

Representative Infrastructure Studies

(Published October 2021)

Appendix 2. Supplemental Water and Sewer Study

This Study is an Appendix to the [NE 85th Street Station Area Plan project](#) **Fiscal Impacts and Community Benefits Analysis Study Technical Memo (Technical Memo)**. The Station Area Fiscal Impacts and Community Benefits Analysis was scoped to answer this question: If the City were to implement its vision of the Station Area as a thriving, walkable urban center with plentiful affordable housing, jobs, sustainable development, and shops and restaurants linked by transit, can the City afford the investments necessary to address increased demand on public services, especially schools, parks/open spaces, transportation, and utilities, and avoid a reduction in service for existing community members and businesses?

Study Purpose

To support the Technical Memo's assumptions, planning level **Representative Infrastructure Studies** were conducted to determine a set of representative infrastructure investments needed to maintain service levels in transportation, water and sewer, and stormwater, in alignment with the full 23-year buildout scenarios described for the two key development alternatives analyzed in the Technical Memo – June Alternatives A and B. The purpose of the Infrastructure Studies was to inform an understanding of area-wide representative infrastructure and service needs and costs and for incorporation as assumptions in the fiscal analysis. Note that as “representative infrastructure,” these identified investments are ones that are likely to be similar in scale and type to those needed to support future Station Area development, but are likely to differ somewhat from the specific infrastructure investments that will ultimately be adopted for the Station Area. Information about the Representative Infrastructure Studies is presented in Section 3 of the Fiscal Impacts and Community Benefits Technical Memo. The Fiscal Impact model assigns all representative infrastructure investments either to development projects or to the City, roughly following City policy. Any assumptions about parcel- and quadrant-level development and phasing included in the studies are hypothetical and not meant to presuppose decision- making by private landowners or the actions of the market. The representative investments identified in the Infrastructure Studies are distinct from and should not be construed as preferred plan recommendations or final project configurations, which will be developed in later stages of planning and are subject to City Council approval.

Key Contacts

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Consultant Project Lead: Mithun

Fiscal Impacts and Community Benefits Supplemental Study Technical Memo

Lead Author: BERK; Contributors: EcoNorthwest, Fehr and Peers, Mithun

Representative Infrastructure Studies

[Appendix 1. Supplemental Transportation Study](#) Lead Author: Fehr and Peers

[Appendix 2. Supplemental Water and Sewer Study](#) Lead Author: RH2

[Appendix 3. Supplemental Stormwater Memo](#) Lead Author: RKI



City of Kirkland

NE 85th Street Station Area Plan Water and Sewer System Analyses

- **Background:** The City has published a Draft Supplemental Environmental Impact Statement (DSEIS) for the NE 85th Street Station Area Plan (SAP). The DSEIS presents several alternatives that consider rezoning most of the area to allow it to develop more residential units and jobs. The alternatives being evaluated in this analysis include June Alternatives A and B; the June Alternatives are derivatives of the No-Action Alternative and Alternative 2 from the DSEIS.
- **Analysis:**
 - **Objective:**
 - Determine water and sewer system improvements required above and beyond the City's existing CIPs to support the SAP development (June Alternative B).
 - **Improvement Alternative Analyses:**
 - Water and sewer system improvements were identified to determine what is needed to support the following scenarios for development in the Station Area:
 - Existing system with redevelopment at the Lee Johnson site.
 - Existing system with redevelopment at the Lee Johnson and Costco sites.
 - Growth based on *2035 Comprehensive Plan*, which is similar to June Alternative A.
 - June Alternative B.
 - All identified improvements were classified and phased based on the following:
 - Those required to be constructed in conjunction with the Bus Rapid Transit (BRT) station.
 - Those required to be constructed to support each of the service areas defined by BERK (Lee Johnson site, Costco site, and NE, NW, SE, and SW quadrants).
- **Results and Cost Estimates:**
 - **Results:** The existing systems cannot support the potential growth analyzed in June Alternative B at the Lee Johnson and Costco sites without the implementation of improvements. With the implementation of the City's existing CIPs as shown in the 2015 WSP and 2018 GSP, the water and sewer systems cannot support the full redevelopment analyzed under SAP June Alternative B. Additional water and sewer system improvements are identified in these analyses to serve the buildout growth studied in SAP June Alternative B.
 - The water system would not be able to support the rezoned fire flow requirements without additional improvements.
 - The sewer system would not be able to support the additional flows from the Station Area without additional improvements.
 - **Cost Estimates:**
 - **Table 1** and **Chart 1** summarize the project costs for several of the scenarios evaluated. The sum of the costs for the Base CIP and the SAP June Alternative B additional improvements may be added to determine the total cost to support the full development proposed for SAP June Alternative B.
 - Each CIP project was assigned an estimate for the portion of the cost that should be funded by the City or by a developer. Based on input from the City, projects were identified as City-funded if the improvement was triggered by a maintenance concern. Projects that were noted with a capacity-related improvement trigger were identified as developer-funded. The funding cost allocations are summarized in **Chart 2** for the total cost of improvements to the existing system to support the full development proposed for SAP June Alternative B.
 - **BRT-Related Projects:**
 - Water system CIP improvement WM2 should be completed in conjunction with the BRT construction. WM2 proposes realigning the existing 24-inch water main that crosses I-405 at NE 85th Street.



- Sewer system improvement SAP-8 should be completed in conjunction with the BRT construction. SAP-8 proposes installing a new I-405 crossing to mitigate additional flows due to the Station Area growth. This project is assumed to be developer-funded as it adds necessary capacity to serve redevelopment; however, if redevelopment does not occur before the BRT station is constructed, the City may need to fund and construct the project and determine the appropriate mechanism to recover the cost from redevelopment when it occurs.

Table 1
Estimated Total Project Costs for SAP Alternative CIPs

Scenario	Estimated Total Project Costs	
	Water	Sewer
Existing System with Redevelopment at Lee Johnson and Costco Sites*	\$4,162,000	\$7,481,000
Base Scenario Improvements	\$27,552,000	\$45,756,000
SAP June Alternative B Additional Improvements	\$559,000	\$12,613,000

* Note these improvements are included in the Base CIP costs for water, and SAP June Alternative B costs for sewer.

Chart 1
Estimated Total Utility CIP Costs for Station Area Alternatives

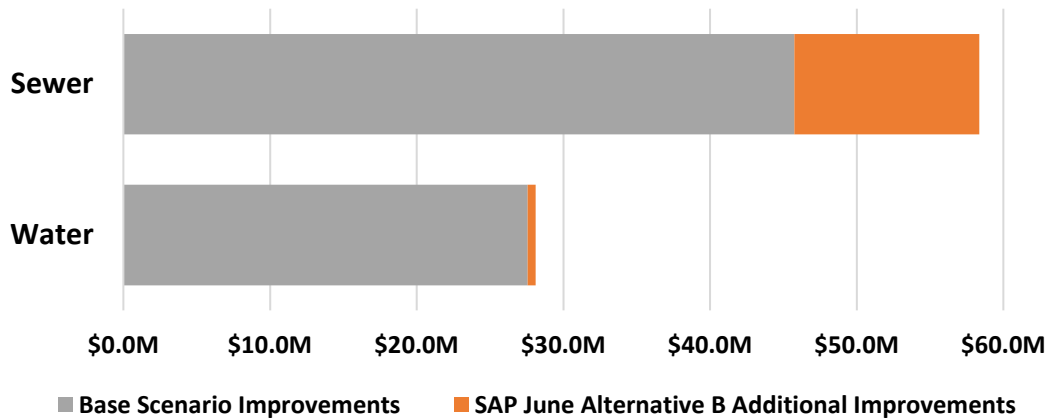
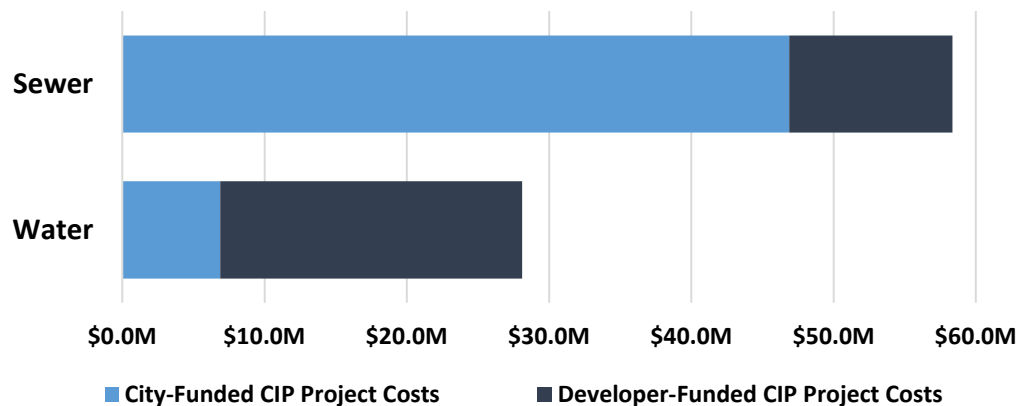


Chart 2
Estimated City- and Developer-Funded CIP Cost Allocation for Station Area June Alternative B



RH2 TECHNICAL MEMORANDUM

Client:	City of Kirkland		
Project:	NE 85 th Street Station Area Plan Water and Sewer System Analyses		
Project File:	KIR 119.168.0001.0106	Project Manager:	Michele Campbell, PE
Composed by:	Dylan Bright		
Reviewed by:	Michele Campbell, PE, and Kenny Gomez, PE		
Subject:	NE 85 th Street Station Area Plan Water and Sewer System Analyses		
Date:	October 18, 2021		



Signed:
10/18/2021

Executive Summary

To help guide transit-oriented growth in the vicinity of the proposed Inline Stride Bus Rapid Transit (BRT) Station at the Interstate 405 (I-405)/NE 85th Street interchange, the City of Kirkland (City) is developing a Station Area Plan (SAP) that considers rezoning within a ½-mile radius of the new BRT Station. Prior to adopting a preferred direction for the SAP, the City is evaluating the fiscal impacts and community benefits of development alternatives for the study area.

This technical memorandum documents the results of water and sewer system analyses performed by RH2 Engineering, Inc., (RH2) to support the SAP evaluation. The alternatives include a Base Scenario that is projected to approximately triple the existing water demands and sanitary sewer flows in the Station Area by the end of the planning horizon. The Base Scenario is slightly modified from the June Alternative A scenario of the SAP. The June Alternative B growth scenario projects water demands and sanitary sewer flows in the Station Area to increase to nearly ten times the current levels. Planning-level flow requirements also are expected to increase under the June Alternative B growth scenario.

The results of the RH2 analyses indicate that the existing water distribution system and sewer collection system infrastructure cannot support the developments associated with the land use

changes and potential redevelopment contemplated for the parcels east of, and nearest to, the I-405 interchange (e.g., existing Lee Johnson and Costco properties) without additional piping improvements. Water and sewer system improvements have been identified in previous planning studies by RH2 to support the growth identified for the Base Scenario. Additional improvements above those required for the Base Scenario are needed to increase system capacity to meet the projected water demands and sanitary sewer flows estimated for the SAP June Alternative B growth scenario.

A summary of the costs for the identified improvements is shown in **Table ES-1**. The sum of the costs for the Base Scenario Capital Improvement Program (CIP) and the SAP June Alternative B additional improvements in the table may be added to determine the total cost for improvements to the existing system to support the full development proposed for SAP June Alternative B. These total costs also are shown in **Chart ES-1**.

Table ES-1

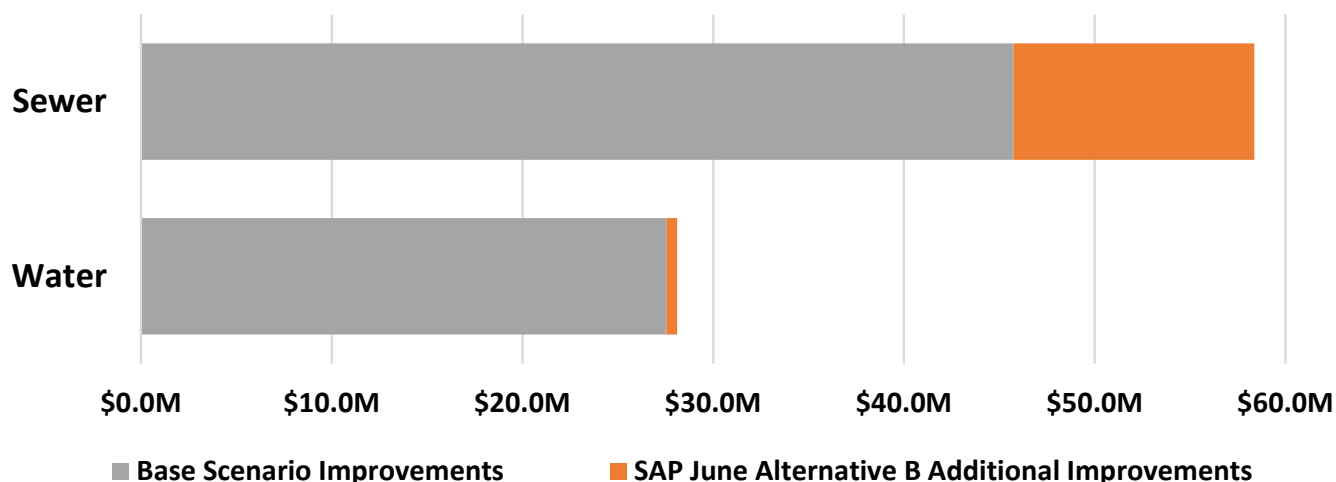
Estimated Total Project Costs for SAP Alternative CIPs

Scenario	Estimated Total Project Costs	
	Water	Sewer
Existing System with Redevelopment at Lee Johnson and Costco Sites*	\$4,162,000	\$7,481,000
Base Scenario Improvements	\$27,552,000	\$45,756,000
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* Note these improvements are included in the Base CIP costs for water, and SAP June Alternative B costs for sewer.

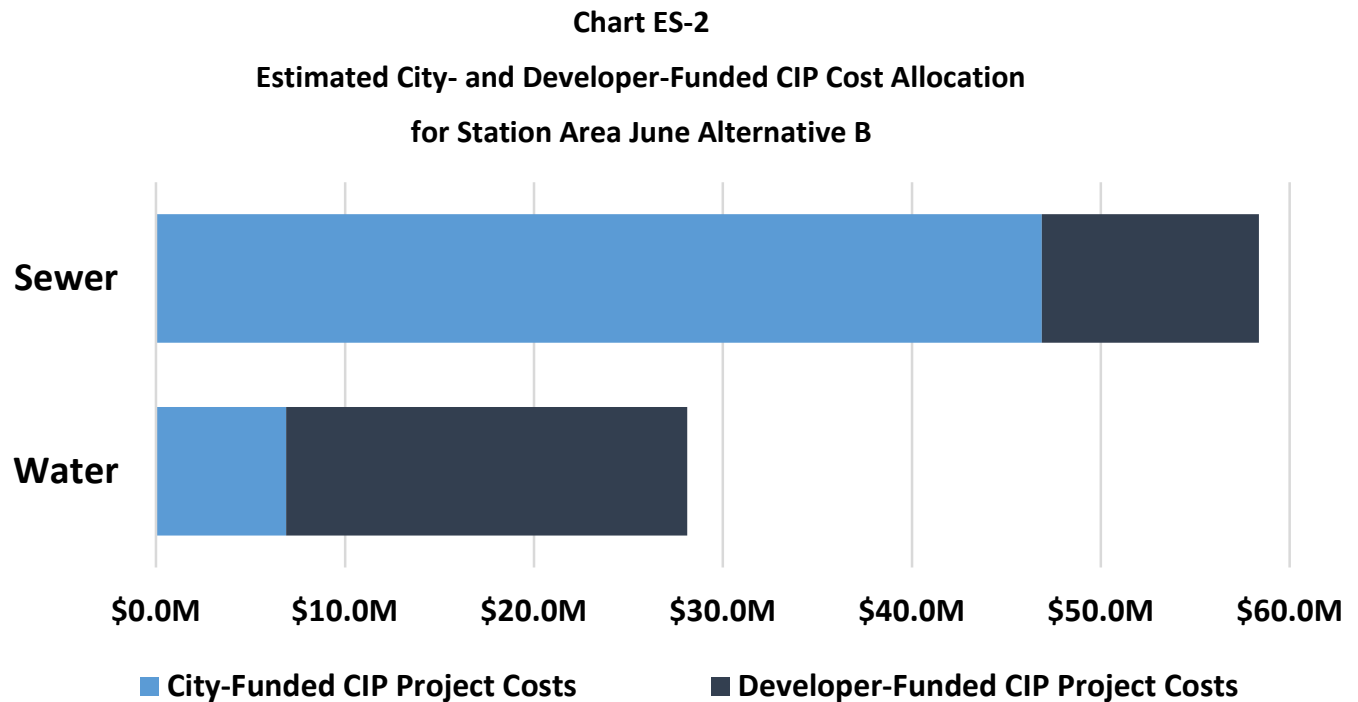
Chart ES-1

Estimated Total Utility CIP Costs for Station Area Alternatives



Each CIP project was assigned an estimate for the portion of the cost that should be funded by the City or by a developer. Based on input from the City, projects were identified as City-funded if the improvement was triggered by a maintenance concern. An example of a project that is considered to be a maintenance concern is sewer alignments that were flagged in the City's

2018 *General Sewer Plan* as needing to be upsized from 6-inch alignments to the minimum design standard of 8 inches. Projects that were noted with a capacity-related improvement trigger were identified as developer-funded. The funding cost allocations are summarized in **Chart ES-2** for the total cost of improvements to the existing system to support the full development proposed for SAP June Alternative B.



Several projects are identified to be constructed in coordination with the BRT Station design and project schedule. Water system CIP WM2, which proposes to realign the existing 24-inch water main that crosses I-405 at NE 85th Street, is required because the BRT Station design conflicts with the existing water main. Sewer system CIP SAP-8 also should be completed in coordination with the BRT construction. SAP-8 proposes installing a new I-405 crossing to mitigate additional flows due to the Station Area growth. A feasibility analysis should be performed to confirm the constructability of the proposed SAP-8 sewer improvements and to compare the cost/benefit of other potential alternative capacity improvements. This project is assumed to be developer-funded as it adds necessary capacity to serve redevelopment; however, if redevelopment does not occur before the BRT Station is constructed, the City may need to fund and construct the project and determine the appropriate mechanism to recover the cost from redevelopment when it occurs.

Background

The City of Kirkland (City) is a municipal corporation that is responsible for providing sanitary sewer and drinking water service within its utility service areas. The City's most recent *Water System Plan* (WSP) and *General Sewer Plan* (GSP) were completed in 2015 and 2018, respectively.

The Washington State Department of Transportation (WSDOT) and Sound Transit are currently planning a new Interstate 405 (I-405)/NE 85th Street Interchange and Inline Stride Bus Rapid Transit (BRT) Station that will be designed to connect the City to major regional transit lines. To help guide transit-oriented growth in the vicinity of the BRT Station, the City is developing a Station Area Plan (SAP) that considers rezoning most of the area from NE 97th Street to NE 75th Street and from 6th Street to 128th Avenue NE, herein referred to as the Station Area and shown on **Figure 1**. The considered rezoning would concentrate more jobs and households in this area with access to high-capacity regional transit.

The City published a Draft Supplemental Environmental Impact Statement (DSEIS) in January 2021, which presents one no-action and two action alternatives for growth within the Station Area through the year 2044. Based on public comment and community feedback on the DSEIS, a charette held with City staff, and guidance from the City Council and Planning Commission, two growth scenarios (June Alternatives A and B) were developed to inform a supplemental scope of work to provide additional detail ahead of choosing a preferred alternative for the Station Area. The June Alternatives are being studied to analyze the fiscal impacts and community benefits of each growth scenario presented therein. The results of the fiscal impacts and community benefits analysis will inform the City's selection of a preferred plan direction that comprehensively considers land use, urban design, open space, transportation, utilities, and sustainability.

The additional growth proposed in the June Alternatives is greater than what had been previously planned for in the City's WSP and GSP. Analyses are needed to determine the impact of the growth on the water and sewer utilities.

Purpose

The City requested RH2 Engineering, Inc., (RH2) to perform analyses to evaluate the impact of the proposed rezoning on the water and sewer utilities. The analyses evaluated whether the City's water and sewer systems have adequate capacity to serve the proposed rezoning alternatives contemplated in the SAP, and identified capital improvements beyond those described in the WSP and GSP to serve the future Station Area through the year 2044 planning horizon.

This technical memorandum documents the analyses performed using the City's water and sewer system hydraulic models to determine the capital improvements required to support the rezoning alternatives contemplated in the SAP.

Growth Alternatives

SAP Alternatives

The DSEIS identified three different growth alternatives that were evaluated for future development in the Station Area through the year 2044 planning horizon. The three DSEIS

alternatives included a No Action Alternative 1, and two action alternatives that would allow for moderate to high growth to maximize transit-oriented development, community benefits, including affordable housing, and quality of life. Alternative 2 growth would be primarily focused on existing commercial areas such as Rose Hill and would allow for a range of mid-rise, mixed-use office/residential with incremental infill in established residential neighborhoods. Alternative 3 would include mixed-use residential and office buildings up to 20 stories in select commercial areas, mid-rise residential mixed-use along NE 85th Street and adjacent to the office mixed-use areas, and smaller scale infill in low-density residential areas.

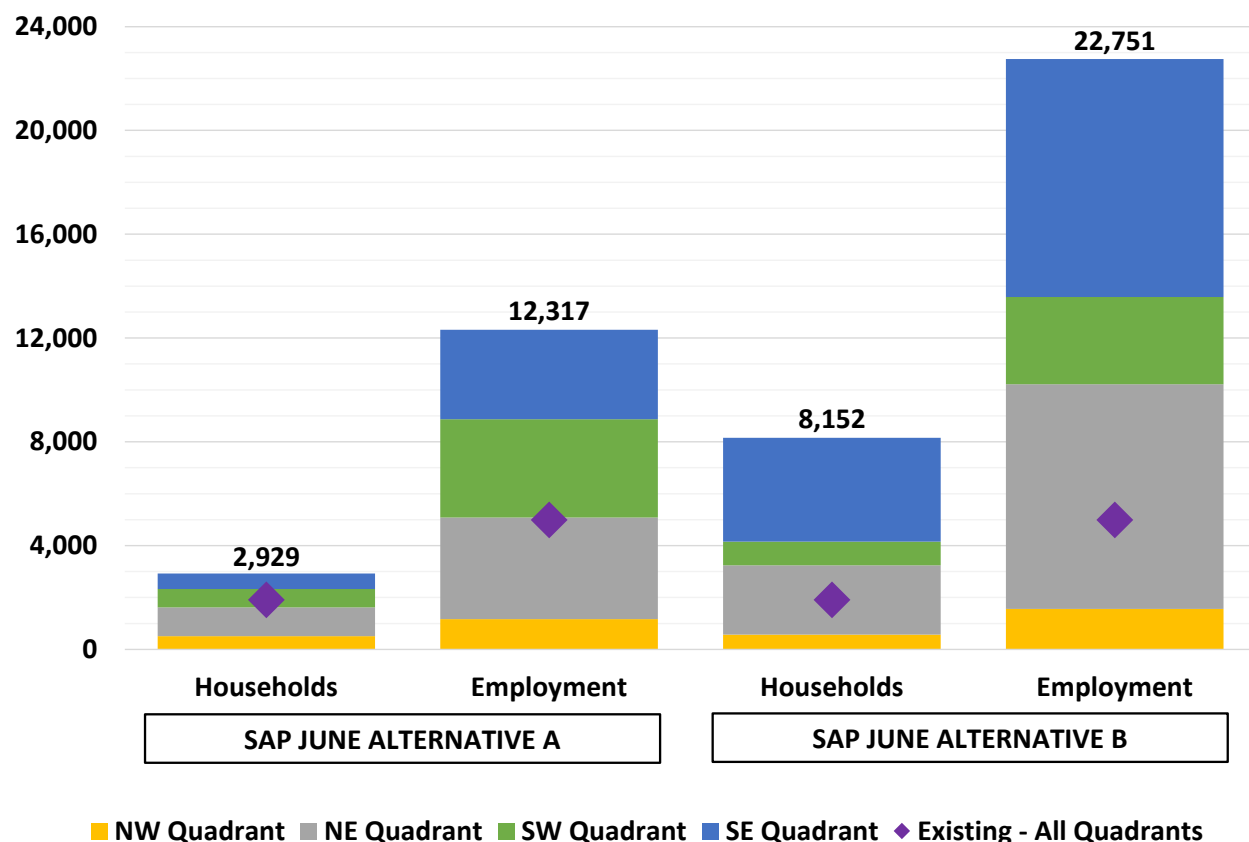
Public comment and community feedback on the DSEIS, a charette held with City staff, and guidance from the City Council and Planning Commission led to the development of two alternatives to inform a fiscal impacts and community benefits analysis, which fall within the bookends of the DSEIS alternatives. These new alternatives, known as the June Alternatives, narrow the range of the alternatives studied in the DSEIS in the following ways:

- Remove the level of growth shown in DSEIS Alternative 3 from further consideration.
- Use a revised version of DSEIS Alternative 1 as the lower limit of growth to be studied (June Alternative A: Current Trends).
- Use a reduced version of DSEIS Alternative 2 as the upper limit of growth to be studied (June Alternative B: Transit-Connected Growth).

The projected year 2044 household and employment for the June Alternatives was provided to RH2 by Mithun, Inc., and is shown in **Chart 1** based on service area quadrants spatially separated by I-405 and NE 85th Street. The numbers in the chart represent the total planned number of households and employees within the Station Area boundary at the end of the planning horizon.

Chart 1

Total Future June Alternatives Household and Employment



Source: Mithun/EcoNW, 2021

RH2 Alternatives

The growth alternatives used by RH2 were slightly modified from the SAP June Alternatives to take advantage of water and sewer planning efforts recently performed by RH2. These efforts included the following.

- 2015 WSP
- 2018 GSP
- 2021 Water Capital Improvement Program (CIP) Update
- Letter report to the City regarding the Water and Sewer Flow Analyses for the Continental Divide Development, dated June 30, 2017, from RH2. The proposed development is located immediately north of NE 85th Street between 131st Avenue NE and 132nd Avenue NE.

- Letter report to the City regarding the Water and Sewer Flow Analyses for the Rose Hill Development, dated December 18, 2020, from RH2. The proposed development also is known as the Petco Development and is located immediately north of NE 85th Street between 120th Avenue NE and 122nd Avenue NE.

RH2's hydraulic analyses were performed under the following two development scenarios.

1. **Base Scenario.** The Base Scenario uses the future growth analyses and CIP planning performed for the WSP, the 2021 Water CIP Update, and the GSP, which reflect the City's current *Comprehensive Plan* growth targets for year 2035. The Base Scenario also includes growth and capital improvements identified for the Petco and Continental Divide developments. It has been noted by the City that this scenario closely aligns with SAP June Alternative A.
2. **June Alternative B.** RH2's second scenario is based on the SAP June Alternative B as presented by Mithun.

Projected Demands and Flow Rates

The City's prime consultant for the Station Area Plan, Mithun, provided a database and GIS data for the year 2044 growth associated with June Alternatives A and B shown in **Chart 1**. The data contained the residential and employment growth between the existing scenario and June Alternatives A and B both on a parcel and traffic analysis zone level. For the purposes of these analyses and assigning demands/flows to the hydraulic models, only the June Alternative B parcel level data was utilized to develop demand and flow projections for the Station Area from the identified household and employment growth numbers provided by Mithun. Demands and flows for the June Alternative A were not projected for this study since they were estimated for the Base Scenario in previous planning work.

Water Demands

To develop water demands for use in the hydraulic model for June Alternative B, the population growth projections were multiplied by a demand per person value, and the employment growth was multiplied by a demand per employee value. The City provided a household size of 1.59, which was used to convert households to population. The calculated commercial demand per employee values were developed using the same data and assumptions used in the City's WSP. These assumptions estimated that 85 percent of the City's employees are located within the City's water service area, and that these employees use approximately 925,000 gallons of water per year, resulting in approximately 29 gallons per employee per day, with distribution system leakage (DSL) factored in. A similar methodology was used to calculate the residential demand per person, which resulted in approximately 66 gallons per person per day.

Applying the demand per person and demand per employee values to the growth projections yielded a total of 808 gallons per minute (gpm) of growth between the existing system scenario

and SAP June Alternative B. **Table 1** shows the residential and employment demands associated with the Station Area growth between the existing system and the SAP scenario.

Table 1

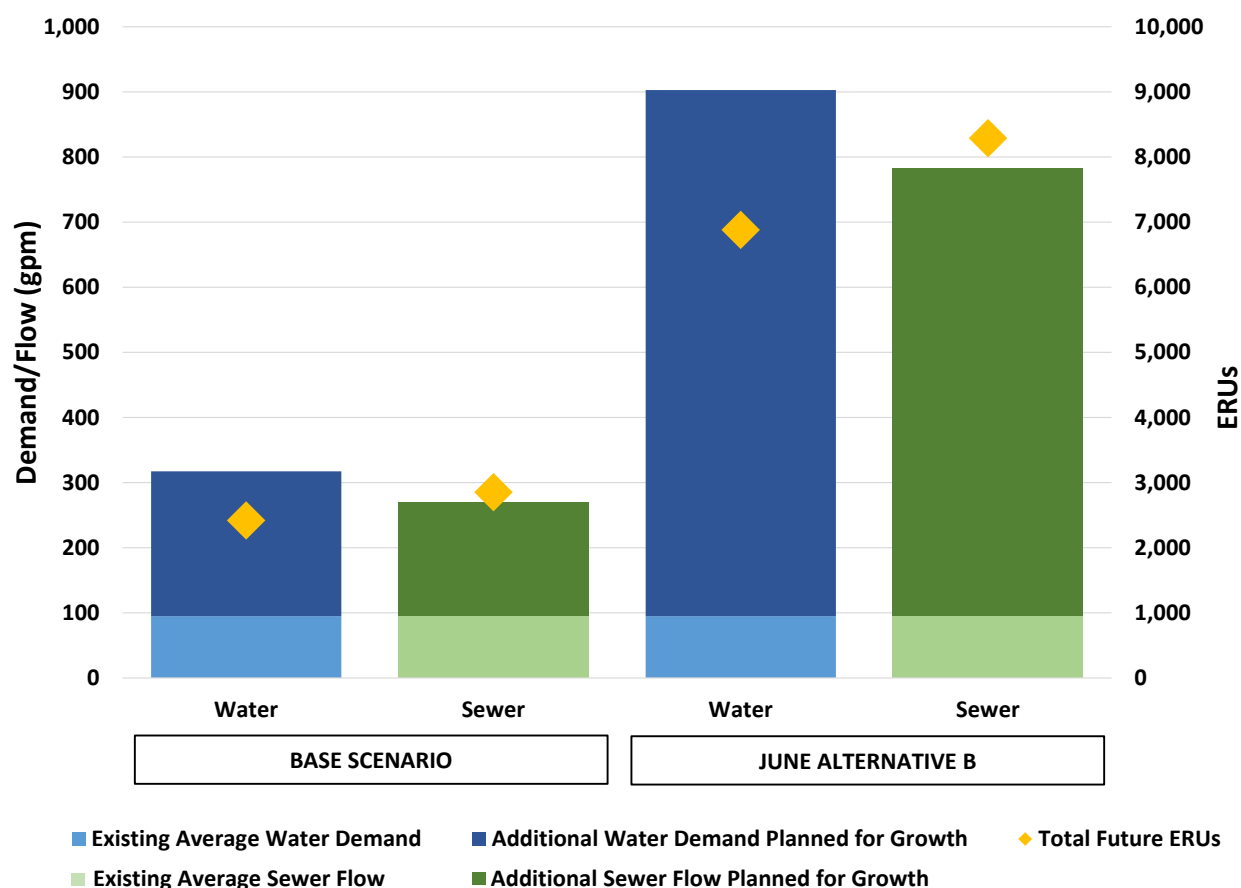
June Alternative B Growth in Demand and Flow Above Existing

Utility	Households	Population	Employment	Residential Demand/Flow (gpm)	Commercial Demand/Flow (gpm)	Total Additional Demand/Flow (gpm)
Water				455	353	808
Sewer	6,243	9,926	17,763	441	247	688

The June Alternative B water demands in **Table 1** may be added to the existing water system demands to estimate the total projected water demand in the Station Area. The total projected water demand for the Base Scenario and June Alternative B is shown graphically in **Chart 2**.

Chart 2

Station Area Projected Water Demand/Sewer Flows and ERUs



Fire Flow Demands

In addition to domestic water demands, the water system infrastructure must also have sufficient capacity to convey fire flow demands. Planning-level fire flow requirements are designated in the hydraulic model based on the different land use categories to provide a target level of service for planning and sizing future water facilities. Actual existing or future fire flow requirements do not necessarily equate to the planning-level fire flow requirements at all buildings, since this is typically based on actual building size, construction type, and fire suppression systems provided for the proposed development.

The existing planning-level fire flow requirements as stated in the WSP and utilized in previous planning studies are shown in **Table 2**. These fire flow requirements also were utilized for the Base Scenario analyses and are allocated based on the land use presented in WSP Figure 3-1. Planning-level fire flow requirements for the June Alternative B were updated based on the rezoned parcel GIS data provided by Mithun and input from the City's Fire Marshal and are shown in **Table 2**. The increased fire flow rates and duration provide consideration for multiple fires, fire spreading outside the sprinkler design area, exposure fires, or fires in buildings under construction (without the benefit of a fire sprinkler system) in the planning for water system capacity. The zoning for June Alternative B that these fire flow rates are based on is presented in **Attachment 1**.

Table 2
Planning-Level Fire Flow Requirements

Land Use Type	2015 Water System Plan		SAP June Alternative B	
	Fire Flow Requirement (gpm)	Duration (hrs)	Fire Flow Requirement (gpm)	Duration (hrs)
Medium Density Residential	1,500 - 2,000	2	1,500 - 2,000	2 - 3
High Density Residential	2,000 - 2,500	2	2,500 - 3,500	3 - 4
Office/Multi-Family Residential	2,500 - 3,500	2 - 3	2,500 - 3,500	3 - 4
Office	2,500 - 3,500	2 - 3	2,500 - 3,500	3 - 4

Sewer Demands

Similar to the water demands, sanitary sewer flows for the residential and employment growth associated with the Station Area were developed to represent future conditions under June Alternative B. The commercial flow per employee and residential flow per person values were calculated using the same assumptions and methodologies used for the water demands, described in the **Water Demands** section, but for water consumption instead of water demand so that DSL is not included in the sewer flows. This resulted in a sanitary sewer flow rate of approximately 20 gallons per employee per day and 64 gallons per residential person per day. Applying these factors to the growth associated with the Station Area projections yielded a total of approximately 688 gpm of growth between the existing system scenario and June Alternative B, as shown in **Table 1**.

The total projected sanitary sewer flow for the Base Scenario and June Alternative B are shown graphically in **Chart 2**.

Equivalent Residential Units

Water and sewer utility capacity is often expressed in terms of Equivalent Residential Units (ERUs) for demand forecasting and planning purposes. One average day of consumption per ERU is equivalent to the amount of water consumed by a single-family residence on an average day. The demand of a multi-family unit is typically less than a single-family residence; therefore, the number of ERUs represented by a single multi-family unit is typically less than 1 ERU. Conversely, the number of ERUs represented by a commercial connection is typically much larger than 1 ERU. The City's WSP estimated the water demand per ERU at 189 gallons per day (gpd), which was used to estimate the projected ERUs for this project. The City's GSP estimated the domestic sewer annual average flow per ERU to be 136 gpd. The total projected ERUs estimated to be served under the Base Scenario and June Alternative B are shown graphically in **Chart 2**. The estimated future water system ERU capacity analyses are presented later in this technical memorandum and are based on ERU capacity analyses performed in the 2015 WSP. The future sewer system capacity was not evaluated based on ERUs in the 2018 GSP; therefore, future sewer ERU capacity for the SAP was not evaluated in this technical memorandum.

Hydraulic Analyses

Hydraulic analyses were performed to evaluate whether the City's water distribution system and sewer collection system have adequate capacity to serve the proposed growth under the rezoning alternatives, and to identify capital improvements beyond those identified in the WSP and GSP that are needed to serve the future Station Area.

The analyses also identified which projects were prompted by growth in various service areas. The service areas, defined by BERK Consulting, Inc., (BERK) include: the parcels nearest the I-405 interchange in the northeast SAP quadrant (currently Costco site); the parcels nearest the I-405 interchange in the southeast SAP quadrant (currently Lee Johnson car dealership site); parcels in the northeast quadrant excluding the Costco site; parcels in the southeast quadrant excluding the Lee Johnson site; parcels in the northwest quadrant; and parcels in the southwest quadrant. The purpose of this task was to gain a better understanding of how the water and sewer system improvements could be phased into the Station Area development, and how these improvements could be linked to other infrastructure projects to optimize construction costs and schedules.

The hydraulic model scenarios that were evaluated for the water and sewer systems were established to identify the following:

- CIP improvements that are needed to upgrade the existing system to support intensive development nearest the I-405 interchange in the southeast SAP quadrant with redevelopment of the Lee Johnson site.

- CIP improvements that are needed to upgrade the existing system to support intensive development nearest to the I-405 interchange, including redevelopment of the Costco site with redevelopment of the Lee Johnson site.
- CIP improvements required to support all growth under the Base Scenario and allocate those improvements to the service area they support.
- CIP improvements required above and beyond the Base Scenario CIP to support the additional growth planned for June Alternative B and allocate those improvements to the service area they support.
- For each CIP project, if it is needed to resolve existing maintenance concerns or future development capacity needs would be triggered by the construction of the BRT Station.

Water System Model Description and Criteria

The City's WaterCAD hydraulic model, which was recently updated as a part of the Water System Model Calibration and Analyses project, was utilized as the basis for the Station Area analyses. The City's hydraulic model has been updated to include recently constructed water mains, updated existing water main property data, current facility setpoints, current demand data, and updated elevation data. The scenarios in the hydraulic model used for the Station Area analyses were developed using the existing system scenario, and then applying the growth between the existing system and future projections on a parcel-by-parcel basis in the Station Area. The demands in the remainder of the system were scaled up to year 2035 demands presented in the City's WSP. Peaking factors identified in the WSP were used to scale up the projected demands in the model from the average day demands shown in **Chart 2** to maximum day demands (MDD) and peak hour demands (PHD) used for the model analyses.

The hydraulic model was run with the projected demands under steady state conditions. Pipe velocities and service pressures in and near the Station Area were evaluated to confirm that the minimum service pressure of 30 pounds per square inch (psi) could be maintained under PHD conditions. Fire flow analyses were conducted based on a minimum residual pressure of 20 psi in the water main adjacent to the hydrant, water velocities in the distribution system of 8 feet per second (fps) or less, and the system operating under a MDD scenario.

A summary of the operational conditions used in the hydraulic model to perform the water system analyses is shown in **Table 3**.

Table 3

Water System Hydraulic Analyses Operational Conditions

Description	Fire Flow Analyses
Demands	Buildout MDD + SAP Growth MDD
Supply Station S1 Head (feet)	544.1
Supply Station S2 Head (feet)	530.6
Supply Station S3 Head (feet)	533.1
North Reservoir HGL (feet)	420.3
South Reservoir HGL (feet)	531.3
650 Zone BPS Status	Three Large Pumps Operating
545 Zone BPS Status	Off

HGL = Hydraulic grade line

Sewer System Model Description and Criteria

The City's existing SewerCAD hydraulic model was utilized as the basis for the Station Area sewer analyses. Sanitary sewer flows associated with the Station Area growth were applied to the specific parcels to which they referred to using SewerCAD's LoadBuilder tool. For areas outside of the Station Area, sanitary sewer flows for the Eastside Interceptor and Kirkland sewer drainage basins were adjusted to represent the future sanitary sewer loadings for the planning horizon in the City's GSP through year 2035.

The SewerCAD model also was updated to address parcels that have existing septic sewer service. Sanitary sewer flows associated with parcels that are currently on septic sewer systems were added to the Station Area scenario, assuming that these parcels would transition to being served by the City's sanitary sewer system by the end of the planning period. The sanitary sewer flows were then multiplied by the peaking factor associated with the major sewer drainage basin in which the growth was located to develop peak hour flows (PHFs). **Table 4** shows the City's major sewer drainage basins and the peaking factors associated with them.

Table 4
Sewer System Peaking Factors

Major Sewer Drainage Basin Name	Domestic PHF Peaking Factor (PHF/AAF)
116th Avenue NE	4.19
Eastside Interceptor	2.67
Juanita	3.40
Juanita Bay	4.04
Kirkland	3.02
NE 124th Street	4.07
Lake Plaza	3.51
Rose Point	4.09
South Bay	4.29
Trend	4.25
Watershed Park	4.24
Waverly Park	4.14
Yarrow Bay	3.48
Yarrow Bay II	4.30

Projected 2035 inflow and infiltration (I/I) rates from the City's GSP for a 20-year storm peak hour event were used for the June Alternative B analyses. This assumed existing I/I rates and an additional 2,000 gallons per acre per day (gpad) for areas currently unsewered that could be potentially sewerred. The sewer model was run with the projected PHFs. Pipe capacities in and downstream of the Station Area were evaluated to confirm that they flow below 80 percent of the pipe's full flow capacity with existing and projected PHFs.

Hydraulic Analyses Results

For both the City's water and sewer systems, it was found that additional improvements above those identified in previous planning studies for the Base Scenario are required to support the growth projected under June Alternative B. This section of the technical memorandum describes the required improvements for each modelled scenario. **Figure 2** shows all improvements required for the City's water system, including the Base Scenario CIP improvements and the improvements identified above and beyond the Base Scenario CIP to support the growth under June Alternative B. **Figure 3** shows all improvements required for the City's sewer system, including the Base Scenario CIP improvements and the improvements identified above and beyond the Base Scenario CIP to support the growth under June Alternative B.

Water Modeling Results

Table 5 lists the June Alternative B improvements required for the hydraulic model scenario of the existing water system with only the growth of either the Costco or the Lee Johnson sites.

The Service Area column of **Table 5** refers to the development that the improvement is prompted by, not necessarily where the project is physically located. For example, CIP 137 is needed to support the Costco development, but the project is in the right-of-way (ROW) and not on the Costco site. Project 180 in **Table 5** is required for both the Lee Johnson and Costco developments, meaning that if either project were to develop, this project would need to be completed to support that development.

Table 5
Proposed Water CIP for Potential Redevelopment of the Lee Johnson and Costco Sites

Existing CIP Number	Improvement Trigger	City vs. Developer Funded	Location			Diameter (in)		Length (ft)	Service Area ¹	Total Project Cost	City Cost	Developer Funded Cost
			In	From	To	Ex.	Prop.					
Existing System with Redevelopment at the Lee Johnson Site												
180	Capacity	Developer	Taco Time NW, 12005 NE 85th St	120th Ave NE	dead end	8	8	5	Lee Johnson	\$301,000		\$301,000
						8	16	184				
			NE 80th St	120th Ave NE	118th Ct NE	12	12	505				
						12	20	25				
184	Capacity	Developer	~118th Ave NE	NE 80th St	120th Ave NE	8	12	1,451	Lee Johnson	\$766,000		\$766,000
185	Capacity	Developer	118th Ct NE	NE 80th St	dead end	2	12	30	Lee Johnson	\$214,000		\$214,000
						8	12	1,206				
Existing System with Redevelopment at the Lee Johnson and Costco Sites												
134	Capacity	Developer	NE 92nd St	124th Ave NE	dead end	8	12	1,439	Costco	\$760,000		\$760,000
136	Capacity	Developer	Slater Ave/Costco	120th Ave NE	120th Ave NE	8	12	2,503	Costco	\$1,213,000		\$1,213,000
						8	16	123				
137	Capacity	Developer	76 Gas Station, 11848 NE 85th St	120th Ave NE	dead end	8	20	507	Costco	\$365,000		\$365,000
						120th Ave NE	NE 85th St	76 Gas Station				
536	Capacity	Developer	~120th Ave NE	12020 NE 85th St PRV	Fire lane south of Costco	12	20	91	Costco	\$47,000		\$47,000
537	Capacity	Developer	Costco, 8629 120th Ave NE	120th Ave NE	-	12	16	838	Costco	\$496,000		\$496,000
Total										\$4,162,000	\$0	\$4,162,000

1 = The quadrants described herein do not necessarily represent the geographical location of the project, but instead represent the quadrant driving the improvement.

Table 6 shows all required water CIPs to support the Base Scenario. As with **Table 5**, **Table 6** indicates the service area that drives the required improvement. The Improvement Trigger column in the table indicates whether the identified improvement is required to resolve an existing maintenance concern, accommodate future development capacity needs, or would be triggered by the construction of the BRT Station. It is recommended that any project crossing I-405 be constructed concurrently with the BRT Station to take advantage of the major construction already planned. The improvement triggers are used in the cost estimates to allocate the project for funding either by the City or by a developer.

Table 6
Proposed Water CIP for the Base Scenario

Existing CIP Number	Improvement Trigger	City vs. Developer Funded	Location			Diameter (in)		Length (ft)	Service Area ¹	Total Project Cost	City Cost	Developer Funded Cost
			In	From	To	Ex.	Prop.					
WM2	BRT	City	405	NE 85th St	~NE 87th St	24	24	2110	-	\$6,510,000	\$6,510,000	
97-R	Capacity	Developer	~I-405 Off-ramp	~NE 87th St	NE 85th St	8	24	459	NW Quadrant/SW Quadrant	\$332,000		\$332,000
133	Capacity	Developer	~124th Ave NE	NE 85th St	Honda of Kirkland, 12420 NE 85th St	6	16	34	NE Quadrant	\$416,000		\$416,000
						8	16	668				
134	Capacity	Developer	NE 92nd St	124th Ave NE	dead end	8	12	1,439	Costco	\$760,000		\$760,000
135-R	Capacity	Developer	122nd Ave NE	NE 85th St	NE 90th St	3	16	10	NE Quadrant	\$1,893,000		\$1,893,000
						4	16	45				
						6	16	19				
						8	12	559				
						8	16	2,628				
136	Capacity	Developer	Slater Ave/Costco	120th Ave NE	120th Ave NE	8	12	2,503	Costco	\$1,213,000		\$1,213,000
						8	16	123				
137	Capacity	Developer	76 Gas Station, 11848 NE 85th St	120th Ave NE	dead end	8	16	507	Costco/NE Quadrant	\$365,000		\$365,000
			120th Ave NE	NE 85th St	76 Gas Station	12	16	201				
146	Capacity	Developer	McLeod Auto Body, 1015 7th Ave #220	NE 87th St	dead end	8	16	365	NW Quadrant	\$216,000		\$216,000
150-R	Capacity	Developer	6th St, Central Ave, and 6th Ave	15th Ave	7th Ave	8	8	6	NW Quadrant	\$1,556,000		\$1,556,000
						8	12	1,432				
						8	16	1,349				
153	Capacity	Developer	~8th St	7th Ave	12th Ave	4	16	130	NW Quadrant	\$1,355,000		\$1,355,000
						6	8	34				
						8	16	2,134				
						6	12	1,448				
169	Capacity	Developer	7th Ave	3rd St	8th St	6	16	6	NW Quadrant	\$1,529,000		\$1,529,000
						8	12	201				
						8	16	562				
						8	20	478				
						8	12	255				
170	Capacity/Maintenance	City & Developer	6th St	7th Ave	Central Way	8	16	186	SW Quadrant	\$346,000	\$101,000	\$245,000
						16	16	171				
						10	24	0				
174	Capacity	Developer	NE 85th St	~116th Ave NE	~114th Ave NE	16	24	287	NW Quadrant/SW Quadrant	\$207,000		\$207,000
175	Capacity	Developer	128th Ave NE/NE 83rd Ct/Rose Park Condominium	NE 85th St	126th Ave NE	8	12	1,663				
176	Capacity	Developer	126th Ave NE	NE 85th St	NE 80th St	6	8	896	NE Quadrant/SE Quadrant	\$735,000		\$735,000
						6	12	327				
						8	12	227				
						8	16	20				
177-R	Capacity	Developer	Safeway parcel, 12519 NE 85th St	124th Ave NE	126th Ave NE	6	12	55	SE Quadrant	\$608,000		\$608,000
						6	16	21				
						8	12	1,073				
178	Capacity	Developer	124th Ave NE	NE 85th St	NE 80th St	8	12	1,493	SE Quadrant	\$788,000		\$788,000
179	Capacity	Developer	122nd Ave NE	NE 85th St	NE 80th St	6	12	1,039	SE Quadrant	\$1,006,000		\$1,006,000
						8	12	403				
						8	16	413				
180	Capacity/Maintenance	City & Developer	Taco Time NW, 12005 NE 85th St	120th Ave NE	dead end	8	8	5	Costco/Lee Johnson/NE Quadrant/SE Quadrant	\$301,000	\$267,000	\$34,000
						8	16	184				
						12	12	412				
						12	20	25				
184	Capacity	Developer	~118th Ave NE	NE 80th St	120th Ave NE	8	12	1,451	Lee Johnson	\$766,000		\$766,000
185	Capacity	Developer	118th Ct NE	NE 80th St	dead end	2	12	30	Lee Johnson	\$214,000		\$214,000
						8	12	435				
						6	16	428				
						8	12	522				
						8	16	714				
						10	16	285				
186	Capacity	Developer	114th Ave NE, Kikrland Way, Ohde Ave, Slater St S	NE 85th St	Kirkland Ave	12	16	815	SW Quadrant	\$1,859,000		\$1,859,000
						12	16	815				
						12	20	218				
						16	20	164				
						6	12	132				
187	Capacity	Developer	4th Ave, 5th Ave, 10th St, 3rd Ave, 9th St, 2nd Ave, 9th Ln	Kikrland Way	6th St	8	12	5,675	SW Quadrant	\$3,156,000		\$3,156,000
						8	16	155				
536	Capacity	Developer	~120th Ave NE	12020 NE 85th St PRV	Fire lane south of Costco	12	16	91	Costco	\$47,000		\$47,000
537	Capacity	Developer	Costco, 8629 120th Ave NE	120th Ave NE	-	12	16	838	Costco	\$496,000		\$496,000
Total										\$27,552,000	\$6,878,000	\$20,674,000

1 = The quadrants described herein do not necessarily represent the geographical location of the project, but instead represent the quadrant driving the improvement.

Table 7 shows additional water system improvements above and beyond the Base Scenario CIP that are needed to support the projected growth under June Alternative B. **Table 7** lists CIP numbers already shown in **Tables 5** and **6** because the improvements identified in **Table 7** have been expanded from the Base Scenario CIP to support the additional June Alternative B growth. Therefore, the costs shown in **Table 7** are only the costs associated with upsizing of the water main above the size requirement for the Base Scenario. The CIP projects listed in **Tables 6** and **7** may be combined to identify the full scope of improvements to the existing water system required to support the June Alternative B development through the planning horizon.

Table 7
Proposed Additional Water CIP for June Alternative B

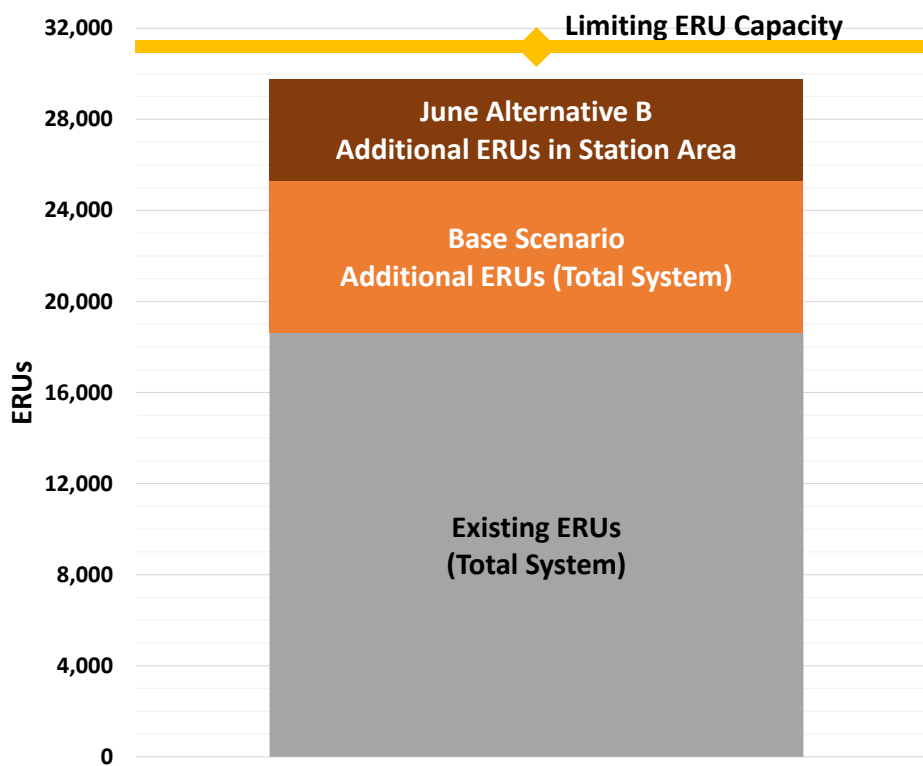
Existing CIP Number ¹	Improvement Trigger	City vs. Developer Funded	Location			Diameter (in)		Length (ft)	Service Area ²	Total Project Cost for Upsizing	Total City Cost for Upsizing	Total Developer Funded Cost for Upsizing
			In	From	To	Ex.	Prop.					
136	Capacity	Developer	Slater Ave/Costco	120th Ave NE	120th Ave NE	8	16	477	Costco	\$32,000		\$32,000
137	Capacity	Developer	76 Gas Station, 11848 NE 85th St	120th Ave NE	dead end	8	20	507	Costco/NE Quadrant	\$60,000		\$60,000
			120th Ave NE	NE 85th St	76 Gas Station	12	20	201				
180	Capacity	Developer	NE 80th St	120th Ave NE	118th Ct NE	8	12	93	Costco/Lee Johnson/NE Quadrant/SE Quadrant	\$50,000		\$50,000
185	Capacity	Developer	118th Ct NE	NE 80th St	dead end	8	12	771	Lee Johnson	\$408,000		\$408,000
536	Capacity	Developer	~120th Ave NE	12020 NE 85th St PRV	Fire lane south of Costco	12	20	91	Costco	\$9,000		\$9,000
Total										\$559,000	\$0	\$559,000

1 = These projects were altered from the Base Scenario CIP to support additional growth planned for June Alternative B.
2 = The quadrants described herein do not necessarily represent the geographical location of the project, but instead represent the quadrant driving the improvement.

Water System ERU Capacity Analysis

Additional analyses were performed to evaluate the water system capacity in terms of ERUs and confirm that the water system supply, storage, and transmission infrastructure has capacity to serve the additional ERUs shown in **Chart 2**. The City's WSP Table 7-13 identified that the existing water system has a capacity of 31,170 ERUs, which is limited by the existing storage capacity of the City's reservoirs. The number of ERUs that is anticipated to be served by the water system through the planning horizon for the Base Scenario is 25,315 ERUs in 2025, as shown in WSP Table 4-12. When added to the ERU projections for the Station Area under June Alternative B, the existing water system is estimated to have an excess capacity of 1,394 ERUs through the planning horizon, as shown in **Chart 3**.

Chart 3
Water System ERU Capacity



If June Alternative B is the selected growth alternative, the City should begin planning for where future storage could be located because there are very few options for siting additional storage in the City. Considerations may include building new, larger tanks on existing reservoir sites. Any proposed improvements on existing reservoir sites should consider potential conflicts and opportunities to accommodate these future storage needs.

Sewer Modeling Results

Table 8 lists the June Alternative B improvements required for the hydraulic model scenario of the existing sewer system with only the growth of either the Costco or the Lee Johnson sites.

Table 8 has two sections of improvements: the first section describes improvements that were identified only for the existing system with the additional flows due to the Lee Johnson development; the second section describes the required improvements with both the Costco and Lee Johnson developments. To clarify, the improvements associated with the first section in **Table 8** are included in the second section of **Table 8**. The existing pipe in the SAP-6 alignment, which is located along the northerly property line of the Lee Johnson site, is very near capacity with the flows associated with the Lee Johnson and Costco developments added to the existing system flows. If any other development projects were to occur in the near term, or if the flow assumptions for the Lee Johnson or Costco developments change, it is likely to trigger the SAP-6 project.

SAP-8 is identified to increase sewer capacity in NE 85th Street, crossing the I-405 corridor. It is envisioned to connect the existing sewer system on NE 90th Street near the Costco site, west across I-405 to the existing pipe in NE 87th Street, and west of NE 116th Avenue NE. These improvements are recommended to be coordinated with the design and construction schedule for the BRT Station. A feasibility analysis should be performed to confirm the constructability of the proposed improvements and to compare the cost/benefit of other potential alternative capacity improvements. This project is assumed to be developer-funded as it adds necessary capacity to serve redevelopment; however, if redevelopment does not occur before the BRT Station is constructed, the City may need to fund and construct the project and determine the appropriate mechanism to recover the cost from redevelopment when it occurs.

Table 8
Proposed Sewer CIP for Potential Redevelopment of Lee Johnson and Costco Sites

SAP Project Number	Existing CIP Number	Improvement Trigger	City vs. Developer Funded	Location			Diameter (in)		Length (ft)	Service Area ¹	Total Project Cost	City Cost	Developer Funded Cost
				In	From	To	Ex.	Prop.					
Existing System with Redevelopment at the Lee Johnson Site													
Portion of SAP-7	-	Capacity	Developer	120th Ave NE	MH No. 1877	NE 90th St	8	12	393	Lee Johnson	\$418,000	-	\$418,000
Existing System with Redevelopment at the Lee Johnson and Costco Sites ²													
Portion of SAP-7 ³	-	Capacity	Developer	120th Ave NE	MH No. 1879	NE 90th St	8	12	865	Lee Johnson/Costco	\$920,000	-	\$920,000
SAP-8	-	Capacity/BRT	Developer	I-405 and NE 87th St	Costco (NE 90th St/Slater Ave)	MH No. 2322	-	18	1821	Lee Johnson/Costco	\$5,744,000	-	\$5,744,000
SAP-9	172	Capacity & Maintenance	Developer & City	NE 87th St	King County - East Side Interceptor	MH No. 2322	8	18	736	Lee Johnson/Costco	\$817,000	\$709,000	\$109,000
Total											\$7,481,000	\$709,000	\$6,773,000

1 = The quadrants described herein do not necessarily represent the geographical location of the project, but instead represent the quadrant driving the improvement.
2 = For project SAP-6, the existing pipe is very near capacity under this scenario; however, a capacity deficiency is only triggered during the June Alternative B scenario.
3 = The portion of SAP-7 that is described in the "Existing System with Redevelopment at the Lee Johnson Site" section is included in this project.

Table 9 shows all required CIPs to support the Base Scenario. **Table 9** has two sections: section one includes the projects that are within the Station Area boundary (shown in **Figure 3**); and section two includes projects downstream of the Station Area that are required to increase the capacity of the City's sewer mains to support the City's projected flows, including existing flows from the Station Area.

The Improvement Trigger column in the table indicates whether the identified improvement is required to resolve an existing maintenance concern, accommodate future development capacity needs, or would be triggered by the construction of the BRT Station. It is recommended that any project crossing I-405 be constructed concurrently with the BRT Station to take advantage of the major construction already planned. The improvement triggers are used in the cost estimates to allocate the project for funding either by the City or by a developer.

Table 9
Proposed Sewer CIP for the Base Scenario

Existing CIP Number	Improvement Trigger	City vs. Developer Funded	Location		Diameter (in)		Length (ft)	Service Area ¹	Total Project Cost	City Cost	Developer Funded Cost
			In	From To	Ex.	Prop.					
102	Maintenance	City	6th St	11th Ave	12th Ave	8	8	322	NW Quadrant	\$335,000	\$335,000
114	Maintenance	City	11th Ave	6th St	~310' W of 8th St	6	8	650	NW Quadrant	\$676,000	\$676,000
115	Maintenance	City	10th Ave	~175' E of 5th St	~330' W of 8th St	6	8	1,025	NW Quadrant	\$1,066,000	\$1,066,000
117	Capacity + Maintenance	City	6th St	Central Way	10th Ave	8	8	1,350	NW Quadrant	\$1,404,000	\$1,404,000
118	Maintenance	City	9th Ave	6th St	~390' E of 6th St	6	8	400	NW Quadrant	\$416,000	\$416,000
119	Maintenance	City	8th St	7th Ave	11th Ave	8	8	1,300	NW Quadrant	\$1,352,000	\$1,352,000
120	Maintenance	City	9th Ave	~4,555' E of 6th St	~275' E of 8th St	8, 6	8	775	NW Quadrant	\$806,000	\$806,000
121	Maintenance	City	112th Ave NE	NE 87th St	~135' N of NE 95th St	12, 8	12, 8	2,069	NW Quadrant	\$1,511,000	\$1,511,000
123	Maintenance	City	NE 95th St	MH - 1543	~130' W of 116th Ave NE	8	8	863	NW Quadrant	\$897,000	\$897,000
124	Maintenance	City	116th Ave NE	~90' S of NE 88th St	NE 95th St	8	8	1,887	NW Quadrant	\$1,962,000	\$1,962,000
125	Maintenance	City	NE 94th St	112th Ave NE	~195' S of NE 95th St	8	8	850	NW Quadrant	\$884,000	\$884,000
126	Maintenance	City	114th Ave NE	NE 94th St	NE 94th St	8	8	625	NW Quadrant	\$650,000	
			NE 94th St	114th Ave NE	~290' W of 116th Ave NE						
			~290' W of 116th Ave NE	NE 94th St	~NE 94th Pl					\$650,000	
127	Maintenance	City	NE 92nd St	112th Ave NE	~140' W of 116th Ave NE	8	8	1,000	NW Quadrant	\$1,040,000	\$1,040,000
128	Maintenance	City	NE 91st St	112th Ave NE	~180' E of 114th Ave NE	8	8	750	NW Quadrant	\$780,000	\$780,000
129	Maintenance	City	NE 91st St	116th Ave NE	~265' W of 116th Ave NE	8	8	300	NW Quadrant	\$312,000	\$312,000
130	Maintenance	City	NE 90th St	112th Ave NE	~180' W of 116th Ave NE	8	8	975	NW Quadrant	\$1,014,000	\$1,014,000
131	Maintenance	City	NE 90th St	116th Ave NE	Slater Ave NE	8	8	1,500	NW Quadrant	\$1,559,000	
			Slater Ave NE	NE 90th St	~117th Ave NE						
			~117th Ave NE	Slater Ave NE	~265' S of NE 95th St					\$1,559,000	
132	Maintenance	City	NE 92nd St	~117th Ave NE	~NE 90th St	8	8	375	NW Quadrant	\$390,000	\$390,000
133	Capacity	City	~Slater Ave NE	~NE 92nd St	~NE 91st St	15	18	325	NE Quadrant/SE Quadrant	\$361,000	\$361,000
134	Capacity	City	NE 90th St	~245' W of 120th Ave NE	120th Ave NE	15	24	300	NE Quadrant/SE Quadrant	\$341,000	\$341,000
159	Maintenance	City	8th Ave	6th St	~360' E of 6th St	6	8	375	NW Quadrant	\$390,000	\$390,000
160	Maintenance	City	7th Ave	6th St	~8th St	8, 6	8	770	NW Quadrant	\$801,000	\$801,000
166	Maintenance	City	6th St	~5th Ave W	1st Ave S	12, 6	12, 8	1,675	NW Quadrant/SW Quadrant	\$1,774,000	\$1,774,000
167	Maintenance	City	6th Ave	6th St	7th Ave	8	8	850	NW Quadrant	\$884,000	\$884,000
168	Maintenance	City	Kirkland Way	6th St	~9th Ln	8, 6	8, 6	1,025	SW Quadrant	\$1,035,000	\$1,035,000
169	Maintenance	City	Residential Easement	~3rd Ave	~55' S of 3rd Ave	8	8	75	SW Quadrant	\$78,000	\$78,000
170	Maintenance	City	NE 88th St	112th Ave NE	~113th Ln NE	8	8	450	NW Quadrant	\$468,000	\$468,000

1 = The quadrants described herein do not necessarily represent the geographical location of the project, but instead represent the quadrant driving the improvement.

Table 9
Proposed Sewer CIP for the Base Scenario (Continued)

Existing CIP Number	Improvement Trigger	City vs. Developer Funded	Location			Diameter (in)		Length (ft)	Service Area ¹	Total Project Cost	City Cost	Developer Funded Cost
			In	From	To	Ex.	Prop.					
171	Maintenance	City	114th Ave NE NE 88th St	NE 87th St 114th Ave NE	NE 88th St 116th Ave NE	8	8	900	NW Quadrant	\$936,000	\$936,000	
172	Maintenance	City	NE 87th St	112th Ave NE	~95 W of 116th Ave NE	8, 6	8, 6	1,025	NW Quadrant	\$1,043,000	\$1,043,000	
173	Maintenance	City	114th Ave NE NE 86th St	NE 87th St 114th Ave NE	NE 86th St NE 86th St cul-de-sac	8	8	600	NW Quadrant	\$624,000	\$624,000	
174	Maintenance	City	~NE 85th St	Cross Kirkland Corridor	~80' E of Cross Kirkland Corridor	8	8	100	SW Quadrant	\$104,000	\$104,000	
175	Maintenance	City	~3rd Ave	Cross Kirkland Corridor	~80' E of Cross Kirkland Corridor	8	8	100	SW Quadrant	\$104,000	\$104,000	
176	Maintenance	City	Slater St	Kirkland Ave	Ohde Ave	6	8	675	SW Quadrant	\$702,000	\$702,000	
180	Maintenance	City	128th Ave NE	NE 84th St	NE 83rd St	8	8	354	SW Quadrant	\$368,000	\$368,000	
196	Maintenance	City	Kirkland Ave	6th St	Cross Kirkland Corridor	12, 10, 8	12, 8	1,275	SW Quadrant	\$1,349,000	\$1,349,000	
197	Maintenance	City	6th St S	Kirkland Ave	3rd Ave S	12	12	775	SW Quadrant	\$824,000	\$824,000	
198	Maintenance	City	~410' N of 5th Ave S	6th St S	8th St S	8	8	675	SW Quadrant	\$702,000	\$702,000	
199	Maintenance	City	6th St S	~410' N of 5th Ave S	5th Ave S	10, 8	12, 8	411	SW Quadrant	\$428,000	\$428,000	
200	Maintenance	City	5th Ave S 7th St S	6th St S 5th Ave S	7th St S ~8th Ave S	8	8	1,375	SW Quadrant	\$768,000	\$768,000	
201	Maintenance	City	8th St S	~3rd Ave S	~130' N of 9th Ave S	8	8	1,850	SW Quadrant	\$929,000	\$929,000	
202	Maintenance	City	10th St S	Kirkland Ave	~4th Ave S	8	8	1,025	SW Quadrant	\$1,066,000	\$1,066,000	
203	Maintenance	City	~340' S of Kirkland Ave	10th St S	~380' E of 10th St S	8, 6	8	400	SW Quadrant	\$416,000	\$416,000	
204	Maintenance	City	Slater St S North Ave 115th PI NE	Kirkland Ave Slater St S ~600' N of North Ave	North Ave 115th PI NE NE 75th St	8	8	1,950	SW Quadrant	\$2,027,000	\$2,027,000	
205	Maintenance	City	NE 80th St (Freeway Crossing)	116th Ave NE	~Kirkland Cemetery	12, 10, 8	12	1,700	SE Quadrant	\$1,807,000	\$1,807,000	
206	Maintenance	City	116th Ave NE	NE 80th St	NE 74th St	12, 8	12, 8	1,525	SE Quadrant	\$1,615,000	\$1,615,000	
207	Maintenance	City		Lake Washington High School		8	8	475	SE Quadrant	\$494,000	\$494,000	
208	Maintenance	City	~115' N of NE 75th St	116th Ave NE	118th Ave NE	8	8	475	SE Quadrant	\$494,000	\$494,000	
209	Maintenance	City	NE 75th St	116th Ave NE	~245' E of 118th Ave NE	8	8	1,600	SE Quadrant	\$1,663,000	\$1,663,000	
211	Maintenance	City	120th Ave NE	NE 75th St	~195' S of NE 73rd St	8	8	850	SE Quadrant	\$324,000	\$324,000	
215	Capacity + Maintenance	City	NE 80th St	123rd Ave NE	128th Ave NE	10, 8	12, 8	1,675	SE Quadrant	\$1,050,000	\$1,050,000	
SM7	Capacity + Maintenance	City	Kirkland Avenue Sewer Main Replacement (SS 0072)			8	12	1,550	SW Quadrant/SE Quadrant	\$1,648,000	\$1,648,000	
Outside of SAP Boundary												
22	Capacity	City	~NE 112th St	I-405	Slater Ave NE	18	24	225	Lee Johnson/Costco/NE Quadrant/SE Quadrant	\$256,000	\$256,000	
48	Capacity	Developer & City	Slater Ave NE	NE 106th St	NE 105th St	21	30	175	Lee Johnson/Costco/NE Quadrant/SE Quadrant	\$211,000	\$199,000	\$12,000
75	Capacity	City	Slater Ave NE	~NE 100th PI	NE 100th PI	21	24	225	Lee Johnson/Costco/NE Quadrant/SE Quadrant	\$256,000	\$256,000	
SM9	Capacity	City	3rd and Central Way Sanitary Sewer Crossing (SS 0082)			24	30	90	NW Quadrant/SW Quadrant	\$362,000	\$362,000	
Total										\$45,756,000	\$45,744,000	\$12,000

1 = The quadrants described herein do not necessarily represent the geographical location of the project, but instead represent the quadrant driving the improvement.

Table 10 shows additional sewer system improvements above and beyond the Base Scenario CIP that are needed to support the projected growth under June Alternative B. Most projects shown in **Table 10** are newly recommended improvements required to support the June Alternative B growth, so these projects have the total planning-level project cost listed. However, some projects, such as SAP-9, SAP-10, and SAP-11, include portions of previously identified CIP projects. The CIP projects listed in **Tables 9** and **10** may be combined to identify the full scope of improvements to the existing sewer system required to support the June Alternative B development through the planning horizon.

Table 10
Proposed Additional Sewer CIP for June Alternative B

SAP Project Number	Existing CIP Number	Improvement Trigger	City vs. Developer Funded	Location			Diameter (in)		Length (ft)	Service Area ¹	Total Project Cost	City Cost	Developer Funded Cost
				In	From	To	Ex.	Prop.					
SAP-1	-	Capacity	Developer	Walgreens (12405 NE 85th St)	NE 85th St	MH No. 2837	8	12	189	SE Quadrant	\$201,000	-	\$201,000
SAP-2	-	Capacity	Developer	NE 85th St	124th Ave NE	MH No. 2835	8	12	256	SE Quadrant/NE Quadrant	\$272,000	-	\$272,000
SAP-3	-	Capacity	Developer	124th Ave NE	NE 85th St	NE 90th St	8	12	1116	SE Quadrant/NE Quadrant	\$1,187,000	-	\$1,187,000
SAP-4	-	Capacity	Developer	NE 90th St	124th Ave NE	122nd Ave NE	8	12	581	Lee Johnson/Costco/NE Quadrant	\$618,000	-	\$618,000
	-	Capacity	Developer	NE 90th St	122nd Ave NE	120th Ave NE	8, 10	15	565		\$611,000	-	\$611,000
	-	Capacity	Developer	NE 90th St	120th Ave NE	I-405	15	21	567		\$635,000	-	\$635,000
SAP-5	-	Capacity	Developer	122nd Ave NE	NE 90th St	MH No. 2669	8	12	270	SE Quadrant/NE Quadrant	\$287,000	-	\$287,000
SAP-6	-	Capacity	Developer	Lee Johnson (11845 NE 85th St)	MH No. 2554	MH No. 2578	8	12	418	Lee Johnson/SE Quadrant	\$444,000	-	\$444,000
SAP-7	-	Capacity	Developer	120th Ave NE	~NE 85th St	NE 90th St	8	12	1263	Lee Johnson/SE Quadrant	\$1,343,000	-	\$1,343,000
SAP-8	-	Capacity/BRT	Developer	I-405 and NE 87th St	Costco (NE 90th St/Slater Ave)	MH No. 2322	-	18	1822	Lee Johnson/Costco/NEQuadrant	\$5,744,000	-	\$5,744,000
SAP-9	172	Capacity	Developer & City	NE 87th St	King County - East Side Interceptor	MH No. 2322	8	18	736	Lee Johnson/Costco/NEQuadrant/SEQuadrant	\$817,000	\$709,000	\$108,000
SAP-10	117	Capacity	Developer & City	6th St	7th Ave	Central Way	8	12	427	NW Quadrant	\$454,000	\$421,000	\$33,000
Total											\$12,613,000	\$1,130,000	\$11,483,000

1 = The quadrants described herein do not necessarily represent the geographical location of the project, but instead represent the quadrant driving the improvement.

Estimating Costs of Improvements

Planning-level conceptual project cost estimates were prepared to assist the City's SAP consultants with the fiscal impact analyses. The estimated total project costs for the identified CIP projects are shown in **Tables 5** through **10**.

Project costs for the proposed water and sewer system improvements were estimated based on costs of similar, recently constructed projects in the Puget Sound Area and are presented in 2021 dollars. The project cost estimates include the estimated construction cost of the improvement, sales tax of 10.2 percent, and a 20-percent contingency, as well as indirect costs estimated at 35 percent of the construction cost for engineering preliminary design, final design, and construction management services, permitting, legal, and administrative services, and an additional 15 percent to account for the in-house work for City staff to implement these projects. No costs are included for extraordinary circumstances, such as potential discovery and remediation of contaminated materials or actions that may be required to address the existence of cultural artifacts. The project costs presented in the CIP tables are capital cost estimates and do not represent life-cycle cost estimates.

Cost estimates for projects in the CIP are considered to be Class 5 estimates based on standards established by the American Association of Cost Engineers. Class 5 estimates are described as generally being prepared with very limited information and subsequently have wide accuracy ranges. The typical accuracy range for this cost estimate class is from -20 percent to -50 percent on the low side and from +30 percent to +100 percent on the high side. Class 5 estimates are prepared for any number of strategic business planning purposes including, but not limited to, market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, long-range capital planning, etc.

The final cost of the projects will depend on actual labor and material costs, actual site conditions, productivity, competitive market conditions, final project scope, final project schedule, and other variable factors. As a result, the final project costs likely will vary from those presented. Because of these factors, funding needs must be carefully reviewed prior to making specific financial decisions or establishing final budgets.

Water Main Unit Costs

The total project cost estimates for proposed water main projects were determined from the water main unit costs (i.e., cost per lineal foot [LF]) shown in **Table 11** and the proposed diameter and approximate length of each improvement.

Table 11
Water Main Unit Costs (Total Project Cost)

Water Main Diameter (inches)	Project Cost Per Foot Length (2021 \$/LF)
6	\$435
8	\$481
12	\$528
16	\$591
18	\$627
20	\$674
24	\$721

The unit costs for each water main size are based on estimates of all construction-related improvements, such as materials and labor for the water main installation, water services, fire hydrants, fittings, valves, connections to the existing system, trench restoration, asphalt surface restoration, and other work necessary for a complete installation.

Sewer Main Unit Costs

The total project cost estimates for proposed sewer main projects were determined from the sewer main unit costs (i.e., cost per LF) shown in **Table 12** and the proposed diameter and approximate length of each improvement.

Table 12
Sewer Main Unit Costs (Total Project Cost)

Sewer Main Diameter (inches)	Project Cost Per Foot Length (2021 \$/LF)
6	\$961
8	\$1,039
10	\$1,051
12	\$1,063
15	\$1,080
18	\$1,110
21	\$1,120
24	\$1,136
30	\$1,204
36	\$1,250

The unit costs for each sewer main size are based on estimates of all construction-related improvements, such as materials and labor for the sewer main installation, side-sewer

connections, manholes, connections to the existing system, trench restoration, asphalt surface restoration, and other work necessary for a complete installation.

Project Cost Allocation

Each CIP project cost was allocated to estimate the portion that may be funded by the City or by a developer. Projects that were noted in **Tables 5** through **10** with an improvement trigger that was maintenance related were identified as City-funded projects. An example of a project that is considered to be a maintenance concern is a sewer alignment that was flagged in the GSP as needing to be upsized from 6 inches to the minimum design standard of 8 inches.

Projects that were noted with a capacity-related improvement trigger were identified as developer-funded. If a CIP project was identified in the Base Scenario as a maintenance-related project and was required to be upsized to meet capacity requirements for June Alternative B, then only the cost for the upsizing was allocated for funding by a developer. The SAP-8 project that crosses I-405, for example, is assumed to be developer-funded as it adds necessary capacity to serve redevelopment; however, if redevelopment does not occur before the BRT Station is constructed, the City may need to fund and construct the project and determine the appropriate mechanism to recover the cost from redevelopment when it occurs. The funding cost allocations are identified in **Tables 5** through **10**.

Conclusion

The existing water distribution system and sewer collection system cannot support the projected growth and rezoned fire flow requirements associated with the Station Area development in their current states. Based on the analyses described in this technical memorandum, implementation of current water and sewer system CIPs identified in previous planning studies by RH2 will not fully support the growth and fire flow requirements associated with SAP June Alternative B. The improvements described in **Tables 7** and **10** should be completed along with those described in **Tables 6** and **9** for the Station Area to be fully supported by the City's water and sewer systems through the planning horizon under SAP June Alternative B.

Improvement SAP-8 and WM2 involve the crossing of I-405 and are recommended to be constructed in conjunction with the BRT Station. It is recommended that a study be performed to evaluate the feasibility and cost/benefits of constructing the SAP-8 alignment shown on **Figure 3** against other potential alternative capacity improvements. This project is assumed to be developer-funded as it adds necessary capacity to serve redevelopment; however, if redevelopment does not occur before the BRT Station is constructed, the City may need to fund and construct the project and determine the appropriate mechanism to recover the cost from redevelopment when it occurs.

Attachments

Attachment 1 – SAP June Alternative B Zoning

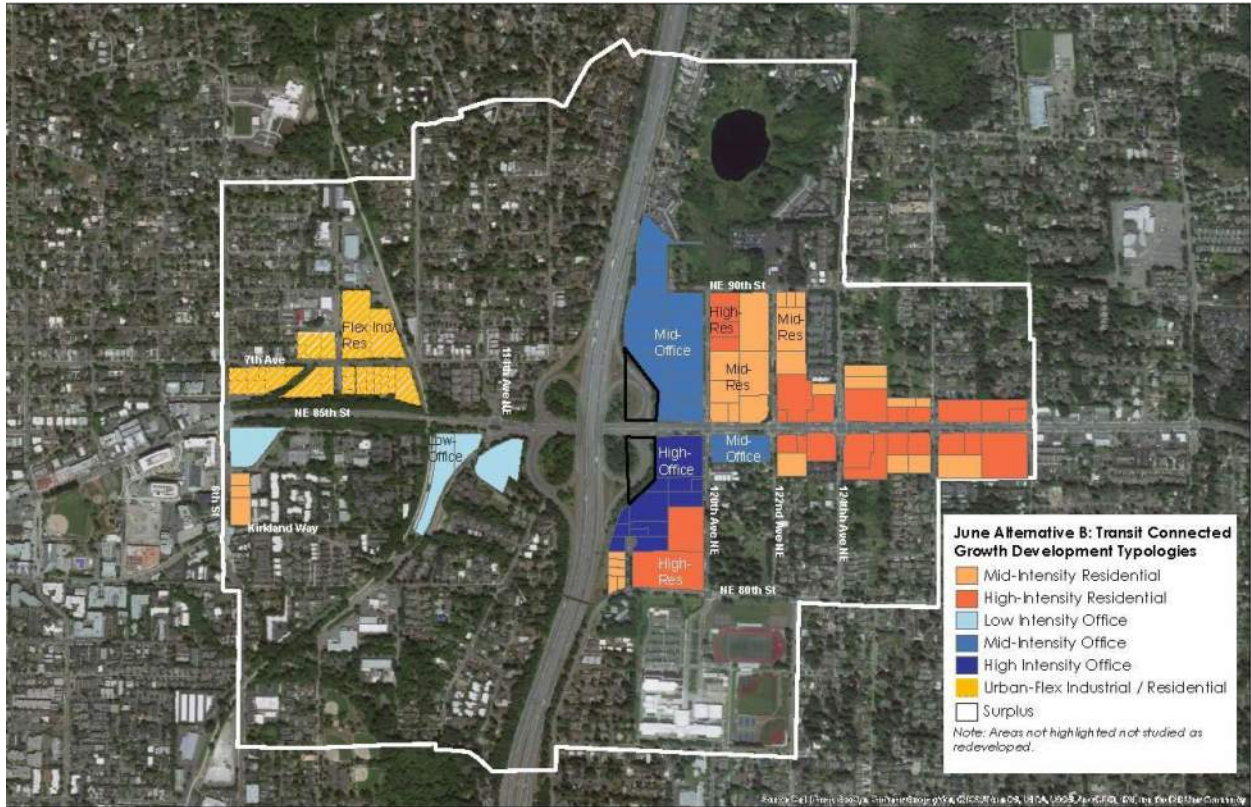
Figure 1 – Station Area

Figure 2 – Water System Proposed Improvements

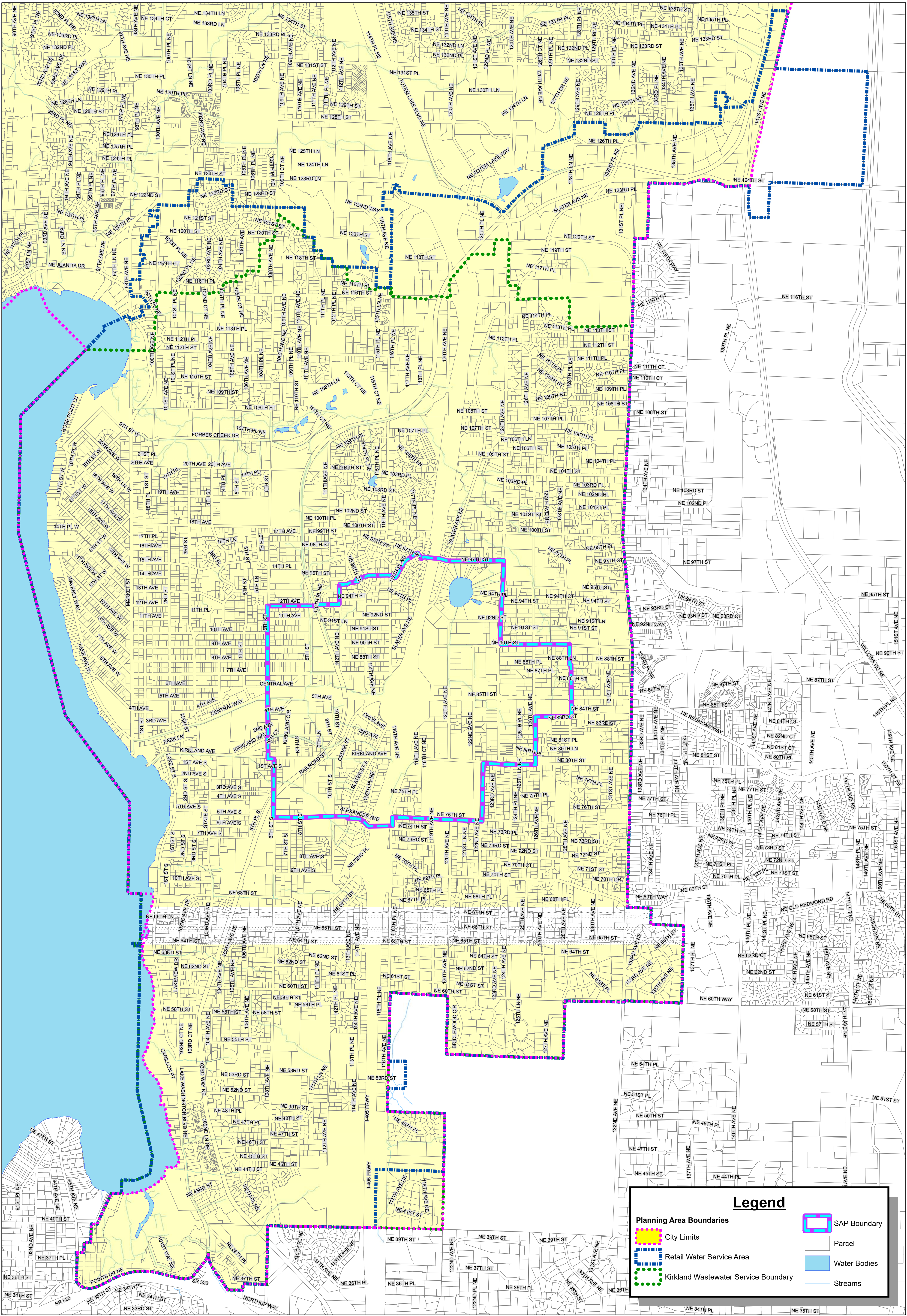
Figure 3 – Sewer System Proposed Improvements

Attachments



Attachment 1
SAP June Alternative B Zoning



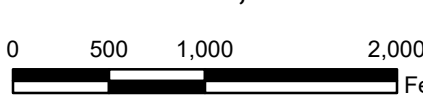
Source: Mithun, 2021.



J:\DATA\KIR\119-168\GIS\MAPS FROM DESKTOP\CURRENT SAP FIGURES\COLORBLIND FRIENDLY\FIGURE 1 - KIR SAP BOUNDARY.MXD BY: LMOJARAB PLOT DATE: OCT 14, 2021 COORDINATE SYSTEM: NAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4601 FEET



1 inch = 1,000 feet



0 500 1,000 2,000 Feet

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"




Figure 1

Station Area Plan Extents

City of Kirkland

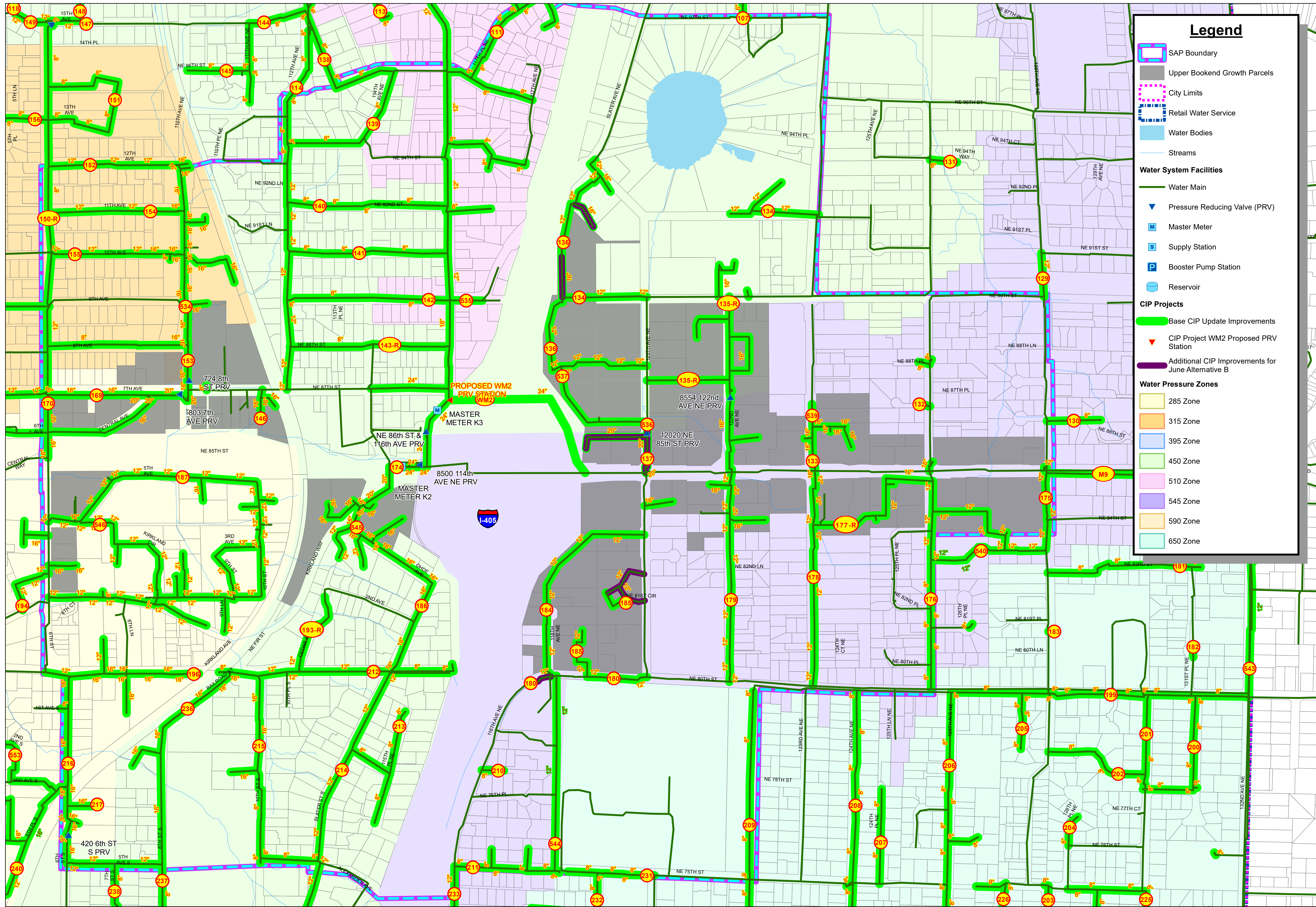
Vicinity Map



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Legend

- SAP Boundary
- Upper Bookend Growth Parcels
- City Limits
- Retail Water Service
- Water Bodies
- Streams
- Water System Facilities**
 - Water Main
 - Pressure Reducing Valve (PRV)
 - Master Meter
 - Supply Station
 - Booster Pump Station
 - Reservoir
- CIP Projects**
 - Base CIP Update Improvements
 - CIP Project WM2 Proposed PRV Station
 - Additional CIP Improvements for June Alternative B
- Water Pressure Zones**
 - 285 Zone
 - 315 Zone
 - 395 Zone
 - 450 Zone
 - 510 Zone
 - 545 Zone
 - 590 Zone
 - 650 Zone

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Vicinity Map



Figure 2
Station Area Plan
Water System Improvements
City of Kirkland

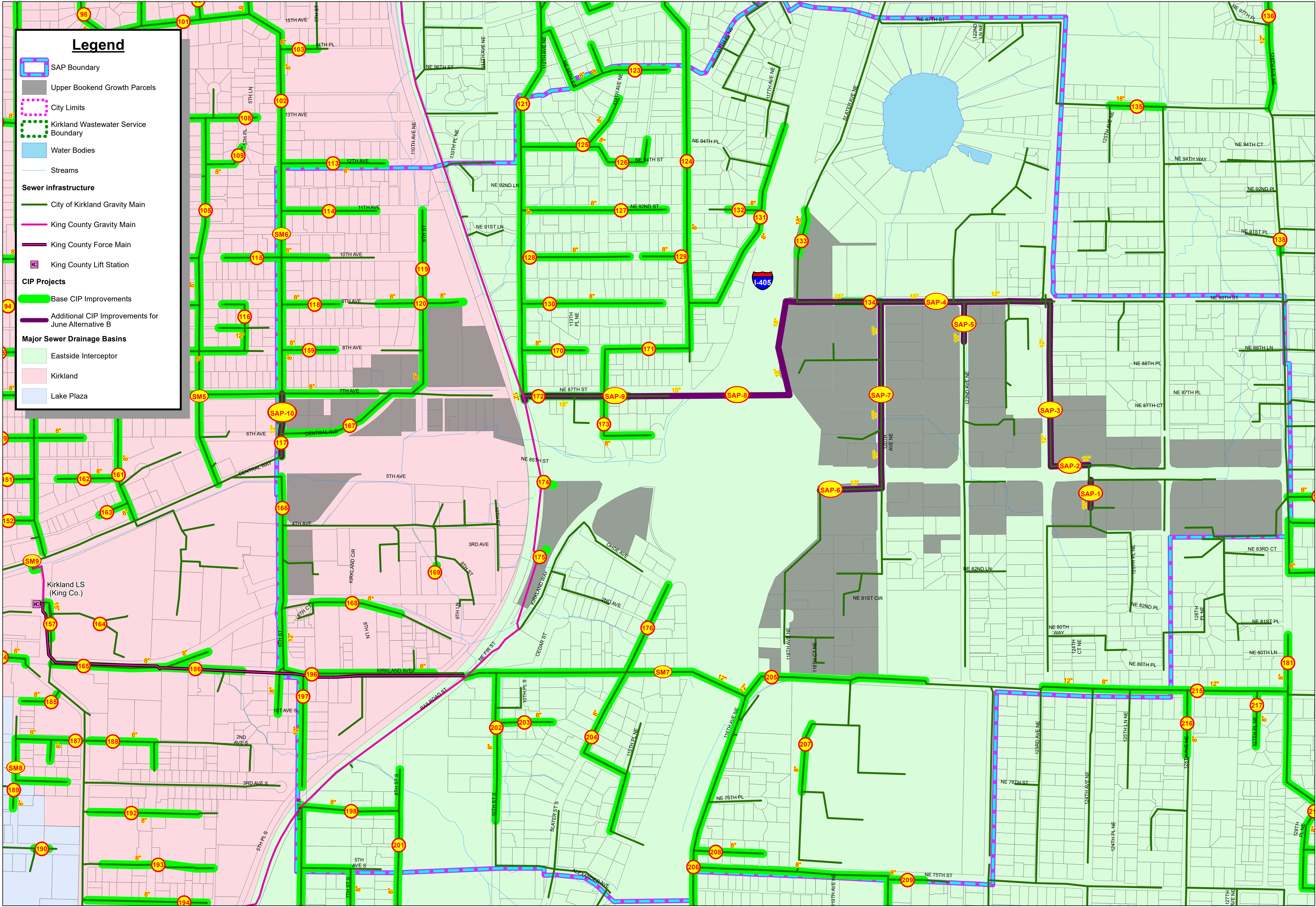


1 inch = 300 feet
0 150 300 600 Feet

DRAWING IS FULL SCALE WHEN BAR MEASURES 2"



C:\USERS\BRIGHTON\DRIVE - RH2\ENGINEERING\INC\DESKTOP\SAP\FIGURES\COLOR\BLIND FIGURES\FIGURE 2 - KIR SAP - WATER IMPROVEMENTS.MXD BY: DBRIGHT PLOT DATE: OCT 18, 2021 COORDINATE SYSTEM: NAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4601 FEET



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Vicinity Map



Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

Figure 3 Station Area Plan Sewer System Improvements *City of Kirkland*



1 inch = 300 feet
0 150 300 600 Feet

DRAWING IS FULL SCALE
WHEN BAR MEASURES 2"



C:\USERS\BRIGHTON\DRIVE - RH2\ENGINEERING\INC\DESKTOP\SAP FIGURES\COLOR BLIND FIGURES\KIR SAP - SEWER IMPROVEMENT\TS3.MXD BY: DBRIGHT PLOT DATE: OCT '15, 2021 COORDINATE SYSTEM: NAD 1983 HARN STATEPLANE WASHINGTON NORTH FIPS 4801 FEET