Part B Water System Plan Update
For The
Webster Hill – 610 Water System
WSID: 59875-5

EXECUTIVE SUMMARY:

The Webster Hill – 610 Water System (DOH ID 59875-5) is submitting a Water System Plan (WSP) Update. This 10-year plan amendment is required for compliance with the Washington Administrative Code. The submitted document is the Part B Water System Plan; please refer to the Thurston PUD Part A (Umbrella) Plan for PUD standards, policies, asset management, and rate setting.

The Webster Hill Water System is currently an approved Group A Community water system approved for 20 connections and has no additional available connections at this time. Webster Hill has significant excess physical and water rights capacity and has been receiving requests for service from properties within and adjacent to the existing service area. This WSP includes a full capacity analysis of the system and proposes an expansion of the existing service area and approval of 20 additional connections.

Population:	43
Sources:	1 permanent well pumping at 96 gpm
Storage:	23,500 gallons
Pressurization:	Two 5 hp booster pumps, five 120 gallon pressure tanks, 50/70 pressure switch
Treatment	Fe/Mn removal using three 24 inch greensand filters, Primary Disinfection (CT-6) using Sodium Hypochlorite.
Distribution	Primarily 4 inch DR18 C900 PVC and smaller sections of 2 inch schedule 40 pvc; the entire distribution system was replaced in 2015. 2-in sch. 40 PVC Pipe: 480 feet 4-in DR18 C900 PVC Pipe: 3,050 feet 2-in blow off: 5 ea 2-in gate valve: 2 ea 4-in gate valve: 9 ea
Water Rights	G2-00989C: 100 gpm, 20.16 acre-feet per year
ADD/ERU	188 gpd
MDD/ERU	819 gpd
Current PHD	52 gpm
20 Yr PHD	86 gpm
Fire Flow Requirements	N/A -The system was installed prior to adoption of Pierce County fire flow standards. New connections to the water system on lots less than 1 acre in size may requre installation of residential fire suppression systems.

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Acronyms

ADD	Average Daily Demand
C	Coefficient of Friction
DSL	Distribution System Leakage
ERU	Equivalent Residential Unit
GWI	Groundwater Under the Influence of Surface Water
HGL	Hydraulic Grade Line
MCL	Maximum Contaminant Level
MDD	Maximum Daily Demand
MPA	Microscopic Particulate Analysis
NTNC	Non-Transient Non-Community
PHD	Peak Hourly Demand
ppb	Parts per Billion
ppm	Parts per Million
RSA	Retail Service Area
SMA	Satellite Management Agency
SWL	Static Water Level
SWSMP	Small Water System Management Program
UTC	Utilities and Transportation Commission
WDM	Water Distribution Manager
WFI	Water Facilities Inventory (form)
WSDM	Water System Design Manual
WSDOH	Washington State Department of Health
WSP	Water System Plan
WUE	Water Use Efficiency

Chapter 1 System Description

1.1 Ownership and Management

The Webster Hill 610 water system is owned and operated by Thurston PUD, a Public Utility District established by the vote of the people in 1938. Thurston PUD owns and manages multiple water systems and has approved umbrella Part A (Part A) and Satellite Management Agency (SMA) plans that cover information that is relevant to the management of multiple systems. These documents are referenced where applicable. See Thurston PUD's Part A for information on the Ownership and Management structure.

Pertinent information about the water system is summarized below:

Water System Name:	Webster Hill -610
System Type:	Group A Community Water System
WSDOH ID Number:	59875-5
Location:	Graham, Washington
Source:	Groundwater
Type of Ownership:	Special Purpose District
Service Connections:	20
Population Served:	50
Ownership	Thurston PUD (owner/operator)
Primary Contact:	Kimberly Gubbe, Compliance Director
Owner Address:	1230 Ruddell Rd SE Lacey WA 98503
Owner Phone:	(360) 357-8783

1.2 System History and Background

Webster Hill 610 was originally developed in the late 1970's by Guy Norman (though the well dates from 1958). At some point, ownership of the water system transferred to James Budnick, who quit claim the water system in 2000 to the Webster Water Homeowner's Association (HOA). The HOA filed Articles of Incorporation with the Washington State Secretary of State in August 2000.

The HOA contracted to Thurston PUD to operate the water system in 2012, and sold the system to Thurston PUD in 2015. The well is the only infrastructure original to the system. A 20 foot diameter by 10 foot tall concrete reservoir was installed in 2010 along with a booster station. Chlorination was installed in 2015 concurrently with distribution system replacement with primarily 4 inch C900 lines. The system has had high manganese since inception, therefore Thurston PUD had a greensand treatment system designed by Murraysmith piloted and approved in 2021 and is currently in the process of installation.

1.2.1 Existing Facilities

The water system is supplied by one permanent well (S01) which pumps to a 23,500 gallon concrete reservoir. Chlorine is injected, achieving contact time for CT-6 using the standby storage component of the reservoir. The system is pressurized by the booster station, consisting of two 5 hp centrifugal pumps and five 120 gallon pressure tanks. The well, reservoir, and booster/treatment building are all located on easement on the HOA owned tax parcel 0418321095. Distribution System consists primarily of 4-inch pipe, with short runs of 2 inch pipe.

1.3 Related Plans

The following documents were consulted in the preparation of this Water System Plan:

- *Thurston PUD Water System Plan: Part A - Umbrella Plan, March 2021*
- *Thurston PUD Satellite Management Agency Plan, March 2021*
- *Pierce County Comprehensive Plan, updated October 1, 2021*
- *Graham Community Plan (Appendix F of 2021 Pierce County Comprehensive Plan)*
- *Nisqually Watershed (WRIA 11), February 2019*
- *Tacoma-Pierce County Health Department Environmental Health Code Chapter 3: Water Regulations, April 2015*
- *Pierce County Coordinated Water System Plan, July 13, 2021*

The nearest neighboring public water systems are the Graham Hill Mutual Water Co to the east, and Sunwood Graham to the west. Nearby Group B water systems include the Vincent water system to the west, and Hall Lambert system to the south.

1.4 Service Area, Maps, and Land Use

The Webster Hill service area is located in the Northeast quarter of Section 23, Township 18 North, Range 04 East, W.M., See Figure 1-1 and Figure 1-4. An expansion of the service area to incorporate 21 additional lots is proposed. See Figure 1-3 for the existing service area, and Figure 1-4 for the proposed service area. The amended service area consists of 48 parcels and encompasses an area of approximately 133 acres, located in unincorporated Pierce County, Washington. 38 of the parcels are developed or partially developed, with 20 served by the Webster Hill water system and 18 by existing private wells. There are 10 undeveloped parcels in the revised service area.

The area is gently sloping to the south at approximately 5%, with minor areas of steeper slopes. The lowest elevation is the southern service area boundary at 650 feet elevation, and highest elevation being the northeast corner of the service area at 770 feet elevation. The system serves all customers using a single pressure zone and with existing service connection elevations varying from 690 to 765 feet. The pumphouse and well are located at approximately 750 feet. Service to parcels below 680 feet in elevation may require pressure reducing valves.

1.4.1 Retail Service Area

The retail service area is where a municipal water supplier has a duty to serve connections under the conditions described in Section 1.6. For the Webster Hill Water System, the retail service area is as shown in Figure 1-4

1.4.2 Service Area Agreements

There are no service area agreements with outside utilities. No competing utilities have registered service areas within the bounds of the existing or future service areas proposed by Webster Hill; therefore, no utility coordination is required.

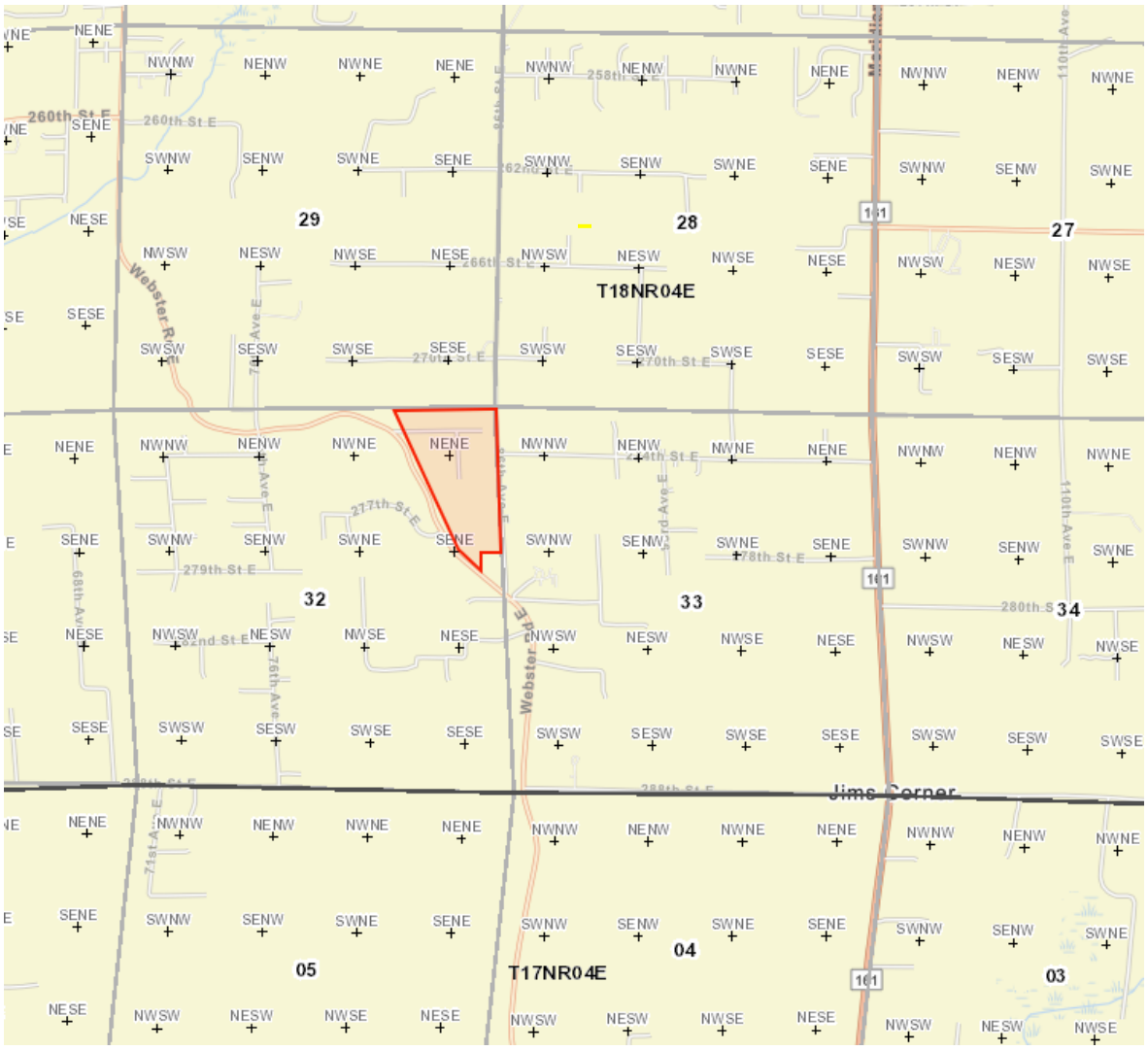

Figure 1-1: Webster Hill Water System Section Map.

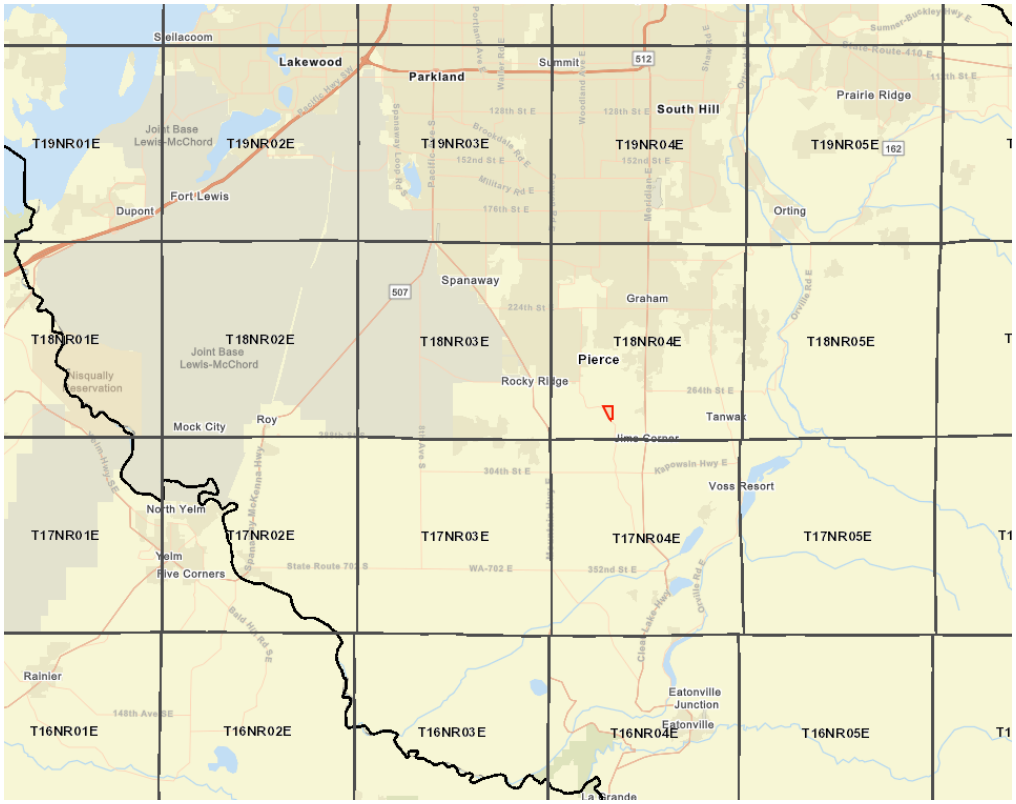

Figure 1-2: Webster Hill Water System vicinity map.

Figure 1-3: Webster Hill Water Existing System Service Area Boundaries

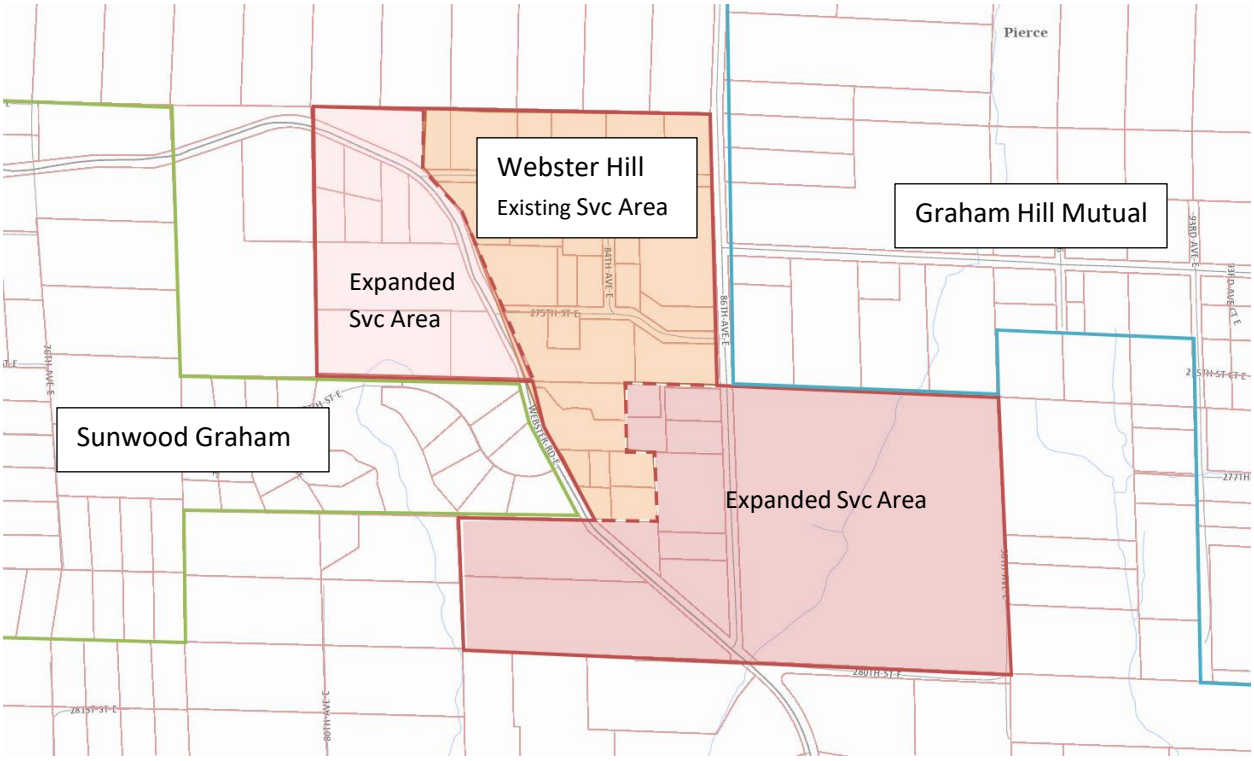

Figure 1-4: Webster Hill Water System Proposed Service Area Boundaries

1.4.3 Land Use and Zoning

Zoning within the Webster Hill community is shown in Figure 1-5. The area is zoned Single Family Residential (R-10). Minimum required lot size for construction of new single family homes is 10-acres. Accessory Dwelling Units (ADU's) are permitted. In the 20-year time horizon it is likely that there will be construction on available vacant parcels and likely some ADU's.

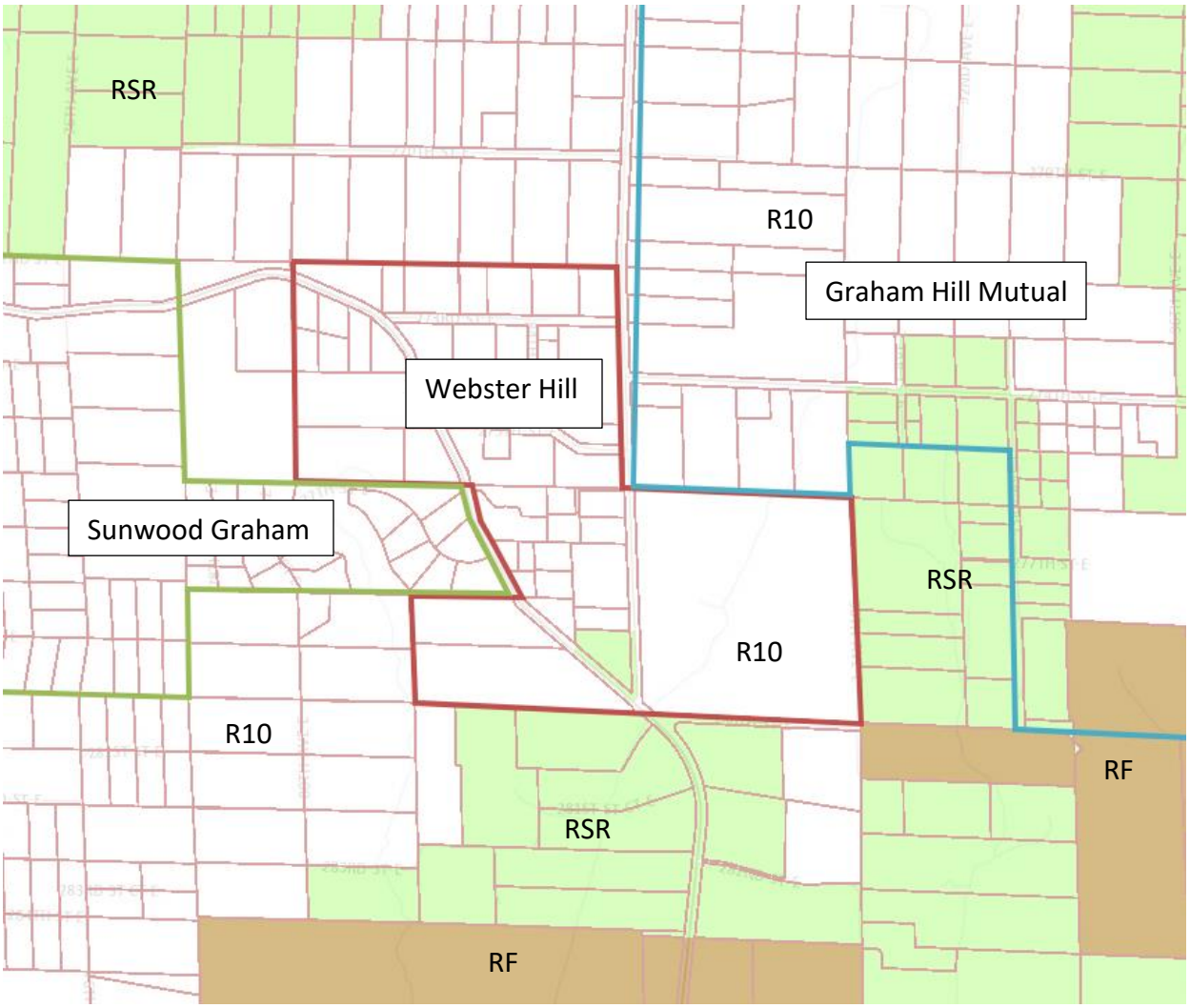

Figure 1-5: Area Zoning Map

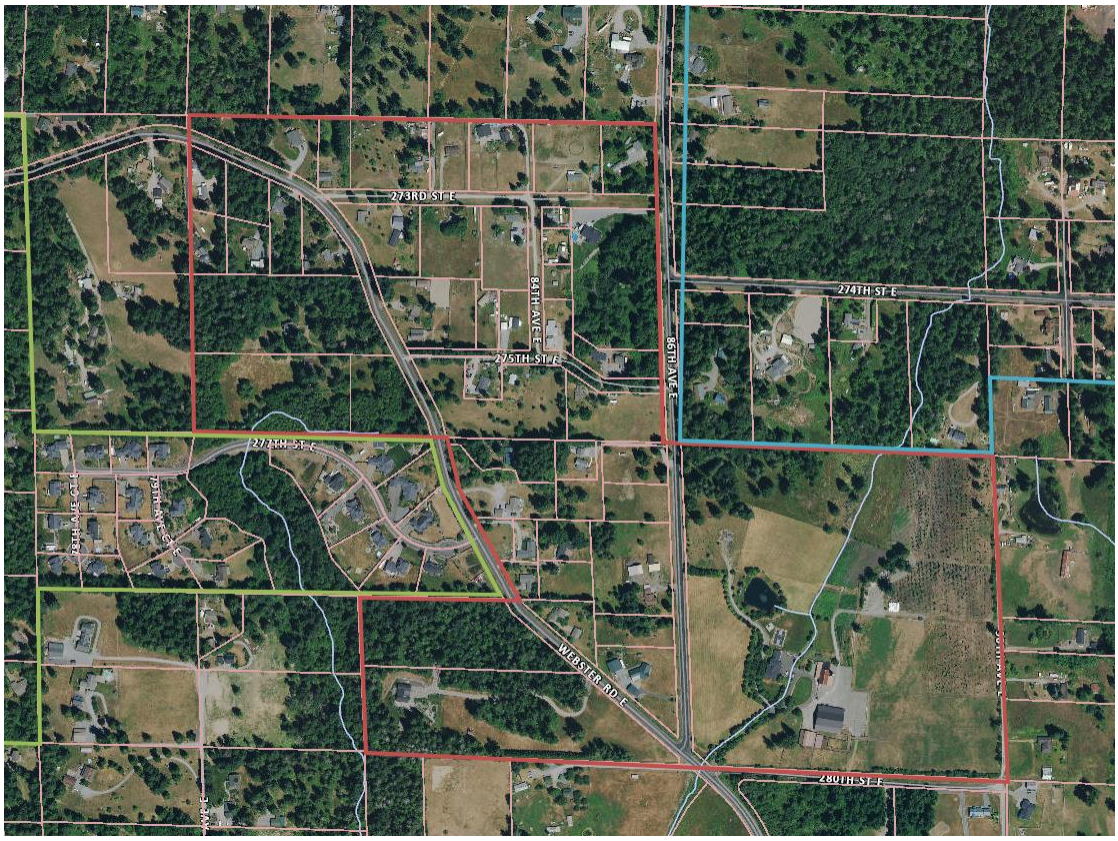

Figure 1-6: Aerial Photographs

1.5 System Policies

Thurston PUD, in its commitment to provide dependable water service in accordance with all applicable regulatory rules and regulations, observes the following general policies.

1.5.1 Direct Connection and Satellite/Remote Systems

Future direct connections to the Webster Hill water system will occur as a result of infill within the retail service area.

Satellite systems are noncontiguous or separate water systems that use separate facilities and infrastructure and may be served by a different source. See SMA plan Section 4 and Part A plan Section 2.3 for policies regarding satellite / remote systems.

1.5.2 Design and Performance Standards

All design and construction shall be completed under the direction of Thurston PUD per the standards of Thurston PUD and Pierce County. Design and construction specifications and standards can be found in

the Pierce County Coordinated Water System Plan and in Thurston PUD's Part A plan, Appendix A, Specifications and Standards for Design and Construction.

1.5.3 Urban Growth Area

The system is not located within an urban growth area.

1.5.4 Late-Comer Agreements

Late-comer agreements may be considered by Thurston PUD on a case by case basis upon request prior to approval of developer extensions.

1.5.5 Oversizing

Please see Part A plan, Appendix A Section 3 for policies regarding oversizing.

1.5.6 Cross-Connection Control Program (CCCP)

Please see Part A plan Section 5.8 and Appendix R for Cross-Connection Control Program. A list of Cross-Connection Control devices and inspection dates can be found in Appendix 10.7 of this Part B water system plan.

1.5.7 Extension

No extensions are anticipated nor proposed at this time. An extension submittal exemption is requested per WAC 246-290-125; all extension design and installation shall be completed per the Design and Construction Specifications and Standards, found in the Part A plan, Appendix A.

1.6 Duty to Serve

See Part A Plan Section 2.3 for policies related to Duty to Serve.

1.7 Local Government Consistency

In accordance with the Municipal Water Law, Thurston PUD is working on obtaining a signed consistency statement from Pierce County to document that this WSP is consistent with local area planning. A copy of the Pierce County consistency statement will be included in Section 10.8 of the WSP.

1.8 Watershed Plan Consistency

As discussed in Section 1.3, Webster Hill is within the Nisqually watershed (WRIA 11). No inconsonances have been identified with the Nisqually Watershed Management Plan.

Chapter 2 Basic Planning Data

2.1 Current Population, Service Connections, and Equivalent Residential Units (ERUs)

2.1.1 Population and Demographics

The Webster Hill Community Club is a residential community comprised of 20 full-time residences. There are no Part-time Residential, Commercial, Industrial, Agricultural or Multi-Family service connections on this water system. Population is estimated at 50 persons based on the statewide average of 2.5 persons per household.

Per the Graham Community Plan, household age in the Graham area is generally younger than that of Pierce County as a whole, and household income is generally higher. The median household income for Pierce County is approximately $45,200 and 64 percent of the households in the plan area have an income of $45,200 or higher. Roughly 10 percent of the households within the plan area have an income less than $20,000 and approximately 11.6 percent have an income level of $100,000 or higher.

2.1.2 ERU Analysis

For the purpose of this report, one ERU is defined as the equivalent usage of a single-family residence occupied full time. Since all services are full time residential connections all connections represent a single ERU.

2.2 Water Production and Usage

2.2.1 Meter Data

Source and Service meters are read on a monthly basis. Service Meter records for the five-year period of August 2017 through July 2022 were used in developing a model of residential water demand for the community. During this period the number of full time residential and total connections has remained unchanged at 20 ERU.

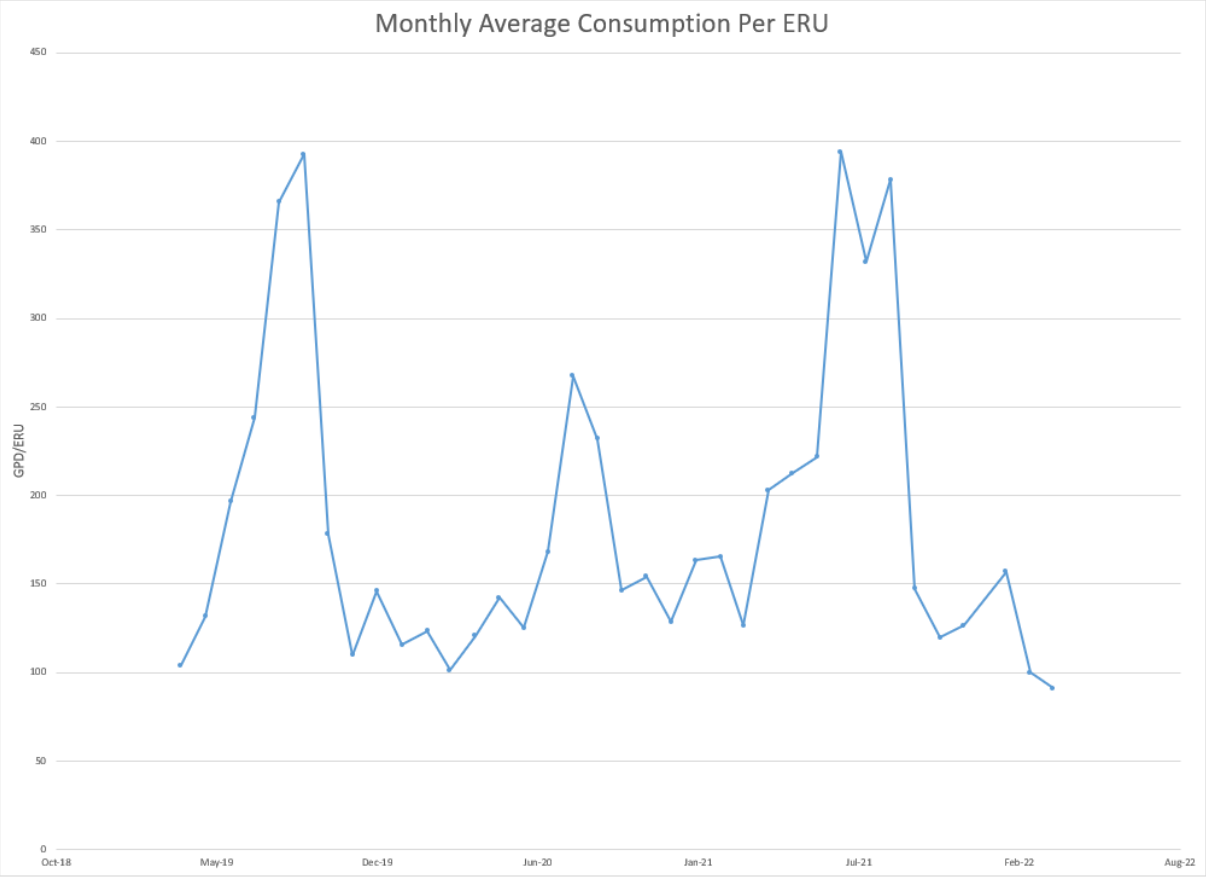

Figure 2-1: Monthly Average Consumption per ERU

2.2.2 System Parameters: ADD, MDD, and PHD

Average daily demand (ADD) is 188 gpd/ERU. The Maximum Month Daily Demand (MMDD) was 451 gpd/ERU and occurred in August of 2017. Maximum Daily Demand (MDD) was calculated based on multiplying MMDD by a scaling factor of 1.65 and a safety factor of 1.1, yielding an MDD of 819 gpd/ERU.

The peak hourly demand (PHD) was estimated based on MDD using Equation 3-1 and Table 3-1 of the WSDM. PHD is calculated both for the existing 20 ERU and for a buildout projection of 40 ERU.

$$PHD_{exist} = \frac{MDD}{1440}\big((C)(N) + F\big) + 18 = \frac{819}{1440}\big((3.0)(20) + 0\big) + 18 = 52\ gpm$$

$$PHD_{40\ ERU} = \frac{MDD}{1440}\big((C)(N) + F\big) + 18 = \frac{819}{1440}\big((3.0)(40) + 0\big) + 18 = 86\ gpm$$

Table 2-1: Summary of Current Systems Design Parameters

Existing Connections	20 ERU
ADD/ERU	188 gpd
MDD/ERU	819 gpd
DSL	3.2 ERU
DSL	0.5 gpm
PHD	52 gpm
PHD w/40 ERU	86 gpm

2.2.3 Pressure Zones

The system is comprised of a single pressure zone. The elevations in the community range from 675' to 770' based on data obtained from the Pierce County GIS. Maintaining system pressure at all services between 30 psi and 80 psi under static and peak opperating conditions requires private Pressure Reducing Valves (PRVs) be installed at all connections below an elevation of 727 feet. Hydraulic analyses at PHD and static conditions are included in Appendix 10.1.

2.3 Distribution System Leakage

Distribution System Leakage (DSL) ranged from 0 to 1.4 gpm during the latest 3-year period as leaks developed and were then found and fixed. The average DSL during this time remained stable at 0.5 gpm. Overall, DSL is 16 percent, which is relatively higher than expected given complete replacement of the distribution system in 2015, but is a significant improvement over DSL when the system was purchased by the PUD (see figure below). With over 3500 feet of mains and only 20 connections the ratio of pipe to connections is relatively high and likely contributes to the somewhat elevated DSL. Average leakage of 0.54 gpm is relatively low and makes finding of leaks very difficult. DSL as a percentage will likely benefit from infill following approval of additional connections. Verification and/or calibration of the source meter is also recommended; service meters were replaced in 2010, with the next planned replacement in 2030. Recording of flushing volume is also recommended; the system has requred regular flushing due to elevated iron and manganese; with the installation of the water treatement system flushing should be significantly reduced and have a positive impact on DSL.

DSL exerts a nominal impact on peak demand (0 – 1.4 gpm), but is currently equivalent to 3.2 ERU based on Annual water rights. It is likely that since future growth will be primarily infill and will not involve significant additional distribution system extension that leakage rate will remain relatively constant. However, as a conservative measure DSL as a percentage of total water use is assumed to remain constant at 16% as connections are added in the future.

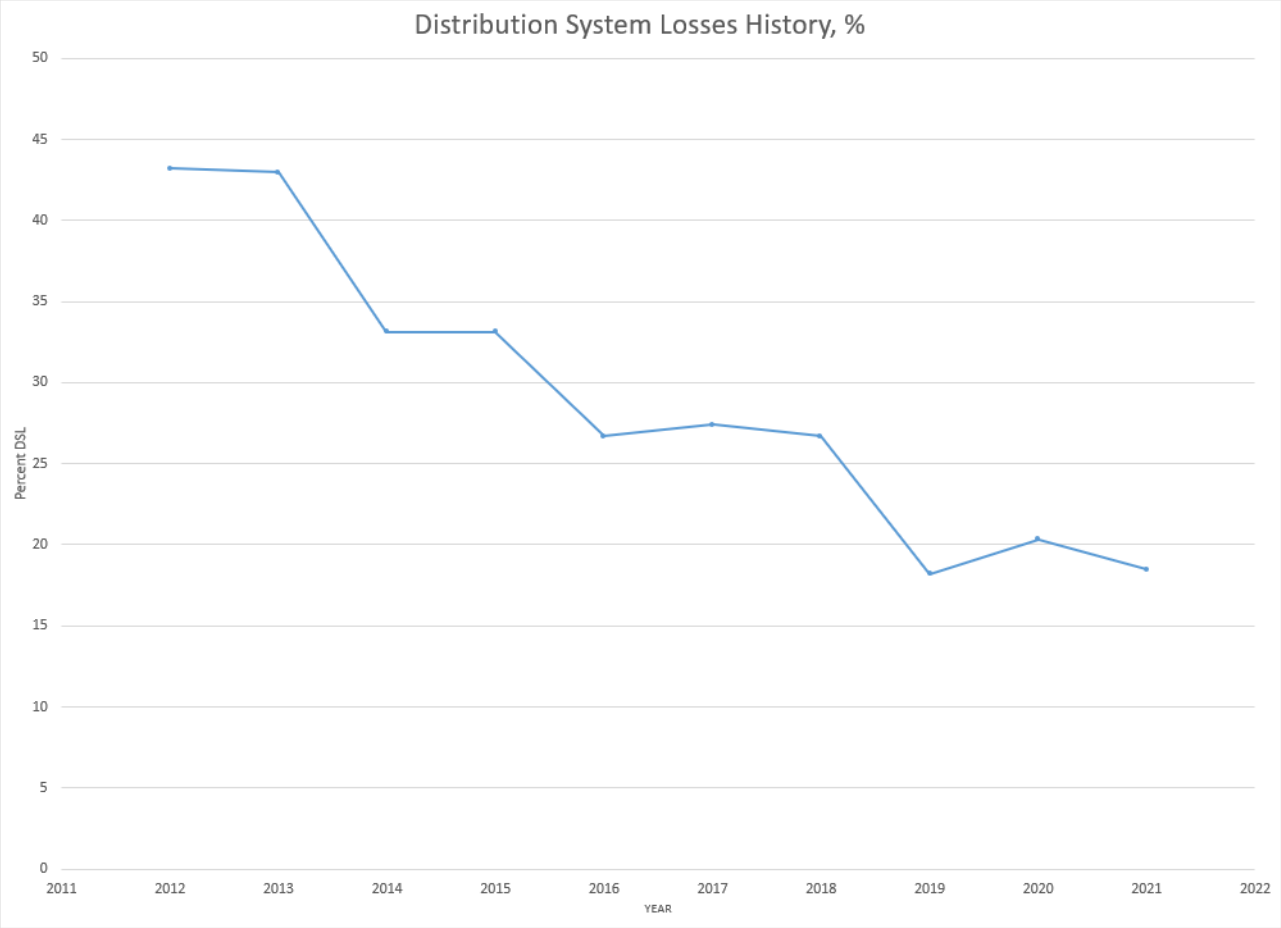

Figure 2-2: DSL Rate

2.4 Water Supply Characteristics

The Webster Hill water system is supplied by a single active groundwater well drilled in 1958. The well is 8 inches diameter and drilled to 167 feet and supplies 96 gpm. The well is chlorinated due to repeated failed coliform tests and requires a free chlorine residual of 0.6 mg/L in the reservoir to achieve CT-6. Raw source water exceeds the secondary MCL for iron and manganese. An iron and manganese treatement design was approved December 29, 2021 and the PUD will be scheduling installation once equipment arrives which is currently on backorder.

2.5 Water Supply Reliability Evaluation

The Webster Hill water system is supplied by one well with a capacity of 100 gpm, but currently opperating at 96 gpm. Standby storage of 200 gallons per connection is provided by the system's reservoir. The water right permit allows for an instantaneous pumping rate of 100 gpm, the CT-6 chlorination system was designed for 96 gpm and oxidation filtration treatement systems was designed for a 100 gpm pumping

rate. The well has been highly reliable and was in operation for most of the history of the water system prior to any standby storage and proved an adequate supply.

To the end of the next 20-year planning period Webster Hill is expected to use an average of 9.75 acre-feet per year. The water right certificate allows for withdrawal of up to 20.16 acre-feet per year, therefore water rights are not a reliability concern.

2.5.1 Interties

No interties with other systems exist or are currently proposed for the Webster Hill Water System, however an intertie with the Sunwood Graham water system would be advantageous to both systems and should be discussed with Sunwood Graham. An intertie with Sunwood Graham would requre installation of approximately 250 feet of transmission main, likely by directional drilling due to existing improvements and crossing of Webster Road E.

2.6 Future Population Projections and Land Use

The existing service area currently contains 27 lots (not including the wellsite parcel), 2 of which are undeveloped and 25 which are developed. Of these, 20 receive their water service from Webster Hill water system, and 5 from private wells. This WSP proposes extension of the service area to incorporate 21 additional parcels, 13 of which are supplied by a private wells and the other 8 being undeveloped. This gives a total of 10 undeveloped parcels following the proposed expansion of the service area.

The Graham Community Plan has not been updated to reflect population growth estimates for the next twenty years, however extrapolation of prior estimates and actual population growth would indicate a population increase of 30% to 40% over the 20 year planning period is a reasonable expectation.

The PUD has been contacted by owners or potential developers of several of the undeveloped parcels. As the chief impediment to development of these parcels has been water availability, it is considered that their development and the addition of several ERU to the water system is likely within a few years of approval of this water system plan. Further development is assumed to proceed inline with population growth estimates of the Graham Community Plan; the plan's extrapolated growth projections of 30%-40% over the next 20 years would result in addition of 6 to 8 ERU in this time span. These additional connections are likely to result from construction of ADU's on parcels with existing dwellings, transition of homes on private wells to the water system, or possible approval of further subdivision. It is not anticipated that this growth will significantly alter the character, demographics, or water use of the community. Altogether approximately 18 to 20 additional ERU are projected within the next 20 years, which can be accommodated by the 20 additional connections requested by this WSP.

2.7 Future Water Demand

ADD is expected to remain relatively stable over the coming planning period due to two counteracting trends. The first trend is increased irrigation due to an increasingly longer and warmer dry season.

Opposing this are declining indoor usage in newer homes due to plumbing code efficiency measures, and typically reduction in lawn and landscaping area of new homes due to environmental code changes. Thurston PUD has a tiered rate structure in place which incentivizes conservation; given that this tiered rate has been in place for several years at Webster Hill, it is unlikely that this will drive further reduction in water use.

Thurston PUD has been actively fixing leaks and replacing old inaccurate meters over the past several years, which has reduced water loss from 40% down to a 3-year rolling average of 16%. It is likely that this will remain relativity constant into the future as Thurston PUD continues repairing leaks occurring as the distribution system ages, though it may be improved by the action of infill in adding domestic demand without commensurate increase in distribution main length.

Assuming ADD and DSL remains stable, TPUD has capacity for up to 80 ERU based on water rights and is therefore able to accommodate a large degree of future growth. At the next WSP update a review of water demand is recommended; expansion of the water system beyond 40 connections will likely requre either installation of a second well, or of a larger reservoir. See water rights self-assessment in appendix 10.5 and capacity analysis of Section 3.3.

Table 2-2: Population and Water Use Projections

Year	No. ERU	DSL ERU	ADD gpd/ERU	MDD gpd/ERU	PHD gpm	System Annual Use Ac-ft
2022	20	3.2	188	819	52	4.88
2032	28	4.5	188	819	66	5.90
2042	32	5.1	188	819	73	6.74

2.7.1 Other Systems

No interties exist or are planned to the Webster Hill water system within the next 20 years. No water use by other systems is therefore considered.

Chapter 3 System Inventory and Analysis

3.1 System Design Standards

All design and future construction shall be completed in accordance with the Washington State Department of Health Water System Design Manual (Design Manual) and Thurston PUD construction standards, which are found in Appendix A of the Umbrella Plan. The following is a brief summary of relevant standards set forth in the Design Manual:

Water Demand	Chapter	3
PHD	Equation	3-1
Capacity Analysis	Chapter	4
Distribution System	Chapter	6
Hydraulic Analysis	Section	6.1

3.2 System Inventory and Asset Condition Assessment

3.2.1 Distribution System

The community's distribution system consists of an array of primarily 4" waterline, with short 2 inch spurs serving a few connections at line ends. Waterlines are not looped but are equipped with blow-offs for flushing. A summary of pipe sizes and quantities in service are shown in Table 3-1.

Table 3-1: Pipe Inventory

Nominal Pipe Size	Installed Length
2"	480 feet
4"	3,050 feet
Total	**3,530 feet**

The community's sources and services are all metered. The service meters are read and billed monthly.

Table 3-2: Valve, Blow-off, and Appurtenance Inventory

Component	Number Installed
2-in valve	2
4-in valve	9
2-in Blow-Off	5
Single Service Assembly	18
Double Service Assembly	1

3.2.2 Sources

Webster Hill is supplied by a single Well which pumps direct to the reservoir, with water being chlorinated, and filtered for iron and manganese. The pump curve and well log are given in Appendix 10.2.

Well 1 is 8 inches diameter and drilled to 167 feet and was drilled in 1958. Based on available records it apears that the well is equipped with a 5 HP 75 gpm Goulds submersible pump installed in 2005. Well 1 is located adjacent to the reservoir and installed on a pitless adaptor. Rated capacity of Well 1 is 100 gpm, however it has been opperating at 96 gpm. Static water level is 82 feet, and pumping water level at 100 gpm is 140 feet. A summary of the wells is shown in Table 3-3.

Table 3-3: Summary of Sources

Well	Well Tag	Well Depth	Static Water Level	Capacity (gpm)	Pump Size	Pump set Depth	Pumps To	Controlled By
1	AEF407	167	82	100	5 hp	Unk.	Reservoir	Float

3.2.3 Water Rights and Capacity

Table 3-4 summarizes the system's water rights and pumping capacities. The water rights self-assessment tables and the water right certificate can be found in Appendix 10.4. The system is within their water rights based on annual usage, and based on water use projections, it is expected that annual water right is sufficient throughout buildout.

Table 3-4: Water Rights and Pumping Capacities

Well	Certificate Number	Priority Date	Qi[1] (gpm)	Qa[2] (acft/yr)	Current Capacity (gpm)
1	G2-00989C	5/27/1971	100	20.16	96

3.2.4 Storage

Storage is provided by a 23,500 gallon concrete reservoir installed in 2010. As-built drawings show a 16.5 foot by 16.5 foot by 10 foot tall square concrete reservoir, however the reservoir is actually a 20 foot diameter by 10 foot tall round concrete tank built by Mount Baker Silo. Overflow is located at 9.5 feet, which combined with the bottom 0.5 feet constitutes 1 foot (2,350 gallons) of Dead Storage. The well pump is operated based on a float, with on/off settings at 8.5 and 9.0 feet respectively, constituting Operational Storage of 1,175 gallons. The remaining 18,800 gallons are available for standby and equalizing storage. The reservoir structure is in good condition and has an expected lifespan of 80 years and a current age of 12 years.

3.2.5 Water Treatment

Webster Hill is equipped with primary disinfection providing CT-6. Disinfection consist of injection of liquid sodium hypochlorite proportionally injected based on well pump on/off operation. Contact time is

[1] Qi is defined as the maximum instantaneous withdrawal rate allowed by water rights.
[2] Qa is defined as the maximum annual withdrawal allowed by water rights.

provided by the standby storage component of the reservoir. Requred minimum residual to achieve disinfection is 0.6 mg/L free chlorine.

A design has recently been completed by Murraysmith for installation of a greensand based oxidation filtration system to remove iron and manganese prior to the reservoir. The system has not yet been installed due to material procurement difficulties, but will consist of four 24 inch diameter by 72 inch tall fiberglass filter tanks bedded with greensand plus. The oxidation filtration treatement system utilizes the already present disinfection chlorine for oxidation, and the catalytic and physical filtration of the greensand media to oxidize and remove iron and manganese. The system is designed to treat a flow rate of 100 gpm, and requires 38 gpm for backwash. Backwash disposal is to a 1,500 gallon backwash tank and existing drainage basin.

3.2.6 Booster Pumps and Pressure Control

The Webster Hill water system is pressurized by two Flint and Walling Model C22253 5 Hp booster pumps and five 120 gallon pressure tanks. The booster pumps operate on a lead lag alternating pressure switch, with a lead pump on/off setting of 50/70 psi, and lag of 40/60 psi. Booster pump capacity is a combined 180 gpm at 60 psi.

3.2.7 Buildings

The Webster Hill water system consist of only one pumphouse building, which houses the booster pumps and controls, pressure tanks, chlorination equipment, and greensand filters. The area surrounding the pumphouse, reservoir, and well head is fenced and gated. See Table 3-5 for building summary.

Table 3-5: Summary of Buildings

Site	Building Size	Year Constructed	Notes
1	12' x 16'	2010	Electrical new in 2010

3.3 Capacity Analysis

Service Area

The service area currently consists of 31 parcels, 27 of which are developed as single family homes, and 4 being undeveloped. As described in Sections 2.1 and 2.6 significant growth is possible based on zoning, however based on Pierce County planning projections, critical areas, and existing development it is likely that approximately 10 to 12 ERU will be added in the next 20 years, for a 20 year connection projection of 30 to 32 ERU total.

Water Rights

The system's water right is limited to 100 gpm and 20.16 acre-feet per year (See Appendix 10.4). Rearranging Equation 3-1 of the Water System Design Guide allows calculation of the number of services which could be supplied by the instantaneous water right without equalizing storage (the existing reservoir does not provide equalizing storage).

$$N_{wr,instant} = \frac{\frac{1440}{MDD} * [Q_i - 18] - F}{C} = \frac{\frac{1440}{819} * [100gpm - 18] - 0}{3} = 48\ ERU$$

Reservoir storage could be increased to serve as many ERU as the instantaneous water right permits be pumped at MDD. Therefore, the number of ERU's that may be served by the system's permitted withdrawal under MDD conditions are considered.

$$N_{wr,instant} = \frac{100\frac{gal}{min} * 1{,}440\frac{min}{day}}{819\frac{gpd}{ERU}} = 146\ ERU$$

From Table 2-1 ADD is 188 gpd/ERU, or multiplying by 365 days per year and converting to acre-feet, a typical ERU uses 0.2101 acre-feet per year. Therefore, annual water rights limit the system as follows:

$$N_{wr,annual} = \frac{20.16\ acft/yr}{0.2101\ acft/yr} = 81\ ERU$$

Source Capacity

The existing reservoir does not supply equalizing storage, therefore the source must be capable of supplying PHD. Given a capacity of 100 gpm, equation 3-1 of the Water System Design Guide can be rearranged to calculate capacity of the well to supply the system without equalizing storage:

$$N_{well,instant} = \frac{\frac{1440}{MDD} * [Q_i - 18] - F}{C} = \frac{\frac{1440}{819} * [100gpm - 18] - 0}{3} = 48\ ERU$$

Reservoir storage can be used to increase the capacity of the system to serve instantaneous demand of the system. The sources must still provide sufficient capacity for the maximum daily demands. Peak daily production is found by taking the product of the instantaneous capacity for each well, the number of minutes in the day, and the percentage of the day that the wells may be operated. In general wells should not be pumped for more than 50% of the day at their peak capacity year-round; however, on peak demand days they may be pumped up to 20 hours. The source capacity in terms of the number of ERUs that may be served is then calculated using the MDD of 819 gpd/ERU as follows:

$$N_{source,ES} = \frac{100\ gpm * 20\frac{hours}{day} * 60\frac{minutes}{hour}}{819\ gpd/ERU} = 146\ ERU$$

Water Treatement

Source water is disinfected with sodium hypochlorite to achieve CT-6, and is also treated to reduce levels of iron and manganese. Disinfection is designed to operate at 96 gpm; this rate could be increased by increasing the chlorine residual, however no change is proposed at this time. The iron and manganese

treatement system is designed to operate at 100 gpm. The more limited current operation of the disinfection system at 96 gpm is used to calculate treatement system capacity:

$$N_{treatement} = \frac{\frac{1440}{MDD} * [Q_i - 18] - F}{C} = \frac{\frac{1440}{819} * [96gpm - 18] - 0}{3} = 46\ ERU$$

Pressure Pumps

The booster pumps listed in Section 3.2.6 have a total combined capacity of 180 gpm. Rearranging Equation 3-1 of the Design Manual, the booster pumps limit the system to:

$$N_{booster} = \frac{\frac{1440}{MDD} * [Q_i - 18] - F}{C} = \frac{\frac{1440}{819} * [180gpm - 18] - 75}{2.0} = 105\ ERU$$

Storage

As discussed in Section 3.2.4, the system is supplied by a single 23,500 gallon 20-ft diameter by 10-ft tall concrete reservoir located on the well parcel. The reservoir has a capacity of 2,350 gallons per foot elevation. Overflow is located at 9.5 feet, giving a usable volume of 22,325 gallons. The well pump is operated based on a float, with on/off settings at 8.5 and 9.0 feet respectively. This makes the Operational Storage (OS) component 1,175 gallons.

The system does not requre Equalizing Storage (ES), as the well and treatment system are capable of meeting PHD.

Dead Storage (DS) is unavailable for other uses due to reservoir configuration. Dead storage represents the bottom 6 inches of the reservoir and the upper 1 foot above the pump cutout float switch setting. A total of 1.5 feet DS equates to 3,525 gallons DS.

The system is not capable of supplying fire flow, and was installed prior to adoption of Pierce County fire flow standards. New connections to the water system on lots less than 1 acre in size may requre installation of residential fire suppression systems.

Standby storage (SB) is required for community water systems and is intended to provide continued water supply during electrical or mechanical failures, source contamination, etc. The system has been highly reliable and opperating on a single source for the past 45 years, the majority of that time prior to installation of a reservoir to provide any level of standby service. Given this the alternative minimum of 200 gpd per connection will be used. Subtracting OS, DS, ES, and FFS from the nominal reservoir volume gives a volume of 18,800 gallons (8.0 feet water column) available as SS.

$$N_{SB} = \frac{18{,}800\ gallons}{200\ gallons/ERU} = 94\ ERU$$

The table below provides a summary of the total storage volume allocation.

Table 3-6: Summary of Reservoir Volume Allocations

Storage Component	Volume (gal)
Dead Storage	3,525
Operational Storage	1,175
Equalization Storage	0
Fire Suppression Storage	0
Standby Storage	18,800
Equalization Storage	0
Total Storage	23,500

Distribution System

Maximum PHD that the current distribution system can support was determined by iteratively increasing flow rates until reaching a pipe velocity of 8 fps or until the worst-case node fell to 30 psi. The limiting factor was pipe velocity, which limits the system to a PHD of 313 gpm. Using this in the rearranged Equation 3-1 from the WSDM as used above yields the distribution system limitation.

$$N_{Distribution} = \frac{\left(\frac{1440 * (313\ - 18)}{819} - 75\right)}{2.0} = 222\ ERU$$

The system cannot provide fire flow with the existing distribution system and reservoir; therefore, no resulting limitations were evaluated.

Summary

The current systems limits are shown in Table 3-7.

Table 3-7: System Capacity Summary

Limitation	Maximum ERU
Water Rights, Instantaneous withdrawal	48
Water Rights, Annual withdrawal	81
Total Source Production	48
Water Treatment	46
Booster Pumps	105
Reservoirs	94
Distribution System	222
Most Limiting Factor: Water Treatment	**46**

3.3.1 Water Rights Self-Assessment

See completed Water Rights Self-Assessment documents in Appendix 10.5 for existing status and 20-year forecast.

3.3.2 Source of Supply Analysis

The water system is served by a single groundwater source, but has a reservoir supplying standby storage. Based on current zoning and development it is unlikely that the system will ever exceed its existing water rights.

3.4 Distribution System Analysis

3.4.1 Model Description

Distribution System hydraulics were modeled using EPAnet 2.2. The entire system consists of a single pressure zone, supplied from the booster station (modeled as a water supply at minimum booster station operating pressure). A surface roughness of 150 was used for C900 pvc pipes, with service connections modeled as nodes.

3.4.2 Scenarios

The system does not provide fire flow; therefore three scenarios were analyzed: Peak hourly demand flow rates, 8 fps velocity flow rate, and Static conditions. Demand was assigned by multiplying the unit demand at the node by a demand adjustment factor. For PHD this model was run at the system limiting condition of maximum output of the treatement system (96 gpm), with pressure at the booster station cut in setting of 40 psi (booster pumps can supply 180 gpm at this pressure). Static conditions were modeled with no flow, and pressure at the booster station cutout pressure of 60 psi. 8 fps velocity conditions were modeled by incrementally increasing node demands until any pipe exceeded a flow rate of 8 fps.

3.4.3 Model Results

Model results show that the system exhibits only very minor friction losses, with pressure differences largely driven by elevation. The system will be able to deliver water to every point in the system at PHD with just 2.7 feet of head loss due to friction to the worst-case connection. Maximum velocity at PHD is 2.4 ft/s. The current projection for minimum system pressure throughout the system at build-out PHD is 33.2 psi.

A pipe flow rate of 8 fps was achieved at a system demand of 313 gpm. At this flow rate minimum pressure at was 31.4 psi; therefore the distribution system is not considered a limiting element of the water system.

Static conditions were evaluated assuming maximum pressure set points for booster pumps are reached. This gives a peak distribution pressure of 96 psi at the southern most and lowest elevation area of the system. System pressures are not being changed from those currently and historically in use; any new connections located below an elevation of 727 feet requre installation of private PRV valves in order to maintain static pressure below 80 psi.

3.5 Summary of System Deficiencies

The distribution system is pressurized by booster pumps and cannot operate by gravity, as some connections are at higher elevation than the reservoir. Though the system has historically had a high level of reliability and consumer satisfaction with level of service, a backup power generator is recommended.

All existing infrastructure is in good working order. With the exception of the well and submersible pump, all infrastructure is quite new and dates from 2010 or later. The well was installed in 1958, and the most recent submersible pump installed in 2005. Replacement of the submersible pump should be anticipated in the next 5 years.

The system has no significant hydraulic capacity limitations. Modeling suggests that the system will be able to provide adequate flow and pressure through any likely level of community build out and occupancy. The distribution system is not currently capable of providing fire flow, but this is not considered a deficiency because it is not required, due to the system being grandfathered in under the old regulations.

Chapter 4 Water Use Efficiency Program

In 2003, the Washington State Legislature passed Engrossed Second Substitute House Bill 1338, known as the Municipal Water Law, to address increasing demand on the state's water resources. The law established that all municipal water suppliers must use water more efficiently in exchange for water right certainty and flexibility to help them meet future demand. The Legislature directed the Department of Health to oversee and enforce a WUE program to help support the collective goal of ensuring a safe and reliable drinking water supply. The WUE program seeks to support this goal in the following ways:

- Contribute to long-term water supply reliability and public health protection,
- Promote good stewardship of the state's water resources, and
- Ensure efficient operation and management of water systems.

This program became effective on January 22, 2007 and established certain responsibilities that water suppliers must fulfill. Fundamental elements include the following:

- Water use efficiency program,
- Distribution leakage standard,
- Goal-setting and performance reporting, and
- Metering requirements

This chapter summarizes Webster Hill's compliance with conservation planning requirements including the actions taken to promote water use efficiency, and the conservation program that Webster Hill will implement. The applicable WUE program requirements and guidelines are contained in *Water Use Efficiency Guidebook*, Third Edition, January 2017 (DOH 331-375).

4.1 Source and Service Metering

4.1.1 Source Meters

All sources are metered. Any additional sources developed in the future will be metered when installed.

4.1.2 Service Meters

The system is fully metered. Meters are read and billed monthly. The system billing software provides month by month total usage reports which are used for calculating distribution system leakage. All new services will be metered upon activation.

4.2 Distribution System Leakage

If a system's distribution system leakage exceeds 10 percent, the conservation program must also provide an implementation program that includes leak detection and repair, and other measures to reduce water loss. Webster Hill's distribution system leakage was historically 25% to 40% prior to PUD ownership, but with leak detection and repair has been significantly decreased to an average of 16% over the past three years. Though the current three-year average leak loss is 16%, this is reflective of the overall low annual water use of the system and high ratio of distribution pipe length per customer rather than high leak loss.

Actual average leak loss is under 0.52 gpm. Staff have training and equipment to respond to leak reports from customers generally within a few hours of the report. Significant discrepancies between service meter and source meter records are investigated. Given the low rate of leak, further improvement via leak detection is not likely feasible.

4.3 Water Use Efficiency Program

4.3.1 Current Program

The Thurston PUD Board of Commissioners recognizes that water is a valuable commodity and the wise and efficient use of water is a goal that is in the best interests of its constituents.

4.3.2 Goals

State regulation (WAC 246-290-830) requires the governing body of the municipal water system to develop the water use efficiency goals through a public process. The current WUE goal was considered in a public meeting held on October 19, 2020. The current goal for years 2021 through 2030 is to reduce and/or maintain the annual average demand per connection, for all Group A systems, to no more than 250 gallons per day. The Webster Hill 610 water system is currently meeting this goal.

4.3.3 Measures

As part of a water system plan, DOH regulations also require the implementation of a specified number of water use efficiency measures. WAC 246-290-810 identifies the minimum number of water use efficiency measures that must be evaluated based on system size. Thurston PUD has less than 9,999 connections and therefore must evaluate or implement six supplementary water use efficiency measures in addition to the mandatory measures. Please see Part A WSP, chapter 3.4 for Water Use Efficiency Measures.

In addition to water efficiency measures identified in the Part A WSP, Thurston PUD currently offers customers the following efficiency related devices and incentives:

- Shower Timers -first come first serve basis
- Irrigation Timers -first come first serve basis
- High Efficiency toilet rebate ($50.00)

4.3.4 Reclaimed Water

Systems serving more than 1,000 connections are required to evaluate reclaimed water opportunities. The Webster Hill system is comprised of properties that have private septic systems, and therefore would not be able to implement a sewer treatment plant for reclaimed water use. With fewer than 1,000 connections, Webster Hill is not requred to further evaluate reclaimed water opportunities.

4.3.5 Consumer Education Program

Thurston PUD sends out seasonal water conservation tips to customers at least bi-annually within our monthly newsletter. Conservation is also included in our annual consumer confidence reports. Newsletters can be found online at http://www.thurstonpud.org/pud-news-newsletters.htm

4.3.6 Annual Reports

The annual report provided to DOH by July 1 must include:

- Total system production and system wide consumption
- Distribution system leakage in percentage and volume
- Goal description, schedule, and progress toward meeting goals

Thurston PUD submits the annual WUE report on DOH's SENTRY database system, https://fortress.wa.gov/doh/eh/portal/odw/si/Disclaimer.aspx?Page=FindWaterSystem.aspx, before July 1 every year and adds a copy of the report to the website at http://www.thurstonpud.org/water-systems-ccr-2017_copy(1).htm. Additionally, the District reports this information to each customer on the annual Consumer Confidence Reports (CCR), example included in the Part A Water System Plan, Appendix J . The CCR provides each individual water system the current goal, total water produced and what the average household used for that water system.

4.3.7 Water Rates

Please see Water System Plan Part A, Section 6-6 and 6-7 for discussion and evaluation of current and future rates. Please see Thurston PUD website for current rates and fees http://thurstonpud.org/our-rates.htm.

4.4 Demand Forecast

See Sections 2.6 and 2.7 for population and demand forecasting.

4.5 Water Use Efficiency Savings

Since acquiring Webster Hill 610, Thurston PUD has reduced leak loss from approximately 40% to under 20%. Thurston PUD has a significant successful history of improving water use efficiency of acquired systems. See WSP Part A section 3.8 for additional history of WUE Program success at Thurston PUD water systems.

4.6 DSL Exemption for Water Systems under 500 Connections

Webster Hill 610 serves less than 500 connections and has a current 12-month leak loss of 9%, with an average DSL rate of 0.36 gpm. Since acquiring the system Thurston PUD has taken significant measures to reduce leak loss, reducing DSL from over 40% in 2012 and 2013, to an average of 16% over the last three years. The current 3-year average leak loss rate is 0.5 gpm; it is unlikely that leak rate can be further reduced given the current limitations in leak detection technology. The distribution system was fully replaced in 2015, with source and service meters replaced in 2010 and not due for their next replacement until 2030. Thurston PUD requests exemption to operate under the 20% leak loss limit, as there are no feasible means by which Thurston PUD may further reduce DSL.

Chapter 5 Source Water Protection

5.1 Wellhead Protection

The wellhead protection program has been developed in conjunction with the WSP. The following susceptibility assessment, protection area, and contamination source inventory will provide the necessary documentation to make educated management and land use decisions to prevent aquifer contamination.

5.1.1 Susceptibility Assessment

Ground Water Contamination Susceptibility Assessment forms for each source for the Webster Hill Water System are included in Appendix 10.6. The results of the assessment are summarized in this Chapter.

5.1.2 Wellhead Protection Area

A map showing the 100-foot protected radii and the 6-month, 1-year, 5-year, and 10-year ground water travel radii is given below. The well protection radii are calculated using the formula found in the susceptibility assessment as provided by the WSDOH.

5.1.3 Contamination Source Inventory

The following are potential sources of contamination within the 10-year travel time radii:

1. Residential Septic Systems
2. Residential Chemical Applications (Pesticides, herbicides, etc)
3. Private and County Roadways

5.1.4 Notification of Findings

The following agencies will be provided with a letter (see Appendix 10.6 for a copy of the notification letter) requesting information about any potential sources of contamination within the Wellhead Protection Radii:

Tacoma-Pierce County Health Department
Pierce County Planning and Community Development
Emergency Services (911)
Washington State Department of Ecology

A letter to all the homeowners with lots within the 10-year radii will also be sent a notification letter. See Appendix 10.6 for copies of the notification letters.

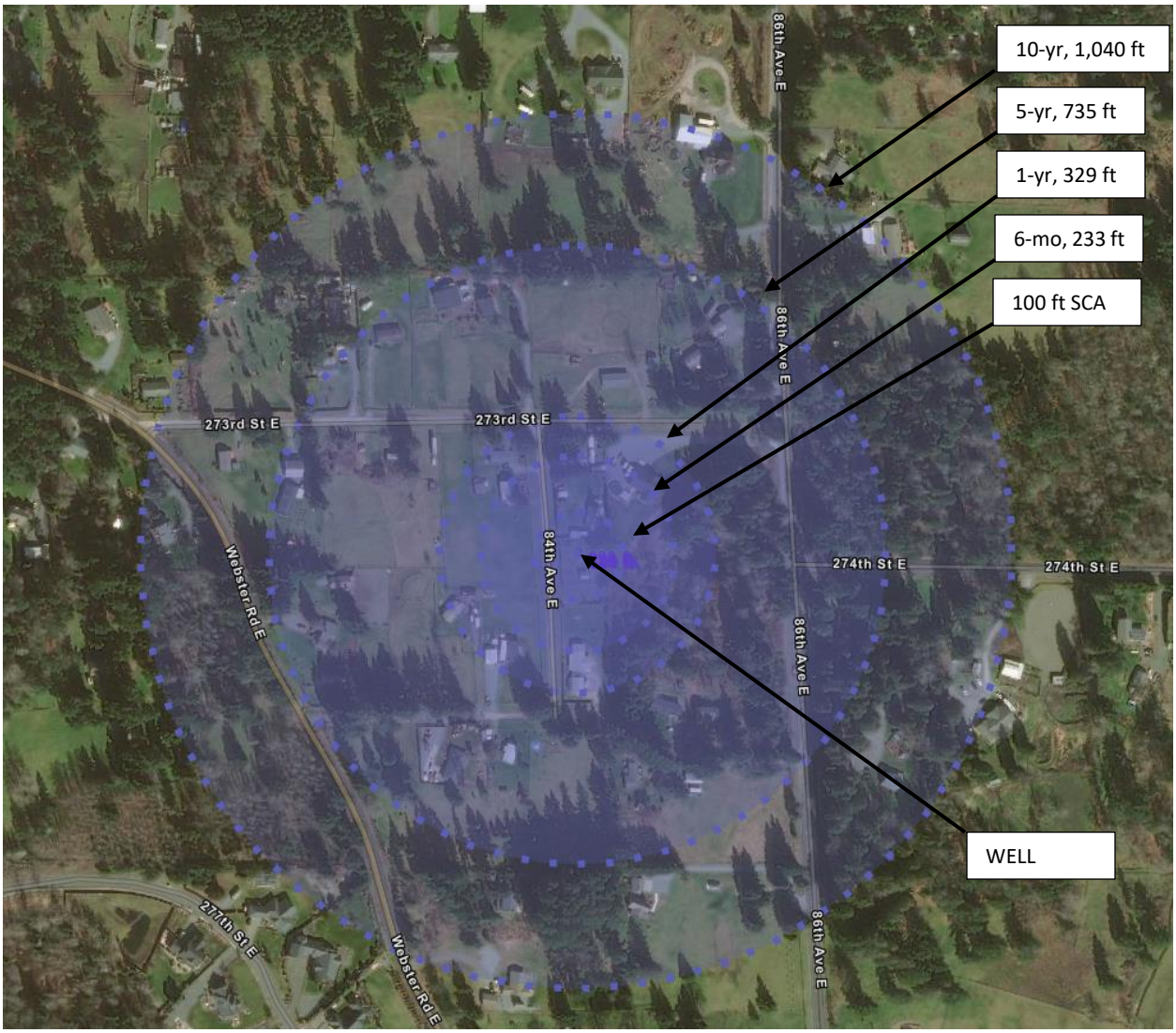

Figure 5-1: Wellhead Protection Areas

5.1.5 Contingency Planning

The well is provided with continuous disinfection, therefore biological contamination is unlikely. In the event of contamination, the well would be taken offline. Thurston PUD has the ability to provide residents with bottled water or to resupply the reservoir by tanker.

5.2 Water Quality Analysis

5.2.1 Bacteriological Testing

The system tests the distribution system for coliform bacteria each month per the coliform monitoring plan, Located in Appendix 10.7. There have been no exceedances in the past 10 years. All other parameters are tested based on the water quality monitoring schedule, located in Appendix 10.7. The water system has historically exceeded the secondary MCL for manganese and is in the process of installing treatement. There are no other known water quality exceedances.

Chapter 6 Operations and Maintenance

6.1 Water System Management, Personnel, and Certifications

See Thurston PUD WSP Part A, Sections 5.1 and 5.2.

6.2 Operations and Preventative Maintenance

The routine operation and preventative maintenance schedule for the system infrastructure is outlined in the WSP Part A in Chapter 5, Table 5-2, and further detailed in Appendix M. O & M procedures are fully detailed in Appendix N of the WSP Part A.

6.2.1 Normal Operating Conditions and Settings

Table 6-1 outlines the normal setpoints for the well pumps, reservoirs levels, and booster pumps.

Table 6-1: Normal Operating Conditions

Component	Pumps To	On Condition	Off Condition
Well 1	Reservoir 1	8.5 ft	9.0 ft
Booster Pumps	Distribution	50 psi	70 psi
Bladder Tanks	N/A	Pre-charge	45 psi
Chlorination	Reservoir 1	Minimum Residual	0.6 mg/L

6.3 Comprehensive Water Quality Monitoring

The system is sampled in accordance with its Water Quality Monitoring Schedule (WQMS), located in Appendix 10.7. If any water quality testing exceeds the standards set forth in WAC 246-290-310, the DOH will be notified immediately.

6.3.1 Coliform Monitoring Plan and Map

The coliform monitoring plan can be found in Appendix 10.7. The system takes one routine samples per month from distribution. If there are any failures, repeat distribution samples and a source sample are taken per this plan. See the Coliform Monitoring Plan for details. Response Plans can be found in the Emergency Response Plan in the WSP Part A, Appendix P.

6.3.2 Lead and Copper Monitoring

The Lead and Copper Monitoring plan can be found in Appendix 10.7.

6.3.3 Water Treatment Monitoring

Chlorine residual is measured downstream of the reservoir 5 days per week and reported to WSDOH on a monthly basis.

6.3.4 Disinfection Byproduct Monitoring

The Disinfection Byproduct Monitoring Plan can be found in Appendix 10.7.

6.4 Emergency Response Program

The Emergency Response Plan is found in the WSP Part A, Appendix P.

6.5 Cross Connection Control

The cross-connection control policy and program are located in the WSP Part A, Appendix R. A list of backflow devices can be found in this WSP Part B, Appendix 10.7.

6.6 Sanitary Survey Findings

The latest Sanitary Survey was performed in 2019. The following significant deficiencies and findings were observed:

- Remove or Plug the former chlorine injection point
- Chlorine solution tank vent screen needs replacement
- Seal duck -bill valve on storage tank outflow.
- Add screen to storage tank drain line.

All significant deficiencies and findings have been addressed.

6.7 Summary of O&M Deficiencies

Overall, the system is well maintained and repairs and upgrades are routinely made. All significant system deficiencies identified during the most recent Sanitary Survey have been addressed. Other O&M items to be addressed include:

6.7.1 Clean and Repair Pumphouse

The pumphouse should be cleaned and undergo minor repair, including ventilation improvement.

6.7.2 Continue to Find and Fix Leaks

Thurston PUD has found and fixed all significant leaks and reduced leak loss considerably, however as the distribution system ages it will continue to develop leaks. Leak loss should continue to be monitored and leaks found and fixed.

6.8 Record Keeping, Reporting, and Customer Complaint Program

See WSP Part A, Section 5.9

6.9 Customer Complaint Response Procedures

See WSP Part A, Section 5.10

Chapter 7 Distribution Facilities Design and Construction Standards

Thurston PUD requests a distribution main project exemption for Webster Hill 610 as allowed under WAC (246-290-125 (2)). The distribution design and construction standards are outlined in the Thurston PUD WSP Part A, Appendix A. Maps of the distribution system is available in Section 10.10 of this WSP Part B.

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Chapter 8 Capital Improvement Program

8.1 Prioritization Criteria

Improvements are prioritized according to the following criteria listed from highest to lowest in importance:

1. Public Health Risks
2. Adequate Supply
3. WSDOH Operation and Design Standards
4. Achieving Conservation Goals
5. Regularly Scheduled Improvements
6. Aesthetic and Optional Improvements

8.2 Prioritized List of Improvements

The reservoir and booster pumps all date from 2010 and distribution system from 2015, and are therefore relatively new and in good condition. Installation of Greensand filtration to remove manganese is currently the highest priority improvement; installation is pending receipt of backordered equipment.

1. Installation of Greensand Filtration System
2. Replace Booster Pumps and Bladder Tanks
3. Installation of new/replacement well
4. Install Backup Generator

8.3 Assessment of Improvements

8.3.1 Installation of Greensand Filtration System

Elevated manganese level has been an ongoing challenge for the water system. Murraysmith completed a design for manganese treatement using greensand filtration in 2021. The construction is approved, but has been delayed due to ongoing equipment shortages. Installation is anticipated in the later part of 2022.

8.3.2 Replace Booster Pumps and Bladder Tanks

Thurston PUD's Asset Management Plan estimates bladder tank replacement in 2027, and booster pump replacement in 2030. Given the redundancy of 5 bladder tanks, tanks can be safely replaced upon failure without negatively impacting the system. Similarly, each of the two booster pumps is able to meet PHD, therefore booster pumps will be replaced as signs of impending failure exhibit.

8.3.3 Installation of New / Replacement Well

The existing well has been operating without issue, however it is currently 64 years old. Thurston PUD uses a depreciation period of 75 years for wells, though it is not uncommon for a well to last upwards of 100 years under good conditions. The existing well is in good condition and is expected to continue to be operable for a number of years. However, proactive installation of a new well would allow increased redundancy if the existing well were maintained as an emergency source. Due to small size of the well

parcel there may be difficulties associated with obtaining a sufficent sanitary control area. It is advisable to proactively pursue a new well in the next 5-10 years.

8.3.4 Install Backup Generator

There is not currently any onsite backup power for the water system. It is the Policy of the PUD to provide automatic backup generators for water systems if a majority of customers request such service. If requested, installation of backup generator's are funded by individual water systems via a monthly customer surcharge. Residents of the water system voted on installation of a generator December 2021; less than a 50% majority of residents of Webster Hill desire a backup generator, therefore backup power will be provided as needed by one of the PUD's mobile generator units. Please See Appendix 10.8 for applicable Correspondence.

8.4 Improvement Program Summary and Schedule

Table 8-1 provides an overview of the likely schedule for capital improvements projects. See Umbrella Plan Appendix U for details of the financial program.

Table 8-1: Improvement Schedule

Improvement	Estimated Cost (2022 dollars)	Schedule	Source of Funds
1. Installation of Mn Treatement	$55,000	2022	Capital Improvement Budget
2. Replacement of Booster pumps	$14,000	2030	Capital Improvement Budget
3. Installation and approval of second well	$65,000	2030	Capital Improvement Budget

Chapter 9 Financial Program

See WSP Part A, Section 6. Thurston PUD's current Asset Management Program incorporates planning for all 273 Thurston PUD systems can be downloaded from the Thurston PUD website or made available upon request.

Chapter 10 Appendices and Supporting Documents

10.1 Hydraulic Analysis
10.2 Well Logs, Pump Curves, and Equipment
10.3 Meter Data
10.4 WFI and Operating Permit
10.5 Water Rights
10.6 Wellhead Contamination Susceptibility Assessments
10.7 Water Quality Monitoring Programs
10.8 Consistency Statements, WSP Adoption, and Correspondence
10.9 Easements, Covenants, Legal Instruments
10.10 Maps and Drawings