Gray & Osborne, Inc.
CONSULTING ENGINEERS

TECHNICAL MEMORANDUM

TO:	DONALD WASHBURN, ENGINEERING TECHNICIAN
FROM:	KEITH STEWART, P.E. MAYA VITA, E.I.T.
DATE:	NOVEMBER 14, 2025
SUBJECT:	PINNACLE DEVELOPMENT WATER SYSTEM ANALYSIS CITY OF POULSBO, KITSAP COUNTY, WASHINGTON G&O #25520.00

INTRODUCTION

The City of Poulsbo (City) is currently reviewing a Preliminary Proposal for a new development located between Baywatch Court Northeast and Sunrise Ridge Avenue Northeast, in the southern part of the City's water service area. To ensure that the proposed 151-unit development may be successfully, efficiently, and cost-effectively served by the existing potable water system, the City has requested that Gray & Osborne provide an engineering analysis on the proposed water system infrastructure.

This memorandum highlights the tactics and findings from this analysis.

According to Preliminary Plans (dated June 20, 2025) provided to Gray & Osborne on August 5, 2025, the Developer has proposed to provide water service to the site via connections to the existing distribution system on Northeast Crystallia Court, Sunrise Ridge Avenue Northeast, Baywatch Court Northeast, and Johnson Parkway Northeast. The City's current water system infrastructure, along with the location of the proposed development are shown in Figure 1. The proposed development spans both the Middle Zone (hydraulic grade line equal to 396 feet), which is supplied by the Lincoln Wells, the Raab Park Reservoir, the Caldart Reservoir, and Pressure Reducing Valves (PRVs) from the East High Zone, and the East High Zone (hydraulic grade line equal to 514 feet), which is supplied by the Lincoln Wells and the Pugh Reservoir. The proposed development is also adjacent to the East High Subzone (hydraulic grade line equal to 320 feet), which is supplied via a PRV from the East High Zone.

MODELLING PARAMETERS

The system was modeled in Autodesk's Infowater® Pro hydraulic modeling software, Version 2025.4, which operates on an ArcGIS Pro platform. The Infowater model is configured with a graphical user interface. Each water system element (pipes, valves, sources, reservoirs, etc.) is assigned a unique graphical representation within the model, and each element is assigned a number of attributes specific to its function in the actual water system. Typical element attributes include spatial coordinates, elevation, water demand, pipe lengths and diameters, and critical water levels for reservoirs. With attributes of each system element as the model input, the InfoWater software simulates

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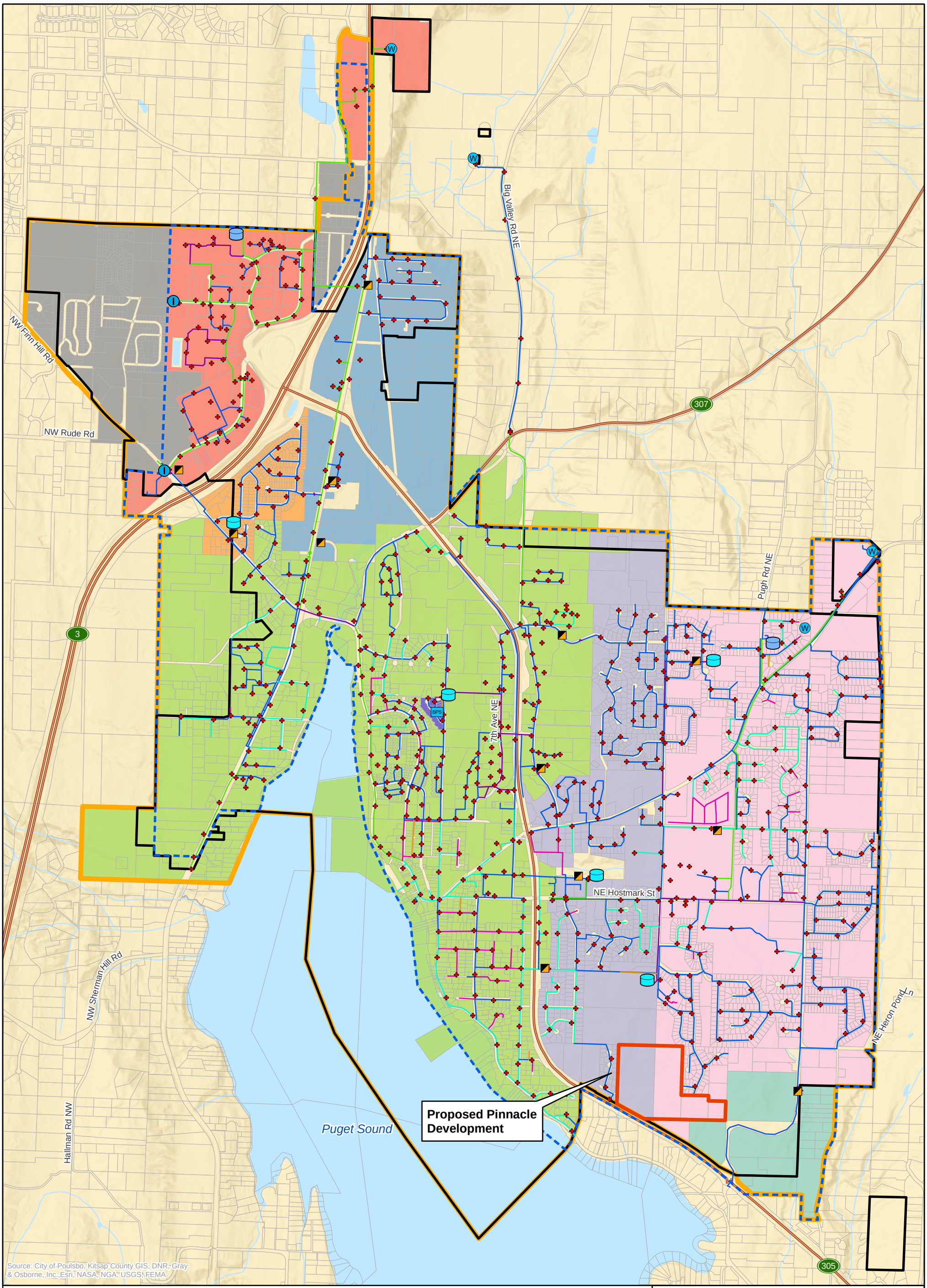

Existing Facility
- Hydrant
- Booster Station
- Intertie
- PRV
- Reservoir
- Standpipe
- Well

Water Main (Diameter)
- 2"
- 4"
- 6"
- 8"
- 10"
- 12"

Pressure Zone
- KPUD Service Area
- Low Zone (244')
- Middle Zone (396')
- West High Zone (492')
- North Viking Subzone (385')
- Stendahl Subzone (350')
- Poulsbo Place Subzone (340')
- East High Zone (514')
- East High Reduced Subzone (320')

Reference
- Proposed Development
- Retail Service Area
- City Limits
- Urban Growth Area
- Parcel
- Surface Water

N

0 625 1,250 2,500 Feet

CITY OF POULSBO

PINNACLE DEVELOPMENT
WATER SYSTEM ANALYSIS

FIGURE 1

EXISTING WATER SYSTEM

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the water system performance and generates an output file that typically includes system flow and pressure at the various modeled nodes.

To develop a baseline, the system was modeled with the Developer's proposed water system infrastructure as shown in the proposed Development Civil Plans. For this analysis, an average day water demand of 160 gallons per day (gpd) per Equivalent Residential Unit (ERU), as established in the City's Draft Water System Plan (WSP), was assumed for each of the proposed 151 residential units. Each unit was assumed to be equivalent to one ERU.

The setup of the hydraulic model and the assumptions used to determine the static pressure and available fire flow are noted as follows.

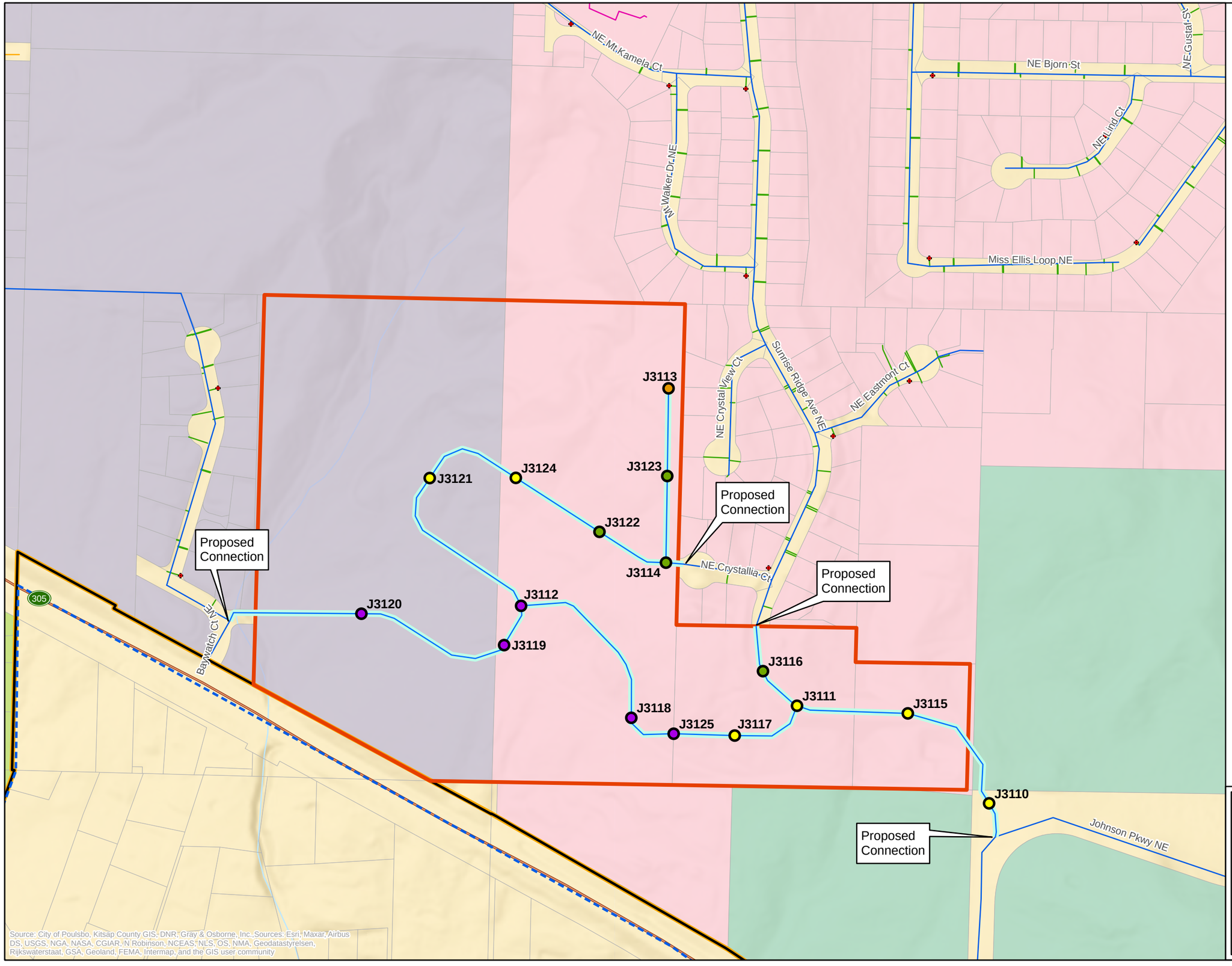
- The available fire flows and pressures are modeled at nine nodes, corresponding to the proposed hydrants in the vicinity of the development. Static pressure is modeled at six additional nodes at the site, as shown in Figure 2.
- Water system demands are based on projected 2044 demands and reservoirs are depleted of equalizing storage, as established in the current draft of the City's WSP.
- The Poulsbo Place booster station is operational.
- The Lincoln Wells and Westside Well are active.
- All water piping within the proposed development is assumed to be 8 inches in diameter.

The water system demands utilized in the model were adjusted according to the peaking factors in the WSP and assumes that each proposed lot is equivalent to one ERU. For this, a maximum day demand value was estimated by multiplying the average day demand by a peaking factor of 2.1. Furthermore, a peak hour demand was estimated by multiplying the maximum day demand by a peaking factor of 1.65. The application of these peaking factors results in a peak day demand of 35 gallons per minute (gpm) and a peak hour demand of 58 gpm. These values were then utilized within the model.

The Washington State Department of Health (DOH) requires that water systems maintain a minimum pressure of 30 psi at each service under peak hour demand conditions and recommends that system pressures be below 100 psi. Optimal water service pressures are 50 to 80 psi.

SYSTEM ANALYSIS

It should be noted that this proposed development is in an extremely difficult location, with a highly variable topography and a location that spans the East High Zone, Middle Zone, and East High Subzone.



Modeled Pressure (PSI)
- 36-50
- 51-80
- 81-99
- > 100

Existing Facility
- Hydrant

Water Main (Diameter)
- 4"
- 6"
- 8"
- Service Line
- Development Pipe

Pressure Zone
- Low Zone (244')
- Middle Zone (396')
- East High Zone (514')
- East High Reduced Subzone (320')

Reference
- Proposed Development
- Retail Service Area
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N

0 125 250 500 Feet

CITY OF POULSBO
PINNACLE DEVELOPMENT
WATER SYSTEM ANALYSIS
FIGURE 2
SYSTEM PRESSURE AS CURRENTLY PROPOSED - 0 PRVs

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Several variations of connections, creations of subzones, connection to existing zones, and inclusions of new PRVs were investigated both within Gray & Osborne and with City staff. Each of these potential scenarios was considered with regards to water quality, desired pressure, fire flow, and future development in this portion of the system. Scenarios investigated included the following.

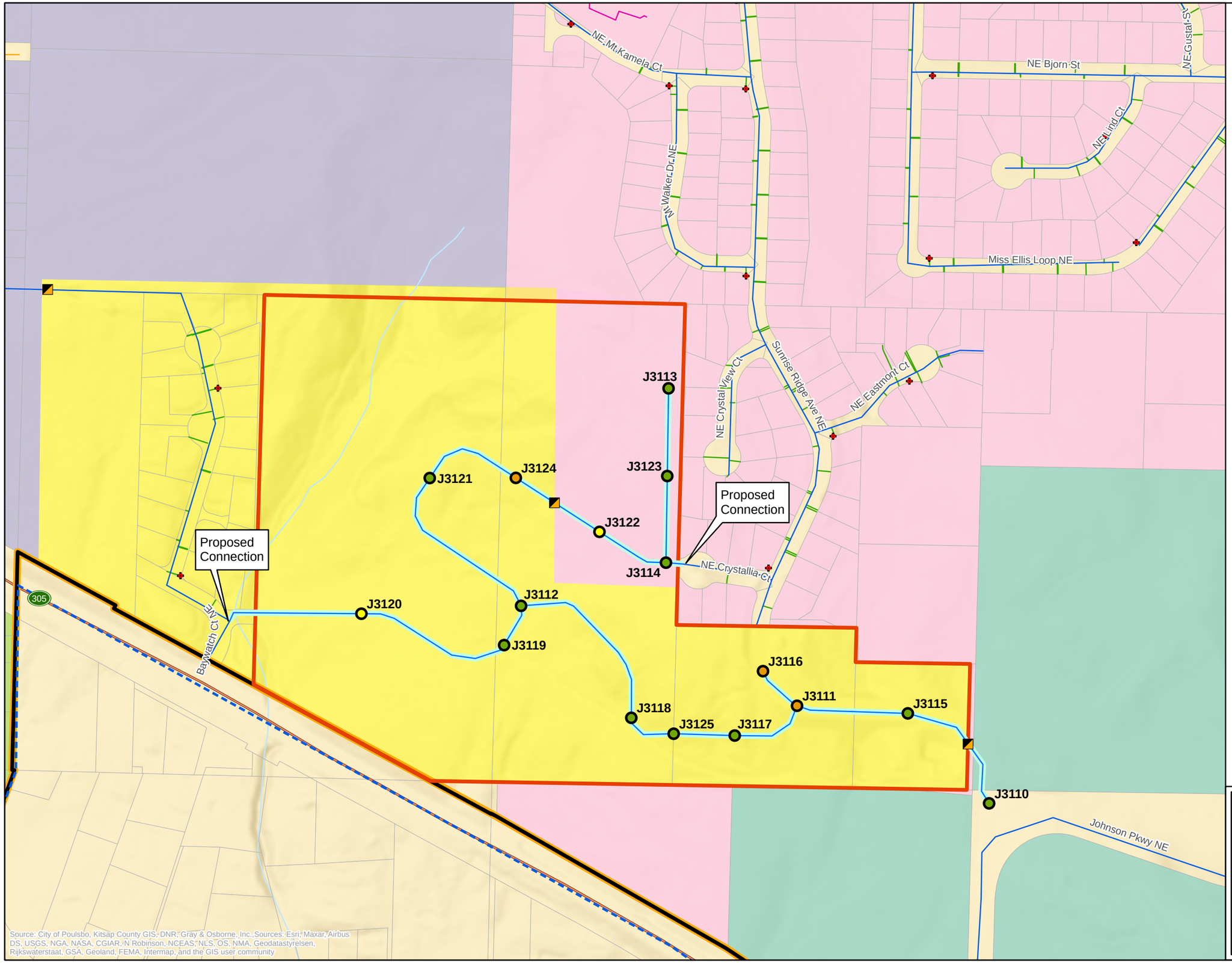
- Connect the proposed development to the East High Zone and utilize individual residential PRVs as needed based on final building elevation.
- Connect the proposed development to the East High Zone, the Middle Zone, and utilize individual residential PRVs as needed based on final building elevation.
- Connect the proposed development to the East High Zone, the Middle Zone, and utilize PRV stations as needed based on final building elevation.
- Connect the proposed development to the East High Zone, the Middle Zone, the East High Subzone, and utilize PRV stations as needed based on final building elevation.

For this analysis, the system was modeled under two scenarios. Scenario 1 included the water system infrastructure as proposed by the Developer. This scenario included connections at Baywatch Court Northeast, Sunrise Ridge Avenue Northeast, and Johnson Parkway Northeast, and 8-inch diameter ductile iron water main piping. The output from this scenario is shown in Figure 2.

Scenario 2 was the recommended system based on an investigation of proposed building elevations, proposed development in the area, and desires of City staff with regards to pressure, maintenance, and zone delineation. Scenario 2 includes a combination of PRVs, connections to the East High Zone and Middle Zones, creation of a new Middle Subzone, and individual residential PRVs. The PRV station settings for Scenario 2 were modeled as follows to achieve a consistent hydraulic grade line (HGL) of roughly 355 feet for the new subzone.

- Crystallia: 37 psi
- Johnson: 59 psi
- Baywatch (if the City installs a PRV at the existing valve): 57 psi

The modeled PRV locations and output of the model results for Scenario 2 are shown in Figure 3. Model output values are also summarized in Table 1.



Modeled Facility
- PRV

Modeled Pressure (PSI)
- 36-50
- 51-80
- 81-99

Existing Facility
- Hydrant

Water Main (Diameter)
- 4"
- 6"
- 8"
- Service Line
- Development Pipe

Pressure Zone
- Low Zone (244')
- Middle Zone (396')
- East High Zone (514')
- East High Reduced Subzone (320')
- Pinnacle Subzone (355')

Reference
- Proposed Development
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N

0 125 250 500 Feet

CITY OF POULSBO

PINNACLE DEVELOPMENT
WATER SYSTEM ANALYSIS

FIGURE 3

SCENARIO 2 SYSTEM PRESSURE WITH RECOMMENDED IMPROVEMENTS

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TABLE 1

Peak Hour Pressure Summary

Node	Elevation (feet)	Peak Hour Pressure (psi)	
		Scenario 1	Scenario 2
J3110	222	99	58
J3111	247	88	47
J3112	201	107	67
J3113	352	43	57
J3114	299	66	80
J3115	227	97	56
J3116	264	81	40
J3117	222	99	58
J3118	205	106	65
J3119	195	109	70
J3120	147	129	90
J3121	230	95	55
J3122	281	73	88
J3123	325	54	69
J3124	256	84	43
J3125	213	103	62

The model output shows that most nodes fall within the City's desired pressure range of 50 to 80 psi. Note that Nodes J3122 and J3120 show pressures above 80 psi during peak hour flows, and residences in this area may need to be served by individual residential PRVs.

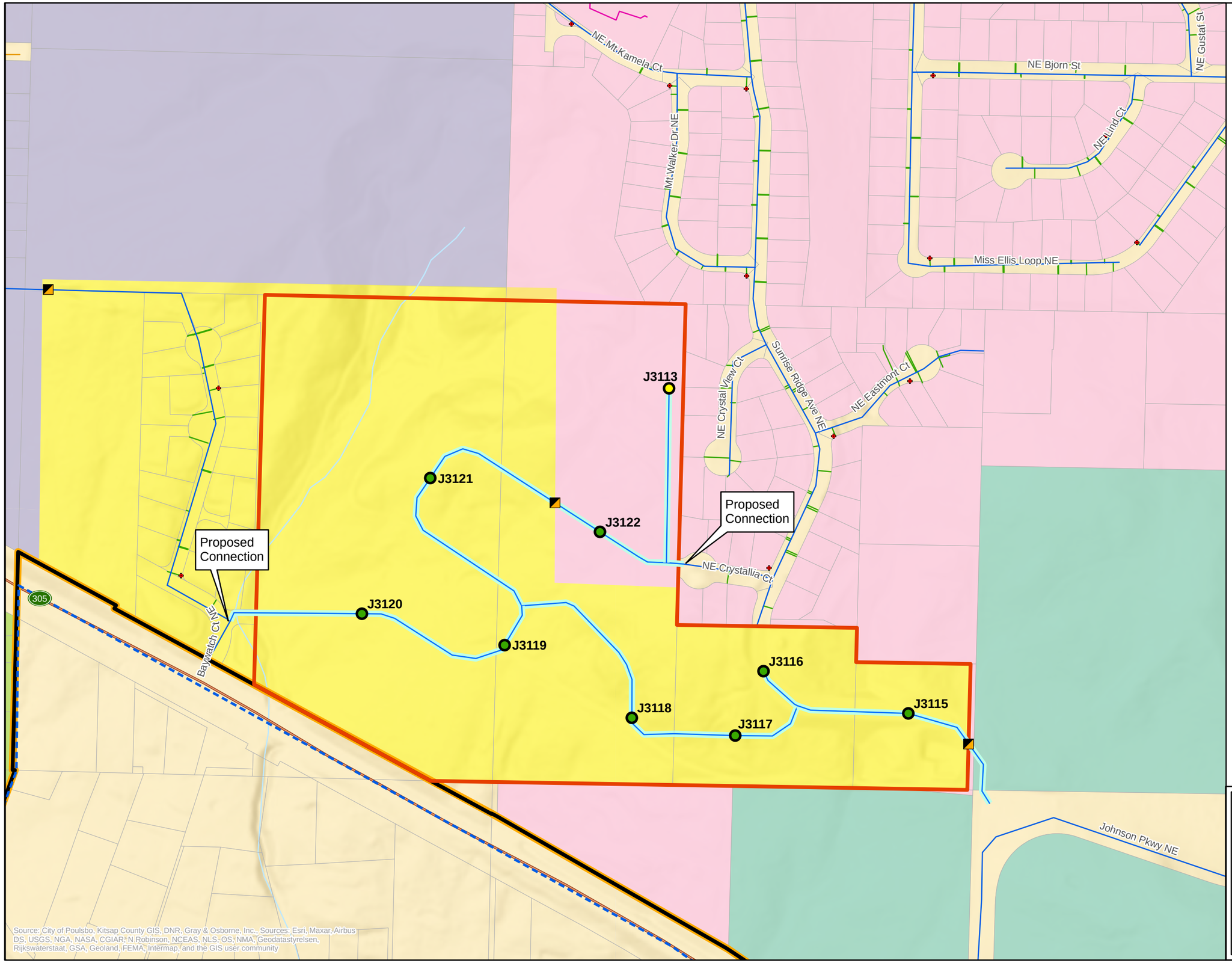
The PRV settings would need to be adjusted after installation to optimize flow and operation, in order to maintain a consistent water pressure and regular flow through each station. This optimization should be performed by City staff.

Under this scenario, the City would own, operate, and manage the PRV stations in order to ensure they are maintained and operated in accordance with the needs of the public water system. The cost for construction of these PRV stations would be borne by the Developer.

Fire Flow Analysis

For both scenarios, available fire flow was modeled at nine proposed hydrants. These results are shown in Figure 4 and are summarized in Table 2.

Table 2 includes the modeled fire flow at each node, the residual pressure at the node under the modeled fire flow, and the minimum pressure at all service locations throughout the system under the modeled fire flow. The minimum pressure that must be



Modeled Facility
- PRV

Fire Flow (GPM)
- 500-1,000
- > 1,000

Existing Facility
- Hydrant

Water Main (Diameter)
- 4"
- 6"
- 8"
- Service Line
- Development Pipe

Pressure Zone
- Low Zone (244')
- Middle Zone (396')
- East High Zone (514')
- East High Reduced Subzone (320')
- Pinnacle Subzone (355')

Reference
- Proposed Development
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N

0 125 250 500 Feet

CITY OF POULSBO

PINNACLE DEVELOPMENT
WATER SYSTEM ANALYSIS

FIGURE 4

SCENARIO 2 AVAILABLE FIRE FLOW

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maintained at all service locations is 20 psi, according to DOH requirements. The modeled fire flow is available at any hydrant node, but not simultaneously. Note that the node laterals are not explicitly modeled.

TABLE 2

Fire Flow Availability, Initial Scenarios

Node	Scenario 1		Scenario 2	
	Available Fire Flow Greater than 20 psi (gpm)	Hydrant Pressure at Modeled Fire Flow (psi)	Available Fire Flow Greater than 20 psi (gpm)	Hydrant Pressure at Modeled Fire Flow (psi)
J3113	591	26	983	25
J3115	596	79	1,239	33
J3116	590	64	1,187	20
J3117	602	82	1,331	38
J3118	610	89	1,429	47
J3119	633	92	1,440	58
J3120	687	110	1,480	76
J3121	611	78	1,381	47
J3122	597	56	1,239	29

The City has adopted the 2021 International Fire Code (IFC) as the minimum fire flow standard. Appendix B of the 2021 IFC, Tables B105.1(1) and B105.1(2), lay out fire flow requirements for residential buildings. For residences under 3,600 square feet, 1,000 gpm of fire flow is required if there is no automatic sprinkler system. If there is an automatic sprinkler system installed, only 500 gpm is required. Therefore, if the Pinnacle development includes an automatic sprinkler system serving all lots, the fire flow is sufficient in all scenarios. However, if there is no sprinkler system the fire flow is at least partially deficient in all scenarios.

The modeling data indicate that fire flow to the proposed hydrants would be restricted by the system pressure in the area along Sunrise Ridge Avenue. This area was found to be generally deficient in fire flow in the Draft WSP due to its high elevation, which results in a lack of available pressure. To resolve this deficiency, the Draft WSP includes a Capital Improvement Plan to add a booster pump station at Raab Park. If this booster pump station were installed, the available fire flow for the development would be greater than 1,000 gpm at all hydrants regardless of PRV placement.

DOH and City Standards for water distribution systems are to meet the peak hourly demand of the system while providing a minimum pressure of 30 psi, system-wide. Under peak daily demand with a fire flow, the system is designed to maintain a minimum pressure of 20 psi, system-wide. Although the peak hourly demand pressure may currently be higher than these standards, the Developer must recognize that the City may not provide pressure higher than 30 psi in the future. The flows and pressures determined in this memorandum are based on the approximate hydrant elevation at ground level.

The Developer may design their sprinkler system for whatever pressure they wish; however, they must recognize and be responsible for conditions when the pressure may be less than currently exists.

SUMMARY OF RECOMMENDATIONS

Figure 5 includes a summary of recommended modifications to the proposed development. The proposed development should include the following components.

- Connection to existing water system at Northeast Crystallia Court.
- Connection to the existing water system at Baywatch Court Northeast.
- Creation of a new Middle Subzone with an HGL of approximately 355 feet.
- Installation of a PRV station located just north of Johnson Parkway Northeast.
- Installation of a PRV station located within the proposed development, between Nodes J3122 and J3124.
- Valve closure at an existing valve west of the Baywatch Court Northeast connection.
- Installation of individual PRVs (as required) on residential properties near Node J3120.
- Installation of individual PRVs (as required) on residential properties near Node J3122.
    - Costs for the design and construction of the required PRV stations shall be borne by the Developer.
    - After construction, the ownership and management responsibility for the PRV stations would be transferred to the City.

City to close existing isolation valve.
Baywatch moves to Pinnacle Subzone.
City to install future PRV station as needed.

PRV #1 - East High to 355 Subzone

Proposed Connection

Proposed Connection

Individual PRVs may be necessary in this area.

PRV #2 - Future connection to Audrey Development (Middle Zone)

J1121
J1122
J1124
J3113
J3123
J3121
J3124
J3122
J3114
J3120
J3112
J3119
J3116
J3111
J3115
J3118
J3125
J3117
J3110

NE Mt Kamela Ct
Mt Walker Dr NE
NE Bjorn St
NE Gustaf St
NE Lind Ct
Miss Ellis Loop NE
NE Crystal View Ct
Sunrise Ridge Ave NE
NE Easmont Ct
NE Crystallia Ct
Baywatch Ct NE
305
Johnson Pkwy NE

Source: City of Poulsbo, Kitsap County GIS, DNR, Gray & Osborne, Inc., Sources: Esri, Maxar, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap, and the GIS user community

Modeled Facility
- Node
- PRV

Existing Facility
- Hydrant

Water Main (Diameter)
- 4"
- 6"
- 8"
- Service Line
- Development Pipe

Pressure Zone
- Low Zone (244')
- Middle Zone (396')
- East High Zone (514')
- East High Reduced Subzone (320')
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N

0 125 250 500 Feet

CITY OF POULSBO

PINNACLE DEVELOPMENT
WATER SYSTEM ANALYSIS

FIGURE 5

SUMMARY OF RECOMMENDATIONS

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