25,000,000. Costs can be covered by reallocating authorized funding in operational or CIP budgets.	Total cost between $25,000,000-$30,000,000. Costs require additional funding through council approval	Total Cost $30,000,000-$50,000,000. Requires extensive funding.	>$50,000,000. Project costs are incredibly high and unreasonable to move forward with the project.
Constructability (15%)	The proposed pipeline is small (<30") and crosses through primarily neighborhood intersections.	The proposed pipeline is small (<30") and crosses through many congested intersections.	The proposed pipeline is large (>30") and crosses through many congested intersections.	The alternative is not feasible to construct
Redundancy (15%)	New line can handle all maximum PHF during wet weather conditions and can withstand all flow that goes to the existing CTP.	New line provides full redundancy for dry weather flows and can withstand additional wet weather flows.	New line can only withstand ADWF or overflows from storm events not greater than ADWFs.	New line cannot handle the ADWF and can only withstand smaller overflows or low flow Summer ADWF.
Rehab of CTP (25%)	Existing CTP can be taken offline while new pipe can withstand all upstream, downstream and connecting flows in the system.	Existing CTP can be taken offline, one section at a time, while new pipe withstands the partial flows.	Existing CTP can be taken offline, one section at a time, but alternative sewers or excessive bypassing is required to handle existing flows.	New pipe will not be able to be utilized at all to divert any flow during rehabilitation of existing CTP
O&M (15%)	"Hands-off approach" New pipeline's typical operation does not interfere with other pipe operations. O&M staff do not need to complete any programming or day-to-day operations of new pipe.	New pipeline's typical operation can be programmed to require the least amount of operator interference/responsibility	Operator is expected to understand the system capabilities and adjust accordingly as well as keep an eye on the daily operations	Pipeline operation will differentiate on a daily basis and will require constant operator attention.
Permitting (10%)	Minimal challenges acquiring land and staying within City ROW. Limited challenges acquiring permits and crossing State Routes.	Some challenges with other entities and private property owners. Requires multiple permitting efforts and new easements.	Multiple challenges that require extensive conversation and permitting with other entities and negotiations with private property owners	Due to known permitting and land acquisition conditions, construction of the alternative is not feasible.

3.3 Alternative Criteria Matrix Scoring

Each alternative received a score for each set of criteria. The unweighted and weighted scores assigned are in Table 3-2 below. Criteria weighting was developed collaboratively with City Operations and Engineering personnel. The weighted score was calculated by multiplying the unweighted score by the collaboratively-defined weight percentage.

Table 3-2: Alternative Evaluation Scoring

	Alternative 1A – Larger Pipe		Alternative 1B – Smaller Pipe		Alternative 2 – Alternate Alignment	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Cost (20%)	2	0.4	3	0.6	2	0.4
Constructability (15%)	1	0.15	2	0.3	3	0.45
Redundancy (15%)	3	0.45	2	0.3	1	0.15
Rehab of CTP (25%)	3	0.75	2	0.5	1	0.25
O&M (15%)	2	0.3	2	0.3	1	0.15
Permitting (10%)	1	0.1	2	0.2	3	0.3
Total	12	2.15	13	2.2	10	1.7

The scores for each alternative were then tallied to get a cumulative total score. Alternative 1B scored the highest when comparing the raw and weighted scores, scoring just slightly higher than 1A.

3.3.1 Alternative 1A Scoring

Alternative 1A scored the second highest, due to its extensive functionality and ability to receive all of the flow the existing CTP receives. The alternative scored a one (1) for constructability due to the difficulty of constructing a large diameter pipe along a busy City corridor. Alternative 1A scored a three (3) for Redundancy and Rehab of CTP. Since this alternative proposes a new pipeline that is the same size as the existing CTP, this allows for full redundancy and the new alignment is very similar to the CTP which makes the bypass pumping the least difficult to divert flows from the CTP. Alternative 1A scored a two (2) for Cost and O&M. This alternative was the second most expensive, mostly due to the large sized pipe required. The O&M scored well for the functionality, but the multifunctionality of the new pipe can make the typical operation difficult; various portions of flow can be sent to the new line, including any number of pump stations that supply the CTP. Alternative 1A scored a one (1) was for the Permitting. The alignment has most of the same challenges as the CTP, including crossing State Highway 3, being parallel to the railroad and Charleston Blvd. and being in close proximity to the Puget Sound Naval Shipyard.

3.3.2 Alternative 1B Scoring

Alternative 1B scored the highest. This alternative is very similar to Alternative 1A (Larger Pipe), but the newly proposed pipe is smaller and cannot handle as much flow as the Larger Pipe alternative. The alternative scored a two (2) for constructability due to the reduced difficulty of constructing a smaller diameter pipe along a busy City corridor as compared to Alternative 1A. The O&M score was the same as the Larger Pipe alternative, because the alignment is the same and there are the same challenges. This alternative scored higher on constructability than its larger pipe counterpart as it is expected that construction of the pipeline through WSDOT's limited access-full control corridor along Charleston will involve utilizing the abandoned 20-inch cast iron pipe as a host pipe, leading to less invasive construction methods within the corridor. This less invasive construction is expected to increase the City's likelihood of obtaining WSDOT approval for construction the alternative. The rehabilitation of CTP score was lower than that of Alternative 1A, however the rehabilitation work can still be completed in the summertime without any capacity issues. Since the proposed pipe is smaller, the cost was the less expensive.

3.3.3 Alternative 2 Scoring

Alternative 2 introduces a brand-new alignment, and also avoids larger permitting obstacles. The new pipeline may not always receive flow and the increase in elevation along the alignment requires a new pump station to get the flow to the WTP. The costs associated with constructing a new pump station to convey flows along Preble Street are the largest factor that makes this alternative the most expensive. This alternative scores poorly for Redundancy and Rehab of CTP. The new pipeline will only alleviate upstream flows from the CTP and all downstream flows will still get sent to the existing CTP with no option to divert flows. In addition, the alignment is not near the exiting CTP and therefore cannot be relied upon for bypass pumping. The new alignment does score highly for Permitting; the alignment was chosen, because it avoids major conflicts by avoiding the Puget Sound Naval Shipyard and the US Navy railroad while also reducing the amount of coordination with WSDOT. Considering operation and maintenance, Alternative 2 is considered less complex due to less operational flow splitting capabilities than Alternatives 1A and 1B. However, it introduces a new pump station that needs to be located and eventually maintained. This alternative ultimately scored the lowest based on the established criteria.

3.3.4 Preferred Alternative Selection

After discussions with City staff and given that the scores for Alternative 1A and 1B were almost the same, either alternative would suffice. Alternative 1A would be more practical and a better long-term solution since it provides complete redundancy. However, the constructability challenges of 1A due to the larger diameter, as well as the higher cost compared to 1B, reduce the appeal of this alternative. Before proceeding further with either of these alternatives, the decision-making process would benefit from field investigation to understand the former 20-inch pipe trench in the WSDOT limited access corridor and to validate the proposed alignment by confirming the crossing utilities conflicts.

References

HDR Engineering, Incorporated. 2014. City of Bremerton Wastewater Comprehensive Plan Update.

Kennedy Jenks Consultants, Incorporated. 2024. City of Bremerton Wastewater Comprehensive Plan Update.

Appendix A: Engineer Opinion of Probable Construction Costs

OPINION OF PROBABLE CONSTRUCTION COST

KENNEDY/JENKS CONSULTANTS, INC.

Project: Bremerton WCP - Crosstown Pipeline Improvements

Building, Area: Alternative 1A - Parallel Pipeline, Larger Pipe

Prepared By: RH/RL/JH
Date Prepared: 29-Jan-25
KJ Proj. No. 2397011

Current at ENR
Escalated to ENR
Months to Midpoint of Construct 48

Estimate Type: [x] Conceptual [ ] Preliminary (w/o plans) [ ] Design Development @ _____ % Complete [ ] Construction [ ] Change Order

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ___ - _____											
		30" PCCP Pipe Rehab	7,830	LF	4.00	31,320	28.00	219,240	467	3,656,610	3,907,170
		36" PCCP Pipe Rehab	6,100	LF	7.00	42,700	46.00	280,600	637	3,885,700	4,209,000
		Bypass Pumping	12	Weeks					40,000	480,000	480,000
		30" HDPE Pipe	5,600	LF	135.00	756,000	125.00	700,000	92	515,200	1,971,200
		36" HDPE Pipe	6,100	LF	150.00	915,000	145.00	884,500	104	634,400	2,433,900
		20" CI Pipe Removal	6,100	LF	5.00	30,500	80.00	488,000	75	457,500	976,000
		Pump Station Connections	5	EA	42,200.00	211,000	22,200.00	111,000	35,400	177,000	499,000
		Utility Crossings	65	EA			2,500.00	162,500			162,500
		Flow Split Structure	2	EA	106,700.00	213,400	48,200.00	96,400	79,600	159,200	469,000
		Traffic Control	1	LS					772,889	772,889	772,889
		Route 3 Crossing	1	LS					350,000	350,000	350,000
		Subtotals				2199920.00		2942240.00		11088498.50	16,230,658.50
		Division 1 Costs	@	10%		219992.00		294224.00		1108849.85	1,623,065.85
		Subtotals				2419912.00		3236464.00		12197348.35	17,853,724.35
		Taxes - Materials Costs	@	9.20%		222631.90					222,631.90
		Subtotals				2642543.90		3236464.00		12197348.35	18,076,356.25
		Taxes - Labor Costs	@								
		Subtotals				2642543.90		3236464.00		12197348.35	18,076,356.25
		Contractor Markup for Sub	@	12%						1463681.80	1,463,681.80
		Subtotals				2642543.90		3236464.00		13661030.15	19,540,038.06
		Contractor OH&P	@	15%		396381.59		485469.60			881,851.19
		Subtotals				3038925.49		3721933.60		13661030.15	20,421,889.24
		Estimate Contingency	@	25%							5,105,472.31
		Subtotals									25,527,361.55
		Escalate to Midpoint of Construct	@	2%							2,042,188.92
		Estimated Bid Cost									27,569,550.48
		Total Estimate									27,600,000

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$41,400,000	**$27,600,000**	**$19,320,000**

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS, INC.**

Project: Bremerton WCP - Crosstown Pipeline Improvements

Building, Area: Alternative 1B - Parallel Pipeline, Smaller Pipe

Prepared By: RH/RL
Date Prepared: 29-Jan-25
KJ Proj. No. 2397011

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type:
- [x] **Conceptual**
- [ ] **Preliminary (w/o plans)**
- [ ] **Design Development @** _____ **% Complete**
- [ ] **Construction**
- [ ] **Change Order**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ___ - _____											
		30" PCCP Pipe Rehab	7,830	LF	4.00	31,320	28.00	219,240	467	3,656,610	3,907,170
		36" PCCP Pipe Rehab	6,100	LF	7.00	42,700	46.00	280,600	637	3,885,700	4,209,000
		Bypass Pumping	12	Week					40,000	480,000	480,000
		18" HDPE Pipe	5,600	LF	80.00	448,000	75.00	420,000	77	431,200	1,299,200
		20" CI Pipe Rehabilitation	6,100	LF	9.00	54,900	42.00	256,200	176	1,073,600	1,384,700
		Pump Station Connections	5	EA	42,200.00	211,000	22,200.00	111,000	35,400	177,000	499,000
		Utility Crossings	65	EA			2,500.00	162,500			162,500
		Flow Split Structure	2	EA	106,700.00	213,400	48,200.00	96,400	79,600	159,200	469,000
		Traffic Control	1	LS					638,029	638,029	638,029
		Route 3 Crossing	1	LS					350,000	350,000	350,000
		Subtotals				1001320.00		1545940.00		10851338.50	13,398,598.50
		Division 1 Costs	@	10%		100132.00		154594.00		1085133.85	1,339,859.85
		Subtotals				1101452.00		1700534.00		11936472.35	14,738,458.35
		Taxes - Materials Costs	@	9.20%		101333.58					101,333.58
		Subtotals				1202785.58		1700534.00		11936472.35	14,839,791.93
		Taxes - Labor Costs	@								
		Subtotals				1202785.58		1700534.00		11936472.35	14,839,791.93
		Contractor Markup for Sub	@	12%						1432376.68	1,432,376.68
		Subtotals				1202785.58		1700534.00		13368849.03	16,272,168.62
		Contractor OH&P	@	15%		180417.84		255080.10			435,497.94
		Subtotals				1383203.42		1955614.10		13368849.03	16,707,666.55
		Estimate Contingency	@	25%							4,176,916.64
		Subtotals									20,884,583.19
		Escalate to Midpoint of Construct	@	2%							
		Estimated Bid Cost									20,884,583.19
		Total Estimate									20,900,000.00

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$31,350,000	**$20,900,000**	**$14,630,000**

OPINION OF PROBABLE CONSTRUCTION COST — **KENNEDY/JENKS CONSULTANTS, INC.**

Project: Bremerton WCP - Crosstown Pipeline Improvements - Alternative 2

Building, Area: Alternative 2 - Alternate Alignment

Prepared By: RH/RL
Date Prepared: 29-Jan-25
KJ Proj. No. 2397011

Current at ENR
Escalated to ENR
Months to Midpoint of Construct

Estimate Type: [x] **Conceptual** [ ] **Construction**
[ ] **Preliminary (w/o plans)** [ ] **Change Order**
[ ] **Design Development @** _____ **% Complete**

Spec. No.	Item No.	Description	Qty	Units	Materials $/Unit	Materials Total	Installation $/Unit	Installation Total	Sub-contractor $/Unit	Sub-contractor Total	Total
DIVISION ___ - _____											
		30" PCCP Pipe Rehab	7,830	LF	4.00	31,320	28.00	219,240	476	3,727,080	3,977,640
		36" PCCP Pipe Rehab	6,100	LF	7.00	42,700	46.00	280,600	637	3,885,700	4,209,000
		Bypass Pumping	20	Week					40,000	800,000	800,000
		28" HDPE Pipe	11,520	LF	120.00	1,382,400	77.00	887,040	82	944,640	3,214,080
		Pump Station Connections	1	EA	42,200.00	42,200	22,200.00	22,200	35,400	35,400	99,800
		Utility Crossings	98	EA			2,500.00	245,000			245,000
		Pump Station	1	EA					4,500,000	4,500,000	4,500,000
		Flow Split Structure	1	EA	106,700.00	106,700	48,200.00	48,200	79,600	79,600	234,500
		Route 3 Crossing	1	LS					350,000	350,000	350,000
		Land Acquisition	1	LS					150,000	150,000	150,000
		Traffic Control	1	LS					881,501	881,501	881,501
		Subtotals				1605320.00		1702280.00		15353921.00	18,661,521
		Division 1 Costs	@	10%		160532.00		170228.00		1535392.10	1,866,152
		Subtotals				1765852.00		1872508.00		16889313.10	20,527,673
		Taxes - Materials Costs	@	9.20%		162458.38					162,458
		Subtotals				1928310.38		1872508.00		16889313.10	20,690,131
		Taxes - Labor Costs	@								
		Subtotals				1928310.38		1872508.00		16889313.10	20,690,131
		Contractor Markup for Sub	@	12%						2026717.57	2,026,718
		Subtotals				1928310.38		1872508.00		18916030.67	22,716,849
		Contractor OH&P	@	15%		289246.56		280876.20			570,123
		Subtotals				2217556.94		2153384.20		18916030.67	23,286,972
		Estimate Contingency	@	25%							5,821,743
		Subtotals									29,108,715
		Escalate to Midpoint of Construct	@	2%							
		Estimated Bid Cost									29,108,715
		Total Estimate									29,200,000

Estimate Accuracy	
+50%	-30%

Estimated Range of Probable Cost		
+50%	Total Est.	-30%
$43,800,000	**$29,200,000**	**$20,440,000**