SAMMAMISH PLATEAU WATER & SEWER DISTRICT

KING COUNTY **WASHINGTON**

Sammamish Plateau Water

NORTH DIVERSION PHASE 1 ANALYSIS

G&O #19582
JANUARY 2021

Gray & Osborne, Inc.
CONSULTING ENGINEERS

SAMMAMISH PLATEAU WATER & SEWER DISTRICT

KING COUNTY **WASHINGTON**

Sammamish Plateau Water

NORTH DIVERSION PHASE 1 ANALYSIS

2/11/2021

G&O #19582
JANUARY 2021

Gray & Osborne, Inc.
CONSULTING ENGINEERS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

EXECUTIVE SUMMARY

INTRODUCTION AND PURPOSE

The North Diversion Phase One Analysis (Analysis) continues the work begun with the 2013 Sammamish Plateau Water (the District) Wastewater Comprehensive Plan (2013 Plan) and continued with the North Diversion Interim Improvements Evaluation, completed in 2015 (2015 Evaluation). The 2015 Evaluation provided a list of interim capital improvements that would allow the District to continue to provide service to growth in the basins served by the Inglewood, North Lake Sammamish and Central Lake Sammamish Lift Stations, which includes the City of Sammamish Town Center. When the 2015 Evaluation was completed, the results were based on the assumption that the King County Wastewater Treatment Division (KCWTD) would have the facilities in place to divert a portion of District flows north by 2025, rather than the current transmission route to the south and the South East Lake Sammamish Interceptor. The King County WTD project name for the North Division is the Sammamish Plateau Diversion Phase Two (SPD), and this name is essentially interchangeable with the District's name of North Diversion.

The purpose of the Analysis is to re-evaluate the interim improvements proposed in the 2015 Evaluation for continued applicability and timing. Prior to initiation of the Analysis, some recommendations from the 2015 Evaluation had been initiated, but other identified improvement projects were suspended for re-evaluation, since the conditions and assumptions had changed.

BACKGROUND

In 2011, Gray & Osborne contracted with the District for the update of its Wastewater Comprehensive Plan/General Sewer Plan (2013 Plan), which was completed and approved in 2014. This work defined existing and projected future sewer flows for the District, including domestic and infiltration and inflow (I/I) flows. The 2013 Plan also put a significant amount of effort into identifying improvements required for basins in the northern portion of the District, specifically the basins served by the Inglewood, North Lake Sammamish, and Central Lake Sammamish Lift Stations and the future North Diversion/Sammamish Plateau Diversion (SPD Basins), which flow to a system nearing capacity. According to the assumptions presented in the 2013 Plan, the North Diversion needed to be in service by 2018 or else the District risked capacity problems downstream of the Inglewood Lift Station. After the 2013 Plan was published, KCWTD notified the District that the earliest the SPD could be in service was approximately 2025. The SPD was ranked as a high priority project in the King County 2007 Conveyance System Improvement (CSI) program.

Based on the lag between needed capacity and the SPD availability, the District again contracted with Gray & Osborne in 2015 to identify whether there were small, incremental improvements that would achieve the goal of staying ahead of growth until the SPD could be constructed. The goal was to avoid larger, more expensive projects that would be stranded investments once the SPD project was completed. This project produced the 2015 Evaluation. The 2015 Evaluation produced a number of projects for consideration. Recommendations from the 2015 Evaluation that were implemented include reviewing the capacities of the pumps at North Lake Lift Station and adding a larger capacity pump at Central Lake Lift Station. This work was completed in 2018.

In 2018, King County adopted the 2017 CSI program that identified planned capital improvements for the next 10 years. The 2017 CSI changed the SPD priority from high to low and indicated that the SPD would be delayed indefinitely. This necessitated the District change focus from small incremental projects to projects that continue to send flows south to the South East Lake Sammamish Interceptor for the foreseeable future. KCWTD also indicated that it would consider contributing financially for District projects that would otherwise have been stranded investments, since the County benefits financially by delaying construction of the SPD. This new phased approach proposed by KCWTD defers costs of the SPD, but it is a significant departure from planning that the District has relied upon for decades.

This change of course by KCWTD dramatically impacted the conclusions of the previous planning efforts. To account for these changes in assumptions, KCWTD requested the District jointly commission the Analysis to identify options for both long-term service to the south, as well as interim projects intended ensure the system continues to function until the long-term improvements can be constructed. Due to the significant change in assumptions regarding the SPD availability, additional work on implementing recommendations from the 2015 Evaluation were tabled while the Analysis was completed.

KING COUNTY PLANNING ASSUMPTION COMPARISON

The Analysis includes a comparison between the County's planning assumptions and the assumptions used in the development of this Analysis and the District's Draft 2021 Wastewater Comprehensive Plan (Draft 2021 Plan). The assumptions are largely similar, but do present a few differences that are highlighted.

Notable differences include:

- KCWTD uses an assumption of 54 gallons per capita per day for residential domestic sewer flow, whereas the District has calculated an actual sewer flow of approximately 36 gallons per capita per day based on measured

AMI flow. There are other differences in the calculated domestic and commercial sewer flows, but this is the most significant assumption.

- Growth for KCWTD is developed using Puget Sound Regional Council planning projections on a 50-year planning period. The District uses known developer extension applications for short-term planning and applies Puget Sound Regional Council growth rates for mid- and long-term growth. The District sizes facilities using the maximum zoning capacity based on current zoning and land use designations for the jurisdiction.

- District assumes a maximum infiltration and inflow (I/I) rate of 1,100 gallons per acre per day. KCWTD assumes an I/I rate of 2,000 gallons per acre per day for new construction, with an assumption for degradation that results in an increase of 7 percent per decade.

The District has operated its system and planned for capital improvements using District-specific standards and design assumptions based on the best information available at the time. Figure E-1 provides a comparison of the flows calculated for the SPD Basins based on the KCWTD assumptions versus the District assumptions, assuming the same population and service area. It is worth noting and illustrated clearly in Figure E-1 that had the District applied KCWTD design assumptions in its planning efforts, the existing capacity of the SPD Basin system would have been exceeded several years ago.

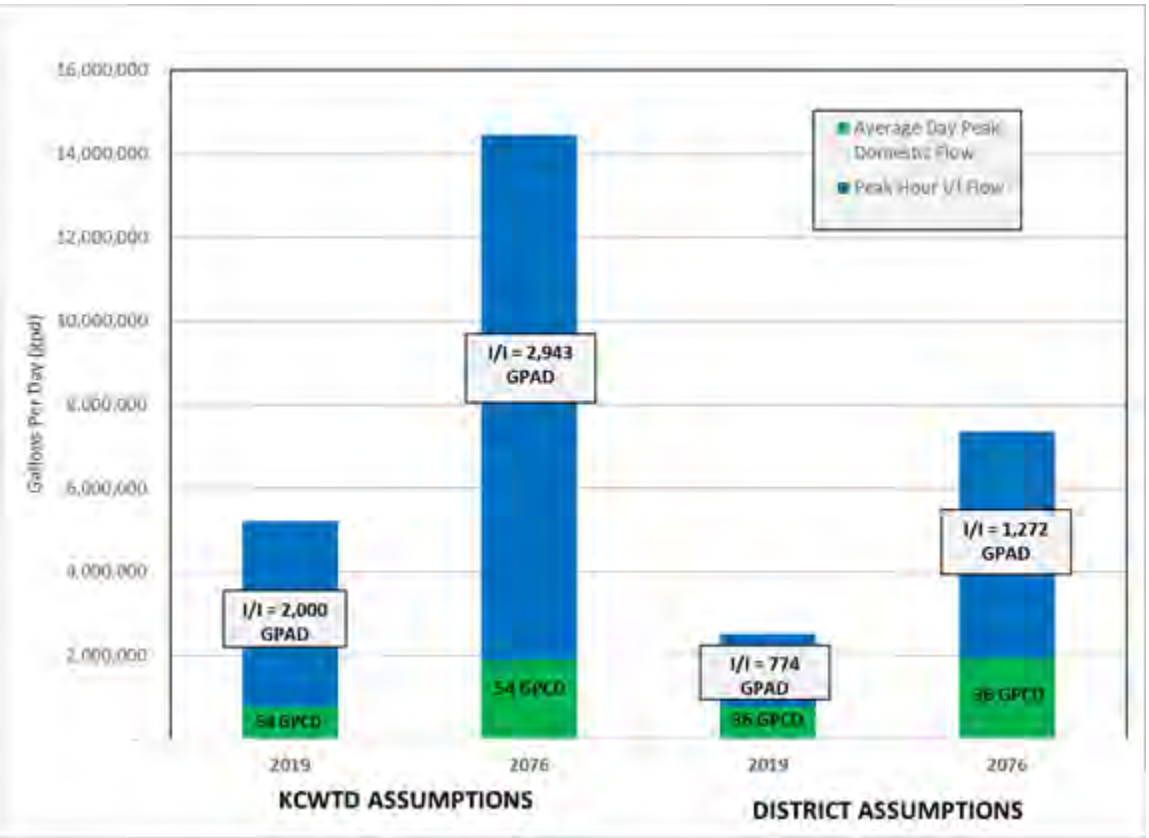


FIGURE E-1

SPD Basin Comparison of Flows – KCWTD vs. District Assumptions

HYDRAULIC MODEL UPDATE

The District provided an updated sewer GIS geodatabase, including manhole locations, pipe diameters, rim elevations, and invert elevations. This information was updated in the District's existing InfoSewer hydraulic model. Existing domestic flows, basin diurnal curves, and infiltration and inflow have been updated using District-provided Automated Metering Infrastructure (AMI) meter information, sewer lift station and control structure flow meter information. Data was focused primarily on two large storms in November 2018 and December 2019.

Growth projections are based on projections developed concurrently as part of the Draft 2021 Plan, including known developer extension projects for near-term growth and Puget Sound Regional Council for long-term growth projections.

HYDRAULIC MODEL RESULTS

Under present-day flow loads, surcharging is indicated within the North Lake Sammamish Basin's major trunk line along East Lake Sammamish Parkway. Modeled surcharging exceeds 1 foot along much of the trunk during peak flow periods. The surcharging worsens in each subsequent planning period and by 2030, surcharging to the surface is indicated in several manholes along the trunk. The bulk of the flow in most basins is due to I/I. The I/I rate is assumed to increase with time due to deterioration of the system, resulting in much higher flows than are currently observed.

Without upgrades to the North Lake Sammamish Lift Station and the trunk line along East Lake Sammamish Parkway, current surcharging will continue to get worse over time.

The District has been required to perform after-hours emergency operation of the system along Lake Sammamish during peak storms in order to ensure overflows and spills do not occur. This includes manual operation of lift stations and redirecting sewer flows to other basins. Results from the hydraulic model support field observations that the existing system is at capacity and that immediate improvements are required.

LONG-TERM IMPROVEMENTS

In order to improve capacity of the existing system and convey flows from the SPD Basins to the south, potential improvements have been identified. Since the majority of these improvements will involve significant disruption to East Lake Sammamish Parkway, and because the life cycle of the existing gravity, force main and lift station structures is expected to exceed 50 years, it is important that the identified improvements can meet the District's needs for decades into the future. Therefore, the improvements are sized to address the estimated flows at zoning capacity to avoid continual disruptions caused by construction projects. The identified long-term alternatives can meet the District's sewer capacity needs for the current maximum zoning capacity flow conditions, including future peak infiltration and inflow levels.

It is anticipated that many of these long-term improvements would ultimately become King County-owned and operated facilities. King County will apply WTD design standards if and when ownership of these facilities is transferred. Table E-1 summarizes level of service assumptions that have been applied to identify deficiencies and to develop design standards for improvements. The deficiency criteria are used to identify a required improvement, the design standard identifies the level of service applied to proposed improvements.

TABLE E-1

Level of Service Assumptions

Facility	Deficiency Criteria	Design Standard
Lift Station	Exceeds maximum pumping capacity. Assumes all pumps in service.	Peak flow at maximum zoning capacity with largest pump out of service.
Force Main	Lift station has reached capacity due to force main deficiencies.	Maximum of 8 feet per second (fps) velocity.
Gravity Main	Greater than 1 foot of surcharge.	No surcharge at peak flow for maximum zoning capacity.

Long-term improvement alternative projects are identified with the prefix "A."

INTERIM IMPROVEMENTS

Any of the long-term improvement alternatives will take several years to implement. Therefore, the initial efforts need to be focused on interim improvements that may be implemented quickly. The interim improvements identified in the Analysis are similar to those originally identified in the 2015 Evaluation. Examples of this include additional storage at the Central Lake and North Lake Lift Stations and the upsizing of approximately 1,000 LF of 8-inch to 12-inch force main for Central Lake Lift Station. These projects have always remained in the District capital improvement program, but the order of implementation has been modified due to the delayed schedule for the SPD project. Interim improvement alternatives are identified with the prefix "I".

IMPROVEMENT ALTERNATIVES SUMMARY

Table E-2 provides a summary of the long-term and interim alternatives and their estimated costs.

TABLE E-2

Alternatives Summary

Alt.	Description	Gravity/ Low Pressure (LF)	Force Main (LF)	Total Pipeline (LF)	Proposed Central Lake Capacity (gpm)	Proposed North Lake Capacity (gpm)	Cost
A-1	Upgrade Existing System	12,020	13,380	25,400	4,300	4,300	$42,178,000
A-2	Inglewood Force Main Extension	5,720	23,380	29,100	4,300	2,000	$36,560,000
A-3	Bypass Central Lake Gravity Main	6,300	19,000	25,300	1,500	4,300	$31,623,000
A-4	Bypass North and Central Lake Gravity Mains	0	29,000	29,000	1,500	4,300	$33,338,000
A-5	Extend South Interceptor	0	29,000	29,000	1,500	2,000	$31,785,000
A-6	Inglewood Lift Station Bypass to Control Structure	1,620	23,000	24,620	2,500	2,000	$24,201,000
SPD	Construct Sammamish Plateau Diversion	15,312	9,821	25,133	1,500	2,000	$107,527,000
I-2	Local Storage at North Lake or Central Lake						$2,000,000
I-3	Automatic Diversion Valve to Mallard Bay						$250,000
I-4	Interim Bypass of Central Lake Gravity – Total	2,870	6,870	9,740	600	2,000	$11,854,000
I-4	Interim Bypass of Central Lake Gravity – Phase 1	0	1,000	1,000	2,100	1,750	$3,017,000
I-4	Interim Bypass of Central Lake Gravity – Phase 2	0	5,870	5,870	600	2,000	$5,142,000
I-4	Interim Bypass of Central Lake Gravity – Phase 3	2,870	0	2,870	600	2,000	$3,717,000
I-5	Diesel-Powered Bypass Pumps at North and Central Lake Lift Stations						$843,000

RECOMMENDATIONS SUMMARY

Based on consideration of the topics listed above and applying knowledge of the local system, the following are the recommendations for both interim and long-term improvements necessary for continued provision of sewer service to the north basins in the District.

As noted in the 2015 Evaluation and confirmed by this Analysis, the existing District SPD Basin system is at capacity. Modeling results aside, there is practical evidence that large storm events and short-term intense rain events stress the existing system. For certain events, District staff are required to be at the lake-front lift stations (North Lake and Central Lake Lift Stations) to manually operate the pumps to achieve their maximum capacity. This situation will continue to worsen as Sammamish Town Center continues to develop.

Timeliness is the most important decision-making criteria. Projects that can be undertaken in the very short term must be considered for immediate implementation to avoid the potential for sewer overflows and spills.

INTERIM IMPROVEMENTS

The interim improvements identified as Phase 1 of Alternative I-4 are recommended to be started immediately. This includes installing larger pumps at the North Lake Lift Station to provide capacity of at least 2,000 gpm. In conjunction with this pumping improvement, installation of the 1,000-linear-foot segment of 16-inch force main from the Central Lake Lift Station is recommended, allowing bypass of the existing 8-inch force main, connecting to the existing 12-inch force main. The segment of larger Central Lake force main will allow the Central Lake Lift Station to increase its pumping capacity using its existing pumps.

Work on Phase 2 of Alternative I-4 should also begin immediately, although it is understood that construction of this almost mile-long section of force main will take longer to install than the improvements identified as Phase 1. The timing of the Phase 3 work is dependent upon additional research into the extent of surcharging upstream of the North Lake Lift Station, and establishment of what level of surcharge is acceptable to prevent overflow.

Alternative I-2, providing additional storage, should also be pursued in the very near term. This initial work would be to determine the feasibility of installation of the storage, especially at the North Lake Lift Station or other off-site location. Use of this alternative at the Central Lake Lift Station is unlikely based on space limitations.

If implementation of Alternative I-2 does not appear to be likely, Alternatives I-5 and I-3 should be pursued.

LONG-TERM IMPROVEMENTS

Alternative A-6, Inglewood Lift Station Bypass to Control Structure, is the recommended long-term alternative. Alternative A-6 is recommended on the basis it will:

- Alleviate the capacity issues with the lakefront sewer, for both gravity and force mains, allowing the system to function as originally designed.
- Minimize improvements necessary at the North Lake and Central Lake Lift Stations.
- Reduce or eliminate odor complaints on Inglewood Hill associated with the current Inglewood force main discharge.
- Reduce the chance for overflows in the East Lake Sammamish Parkway area that could flow to Lake Sammamish.
- If the existing Inglewood force main connection is retained, provide a redundant force main for use during planned or unplanned maintenance on the Alternative A-6 force main.
- Have the easiest construction connection, with only one tie-in point at the existing Inglewood force main at 216th Avenue NE.
- Avoids construction on East Lake Sammamish Parkway.

If Alternative A-6 is not chosen, Alternatives A-3, A-4, or A-5 should be considered. These three alternatives share many similar segments and the final decision can be made as the project is moved forward. Alternative A-5 has the lowest estimated cost, but Alternative A-3 shares the most segments with Alternative I-4.

CONCLUSION

Timeliness is the most important decision-making criteria. Implementation of Alternative I-4 should be undertaken immediately. This can provide the time to install long-term Alternative A-6, the best long-term solution. Growth is continuing in the basins served by these facilities. Even with installation of Alternative I-4, until installation of a long-term alternative is completed, there will be continued pressure on operations to avoid overflows and meet capacity.

Implementation of the interim and long-term alternatives described in the Analysis only address one aspect of reliability. These projects would continue to rely solely on a single KCWTD southern-flowing system that would be susceptible to a single point of failure. These proposed alternatives would not deliver the level of service and reliability to the District that the SPD would provide.

CHAPTER 1

PLANNING AND FLOW CRITERIA

INTRODUCTION AND PURPOSE

The North Diversion Phase One Analysis (Analysis) continues the work begun with the 2013 Sammamish Plateau Water (the District) Wastewater Comprehensive Plan (2013 Plan) and continued with the North Diversion Interim Improvements Evaluation, completed in 2015 (2015 Evaluation). The 2015 Evaluation provided a list of interim capital improvements that would allow the District to continue to provide service to growth in the basins served by the Inglewood, North Lake Sammamish and Central Lake Sammamish Lift Stations, which includes the City of Sammamish Town Center. When the 2015 Evaluation was completed, the results were based on the assumption that when the King County Wastewater Treatment Division (KCWTD) would have the facilities in place to divert a portion of District flows north by 2025, rather than the current transmission route to the south and the South East Lake Sammamish Interceptor. The King County WTD project name for the North Division is the Sammamish Plateau Diversion Phase Two (SPD), and this name is essentially interchangeable with the District's name of North Diversion.

KCWTD now indicates that the SPD project has been delayed until at least 2050. The purpose of the Analysis is to take a new look at the previously identified capital projects, identify any new capital projects and reconsider the order and timing of the projects. The Analysis is being completed in coordination with the District's Draft 2021 Wastewater Comprehensive Plan (Draft 2021 Plan) and the District's Sewer Hydraulic Model Update, completed simultaneously under separate contracts.

BACKGROUND

In 2011, Gray & Osborne contracted with the District for the update of its Wastewater Comprehensive Plan/General Sewer Plan (2013 Plan), which was completed and approved in 2014. This work defined existing and projected future sewer flows for the District, including domestic and infiltration and inflow (I/I) flows. The 2013 Plan also put a significant amount of effort into identifying improvements required for basins in the northern portion of the District, specifically the basins served by the Inglewood, North Lake Sammamish, and Central Lake Sammamish Lift Stations and the future North Diversion/Sammamish Plateau Diversion (SPD Basins), which flow to a system nearing capacity. According to the assumptions presented in the 2013 Plan, the North Diversion needed to be in service by 2018 or else the District risked capacity problems downstream of the Inglewood Lift Station. After the 2013 Plan was published, KCWTD notified the

District that the earliest the SPD could be in service was approximately 2025. The SPD was ranked as a high priority project in the King County 2007 Conveyance System Improvement (CSI) program.

Based on the lag between needed capacity and the SPD availability, the District again contracted with Gray & Osborne in 2015 to identify whether there were small, incremental improvements that would achieve the goal of staying ahead of growth until the SPD could be constructed. The goal was to avoid larger, more expensive projects that would be stranded investments once the SPD project was completed. This project produced the 2015 Evaluation. The 2015 produced a number of projects for consideration. Recommendations from the 2015 Evaluation that were implemented include reviewing the capacities of the pumps at North Lake Lift Station and adding a larger capacity pump at Central Lake Lift Station. This work was completed in 2018.

In 2018, King County adopted the 2017 CSI program that identified planned capital improvements for the next 10 years. The 2017 CSI changed the SPD priority from high to low and indicated that the SPD would be delayed indefinitely. This necessitated the District change focus from small incremental projects to projects that continue to send flows south to the South East Lake Sammamish Interceptor for the foreseeable future. KCWTD also indicated that it would consider contributing financially for District projects that would otherwise have been stranded investments, since the County benefits financially by delaying construction of the SPD. This new phased approach proposed by KCWTD defers costs of the SPD, but it is a significant departure from planning that the District has relied upon for decades.

This change of course by KCWTD dramatically impacted the conclusions of the previous planning efforts. To account for these changes in assumptions, KCWTD requested the District jointly commission the Analysis to identify options for both long-term service to the south, as well as interim projects intended ensure the system continues to function until the long-term improvements can be constructed. Due to the significant change in assumptions regarding the SPD availability, additional work on implementing recommendations from the 2015 Evaluation were tabled while the Analysis was completed.

HYDRAULIC MODEL UPDATE

The District provided an updated sewer GIS geodatabase, including manhole locations, pipe diameters, rim elevations, and invert elevations. This information was updated in the District's existing InfoSewer hydraulic model.

Existing domestic flows, basin diurnal curves, and infiltration and inflow have been updated as described in the following sections.

DOMESTIC FLOW EVALUATION

Winter water use data is used as a proxy for domestic sewer demand as little irrigation occurs during the winter and it is assumed that nearly all indoor water use is eventually discharged to sewer. Winter water use data was provided by the District for the month of January 2019. The water use data is measured hourly at each water meter within the District sewer service area, using the District's automatic metering infrastructure (AMI) system, which was not available for use in the District's 2013 Plan or the 2015 Evaluation. Winter water use data was divided by basin and by subbasin in order to produce diurnal curves for each subbasin. Average winter water use during this period is approximately 96 gpd per single family residential meter, excluding any zero-use meters.

Future flows (6-year, 10-year, 20-year, and zoning capacity) are based upon the projected number of sewer equivalent residential units (ERUs) per parcel established by the District through a combination of known developer extension applications and land use/zoning criteria. The estimated number of sewer ERUs for each parcel and the sewer customer type (single family, multifamily, non-residential, or mixed) are used to establish a flow per customer. This is outlined in detail in the District's Draft 2021 Plan.

Average daily sanitary flow is assigned to each manhole per the Thiessen polygon method. Each parcel has been analyzed to determine the nearest manhole to the centroid of that parcel using these Thiessen polygons. It is assumed that the nearest manhole to the centroid of each parcel will act as the recipient of domestic or commercial wastewater flows from that parcel. It is recognized that for larger parcels, the centroid of the parcel may not be located near the sewer connection. For modeling purposes, this method provides a simplification and allows a greater extent of the entire system to be evaluated.

Domestic diurnal curves were developed for each subbasin independently based on the winter water use data. Water use patterns differ by land use and by weekday, so the average daily flow in hourly increments for each subbasin was determined using the AMI data across the 31-day dataset for each day of the week. From this, the winter water use diurnal curves were established. For simplification purposes, each subbasin in the model is assigned an average daily diurnal curve, which is a composite of each of the separate weekday curves. The model is run for a 72-hour duration and does not encompass an entire week.

INFILTRATION AND INFLOW

Infiltration and inflow (I/I) estimates for each of the larger lift station basins were determined by comparing the winter water use data (as a proxy for domestic sewage flow) with hourly lift station flow data recorded during several storm events during the winters of 2018 and 2019. The individual weekday diurnal curves developed using winter

water use data for each subbasin were combined based on their downstream lift station to produce an aggregate set of daily diurnal curves for each lift station. The lift station diurnal curves were then compared to the measured lift station flow data to determine the difference in domestic flow and recorded flow. The difference is assumed to be additional flow contribution from I/I. The maximum difference in the hourly flow data during each storm event was determined by comparing the hourly diurnal curves and the hourly lift station data for each major lift station basin. Holidays were ignored in the analysis as they tend to have irregular water use patterns.

Average daily lift station flow data during July and August 2018 was provided by the District and was compared to the wet weather water use data to determine an estimate of dry season base flow (as opposed to the peak I/I determined using wet season lift station data) and to check the accuracy of the wet weather water use data.

Table 1-1 includes the domestic flow for the larger basins as well as the average dry day base flow.

TABLE 1-1

Domestic Flow and Dry Weather Base Flow Estimates

Lift Station	ADD (gpd, winter water use)	ADD (gpd, summer sewer)	Dry Base Flow (gpd)	Basin Size (acres)	Dry Base Flow Rate (gpad)
Aldarra	96,651	126,261	29,610	382	78
Beaver Dam	100,313	107,913	7,600	393	19
Benham Ridge(1)	5,905	5,065	-840	15	-56
Camden	17,689	36,174	18,485	120	154
Central Lake(1)	41,579	34,402	-7,176	143	-50
Control Structure(1)	698,675	782,620	83,944	2,826	30
Freegard	274,278	316,599	42,321	437	97
Inglewood	219,271	323,783	104,512	772	135
Mallard(1)	41,723	40,533	-1,190	190	-6
North Lake	97,387	129,652	32,265	773	42
Redford	39,067	42,217	3,150	75	42
Trossachs	139,631	203,728	64,097	573	112

(1) These basins had lower average daily flows recorded at the lift station than the average daily domestic flow from the winter water use data. It is assumed that there is relatively little dry weather base flow in these basins.

Because the I/I rate determined for each basin represents the peak hour I/I rate, a curve is used to apply the I/I at different rates depending on the time step in the model. The peak hourly I/I rate is not applied for the entire duration, as this would be unrealistic. The hourly lift station data recorded during the large December 2019 storm is used to calibrate the model such that the model approximately reflects the conditions during this

event. A base I/I rate of 40 percent of the peak hour I/I is applied to approximate infiltration flow, and the I/I rate is then peaked according to the hourly rainfall intensity recorded during the storm event. During the first 24-hour period simulated, the base I/I rate is applied to distribute flow throughout the system. The following 24-hour period simulated includes a curve to increase the I/I flow to 100 percent (simulating the peak hour I/I rate) then decreases the I/I applied back to the 40 percent base I/I rate, which is sustained through the final 24-hour period of the 72-hour analysis.

Table 1-2 includes the wet season peak hourly I/I rate determined for each of the larger lift station basins during several storm events in 2018 and 2019. ADD determined on an hourly basis from winter water use data was subtracted from the hourly lift station data recorded during several storm events. The difference between these hourly flows is assumed to represent hourly I/I flow. The maximum peak hourly I/I rate was selected for each lift station to load into the model.

Figure 1-1 provides a visual display of the I/I calculation process. The hourly flow recorded at the Inglewood Lift Station is compared with the average hourly flow determined for the Inglewood Basin based on the winter water use data for the basin. The difference between these flows is shown on the chart as the hourly I/I rate. The rainfall rate in inches per hour is underlain on the chart to indicate where the periods of rain coincide with the peaks in recorded flow at the lift station.

TABLE 1-2

Wet Weather I/I Estimates

Precipitation Period	1/1/18-1/15/18	11/21/18-12/4/18	1/21/19-1/26/19	2/7/19-2/16/19	12/19/19-12/21/19	
Peak Rainfall Amount	0.65 inch	2.11 inches	0.61 inch	0.8 inch	4.01 inches	
Peak Rainfall Duration	24 hours	48 hours	24 hours	24 hours	36 hours	
Lift Station	Peak Hour (gpad)	Peak Hour (gpad)	Peak Hour (gpad)	Peak Hour (gpad)	Peak Hour (gpad)	Maximum (gpad)
Aldarra	336	307	285	302	720	**720**
Beaver Dam	253	177	187	188	670	**670**
Benham Ridge	355	592	403	460	1,499	**1,499**
Camden	560	519	604	569	1,233	**1,233**
Central Lake Sammamish	240	80	176	287	914	**914**
Control Structure	217	127	108	119	471	**471**
Freegard	373	641	329	395	1,213	**1,213**
Inglewood	466	378	357	346	780	**780**
Mallard	185	183	121	220	459	**459**
North Lake Sammamish	70	89	21	112	792	**792**
Redford	525	552	526	508	1,344	**1,344**
Trossachs	376	334	285	371	693	**693**

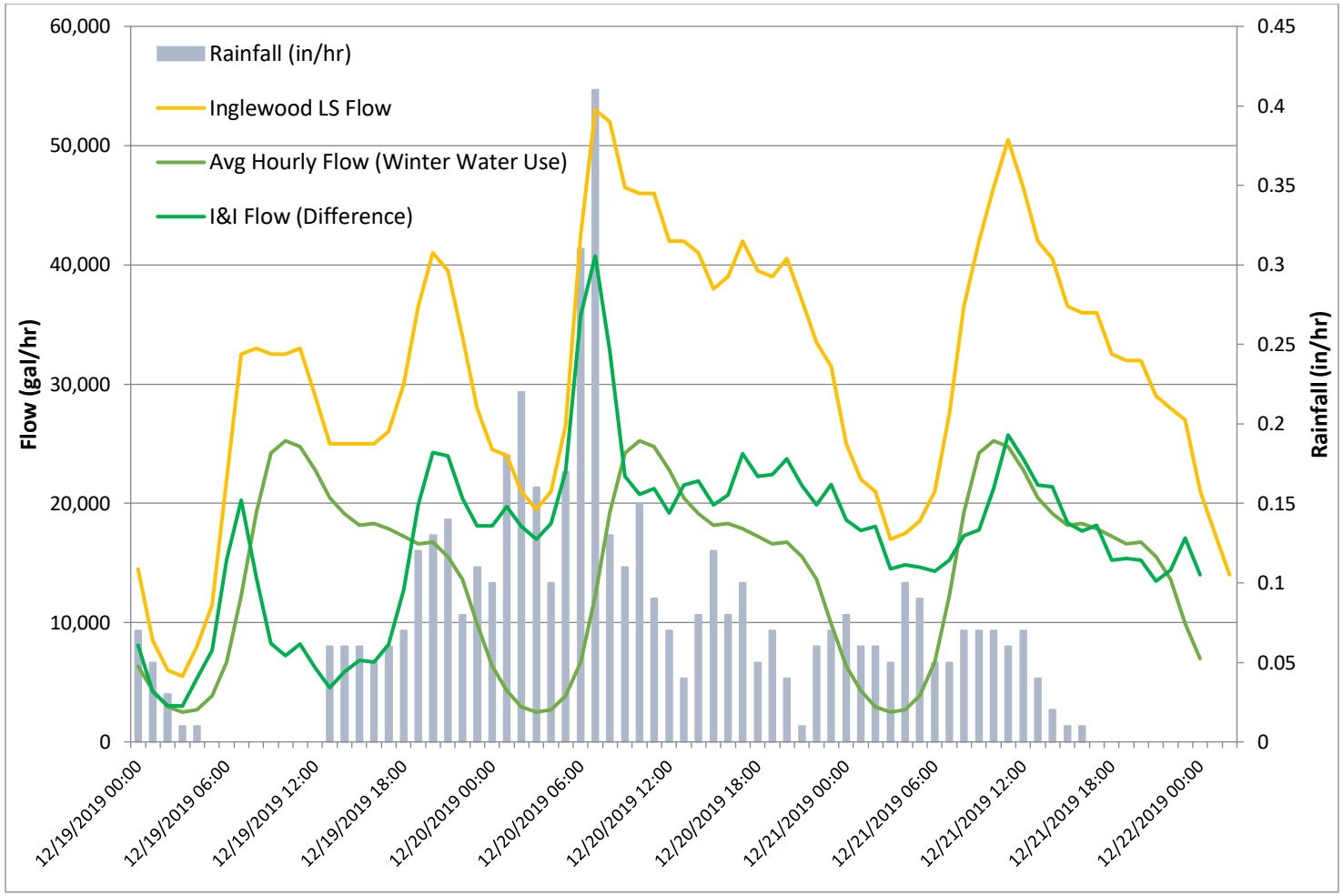


FIGURE 1-1

Inglewood Lift Station I/I Determination for December 2019

GROWTH AND I/I PROJECTIONS

Future growth rates within the District have been developed in conjunction with the District's Draft 2021 Plan using ERU projection data provided by the District. Six-year planning data are provided by the District based on development projects currently in the planning, design, and construction phases. Domestic use estimates at zoning capacity (i.e., buildout) are determined by the District based on zoning designations for each subbasin. Maximum developable residential densities are assumed throughout the sewer service area based on City and County zoning. Additionally, water use customers that are within the sewer service area but are currently not connected to the sewer system are assumed to connect at a consistent rate during the 20-year planning period. All septic users within the District's sewer service area are assumed to eventually connect to the sewer system such that there are no remaining septic customers within the District's sewer service area at the time of zoning capacity.

For the 10-year and 20-year projections, growth projections are determined by extrapolating the average annual growth in sewer ERUs for the entire District during the first 6 years. The 6-year ERU growth rate for the District as a whole is approximately 1.5 percent per year, including septic conversions. In order to ensure that the growth rate used to determine the 10- and 20-year population truly reflects background population growth throughout the whole District and not infill growth from septic connections or concentrated growth in certain areas, the estimated Sammamish Town Center growth and added septic connections are removed from the 6-year growth rate. The resulting background growth rate used in the 10-year and 20-year projections is 0.73 percent per year. This rate is applied to the ERU count within the District excluding planned septic conversions and Town Center growth. The Sammamish Town Center growth and anticipated septic connections (42 per year through 2025, based on recent historical averages, then 50 per year through 2040) are then added back into the total ERU count to complete the 10- and 20-year ERU estimates.

The District estimates the anticipated zoning capacity population based on zoning capacity ERU and household population estimates. Based on carrying forward the 6-year sewered population growth rate of 0.73 percent per year, the year of zoning capacity was determined to be 2076. Interim ERU estimates are determined by interpolation between 2025 estimates (i.e., 6-Year) and Zoning Capacity estimates.

Puget Sound Regional Council (PSRC) growth rates are often used for planning purposes to predict future growth. PSRC current projections estimate anticipated household population for each 5-year period through 2040. Upon review, it appeared that these growth rates significantly underestimated known high growth areas of the District and therefore it was decided these growth rates may be too conservative. The District is aware of the rapidly densifying portion of its service area, primarily the Sammamish Town Center area, which appears not to be captured in the PSRC estimations.

For future peak hour flows, the I/I rate in each basin is increased by 7 percent per decade through the year of zoning capacity, or a maximum I/I rate of 1,100 gpad is used, whichever is greater. The I/I rates are increased instead of using currently measured I/I rates in order to account for the likely increase of I/I due to pipe degradation and other problems as the District's system ages. In addition, the area served within each basin is assumed to increase linearly from the existing service area to the service area at zoning capacity. This also increases the total I/I flow in each basin. The same I/I peaking curve applied in the existing scenario is applied in the future scenarios as well.

The maximum peak hour I/I rate of 1,100 gpad had been King County's preferred planning assumption for I/I flows in the past. The County has since revised this planning level assumption to 2,000 gpad, with a further recommendation to escalate existing I/I flow at a rate of 7 percent per decade. Due to the relatively low I/I rates calculated for most of the District's basins, the 2,000 gpad maximum I/I rate appears to be too high of an estimate for most of the service area, but as noted previously, the 7 percent increase per decade is applied. The I/I flows in 2030 and 2040 are interpolated between the existing I/I flows for the existing sewered area and the zoning capacity I/I flows for the future sewered area. Zoning capacity is assumed to occur in 2076 based on PSRC growth rates.

Table 1-3 summarizes the current and projected domestic flow and I/I flow.

TABLE 1-3

Projected Domestic and I/I Flow

Basin	Domestic				Infiltration and Inflow (I/I)			
	2019 (gpm)[1]	2030 (gpm)	2040 (gpm)	Zoning Capacity (gpm)	2019 (gpm)[2]	2030 (gpm)[3]	2040 (gpm)[3]	Zoning Capacity (gpm)
Beaver Dam	54	54	54	55	158	175	193	356
Central Lake Sammamish	19	25	32	50	91	142	195	447
Freegard	133	142	155	223	368	446	528	907
Inglewood East	165	266	324	348	419	464	512	727
Laughing Jacobs	137	145	150	163	218	229	241	463
Mallard Bay	25	28	30	35	60	75	91	267
North Lake Sammamish	85	148	196	285	428	543	664	1228
North Sunnyhills	130	157	184	258	247	302	359	1001
Northeast Plateau	30	46	57	92	82	157	236	611
South Pine Lake	112	137	143	160	175	196	219	511
Tiburon	3	9	18	41	16	70	126	398
Trossachs	104	107	110	120	276	320	367	631
Yellow Lake	227	234	244	270	284	310	338	733
Total (gpm)	1,222	1,497	1,696	2,100	**2,822**	**3,429**	**4,069**	**8,280**
Total (gpd)	**1,760,009**	**2,154,960**	**2,441,664**	**3,024,216**	**4,064,612**	**4,937,760**	**5,859,360**	**11,924,710**

(1) Determined from winter water use data from January 2019.
(2) Based on the peak I/I rates presented in Table 2.
(3) Interpolated between 2019 I/I rates and Zoning Capacity I/I rates.

KING COUNTY PLANNING ASSUMPTIONS COMPARISON

King County has published its planning assumptions in the *Updated Planning Assumptions for Wastewater Flow Forecasting* (July 2014). These planning assumptions are used by the County in determining appropriate flow rates for planning purposes.

The planning assumptions used to develop the District's sewer flow estimates are largely similar to King County's guidelines with a few differences. A comparison between the County's planning assumptions and the assumptions used in the development of this Analysis and the District's draft Sewer Comprehensive Plan are included in Table 1-4.

TABLE 1-4

Comparison of King County and District Design Assumptions

King County	District
Design Flow	
King County policy requires use of a 20-year peak flow standard for sizing and estimating costs of conveyance facilities in the portion of the wastewater system with separated sewers. Modern computing allows for long-term (multiple decades) model runs that can simulate antecedent moisture content and estimate the recurrence interval of peak flow events. Antecedent moisture is the buildup of groundwater over time that affects total infiltration and inflow (I/I) during a storm event. A "design storm" approach based solely on the amount of rain from a 20-year storm does not take antecedent moisture conditions into account.	The District's approach to determining I/I is based on a single storm that occurred on December 18 to 20, 2019. The rainfall intensity for this storm event was greater than the 20-year event. The peak hourly I/I for the larger sewer lift station basins was determined by comparing the hourly flow during the storm event with average winter water usage within each basin. The peak hourly I/I flow for each basin is distributed among the loading manholes in each basin. A curve is included in the model to peak the I/I flow such that the peak hourly I/I flow occurs at 7:00 a.m., to approximate the observed peak rainfall rate in the December 2019 storm. The 3-day simulation begins with I/I at 40 percent of the peak hourly rate until the rainfall begins. The I/I rate then increases hourly (depending on the hourly rainfall rate recorded during the storm) until the peak I/I rate occurs at the time of maximum rainfall intensity. The I/I rate then decreases for the remainder of the 3-day simulation, falling to 40 percent of the maximum at the end of the simulation. This application of the I/I rate was compared with measured flow at the lift stations during the storm and appears to approximate the measured peak flow fairly well.

TABLE 1-4 – (continued)

Comparison of King County and District Design Assumptions

King County	District
Planning Horizon	
The planning horizon is the furthest point in the future that the Wastewater Treatment Division (WTD) estimates future wastewater flows. The planning horizon is 50 years.	The District has developed revised planning estimates for maximum zoning capacity that have been incorporated into the updated modeling used in the development of the Sewer Comprehensive Plan. The District has estimated maximum zoning capacity to occur in 2076, or 56 years from the present, based on recent population growth rates and estimated maximum zoning capacity population. This presents a slightly more conservative estimate of future flows beyond the 50-year horizon.
Extent of Eventual Service Area	
Washington State's Growth Management Act restricts the provision of sewer services to development in the urban growth area (UGA). Thus, the assumed extent of the eventual service area is the potentially sewerable area in UGAs in King, Snohomish, and Pierce Counties where WTD provides service.	The District's future service area is based on UGA boundaries.
Future Service Area Population	
The projected population of the sewered and unsewered potentially sewerable areas in the UGAs is based on the 2013 Puget Sound Regional Council's (PSRC's) forecasted population for the Puget Sound region through 2040. The maximum wastewater service area population is calculated as a straight-line extrapolation of the growth rate between 2030 and 2040 to produce forecasts for 2050 and 2060.	Sewer growth is based on an extrapolation of the District's planned 6-year growth through the year of maximum zoning capacity. Three separate populations are considered for growth – growth within the planned Sammamish Town Center, septic system conversion to sewer growth, and background population growth. Over the next 6 years, the District expects to grow by 1.5 percent per year (including growth from all of these populations). Septic infill is estimated at approximately 42 connections per year for the next 6 years.

TABLE 1-4 – (continued)

Comparison of King County and District Design Assumptions

King County	District
	then 50 connections per year through the 20-year planning period. The Sammamish Town Center is estimated to grow much faster than the surrounding areas due to increased density. The Sammamish Town Center growth and septic conversion infill growth are removed from the other anticipated growth over the next 6 years as these populations are not indicative of the true population growth in the area. This results in a background growth rate of 0.73 percent, which was used to estimate the time of maximum zoning capacity based on the anticipated maximum zoning capacity equivalent residential unit (ERU) count. Several other sources were consulted for growth projections including PSRC population and household growth rates and the Sammamish and Issaquah Comprehensive Plans. The growth rates estimated in these sources did not appear to reflect the reality of the District's recent growth and known developments planned for the next 6 years. PSRC estimates an average growth rate of 0.43 percent for the next 30 years within the District's service area. Between 2006 and 2031, Sammamish projects annual household growth of 1.31 percent per year, and Issaquah projects 1.92 percent per year (or 1.4 percent per year from 2020 through 2035). Neither of the comprehensive plans identified a maximum zoning capacity year/population or identified a growth rate past 2040. Population projections alone may not reflect the District's growth, as the District's service area contains a large number of septic customers who will eventually connect to the system but who would not be included in a population growth estimate.

TABLE 1-4 – (continued)

Comparison of King County and District Design Assumptions

King County	District
Water Consumption and Conservation	
Using a base year of 2010: • Residential: 54 gallons per capita per day (gpcd) • Commercial: 18 gallons per ERU per day (gped) • Industrial: 45−56 gped • Residential: 10 percent reduction between 2010 and 2030; no additional reduction after 2030 • Commercial/Industrial: Same as Residential	The District's sewer flow and winter water use data indicates an average of 96 gallons per day (gpd) per residential customer equivalent. The current household population is about 2.7 to 2.8 persons per household (pph) per PSRC estimates, which translates to approximately 36 gpcd. For non-residential use, domestic sewer estimates are based on estimated ERUs per connection rather than estimating the number of employees for existing or future businesses.
Septic System Conversion to Sewer	
It is assumed that 100 percent of the unsewered potentially sewerable area in 2010 will be sewered by 2060 at a rate of 20 percent per decade, starting in 2010.	The District tracks annual septic system conversions to sewer and notes a maximum of approximately 40 conversions per year over the past decade. The updated septic system conversion rate assumes 42 conversions per year thorough 2025 and 50 conversions per year through 2040. The District has 3,420 septic customers within the service area, so a connection rate of 20 percent per decade through 2060 would result in 85 conversions per year, which is more than double the District's observed conversion rate. All septic systems are assumed to be converted by maximum zoning capacity.

TABLE 1-4 – (continued)

Comparison of King County and District Design Assumptions

King County	District
I/I Degradation	
Degradation is the slow decline in the condition of the conveyance system that allows an increase in I/I. Increases in I/I can also be caused by illicit connections to the sewer system. It is assumed that degradation (increase in peak I/I rate) from 2010 will be 7 percent per decade.	For interim peak I/I estimates, a degradation rate of 7 percent per decade (starting with the peak I/I rate determined in 2019) is used. The maximum zoning capacity I/I rate is based on the greater of either the I/I rate determined at maximum zoning capacity (year 2076) using the 7 percent per decade degradation rate or 1,100 gallons per acre per day (gpad). Some of the District's basins will not reach 1,100 gpad at a degradation rate of 7 percent per decade. The 1,100 gpad is used per King County past guidance, and a higher I/I rate does not appear to be warranted due to the low measured I/I within portions of the service area.
New Construction I/I	
Based on flow monitoring of newly constructed conveyance facilities, WTD assumes 2,000 gpad for new construction I/I, with an increase of 7 percent per decade.	The District-wide overall average peak hourly I/I rate is determined to be approximately 650 gpad, with some small areas of high I/I. I/I is escalated at 7 percent per decade. At maximum zoning capacity, peak I/I is assumed to be the greater of the I/I calculated at a degradation rate of 7 percent per decade or 1,100 gpad. The District-wide maximum zoning capacity I/I is calculated at approximately 1,220 gpad. It should be noted that I/I is applied per basin, and the service area of each basin is expanded over time such that the estimated I/I rate is applied to a larger area resulting in greater I/I flows over time.

The District has operated its system and planned for capital improvements using District-specific standards and design assumptions based on the best information available at the time. Figure 1-2 provides a comparison of the flows calculated for the SPD Basins based on the KCWTD assumptions versus the District assumptions, assuming the same population and service area. It is worth noting and illustrated clearly in Figure 1-2 that had the District applied KCWTD design assumptions in its planning efforts, the existing capacity of the SPD Basin system would have been exceeded several years ago or sooner.

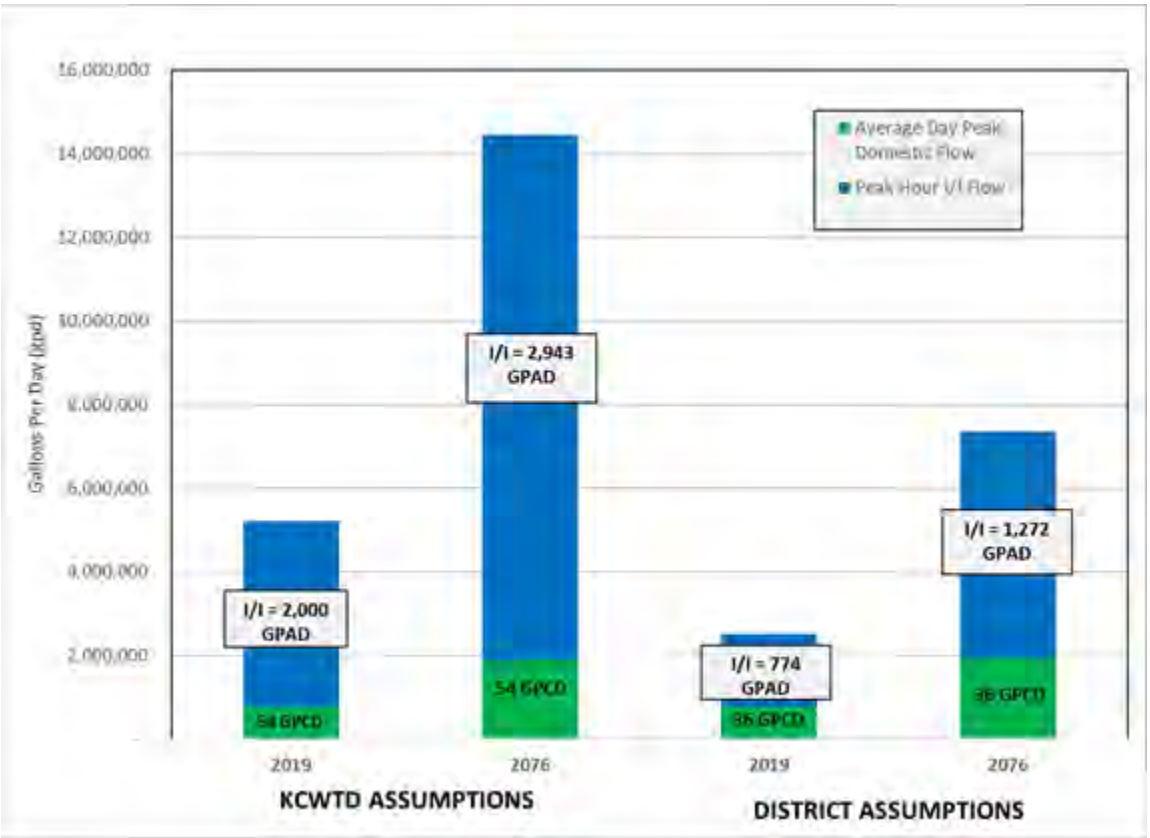


FIGURE 1-2

SPD Basin Comparison of Flows – KCWTD vs. District Assumptions

HYDRAULIC MODEL RESULTS

Figure 1-3 illustrates the model results for the existing system for 2019 flows based on the assumptions outlined in the Analysis. Figures 1-4 through 1-7 provide the same information for the existing system using 6-year, 10-year, 20-year, and zoning capacity flow conditions.

Under present-day flow loads, surcharging is indicated within the North Lake Sammamish Basin's major trunk line along East Lake Sammamish Parkway. Surcharging exceeds 1 foot along much of the trunk during peak flow periods. The surcharging worsens in each subsequent planning period and by 2030, surcharging to the surface is indicated in several manholes along the trunk. As noted in Table 1-3, the bulk of the flow in most basins is due to I/I. The I/I rate is assumed to increase with time due to deterioration of the system, resulting in much higher flows than are currently observed.

LEGEND

- Not Surcharged
- Surcharged <1 ft
- Surcharged >1 ft
- Over Capacity Pipe
- Gravity Pipes
- Gravity Force Main
- Force Main
- Low Pressure Force Main
- Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

2019 domestic sewer flows determined using winter water use data

SAHALEE WAY NE
Cedar Hills
216TH AVE NE
228TH AVE NE
244TH AVE NE
Benham Ridge
NE INGLEWOOD HILL RD
NE 8TH ST
INGLEWOOD
LOUIS THOMPSON RD NE
LOUIS THOMPSON RD SE
The Greens
North Lake Samm
SE 4TH ST
218TH AVE SE
SE 8TH ST
Redford Hudson
SE 20TH ST
SE 24TH ST
Todds Landing
212TH AVE SE
Pine Lake Heights
Pine Lake Glen
First Branch
228TH AVE SE
SE 32ND ST
SE 32ND WAY
Central Lake Samm
EAST LAKE SAMMAMISH PKWY SE
SE 43RD WAY
Control Structure
Alexanders
Mallard Bay
Providence Ridge
ISSAQUAH-PINE LAKE RD SE
SE KLAHANIE BLVD
SE ISSAQUAH-FALL CITY RD

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER

NORTH DIVERSION PH 1 ANALYSIS
FIGURE 1-3
OVER CAPACITY IN 2019

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\Resultsworking.mxd

LEGEND

- Not Surcharged
- Surcharged <1 ft
- Surcharged >1 ft
- Over Capacity Pipe
- Gravity Pipes
- Gravity Force Main
- Force Main
- Low Pressure Force Main
- LS Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

2025 domestic sewer flows determined by the District

SAHALEE WAY NE
Cedar Hills
216TH AVE NE
228TH AVE NE
244TH AVE NE
Benham Ridge
NE INGLEWOOD HILL RD
INGLEWOOD
NE 8TH ST
LOUIS THOMPSON RD NE
LOUIS THOMPSON RD SE
North Lake Samm
SE 4TH ST
218TH AVE SE
The Greens
244TH AVE SE
SE 8TH ST
Redford Hudson
SE 20TH ST
SE 24TH ST
Todds Landing
212TH AVE SE
Pine Lake Heights
Pine Lake Glen
First Branch
228TH AVE SE
SE 32ND ST
SE 32ND WAY
Central Lake Samm
N
EAST LAKE SAMMAMISH PKWY SE
SE 12TH WAY SE
SE 43RD WAY
Alexanders
Control Structure
Mallard Bay
Providence Ridge
ISSAQUAH PINE LAKE RD SE
SE KLAHANIE BLVD
SE ISSAQUAH FALL CITY RD

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER

NORTH DIVERSION PH 1 ANALYSIS
FIGURE 1-4
OVER CAPACITY IN 2025

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\Resultsworking.mxd

LEGEND

- Not Surcharged
- Surcharged <1 ft
- Surcharged >1 ft
- Over Capacity Pipe
- Gravity Pipes
- Gravity Force Main
- Force Main
- Low Pressure Force Main
- LS Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

2030 domestic sewer flows determined by the District

SAHALEE WAY NE
Cedar Hills
244TH AVE NE
216TH AVE NE
228TH AVE NE
Benham Ridge
NE INGLEWOOD HILL RD
NE 8TH ST
INGLEWOOD
The Greens
LOUIS THOMPSON RD NE
LOUIS THOMPSON RD SE
North Lake Samm
SE 4TH ST
218TH AVE SE
244TH AVE SE
SE 8TH ST
Redford Hudson
SE 20TH ST
SE 24TH ST
Todds Landing
Pine Lake Heights
212TH AVE SE
Pine Lake Glen
First Branch
228TH AVE SE
SE 32ND ST
SE 32ND WAY
Central Lake Samm
EAST LAKE SAMMAMISH PKWY SE
SE 12TH WAY
Alexanders
SE 43RD WAY
Control Structure
Mallard Bay
Providence Ridge
ISSAQUAH-PINE LAKE RD SE
SE KLAHANIE BLVD
SE ISSAQUAH-FALL CITY RD

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER

NORTH DIVERSION PH 1 ANALYSIS
FIGURE 1-5
OVER CAPACITY IN 2030

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\Resultsworking.mxd

LEGEND

- Not Surcharged
- Surcharged <1 ft
- Surcharged >1 ft
- Over Capacity Pipe
- Gravity Pipes
- Gravity Force Main
- Force Main
- Low Pressure Force Main
- LS Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

2040 domestic sewer flows determined by the District

SAHALEE WAY NE
Cedar Hills
216TH AVE NE
228TH AVE NE
244TH AVE NE
Benham Ridge
NE INGLEWOOD HILL RD
NE 8TH ST
INGLEWOOD
The Greens
LOUIS THOMPSON RD NE
LOUIS THOMPSON RD SE
North Lake Samm
SE 4TH ST
218TH AVE SE
244TH AVE SE
SE 8TH ST
Redford Hudson
SE 20TH ST
SE 24TH ST
Todds Landing
Pine Lake Heights
212TH AVE SE
Pine Lake Glen
First Branch
228TH AVE SE
SE 32ND ST
SE 32ND WAY
Central Lake Samm
EAST LAKE SAMMAMISH PKWY SE
SE 12TH WAY
Alexanders
SE 43RD WAY
Control Structure
Mallard Bay
Providence Ridge
ISSAQUAH-PINE LAKE RD SE
SE KLAHANIE BLVD
SE ISSAQUAH-FALL CITY RD

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER

NORTH DIVERSION PH 1 ANALYSIS
FIGURE 1-6
OVER CAPACITY IN 2040

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\Resultsworking.mxd

LEGEND

- Not Surcharged
- Surcharged <1 ft
- Surcharged >1 ft
- Over Capacity Pipe
- Gravity Pipes
- Gravity Force Main
- Force Main
- Low Pressure Force Main
- LS Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

Zoning Capacity domestic sewer flows determined by the District

SAHALEE WAY NE
Cedar Hills
216TH AVE NE
228TH AVE NE
244TH AVE NE
Benham Ridge
NE INGLEWOOD HILL RD
NE 8TH ST
INGLEWOOD
The Greens
LOUIS THOMPSON RD NE
LOUIS THOMPSON RD SE
North Lake Samm
SE 4TH ST
218TH AVE SE
SE 8TH ST
Redford Hudson
SE 20TH ST
SE 24TH ST
Todds Landing
Pine Lake Heights
212TH AVE SE
Pine Lake Glen
First Branch
228TH AVE SE
SE 32ND ST
SE 32ND WAY
Central Lake Samm
EAST LAKE SAMMAMISH PKWY SE
SE 43RD WAY
Control Structure
Alexanders
Mallard Bay
Providence Ridge
ISSAQUAH-PINE LAKE RD SE
SE KLAHANIE BLVD
SE ISSAQUAH-FALL CITY RD

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 1-7
OVER CAPACITY AT ZONING CAPACITY

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\Resultsworking.mxd

Without upgrades to the North Lake Sammamish Lift Station and the trunk line along East Lake Sammamish Parkway, current surcharging will continue to get worse over time.

The District has been required to perform after-hours emergency operation of the system along Lake Sammamish during peak storms in order to ensure overflows and spills do not occur. This includes manual operation of lift stations and redirecting sewer flows to other basins. Results from the hydraulic model support field observations that the existing system is at capacity and that immediate improvements are required.

The existing capacity of the SPD impacted lift stations is included in Table 1-5.

TABLE 1-5

Existing Lift Station Capacity

Lift Station	Capacity (gpm)
North Lake Sammamish	1,250 (1)
Central Lake Sammamish	1,500
Inglewood	2,880
Mallard Bay	900

(1) Requires three pumps running. Three-pump operation requires manual on-site operation by District staff.

The modeling indicates that the gravity main upstream of the North Lake Lift Station may surcharge more than 3 feet during peak flow times. This is due to both the North Lake Lift Station being undersized for the tributary flow and the relatively flat 12- and 15-inch pipes along some sections of the gravity main. Several sections of the main have a full-pipe capacity of 900 to 1,000 gpm.

The gravity main upstream of the Central Lake Lift Station has a full-pipe capacity of approximately 1,000 to 3,600 gpm and generally does not surcharge in the modeling under present-day peak flows. The North Lake Lift Station discharges approximately 1,250 gpm maximum to the gravity main and there is limited additional flow generated within the Central Lake Basin. The gravity main is capable of conveying the existing flows, though the modeling indicates that parts of the main may flow full or close to full during peak flow times. However, if the North Lake Lift Station capacity is increased to meet future flow requirements, the capacity of the Central Lake gravity main will be exceeded.

In the future, growth is expected throughout the District's service area, and particularly within the SPD Basins. It is estimated that I/I flows will also increase over time due to deterioration of the pipes. The existing infrastructure does not have sufficient capacity

to convey the existing peak flows and the capacity problems will only get worse over time without improvements.

CHAPTER 2

ALTERNATIVES ANALYSIS

LONG-TERM IMPROVEMENTS

In order to improve capacity of the existing system and convey flows from the SPD Basins to the south, potential improvements have been identified. Since the majority of these improvements will involve significant disruption to East Lake Sammamish Parkway, and because the life cycle of the existing gravity, force main and lift station structures is expected to exceed 50 years, it is important that the identified improvements can meet the District's needs for decades into the future. Therefore, the improvements are sized to address the estimated flows at zoning capacity to avoid continual disruptions caused by construction projects. The identified long-term alternatives can meet the District's sewer capacity needs for the current maximum zoning capacity flow conditions, including future peak infiltration and inflow levels.

It is anticipated that many of these long-term improvements would ultimately become King County-owned and operated facilities. King County will apply WTD design standards if and when ownership of these facilities is transferred. Table 2 -1 summarizes level of service assumptions that have been applied to identify deficiencies and to develop design standards for improvements. The deficiency criteria are used to identify a required improvement, the design standard identifies the level of service applied to proposed improvements.

TABLE 2-1

Level of Service Assumptions

Facility	Deficiency Criteria	Design Standard
Lift Station	Exceeds maximum pumping capacity. Assumes all pumps in service.	Peak flow at maximum zoning capacity with largest pump out of service.
Force Main	Lift station has reached capacity due to force main deficiencies.	Maximum of 8 feet per second (fps) velocity.
Gravity Main	Greater than 1 foot of surcharge.	No surcharge at peak flow for maximum zoning capacity.

Long-term improvement alternative projects are identified with the prefix "A."

ALTERNATIVE A-1 – UPGRADE EXISTING SYSTEM

Alternative A-1 assumes that the existing system capacity will be increased to accommodate increased flows. The gravity mains, lift stations, and force mains will be replaced to accommodate increased flows and the system will operate as it currently operates. Table 2-2 includes the lengths of pipe required along each of the gravity and pressure mains in the Central and North Lake Lift Station Basins. The entire length of gravity main in each basin along East Lake Sammamish Parkway will need to be replaced with larger pipe, as will the force mains discharging from both lift stations. For reference, the majority of the facilities along East Lake Sammamish Parkway were constructed in the late 1980s, so there is still significant useful life left in the gravity mains. This alternative is shown on Figure 2-1.

TABLE 2-2

Alternative A-1 Sewer Conveyance Improvements

Sewer Line	Required Capacity (gpm)	New Pipe Diameter (in.)	Length (ft)
North Lake Gravity	3,000 to 4,300	15	560
		18	360
		21	4,360
		24	1,020
Central Lake Gravity	4,300 to 4,800	15	0
		18	1,900
		21	3,820
		24	0
North Lake Force Main	4,300	16	6,510
Central Lake Force Main	4,300	16	6,870

Table 2-3 illustrates the required lift station capacity at both the Central Lake and North Lake Lift Stations to pump the tributary peak flows estimated at the time of zoning capacity. The capacity required at the Central Lake Lift Station is primarily dictated by the capacity of the North Lake Lift Station, as the majority of the flow to the Central Lake Basin comes from the North Lake Basin.

It should be noted that the Mallard Bay Lift Station pumps to a common force main with the Central Lake Lift Station. Improvements to the Central Lake Lift Station that increase the lift station pumping capacity may change the head conditions within the force main, and the Mallard Bay Lift Station may require additional improvements to pump against increased head.

LEGEND

- Existing Manholes
- Existing Pipes
- Gravity Improvements Necessary in 2019
- Gravity Improvements Necessary at Zoning Capacity
- Force Main Improvements Necessary at Zoning Capacity
- Force Main
- Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

ALTERNATIVE 1
UPGRADE EXISTING SYSTEM

Estimated Project Cost
$43,027,000

2019 domestic sewer flows determined using winter water use data. Zoning capacity domestic sewer flows determined by the District.

560 LF 15-inch
360 LF 18-inch
4,360 LF 21-inch
1,020 LF 24-inch

Upgrade North Lake Sammamish Lift Station: 4,300 gpm

North Lk Samm LS

6,510 LF 16-inch Forcemain

1,900 LF 18-inch
3,820 LF 21-inch

Upgrade Central Lake Lift Station: 4,300 gpm

Central Lk Samm LS

6,870 LF 16-inch Forcemain

Alexander's LS

Mallard Bay LS

Upgrade Mallard Bay Lift Station

Cimmeron (NE SAMM)

Inglewood LS

The Greens LS

Redford Hudson LS

Todd's Landing LS

Pine Lk Hts LS

Pine Lk Glen LS

First Branch LS

Inglewood Jr High (PRIVATE)

East Lake Sammamish Pkwy SE

NE Inglewood Hill Rd

NE 8th St

SE 32nd Way

SE 32nd St

SE 43rd Way

Private Rd

216th Ave NE

228th Ave NE

244th Ave NE

212th Ave SE

228th Ave SE

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 2-1
ALTERNATIVE 1
UPGRADE EXISTING SYSTEM

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\F2-1 ImprovementsGravity.mxd

TABLE 2-3

Alternative A-1 Lift Station Improvements

Lift Station	Existing Capacity (gpm)	Improved Capacity (gpm)
North Lake	1,250 (1)	4,300
Central Lake	1,500 (2)	4,300
Mallard Bay	940	Potential improvements required due to changes in downstream head conditions.

(1) Capacity with all three pumps running.
(1) Capacity with largest pump running.

Alternative A-1 would require the greatest amount of deep sewer installation of the alternatives, resulting in the most public disruption and highest capital cost.

Estimated Cost: $43,027,000

Phasing Opportunities

The North Lake Lift Station is the current system limitation. Upsizing the North Lake Lift Station will, however, require upsizing the Central Lake Lift Station and its force main, which are also presently at capacity. Construction of Alternative A-1 could possibly be phased as follows:

Phase One

- Increase capacity of both the North Lake and Central Lake Lift Stations to 2,800 gpm, but expandable to 4,300 gpm.
- Replace 1,000 linear feet of 8-inch force main for Central Lake Lift Station with 16-inch force main.

Phase Two

- Increase capacity of North Lake and Central Lake Lift Stations to 4,300 gpm. Install remaining force main and gravity improvements.

Advantages

- Inglewood Lift Station can still be diverted to the SPD when it is ultimately constructed. This provides treatment system redundancy for the

Inglewood Basin as it could be diverted to either Brightwater or the South Treatment Plant.

Disadvantages

- Most expensive alternative.
- Most disruptive to the public due to extensive work on East Lake Sammamish Parkway.
- Significant stranded investments if the SPD is constructed.

ALTERNATIVE A-2 – INGLEWOOD FORCE MAIN EXTENSION

Alternative A-2 is similar to Alternative A-1, but instead of upgrading the capacity of the North Lake Basin gravity main, the Inglewood Lift Station force main would be extended from the existing lift station discharge location at NE Inglewood Hill Road and 211th Avenue NE, along NE Inglewood Hill Road and East Lake Sammamish Parkway to discharge into the North Lake Lift Station wet well. This force main extension would bypass the North Lake Basin gravity main such that gravity improvements in that basin would not be necessary. The North Lake Lift Station would still require improvements to handle the increased flow. The improvements required are summarized in Tables 2-4 and 2-5. This alternative is shown on Figure 2-2.

TABLE 2-4

Alternative A-2 Sewer Conveyance Improvements

Sewer Line	Required Capacity (gpm)	New Pipe Diameter (in.)	Length (ft)
North Lake Gravity	500 to 2,000	15	0
		18	0
		21	0
		24	0
Central Lake Gravity	4,300 to 4,800	15	0
		18	1,900
		21	3,820
		24	0
North Lake Force Main	4,300	16	6,510
Central Lake Force Main	4,300	16	6,870
Inglewood Force Main	2,880	16	10,000

LEGEND

- Existing Manholes
- Existing Pipes
- Gravity Improvements Necessary at Zoning Capacity
- Force Main Improvements Necessary at Zoning Capacity
- Force Main
- Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

ALTERNATIVE 2
UPGRADE EXISTING SYSTEM W/ INGLEWOOD FM EXTENSION

Estimated Project Cost
$37,791,000

2019 domestic sewer flows determined using winter water use data. Zoning capacity domestic sewer flows determined by the District.

10,000 LF 16-inch Forcemain

Upgrade North Lake Sammamish Lift Station: 4,300 gpm

6,510 LF 16-inch Forcemain

1,900 LF 18-inch
3,820 LF 21-inch

Upgrade Central Lake Lift Station: 4,300 gpm

6,870 LF 16-inch Forcemain

Upgrade Mallard Bay Lift Station

East Lake Sammamish Pkwy SE

216th Ave NE

228th Ave NE

244th Ave NE

NE Inglewood Hill Rd

NE 8th St

212th Ave SE

228th Ave SE

Private Rd

SE 32nd Way

SE 32nd St

SE 43rd Way

Cimmeron (NE SAMM)

Inglewood Jr High (PRIVATE)

Inglewood LS

The Greens LS

North Lk Samm LS

Redford Hudson LS

Todd's Landing LS

Pine Lk Hts LS

Pine Lk Glen LS

First Branch LS

Central Lk Samm LS

Alexander's LS

Mallard Bay LS

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 2-2
ALT. 2: UPGRADE EXISTING SYSTEM
W/ INGLEWOOD FM EXTENSION

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\F2-2 ImprovementsIngBypassCent.mxd

TABLE 2-5

Alternative A-2 Lift Station Improvements

Lift Station	Existing Capacity (gpm)	Improved Capacity (gpm)
North Lake	1,250 (1)	4,300
Central Lake	1,500 (2)	4,300
Mallard Bay	940	Potential improvements required due to changes in downstream head conditions.

(1) Capacity with all three pumps running.
(2) Capacity with largest pump running.

As in Alternative A-1, the extensive gravity improvements in the Central Lake Basin would require substantial deep sewer construction. The extension of the Inglewood Lift Station force main would result in shallower construction as compared with the North Lake Basin gravity improvements detailed in Alternative A-1. However, the length of construction of the force main would be significantly longer along both NE Inglewood Hill Road and East Lake Sammamish Parkway. It is assumed the Inglewood Lift Station has adequate head capacity to pump through the extended force main, since it is primarily downhill to the North Lake Lift Station.

Estimated Cost: $37,791,000

Phasing Opportunities

Construction of Alternative 2 could be phased as follows:

Phase One

- Increase capacity of both the North Lake and Central Lake Lift Stations to 2,800 gpm, but expandable to 4,300 gpm.
- Replace 1,000 linear feet of 8-inch force main for the Central Lake Lift Station with 16-inch force main.
- Install Inglewood Lift Station force main extension.

Phase Two

- Increase capacity of North Lake and Central Lake Lift Stations to 4,300 gpm.

- Install remaining force main and gravity improvements.

Advantages

- Avoids gravity main construction for the North Lake Basin.
- Inglewood force main extension could be used to pump the North Lake Lift Station to the SPD when it is constructed.

Disadvantages

- Still requires costly Central Lake Lift Station, force main, and gravity basin improvements.
- Disruptive to the public due to extensive work on East Lake Sammamish Parkway.
- Other alternatives are less expensive and less disruptive.
- Central Lake Basin facilities will be oversized if Inglewood and North Lake Lift Station flows are routed to the SPD in the future.

ALTERNATIVE A-3 – BYPASS CENTRAL LAKE GRAVITY MAIN

Alternative A-3 includes construction of a force main to pump flows from the North Lake Lift Station directly to the interceptor south of the Mallard Bay Lift Station. This improvement would bypass flow from the North Lake Lift Station around the Central Lake Lift Station and its upstream gravity main.

Table 2-6 includes the lengths of pipe required along each of the gravity and pressure mains in the North Lake Basin. As in Alternative A-1, the entire length of gravity main in the North Lake Basin along East Lake Sammamish Parkway will need to be replaced with larger pipe as will the force mains discharging from the lift station.

Alternative A-3 includes the construction of a new force main to convey flow from the North Lake Lift Station directly to the common force main downstream of the Central Lake Lift Station. This bypass avoids the need to upsize any infrastructure within the Central Lake Lift Station. It is assumed that the alignment of the new 16-inch bypass force main will follow along the Central Lake gravity main from north to south along East Lake Sammamish Parkway. Table 2-6 includes the lengths of main replacement required in the North Lake Lift Station Basin. This alternative is shown on Figure 2-3.

LEGEND

- Existing Manholes
- Existing Pipes
- Gravity Improvements Necessary in 2019
- Gravity Improvements Necessary at Zoning Capacity
- Force Main Improvements Necessary at Zoning Capacity
- Force Main
- Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

ALTERNATIVE 3
BYPASS CENTRAL LAKE GRAVITY

Estimated Project Cost
$32,690,000

2019 domestic sewer flows determined using winter water use data. Zoning capacity domestic sewer flows determined by the District.

560 LF 15-inch
360 LF 18-inch
4,360 LF 21-inch
1,020 LF 24-inch

Upgrade North Lake Sammamish Lift Station: 4,300 gpm

19,000 LF 16-inch Forcemain Extends to Control Structure

Redirect Central Lake Discharge to Mallard Bay

Upgrade Mallard Bay Lift Station

East Lake Samma

NE

216th Ave NE

228th Ave NE

244th Ave NE

NE Inglewood Hill Rd

NE 8th St

Cimmeron (NE SAMM)

Inglewood Jr High (PRIVATE)

Inglewood LS

The Greens LS

228th Ave SE

Private Rd

North Lk Samm LS

212th Ave SE

Redford Hudson LS

Todd's Landing LS

Pine Lk Hts LS

Pine Lk Glen LS

First Branch LS

SE 32nd Way

SE 32nd St

Cent al Lk Samm LS

228th Ave SE

Alexander's LS

Mallard Bay LS

SE 43rd Way

East Lake Sammamish Pkwy SE

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 2-3
ALTERNATIVE 3: BYPASS
CENTRAL LAKE GRAVITY MAIN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\F2-3 ImprovementsNorthBypass.mxd

TABLE 2-6

Alternative A-3 Sewer Conveyance Improvements

Sewer Line	Required Capacity (gpm)	New Pipe Diameter (in.)	Length (ft)
North Lake Gravity	3,000 to 4,800	15	560
		18	360
		21	4,360
		24	1,020
Central Lake Gravity	10 to 530	15	0
		18	0
		21	0
		24	0
North Lake Force Main	4,300	16	19,000
Central Lake Force Main	1,500	16	0
Inglewood Force Main	2,880	16	0

Table 2-7 includes the required lift station capacity at the North Lake Lift Station to pump the estimated zoning capacity flows. In this alternative, the Central Lake Lift Station no longer receives flow from the North Lake Lift Station, so it does not require improvements. As in Alternative A-1, the Mallard Bay Lift Station may require additional improvements to pump against increased head in the common force main to which the North Lake Lift Station bypass force main will discharge. If the Central Lake Lift Station continues to pump to the common force main, it may also require improvements to pump against the increased head from the North Lake Lift Station. Since the Central Lake Lift Station pumping requirements will be significantly reduced by this alternative, the District could elect to pump from the Central Lake Lift Station to the Mallard Bay Basin permanently, utilizing the existing smaller capacity pumps. The flow within the Central Lake Basin is low, even at the time of zoning capacity, and the Mallard Bay Basin has sufficient capacity for the additional flow.

TABLE 2-7

Alternative A-3 Lift Station Improvements

Lift Station	Existing Capacity (gpm)	Improved Capacity (gpm)
North Lake	1,250 (1)	4,300
Central Lake	1,500 (2)	600 Redirect flow to Mallard Bay Basin.
Mallard Bay	940 gpm	940 (3)

(1) Capacity with all three pumps running.
(2) Capacity with largest pump running.
(3) Pumping improvements may be required due to changed head conditions.

This alternative meets several of the District's goals for its system, which are detailed later in this memo. The construction of a long force main is less disruptive than the construction of the large-diameter, deep gravity main described in Alternative A-1. The depth of construction of a force main reduces the duration of construction considerably when compared with deep gravity sewer construction. The reduced construction duration and depth also are less expensive per linear foot. It would increase long-term pumping costs due to the longer force main.

Estimated Cost: $32,690,000

Phasing Opportunities

Construction of Alternative A-3 could be phased as follows:

Phase One

- Increase capacity of North Lake Lift Station to 2,800 gpm, expandable to 4,300 gpm.
- Install 19,000 linear feet of 16-inch force main.

Phase Two

- Increase capacity of North Lake Lift Station to 4,300 gpm.
- Install remaining force main and gravity improvements.

Advantages

- Avoids improvements to the Central Lift Station, force main, and gravity basin.
- Force main improvements have less cost and public disturbance impacts than deep gravity sewers.

Disadvantages

- Still requires costly North Lake Basin gravity improvements.
- Disruptive to the public due to extensive work on East Lake Sammamish Parkway.
- Facilities will be oversized if Inglewood Lift Station flows are routed to the SPD in the future.

ALTERNATIVE A-4 – BYPASS NORTH AND CENTRAL LAKE GRAVITY MAINS

Alternative A-4 is a combination of Alternatives A-2 and A-3. In this case, flow from the Inglewood Lift Station is bypassed around the North Lake gravity main and pumped directly to the North Lake Lift Station wet well. Also, the force main from the North Lake Lift Station is replaced and extended to pump past the Central Lake Basin.

Table 2-8 includes the length of new pressure mains in the Inglewood Lift Station and North Lake Lift Station Basins. It is assumed that the alignment of the new 16-inch force main from the Inglewood Lift Station will follow along NE Inglewood Hill Road and East Lake Sammamish Parkway, and the North Lake Lift Station bypass force main will follow along the Central Lake gravity main from north to south along East Lake Sammamish Parkway. This alternative is shown on Figure 2-4.

TABLE 2-8

Alternative A-4 Sewer Conveyance Improvements

Sewer Line	New Pipe Diameter (in.)	Length (ft)
North Lake Gravity	15	0
	18	0
	21	0
	24	0
Central Lake Gravity	15	0
	18	0
	21	0
	24	0
North Lake Force Main	16	19,000
Central Lake Force Main	16	0
Inglewood Force Main	16	10,000

Table 2-9 includes the required lift station capacity at the North Lake Lift Station to pump the estimated zoning capacity flows. In this alternative as in Alternative A-2, the Central Lake Lift Station no longer receives flow from the North Lake Lift Station, so it does not require improvements. As in the previously described alternatives, the Mallard Bay Lift Station may require additional improvements to pump against increased head in the common force main to which the North Lake Lift Station bypass force main will discharge. Similarly, it is again recommended that the Central Lake Lift Station force main be reconfigured to discharge to the Mallard Bay Gravity Basin full time.

The new 16-inch force main from the Inglewood Lift Station will discharge to the North Lake Lift Station wet well, so the North Lake Lift Station will need to be upsized to be able to convey this flow. It is assumed the Inglewood Lift Station has adequate head capacity to pump through the extended force main, since it is primarily downhill to the North Lake Lift Station.

LEGEND

- Existing Manholes
- Existing Pipes
- Gravity Improvements Necessary in 2019
- Gravity Improvements Necessary at Zoning Capacity
- Force Main Improvements Necessary at Zoning Capacity
- Force Main
- Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

ALTERNATIVE 4
BYPASS NORTH AND CENTRAL GRAVITY MAINS

Estimated Project Cost
$34,253,000

2019 domestic sewer flows determined using winter water use data. Zoning capacity domestic sewer flows determined by the District.

10,000 LF 16-inch Forcemain

Upgrade North Lake Sammamish Lift Station: 4,300 gpm

19,000 LF 16-inch Forcemain Extends to SE 43rd Way

Redirect Central Lake Discharge to Mallard Bay

Upgrade Mallard Bay Lift Station

East Lake Sammamish Pkwy SE

216th Ave

228th Ave NE

244th Ave NE

NE Inglewood Hill Rd

NE 8th St

Private Rd

212th Ave SE

228th Ave SE

SE 32nd Way

SE 32nd St

SE 43rd Way

Cimmeron (NE SAMM)

Inglewood Jr High (PRIVATE)

Inglewood LS

The Greens LS

North Lk Samm LS

Redford Hudson LS

Todd's Landing LS

Pine Lk Hts LS

Pine Lk Glen LS

First Branch LS

Cent al Lk Samm LS

Alexander's LS

Mallard Bay LS

N

1,000 0 1,000 2,000 3,000 4,000

Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 2-4
ALTERNATIVE 4: BYPASS NORTH AND CENTRAL LAKE GRAVITY MAINS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\F2-4 ImprovementsNorthIngBypass.mxd

TABLE 2-9

Alternative A-4 Lift Station Improvements

Lift Station	Existing Capacity (gpm)	Improved Capacity (gpm)
North Lake	1,250 (1)	4,300
Central Lake	1,500 (2)	600 Redirect flow to Mallard Bay Basin.
Mallard Bay	940	940 (3)

(1) Capacity with all three pumps running.
(2) Capacity with largest pump running.
(3) Pumping improvements may be required due to changed head conditions.

This alternative has similar benefits and drawbacks as Alternative A-2. The long force mains can be installed at a more shallow depth than the gravity main improvements, which may reduce disruption during construction. Additionally, the gravity mains can remain in service while the force mains are installed without the need for long-term bypass pumping.

Estimated Cost: $34,253,000

Phasing Opportunities

Construction of Alternative A-4 could be phased as follows:

Phase One

- Install 19,000 linear feet of 16-inch force main for North Lake Lift Station.

Phase Two

- Increase capacity of North Lake Lift Station to 4,300 gpm.
- Install remaining force main improvements.

Advantages

- Avoids gravity main construction for North Lake Basin.
- When SPD is constructed, North Lake and Central Lake Lift Stations could be configured to pump north and south. Avoids stranded investments in capital projects.

Disadvantages

- Disruptive to the public due to extensive work on East Lake Sammamish Parkway, but of the Parkway alternatives is less due to limited gravity.
- Long force mains can have odor issues.

ALTERNATIVE A-5 – EAST LAKE SAMMAMISH PARKWAY INTERCEPTOR

Alternative A-5 would require the extension of a new force main along East Lake Sammamish Parkway from the Inglewood Lift Station discharge to the twin 20-inch interceptor mains. Due to topography, the pipeline would need to be a low-pressure force main. The length of the new 16-inch diameter force main would be approximately 29,000 linear feet. The Inglewood, Central Lake, and North Lake Lift Stations would all need to be retrofitted to pump a short distance into the new interceptor, and the existing force mains could be abandoned. This alternative is indicated on Figure 2-5.

Table 2-10 provides the pipeline length of the East Lake Sammamish Parkway Interceptor low-pressure force main alternative.

TABLE 2-10

Alternative A-5 Sewer Conveyance Improvements

Sewer Line	New Pipe Diameter (in.)	Length (ft)
East Lake Sammamish Parkway Interceptor	16	29,000

Table 2-11 includes the required lift station capacities to pump the estimated zoning capacity flows. The hydraulic conditions of the East Lake Sammamish Parkway Interceptor would be variable depending upon how many pumps are running. It is also probable that parts of the new interceptor will be in open channel rather than pressurized conditions at times, depending upon the flow conditions.

LEGEND

- Existing Manholes
- Existing Pipes
- Gravity Improvements Necessary in 2019
- Gravity Improvements Necessary at Zoning Capacity
- Force Main Improvements Necessary at Zoning Capacity
- Force Main
- Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

ALTERNATIVE 5 - E LAKE SAMMAMISH PKWY INTERCEPTOR

Estimated Project Cost
$32,532,000

2019 domestic sewer flows determined using winter water use data. Zoning capacity domestic sewer flows determined by the District.

Upgrade Inglewood Lift Station

Upgrade North Lake Sammamish Lift Station

29,000 LF 16-inch Forcemain Extends to SE 43rd Way

Upgrade Central Lake Sammamish Lift Station

Upgrade Mallard Bay Lift Station

East Lake Sammamish Pkwy
216th Ave NE
228th Ave NE
244th Ave NE
NE Inglewood Hill Rd
NE 8th St
Cimmeron (NE SAMM)
Inglewood Jr High (PRIVATE)
Inglewood LS
The Greens LS
228th Ave SE
Private Rd
212th Ave SE
North Lk Samm LS
Redford Hudson LS
Todd's Landing LS
Pine Lk Hts LS
Pine Lk Glen LS
First Branch LS
SE 32nd Way
SE 32nd St
Central Lk Samm LS
Alexander's LS
Mallard Bay LS
SE 43rd Way
East Lake Sammamish Pkwy SE

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 2-5
ALTERNATIVE 5 - E LAKE SAMMAMISH PKWY INTERCEPTOR

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\F2-5 ImprovementsExtInterceptor.mxd

TABLE 2-11

Alternative A-5 Lift Station Improvements

Lift Station	Existing Capacity (gpm)	Improved Capacity (gpm)
North Lake	1,250 (1)	2,000
Central Lake	1,500 (2)	600 (3)
Mallard Bay	940	940 (3)

(1) Capacity with all three pumps running.
(2) Capacity with largest pump running.
(3) Pumping improvements may be required due to changed head conditions.

Estimated Cost: $32,532,000

Phasing Opportunities

Construction of Alternative A-5 could be phased as follows:

Phase One

- Install 29,000 linear feet of 16-inch low-pressure force main and connect to existing Inglewood Lift Station force main.

Phase Two

- Increase capacity of North Lake Lift Station to 2,000 gpm and retrofit to pump directly into the low-pressure force main.
- Retrofit Central Lift Station to pump directly into the low-pressure force main.

Advantages

- Removes “leap-frogging” of lift stations, so one failure ceases to impact multiple basins.
- Improvements to North Lake and Central Lake Lift Stations can be delayed for a significant period of time.
- When the SPD is constructed in the future, provides the ability to direct flows either north or south, creating a more flexible system for King County

to operate. A larger engineering effort and potentially a larger pipeline may be required in order for this to be possible.

Disadvantages

- Disruptive to the public due to extensive work on East Lake Sammamish Parkway, but of the Parkway alternatives is less due to limited gravity.

- Hydraulics are more complicated than other alternatives. May require head capacity upgrades of all lift stations (Central Lake, North Lake, Inglewood, and Mallard Bay) to pump to the new interceptor at zoning capacity flow conditions.

ALTERNATIVE A-6 – INGLEWOOD LIFT STATION BYPASS TO CONTROL STRUCTURE

Alternative A-6 includes construction of a force main to pump flows from the Inglewood Lift Station directly to the control structure at SE 43rd Way. This improvement would bypass flow from the Inglewood Lift Station around the North Lake and Central Lake Lift Station Basins.

Table 2-12 includes the lengths of pipe required to implement this project. Alternative 6 includes the construction of a new force main to convey flow from the Inglewood Lift Station directly to the dual 20-inch force mains at the control structure. This bypass avoids the need to upsize any gravity infrastructure within the North Lake or Central Lake Lift Stations in the next 20 years. The force main is assumed to follow an existing gravity main alignment that connects to the control structure on SE 43rd Way. This alignment was chosen to avoid impacts to East Lake Sammamish Parkway. The alignment is shown on Figure 2-6.

Beyond the 20-year horizon, flow within the North Lake and Central Lake Basins will exceed the capacity of the Central Lake gravity main as well as both lift stations and some improvements will be required.

LEGEND

- Existing Manholes
- Existing Pipes
- Gravity Improvements Necessary at Zoning Capacity
- Force Main Improvements Necessary at Zoning Capacity
- Force Main
- Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

ALTERNATIVE 6
BYPASS INGLEWOOD TO CONTROL STRUCTURE

Estimated Project Cost
$25,261,000

2019 domestic sewer flows determined using winter water use data. Zoning capacity domestic sewer flows determined by the District.

Upgrade Inglewood Lift Station

Upgrade North Lake Sammamish Lift Station: 2,000 gpm

22,000 LF 16-inch Forcemain

1,620 LF 18-inch

Upgrade Central Lake Sammamish Lift Station: 2,500 gpm

East Lake Sammamish Pkwy NE

216th Ave NE

228th Ave NE

244th Ave NE

NE Inglewood Hill Rd

NE 8th St

Cimmeron (NE SAMM)

Inglewood Jr High (PRIVATE)

Inglewood LS

North Lk Samm LS

The Greens LS

228th Ave SE

Private Rd

Redford Hudson LS

Todd's Landing LS

Pine Lk Hts LS

Pine Lk Glen LS

First Branch LS

SE 32nd Way

SE 32nd St

Central Lk Samm LS

Alexander's LS

Mallard Bay LS

SE 43rd Way

East Lake Sammamish Pkwy SE

N

1,000 0 1,000 2,000 3,000 4,000

Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 2-6
ALTERNATIVE 6: BYPASS INGLEWOOD TO CONTROL STRUCTURE

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\F2-6 ImprovementsIngCtrlBypass.mxd

TABLE 2-12

Alternative A-6 Sewer Conveyance Improvements

Sewer Line	Required Capacity (gpm)	New Pipe Diameter (in.)	Length (ft)
North Lake Gravity	500 to 2,000	15	0
		18	0
		21	0
		24	0
Central Lake Gravity	2,000 to 2,500	15	0
		18	1,620
		21	0
		24	0
North Lake Force Main	2,000	12	0
Central Lake Force Main	2,500	12	1,000
Inglewood Force Main	2,880	16	22,000

Table 2-13 includes the required lift station capacity at the North Lake and Central Lake Lift Stations to pump the estimated zoning capacity flows. In this alternative, the North Lake Lift Station continues to pump to the Central Lake Lift Station, but all flow from the Inglewood Lift Station is diverted away from the North Lake Basin. Growth in the North Lake and Central Lake Basins will necessitate increased capacity at each lift station by the time zoning capacity is reached.

TABLE 2-13

Alternative A-6 Lift Station Improvements

Lift Station	Existing Capacity (gpm)	Improved Capacity (gpm)
North Lake	1,250 (1)	2,000
Central Lake	1,500 (2)	2,500
Mallard Bay	940	None.
Inglewood	2,880	Increased head requirements.

(1) Capacity with all three pumps running.
(2) Capacity with largest pump running.

The length of force main required to extend from the Inglewood Lift Station to the control structure is substantial; however, the construction of a long force main is less disruptive than the construction of the large-diameter, deep gravity mains described in the previous alternatives. Additionally, this improvement would avoid the intensive work along East

Lake Sammamish Parkway that is required in the other alternatives. Some gravity improvements within the North Lake and Central Lake Basins cannot be avoided due to anticipated growth at zoning capacity and the two lift stations would require increased capacity.

Preliminary calculations indicate that 200-horsepower (hp) pumps would be required at the Inglewood Lift Station to meet the proposed pumping conditions. The Inglewood Lift Station does have two currently unused pumping ports that could be retrofitted for the higher-capacity pumps while the existing system remains in service. The existing pumps could also remain in service to allow for conversion to pumping to a future SPD project.

Estimated Cost: $25,261,000

Phasing Opportunities

Construction of Alternative A-6 could be phased as follows:

Phase One

- Install 22,000 linear feet of 16-inch of force main extension for the Inglewood Lift Station.
- Retrofit Inglewood Lift Station for significantly higher head conditions.

Phase Two

- Increase capacity of North Lake Lift Station to 2,000 gpm and Central Lake Lift Station to 2,500 gpm.
- Upgrade 1,000 linear feet of Central Lake Lift Station force main to 12-inch diameter.
- Upgrade 1,620 linear feet of Central Lake Basin gravity main to 18-inch.

Advantages

- Minimizes work in East Lake Sammamish Parkway. Minimal gravity improvements are required.
- Improvements to Central Lake Lift Station and North Lake Lift Station can be significantly delayed; possible to be coordinated with planned

improvements to East Lake Sammamish Parkway to minimize restoration and disruption.

- Removes flows of Inglewood Lift Station from Central Lake Lift Station and North Lake Lift Station.

Disadvantages

- Significant upgrades to Inglewood Lift Station required.
- Hydraulics of this evaluation have not been completed, but horsepower requirements are significantly higher than the existing station and long-term pumping costs will be higher as a result.
- Easements and critical areas may be a challenge for installation of the new force main.

CONSTRUCT SAMMAMISH PLATEAU DIVERSION PHASE 2

Planning to this point and time was intended for a pipeline that connected the District's Inglewood Lift Station discharge to a new King County pipeline that would discharge in the Northeast Lake Sammamish Interceptor. King County included the project in its 2017 Conveyance System Improvement (2017 CSI) Program, but it was given an estimated project time frame of 2050 to 2070 for project completion, despite determining that the 20-year peak capacity will be exceeded in 2027. The Sammamish Plateau Diversion Phase 2 project included over 44,000 linear feet of 27- to 36-inch gravity, low-pressure force main, and force main, along with a 36.6 million gallons per day (mgd) pump station (Lift Station 14) that discharged to the King County system somewhere near Marymoor Park, and improvements to the North Lake Lift Station and Central Lake Lift Station. The proposed project would have connected with the District's Control Structure, providing service to nearly all the District's collection system. The 2017 CSI project included a conceptual estimated project cost of $218 million. The project description and project cost estimate are included in Appendix B.

The project identified in the 2017 CSI Program was significantly larger than what is needed to provide service to the Inglewood Lift Station and serve the current needs of the District. The project could easily be phased into smaller portions of work. Based on the cost estimate provided, the improvements to serve only the Inglewood and North Lake Basins are shown here. These improvements would eliminate all capacity deficiencies in the District's collection system. Approximately 49 percent of the total direct construction costs included in the total project are related to this portion of the work. This 49 percent has been applied to the non-direct costs provided by King County to develop the total

project cost shown here. This modified Sammamish Plateau Diversion Phase 2 cost is included to provide comparison and context when discussing North Diversion Phase 1 alternatives.

Estimated Cost: $107,527,000

INTERIM IMPROVEMENT ALTERNATIVES

The District's system along East Lake Sammamish is at capacity. Alternatives A-1 through A-6 and the SPD provide long-term solutions to this problem, but all these alternatives will take years to plan, finance, design, and construct. The District needs relief in the interim in order to prevent spills during severe wet weather conditions. The following section analyzes potential projects that may be constructed more quickly to provide some relief while the long-term solution is developed. Interim improvement projects are denoted with the prefix "I."

NORTH DIVERSION INTERIM IMPROVEMENTS EVALUATION - 2015 EVALUATION

The 2015 Evaluation identified several interim improvements that could potentially provide additional capacity within the SPD Basins to accommodate growth for the next 5 to 10 years from the date of the evaluation. The purpose of the report at that time was to identify improvements that could bridge the time it took for King County to plan, design, and construct the SPD. For the purpose of continuity, these options have been reassessed following an update of the sewer model with updated present-day flows and flow projections.

ALTERNATIVE I-1 – VFDS AT INGLEWOOD LIFT STATION

Currently, the Inglewood Lift Station has a capacity of approximately 2,800 gpm, but there are no controls on the pumps to modulate the flow. In the previous assessment of potential interim improvements, installing variable frequency drives (VFDs) at Inglewood was considered to be a feasible method of mitigating the load on the North Lake Lift Station during peak flows for an interim period of time.

In this scenario, VFDs run at slower speeds would reduce the Inglewood Lift Station flows to approximately 2,100 gpm and the pumps would run for a longer period of time. Attenuation in the gravity system downstream of the Inglewood Lift Station force main discharge would reduce the peak flows impacting the North Lake Lift Station and the gravity system upstream of the North Lake Lift Station. This can work as long as the gravity system receiving flows from Inglewood Lift Station is not at capacity, which is why this potential improvement showed promise in the previous study.

This option was reevaluated based on updated flows, and it no longer appears that the VFDs would be able to sufficiently reduce peak flows to the North Lake Lift Station. Flows to the Inglewood Lift Station and North Lake Lift Station have increased significantly over the past 5 years, and this is no longer a viable interim improvement. Also, reducing flows below 2,100 gpm is not an acceptable solution, because flows would be below minimum design velocity in the Inglewood force main, which would lead to solids settling in the pipeline and a reduction in force main capacity.

Recommendations

Alternative I-1 is no longer an effective short-term improvement.

ALTERNATIVE I-2 – LOCAL STORAGE AT NORTH LAKE OR CENTRAL LAKE

The possibility of installing large-volume vaults at the North Lake or Central Lake Lift Station for peak flow volume and emergency overflow storage was previously considered. These vaults would hold flow in excess of the lift stations' capacities until the peak flow period passes.

For the purpose of this analysis, it is assumed that 1 hour of storage would provide adequate time for peak flows to pass and additional time for District staff to assess the lift stations for any operational problems. One hour was the time determined by District Operations staff needed to respond to an event. The volumes required to provide this amount of storage at each lift station are large: 90,000 gallons at the Central Lake Lift Station and 112,000 gallons at the North Lake Lift Station. This volume of storage requires a vault 35 feet long by 25 feet wide by 15 feet deep for the Central Lake Lift Station, and 40 feet long by 25 feet wide by 15 feet deep for the North Lake Lift Station.

Available space at the Central Lake Lift Station site in particular is limited, as it is surrounded by developed parcels and City roads. There is some vacant area in the vicinity of the North Lake Lift Station, but construction of a large-volume storage vault would occupy space that may otherwise be needed to construct improvements to the lift station itself in the future. Additionally, the vaults would not address the actual lift station capacity deficiencies. For these reasons, storage vaults are not recommended as stand-alone projects; only in coordination with other lift station capacity improvement projects.

Recommendation

Alternative I-2 has limited effectiveness due to space considerations, and should only be considered in conjunction with lift station capacity improvement projects. Storage will need to be considered as part of a pumping improvement project to meet Washington State Department of Ecology Orange Book requirements. Storage is an important

component in ensuring reliability of pumps by limiting the number of starts, especially during large and intense storms. Storage at alternate locations may also be considered if the District decides to implement Alternative I-2. The estimated project cost for Alternative I-2, provided appropriate space can be found, is $2,000,000.

OTHER INTERIM IMPROVEMENTS

ALTERNATIVE I-3 – AUTOMATIC DIVERSION VALVE TO MALLARD BAY

The Central Lake Lift Station force main consists of an original section of 8-inch force main, and a second segment of 12-inch force main that connects to the twin 20-inch interceptors. Under normal operation, flow from the Central Lake Lift Station bypasses the Mallard Bay Basin, joining with the Mallard Bay force main in the vicinity of the Mallard Bay Lift Station. During high-flow events, the District can open a valve approximately 1,000 feet south of the Central Lake Lift Station. This valve diverts a portion of the flow to an adjacent force main that discharges to the Mallard Bay Basin gravity system. Opening this valve increases the capacity of the Central Lake Lift Station pumps by reducing the downstream head. The exact flow rate of the Central Lake Lift Station while operating in this manner has not been determined, but Operations staff indicate that the capacity of the Central Lake Lift Station increases when this action is performed. This diversion can only be done for approximately 1 hour before the capacity of the Mallard Bay Lift Station is overwhelmed, after which time the District must return the Central Lake Lift Station force main to its normal condition.

Installation of a motor-operated valve with SCADA controls could automate this functionality and save staff time by allowing for remote access and monitoring. The valve could be called to open remotely via SCADA and could be shut off when the Mallard Bay Lift Station wet well fills to a predetermined level to prevent overflow of the station.

This improvement would provide a low-cost operational improvement for District staff as the valve is currently operated manually and operation of the valve usually needs to be done on short notice.

This project only serves to curb peaks on the Central Lake Lift Station, automating a process District Operations staff perform during peak storms. It also helps provide Operations staff time to arrive on site during peak storm events, similar to the concept of lift station overflow storage discussed previously.

Recommendation

Alternative I-3 is a relatively low-cost improvement that would improve operations response time. This project could also be done in conjunction with other improvements. The estimated project cost is approximately $250,000.

ALTERNATIVE I-4 – INTERIM BYPASS OF CENTRAL LAKE GRAVITY BASIN

As an alternative to installing all of the improvements required for Alternative A-4 at one time, an interim improvement would involve installing only a portion of the facilities identified in the long-term alternatives to provide capacity through the next 10 to 20 years. This interim improvement could be used to either phase the full project over time, or to provide time for King County to complete the SPD project to the north.

The project would construct approximately 6,500 linear feet of 16-inch force main from the end of the existing North Lake Lift Station force main, south to where the existing Central Lake Lift Station force main increases from 8 to 12 inches. The force main installation could be completed in phases to make permitting easier and to ensure immediate improvements are made. Phasing identified for incremental improvement includes the following:

- **Phase 1 –** Install 1,000 linear feet of 16-inch force main from the Central Lake Lift Station south, replacing the existing 8-inch diameter section of force main and connecting with the existing 12-inch force main. This improvement could increase the capacity of the Central Lake Lift Station without any improvements to the lift station itself. Review of the existing pump curves and hydraulics will be required to ensure the existing pumps can pump through the improved force main without cavitation, but it is likely that it will work. Phase 1 would also include increasing the capacity of the North Lake Lift Station to 1,750 gpm. This is the maximum capacity that the Central Lake gravity system can accept without unacceptable surcharge levels. The Phase 1 improvements will improve system reliability by ensuring that pumps do not need to be run manually during peak storm events, and will alleviate surcharging in the gravity system upstream of North Lake Lift Station, north to approximately the crossing of Ebright Creek. Phase 1 does not alleviate the surcharging identified north of the Ebright Creek crossing.

- **Phase 2 –** Phase 2 includes the construction of 5,900 linear feet of 16-inch force main, connecting the existing 10-inch diameter North Lake Lift Station force main to the force main constructed as part of Phase 1. This will allow the North Lake Lift Station flows to bypass the Central Lake Lift

Station Basin altogether. The North Lake Lift Station capacity would be increased to 2,000 gpm to maximize the capacity of the existing 10-inch force main. Flows from the Central Lake Lift Station would be diverted to the Mallard Bay Lift Station through the existing 8-inch force main.

- **Phase 3 –** Phase 3 includes the installation of approximately 400 linear feet of 18-inch and 2,500 linear feet of 21-inch gravity main in the North Lake Gravity Basin to accommodate flows from the Inglewood Lift Station. Based on the hydraulic model, the gravity main upstream of the North Lake Lift Station can provide adequate service if flow through the main does not exceed 1,600 gpm. The modeling indicates that surcharging during existing peak flow times may reach 2 to 2.5 feet, but surcharging is only sustained for approximately 1 to 2 hours. The existing system may be able to accommodate surcharging of this amount because the existing homes on the lake-side of Lake Sammamish Parkway are served on low pressure grinder systems, and the homes served to the east side of Lake Sammamish Parkway are higher than the road. This should be confirmed in the field if it is going to be used as an acceptable interim design criterium. By the end of the 10-year planning period (approximately 2030), flow through the North Lake gravity main may exceed 1,800 gpm and overflow of the gravity system downstream of the Inglewood Lift Station is identified. This assumes that flows in the system increase due to growth and increasing I/I rates. Phase 3 gravity improvements are necessary to accommodate future flows from the Inglewood Lift Station.

Improvements identified for the North Lake Lift Station recommended as part of Phase 1 should be constructed with the needs required for Phase 2 in mind. For example, the electrical and pumping improvements should be sized to accommodate the full 2,000 gpm required for Phase 2, but should include variable frequency drives to allow the District to reduce flows to prevent downstream surcharging prior to construction of additional force main improvements included in Phase 2.

The SPD project identified by King County includes the construction of two parallel force mains; 30- and 12-inch mains. Alternative I-4 identifies the construction of 16-inch force main because the maximum zoning capacity requires a pumping capacity of 4,300 gpm for several of the identified long-term alternatives. Instead of 16-inch force main, Alternative I-4 could be constructed with 12-inch main, which could be incorporated into the long-term SPD project and would not be a stranded investment. This would be less cost and slightly easier construction than the larger 16-inch main. The risk with this approach is that King County has not constructed the SPD before the 12-inch force main has reached capacity.

Table 2-14 includes the pipe improvements required for this alternative. This alternative is shown on Figure 2-7.

TABLE 2-14

Alternative I-4

Construction Phase	Existing	Phase 1	Phase 2	Phase 3	Total
Completion Year	2020	2021	2023	2025	—
North Lake Lift Station Capacity (gpm)	1,250(1)	1,750	1,750	2,000	2,000
Central Lake Lift Station Capacity (gpm)	1,500	2,100	600(3)	600(3)	600(3)
16-Inch Central Lake Force Main (LF)	0	1,000	0	0	1,000
16-Inch North Lake Force Main (LF)	0	0	5,900	0	5,900
North Lake 18-Inch Gravity (LF)	0	0	0	360	360
North Lake 21-Inch Gravity (LF)	0	0	0	2,510	2,510
Estimated Project Cost(2)	—	$3.017M	$5.142M	$3.717M	$11.854M

(1) Requires manual operation of all three pumps to achieve full 1,250 gpm capacity.

(2) Due to inefficiencies of constructing three small projects, as opposed to one large project, the three phases of Alternative I-4 do not add up to exactly the same cost as the I-4 Total Project Cost.

(3) Once North Lake Lift Station can bypass the Central Lake Lift Station, the Central Lake Lift Station capacity should be reduced to allow to send Central Lake Lift Station flows to the Mallard Bay Lift Station.

Estimated Cost: $11,854,000

This alternative can be constructed to provide adequate capacity in the SPD Basins for the next 10 to 20 years while other improvements are designed and constructed. The pipeline constructed for this alternative could be incorporated into future designs, so it would not be a stranded investment.

Alternative I-4 could be constructed in phases, with the force main and lift station improvements being constructed in the near term, and the North Lake Sammamish Basin gravity improvements constructed later, as the North Lake Sammamish Basin grows.

Recommendation

Phase 1 of Alternative I-4 is recommended regardless of the long-term alternative selected as it has the greatest ability to be designed, permitted, and constructed in the shortest period of time. Phases 2 and 3 of Alternative I-4 will be stranded investments if Alternatives A-3 through A-5 are not the preferred long-term options.

ALTERNATIVE I-5 – DIESEL-POWERED BYPASS PUMPS AT NORTH LAKE AND CENTRAL LAKE LIFT STATIONS

One interim improvement that could improve reliability until the long-term alternatives can be constructed would be to purchase and install permanent diesel-powered bypass pumps at both the Central Lake and North Lake Lift Stations. The equipment can be permanently installed with a wet well overflow structure, independent floats or transducers, and a bypass pumping connection. Similar to the purpose of the storage vault project, this would not increase the capacity of the stations, but it would allow operations staff additional time to get to the site in an emergency, and also provide an alternate pump in the event the largest pump is out of service. The bypass pumping system could also be useful during improvements to the station as part of the long-term alternatives.

Estimated Cost: $843,000

Recommendation

Alternative I-5 is recommended because it is a relatively inexpensive option to improve the reliability of the stations. If properly planned, they could be reused and incorporated into future improvements for the stations.

IMPROVEMENT ALTERNATIVES SUMMARY

Table 2-15 provides a summary of the long-term and interim alternatives and their estimated costs. Figure 2-8 provides a summary of Alternatives A-1 through A-6 and also includes Alternative I-4.

LEGEND

- Existing Manholes
- Existing Pipes
- Gravity Improvements Necessary in 2039
- Force Main Improvements Necessary in 2039
- Force Main
- Lift Station

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

ALTERNATIVE I-4 INTERIM BYPASS OF CENTRAL LAKE GRAVITY

Estimated Project Cost
$11,854,000

2019 domestic sewer flows determined using winter water use data. Zoning capacity domestic sewer flows determined by the District.

Phase 3:
360 LF 18-inch
2,510 LF 21-inch

Upgrade North Lake Sammamish Lift Station:
Phase 1: 1,750 gpm
Phase 2: 2,000 gpm

Phase 2:
5,870 LF 16-inch Forcemain

Phase 1:
1,000 LF 16-inch Forcemain

East Lake Samma

NE

216th Ave NE

228th Ave NE

244th Ave NE

NE Inglewood Hill Rd

NE 8th St

Cimmeron (NE SAMM)

Inglewood Jr High (PRIVATE)

Inglewood LS

The Greens LS

228th Ave SE

Private Rd

North Lk Samm LS

212th Ave SE

Redford Hudson LS

Todd's Landing LS

Pine Lk Hts LS

Pine Lk Glen LS

First Branch LS

SE 32nd Way

SE 32nd St

Central Lk Samm LS

228th Ave SE

Alexander's LS

Mallard Bay LS

SE 43rd Way

East Lake Sammamish Pkwy SE

N

1,000 0 1,000 2,000 3,000 4,000
Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 2-7
ALTERNATIVE I-4 INTERIM BYPASS OF CENTRAL LAKE GRAVITY BASIN

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\F2-7 ImprovementsNorthBypass2.mxd

LEGEND

- Existing Manholes
- Existing Pipes
- Gravity Main Improvements
- Force Main Improvements
- Force Main
- Lift Station
- Lift Station Improvements

- Beaver Dam
- Central Lake Sammamish
- Freegard
- Inglewood East
- Laughing Jacobs
- Mallard Bay
- North Lake Sammamish
- North Sunnyhills
- Northeast Plateau
- South Pine Lake
- Tiburon
- Trossachs
- Yellow Lake

Segment Description and Alternatives

Interim Improvement

SUMMARY OF IMPROVEMENTS REQUIRED FOR ALTERNATIVES

2019 domestic sewer flows determined using winter water use data. Zoning capacity domestic sewer flows determined by the District.

N Lake Gravity

560 LF 15": 1, 3

360 LF 15": 1, 3, Interim

4,360 LF 21": 1, 3
2,510 LF 21": Interim

1,020 LF 24" 1, 3

10,000 LF 16" FM: 2, 4, 5

Upgrade LS Head: 6, SPD

22,000 LF 16" FM: 6

North Lk Samm LS

2,000 gpm: 5, 6, Interim

2,800 gpm: Ph. 1 of 1, 2, 3

4,300 gpm: 1, 2, 3, 4

6,510 LF 16" FM
North Lake FM Upgrade
1, 2, 3, 4, 5

5,620 LF 16" FM
North Lake FM Upgrade
3, 4, 5, Interim

C Lake Gravity

1,900 LF 18": 1, 2

3,820 LF 21": 1, 2

2,800 gpm: Ph. 1 of 1, 2, 3
Interim

1,000 LF 16"
Cent. Lake FM N
1, 2, 3, 4, 5, Interim

Central Lk Samm LS

4,300 gpm: 1, 2, 3, 4

5,870 LF 16"
Cent. Lake FM S
1, 2, 3, 4, 5

Upgrade Head
1, 2, 3, 4, 5

East Lake Sammamish Pkwy SE

216th Ave NE

228th Ave NE

244th Ave NE

228th Ave SE

NE 8th St

NE Inglewood Hill Rd

SE 32nd Way

SE 32nd St

SE 43rd Way

Private Rd

Cimmeron (NE SAMM)

Inglewood Jr High (PRIVATE)

Inglewood LS

The Greens LS

Redford Hudson LS

Todd's Landing LS

Pine Lk Hts LS

Pine Lk Glen LS

First Branch LS

Alexander's LS

Mallard Bay LS

N

1,000 0 1,000 2,000 3,000 4,000

Feet

SAMMAMISH PLATEAU WATER
NORTH DIVERSION PH 1 ANALYSIS
FIGURE 2-8
SUMMARY OF IMPROVEMENTS
REQUIRED FOR ALTERNATIVES

Gray & Osborne, Inc.
CONSULTING ENGINEERS

Document Path: M:\SammPlat\19582 North Diversion Phase 1 Analysis\GIS\Report\F2-8 ImprovementsSummary.mxd

TABLE 2-15

Alternatives Summary

Alt.	Description	Gravity/ Low Pressure (LF)	Force Main (LF)	Total Pipeline (LF)	Proposed Central Lake Capacity (gpm)	Proposed North Lake Capacity (gpm)	Cost
A-1	Upgrade Existing System	12,020	13,380	25,400	4,300	4,300	$42,178,000
A-2	Inglewood Force Main Extension	5,720	23,380	29,100	4,300	2,000	$36,560,000
A-3	Bypass Central Lake Gravity Main	6,300	19,000	25,300	1,500	4,300	$31,623,000
A-4	Bypass North and Central Lake Gravity Mains	0	29,000	29,000	1,500	4,300	$33,338,000
A-5	Extend South Interceptor	0	29,000	29,000	1,500	2,000	$31,785,000
A-6	Inglewood Lift Station Bypass to Control Structure	1,620	23,000	24,620	2,500	2,000	$24,201,000
SPD	Construct Sammamish Plateau Diversion	15,312	9,821	25,133	1,500	2,000	$107,527,000
I-2	Local Storage at North Lake or Central Lake						$2,000,000
I-3	Automatic Diversion Valve to Mallard Bay						$250,000
I-4	Interim Bypass of Central Lake Gravity – Total	2,870	6,870	9,740	600	2,000	$11,854,000
I-4	Interim Bypass of Central Lake Gravity – Phase 1	0	1,000	1,000	2,100	1,750	$3,017,000
I-4	Interim Bypass of Central Lake Gravity – Phase 2	0	5,870	5,870	600	2,000	$5,142,000
I-4	Interim Bypass of Central Lake Gravity – Phase 3	2,870	0	2,870	600	2,000	$3,717,000
I-5	Diesel-Powered Bypass Pumps at North and Central Lake Lift Stations						$843,000

ALTERNATIVES ANALYSIS

The following sections provide an analysis of the identified long-term alternatives.

The alternatives were evaluated using the following criteria:

- **Capital Cost –** Capital cost can be important in determining whether a project is affordable. In this case, a project must be built, so the capital cost provides a means of comparison between alternatives. Detailed cost estimates are enclosed for review.

  Of the six new options, Alternative A-1 has the highest capital cost, followed by Alternative A-2. Alternatives A-3, A-4, and A-5 are all relatively close in cost and should be considered equal. Alternative A-6 is the least expensive of the long-term alternatives. The SPD has a cost based on a different cost basis so is not directly comparable, but is also more than twice the cost of Alternative A-1.

  It is not realistic to compare the interim alternatives directly to the long-term alternatives since they accomplish different objectives. Even within the interim alternatives, direct comparisons are not reasonable. However, installation of certain Alternative I-4 components would reduce the cost of Alternatives A-2, A-3, A-4, and A-5.

- **Phasing Potential –** The ability to phase the alternatives is generally considered a positive. An earlier phase may allow expansion of the system capacity, with future phases required to meet the maximum zoning capacity. Phasing can allow for flexibility in scheduling and spread the capital cost of an alternative over a longer period. In addition, it may be easier to obtain permits when considering a smaller section of a project. Finally, when looking at significantly long planning periods, as we are with these large regional projects, phasing allows for flexibility to adapt to the unforeseeable, such as zoning changes, partnering with future transportation projects, and improvements in construction techniques.

  Alternatives A-1, A-2, A-3, and A-4 all have phasing potential associated with lift station capacity. Alternatives A-1 and A-2 have phasing potential associated with Central Lake force main improvements, and Alternative A-4 also has phasing potential with the Inglewood force main improvements.

Alternative I-4 includes planned phasing between improvements to the North Lake Lift Station and Central Lake force main, the North Lake force main, and to the North Lake gravity main. The North Lake force main is segregated from the North Lake Lift Station and Central Lake force main phase due to perceived time to complete the North Lake force main project, rather than the ability to defer capacity improvements.

- **Timeliness –** As identified in the prior report that identified system deficiencies, the District's need for additional capacity in the sewer system is already overdue. Therefore, the ability to install improvements in a timely manner is imperative to avoid system failure and sewage spills.

  All of the long-term alternatives will take several years to go from design through full installation. If it is necessary to have the projects integrated into the King County CSI portfolio, then the timeliness of any of the long-term alternatives will be further impacted.

  The interim alternatives have a much higher likelihood to be timely. Alternatives A-2, A-3, and A-5 are focused on specific locations that will likely provide shorter construction times. Full implementation of Alternative I-4 will take multiple years due to the total length of force main and gravity main included, similar to the long-term alternatives. Alternative I-4 has identified phases, specifically to shorten the time to install certain improvements to alleviate the existing problems enough to allow the time for the remaining improvements to be installed.

- **Construction Risk –** Construction risk has impacts on capital costs, environmental impacts, property damage, and legal claims. Construction in critical areas, deeper gravity construction, trenchless construction methods, and crowded utility corridors are examples of items that can increase a project's construction risk.

  Alternative A-1 has the most gravity with deeper construction than force mains. Alternatives A-2 and A-3 also have significant gravity segments. Alternative A-6 may have portions located in critical areas

  Many of the interim alternatives are located at specific sites which limits the risk. Alternative I-4 does include some gravity construction in later phases.

- **Permitting –** Permitting can have significant impacts on the construction schedule due to the time required to acquire different permits. Alternatives A-1, A-2, A-3, A-4, and A-5 are assumed to have the pipeline segments within the right-of-way, requiring a right-of-way permit. Alternatives A-6 and the SPD have significant portions of their route in right-of-way, but also have sections where the route is not fully defined and will likely require additional studies associated with permitting to define sensitive area extents and subsurface conditions as required for a grading permit. Permits for improvements at the lift station sites for the long-term alternatives may be limited if the improvements are contained within the existing facility structures.

  Alternatives I-3 and I-4 will primarily require right-of-way permits. Alternatives I-2, I-5, and the lift station segments of I-4 will likely require grading and building permits at the lift station sites.

- **Public Disruption –** All of the long-term alternatives, except Alternative A-6, require significant construction in the East Lake Sammamish Parkway, a heavily trafficked two-lane arterial. Construction in East Lake Sammamish Parkway will be of considerable nuisance and hardship to the region.

  Projects with gravity sewer installations are generally more disruptive because the duration of construction when compared with a force main, is longer, and thus a greater hardship. Alternative A-6 avoids construction in the parkway altogether, but would have disruption to a series of roads, including the majority of the length of 212th Avenue.

  Alternative I-4 is the only interim alternative with significant construction in East Lake Sammamish Parkway.

- **Operational Costs –** Operational costs are considered primarily based on the relative energy and pumping costs required. Detailed energy evaluations were not performed but generally speaking, alternatives with higher portions of gravity mains result in lower energy costs. Lift station improvements for either increased capacity or head will result in an increase in energy costs. Further, long force mains typically result in long detention time and hydrogen sulfide formation. Hydrogen sulfide results in odor issue when discharged and can corrode downstream sewer facilities. Chemicals, such as BIOXIDE®, are typically required to neutralize hydrogen sulfide formation. Increased chemical addition due to the longer force mains of some alternatives will also result in increased operating

costs compared with the alternatives with shorter force mains and more gravity main construction.

Alternative A-1 utilizes the most gravity, and also includes capacity upgrades at both North Lake and Central Lake Lift Stations. Alternative A-2 includes some gravity and also capacity upgrades at both North Lake and Central Lake Lift Stations. Alternative A-3 also includes some gravity, but only has capacity upgrades at North Lake Lift Station. Alternatives A-4 and A-5 both utilize long force mains from the Inglewood Lift Station, and will have increased pumping costs at Inglewood Lift Station, with A-4 also requiring increased capacity at North Lake Lift Station. Alternatives A-6 and the SPD will require significant increases in horsepower at the Inglewood Lift Station, increasing those pumping costs.

Alternative I-4 includes improvements to the North Lake Lift Station, with commensurate energy cost increase.

- **Reliability –** All of the long-term alternatives improve the system reliability with increased capacity. There are issues based on the operational configuration of the existing system. A single point of failure can take out a significantly large service area. For example, if there is a failure at the Central Lake Lift Station, this also impacts flows from both the Inglewood East and North Lake Basins. Some of the alternatives presented increase the reliability of the system by reducing the system's reliance on downstream stations. Alternatives that maintain the status quo with serial lift stations, "leap-frogging" from one station to the next, have lower reliability. Reliability is very important in a sewer system, where environmental and property damage can be significant.

  Alternatives A-1 and A-2 maintain the current use of serial lift stations so does not improve reliability over the current system. Alternatives A-3 and A-4 remove the Central Lake Lift Station from the series. Alternatives A-5, A-6, and the SPD remove both the Central Lake and North Lake Lift Stations from the series. Alternative A-6 has additional redundancy with the capability to utilize the lakefront system if there were a problem with the force main over the plateau.

  Alternative I-4 maintains the use of serial lift stations in Phase 1, but removes the Central Lake Lift Station following Phase 2.

  Implementation of the interim and long-term alternatives described in the Analysis only address one aspect of reliability. These projects would

continue to rely solely on a single KCWTD southern-flowing system that would be susceptible to a single point of failure. These proposed alternatives would not deliver the level of service and reliability to the District that the SPD would provide.

RECOMMENDATIONS SUMMARY

Based on consideration of the topics listed above and applying knowledge of the local system, the following are the recommendations for both interim and long-term improvements necessary for continued provision of sewer service to the north basins in the District.

As noted in the 2015 Evaluation and has been revisited in this report, the existing District system is at capacity. Modeling results aside, there is practical evidence that large storm events and short-term intense rain events stress the existing system. For certain events, District staff are required to be at the lakefront lift stations (North Lake and Central Lake Lift Stations) to manually operate the pumps to achieve their maximum capacity. This situation will continue to worsen as SPD Basins continue to develop, including the Sammamish Town Center.

Timeliness is the most important decision-making criteria. Projects that can be undertaken in the very short term must be considered for immediate implementation to avoid the potential for sewer overflows and spills.

INTERIM IMPROVEMENTS

The interim improvements identified as Phase 1 of Alternative I-4 are recommended to be started immediately. This includes installing larger pumps at the North Lake Lift Station to provide capacity of at least 2,000 gpm. In conjunction with this pumping improvement, installation of the 1,000-linear-foot segment of 16-inch force main from the Central Lake Lift Station is recommended, allowing bypass of the existing 8-inch force main, connecting to the existing 12-inch force main. The segment of larger Central Lake force main will allow the Central Lake Lift Station to increase its pumping capacity using its existing pumps.

Work on Phase 2 of Alternative I-4 should also begin immediately, although it is understood that construction of this almost mile-long section of force main will take longer to install than the improvements identified as Phase 1.

Alternative I-2, providing additional storage, should also be pursued in the very near term. This initial work would be to determine the feasibility of installation of the storage,

especially at the North Lake Lift Station or other off-site location. Use of this alternative at the Central Lake Lift Station is unlikely based on space limitations.

If implementation of Alternative I-2 does not appear to be likely, Alternatives I-5 and I-3 should be pursued.

LONG-TERM IMPROVEMENTS

Alternative A-6, Inglewood Lift Station Bypass to Control Structure, is the recommended long-term alternative. Alternative A-6 is recommended on the basis it will:

- Alleviate the capacity issues with the lakefront sewer, for both gravity and force mains, allowing the system to function as originally designed.
- Minimize improvements necessary at the North Lake and Central Lake Lift Stations.
- Reduce or eliminate odor complaints on Inglewood Hill associated with the current Inglewood force main discharge. (This is one of the areas with the most odor complaints.)
- Reduce the chance for overflows in the East Lake Sammamish Parkway area that could flow to Lake Sammamish.
- If the existing Inglewood force main connection is retained, provide a redundant force main for use during planned or unplanned maintenance on the Alternative A-6 force main.
- Have the easiest construction connection, with only one tie-in point at the existing Inglewood force main at 216th Avenue NE.
- Avoids construction on East Lake Sammamish Parkway.

If Alternative A-6 is not chosen, Alternatives A-3, A-4, or A-5 should be considered. These three alternatives share many similar segments and the final decision can be made as the project is moved forward. Alternative A-5 has the lowest estimated cost, but Alternative A-3 shares the most segments with Alternative I-4.

CONCLUSION

Timeliness is the most important decision-making criteria. Implementation of Alternative I-4 should be undertaken immediately. This improvement alleviates deficiencies

identified from existing flows and provides the time to design, permit and construct long-term Alternative A-6, the best long-term solution. Growth is continuing in the basins served by these facilities. Even with installation of Alternative I-4, until installation of a long-term alternative is completed, there will be continued pressure on operations to avoid overflows and meet capacity if the District is to continue to serve planned growth in the region.

Implementation of the interim and long-term alternatives described in the Analysis only address one aspect of reliability. These projects would continue to rely solely on a single KCWTD southern-flowing system that would be susceptible to a single point of failure. These proposed alternatives would not deliver the level of service and reliability to the District that the SPD would provide.

APPENDIX A

DETAILED COST ESTIMATES

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Alternative 1 (A-1): Upgrade Existing System
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$1,711,000	$1,711,000
2.	Survey	1	LS	$50,000	$50,000
3.	Locate Existing Utilities	1	LS	$40,000	$40,000
4.	Project Temporary Traffic Control	1	LS	$713,000	$713,000
5.	Temporary Erosion Control	1	LS	$50,000	$50,000
6.	Trench Excavation Safety Systems	1	LS	$100,000	$100,000
7.	Connection to Existing Sewer System	17	EA	$5,000	$85,000
8.	Removal of Unsuitable Material	9,700	CY	$50	$485,000
9.	Manhole, 48 In. Diam.	60	EA	$6,000	$360,000
10.	Manhole Additional Height 48-In. Diam. (S.P. 7-05.5)	80	VF	$300	$24,000
11.	Crushed Surfacing Top Course	3,110	TN	$30	$93,300
12.	Crushed Surfacing Base Course	6,210	TN	$30	$186,300
13.	Bank Run Gravel for Trench Backfill	82,900	TN	$25	$2,072,500
14.	Foundation Gravel	9,700	CY	$100	$970,000
15.	15-inch PVC Sewer Pipe (Incl Bedding)	560	LF	$95	$53,200
16.	18-inch PVC Sewer Pipe (Incl Bedding)	2,260	LF	$150	$339,000
17.	21-inch PVC Sewer Pipe (Incl Bedding)	8,180	LF	$250	$2,045,000
18.	24-inch PVC Sewer Pipe (Incl Bedding)	1,020	LF	$300	$306,000
19.	16-inch DI Force Main (incl bedding)	13,380	LF	$160	$2,140,800
20.	Lift Station	2	LS	$4,000,000	$8,000,000
21.	Side Sewer Connection	45	EA	$2,000	$90,000
22.	Sawcutting	60,500	LF	$5	$302,500
23.	HMA Trench Repair	3,820	TN	$150	$573,000
24.	HMA Overlay	4,530	TN	$150	$679,500
25.	CIP Concrete Panel	2,620	CY	$600	$1,572,000
26.	Site Restoration	1	LS	$50,000	$50,000
27.	Unexpected Site Changes	1	LS	$50,000	$50,000
28.	SPCC plan	1	LS	$2,000	$2,000

Subtotal	**$23,144,000**
Contingency (30%)	$6,944,000
Subtotal	$30,088,000
Sales Tax at 10.0% per Washington State Dept of Revenue	$3,009,000
Total Construction Cost:	**$33,097,000**
Design, Permitting, and Construction Administration (30%)	$9,930,000
Total Project Cost	**$43,027,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Alternative 2 (A-2): Upgrade Existing System With Inglewood Force Main Extension
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$1,511,000	$1,511,000
2.	Survey	1	LS	$55,000	$55,000
3.	Locate Existing Utilities	1	LS	$40,000	$40,000
4.	Project Temporary Traffic Control	1	LS	$600,000	$600,000
5.	Temporary Erosion Control	1	LS	$55,000	$55,000
6.	Trench Excavation Safety Systems	1	LS	$90,000	$90,000
7.	Connection to Existing Sewer System	13	EA	$5,000	$65,000
8.	Removal of Unsuitable Material	11,100	CY	$50	$555,000
9.	Manhole, 48 In. Diam.	37	EA	$6,000	$222,000
10.	Crushed Surfacing Top Course	3,500	TN	$30	$105,000
11.	Crushed Surfacing Base Course	6,990	TN	$30	$209,700
12.	Bank Run Gravel for Trench Backfill	81,400	TN	$25	$2,035,000
13.	Foundation Gravel	9,800	CY	$100	$980,000
14.	18-inch PVC Sewer Pipe (Incl Bedding)	1,900	LF	$150	$285,000
15.	21-inch PVC Sewer Pipe (Incl Bedding)	3,820	LF	$250	$955,000
16.	16-inch DI Force Main (incl bedding)	23,380	LF	$160	$3,740,800
17.	North Lake Lift Station	1	LS	$1,000,000	$1,000,000
18.	Central Lake Lift Station	1	LS	$4,000,000	$4,000,000
19.	Sawcutting	61,000	LF	$5	$305,000
20.	HMA Trench Repair	4,200	TN	$150	$630,000
21.	HMA Overlay	6,240	TN	$150	$936,000
22.	CIP Concrete Panel	3,000	CY	$600	$1,800,000
23.	Site Restoration	1	LS	$75,000	$75,000
24.	Unexpected Site Changes	1	LS	$75,000	$75,000
25.	SPCC plan	1	LS	$3,000	$3,000
	Subtotal				**$20,328,000**
	Contingency (30%)				$6,099,000
	Subtotal				$26,427,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$2,643,000
	Total Construction Cost:				**$29,070,000**
	Design, Permitting, and Construction Administration (30%)				$8,721,000
	Total Project Cost				**$37,791,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Alternative 3 (A-3): Bypass Central Lake Gravity Main
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$1,303,000	$1,303,000
2.	Survey	1	LS	$40,000	$40,000
3.	Locate Existing Utilities	1	LS	$35,000	$35,000
4.	Project Temporary Traffic Control	1	LS	$540,000	$540,000
5.	Temporary Erosion Control	1	LS	$50,000	$50,000
6.	Trench Excavation Safety Systems	1	LS	$75,000	$75,000
7.	Connection to Existing Sewer System	8	EA	$5,000	$40,000
8.	Removal of Unsuitable Material	9,600	CY	$50	$480,000
9.	Manhole, 48 In. Diam.	27	EA	$6,000	$162,000
10.	Manhole Additional Height 48-In. Diam. (S.P. 7-05.5)	30	VF	$300	$9,000
11.	Crushed Surfacing Top Course	2,640	TN	$30	$79,200
12.	Crushed Surfacing Base Course	5,280	TN	$30	$158,400
13.	Bank Run Gravel for Trench Backfill	74,200	TN	$25	$1,855,000
14.	Foundation Gravel	9,600	CY	$100	$960,000
15.	15-inch PVC Sewer Pipe (Incl Bedding)	560	LF	$95	$53,200
16.	18-inch PVC Sewer Pipe (Incl Bedding)	360	LF	$150	$54,000
17.	21-inch PVC Sewer Pipe (Incl Bedding)	4,360	LF	$250	$1,090,000
18.	24-inch PVC Sewer Pipe (Incl Bedding)	1,020	LF	$300	$306,000
19.	16-inch DI Force Main (incl bedding)	19,000	LF	$160	$3,040,000
20.	Lift Station	1	LS	$4,000,000	$4,000,000
21.	Side Sewer Connection	10	EA	$2,000	$20,000
22.	Sawcutting	50,600	LF	$5	$253,000
23.	HMA Trench Repair	3,670	TN	$150	$550,500
24.	HMA Overlay	5,420	TN	$150	$813,000
25.	CIP Concrete Panel	2,610	CY	$600	$1,566,000
26.	Site Restoration	1	LS	$25,000	$25,000
27.	Unexpected Site Changes	1	LS	$25,000	$25,000
28.	SPCC plan	1	LS	$1,000	$1,000
	Subtotal				**$17,584,000**
	Contingency (30%)				$5,276,000
	Subtotal				$22,860,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$2,286,000
	Total Construction Cost:				**$25,146,000**
	Design, Permitting, and Construction Administration (30%)				$7,544,000
	Total Project Cost				**$32,690,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Alternative 4 (A-4): Bypass North and Central Lake Gravity Mains
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$1,365,000	$1,365,000
2.	Survey	1	LS	$55,000	$55,000
3.	Locate Existing Utilities	1	LS	$45,000	$45,000
4.	Project Temporary Traffic Control	1	LS	$424,000	$424,000
5.	Temporary Erosion Control	1	LS	$55,000	$55,000
6.	Trench Excavation Safety Systems	1	LS	$105,000	$105,000
7.	Connection to Existing Sewer System	4	EA	$5,000	$20,000
8.	Removal of Unsuitable Material	11,000	CY	$50	$550,000
9.	Manhole, 48 In. Diam.	4	EA	$6,000	$24,000
10.	Crushed Surfacing Top Course	3,030	TN	$30	$90,900
11.	Crushed Surfacing Base Course	6,050	TN	$30	$181,500
12.	Bank Run Gravel for Trench Backfill	72,700	TN	$25	$1,817,500
13.	Foundation Gravel	14,400	CY	$100	$1,440,000
14.	16-inch DI Force Main (incl bedding)	29,000	LF	$160	$4,640,000
15.	Lift Station	1	LS	$4,000,000	$4,000,000
16.	Sawcutting	76,000	LF	$5	$380,000
17.	HMA Trench Repair	4,050	TN	$150	$607,500
18.	HMA Overlay	4,850	TN	$150	$727,500
19.	CIP Concrete Panel	2,990	CY	$600	$1,794,000
20.	Site Restoration	1	LS	$50,000	$50,000
21.	Unexpected Site Changes	1	LS	$50,000	$50,000
22.	SPCC plan	1	LS	$2,000	$2,000
	Subtotal				**$18,424,000**
	Contingency (30%)				$5,528,000
	Subtotal				$23,952,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$2,396,000
	Total Construction Cost:				**$26,348,000**
	Design, Permitting, and Construction Administration (30%)				$7,905,000
	Total Project Cost				**$34,253,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Alternative 5 (A-5): East Lake Sammamish Parkway Interceptor
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$1,297,000	$1,297,000
2.	Survey	1	LS	$15,000	$15,000
3.	Locate Existing Utilities	1	LS	$10,000	$10,000
4.	Project Temporary Traffic Control	1	LS	$430,000	$430,000
5.	Temporary Erosion Control	1	LS	$15,000	$15,000
6.	Trench Excavation Safety Systems	1	LS	$20,000	$20,000
7.	Connection to Existing Sewer System	2	EA	$5,000	$10,000
8.	Removal of Unsuitable Material	11,000	CY	$50	$550,000
9.	Manhole, 48 In. Diam.	8	EA	$6,000	$48,000
10.	Crushed Surfacing Top Course	2,850	TN	$30	$85,500
11.	Crushed Surfacing Base Course	5,690	TN	$30	$170,700
12.	Bank Run Gravel for Trench Backfill	69,200	TN	$25	$1,730,000
13.	Foundation Gravel	11,000	CY	$100	$1,100,000
14.	16-inch DI Force Main (incl bedding)	29,000	LF	$200	$5,800,000
15.	Lift Station Improvements	3	EA	$1,000,000	$3,000,000
16.	Sawcutting	29,000	LF	$5	$145,000
17.	HMA Trench Repair	4,040	TN	$150	$606,000
18.	HMA Overlay	4,140	TN	$150	$621,000
19.	CIP Concrete Panel	2,990	CY	$600	$1,794,000
20.	Site Restoration	1	LS	$25,000	$25,000
21.	Unexpected Site Changes	1	LS	$25,000	$25,000
22.	SPCC plan	1	LS	$1,000	$1,000
	Subtotal				**$17,499,000**
	Contingency (30%)				$5,250,000
	Subtotal				$22,749,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$2,275,000
	Total Construction Cost:				**$25,024,000**
	Design, Permitting, and Construction Administration (30%)				$7,508,000
	Total Project Cost				**$32,532,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Alternative 6 (A-6): Inglewood By-pass To Control Structure
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$933,000	$933,000
2.	Survey	1	LS	$40,000	$40,000
3.	Locate Existing Utilities	1	LS	$32,000	$32,000
4.	Project Temporary Traffic Control	1	LS	$413,000	$413,000
5.	Temporary Erosion Control	1	LS	$37,000	$37,000
6.	Trench Excavation Safety Systems	1	LS	$65,000	$65,000
7.	Connection to Existing Sewer System	6	EA	$5,000	$30,000
8.	Removal of Unsuitable Material	9,300	CY	$50	$465,000
9.	Manhole, 48 In. Diam.	16	EA	$6,000	$96,000
10.	Manhole Additional Height 48-In. Diam. (S.P. 7-05.5)	17	VF	$300	$5,100
11.	Crushed Surfacing Top Course	2,680	TN	$30	$80,400
12.	Crushed Surfacing Base Course	5,350	TN	$30	$160,500
13.	Bank Run Gravel for Trench Backfill	55,200	TN	$25	$1,380,000
14.	Foundation Gravel	9,300	CY	$100	$930,000
15.	18-inch PVC Sewer Pipe (Incl Bedding)	1,620	LF	$150	$243,000
16.	12-inch DI Force Main (incl bedding)	1,000	LF	$120	$120,000
17.	16-inch DI Force Main (incl bedding)	22,000	LF	$160	$3,520,000
18.	Side Sewer Connection	10	EA	$2,000	$20,000
19.	Lift Station Improvements	3	EA	$1,000,000	$3,000,000
20.	Sawcutting	47,240	LF	$5	$236,200
21.	HMA Trench Repair	4,960	TN	$150	$744,000
22.	HMA Overlay	5,280	TN	$150	$792,000
23.	CIP Concrete Panel	270	CY	$600	$162,000
24.	Site Restoration	1	LS	$40,000	$40,000
25.	Unexpected Site Changes	1	LS	$40,000	$40,000
26.	SPCC Plan	1	LS	$2,000	$2,000
	Subtotal				**$13,587,000**
	Contingency (30%)				$4,077,000
	Subtotal				$17,664,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$1,767,000
	Total Construction Cost:				**$19,431,000**
	Design, Permitting, and Construction Administration (30%)				$5,830,000
	Total Project Cost				**$25,261,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Interim Alternative I-2: Emergency Storage for North Lake and Central Lake Lift Stations
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$80,000	$80,000
2.	Survey	1	LS	$5,000	$5,000
3.	Locate Existing Utilities	1	LS	$2,000	$2,000
4.	Project Temporary Traffic Control	1	LS	$15,000	$15,000
5.	Temporary Erosion Control	1	LS	$2,000	$2,000
6.	Trench Excavation Safety Systems	1	LS	$50,000	$50,000
7.	Connection to Existing Sewer System	1	EA	$5,000	$5,000
8.	Removal of Unsuitable Material	70	CY	$50	$3,500
9.	Central Lake Sammamish Lift Station Storage Vault (90,000 gallon)	200	CY	$2,000	$400,000
10.	North Lake Sammamish Lift Station Storage Vault (12,000 gallon)	220	CY	$2,000	$440,000
11.	Excavation and Wastehaul	560	CY	$20	$11,200
12.	Crushed Surfacing Top Course	70	TN	$30	$2,100
13.	Bank Run Gravel for Backfill	170	TN	$25	$4,250
14.	Foundation Gravel	70	TN	$100	$7,000
15.	18-inch PVC Sewer Pipe (Incl Bedding)	40	LF	$200	$8,000
16.	HMA	50	TN	$150	$7,500
17.	Site Restoration	1	LS	$15,000	$15,000
18.	Unexpected Site Changes	1	LS	$15,000	$15,000
19.	SPCC Plan	1	LS	$1,500	$1,500
	Subtotal				$1,075,000
	Contingency (30%)				$323,000
	Subtotal				$1,398,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$140,000
	Total Construction Cost:				**$1,538,000**
	Design, Permitting, and Construction Administration (30%)				$462,000
	Total Project Cost				**$2,000,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Interim Alternative I-4: Interim Bypass of Central Lake Gravity Basin
TOTAL COST
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$472,000	$472,000
2.	Survey	1	LS	$50,000	$50,000
3.	Locate Existing Utilities	1	LS	$20,000	$20,000
4.	Project Temporary Traffic Control	1	LS	$209,000	$209,000
5.	Temporary Erosion Control	1	LS	$25,000	$25,000
6.	Trench Excavation Safety Systems	1	LS	$50,000	$50,000
7.	Connection to Existing Sewer System	5	EA	$5,000	$25,000
8.	Removal of Unsuitable Material	3,700	CY	$50	$185,000
9.	Manhole, 48 In. Diam.	8	EA	$6,000	$48,000
10.	Manhole Additional Height 48-In. Diam. (S.P. 7-05.5)	19	VF	$300	$5,700
11.	Crushed Surfacing Top Course	1,170	TN	$30	$35,100
12.	Crushed Surfacing Base Course	2,330	TN	$30	$69,900
13.	Bank Run Gravel for Trench Backfill	30,300	TN	$25	$757,500
14.	Foundation Gravel	3,700	TN	$100	$370,000
15.	18-inch PVC Sewer Pipe (Incl Bedding)	360	LF	$150	$54,000
16.	21-inch PVC Sewer Pipe (Incl Bedding)	2,510	LF	$250	$627,500
17.	16-inch DI Force Main (incl bedding)	6,870	LF	$160	$1,099,200
18.	Lift Station	1	LS	$1,000,000	$1,000,000
19.	Side Sewer Connection	8	EA	$2,000	$16,000
20.	Sawcutting	19,480	LF	$5	$97,400
21.	HMA Trench Repair	1,440	TN	$150	$216,000
22.	HMA Overlay	2,080	TN	$150	$312,000
23.	CIP Concrete Panel	1,000	CY	$600	$600,000
24.	Site Restoration	1	LS	$15,000	$15,000
25.	Unexpected Site Changes	1	LS	$15,000	$15,000
26.	SPCC Plan	1	LS	$1,000	$1,000
	Subtotal				$6,376,000
	Contingency (30%)				$1,913,000
	Subtotal				$8,289,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$829,000
	Total Construction Cost:				**$9,118,000**
	Design, Permitting, and Construction Administration (30%)				$2,736,000
	Total Project Cost				**$11,854,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Interim Alternative I-4: Interim Bypass of Central Lake Gravity Basin
PHASE 1 COST
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$120,000	$120,000
2.	Survey	1	LS	$10,000	$10,000
3.	Locate Existing Utilities	1	LS	$4,000	$4,000
4.	Project Temporary Traffic Control	1	LS	$41,800	$41,800
5.	Temporary Erosion Control	1	LS	$5,000	$5,000
6.	Trench Excavation Safety Systems	1	LS	$10,000	$10,000
7.	Connection to Existing Sewer System	2	EA	$5,000	$10,000
8.	Removal of Unsuitable Material	400	CY	$50	$20,000
9.	Manhole, 48 In. Diam.	0	EA	$6,000	$0
10.	Manhole Additional Height 48-In. Diam. (S.P. 7-05.5)	0	VF	$300	$0
11.	Crushed Surfacing Top Course	100	TN	$30	$3,000
12.	Crushed Surfacing Base Course	190	TN	$30	$5,700
13.	Bank Run Gravel for Trench Backfill	2,600	TN	$25	$65,000
14.	Foundation Gravel	400	TN	$100	$40,000
15.	18-inch PVC Sewer Pipe (Incl Bedding)	0	LF	$150	$0
16.	21-inch PVC Sewer Pipe (Incl Bedding)	0	LF	$250	$0
17.	16-inch DI Force Main (incl bedding)	1,000	LF	$160	$160,000
18.	Lift Station	1	LS	$1,000,000	$1,000,000
19.	Side Sewer Connection	0	EA	$2,000	$0
20.	Sawcutting	2,000	LF	$5	$10,000
21.	HMA Trench Repair	140	TN	$150	$21,000
22.	HMA Overlay	210	TN	$150	$31,500
23.	CIP Concrete Panel	100	CY	$600	$60,000
24.	Site Restoration	1	LS	$3,000	$3,000
25.	Unexpected Site Changes	1	LS	$3,000	$3,000
26.	SPCC Plan	1	LS	$200	$200
	Subtotal				$1,623,000
	Contingency (30%)				$487,000
	Subtotal				$2,110,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$211,000
	Total Construction Cost:				**$2,321,000**
	Design, Permitting, and Construction Administration (30%)				$696,000
	Total Project Cost				**$3,017,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Interim Alternative I-4: Interim Bypass of Central Lake Gravity Basin
PHASE 2 COST
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$205,000	$205,000
2.	Survey	1	LS	$16,000	$16,000
3.	Locate Existing Utilities	1	LS	$6,400	$6,400
4.	Project Temporary Traffic Control	1	LS	$66,880	$66,880
5.	Temporary Erosion Control	1	LS	$8,000	$8,000
6.	Trench Excavation Safety Systems	1	LS	$16,000	$16,000
7.	Connection to Existing Sewer System	2	EA	$5,000	$10,000
8.	Removal of Unsuitable Material	2,200	CY	$50	$110,000
9.	Manhole, 48 In. Diam.	0	EA	$6,000	$0
10.	Manhole Additional Height 48-In. Diam. (S.P. 7-05.5)	0	VF	$300	$0
11.	Crushed Surfacing Top Course	540	TN	$30	$16,200
12.	Crushed Surfacing Base Course	1,080	TN	$30	$32,400
13.	Bank Run Gravel for Trench Backfill	15,100	TN	$25	$377,500
14.	Foundation Gravel	2,200	TN	$100	$220,000
15.	18-inch PVC Sewer Pipe (Incl Bedding)	0	LF	$150	$0
16.	21-inch PVC Sewer Pipe (Incl Bedding)	0	LF	$250	$0
17.	16-inch DI Force Main (incl bedding)	5,870	LF	$160	$939,200
18.	Lift Station	0	LS	$4,000,000	$0
19.	Side Sewer Connection	0	EA	$2,000	$0
20.	Sawcutting	11,740	LF	$5	$58,700
21.	HMA Trench Repair	820	TN	$150	$123,000
22.	HMA Overlay	1,260	TN	$150	$189,000
23.	CIP Concrete Panel	600	CY	$600	$360,000
24.	Site Restoration	1	LS	$4,800	$4,800
25.	Unexpected Site Changes	1	LS	$4,800	$4,800
26.	SPCC Plan	1	LS	$320	$320
	Subtotal				$2,765,000
	Contingency (30%)				$830,000
	Subtotal				$3,595,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$360,000
	Total Construction Cost:				**$3,955,000**
	Design, Permitting, and Construction Administration (30%)				$1,187,000
	Total Project Cost				**$5,142,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Interim Alternative I-4: Interim Bypass of Central Lake Gravity Basin
PHASE 3 COST
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$148,000	$148,000
2.	Survey	1	LS	$24,000	$24,000
3.	Locate Existing Utilities	1	LS	$9,600	$9,600
4.	Project Temporary Traffic Control	1	LS	$100,320	$100,320
5.	Temporary Erosion Control	1	LS	$12,000	$12,000
6.	Trench Excavation Safety Systems	1	LS	$24,000	$24,000
7.	Connection to Existing Sewer System	3	EA	$5,000	$15,000
8.	Removal of Unsuitable Material	1,100	CY	$50	$55,000
9.	Manhole, 48 In. Diam.	8	EA	$6,000	$48,000
10.	Manhole Additional Height 48-In. Diam. (S.P. 7-05.5)	19	VF	$300	$5,700
11.	Crushed Surfacing Top Course	530	TN	$30	$15,900
12.	Crushed Surfacing Base Course	1,060	TN	$30	$31,800
13.	Bank Run Gravel for Trench Backfill	12,600	TN	$25	$315,000
14.	Foundation Gravel	1,100	TN	$100	$110,000
15.	18-inch PVC Sewer Pipe (Incl Bedding)	360	LF	$150	$54,000
16.	21-inch PVC Sewer Pipe (Incl Bedding)	2,510	LF	$250	$627,500
17.	16-inch DI Force Main (incl bedding)	0	LF	$160	$0
18.	Lift Station	0	LS	$4,000,000	$0
19.	Side Sewer Connection	8	EA	$2,000	$16,000
20.	Sawcutting	5,740	LF	$5	$28,700
21.	HMA Trench Repair	480	TN	$150	$72,000
22.	HMA Overlay	610	TN	$150	$91,500
23.	CIP Concrete Panel	300	CY	$600	$180,000
24.	Site Restoration	1	LS	$7,200	$7,200
25.	Unexpected Site Changes	1	LS	$7,200	$7,200
26.	SPCC Plan	1	LS	$480	$480
	Subtotal				$1,999,000
	Contingency (30%)				$600,000
	Subtotal				$2,599,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$260,000
	Total Construction Cost:				**$2,859,000**
	Design, Permitting, and Construction Administration (30%)				$858,000
	Total Project Cost				**$3,717,000**

Sammamish Plateau Water
Sammamish Plateau Diversions Phase 1 Improvements
Interim Alternative I-5: Diesel-Powered Bypass Pumps at Central Lake and North Lake Lift Stations
ENGINEER'S PRELIMINARY COST ESTIMATE
January 10, 2021

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	AMOUNT
1.	Mobilization, Cleanup, and Demobilization	1	LS	$34,000	$34,000
2.	Survey	1	LS	$8,000	$8,000
3.	Locate Existing Utilities	1	LS	$5,000	$5,000
4.	Project Temporary Traffic Control	1	LS	$2,000	$2,000
5.	Temporary Erosion Control	1	LS	$3,000	$3,000
6.	Trench Excavation Safety Systems	1	LS	$6,000	$6,000
7.	By-pass Pumping System	2	EA	$125,000	$250,000
8.	By-pass Pumping Connection	2	EA	$10,000	$20,000
9.	Wet Well Overflow Connection	2	EA	$15,000	$30,000
10.	Removal of Unsuitable Material	20	CY	$50	$1,000
11.	Manhole, 60 In. Diam.	2	EA	$12,000	$24,000
12.	Bank Run Gravel for Trench Backfill	50	TN	$25	$1,250
13.	Foundation Gravel	20	TN	$100	$2,000
14.	HMA Trench Repair	100	TN	$150	$15,000
15.	Site Restoration	1	LS	$5,000	$5,000
16.	Electrical/SCADA	1	LS	$30,000	$30,000
17.	Unexpected Site Changes	1	LS	$15,000	$15,000
18.	SPCC Plan	1	LS	$1,000	$1,000
	Subtotal				$453,000
	Contingency (30%)				$136,000
	Subtotal				$589,000
	Sales Tax at 10.0% per Washington State Dept of Revenue				$59,000
	Total Construction Cost:				**$648,000**
	Design, Permitting, and Construction Administration (30%)				$195,000
	Total Project Cost				**$843,000**

APPENDIX B

KING COUNTY CSI SAMMAMISH PLATEAU DIVERSION COSTS

Conceptual Project: Sammamish Plateau Diversion Phase 2

Capacity Needs Addressed

Issaquah Interceptor Section 1

Location

Sewer Agency: Sammamish Plateau Water and Sewer District
Jurisdiction: City of Sammamish
Planning Area: South Lake Sammamish

Existing Facilities and Capacity Needs

Conveyance Facility	Upstream Manhole	Downstream Manhole	Length (ft)	Diameter (in)	Year Built	Capacity (mgd)	2060 20-yr Peak Flow (mgd)	2060 20-yr Peak Flow Exceeded (mgd)	Year Exceeded	2010 Level of Service (yr)
RE*SELKSAMM.R28-03(2)	R28-03	R28-02	993	20	1995	16.80	21.94	5.14	2044	> 20
RE*ISSAQ1.R17-31(29)	R17-31	R17-02	14,004	48	1969	24.56	41.57	17.00	2024	> 20
Sunset Pump Station	SUNSET	N/A	150	0	1965	30.00	44.91	14.91	2030	> 20
RE*ISSAQ1.SUNSET(1)FM	SUNSET	HEATHFIEL	3,445	24	1982	20.31	24.60	4.29	2051	> 20
Heathfield Pump Station	HEATHFIEL	N/A	145	0	1965	30.00	44.91	14.91	2030	> 20
RE*ISSAQ1.HEATHFIEL(1)FM	HEATHFIEL	R11-67	1,685	24	1982	20.31	24.60	4.29	2051	> 20
RE*EGATE.R11-62B(2)	R11-62B	R11-60B	1,826	42	1984	31.74	48.54	16.80	2030	> 20
RE*EGATE.R11-60(4)	R11-60	R11-56	1,565	24	1964	22.10	35.73	13.63	2035	> 20
RE*EGATE.R11-56B(2)	R11-56B	R11-54B	1,238	42	1984	27.79	46.25	18.47	2027	> 20
RE*EGATE.R11-54B(8)	R11-54B	R11-46B	2,402	36	1984	33.80	46.25	12.46	2038	> 20
RE*EGATE.R11-46B(3)	R11-46B	R11-43B	1,405	42	1984	28.14	46.25	18.11	2027	> 20
RE*EGATE.R11-43B(1)	R11-43B	R11-42B	474	48	1984	30.75	46.25	15.50	2032	> 20
RE*LKHILLS.RO3-20(11)	RO3-20	RO3-09	4,999	48	1965	73.19	77.63	4.44	2054	> 20
RE*ESI10.RO2-39A(2)	RO2-39A	RO2-39	2,637	72	1962	146.45	170.16	23.71	2042	> 20
RE*ESI4.RO2-27(5)	RO2-27	RO2-21	3,504	84	1966	203.63	224.98	21.35	2047	> 20

Project Description

Components and Construction Methods

The primary purpose of the Sammamish Plateau Diversion is to limit projected 20-year peak flows to the 24.6-mgd capacity of Issaquah Interceptor Section 1 in Lake Sammamish. Additionally, the diversion addresses several other downstream pipe reach and pump station capacity needs between the Sunset Pump Station and the South Treatment Plant.

Assumptions for the diversion are as follows:

- The diversion will be completed in two phases. (Phase 1 is in progress.)
- Phase 2 will be implemented after Phase 1 has been completed (by 2028).

- The design of Phase 1 may consider and incorporate the wastewater flows associated with Phase 2 where practical. Otherwise, minimal accommodations will be made for Phase 2 flows during Phase 1.

- Existing Sammamish Plateau Water and Sewer District (SPWSD) and Northeast Sammamish Sewer and Water District (NESSWD) conveyance facilities will be used where practical to limit the scope of Phase 1.

- If it is not practical to use local agency facilities, the scope of Phase 1 may be limited to Phase 1 flows in order to defer capital expenses. Upgrades to Phase 1 conveyance are then likely to be included as part of Phase 2.

- Cost estimates for the Phase 2 conceptual project described here assume that no Phase 2 flows were accommodated in Phase 1. The pump station replacements will be designed to accommodate total Phase 1 and Phase 2 peak flows in 2060. Design flows will be updated for the 50-year planning horizon prior to construction.

Phase 1 and Phase 2 concepts are as follows:

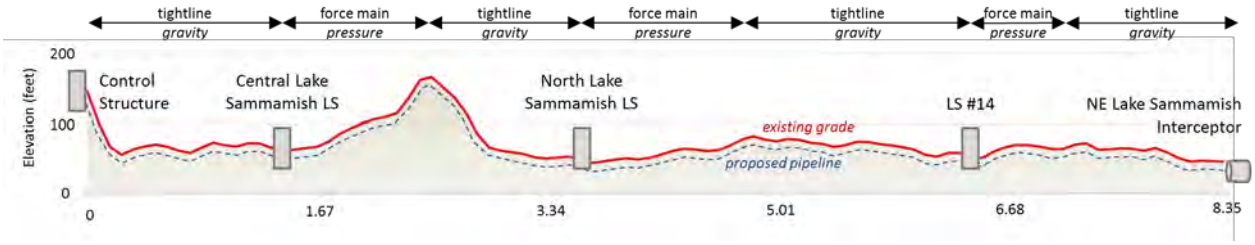
- Phase 1 redirects all NESSWD and SPWSD sanitary flows upstream of the SPWSD North Lake Sammamish and Inglewood lift stations to the WTD Northeast Lake Sammamish Interceptor at manhole R19-65A. Phase 1 consists of a new pump station ("intermediate" pump station) in the vicinity of Lift Station #14 and 4.76 miles of force mains and gravity pipelines.

- The Sammamish Plateau Diversion Phase 2 Project addresses the capacity needs shown in the table above. The project redirects additional SPWSD sanitary flow upstream of SPWSD's Control Structure and Central Lake Sammamish Lift Station by tightline to the Northeast Lake Sammamish Interceptor at manhole R19-65A. Tightlines have no interim connections, which allows surcharging of flow that would otherwise back up or overflow local connections. SPWSD local flows enter the tightline at the Control Structure, Mallard Bay Lift Station, and Central Lake Sammamish Lift Station. Phase 2 consists of replacing the Central Lake Sammamish and North Lake Sammamish lift stations, upgrading the intermediate pump station near Lift Station #14, and 8.35 miles of force mains and gravity tightline. This includes paralleling the entire length of Phase 1 (4.76 miles).

  The conceptual alignment for the Sammamish Plateau Diversion Phase 2 follows the East Lake Sammamish Parkway SE (see profile below). The diversion includes both tightline and parallel force main pipelines. Tightlines will operate by gravity; force mains will operate under pressure. Trench-cut construction is assumed for all pipelines, as well as several culvert crossings.

  Relocating the conceptual alignment to the East Lake Sammamish Trail would significantly reduce construction costs, limit traffic disruption, and mitigate or potentially eliminate the proposed pump station replacements. However, railroad regulations, potential impacts to

environmentally sensitive areas, and acquisition of residential underground easements are expected to prevent use of the trail. More detailed examination during project predesign is recommended to determine whether the East Lake Sammamish Trail is a viable alignment.



Conceptual Profile for Sammamish Plateau Diversion Phase 2 Project

Conveyance Facility	Segment (manholes)	Project Element	Construction Methodology	Diameter (in)	Length (ft)	Design Capacity (mgd)
Sammamish Plateau Diversion Phase 2	Control Structure to Central Lake Sammamish Lift Station (LS)	Pipeline	Trench-cut	27	7,498	18.0
	Control Structure to Central Lake Sammamish LS	Culvert creek crossing	Trench-cut	36	50	N/A
	Control Structure to Central Lake Sammamish LS	Culvert creek crossing	Trench-cut	36	50	N/A
	Control Structure to Central Lake Sammamish LS	Culvert creek crossing	Trench-cut	36	50	N/A
	Central Lake Sammamish LS	Pump station replacement	N/A	N/A	N/A	22.9
	Central Lake Sammamish LS to FM discharge	Parallel force mains	Trench-cut	30/12	5,755	22.9
	FM discharge to North Lake Sammamish LS	Pipeline	Trench-cut	27	5,702	22.9
	FM discharge to North Lake Sammamish LS	Culvert creek crossing	Trench-cut	36	50	N/A
	North Lake Sammamish LS	Pump station replacement	N/A	N/A	N/A	27.9
	North Lake Sammamish LS to force main (FM) discharge	Parallel force mains	Trench-cut	30/12	6,917	22.9
	FM discharge to Intermediate Pump Station	Pipeline	Trench-cut	36	8,078	22.9
	Intermediate Pump Station	Pump Station upgrade	N/A	N/A	N/A	36.6
	Intermediate Pump Station to FM discharge	Parallel force mains	Trench-cut	30/12	2,904	22.9
	FM discharge to R19-65A	Pipeline	Trench-cut	36	7,234	22.9

Upstream and Downstream Projects

Upstream Projects: None

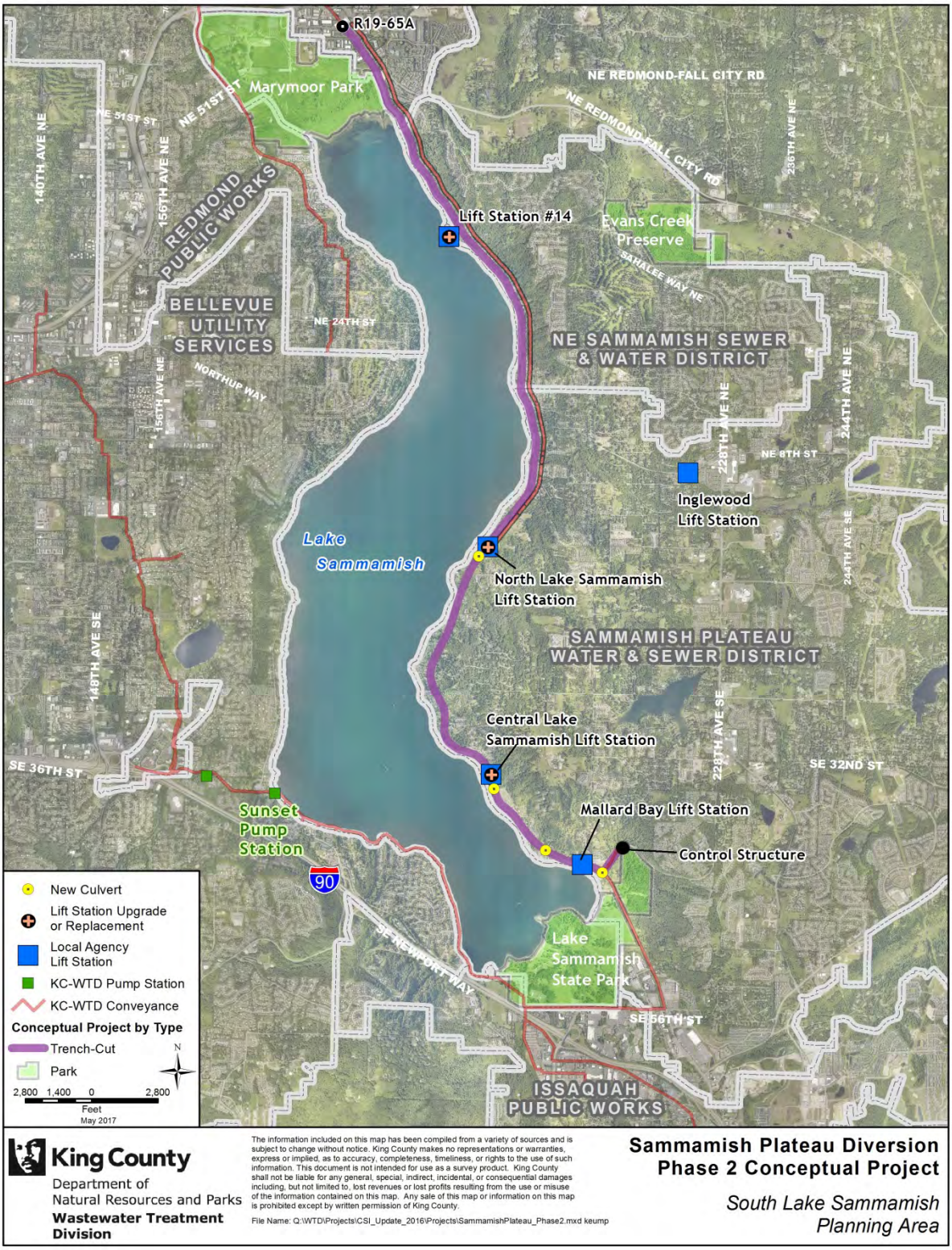
Downstream Projects: None

Other Concepts Evaluated

- **Storage**. Storage was evaluated by the volume required to address the capacity need in the downstream Issaquah Interceptor Section 1 Lakeline. A peak flow reduction-to-volume recurrence relationship developed at upstream manhole R17-31 determined that the peak flow reduction cannot be achieved through storage. Series storage at two alternative locations was

evaluated. However, peak flow reduction-to-volume recurrence relationships developed at upstream manholes R17-37 and R17-36A also determined that the peak flow reduction cannot be achieved through storage. Storage therefore was not considered further for a conceptual project.

- **Storage/Diversion**. A combined storage and reduced diversion concept was evaluated by the volume and construction cost to address the capacity need in the downstream Issaquah Interceptor Section 1 Lakeline. The concept includes a smaller diversion to the Northeast Lake Sammamish Interceptor of 9.67 mgd and storage of the remaining 16.8 mgd of projected flow in excess of the lakeline capacity. Two peak flow reduction-to-volume recurrence relationships developed at upstream manhole R17-37 and within the local collection system determined the required storage volumes to be 18 MG and 10.1 MG, respectively. However, the estimated construction cost of $206M for storage and diversion exceeds the cost of diversion-only. Storage and diversion therefore were not considered further for a conceptual project.
- **Paralleling/Replacement**. Paralleling and replacement were not evaluated because there is no existing conveyance pipe.


R19-65A
Marymoor Park
NE REDMOND-FALL CITY RD
NE REDMOND-FALL CITY RD
236TH AVE NE
140TH AVE NE
NE 51ST ST
NE 51ST ST
156TH AVE NE
REDMOND PUBLIC WORKS
Lift Station #14
Evans Creek Preserve
SAHALEE WAY NE
BELLEVUE UTILITY SERVICES
NE 24TH ST
NE SAMMAMISH SEWER & WATER DISTRICT
NORTHUP WAY
156TH AVE NE
228TH AVE NE
244TH AVE NE
NE 8TH ST
Inglewood Lift Station
Lake Sammamish
North Lake Sammamish Lift Station
244TH AVE SE
148TH AVE SE
SAMMAMISH PLATEAU WATER & SEWER DISTRICT
Central Lake Sammamish Lift Station
228TH AVE SE
SE 36TH ST
SE 32ND ST
Sunset Pump Station
Mallard Bay Lift Station
Control Structure
90
SE NEWPORT WAY
Lake Sammamish State Park
SE 56TH ST
ISSAQUAH PUBLIC WORKS
New Culvert
Lift Station Upgrade or Replacement
Local Agency Lift Station
KC-WTD Pump Station
KC-WTD Conveyance
Conceptual Project by Type
Trench-Cut
Park
N
2,800 1,400 0 2,800
Feet
May 2017
King County
Department of Natural Resources and Parks
Wastewater Treatment Division
The information included on this map has been compiled from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a survey product. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.
File Name: Q:\WTD\Projects\CSI_Update_2016\Projects\SammamishPlateau_Phase2.mxd keump
Sammamish Plateau Diversion
Phase 2 Conceptual Project
South Lake Sammamish Planning Area

Estimated Project Costs

Estimated project costs for the Sammamish Plateau Diversion Phase 2 Project are shown in the table below. Cost estimating methodologies are as follows:

- The construction cost was estimated with Tabula conveyance system cost estimating software. Tabula is a parametric construction cost estimation tool used for conceptual or feasibility studies for projects at the 0 to 2 percent design level. Additional information on Tabula can be found at http://www.kingcounty.gov/services/environment/wastewater/csi/tabula.aspx.

- Allowances were made for items not included in Tabula such as street use permits, owner-furnished elements, utility relocations, real estate acquisition, and other construction items such as complex staging constraints.

- Adjustments were made to Tabula. Examples include the following:

    - Dimensions for project components were rounded up. For example, the construction cost for a pipe reach of 4,756 feet was estimated for a reach of 4,800 feet.

    - Effluent pumping costs are included for box storage facilities but not for pipe/tunnel storage facilities. Effluent pumping costs for pipe/tunnel storage facilities were estimated separately or covered under an allowance for indeterminate items that accounts for further engineering development and progression of the concept when it enters the project delivery process from the conceptual planning phase.

- Lump sum items were used for recurring or similar types of construction elements, such as jack-and-bore construction, comprised of various components and units of measurement. The anticipated conceptual cost was presented as a single item without listing multiple associated items that may not immediately be understood to be part of the same work.

- Allied costs (including design allowance, change order allowance, engineering, permitting, and WTD staffing) were estimated based on a percentage of project construction costs in WTD's project management database, PRISM. These allied cost percentages were based on a statistical analysis of different types and sizes of WTD's historical project costs over time.

- Overall project contingency (30 percent), construction cost allowances for indeterminate items (25 percent), and construction change order allowances (10 percent) are added in accordance with WTD estimating guidelines appropriate to this class of estimate.

- The estimate is an early AACE International Class 5 cost estimate based on 0 to 2 percent project design. Class 5 estimates are considered to have an accuracy range of –50 percent to +100 percent (AACE RP No. 18R-97, Cost Estimate Classification System – As Applied in Engineering, Procurement, and Construction for the Process Industries: http://www.aacei.org/toc/toc_18R-97.pdf).

Conceptual Estimate - AACEI Class 5					
Project Name:	Sammamish Plateau Diversion Phase 2			**Date:**	12/20/2016
Location:	The conceptual alignment follows the East Lake Sammamish Parkway SE.			**Estimator:**	Greg Brink (VMS) Douglas Leo (VMS)
Description:	Diversion to redirect flows from Sammamish Plateau Sewer & Water District currently flowing south to the north. Includes trench cut piping and pump station upgrades/replacements.			**Version:**	1
DIRECT: SUBTOTAL CONSTRUCTION COSTS					
Item No.	**Item Description**	**Quantity**	**Units**	**Unit Cost**	**Item Cost**
1	27-in Tightline (Control Structure to Central Lake Sammamish LS)	7,498	LF	$ 660	$ 4,950,792
2	Creek Crossings (1-3)	3	EA	$ 95,470	$ 286,409
3	23-mgd Central Lake Sammamish LS Replacement	23	MGD	$ 464,577	$ 10,685,274
4	30-in/12-in Force Main (C. Lake Sammamish LS to FM discharge)	5,755	LF	$ 1,013	$ 5,827,666
5	27-in Tightline (FM discharge to N. Lake Sammamish LS)	5,702	LF	$ 661	$ 3,770,569
6	Creek Crossings (4)	1	EA	$ 95,470	$ 95,470
7	28-mgd North Lake Sammamish LS Replacement	28	MGD	$ 363,064	$ 10,165,805
8	30-in/12-in Forcemain (N. Lake Sammamish LS to FM discharge)	6,917	LF	$ 947	$ 6,549,837
9	36-in Tightline (FM discharge to LS #14)	8,078	LF	$ 944	$ 7,628,394
10	37-mgd LS #14 Replacement	37	MGD	$ 319,396	$ 11,817,643
11	30-in/12-in Forcemain (LS #14 to FM discharge)	2,904	LF	$ 947	$ 2,749,843
12	36-in Tightline (FM discharge to NE Lake Sammamish)	7,234	LF	$ 804	$ 5,812,656
13					$ -
14					$ -
15					$ -
16					$ -
17					$ -
18					$ -
19					$ -
20					$ -
				Subtotal Construction Costs	***$ 70,340,000***
DIRECT: SUBTOTAL ADDITIONAL CONSTRUCTION COSTS					
				Street Use Permit	$ -
				Mitigation Construction Contracts	$ -
				Allowance for Indeterminates (Design Allowance)	$ 17,585,000
				Subtotal Construction Bid Opening Amount	***$ 87,925,000***
				Owner Furnished Equipment	$ 500,000
				Outside Agency Construction	$ 5,000,000
				Construction Contract/OFE Change Order Allowance	$ 9,342,500
				Subtotal KC Contribution to Construction	***$ 102,767,500***
				Sales Tax	***$ 9,865,680***
DIRECT: SUBTOTAL OTHER CAPITAL CHARGES					
				KC/WTD Direct Implementation	$ -
				Misc. Capital Costs	$ 287,749
				TOTAL DIRECT CONSTRUCTION COSTS	***$ 112,920,000***
INDIRECT: NON-CONSTRUCTION COSTS					
				Engineering Services	$ 22,608,850
				Planning & Management Services	$ 9,249,075
				Permitting & Other Agency Support	$ 1,284,594
				Right-of-Way	$ 4,531,800
				Misc. Service & Materials	$ 3,391,328
				Non-WTD Support	$ 1,592,896
				WTD Staff Labor	$ 11,783,835
				Subtotal Non-Construction Costs	***$ 54,442,378***
				Project Contingency	$ 50,208,992
				Initiatives	$ 1,284,594
				TOTAL INDIRECT NON-CONSTRUCTION COSTS	***$ 105,940,000***
				TOTAL PROJECT COST	***$ 218,860,000***