MEADOWS WATER SYSTEM
ID 87784Q

Water System Plan

Prepared for:

PUD #1 of Thurston County
1230 Ruddell Road SE
Lacey, WA 98503

(360) 357-8783

June 7, 2017

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Prepared by:

Steven D. Hatton, PE
HATTON GODAT PANTIER
3910 Martin Way E, Suite B
Olympia, WA 98506
(360) 943-1599

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I hereby certify that this Water System Plan for the **MEADOWS WATER SYSTEM (ID 87784Q)** was prepared under the supervision and direction of the undersigned, whose seal as a licensed professional engineer in the State of Washington is affixed below.

Signature

3/13/18
Date

Seal

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1. DESCRIPTION OF WATER SYSTEM

1.1 Water System History and Background

Construction of the Meadows Water System (MWS) began in 1979 to provide water supply facilities for "The Meadows", a residential development located east of Lacey, Washington, approximately 1.5 miles south of Interstate 5, one-half mile east of Marvin Road. The first stage of construction was certified complete in January 1980, providing water to 129 residential building sites. By 1987, Washington State Department of Social and Health Services (DSHS) approval for MWS as up to 646 connections. The Washington State Department of Health (DOH), successor agency to DSHS, approval currently is for a total of 1,894 connections.

MWS currently provides water service to 805 single family residential connections, the Meadows Elementary School, and four irrigation connections. Of the non-residential connections, water usage at the school accounts for 7 Equivalent Residential Units (ERU) while the four irrigation connections account for 16 ERUs. Total connected ERUs are, therefore, 828. A copy of the Water Facility Inventory form (WFI) is included in Appendix A.

Six wells with a combined total pumping capacity of 655 gpm alternately supply water to three pressure zones and three storage reservoirs. The main distribution system consists of a network of pipelines ranging from 4 inches to 8 inches in diameter. Currently, the water supply system is operating effectively with no incidents of low pressure.

This WSP is submitted in accordance with DOH regulations as an update to the WSP approved by DOH in May 2008. This update includes a hydraulic analysis, a source and storage capacity analysis, water right analysis, and other required elements. A Pre-planning meeting with DOH Regional Planner and Engineer was held November 6, 2015. A Pre-Plan Checklist was provided by the Regional Planner Mark Mazeski February 4, 2016. This WSP is a revision to the June 7, 2017 version originally submit to DOH who provided comments dated September 27, 2017.

MWS was originally owned by James W. Hodges and Keith Hodges. In 1996, the Hodges sold the service area to the west of "The Meadows" development, known as "Madrona Park", to the City of Lacey. A portion of their existing water rights and a City of Lacey well were included in the purchase. The City of Lacey installed an emergency intertie between the City and Meadows systems in 2000.

The City had not connected Well #7 to their system as they found more productive water sources in the Madrona Park area. Consequently, MWS purchased Well #7 back from the City in 2017. Additional well information and discussion is provided elsewhere in this WSP.

MWS was purchased by Stephen L. Harrington and Nick Adams in 1997 who reorganized in 2005 as H&R Waterworks, Inc. (HRWW). PUD #1 of Thurston County purchased H & R Waterworks late in 2017.

1.2 Ownership and Management

MWS is one of several water systems owned by PUD #1 of Thurston County (TPUD).

TPUD employs five field service technicians as well as multiple office personnel with which they implement the business plan and operate systems both owned and managed by TPUD. One of the field service technicians is responsible for inspections and testing of cross connection backflow prevention assemblies. This technician also assists with general operation, maintenance, repair and data collection activities as time permits and needs demand.

TPUD is an approved Satellite Management Agency (SMA) currently licensed by the Washington State Department of Health, Office of Drinking Water as SMA #147.

TPUD's physical address:

1230 Ruddell Road SE
Lacey, WA 98503

Phone: (360) 357-8783

Mailing address:

1230 Ruddell Road SE
Lacey, WA 98503

Fax: (360) 357-1172

1.3 Related Plans

The related plans reviewed for this water system include the following:

- PUD #1 of Thurston County - Part A Umbrella
- Thurston County Comprehensive Plan.
- Thurston County Coordinated Water System Plan
- City of Lacey Water System Plan
- City of Lacey Meadows Sub Area of the Lacey Urban Growth Area Plan

The land use for this water system is largely established by existing residential developments located within the service area and connected to the water system. For the developed properties, future subdivision or an increase in population through other means is highly improbable due to existing zoning regulations and comprehensive plans. Appendix C contains a service area map of MWS as well as a Land Use Zoning Map as published by the Thurston County GeoData website.

1.4 Service Areas and Characteristics

1.4.1 Service Area

The Meadows water service area is located at the southern tip of the Puget Sound basin, immediately east of the City of Lacey (Lacey) and is approximately 0.47 square miles in size. The original service area for The Meadows was established during the County's coordinated water supply planning process in the 1980's. Since then there have been some minor adjustments. The Service Area Map, Figure 1, depicts the service area boundary. That area is bordered on the north by Steilacoom Road and on the south by Pacific Highway; to the west by the City of Lacey Water System and the Washington Land Yacht Harbor Water System service areas. The boundary to the east includes undeveloped areas along the Nisqually River bluff and McAllister Creek

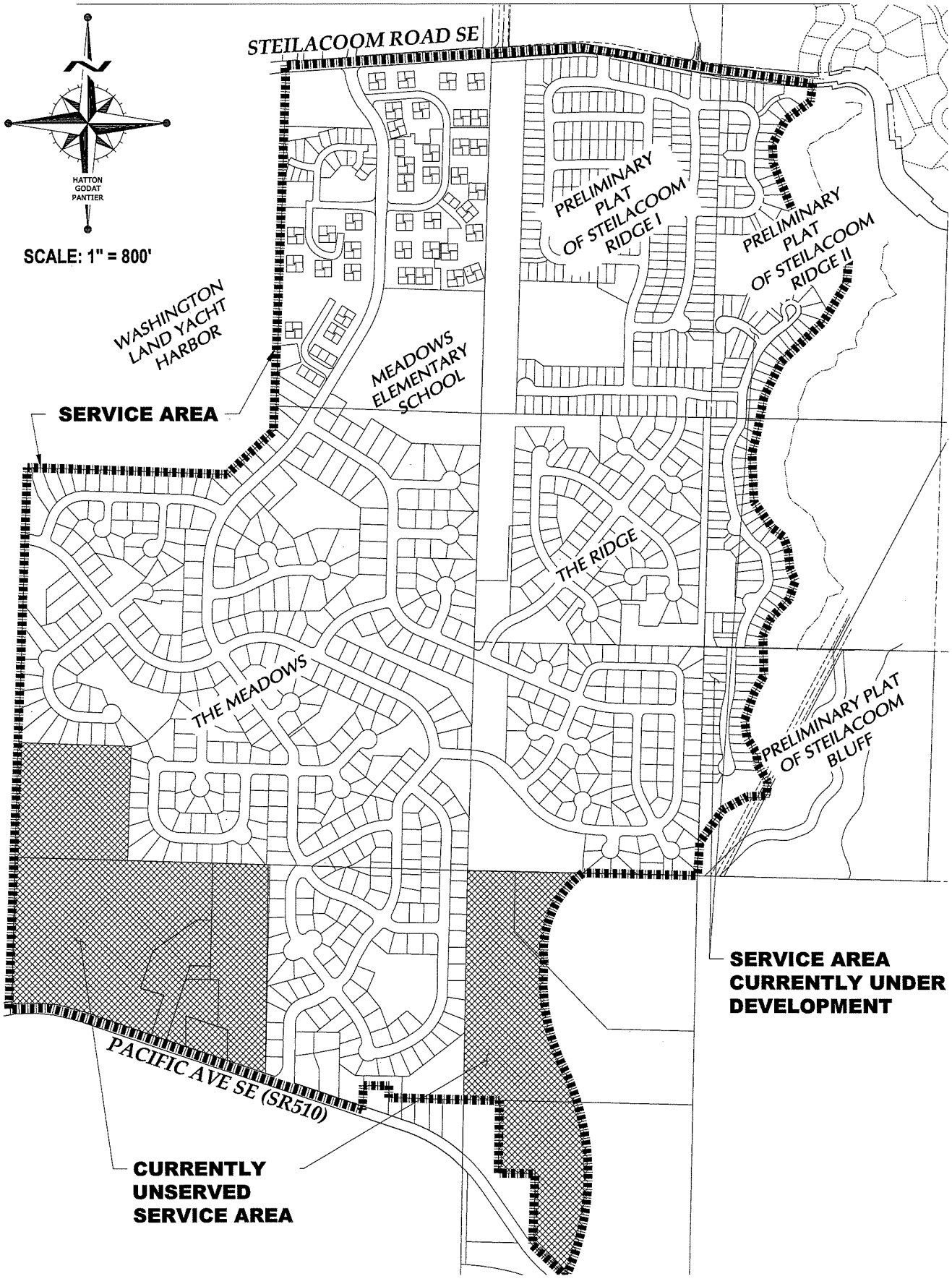
Currently undeveloped and therefore unserved portions of the service area are divided into two categories. Area #1 includes property currently occupied or under development as single family homes. The under-development land is in various permitting review phases with Thurston County. The area can generally be described as the northeastern portion of the service area. There are currently three residential subdivisions with a proposed 409 residential lots proposed in this area, all of which will be served by MWS.

Area #2 is land that MWS intends to serve but where there are no current specific plans for development. This area appears hatched in Figure 1 and includes areas north of Pacific Highway both west and east of the existing water distribution system for MWS. This part of the service area is currently mapped in the Coordinated Water System Plan (CWSP) for Thurston County as Meadows Water's service area. See Appendix C. The land lies easterly of the City of Lacey service area of Madrona Park.

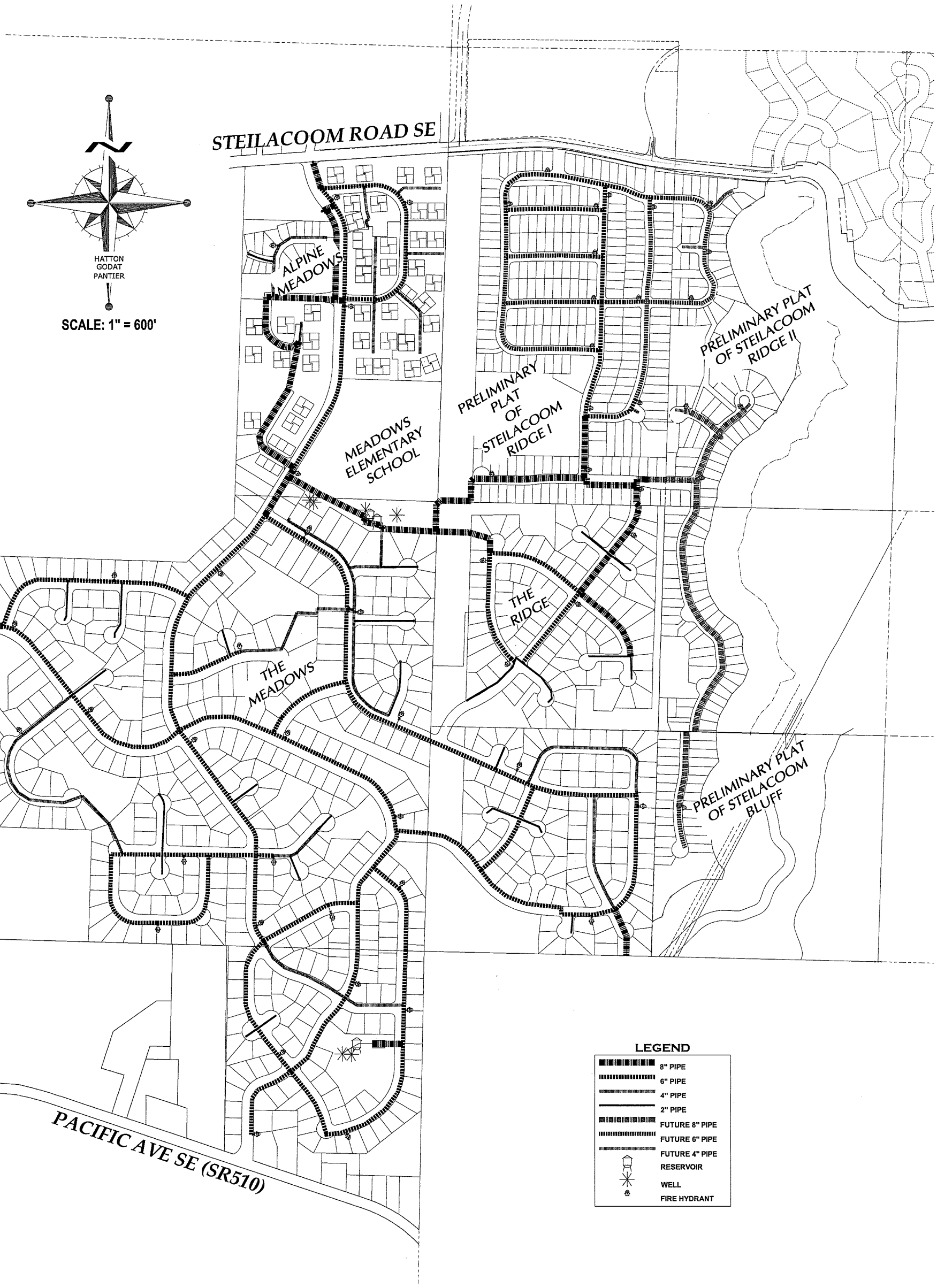
1.4.2 Service Area Agreements

No service area agreements are necessary because, at this time, there are no adjacent water service utilities to The Meadows water utility that claim the same service area as the Meadows Water System.

FIGURE 1 - MEADOWS WATER SYSTEM SERVICE



MEADOWS WATER SYSTEM MAP



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1.4.3 Service Area Policies

DEVELOPER EXTENSION AGREEMENTS

The developer requesting an extension to the Meadows Water System shall finance all costs associated with the water system extension and any improvements required for the capacity to provide service to the new services. TPUD will provide a developer extension agreement to reflect the extension or improvement needed to serve the new development. All new expansion or new construction shall meet TPUD construction standards included in Part A. The extension of watermains or the construction of new water system infrastructure will be completed at no cost to existing customers.

CROSS CONNECTION CONTROL

A cross connection control program (CCCP) has been developed for TPUD and is included in Part A. The intent of the CCCP is to prevent the inadvertent flow of contaminants back into the public water supply. An inventory of backflow assemblies installed in Meadows Water System is also included in Appendix M.

1.4.4 Conditions of Service

TPUD establishes conditions of water service at the time a development proposal is presented for review and approval. Specific conditions of approval are negotiated with the applicant/developer to insure all costs associated with the development proposal are paid by the applicant/developer. The development review and approval by TPUD will be consistent with its comprehensive water system plan, its service area, the coordinated water system planning process and TPUD's duty to serve.

Specific conditions of service will address all aspects of efficient water use, conservation, infrastructure life cycle cost analysis, infrastructure construction, engineering design, hydraulic analysis, storage requirements, fire flow as required, source development and/or acquisition, service area and any other costs of permits, approvals, licenses, updates to the Water System Plan, mapping, surveying and other costs incurred by TPUD and the applicant/developer for the proposed project.

All work, including water system engineering and construction, shall be performed at the applicant/developer's expense by companies approved and selected by TPUD.

TPUD will determine the extent of easements it believes are necessary to ensure adequate control and access to the project area. The applicant/developer will provide blanket non-exclusive easements and/or distribution easements over, under and across the open space areas and right-of-ways in the project area for TPUD for the construction, maintenance, use, operation, repair, replacements of water lines, appurtenances and water supply facilities, including erection and/or construction of necessary facilities and structures, to provide domestic and fire flow water service in the TPUD water system service areas.

2. BASIC PLANNING DATA

2.1 Current Population, Number of Service Connections and ERUs

Table 2.1 presents current and projected population and service connections over the next twenty years. Other than one elementary school, there are no current or projected commercial, industrial, agricultural or multi-family service connections on this water system.

The number of services is presented in Equivalent Residential Units (ERUs). An ERU is a measure of the daily water consumption for a typical household. The value of an ERU can vary based on size of the residential lot, income level of the house, and age of the system. For MWS, an ERU is based on the average daily volume of water used by all connections.

Service connections over the next 10 years are projected by expected lot sales by the developer of the 409 lots in the northeast part of the service area as this growth will make up the majority of the system growth. Beyond 2027, growth is projected at approximately 4% reflecting County - wide trends.

Table 2.1 Projected Future and Population

Year	Number of ERU's	Average Persons/ Household	Estimated Population
2017	828	2.5	2,070
2018	850	2.5	2,125
2019	875	2.5	2,188
2020	900	2.5	2,250
2021	950	2.5	2,375
2022	1,000	2.5	2,500
2023	1,050	2.5	2,625
2027	1,290	2.5	3,225
2037	1,900	2.5	4,750

2.2 Current Water Use and Data Reporting

"Accounted For" water consumption for the last five years is provided in Appendix L which records water pumped from all sources and the volume used through all water service meters. The number of services remained effectively unchanged over this time frame. Examples of "Accounted For" water uses also include line flushing, fire-fighting and water used for reservoir cleaning and street cleaning. These non-consumer uses are also shown in Appendix L.

"Unaccounted" water is defined as the difference in the volume pumped and that measured in the service meters or otherwise accounted for. Examples of unaccounted water include theft, meter inaccuracies, meter reading errors, water line leakage, watermain breaks and accounting errors.

Water consumption data is summarized in Table 2.2 as derived from the usage table included in Appendix L. See also Chapter 4 for more on distribution system leakage.

Table 2.2 Water Usage Data

Year	Total Use (gal/yr)	Water Right Use (ac-ft/yr)	DSL Unaccounted for Water (gpd/____)	DSL %	Authorized Consumption (gpd/ERU)	Total (gpd/ERU)
2016	67,157,168	206	13,632,060	20%	177	222
2015	70,125,216	215	17,291,283	25%	175	232
2014	64,235,696	197	10,993,662	17%	176	213
2013	58,139,290	178	6,327,793	11%	171	192
2012	52,794,776	162	0	0%	175	175
					AVERAGE	**207 gpd**
					MEDIAN	**213 gpd**

2.3 Projected Land Use, Future Population and Water Demand

2.3.1 Projected Land Use

The land use for The Meadows Water supply service area has four different zoning classifications (see Meadows Zoning Map in Appendix C) including:

- Open Space Institutional OS-I
- Agricultural AG
- Low Density Residential (0-4) LD 0-4
- Low Density Residential (3-6) LD 3-6

The areas projected for development are within the eastern portion of the MWS service area and are all zoned Low Density Residential, 0-4 dwelling units per acre (LD 0-4). This same zoning comprises the majority of the area within the Service Area

A small future service area on Pacific Highway near the southwesterly extent of the water system is zoned Low Density Residential, 3-6 dwelling units per acre. Lots in the both the LD-3-6 and LD 0-4 zone are expected to average 5,000 square feet in size, a very urban lot size. Existing lots within the MWS are generally significantly larger, oftentimes 2-3 times as large. Irrigation demand for the future lots will, therefore, be reduced, on average, from existing services.

2.3.2 Future Population

The future population served by this water system is estimated in Table 2.1. Population estimates assume undeveloped areas will develop at the maximum density allowed based on current zoning for each area.

There are approximately 220 acres of undeveloped land in the declared Retail Service Area for MWS. Development of these properties could include up to 1,320 additional ERUs in addition to the 409 lots currently being developed. At maximum development, MWS could exceed 2,500 ERUs. This is not expected to occur within a 20 year planning horizon.

2.3.3 Water Demand Forecasting

The maximum average water use per ERU was calculated at 232 gpd which is the same as computed in the last WSP updated in 2006. This figure is defined as the Average Daily Demand (ADD). See Table 2.2. ADD has varied substantially over the last 5 years ranging from a low of 175 gpd up to a high of 232 gpd. For this planning cycle, ADD is assumed at 225 gpd, approximately 5% greater than the median value of 213 gpd from Table 2.2.

At ADD as described above, MWS can support up to 1,975 ERUs based on existing water rights (498 acre-feet per year total withdrawal). Additional discussion regarding water rights is included in Chapter 4.

ERU's for the Elementary School are calculated from water usage over the 40 month period, January 2005 to April 2008. Average monthly demand over this period was 9,890 cubic feet. However, that average included two months, nearly ten times the average. Throwing out these two high readings and corresponding low readings, yields an average of 6,200 cubic feet per month (46,376 gal/mo or 1,546 gpd). Setting an ERU at 225 gpd, the school equates to approximately 7 ERU's.

Irrigation usage is taken from 2016 meter readings at the four irrigation meters (1.3 MMgal). See Appendix L. At an ERU of 225 gpd, this equates to 16 ERUs. However, 68% of that usage was from one of the new subdivisions and relates to starting landscaping. That figure is expected to reduce to 12 ERUs as landscaping matures and needs decline.

Table 2.3 shows the proposed water system demand forecast through the next 20 years. The annual water demand is expected to increase to 447 acre-feet of water assuming planned conservation measures are effective. Without conservation measures the water use efficiency (WUE) would increase by an estimated 8% for a total of 479 acre-feet of water used by all customers.

Table 2.3 Water Demand Forecast

Year	#ERUs	Projected Population	Average Water Use per ERU without WUE (gpd/ERU)	Projected Annual Water Demand (ac-ft)	Average Water Use per ERU with WUE (gpd/ERU)	Projected Annual Water Demand (ac-ft)
2017	828	2,070	225	209	225	209
2018	850	2,125	225	214	222	211
2019	875	2,188	225	220	219	215
2020	900	2,250	225	227	216	218
2021	950	2,375	225	239	213	227
2022	1,000	2,500	225	252	210	235
2023	1,050	2,625	225	265	210	247
2027	1,290	3,225	225	325	210	304
2037	1,900	4,750	225	479	210	447

3. SYSTEM ANALYSIS

3.1 Overview

TPUD uses the design standards in accordance with the DOH Design Manual. Since they own and operate many water systems in various jurisdictions, TPUD has decided to adopt and use those standards to provide consistency throughout their service area.

MWS consists of six wells as the source of supply, three booster pump stations and reservoirs flow. MWS provides fire flow throughout the service area with a minimum of 750 gpm for over 60 minutes as required for systems of this size and density by the Thurston County Fire Marshal.

There is no water treatment on the system.

MWS includes three pressure zones as shown in Figure 3.1. The original pressure zone is known as the Foxfire Pressure Zone and serves the majority of MWS. The Pinedrop and Foxfire reservoirs are located within this zone which also includes all system wells and Booster Pump Station #1 (BS-1).

The Widgeon Court Pressure Zone serves just 52 connections located just south of the Pinedrop Reservoir. This system draws its water from the reservoir which is pressurized further through Booster Pump Station #2 (BS-2). Fire protection in this zone is provided by fire hydrants connected to the distribution system in the Foxfire Pressure Zone.

Pressure Zone #3 is known as The Ridge Pressure Zone. It was originally developed to serve the 97 lots in The Ridge Subdivision but was expanded in 2015 to include up to 409 additional ERUs. This pressure zone also draws its water from the Pinedrop Reservoir through a new Ridge Reservoir also constructed in 2015. The Ridge Pressure Zone is served by Booster Pump Station #3 which was upgraded in 2015 and is capable of providing both domestic and fire protection flows.

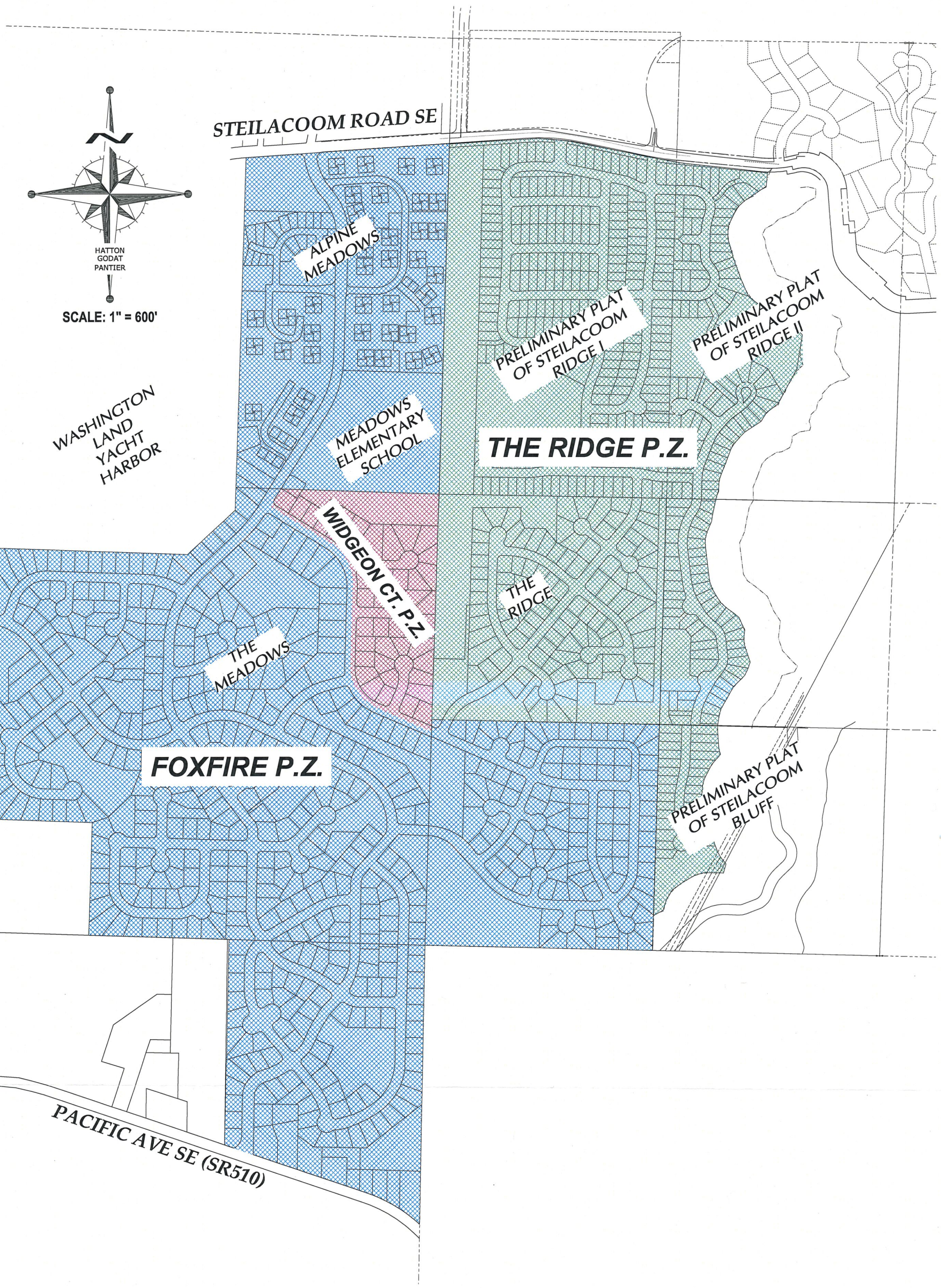
3.2 Sanitary Survey

In May 2014 the regional engineer from the State of Washington Department of Health (DOH) Office of Drinking Water conducted a sanitary survey of the Meadows Water System. A copy of that survey is in included in Appendix D.

Deficiencies found during this inspection have all been addressed except for 6) Modify plumbing on Wells 3-6 to act as a blended source or test as individual wells rather than blended. TPUD will return to testing sources individually.

MEADOWS WATER SYSTEM

FIGURE 3.1
PRESSURE ZONES



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3.3 Water Quality Analysis

Currently, this water system does not require nor provide water treatment. Water quality meets the monitoring and water quality requirements in WAC 246-240-300. While initial screening for lead and copper suggested action levels were exceeded, supplemental testing in May and September 2017 demonstrated that water at MWS was not corrosive. Consequently, installation of water treatment facilities in the foreseeable future. MWS has a consistent testing history without exceedance of maximum contaminant levels (MCL) for coliform bacteria or for chemical parameters.

Copies of the recent analyses excluding coliform bacteria results are included in Appendix E. See also the corrosion control treatment decision letter from February 2018. Also included in Appendix E is a copy of the 2016 Water Quality Monitoring Report (WQMR). This is a document sent annually to all Group A water systems by DOH. It identifies on a monthly basis all the water quality tests a water system must collect and submit for analysis throughout the year.

There is a more complete evaluation of water quality parameters including the various rules, regulations and required sampling included in Chapter 8.

3.4 Inventory of Existing Facilities (Systems)

See system maps in Appendix B for more information.

3.4.1 Wells

The MWS water supply system currently has six wells. Each well has a flow meter to record the volume of water pumped and a run time meter to measure the number of hours each well is operated. A comparison of the two over time will show when the well pump needs some type of maintenance by observing a fall off in the flow rate from the well.

Table 3.1 lists each of the wells and gives the year it was drilled, depth, static water level and pumping water level when the well was first drilled and capacity. Each well has a single pump with the exception of SO3, which has two. The pumps in SO3 alternate first call but both pumps can operate at the same time. Copies of well logs, pump test results, and well pump information for each well is included in Appendix G. Except for Wells #4 and #6, all pumps are original equipment.

Well #1 and Well #2 pump directly to the Foxfire Reservoir. Wells #3 through #6 are located near the upper Pinedrop Reservoir and pump into the distribution system that feeds this reservoir. Total installed pump capacity for all wells is 655 gpm. Original pump tests indicate an available 754 gpm maximum capacity. Instantaneous withdrawal is limited to 1,655 gpm per available water rights. See Chapter 4.

Table 3.1 Water Supply Wells

DOH ID #	Depth (ft)	Date Drilled	Pump Capacity (gpm)	Capacity per WFI (gpm)	Well Elevation (MSL)	Static Water Level[1]	Pumping Water Elev[1] @ Flow (gpm)	Pump Test Date
SO1	797	4/27/79	175	149	215	49	-15 @ 200	1979
SO2	104	5/26/81	34	30	215	171	125 @ 30	Bailer Only
SO3[2]	321	5/7/84	50	78	270	29	213 @ 144	1984
SO4	293	10/22/83	200	182	245	216	202 @ 268	1984
SO5	336	11/24/86	45	30	253	227	186 @ 17	1986
SO6	325	3/30/89	250	186	245	220	215 @ 300	1989

1. The static and pumping water levels are the elevation above Mean Sea Level.
2. Listed capacity is with both pumps in the well operating simultaneously.

3.4.2 Booster Pump Stations

MWS utilizes three booster pump stations. A description of each is provided below:

BOOSTER PUMP STATION #1,

Location: Adjacent to the Foxfire Reservoir serving the Foxfire Pressure Zone

This station draws water from the Foxfire Reservoir and pumps it into the distribution system. The purpose of this station is to provide adequate service pressure in the main distribution system as well as fill the Pinedrop Reservoir.

Pumps No. 1, 2, and 3 are all Berkley, Model B1 ½ TPLS
5 hp, 230 volt, 3 phase
Motor Century Model No. 6-333062-03
Pump #1 Motor was rebuilt in August 2006
Capacity ranges from 68 gpm to 112 gpm depending on tank status and pressure switch.

Pump No. 4 is a Berkeley Model B2TPMS
7 ½ HP, 230 volts, 3 phase
Pump motor was rebuilt in December 2004
210 gpm at midpoint of operating range

BOOSTER PUMP STATION #2

Location: Adjacent to the Pinedrop Reservoir serving the Widgeon Court Pressure Zone

The purpose of the booster pump station is to pressurize the 52-lot upper pressure zone serving Widgeon Court, Pinedrop Drive, and Fern Leaf Court. BS-2 draws water directly from the Pinedrop Reservoir. This station only provides domestic flow capacity (68 gpm) including residential irrigation for the 52 lots in this zone. Fire flow (750 gpm) is provided to these lots from hydrants located in the area but connected to the Foxfire Pressure Zone.

Pump No. 1 is a Berkley Model B1 ½ TPLS
1 ½ hp, 230 volt, single phase
Mid-Range Capacity ~ 65 gpm

Pump No. 2 is a Berkley Model CP1 ¼ M-1 ½
1 ½ HP, 230 volts, single phase
Mid-Range Capacity ~ 70 gpm

BOOSTER PUMP STATION #3

Location: Southeasterly of the Pinedrop Reservoir serving The Ridge Pressure Zone

The purpose of the booster pump station is to pressurize the area known as The Ridge which includes the plats of Steilacoom Ridge (under construction) and the future plats of Nisqually Bend and Steilacoom Bluff. This booster station pressurizes water from an 79,000-gallon concrete storage reservoir completed in March 2016 (DOH Project #14-1012). This new reservoir receives water from the 175,000 gallon Pinedrop Reservoir. There are expected to be approximately 500 lots total, existing and proposed, located within this pressure zone. Irrigation needs will likely result in 10-12 net ERUs as well. BS-3 was upgraded in 2016 to provide both domestic (341 gpm) as well as fire protection flow (750 gpm) or a total of 1,091 gpm.

Pump Nos. 1, 2 and 3 are all Franklin 10 hp, 460v, 3 phase end suction centrifugal pumps. Pumps are controlled by variable frequency drives. Fireflow capacity at 24 psi minimum system pressure is 375 gpm each.

3.4.3 Water Storage Reservoirs

MWS has three storage reservoirs. The original reservoir is in the lower portion of the subdivision and is known as the Foxfire Reservoir. It is a Mt. Baker concrete circular reservoir 26 feet in diameter and 30 feet tall with a volume of 116,000 gallons. This reservoir is at a low elevation (the base elevation at 222 feet) and cannot serve the water system by gravity flow with adequate pressure. It requires booster pumps to provide water at acceptable pressure of 30 psi throughout the Foxfire Pressure Zone.

The second reservoir, Pinedrop Reservoir, is in the upper area of the subdivision and can provide gravity flow to most of the system. This reservoir is 75 feet tall, 20 feet in diameter, and has a total volume of 175,000 gallons at a base elevation of 270 feet. Water is pumped into this reservoir from Wells #3, #4, #5, and #6 and Booster Pump Station #1. Floats in the Pinedrop Reservoir control the operation of the wells.

A third reservoir, The Ridge Reservoir, was constructed in 2016 under DOH Project #14-1012. This 79,000 gallon reservoir is 26 feet in diameter and 20 feet tall and receives water from the Pinedrop Reservoir through an altitude valve with a flow capacity of 750 gpm. The Ridge Reservoir supplies water to BS-3 serving The Ridge Pressure Zone. Base elevation of The Ridge Reservoir is 266 feet MSL.

3.4.4 Distribution Water System

The water distribution system for the MWS consists of approximately 7 miles of watermain ranging in size from 4 to 8 inches in diameter. The water lines are arranged in loops to improve flow and pressure throughout the system. Table 3.2 shows approximate linear footages of medium to large distribution mains within the system.

Table 3.2 Installed Distribution by Pipe Diameter

Pipe Diameter	Length (ft)
2- & 2.5-inch	5,340
4-inch	9,720
6-inch	31,010
8-inch	8,010
Total	54,080

The topography of the system rises and falls gently from an elevation of approximately 200 throughout most of the lower pressure zone to a high elevation of approximately 280 feet at the northeast corner of the plat of The Ridge (Ridge pressure zone).

The hydraulic analyses confirm that low pressure in the distribution system should not be an issue for the customers. This fact has been confirmed because the Meadows Water System has received no complaints of low pressure or other distribution-related problems. For more information see Section 3.5.5.

3.5 System Physical Capacity Analysis

A summary of limiting system capacity factors is provided on multiple Worksheets 6-1 at the end of this section. Analyses are provided for each pressure zone individually as well as for the system in aggregate. Since storage and source of supply is available to all pressure zones, capacity per zone for storage and source of supply is allocated proportionately to total available ERUs.

3.5.1 Source

MWS has six operating wells. Pumps in service in all wells are similar to the original equipment (which have been replaced since initial installation) except for the pumps in Wells #4 and #6. Those pumps are now both 20-hp Franklin 460-volt, 3-phase motors with custom Robbco pumps (see pump curves in Appendix G). Well #7 is expected to be placed into service by the end of 2017.

Water rights for MWS allow up to an annual withdrawal of 498 acre-feet. Water rights also allow MWS to operate up to nine wells. To pump 498 acre-feet of water, the existing wells would have to operate approximately 47% of the time throughout the year. During 2015, the water system pumped some 70 million gallons of water from the six wells. This volume required an average pumping rate for the six wells of about 22% of the time.

Over the next 20 years, projected growth estimates 1,900 ERUs on the system. At current water use the corresponding volume would require the wells to pump approximately 45% of the time. Maximum day demand, however, is estimated at nearly 3 times ADD meaning that at the 20-year planning horizon, existing sources of supply would exceed capacity.

Since required pumping could exceed well capacity for peak day demand over the 20-year planning horizon, an additional source of supply is required. Flow capacity for the new source, for planning purposes in this WSP, is estimated at 245 gpm. This rate is estimated from flow testing completed for Well #7 in 1995. See Appendix G.

3.5.2 Treatment

This water system does not provide any treatment because water quality results have consistently been below the maximum contaminant levels (MCL) for bacterial and chemical contaminants. The system meets the monitoring and water quality requirements as stated in WAC 246-240-300. The recent water test results are included in Appendix E.

3.5.3 Well Protective Covenants

The well protective covenants are shown on the face of the plat. The covenants provide for a 100-foot well protection radius: no septic tanks, drainfields or other pollution sources are allowed within this area. These areas are maintained by The Meadows Homeowners' Association.

3.5.4 Storage

All three existing storage reservoirs are concrete reservoirs built by Mt. Baker Silo, Inc.

The original reservoir, known as "Foxfire", is 26 feet in diameter and 30 feet tall. Capacity is 116,000 gallons. This reservoir is set too low in elevation to be used for gravity supply to the system. Booster Pump Station #1 (BS-1) pumps from the Foxfire reservoir to supply water into the distribution system to the Pinedrop reservoir which maintains pressure in the Foxfire pressure zone. Reservoir operations allow for the top 3-feet of storage to fluctuate.

The upper reservoir, known as "Pinedrop", is located near the Meadows Elementary School. The reservoir is 20 feet in diameter and 75 feet high with a capacity of 175,000 gallons. This reservoir is supplied directly by Wells #3, #4, #5 and #6 and by the booster pump station at the Foxfire Reservoir. Reservoir operations allow for the top 3-feet of storage to fluctuate

The third reservoir, The Ridge reservoir, was constructed in early 2016 and is located just to the southeast of the Pinedrop reservoir. The Ridge reservoir has a total capacity of 79,000 gallons and is 26 ft in diameter and 20 ft tall. The Ridge reservoir draws water from the Pinedrop reservoir through an altitude valve. The Ridge reservoir feeds Booster Pump Station #3 (BS-3) that serves The Ridge Pressure Zone. Reservoir operations allow for the top 3-feet of storage to fluctuate

Table 3.3 lists storage requirements for the next 20 years using estimated water demand as presented in Chapter 2. Tables 3.4 and 3.5 detail the many components that makeup total required storage. Table 3.4 assumes existing wells continue to operate at their current pumping capacity of 655 gpm. Table 3.5 lists similar data but includes the addition of a 7th source of supply with a pumping capacity of 245 gpm.

Table 3.3 Water System Storage

Year	Number ERUs	Total Well Pumping Rate (gpm)	PHD (gpm)	Operational Storage (gallons)	Equalizing Storage (gallons)	Standby Storage (gallons)	Dead Storage (gallons)	Total Storage Required (gallons)	Total Existing Storage (gallons)	Additional Storage Needed (gallons)
2017	828	655	529	28,900	0	165,600	13,453	207,953	370,000	0
2018	850	655	541	28,900	0	170,000	13,453	212,353	370,000	0
2019	875	655	554	28,900	0	175,000	13,453	217,353	370,000	0
2020	900	655	567	28,900	0	180,000	13,453	222,353	370,000	0
2021	950	655	594	28,900	0	190,000	13,453	232,353	370,000	0
2022	1,000	655	620	28,900	0	200,000	13,453	242,353	370,000	0
2023	1,050	655	646	28,900	0	210,000	13,453	252,353	370,000	0
2027	1,290	655	773	28,900	17,708	258,000	13,453	318,061	370,000	0
2037	1,900	900	1,095	40,000	29,249	380,000*	15,000	464,249	370,000	94,249*

Where:
Operation storage = 3 ft in Pinedrop (20 ft dia) and Foxfire (26 ft dia) reservoirs and 2.5 ft in The Ridge (26 ft dia) reservoir
Equalizing storage = (PHD - Q) 150 Where Q is the total pumping capacity for all wells (655 gpm).
Standby storage = (200 gallons) × (number of connections)
Dead Storage = 1.5 ft in Pinedrop and Foxfire reservoirs and 0.5 ft in The Ridge reservoir

*Additional Storage = With the addition of Well #7 at ~150gal per ERU standby storage, no additional storage is required.

Table 3.4 Source-Storage Calculation: EXISTING WELLS

WELL DATA (list from highest to lowest capacity)		**ERUs DATA**	
Source #	Capacity	# of ERUs:	**1,500**
SO6	186 gpm	PHD Coefficient "C"	1.6
SO4	182 gpm	PHD Factor "F"	225
SO1	149 gpm		
SO3	78 gpm	Annual Rainfall	50 inches
SO2	30 gpm		
SO5	30 gpm	Average Daily Demand:	225 gpd
		Maximum Daily Demand:	475 gpd
Total source capacity:	655 gpm		
		Peak Hourly Demand	884 gpd
Capacity w/o largest producer:	469 gpm		
		Fire Flow Requirement	750 gpd

STORAGE CALCULATION			
Equalizing Storage:	34,333	gallons	*ES = (PHD-Qtot)*150*
Fire Suppression Storage:	45,000	gallons	*FS= flow req'd * 60 min.*
Standby Storage:	0	gallons	*SS = 2*ADD*N-1440*Q*
OR:	300,000	gallons	*SS = 200*N*
Nested storage figure:	300,000	gallons	
Operational storage:	28,900	gallons	*36" in all reservoirs*
Dead Storage:	13,453	gallons	*18" in Pinedrop & Foxfire, 12" in The Ridge*
TOTAL STORAGE:	376,686	gallons	@ Minimum 200 gal/ERU
	370,000	gallons	INSTALLED STORAGE
SHORTAGE:	0	gallons	@ 195 gal per ERU standby storage

Table 3.5 Source-Storage Calculation: ADDITIONAL SOURCE (20 yr Horizon)

WELL DATA (list from highest to lowest capacity)		**ERUs DATA**	
Source #	Capacity	# of ERU:	**1,900**
SO7 (New source, estimated capacity)	**245 gpm**	PHD Coefficient "C"	1.6
SO6	186 gpm	PHD Factor "F"	225
SO4	182 gpm		
SO1	149 gpm	Annual Rainfall	50 inches
SO3	78 gpm		
SO2 & S05	60 gpm	Average Daily Demand:	225 gpd
		Maximum Daily Demand:	475 gpd
Total source capacity:	900 gpm		
		Peak Hourly Demand	1,095 gpd
Capacity w/o largest producer:	655 gpm		
		Fire Flow Requirement	750 gpd

STORAGE CALCULATION			
Equalizing Storage:	29,249	gallons	*ES = (PHD-Qtot)*150*
Fire Suppression Storage:	45,000	gallons	*FS= flow req'd * 60 min.*
Standby Storage:	0	gallons	*SS = 2*ADD*N-1440*Q*
OR:	380,000	gallons	*SS = 200*N*
Nested storage figure:	380,000	gallons	
Operational storage:	40,000	gallons	*8% of total storage*
Dead Storage:	15,000	gallons	*3% of total storage*
TOTAL STORAGE:	464,249	gallons	
	370,000	gallons	INSTALLED STORAGE
SHORTAGE:	94,249	gallons	*Actual Standby Storage ~150 gpd per connection*

3.5.5 Distribution System

The Pinedrop reservoir provides Peak Hourly Demand (PHD) to the Foxfire pressure zone and Widgeon Court pressure zone and fire flow to both Foxfire and Widgeon Court pressure zones. Pinedrop feeds water to The Ridge reservoir which with BS-3 provides PHD and fireflow to The Ridge pressure zone.

Maximum Daily Demand (MDD) is computed as 1.7 times the maximum month Average Daily Demand. Total used water volume during the peak month for the last five years is presented in Table 3.6 below. Average MDD is computed at 477 gpd per ERU over these five years with a median value of 473 gpd. The WSP sets MDD at 475 gpd/ERU which is approximately 2.1, times ADD.

Table 3.6 Maximum Daily Demand Calculation

Year	Maximum Month	Maximum Month Usage	ADD/ERU	1.7 x ADD
2016	August	7,807,871	304	517
2015	July	7,199,881	280	476
2014	July	6,809,635	265	450
2013	August	7,132,711	278	473
2012	August	7,073,881	276	469
			Average	477 gpd/ERU
			Median	473 gpd/ERU

Peak Hourly Demand (PHD) is calculated by equation 5.3 of the DOH Design Manual.

Equation 5.3: $PHD = (MDD/1440)\ (1.6 \times N + 225) + 18$

Table 3.7 Projected Peak Hourly Demand (PHD)

Year	Number of ERUs	Estimated Population	Peak Hourly Demand (gal/min)
2017	828	2,070	529
2018	850	2,125	541
2019	875	2,188	554
2020	900	2,250	567
2021	950	2,375	594
2022	1,000	2,500	620
2023	1,050	2,625	646
2027	1,150	2,875	773
2037	1,900	4,750	1,095

Provided by pressure zones
PHD Calculation by Pressure Zone:

Foxfire - 1,339 connections = 800 gpm at 20 years w/ current MDD (750 gpm w/ 6% reduction in MDD)
Widgeon Court - 52 connections = 69 gpm at build out/existing.
The Ridge - 509 connections = 361 gpm at build out (20 yrs).

A hydraulic model for the Meadows Water System was developed using WaterCAD® from Bentley Systems, Inc., Heastad Methods Solution. In order to calibrate the model, TPUD ran five separate fire hydrant test flows covering both the Pinedrop and Ridge Pressure Zones (The Widgeon Court PZ only has 52 connections and does not provide fire flow.). Model Calibration Runs are included in Appendix L. Demands at nodes (off peak hour testing), reservoir operating levels, and pipe friction coefficients were all manipulated, within appropriate engineering judgement ranges, in order to obtain reasonably close results for the actual tested capacities at these hydrants.

All pipes 4 inches in diameter or larger were included in the model. Reports for all the pipes, junctions, reservoirs, and booster pumps are provided in Appendix L for all three pressure zones. The wells were not included in the hydraulic analysis but rather assumed capable of maintaining reservoir levels (as indicated by source capacity in Worksheet 6-1).

The hydraulic analysis software program is capable of simulating a fire flow at each node in the model and checks that the water system pressure in the remaining distribution system meets specific minimum pressure requirements. A fire flow report spreadsheet is included in Appendix L. It states the maximum flow available from each node and the node with the minimum pressure including the pressure at that node and pipe with the maximum water velocity flow through it.

The existing distribution systems, including booster pump stations and piping network were all found adequate to meet fire flow concurrently with peak hour demand. Additionally, near term growth area, over the next 10 years principally in the northeast region of the service area, was also modeled for The Ridge Pressure Zone. All future connections in this expanding region similarly meet minimum pressure requirements during PHD (30 psi) as well as PHD plus fire flow (20 psi).

SUMMARY OF RESULTS:

Pressure Zone	Fire Flow Available	Minimum Pressure	Maximum Pressure	Max. Pipe Velocity
Foxfire	990 gpm	37 psi	65 psi	3.4 fps
The Ridge	855 gpm	43 psi	79 psi	2.5 fps
Widgeon	Not Appl	67 psi	76 psi	2.0 fps

3.6 Summary of System Deficiencies

This water system has no system deficiencies identified to serve projected connections up to approximately 1,070 ERUs. The system currently is limited by available Equalizing Storage, assuming that a full 200 gpd is allocated to customers as Standby Storage. This storage limit may be reached in 6-7 years at current projected growth rates for the new subdivisions in the northeast portion of the service area. Well #7 should be brought online before this limit is reached, or alternatively, additional storage could be constructed. Approval and activation of Well #7 is recommended in this WSP.

See Worksheets 6-1 for the system in aggregate as well as for individual pressure zones following this section.

In order to more accurately plan for long term needs, MWS is undertaking a comprehensive review and testing of all existing sources of supply to confirm installed and available well capacity. Current planning is based on best available information including well logs, original well tests, installed pump capacity, and operational considerations. Complete well testing with installed equipment will be completed by the end of 2018 and will be compared to planning assumptions.

Additionally, monitoring of ADD and MDD as well as emergency outages is necessary to verify the need for and rate of Standby Storage. A shortfall in recommended Standby Storage at 200 gallons per day per connection is indicated in a 10-15 year horizon.

Table 3.8 Proposed Improvements

Year	Description
2018	Well Capacity Testing
2018	Distribution system, ~100 new ERUs
2019	Construct a new source (Well #7)
2019	Fence all not secured wells
2020	Future distribution systems
2025	Complete service area distribution

WORKSHEET 6-1: ERU Determinations

Water System Physical Capacity Documentation based on MDD

Note: *Capacity determinations are only for existing facilities that are operational for the water system.*

Specific Single-Family Residential Connection Criteria (measured or estimated demands) (see Chapter 5):

Average Day Demand (ADD): 225 gpd/ERU

Maximum Day Demand (MDD) 475 gpd/ERU

Water System Service Connections correlated to ERUs			
Service Classification	**Total MDD for the classification, gpd**	**Total # Connections in the classification**	**ERUs**
Residential			
Single-family	475	809	809
Multifamily			
Nonresidential			
Industrial			
Commercial			
Governmental	475	1	7
Agricultural			
Recreational			
Other (specify)		4	12
DSL		N/A	
Other (identify)			
Total existing ERUs (Residential + Nonresidential + Non-revenue + Other) =			828

Physical Capacity as ERUs	
Water System Component (Facility)	**Calculated Capacity in ERUs for each component**
Source(s)	1,986 @ MDD & 18hrs/Day Pumping
Treatment	Not Applicable
Equalizing Storage	1,070 w/o Well #7 or EQS; 1,545 w/ Well #7
Standby Storage	1,500 at 200 gal per ERU SS
Distribution	1,986 @ PDH + Fire Flow
Transmission	Not Applicable
Other (specify)	
Water System Physical Capacity (ERUs) = 1,070 **(based on the limiting water system component shown above)**	

Note: *If multiple-day storage is needed to meet MDD, another approach to estimate the ERU capacity is necessary.*

WORKSHEET 6-1: ERU Determinations

Water System Physical Capacity Documentation based on MDD

Note: *Capacity determinations are only for existing facilities that are operational for the water system.*

Specific Single-Family Residential Connection Criteria (measured or estimated demands) (see Chapter 5):

Average Day Demand (ADD): 225 gpd/ERU

Maximum Day Demand (MDD) 475 gpd/ERU

Water System Service Connections correlated to ERUs			
Service Classification	**Total MDD for the classification, gpd**	**Total # Connections in the classification**	**ERUs**
Residential			
Single-family	475	662	662
Multifamily			
Nonresidential			
Industrial			
Commercial			
Governmental	475	1	7
Agricultural			
Recreational			
Other (specify)		4	12
DSL		N/A	
Other (identify)			
Total existing ERUs (Residential + Nonresidential + Non-revenue + Other) =			681

Physical Capacity as ERUs	
Water System Component (Facility)	**Calculated Capacity in ERUs for each component**
Source(s)	1,425 @ MDD & 18hrs/Day Pumping
Treatment	Not Applicable
Equalizing Storage	681 w/o Well #7 or EQS; 984 w/ Well #7
Standby Storage	939 at 200 gal per ERU SS
Distribution	1,339
Transmission	Not Applicable
Other (specify)	
Water System Physical Capacity (ERUs) = 681 **(based on the limiting water system component shown above)**	

Note: *If multiple-day storage is needed to meet MDD, another approach to estimate the ERU capacity is necessary.*

WORKSHEET 6-1: ERU Determinations

Water System Physical Capacity Documentation based on MDD

Note: *Capacity determinations are only for existing facilities that are operational for the water system.*

Specific Single-Family Residential Connection Criteria (measured or estimated demands) (see Chapter 5):

Average Day Demand (ADD): 225 gpd/ERU

Maximum Day Demand (MDD) 475 gpd/ERU

Water System Service Connections correlated to ERUs			
Service Classification	**Total MDD for the classification, gpd**	**Total # Connections in the classification**	**ERUs**
Residential			
Single-family	475	52	52
Multifamily			
Nonresidential			
Industrial			
Commercial			
Governmental	475		
Agricultural			
Recreational			
Other (specify)			
DSL		N/A	
Other (identify)			
Total existing ERUs (Residential + Nonresidential + Non-revenue + Other) = 52			

Physical Capacity as ERUs	
Water System Component (Facility)	**Calculated Capacity in ERUs for each component**
Source(s)	52 @ MDD & 18hrs/Day Pumping
Treatment	Not Applicable
Equalizing Storage	52
Standby Storage	52 at 200 gal per ERU SS
Distribution	52
Transmission	Not Applicable
Other (specify)	
Water System Physical Capacity (ERUs) = 52 **(based on the limiting water system component shown above)**	

Note: *If multiple-day storage is needed to meet MDD, another approach to estimate the ERU capacity is necessary.*

WORKSHEET 6-1: ERU Determinations

Water System Physical Capacity Documentation based on MDD

Note: *Capacity determinations are only for existing facilities that are operational for the water system.*

Specific Single-Family Residential Connection Criteria (measured or estimated demands) (see Chapter 5):

Average Day Demand (ADD): 225 gpd/ERU

Maximum Day Demand (MDD) 475 gpd/ERU

Water System Service Connections correlated to ERUs			
Service Classification	**Total MDD for the classification, gpd**	**Total # Connections in the classification**	**ERUs**
Residential			
Single-family	475	497	497
Multifamily			
Nonresidential			
Industrial			
Commercial			
Governmental	475		
Agricultural			
Recreational			
Other (specify)		4	12
DSL		N/A	
Other (identify)			
Total existing ERUs (Residential + Nonresidential + Non-revenue + Other) =			509

Physical Capacity as ERUs	
Water System Component (Facility)	**Calculated Capacity in ERUs for each component**
Source(s)	509 @ MDD & 18hrs/Day Pumping
Treatment	Not Applicable
Equalizing Storage	337 w/o Well #7 or EQS; 509 w/ Well #7
Standby Storage	509 at 200 gal per ERU SS
Distribution	509
Transmission	Not Applicable
Other (specify)	
Water System Physical Capacity (ERUs) = **(based on the limiting water system component shown above)**	337

Note: *If multiple-day storage is needed to meet MDD, another approach to estimate the ERU capacity is necessary.*

4. WATER RESOURCE ANALYSIS

4.1 Conservation Program Development and Implementation

The TPUD Conservation Plan for MWS is contained in Chapter 3 of TPUD April 2014 Part A Umbrella Plan update. This plan was developed based on the Water Use Efficiency (WUE) rule, WAC 246-290-800. This conservation plan was developed for the majority of TPUD water systems which are less than 500 connections. The Meadows is currently at 828 ERUs and is expected to exceed 1,000 service connections sometime around 2022.

According to the WUE, as the number of service connections on a water system increases, there is a corresponding increase in the number of conservation measures a water system must implement. At 1,000 connections, MWS is required to implement a minimum of five measures. The conservation plan lists a total of twelve possible conservation measures that will be implemented. By implementing these measures, MWS should expect average water use to remain the same or drop slightly below current usage. Over the next six years, it is projected that the average water usage per connection will decrease between 2 and 3 percent.

4.2 Water Use Data Collection

TPUD reads both source and individual service meters monthly at MWS. Both source and service meter are read at the same or similar times in order to more accurately evaluate unaccounted for water loss. Included within water loss calculation will be measured or estimated water uses for such items as line flushing, fire hydrant use, and other known extraordinary water usage. When line flushing occurs, source readings are taken before and after to better estimate water volume used during this operation.

4.3 Source of Supply Analysis

This water system does not plan on pursuing additional water rights within the next twenty years. An analysis of the sources of supply can be found in Chapter 3. Existing wells only operate about 22% of the time based on total water pump reported in 2015 (20% in 2016). In the next 20 years it is projected that well operation time will increase to about 45% as the number of system connections increase.

4.4 Water Right Assessment

MWS holds two water right certificates as well as a water right permit. Certificates G2-24972C and G2-26251C were both issued to Grays Harbor Enterprises, Inc. Permit G2-26623 was issued to Meadows Water System, LLC. The rights to all permits and certificates were subsequently acquired by TPUD late in 2017. Together, all permitted and certificated water rights authorize a total annual withdrawal (Q_a) of 498 acre-feet and a peak withdrawal rate (Q_i) of 1,655 gpm.

Permit G2-26623A authorized 48 acre-feet in addition to 450 acre-feet supplemental to existing water rights, G2-24972C and G2-26251C. The existing water system currently has six wells with a combined pumping capacity of 655 gpm. Total production of water in 2015 was 215 acre-feet.

Both Existing and Project Water Right Self-Assessment tables are included in Appendix I. MWS has adequate water rights for both the existing and future service areas of this system through the next 20 years. In 20 years it is projected that Q_a will be near the annual volume limit.

4.5 Water Supply Reliability Analysis

From the discussion in Chapter 3, the water system as designed has adequate water rights and source capacity to serve the existing and future service area for this system.

4.6 Interties

This system has an emergency intertie with the City of Lacey Water System. This intertie was installed in 2000 based on an agreement between the City of Lacey MWS. A copy of an agreement with the language relating to an intertie is included in Appendix N. Up to this time, this intertie has never been activated by either the City of Lacey or MWS.

4.7 Distribution System Leakage

Distribution System Leakage (DSL) has exceeded 10% for several years growing from 11% in 2013 (0% in 2012 must be considered as unreliable data) to 25% in 2015. For the most recent year DSL is calculated at 20%. Since all years exceeded 10%, a Water Loss Control Action Plan (WLCAP) is required to be incorporated into this WSP.

The Water Conservation Program adopted by TPUD in Part A of their Umbrella Water System Plan, includes a multifaceted approach to conservation that is briefly summarized as follows:

1. Allocating time and resources to Public Education in the form of messaging customers on invoices, quarterly newsletters, specific notice to high-use customers and other related annual mailings.

2. Providing technical assistance to customers including review of detailed water usage records and relating that to averages.

3. Implementing system measures such as metering sources and services as well as leak detection.

4. Providing incentives for water conservation to customers such as offering low-flow fixtures, providing technical assistance to agricultural customers on water use practices as well as similar assistance to customers with respect to irrigation of lawns and gardens.

5. TPUD utilizes an inclining block rate structure as well.

Considering the above utility-wide conservation measures, the DSL experienced at Meadows Water specifically, and in consideration of both annual average and peak use, the following Water Loss Control Action Plan for the Meadows Water System is hereby incorporated into this Water System Plan.

WATER LOSS CONTROL ACTION PLAN

The 2014 Part A Umbrella Water System Plan for TPUD adopts a 10% Distribution System Leakage (DSL) goal for all systems on a three-year rolling average basis. DSL for the Meadows Water system has ranged from 11% to 25% over the last 4 years for a rolling average of 18%. However, it must be noted that TPUD did not take ownership of MWS until October 2017 so none of the available data or water use has occurred under the auspices of TPUD management nor with the benefit of TPUD's District-wide Water Conservation Plan.

Therefore, starting immediately, TPUD will implement the following at MWS:

1. Reach out to the newly acquired customers at MWS and ensure that they are aware of all public educational and technical assistance opportunities available through TPUD, all aimed at water conservation education in accordance with TPUDs conservation plan.

2. Review all historic operational practices such as metering construction water use, particularly with ongoing and active construction within the service area and monitoring the volume of water used in blow-off and other system operations. Also ensure that proper processes are available to record rare but significant water uses such as fire flows, major system breaks (again, potentially of significant importance with active distribution system expansion currently underway within the service area). Ensure that all practices going forward are accurately capturing non-consumed but accountable water rather than becoming unaccounted for water loss.

3. All sources and services are metered and system piping is relatively new in terms of expected life for what is mostly PVC pipe. Nevertheless, as new owners of the water system, a thorough review with old and new TPUD staff of problem areas, if any, or meters that may be due for replacement should be conducted in order to confirm that old pipe or broken and leaking meters are not a significant contributor to DSL.

Average Daily Demand for MWS ranged from 175 gpd to 232 gpd over the last 5 years. Even considering DSL of 20%, gross consumption per ERU is not inordinately high. Consequently, there is a reasonable expectation that better monitoring of unaccounted for water coupled with the extensive public education program common to all TPUD water systems, that DSL can be brought down to 10% within the next 2-3 years.

5. SOURCE WATER PROTECTION

5.1 Wellhead Protection Program

MWS is currently served by six wells in two well fields as previously detailed in this WSP. Wells #1 and #2 are located near the Foxfire Reservoir. The remaining four wells (3, 4, 5, & 6) are located near the Pinedrop Reservoir. A seventh well is proposed (see Section 7 Improvement Program) to be brought online prior to the end of 2019. The location lies southeast of Well 5 in the open space tract for the plat of The Ridge which is also a power line easement occupied by two overhead power transmission lines owned by Puget Sound Energy. Separate susceptibility assessments have been completed for each well. Copies of those reports are included in Appendix J along with Time of Travel Maps.

All wellhead protection areas are predominantly single-family residences with no commercial establishments in those areas. The Meadows Elementary School is located within the 6 Month Time of Travel of the Wellhead Protection Area for Wells 3-6 and just outside of the 6 Month Time of Travel for the future Well 7.

The character of land uses located within the well head protection areas have not changed since the assessment noted herein was completed. The Well Head Protection Program for MWS consists primarily of company personnel frequently conducting visual surveillance during normal operations and maintenance activities for the water system and notifying affected property owners. Copies of notification letters and a mailing list is included in Appendix J.

6. FINANCIAL PROGRAM

Meadows Water System is just one of many water systems operating under the financial program for TPUD. The financial program for TPUD is detailed in Chapter 6 of the April 2014 Part A of their Water System Umbrella Plan. That chapter is applicable to the WSP for MWS and is reproduced hereafter for ease of reference.

Section 6
Financial Program

6.1 Introduction

The effective implementation of a WSP is dependent upon accurately developing a document that can be financially supported by the utility, will meet State and local regulatory requirements, and provides the flexibility to deal with unforeseen changes.

This section presents a financial plan that reviews the sources of funds (revenues) and applications of funds (expenses) for the PUD. The financial plan includes projected operating and capital costs of the system for the six-year time horizon of 2014-2019. The revenues and expenses used in the financial plan were obtained from the PUD's 2013 budget in conjunction with historical consumption information. The capital costs contained within the financial plan are based on 2013 and projected 2014-2019 costs detailed in the PUD's CIP (see Section 5).

6.2 Past Financial History

As discussed in Section 1.2, the PUD was created in 1938, and for a long period of time owned only one water system (Tanglewilde, in Thurston County). In 2005, the PUD acquired multiple water systems in western Washington. Presently, the PUD owns 155 systems in five counties. The financial analysis presented in this WSP includes the PUD's financial history for the years 2010-2012, as well as the current operating budget for 2013.

6.3 Development of the Financial Plan (Revenue Requirement)

A financial plan is developed to determine the PUD's ability to meet its capital improvement and operating needs over the six-year review period. In developing the financial plan, fund balance and reserve levels were also analyzed. The financial plan was developed to review the projected revenues and expenses of the water system for 2014 – 2019. The PUD's 2013 budget forecast was used as a base. Future years were escalated by applying factors for inflation and growth, as described below.

6.3.1 Revenues

The first component of the financial plan is a review of the sources of funds of the water system. The different revenues received from operations are:

- Rate revenues – water sales to customers;
- Other revenues – ancillary fees; and
- Interest Revenue –interest earnings on fund balance; and
- Tax Levy

Projections for future year revenues were developed by applying a projected growth rate of 3 percent to the 2013 budgeted rate revenue. The 3 percent growth level appeared to be appropriate when reviewing the water sales from 2010-2012. Other miscellaneous revenues, including investment interest, fees and other revenue, are projected to increase approximately 3 percent per year through 2013.

Rate revenues are projected to be $2.1 million in 2013. The rate revenues of the PUD come from retail sales to the metered and irrigation customers. With growth applied at 2 percent per year, a general rate increase of 3% annually appears to be likely in 2014-2016, and with the growth rate continuing at 2 percent the total rate revenue is expected to reach $2.7 million by 2013.

Other water revenues for 2012 total $200,559. The other revenue increases is anticipated to remain the same over the six years, totaling $186,797 by 2019.

Tax levy revenue for 2013 is expected at $248,147. The tax levy is expected to increase at a rate of 1% annually reaching $263,413 by 2019.

The total revenue available to offset the operating and capital requirements of the water system total $2.69 million in 2013 increasing to $3.2 million by 2019.

6.3.2 Expenses

The second part of the financial plan is a review of the applications of funds. In developing the financial forecast, four main cost components were reviewed:

- Operations and Maintenance (O&M) Expenses
- Taxes
- Debt Service
- Capital Improvements Funded From Rates

The projection of operating expenses is based on the 2013 budget forecast. These expenses are then projected for future years by applying escalation factors dependent upon the type of expense being reviewed.

Operation and Maintenance Expenses

Using the budget as a starting point, expenses were escalated by factors representing assumed inflationary rates to obtain projected costs. Escalation factors range from the purchase water costs for our Tanglewilde water system which is impacted by the investments the city of Olympia has made in its infrastructure which drastically impacts the purchase water costs in the years 2014 – 2017. While this expense is highlighted as a major expense of the PUD, it should be noted that purchase water is budgeted at just 3% of operating revenue in 2013 increasing to 4.5% in 2019 if there is no change in the PUD's operations. The PUD has made plans to install a generator on the Tanglewilde water system in 2014 which will enable the PUD to change the contract with the City of

Olympia to an emergency services only contact. Once that occurs the purchase water agreement will be renegotiated dramatically reducing the total purchase water costs.

Other expense changes noted in the planning period are administrative costs which are expected to increase by 2 percent per year. Labor and benefit costs have been escalated at a rate of 4 percent, while miscellaneous items and materials and supplies increase 3 percent.

O&M expenses ranged from $1.99 million in 2013 to $2.5 million in 2019, including state utility taxes.

Taxes

The water system currently has tax obligations to the State in the form of excise taxes. The state public utility tax is calculated as 5.029 percent of the water utility rate revenues. The District also incurs the cost of county operating permits and payroll taxes on its employees. For, these tax payments total approximately $210,000 and increase to $281,601 by 2019. Projected taxes for the period assume constant tax rates over time.

Debt Service

The debt service payment on the current outstanding debt ranges from $299,000 in 2010 to a high of $554,000 in 2012. The bulk of this payment, $216,000 – $303,000 is for revenue bonds with a maturity of December 2031. In addition the PUD has existing Public Works Trust Fund (PWTF) and Drinking Water State Revolving Fund (DWSRF) payments of approximately $240,000 per year.

The PUD has applied for additional PWTF and DWSRF to fund capital projects on existing systems. As these loans have not yet been approved by the funding agencies, the loan repayments have not been factored into the financial projections provided. The PUD would need to obtain a bank loan to fund any future acquisitions. It is anticipated that the revenue from the customers acquired would pay the cost of any new bank loan.

Meeting debt service coverage requirements is an important financial indicator for well managed utilities. Debt service coverage is a financial measurement of an entity's ability to repay debt. A debt service coverage ratio is a comparison of net income before debt service payments to the total debt service on revenue bonds. The PUD must meet a 1.25 coverage ratio test according to existing bond covenants. Typically this does not include any PWTF loans or other short-term credit instruments. The PUD has been successful in meeting this covenanted debt ratio since 2010. It is anticipated that the additional rates expected from the planned future rate adjustments, the PUD will continue to meet this debt coverage requirement. The PUD will remain watchful of this requirement during its financial evaluations.

Capital Improvement Projects from Rates

Capital improvement projects are related to the infrastructure of a utility. Section 5 provides a description of how the PUD develops its CIP. A summary of the capital projects is provided in Appendix C.

The PUD has reserve funding available, which has helped to fund planned and unanticipated capital improvements in the past. It is anticipated that the PUD will use some reserve funding, and continue to maintain reserve balances through the test period. Reserve funds are discussed later in this section.

6.3.3 External Sources of Funds for Capital Projects

The PUD has the ability to apply for grant and loan funds available to public entities for water system projects. Table 6-1 provides a summary of the contacts for various funding agencies. These sources rarely provide full funding of a construction project. The PUD would need to supplement any of these funds with matching funds to meet eligibility criteria and to ensure that implementation of the recommended capital improvement projects can occur.

Table 6-1
Funding Agency Contacts

Program	Address	Phone	Fax	Internet
Centennial Clean Water Fund	Department of Ecology P.O. Box 47600 Olympia, WA 98504-7600	(360) 407-6566	(360) 407-6426	www.ecy.wa.gov
Drinking Water State Revolving Fund	Department of Health DWSRF PO Box 47822 Olympia, WA 98504-7822	(360) 236-3116	(360) 236-2253	www.doh.wa.gov
Public Works Trust Fund	Public Works Board P.O. Box 48319 Olympia, WA 98504-8319	(360) 586-7186	(360) 664-3029	www.pwb.wa.gov
Infrastructure Database (over 200 funding programs)	Infrastructure Assistance Coordinating Council (IACC)	(360) 725-5002		www.infrafunding.wa.gov

A brief description of these funding sources is provided below.

Department of Ecology

The Centennial Clean Water Fund (CCWF) is available to local governments and tribes for measures to prevent and control water pollution. Both grants and loans are available on a yearly funding cycle.

CCWF is the largest State grant program for water projects. It provides grants for planning, design, and construction of facilities and other activities related to water quality. The primary focus of the program is pollution prevention and funding projects with a quantifiable water quality benefit. Funds are available to protect a source of water supply, as well as funding of water conservation or water reuse projects, if they can be shown to be the cost-effective alternative to solve a water quality problem. Funding from this program is not available to provide excess capital, but must be used to meet existing residential needs. Funding can also not be used to provide a source of supply. Grants and loans from this program are also available for the wellhead protection activities.

Interest rates are 0.5 percent for loans up to five years while those over five years but less than 20 years have a 1.5 percent rate. Grant funding of 50 to 75 percent of a project is available depending on the type of project.

Another source of Washington Department of Ecology (Ecology) grant funding provided by the Remedial Action grant program is normally used only to mitigate contamination events.

Washington Department of Health

The Safe Drinking Water Act (SDWA) appropriates funding for states to develop their Drinking Water State Revolving Fund (DWSRF) loan programs. Each state receives annual allocations in the form of a capitalization grant. In Washington State, the DWSRF is jointly managed by the Department of Health (DOH), Division of Drinking Water, the

Public Works Trust Fund Board (Board), along with its partner, the Department of Community, Trade and Economic Development.

DWSRF loans are available to all community public water systems, and non-profit, non-community public water systems, except federally owned and State-owned systems. The loans may be used to address SDWA health standard violations, replace infrastructure for SDWA compliance, or consolidate supplies and acquire property if needed for SDWA compliance. DWSRF loans are highly competitive for each cycle and receiving funding from this program in not a sure thing.

The interest rates on DWSRF loans range from 0 percent to 1.5 percent with a 1 percent loan fee on all loans. The interest rate is dependent on the economic situation of the area, and the loan term is 20 years. Economically disadvantaged or other eligible projects can obtain principal forgiveness of 30 to 50 percent.

Public Works Board

The Public Works Trust Fund loan program is set up by the Legislature to assist cities, towns, counties, or special districts with funding for different types of public works projects. The projects can include streets, roads, drainage systems, water systems, and sanitary sewer systems. The emphasis of allocating funds is for replacement and/or repair of existing systems. Funds are not allocated to install new water systems. Rather, funds are granted to rehabilitate or replace existing systems serving an existing population. The Public Works Trust Fund loans are highly competitive for each cycle and receiving funding from this program in not a sure thing.

The loans are issued at up to 2.55 percent interest rate for a maximum term of 20 years for applications requesting 95 percent project funding. The interest rate decreases to 0.5 percent when applicants provide at least 15 percent of the project funding. Debt service coverage is not imposed on the PWTF loan.

Infrastructure Assistance Coordinating Council

There are numerous other programs with funding available for various other aspects of water utility capital projects. The Infrastructure Assistance Coordinating Council (Council) provides resources and conferences on the available funding sources. This Council is comprised of State and local organizations whose function is to provide funding for infrastructure repair and development. The purpose of the Council is to assist local governments in coordinating funding efforts for infrastructure improvements. This is an important resource as the Council will be aware of any new funding opportunities that may arise.

While the above list of possible grant and loan opportunities for the PUD is not exhaustive, it does highlight the most probable outside funding sources, excluding revenue bonds, available to the PUD for its water capital improvement needs. Revenue bonds are another external source of funding for capital projects.

Internal funding sources available to offset capital costs include contributions received from new water connections and existing reserves. The PUD's contributions appear low. This may warrant reviewing the system development charges of the utility to ensure they are consistent with system planning criteria and are keeping pace with inflation.

6.4 Summary of the Financial Projections

A detailed financial plan and analysis using the assumptions provided in Section 6.3 above, is provided in Appendix D.

It is important to note that the financial plan presented in Appendix D is predicated upon an assumed level of growth on the system (3.0 percent per year), and assumptions related to inflation. Should this growth increase, slow down, or not occur, the level of rate adjustment required will be affected. Likewise, if costs escalate faster or slower than indicated in this plan, the rate adjustments needed would also be affected.

6.5 Reserve Levels

A key indicator of financial health and viability is a utility's reserve levels. Because a majority of the utility's revenue is consumption based, and therefore dependent upon optimal weather conditions, maintaining adequate reserve levels is important for stable fiscal management of the utility. A discussion of the utility's reserves is provided below.

Industry standards (American Waterworks Association – AWWA) recommend that utilities maintain working capital reserves at a level adequate to handle unexpected occurrences, including unexpected cash flow fluctuations. The Financial Policies of the PUD establish target reserve levels at a minimum of 60 days of operations and tax expense. For the PUD, that minimum balance would equate to approximately $333,000 in 2013 and increasing to $421,000 by 2019. The PUD begins 2013 with a balance of $903,000 in working capital. Throughout the planning period this balance fluctuates, but always stays above the target level.

The PUD has implemented a catastrophe reserve. This reserve was started in 2006 with a transfer from operating reserves of $100,000 as stated in the Financial Policies of the District.

The PUD also has a balance in the capital reserve fund. In 2013 this reserve has approximately $353,900. The PUD plans to use loan funding for the planned capital projects through 2019, allowing the District to increase its capital reserves from the receipt of general facility charges. Sound financial policies indicate that a fund balance equal to an average year's worth of capital projects is a healthy reserve amount or an amount equal to 1.25 of the PUD's depreciation. These funds are available should the assumed PWTF loans not be obtainable by the PUD to fund future capital projects.

The PUD maintains a revenue bond fund, with a balance in 2013 of $237,680. This fund is set aside to make debt service payments if needed. These funds can only be used as bonds are retired and the reserve is no longer required.

A summary of the projected reserve levels is provided in Appendix D.

The reserve review indicates that the PUD has adequate reserve funding to meet unanticipated obligations and general operating fluctuations given the PUD adjusts rates to meet the revenue requirement as developed in this analysis. All reserve target minimums stated in the Financial Policies are met. See the end of Appendix A (Financial Policies/Guidelines to Aid in Setting Rates) for more detail regarding PUD reserve policies.

6.6 Review of the Existing Water Rates

There are various "generally accepted" water rate structures that can be used to establish or develop rates. The initial starting point in considering a rate structure is the relationship between fixed costs and variable costs. Fixed costs are generally collected as a fixed charge on a monthly basis (e.g. $5.00 per month/meter). This charge may be called by various names (e.g. customer charge, meter charge, base charge, etc.) but in all cases, it is intended to collect those fixed costs that the utility incurs.

Currently, the PUD has both a meter charge for service and a consumption charge based on usage. The consumption rate is based on a four tier block of usage. For purposes of this overview, the rates in effect as of January 2014 are presented in Table 6-2.

Table 6-2 Overview of the PUD's Current Water Rates

	Residential				Non-Residential			
Base Rate	Inside Thurston	Tanglewilde / Thompson Place	Outside Thurston		Inside Thurston	Tanglewilde / Thompson Place	Tanglewilde Parks & Rec	Outside Thurston
3/4"	$ 24.75	$ 26.20	$ 28.75		$ 28.46	$ 29.91		$ 32.46
1"	$ 61.89	$ 63.34	$ 65.89		$ 71.16	$ 72.61		$ 75.16
1 1/2"	-	-	-		$142.32	$143.77	$47.44	$146.32
2"	-	-	-		$227.70	$229.15		$231.70
3"	-	-	-		$426.95	$428.40		$430.95
Flat rate	$ 65.63	$ 65.63	$ 69.63		-	-		-
Consumption charges								
Residential								
0-500	$ 2.21	$ 2.21	$ 2.21		-	-		-
501-1500	$ 3.39	$ 3.39	$ 3.39		-	-		-
1501-3000	$ 4.68	$ 4.68	$ 4.68		-	-		-
3001+	$ 5.32	$ 5.32	$ 5.32		-	-		-
Commercial								
Nov-Jun	-	-	-		$ 3.39	$ 3.39	$1.12	$ 3.39
Jul-Oct	-	-	-		$ 5.32	$ 5.32	$1.75	$ 5.32
Irrigation	-	-	-		$ 5.32	$ 5.32		$ 5.32

The consumption charge uses a tiered rate structure. This type of rate structure is designed to send a price signal to customers that use of water in the high tiers will cost more. Occasionally the PUD will serve customers who are unmetered. For these customers, a flat rate is in place to charge the customers. Under the flat rate the customers pay the same charge regardless of usage. The PUD's meter charge is based on the size of the customer's meter. This approach is used often to identify that different meter sizes place different demands and capacity requirements on the system. It is common to base the meter charge rate differential on the American Water Works Association safe operating capacity of the meter. The meter capacity approach is summarized in Table 6-3.

Table 6-3
Example of the Development of Fixed Meter Charges Based Upon Meter Capacity

Meter Size	Safe Maximum Oper. Capacity GPM [1]	Capacity Meter Weights	Meter Charges at Capacity Weightings
3/4"	30	1.00	$12.00/month
1"	50	1.67	20.00
1-1/2"	100	3.33	40.00
2"	160	5.33	64.00
3"	300	10.00	120.00
4"	500	16.67	200.00
6"	1,000	33.33	400.00
8"	1,600	53.33	640.00
10"	2,300	76.67	920.00
12"	3,375	112.50	1,350.00

[1] AWWA C-700-77 Cold Water Meters - Displacement Type

As Table 6-3 indicates, the fixed meter or base charge increases in relationship to the safe operating capacity of the various meter sizes. Meter capacity is an important concept in that a

customer that has a 2" meter is regarded, from a capacity perspective, as the equivalent of 5.33 -3/4" customers. Another way of saying this is the commercial customer with a 2" meter is, from a capacity perspective, the equivalent of five (5.33) single-family homes with 3/4" meters. Since a large portion of costs are generally related to meeting capacity requirements, one can see the importance of taking into account capacity in establishing rates for customers. As the PUD determines the need for larger meters for its customers, the above meter ratios are used to calculate the monthly fixed meter charge.

The conceptual rate review undertaken indicates that the PUD's rates are contemporary and attempt to capture the cost differential to serve customers with varying usage characteristics and facility requirements. Completion of a comprehensive rate structure review would assist the PUD identify if any rate structure changes are warranted based on the PUD's goals, objectives and the manner in which costs are incurred.

6.7 Overview of Future Water Rates

Based upon the results of the financial analysis, the PUD will require adjustments in rates in future years to meet the on-going needs of the water utility system, as identified within this document.

The PUD may wish to conduct a review of its water rates which would provide possible changes to its current rate schedules. These changes may be to simplify the rates for all of the PUD's customers (i.e., single rate for all systems) or develop rates by system to account for specific costs associated with operating and maintaining each unique system. In any case, this analysis would provide alternative rate structures that meet the goals and objectives of the PUD.

6.8 Summary

The financial plan results presented in this section indicate that water rates for the six-year projected time horizon of 2014 to 2019 will adequately fund the projected O&M, capital, and debt service requirements if the recommended rate adjustments are made. The PUD has been proactive in its financial management in the past. It has demonstrated its commitment to responsible management of the utility by funding adequate levels of operations, capital and reserves. Continued fiscal management will enable the water utility to operate on a financially sound basis.

7. IMPROVEMENT PROGRAM

7.1 Overview

Two new subdivisions totaling approximately 360 single family homes have received approval from Thurston County. The first phase of system construction was completed in 2016 and home construction and connection to MWS is underway. Home builder planning suggests that the balance of these home will be completed over the next 6-8 years. A third project with the balance of the lots in the planning area remains under review at Thurston County. Home construction is planned for 8-10 years.

System improvements include distribution systems to serve the new homes in the above referenced subdivisions as well as bringing a seventh well online. Distribution improvements are developer funded. Extensions for new distribution mains remains unchanged from the WSP approved in 2010 and is hereby incorporated in this WSP update. The hydraulic analysis and booster pump capacity required is as previously evaluated and remains applicable over this planning horizon. Pipe sizes are as presented in the hydraulic analysis included in Appendix L. Construction will follow the guidelines and construction specifications and details of PUD #1 Thurston County as presented in Section 7.7 of their April 2014 Part A Umbrella Plan update.

7.2 Well #7 Activation

Well #7 is an existing well drilled in 1992 for MWS. However, shortly after construction the City of Lacey entered into an agreement with MWS to purchase Well #7. The well has never been activated nor connected to the MWS system. The City of Lacey conducted extensive testing of the well in 1995. See report contained in Appendix G which includes water quality and well capacity testing, capacity recommendations, and a well log. The City of Lacey subsequently sold the well back to MWS in 2017.

Draft improvement plans for future activation of Well #7 are included at the end of this WSP. A separate project report will be prepared later in 2018 with a goal of bringing Well #7 online sometime during 2019.

Capacity: Well #7 was tested extensively by the City of Lacey and their consultants in 1995. They concluded that with the casing and screen in place that well capacity would be 400-500 gpm. With additional redevelopment and well design, Well #7 may yield as much as 660 gpm. However, without additional development, the consultant felt that well capacity would be limited to approximately 200 gpm. As a place to start, we have assumed 245 gpm.

Pump Sizing: Well depth is 334 feet and is fitted with a stainless steel slotted Wesco screen from 329 to 334. Drawdown was relatively insignificant, ~8 ft, even when pumped at 504 gpm. At an assumed 245 gpm pumping rate, head loss in the 325 ft long 4-inch diameter drop pipe would be 11 ft. The well is located approximately 570 ft away from the point of connection to the Well #5 plumbing. Using 4-inch pipe would add 20 ft of head loss for a total of 31 ft of friction loss.

Elevation gain includes the height of the Pinedrop Reservoir, the elevation change between the reservoir and the well site plus the drawdown depth.

Vertical Gain = Base El 270 – Well El 263 + 236 ft static water level + 8 ft drawdown + 75 ft reservoir height = 326 ft

Total Head to Pump = 326 ft vertical + 31 ft friction loss = 357 ft

Select Grundfos 300S300-9B, 30 hp, 460v, 3 phase, 250 gpm @ 360' TDH

7.3 Improvement Schedule

Future improvements noted herein are to be funded by the developer(s) of the projects noted above. Agreements are already in place for the distribution system extensions cited herein.

Table 7.1 - Proposed Improvements

Year	Description
2018	Well Capacity Testing
2018	Distribution system, ~100 new ERUs
2019	Construct a new source (Well #7)
2019	Fence all not secured wells
2020	Future distribution systems
2025	Complete service area distribution

Estimated costs for the proposed improvements are shown in Table 7.2. Distribution main extensions completed in accordance to the design and analysis included in this WSP may be completed without additional WSDOH review.

Table 7.2 - Cost of Proposed Improvements

Year	Description	Cost
2018	Distribution system for ~100 units	By Developer
2018	Convert lower reservoir to top fill	$6,500
2019	Bring Well #7 on line	$65,000
2019	Install fencing around wells not currently enclosed	$7,000
2025	385 lot distribution systems	By Developer

7.4 Replacement Costs

MWS is a relatively new system in that it only dates back to the early 1980s. Most all buried pipe is PVC and could be expected to last another 75 years. Well pumps and booster pumps are the only plant that will require replacement in the near term. TPUD should expect to spend approximately $200,000 over the next several years to replace these older system parts. Table 7.3 lists the major system components, estimates remaining useful life, and budgets replacement costs. A weighted average remaining life of all MWS plant and equipment computes to 58 years.

TABLE 7.3 - EXISTING FACILITIES SUMMARY

Component	*Unit*	*Quantity*	*Unit Cost*	*Cost*	*Year Installed*	*Expected Life (yrs)*	*Remaining Life (yrs)*
Well #1	LF	789	$ 100.00	$ 78,900	1979	100	61
Well #2	LF	103	$ 100.00	$ 10,300	1981	100	63
Well #3	LF	307	$ 100.00	$ 30,700	1983	100	65
Well #4	LF	293	$ 100.00	$ 29,300	1983	100	65
Well #5	LF	336	$ 100.00	$ 33,600	1986	100	68
Well #6	LF	325	$ 100.00	$ 32,500	1989	100	71
Well #1 Pump - 15 hp	EA	1	$ 10,000	$ 10,000	1979	25	-14
Well Drop Pipe	LF	789	$ 20.00	$ 15,780	1979	25	-14
Well #2 Pump - 1.5 hp	EA	1	$ 3,000	$ 3,000	1981	25	-12
Well Drop Pipe	LF	103	$ 10.00	$ 1,030	1981	25	-12
Well #3 Pump - 5 hp	EA	1	$ 6,000	$ 6,000	1983	25	-10
Well Drop Pipe	LF	307	$ 15.00	$ 4,605	1983	25	-10
Well #4 Pump - 20 hp	EA	1	$ 12,500	$ 12,500	2007	25	14
Well Drop Pipe	LF	293	$ 20.00	$ 5,860	2007	25	14
Well #5 Pump - 5 hp	EA	1	$ 6,000	$ 6,000	1986	25	-7
Well Drop Pipe	LF	336	$ 15.00	$ 5,040	1986	25	-7
Well #6 Pump - 20 hp	EA	1	$ 12,500	$ 12,500	2006	25	13
Well Drop Pipe	LF	325	$ 20.00	$ 6,500	2006	25	13
Well Site Improvements	LS	3	$ 25,000	$ 75,000	1985	100	67
Reservoirs	GAL	370,000	$ 1.50	$ 555,000	1995	100	77
Booster Pump Stations	LS	3	$ 50,000	$ 150,000	1995	25	2
Auxillary Power	EA	1	$ 25,000	$ 25,000	2016	25	23
Pump Houses	SF	1,200	$ 50.00	$ 60,000	1990	50	22
8-in PVC - 1st install	LF	250	$ 55.00	$ 13,750	1979	100	61
8-in PVC - 2nd install	LF	3,530	$ 55.00	$ 194,150	1981	100	63
8-in PVC - 3rd install	LF	280	$ 55.00	$ 15,400	1983	100	65
8-in PVC - 4th install	LF	1,850	$ 55.00	$ 101,750	1989	100	71
8-in PVC - 2016 install	LF	2,100	$ 55.00	$ 115,500	2016	100	98
6-in PVC - 1st install	LF	12,700	$ 50.00	$ 635,000	1979	100	61
6-in PVC - 2nd install	LF	6,300	$ 50.00	$ 315,000	1981	100	63
6-in PVC - 3rd install	LF	6,300	$ 50.00	$ 315,000	1983	100	65
6-in PVC - 4th install	LF	1,800	$ 50.00	$ 90,000	1989	100	71
6-in PVC - 2016 install	LF	3,910	$ 50.00	$ 195,500	2016	100	98
4-in PVC - 1st install	LF	2,825	$ 45.00	$ 127,125	1979	100	61
4-in PVC - 2nd install	LF	2,693	$ 45.00	$ 121,185	1981	100	63
4-in PVC - 3rd install	LF	4,150	$ 45.00	$ 186,750	1983	100	65
4-in PVC - 4th install	LF	-	$ 45.00	$ -	1989	100	71
4-in PVC - 2016 install	LF	50	$ 45.00	$ 2,250	2016	100	98
2 & 2.5-in PVC - 1st	LF	1,350	$ 35.00	$ 47,250	1979	75	36
2 & 2.5-in PVC - 2nd	LF	990	$ 35.00	$ 34,650	1981	75	38
2 & 2.5-in PVC - 3rd	LF	1,500	$ 35.00	$ 52,500	1983	75	40
2 & 2.5-in PVC - 4th	LF	1,500	$ 35.00	$ 52,500	1989	75	46
2 & 2.5-in PVC - 2016	LF	-	$ 35.00	$ -	2016	75	73
Service Meter Sets	EA	850	$ 500	$ 425,000	1995	50	27
Fire Hydrants	EA	42	$ 3,500	$ 147,000	1995	75	52
Controls	LS	1	$ 50,000	$ 50,000	2008	25	15
		Replacement Cost:		**$ 4,406,375**	**Ex. Weighted Life:**		**58** yrs

8. OPERATION AND MAINTENANCE PROGRAM

8.1 General

The Operation and Maintenance Program for MWS follows Chapter 7 of the April 2014 TPUD Water System Plan – Part A. That section is reproduced at the end of this chapter for ease of reference. MWS specific requirements are presented in this section which supplement the Part A Operation and Maintenance Program for TPUD.

8.2 Organization and Responsibilities

The operation and maintenance section of a water system plan provides the basis upon which to understand the functioning of a public water supply. This program identifies the work elements that are required on a routine basis and during an emergency.

TPUD operates its water systems in accordance with state and local regulations. The design and operation of MWS is based on the following documents:

State of Washington Documents:

- Washington State Board of Health Drinking Water Regulations (WAC 246-290);
- Sizing Guidelines for Public Water Supplies
- Planning Handbook: A Guide for Preparing the Water System Plans
- Manual for the preparation of Coliform Monitoring Plan
- Water System Coordination Act – Fire Flow Regulations (WAC 246-293)
- Getting Started "Water Use Efficiency Guidebook"

Other Documents:

- American Waterworks Association Standards and Manuals.
- Recommended Standards for Waterworks, Policies for the Review and Approval of Plans and Specifications for Public Water Supplies (also known as "Ten State Standards").

8.3 Routine Operation Procedures

Routine operation and maintenance activities for MWS are listed in Table 7-2 of the TPUD Operation and Maintenance Program included at the end of this chapter. Items not listed in Table 7-2, such as valve and hydrant maintenance are conducted on an as-needed basis. Customer service meters are read monthly. Other MWS specific tasks are as shown in Table 8.1.

Table 8.1 Routine Operation and Maintenance Activities

Activity
Daily
Check reservoir water levels and water system pressures.
Respond to customer questions and comments, as needed.
Minor System repairs, new construction, billing and reading meters for move-in and move-outs, as needed.
Check SCADA and monitoring equipment
Conduct locates for construction activities, as needed
Monthly
Collect bacteria coliform samples
Determine quantity of unaccounted-for water for systems with source meters and service meters installed.
Evaluate meter performance. Replace as needed.

8.4 Standard System Operation

8.4.1 General

Effective operation, maintenance and control are essential components of managing our water systems. The operational staff of the water company must manage routine maintenance tasks, essential operation tasks, new system modifications to the existing infrastructure, and emergencies. The following sections describe the typical day to day operation, maintenance and control of the various water system components and the intrinsic capability of the existing control system/structure to meet unexpected events or changes in water system conditions.

Customers are apprised of all upcoming maintenance, repair and construction work in three ways: by direct mail postcards, signs posted at entrances to the subdivisions announcing work schedules, and by postings on the TPUD website.

8.4.2 SCADA System

The master control of the Company's SCADA system is located at the Main Office. The company uses HACH and individual component monitoring equipment used to provide a graphical front end user interface to observe operations at the water systems which such in place. Presently the Company monitors well levels, booster pump flow and pressure, pump status, pump run time, and aquifer levels at some wells, reservoir levels, and system alarms at seven systems.

Due to the large variation in water system demand between the summer months and the rest of the year, the Company uses the pumping data to periodically change the reservoir call levels for the wells to maintain water quality. AWWA recommends approximately 30 percent of available storage be cycled daily to maintain water quality During high demand periods such as summer months, the Company plans to raise the call levels for the wells to higher reservoir levels and to maintain pressure in the system. Turnover in the reservoirs is not as critical during summer months, due to the higher system demands.

8.4.3 Source Operation and Control

Well pump "On Calls" are activated by reservoir level controls to maintain pressure in the system (Pinedrop), or to fill the Foxfire Reservoir. The priority calls for the six wells varies depending on the decisions of the operator. There is an intertie with the City of Lacey at the Meadows Water System. This intertie has never been activated by either The Meadows or the City of Lacey.

Each well house is equipped with a flow meter. All well houses are equipped with a pressure relief valve, set to open if excessive pressures occur in the distribution system to prevent pipe breaks. Pressure surges could occur during a power outage when pumps are operating, or the result of closing a hydrant or valve too quickly

8.4.4 Reservoir Preventative Maintenance

Table 8.2 is provided to give a sense of MWS's reservoir preventative maintenance program. Reservoir preventative maintenance duties include regular tasks such as visual inspections to ensure reservoir condition, screening, security checks and painting. Preventative maintenance includes infrequent tasks such as reservoir cleaning and painting

Table 8.2 Reservoir Preventative Maintenance Program

Recommended Frequency	Examples of Critical Tasks
Daily	None
1x per Week	Check and ensure physical operation of flow monitoring Inspect all access points for security breaches
1x per Month	Inspect vents and screen, clean as needed Draw water from tank and note appearance
1x per Quarter	Inspect and comment on structure condition Inspect hatch seal and gasket
1x per 6 Months	Clean and inspect pressure, Scada gauges Operate, calibrate level control components
1x per Year	Inspect and confirm operation of valves Replace batteries in transmitters Calibrate facility flow monitoring equipment

8.4.5 Booster Station Preventative Maintenance

Table 8.3 summarizes MWS's booster station preventative maintenance program. The table below lists their company's goal for tasks and recommended frequency.

Table 8.3 Booster Station Preventative Maintenance Program

Recommended Frequency	Examples of Critical Tasks
Daily	None, when operating
1x per Week	Inspect for security breach Inspect pre-lube filter Ensure physical operation of flow monitors
1x per Month	Inspect packing and seals
1x per Quarter	Check amp draw
1x per 6 Months	Grease bearings Perform in-house PMs on valves Calibrate pressure sensors
1x per Year	Tighten breaker screws Adjust impeller clearance

8.4.6 Emergency Generator Maintenance

Table 8.4 summarizes the recommended maintenance for emergency generators. The tables provide the specific tasks to be performed, the frequency of performance and recommended frequencies for comparison purposes.

Table 8.4 Emergency Generator Maintenance Program

Monthly	250 Hours or 12 Months	1,500 Hours	6,000 Hours
Check operator's report. Check and bring to correct level: Engine oil Coolant Visually inspect fan. Visually inspect engine Drain fuel-water separator. Check air intake system for wear points or damage to piping, loose clamps and leaks. Check air cleaner restriction. Check and clean air cleaner element. Drain moisture from air tanks. Run generator for two (2) hours	Change lubricating oils and filters. Change fuel filter. Change coolant filter. Replace element on cylinder air compressor if equipped with an air cleaner. Check engine coolant concentration level. Add make up coolant if required.	Adjust valves and injectors. Steam clean engine. Check torque on turbocharger mounting nuts. Check torque on engine mounting bolts. Replace hoses as required. Check shutterstats and thermatic fans. Inspect water pump.	Clean cooling system and change coolant and antifreeze. Clean and calibrate injectors, fuel pump. Inspect: Turbocharger Air compressor Fan clutch Water pump Fan hub Fan idler pulley assembly Vibration damper

8.5 Distribution System Cleaning Program

8.5.1 General

Traditionally, utilities have implemented line cleaning or flushing programs as corrective measures in response to customer complaints or to expel contaminants from the system. There is a growing consensus among industry purveyors that flushing programs should be included as best management practices as preventative maintenance of distribution systems. There are two basic methods of cleaning water lines: pigging or flushing.

Flushing strategies include both a conventional approach as well as a unidirectional flushing approach. Conventional flushing is used to move and purge water by opening hydrants without valve isolation. The benefit is that it requires little planning. The drawback is that the operator cannot control the source or velocity of the water. Unidirectional flushing is a more planned and targeted approach with a well organized, sequential valve and hydrant operation plan. This method starts at a known "clean" location working towards the system extremities always using previously flushed mains to create flushing flows for sequential sections. The benefit is that it is very effective at removing deposits in pipes, and uses 30 to 40 percent less water than conventional flushing. However, unidirectional flushing requires extensive planning to implement. MWS utilizes unidirectional flushing wherever system valving makes the method practical.

The AWWA-published *Guidance Manual for Maintaining Distribution System Water Quality*, contains a four-step program for developing, implementing and evaluating a flushing program, which we are following. The following information on Flushing Programs has been edited from this Guidance Manual. The four steps are as follows:

Step 1 – Determining appropriateness of flushing as part of maintenance program
Step 2 – Planning and managing a flushing program
Step 3 – Implementing a flushing program and data collection
Step 4 – Evaluating and revising a flushing program

8.5.2 Expected Results and Conclusions

TPUD will benefit from a flushing program and believes a unidirectional flushing program should be used system-wide as it is expected to reduce biofilm, iron, manganese, and sand that can accumulate in pipes. Unidirectional flushing is also expected to result in reduced customer complaints during flushing operations. In addition to improving water quality by cleaning the pipes, unidirectional flushing at scouring velocities may also increase pressure in the system. Buildup causes increased friction in transmission and distribution pipes and reduces pressure at water meters in periods of high water demand.

Based on TPUD experience, a two-man crew can flush an entire system in the most efficient manner. This has required a great deal of work including identifying the valve locations physically and on a map, identifying valves that do not work, collecting source meter readings before and after each flush and the inefficiencies associated with developing a new program. Again, this information and data is being inputted to Elements. The company concludes that its aggressive flushing program is limiting the potential for bacterial contamination within the distribution systems.

8.6 Water Quality

8.6.1 General

TPUD takes a proactive approach to water quality testing, insuring that each source and site is protected. Susceptibility Assessments have been completed on the Meadows Water System sources of supply.

8.6.2 Regulatory Authority and Responsibility

The Safe Drinking Water Act (SDWA) of 1974, amended in 1986 and 1996, established specific roles for the federal government, state government and water system purveyors with respect to water quality monitoring. The US Environmental Protection Agency (USEPA) is authorized to develop national drinking water regulations and oversee the implementation of the SDWA.

State governments are expected to adopt the federal regulations and accept primary responsibility or "primacy" for administration and enforcement of the Act. States can also regulate contaminants and set advisory levels. Public water system companies are assigned the day-to-day responsibility of meeting regulations by incorporating monitoring, recordkeeping and sampling procedures into their operation and maintenance programs.

8.6.3 Water Quality Standards

The Phase II Rule became effective in 1991 and set drinking water standards for 38 inorganic and organic chemicals. The Phase II Rule essentially doubled the number of drinking water standards that were in place at the time. The Phase V Rule set drinking water standards for an additional 23 contaminants. These rules established enforceable standards known as maximum contaminant levels (MCLs) for IOCs, VOC, SOCs and other organic contaminants. These rules form the basis of the Washington State Department of Health (WSDOH) regulations, Chapter 246-290 WAC.

8.6.4 Drinking Water Regulations (Chapter 246-290 WAC)

Table 8.6 lists drinking water regulations and the status of each regulation for a variety of contaminants and compounds. These regulations are applicable to all of TPUD Group A water systems. Existing state law contains regulations for bacteriological contaminants, inorganic chemicals and inorganic physical parameters (IOCs), volatile organic chemicals (VOCs), synthetic organic chemicals (SOCs), radionuclides, trihalomethanes (THMs), arsenic and unregulated contaminants.

TPUD is responsible for complying with all state and federal regulations applicable to water systems supplying groundwater as the sole source of drinking water. Promulgated, proposed and anticipated regulations are listed in Table 8.6 – 8.10. Monitoring requirements are determined for a population of less than 2,500 in the system.

Water quality data is reviewed by TPUD to evaluate whether each water system has met monitoring requirements and the maximum contaminant levels (MCLs) and to make recommendations that will help the utility meet future WSDOH and USEPA regulations.

REGULATED CONTAMINANTS

Minimum standards for water quality are specified in terms of maximum contaminant levels (MCLs). The state drinking water regulations (WAC 246-290) sets both primary and secondary MCLs contaminants. Primary MCLs are based on chronic and/or acute human health effects. Secondary MCLs are based on factors other than health effects, including aesthetics. The following sections discuss the applicable water quality regulations including a description and requirements for monitoring.

Water systems are monitored at the source and in the distribution system. Distribution monitoring includes coliform, lead and copper monitoring and asbestos. Source monitoring includes inorganic, volatile organic and synthetic organic chemicals, plus additional arsenic and radionuclide monitoring.

8.6.5 Total Coliform Rule

The USEPA regulates total coliform bacteria in finished drinking water. Biologically safe water continues to take the highest priority as evidenced by current standard setting trends. The Revised Total Coliform Rule (RTCR) became effective April 1, 2016 and establishes monitoring requirements, maximum contaminant levels (MCL), and response requirements for public water systems. Significant elements of the RTCR are discussed below. Full RTCR is provided in DOH PUB #331-556 which is included in Appendix F.

MAXIMUM CONTAMINANT LEVELS

The RTCR denotes an acute MCL as an "E. coli MCL" as opposed to a non-acute MCL as being other coliform present samples. An acute MCL is triggered in one of four ways:

1. A total coliform-present repeat sample follow an E. coli-present routine sample.
2. An E. coli-present repeat sample follows a total coliform-present routine sample.
3. The lab fails to test a total coliform-present repeat sample for E. coli.
4. A system fails to take 3 repeat samples following an E. coli-present routine sample.

REQUIRED MONITORING

The RTCR did not change the requirements for routine sampling. See the Coliform Monitoring Plan in Appendix F for more information on sampling locations and frequency.

However, the RTCR requires THREE repeat samples for EVERY total coliform-present routine sample. Repeat samples shall be taken as shown on Table 8.5:

Table 8.5 – Coliform Monitoring – Repeat Samples

System Group (Number of Routine Samples Collected Per Month)	Number of Samples in a Set of Repeat Samples	Locations for Repeat Samples (collect at least one per site)	Number of Routine Samples in Following Month
Group A – More than one routine sample each month	3 per every routine sample w/ coli-present	Site of previous sample with a total coliform presence.	Normal Sampling per CMP
		Within 5 active services upstream of site of sample with a coliform presence.	
		Within 5 active services downstream of site of sample with a coliform presence.	

After the laboratory notifies TPUD of a coliform presence, repeat samples shall be collected on the same day and submitted for analysis within 24 hours. When repeat samples have coliform presence, TPUD shall collect one additional set of repeat samples for each sample where coliform presence was detected.

SYSTEM DEFECTS AND TREATMENT TRIGGERS

The RTCR distinguishes between "Sanitary Defects" and "Defects". A Sanitary Defect is a defect that opens a pathway for contaminants to enter the system or can also be a failure or imminent failure that would eliminate an existing barrier. A Defect is a feature or technique that may lead to a coliform-present sample, typically identified during an assessment.

The RTCR requires water systems to conduct an assessment to find and correct any sanitary defect whenever a Treatment Technique Trigger occurs, such as total coliform-present in a routine sample. A Level 1 Assessment must be completed by the system owner or operator per the RTCR immediately upon notice of a Treatment Trigger. Depending on the severity of the trigger, a Level 2 Assessment may also be required. This would include an E. coli MCL violation or two Level 1 treatment technique triggers within a rolling 12-month period. Level 2 Assessments can only be performed by state certified qualified personnel. See also the Coliform Monitoring Plan and information in Appendix F.

8.6.6 Inorganic Chemicals (IOCs)

This category includes several inorganic elements and compounds. Many of the inorganic chemicals (IOCs) include elemental metals such as mercury, arsenic and iron. Some non-metallic constituents such as chloride, fluoride and sulfate are also included in this category. Physical properties of IOCs that affect water quality in this category include turbidity, specific conductivity, total dissolved solids, and color. WAC 246-290 specifies primary and secondary MCLs for IOCs, VOCs and SOCs, which are summarized in Tables 8.9, 8.10 and 8.11, respectively.

IOC MONITORING REQUIREMENTS

The Meadows' groundwater sources must be sampled for IOCs once every three years. Nitrate samples are required for all sources annually. Since nitrates are included in IOC sampling, additional samples are not required in years when an IOC is taken from the source.

8.6.7 Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs)

Volatile organic chemicals (VOCs) are manufactured, carbon-based chemicals that vaporize quickly at normal temperatures and pressures. VOCs include many hydrocarbons associated with fuels, paint thinners and solvents. This group does not include organic pesticides, which are regulated separately as synthetic organic chemicals (SOCs). VOCs are divided into the two following groups:

- Regulated VOCs that have been determined to pose a significant risk to human health.
- Unregulated VOCs for which the level of risk to human health has not been established.

There are currently 21 regulated volatile organic chemicals (VOCs) and 33 regulated synthetic organic chemicals (SOCs). A list of these compounds and MCLs is included in Table 8.11.

VOC AND SOC MONITORING REQUIREMENTS

Per Department of Health requirements, VOCs and SOCs must be sampled once every three years unless a waiver is in place. Water systems can qualify for waivers based upon source susceptibility and prior sampling results. Waivers are granted automatically if conditions are met.

A waiver remains in place for two years, during which time there are no requirements for monitoring. Once a waiver expires, monitoring frequency for VOCs and SOCs is one sample every three years.

8.6.8 Arsenic

Arsenic is a naturally occurring element in the earth's crust. Arsenic can be released into the environment through natural processes such as volcanic action, erosion of rock or by human activities such as mining or smelting of arsenic-containing ores and orchard spraying. It has been used commercially in wood preservatives, agricultural chemicals, and the manufacture of semi-conductors.

Most arsenic in drinking water comes from natural rock formations. Water that encounters these rock formations can dissolve arsenic and carry it into underground aquifers, streams, and rivers that may be used as drinking water supplies. Arsenic deposited on the ground from industrial or agricultural uses tends to remain in the top few feet of soil for a long time and is not likely to have a significant impact on most aquifers. When dissolved in water, arsenic has no smell, taste or color, even at high concentrations.

Arsenic has been reported to cause more than 30 different adverse health effects including cardiovascular disease, diabetes mellitus, skin changes, nervous system damage and various forms of cancer. The odds that one or more of these could occur depend upon the amount of arsenic a person consumes and how sensitive they are to the effects of arsenic. Getting arsenic on the skin when bathing or washing is not considered a major contributor to health risk. There is a small chance that some people who drink water containing low levels of arsenic for many years could develop circulatory disease, cancer or other health problems. Most cancers and circulatory diseases are due to factors other than exposure to arsenic.

ARSENIC WATER TREATMENT

These treatment technologies are available to remove arsenic from water:

- *Coagulation/filtration*: This method uses conventional treatment processes to coagulate the arsenic. The treated water is then filtered.
- *Activated alumina*: This method removes arsenic from water by adsorption onto alumina.
- *Reverse osmosis*: This technology uses pressure to force water through a membrane filter, leaving arsenic behind.
- *Anion exchange*: Arsenic is adsorbed onto a resin, and the resin is periodically regenerated with sodium chloride solution.
- *Oxidation/filtration*: This technology oxidizes naturally occurring iron, which binds to arsenic followed by filtration.

NEW DRINKING WATER STANDARD FOR ARSENIC

In January 2001, the USEPA lowered the MCL for arsenic from 50 parts per billion (ppb) to 10 ppb. Under the new arsenic rule, more sensitive analytical equipment and methods were also required. As a result, the State Report Level (SRL) for arsenic was lowered from 10 ppb to 2 ppb.

NEW MONITORING REQUIREMENT FOR ARSENIC

In order to obtain more current and accurate information for systems that may be affected by the lower drinking water standard for arsenic, WSDOH requested all community and non-transient community water systems to collect an arsenic sample by September 30, 2002 from each active permanent or seasonal source and have it analyzed in accordance with the new SRL of 2 ppb.

8.6.9 Radionuclides

Radionuclides include radioactive substances occurring naturally in subsurface waters such as radium-226, radium-228, uranium, and gross alpha and beta particles. Table 8.12 summarizes MCLs as defined by USEPA's Radionuclide Rule and WAC 246-290-310 (6).

RADIONUCLIDE MONITORING REQUIREMENT

TPUD shall monitor for gross alpha once every six (6) years per WAC 246-290-300 (8) and 40 CFR141.26. A water system purveyor may omit analysis for radium-226 and radium-228 if the gross alpha particle is less than 5 pCi/L.

8.6.10 Lead and Copper Rule

In 1991, the USEPA promulgated the Federal Lead and Copper Rule. The State of Washington adopted this rule in 1995 with minimal changes. The Lead and Copper Rule is intended to reduce the tap water concentrations that can occur when corrosive source water causes lead and copper to leach from water meters and other plumbing fixtures. Possible treatment techniques to reduce lead and copper leaching include addition of soda ash or sodium hydroxide to the source water or by passing the water through calcite contact chambers prior to distribution.

LEAD AND COPPER MONITORING REQUIREMENTS

Based on the requirements of USEPA's Lead and Copper Rule (40 CFR 141, Subpart I), lead and copper monitoring must be completed for two consecutive six-month monitoring periods. If lead and copper action levels are not exceeded, then the number of samples may be reduced to one-half the original number for three consecutive annual periods. Assuming compliance with the action level is maintained, reduced sampling may continue once every three years thereafter.

8.6.11 Asbestos

Asbestos is the name for a group of naturally occurring, hydrated silicate minerals with fibrous morphology. Included in this group are chrysotile, corcidolite, amosite, and the fibrous varieties of anthophyllite, tremolit and actinolite. Most commercially-mined asbestos is chrysotile. Historically, the flexibility, strength and chemical and heat resistance properties of asbestos have adapted it to many uses including building insulation, brake linings and water pipe.

In recent years, there has been much concern with the health risks associated with the use of asbestos in the everyday environment. Several studies and case histories have documented the hazards to internal organs as a result of inhalation of asbestos fibers. Data is limited on the effects of ingestion of asbestos fibers or on the effects of inhalation exposure from drinking water. Ingestion studies have not caused cancer in laboratory animals, though studies of asbestos workers have shown increased rates of gastrointestinal cancer.

ASBESTOS MONITORING REQUIREMENT

Asbestos is listed as a primary inorganic contaminant. However, it is not routinely included in IOC samples for public water systems. If TPUD water systems' distribution networks have more than ten percent (10 percent) asbestos cement pipe, an asbestos sample must be collected from the distribution system at least once every nine years or more frequently if required by WSDOH.

8.6.12 Groundwater Rule

The 1986 amendments to the SDWA require that the USEPA promulgate disinfection requirements for all public water systems. Publication of the final Groundwater Rule was completed in November 2006 with an effective date of January 8, 2007. In accordance with that rule, since December 1, 2009, MWS has been required to conduct triggered source water monitoring whenever a sample is tested positive for total coliform-present.

According to provisions under consideration, a public water system would need to disinfect water from each of its wells (or well fields) unless one or more of the wells meets the "natural disinfection" criteria or the system qualifies for a variance. Systems may also meet "pre-qualifying conditions" to avoid source water disinfection. This rule will establish a method for determining if disinfection of a groundwater source is required, and it would establish disinfection standards for those sources where disinfection is required.

PRE-QUALIFYING CONDITIONS

- The well must not have been identified as a source of waterborne disease outbreak.
- The well must meet State-approved construction codes.
- The system must not have violated the Total Coliform Rule unless the cause of the violation has been identified and corrected.

"NATURAL DISINFECTION" CRITERIA

"Natural disinfection" may apply to a well that meets the criteria related to issues listed below in addition to all the conditions listed under "pre-qualifying conditions." Details of the criteria listed below have not yet been finalized, but the issues will address the following:

- Distance from the nearest potential source of fecal contamination and the presence of large fractures or flow through caves.
- Travel time of a particle from the nearest source of fecal contamination.
- The travel time of a pathogen from the nearest source of fecal contamination.
- The presence of a thick unsaturated zone and the human impact on the zone.

SANITARY SURVEYS

Sanitary surveys are conducted once every five years in Washington State. Federal laws indicate they must be conducted every three years and meet the provisions of the 1998 Interim Enhanced Surface Water Treatment Rule as it relates to populations served. In addition, the sanitary survey shall implement the eight elements of the USEPA/State Joint Guidance on Sanitary Surveys. These elements relate to source protection; identification of the physical components and their condition; and description and implementation of programs for treatment, distribution, storage, pumping, monitoring, operation and maintenance; and operator certification.

HYDROGEOLOGIC SENSITIVITY ASSESSMENTS

Hydrogeologic sensitivity assessments apply to all groundwater systems that do not provide 99.99 percent virus removal. USEPA considers aquifers to be sensitive to microbial

contamination if the hydrogeologic setting includes a geological layer characterized by relatively large interconnected void spaces allowing rapid interstitial water flow velocities. Interconnected voids may include characteristics such karst formations, gravel and cobbles, or fractured bedrock. The assessment must be performed by WSDOH once within six years of final rule publication.

SOURCE WATER MONITORING

If the state determines that a source is hydrogeologically sensitive, monthly monitoring for fecal indicators must be performed. Hydrogeological sensitivity can be determined through monthly routine monitoring or by conducting a hydrogeological sensitivity assessment. After 12 negative routine samples, the monitoring frequency can be reduced. Once a total coliform-positive sample is found within a distribution system, the system is required to collect one source water sample and monitor for a fecal indictor. Washington State may choose to issue a waiver if the groundwater source has a hydrogeologic barrier.

CORRECTIVE ACTIONS

Corrective actions must be taken by "groundwater systems that have a significant deficiency or have detected a fecal indicator in their source water." USEPA guidelines recommend that corrective actions take place within 90 days, or longer if approved by the State. The problem should be solved by eliminating the contaminate source, correcting the significant deficiencies, or providing an alternate source of water supply. If any Meadows' well sources indicate a significant deficiency, monitoring shall be provided to document that 99.99 percent of the virus is inactivated or removed.

COMPLIANCE MONITORING

Compliance monitoring applies to all groundwater systems that disinfect as a corrective action. Systems serving greater than 3,300 individuals must continuously monitor their disinfection treatment process. If disinfection concentrations are below the required level, the system must restore disinfection concentration within four (4) hours.

8.6.13 Disinfection/Disinfection Byproduct Rule (D/DBP)

Stage 2 of the D/DBPs became effective January 4, 2006. The major goal of the D/DBP Rule is to reduce human exposure to concentrations of disinfectants and their byproducts without compromising microbiological treatment.

The Stage 2 D/DBP Rule applies to all public water systems using disinfection, except for ultra-violet light. However, only systems serving more than 10,000 people are required to complete an Initial Distribution System Evaluation (IDSE). **MWS does NOT add any disinfectants to the water.** The rule establishes MCLs for several regulated compounds. The list of compounds regulated includes:

REGULATED CONTAMINANTS	MCLG (MG/L)	MCL (MG/L)
• Total Trihalomethanes (TTHM)		0.080 LRAA
o Chloroform	0.07	
o Bromodichlromethane	0	
o Dibromochloromethane	0.06	
o Bromoform	0	
• Haloacetic Acids (HAA5)		0.060 LRAA
o Monochloroacetic acid	0.07	
o Dichloroacetic acid	0	
o Trichloracetic acid	0.020	
o Bromoacetic acid	-	
o Dibromoacetic acid	-	

Stage 2 of the D/DBR requires water systems to meet disinfection byproduct maximum contaminant levels (MCLs) at each monitoring site in the distribution system. The intent of this proposed regulation is to reduce disinfection byproduct exposure and provide more equitable health protection, lower cancer, reproductive and development risks.

8.7 Reporting Requirements

8.7.1 Bacteriological Reporting Requirements

The Revised Total Coliform Rule (TCR) distinguishes between "sanitary defects" and "defects". (See TCR summary sheets in Appendix F.) Sanitary defects present a pathway for contaminants to enter the water system which includes the failure or imminent failure of a barrier to contaminants entering the water system. A "defect" represent other issues that may contribute to a coliform-present sample such as improper sample collection techniques. The presence of total coliforms in a repeat sample may be caused by either kind of defect. In either case, the event triggers the "Assessment Requirement" as prescribed in the TCR.

A Level 1 Assessment is triggered for a system the size of MWS if there are two or more total coliform-present results in the same month. Failure to collect three repeat samples for every coliform-present routine sample also triggers a Level 1 Assessment. See Level 1 Assessment Guidance Template in Appendix F. Level 1 Assessments can be completed by competent staff or system operators.

A Level 2 Assessment is a more complex evaluation that must be completed by an individual properly certified by the State of Washington. A Level 2 Assessment is triggered whenever an *E. coli* MCL violation occurs or a second Level 1 Assessment trigger is exceeded within a rolling 12-month time period. See Appendix F for Level 2 Assessment Guidance Template.

PUBLIC NOTIFICATION

Public notification is required within 30 days should MWS fail to conduct a required Level 1 or Level 2 Assessment within 30 days of first learning of the triggering of either. Notification is also required should MWS fail to correct a sanitary defect within 30 days of learning of the triggering, either Level 1 or Level 2.

WSDOH NOTIFICATION

If bacteriological presence is detected in a routine sample, the following reporting requirements are required:

- Coliform-presence in a routine sample without an E. Coli MCL violation: Notify WSDOH within 10 days. If two occurrences in the same month, implement Level 1 Assessment.
- E. coli is detected in a routine sample: Notify WSDOH immediately and implement Level 2 Assessment.
- If an E. Coli MCL violation occurs, WSDOH must be notified within 24 hours. Water system users must be notified through an approved public notice (i.e., boil water notice) within 72 hours.

The materials listed below are tools to help water systems respond to the presence of fecal contamination in the water supply. If TPUD were to have fecal contamination in their systems, the WSDOH would work closely with the system operator to help resolve the situation and determine if a public health advisory is required.

Coliform Bacteria and Drinking Water (fact sheet)

Troubleshooting Checklist for Coliform Contamination (fact sheet)

Emergency Water Supply Guidelines for Food Service Establishments (fact sheet)

Drinking Water After-Hours Emergency Hotline Printed versions of this page in brochure format are available by emailing the TPUD office.

Treatment of Drinking Water for Emergency Use (brochure)

Information sheet: *Coliform Reporting Addresses and Phone Numbers (with map)*

Drinking Water Warning - Public Notification Form

Door Hanger (English and Spanish); *Door Hanger (English only)*

Public Notice Certification

Press Release Announcing Boil Water Advisory

Press Release Boil Water Advisory Rescinded

DRINKING WATER WARNING - PUBLIC NOTIFICATION FORM

Water systems may use this to notify your customers in response to an E. coli positive sample result. Water systems can complete the form online and make copies or print the form on white paper, then type or hand-write information on the form. It can then be photocopied and distributed to customers. Water systems can also staple or tape the warning to a yellow door-hanger to make it easier to distribute door-to-door.

DOOR HANGER

This tool is to assist water system to quickly inform customers of contamination in the system and precautions they can take. Supplies of these on heavy bright colored paper and designed for hanging on door knobs are available through local health departments and the WSDOH Drinking Water Division regional offices. Water systems can also print the two page door hangers and copy back to back (English version on one side and Spanish on the other) to make their own.

PUBLIC NOTICE CERTIFICATION

Water systems must complete this certification and mail it to WSDOH Drinking Water Division regional office within 10 days of notifying customers of an E. Coli MCL violation.

NEWS RELEASES

Press Release Announcing Boil Water Advisory
Press Release Boil Water Advisory Rescinded

These templates include sample information that the WSDOH recommends including in a news release for television, radio and newspaper outlets. News releases are recommended for systems serving more than 100 connections as is the case for MWS. The WSDOH can assist water systems in contacting the news media, upon request. Contact your regional office for details.

8.7.2 IOC/VOC/SOC Reporting Requirements

FOLLOW UP ACTION

Follow up action and reporting are required for MCL exceedance following IOC, VOC, and SOC sampling and testing. For non-nitrate/nitrite primary inorganic chemicals (IOC), follow up action shall conform to 40 C.F.R. 141.23 (a)(4), 141.23 (b)(8), 141.23 (c)(7), 141.23 (c)(9), 141.23 (f)(1), 141.23(g), 141.23(m) and 141.23(n).

For nitrate, the following C.F.R.s apply: 40 C.F.R. 141.23 (a)(4), 141.23 (d)(2), 141.23 (d)(3), 141.23 (f)(2), 141.23(g), 141.23(m), 141.23(n), and 141.23(o).

For nitrite, comply with the following: 40 C.F.R. 141.23 (a)(4), 141.23 (e)(3), 141.23 (f)(2), and 141.23(g).

Alternatively, DOH may stipulate follow-up action commensurate with the degree of consumer acceptance of the water quality and their willingness to bear the costs of meeting the secondary standard.

For organic chemicals, follow-up monitoring shall be conducted in accordance as follows:

VOCs per 40 C.F.R. 141.24 (f)(11) through 141.24 (f)(15), and 141.24 (f)(22)
SOCs, 40 C.F.R. 141.24(b), 141.24(c) and 141.24 (h)(7) through 141.24 (h)(11), and 141.24 (h)(20).

PUBLIC NOTIFICATION

MWS shall notify all water system users in accordance with 40 C.F.R. 141.201 through 208 when the system violates a National Primary Drinking Water Regulation and when any of the situations listed in Table 1 of 40 C.F.R. 141.201 occur excepting section (a)(3)(ii).

Public notifications for violations and other situations are categorized as Tier 1, Tier 2, and Tier 3. Notification requirements shall be per the tables included in Appendix E. Additionally, MWS shall consult with DOH as soon as possible but no later than twenty-four hours after learning of a Tier 1 violation or situation in order to determine if additional public notice is required. MWS shall then comply with any additional public notification requirements established as a result of the consultation.

MWS shall notify the water system users when the system whenever MWS is issued a department order; fails to comply with a department order; or is issued a category red operating permit.

8.7.3 Arsenic Reporting Requirements

The U.S. Environmental Protection Agency (USEPA) requires that water utilities classified as community water systems serving more than 25 people and non-transient non-community water systems reduce the level of arsenic in their water from 50 parts per billion (ppb) to 10 ppb by January 2006. This requirement was met. No arsenic was detected in the Meadows' well water.

Community water systems that have arsenic levels greater than 10 ppb must include the concentration of arsenic detected in their most recent sample, along with a statement on health risks, in the annual Consumer Confidence Report (CCR) distributed to customers in July of each year. Water systems that have arsenic levels of 5-10 ppb must include an educational statement about arsenic in their CCR's.

ARSENIC AND CONSUMER CONFIDENCE REPORTS

Arsenic information must be included in annual CCRs sent to water customers by water systems. The WSDOH Drinking Water Division is also recommending a special educational statement for systems that are reporting arsenic levels at "less than 10 ppb" where the concentration of arsenic (if any) below 10 ppb is unknown.

For systems reporting 5-10 ppb arsenic either of these language options will meet the requirement:

USEPA's Educational Statement—in federal rule:

While your drinking water meets USEPA's standard for arsenic, it does contain low levels of arsenic. USEPA's standard balances the current understanding of arsenic's possible health effects against the costs of removing arsenic from drinking water. USEPA continues to research the health effects of low levels of arsenic, which is a mineral known to cause cancer in humans at high concentrations and is linked to other health effects such as skin damage and circulatory problems.

Washington State Department of Health Recommended Educational Statement:

Your drinking water currently meets USEPA's revised drinking water standard for arsenic. However, it does contain low levels of arsenic. There is a small chance that some people who drink water containing low levels of arsenic for many years could develop circulatory disease, cancer or other health problems. Most types of cancer and circulatory diseases are due to factors other than exposure to arsenic. USEPA's standard balances the current understanding of arsenic's health effects against the costs of removing arsenic from drinking water.

For systems reporting less than 10 ppb arsenic:

Arsenic in your drinking water has been reported at less than 10 ppb. This means that your drinking water currently meets USEPA's newly revised drinking water standard for arsenic. In the future, your Consumer Confidence Report will reflect improved laboratory methods that will more accurately detect the level of arsenic (if any) in your drinking water. USEPA believes that consumers should be aware of the uncertain health risks presented by very low levels of arsenic. USEPA's standard balances the current understanding of arsenic's health effects against the costs of removing arsenic from drinking water.

For system reporting over 10 ppb arsenic:

(USEPA language) Some people who drink water that contains arsenic in excess of the MCL over many years could experience skin damage or problems with their circulatory system and may have an increased risk of getting cancer.

8.7.4 Unregulated Contaminants

Reporting procedures for unregulated contaminants are similar to the reporting requirements for IOCs, VOCs and SOCs. If the unregulated contaminant has a proposed MCL, then the reporting requirements are the same as those stated for IOCs, VOCs and SOCs. If the contaminant does not have a proposed MCL, WSDOH must be contacted and the Drinking Water Division will determine further action.

8.7.5 Consumer Confidence Reports (a.k.a. Annual Water Quality Report)

The Consumer Confidence Report (CCR) federal rule (40 CFR 141 Subpart O) was adopted as a state rule (WAC Chapter 246-290 Part 7 Subpart B) and became effective on August 21, 2000. This state regulation requires Group A community water systems to provide their customers with a report each year about the quality of water being served by the system.

The Consumer Confidence Report (CCR) must be delivered to water system customers and WSDOH before July 1 of each year. The CCR provides information to customers as to the quality of their drinking water supply and whether their water meets state and federal drinking water standards. The CCR includes information on the source of supply and both regulated and unregulated contaminants detected during the year including concentration levels. The report also provides information on disinfection byproducts or microbial contaminants and the potential health effects of the contaminants at concentrations greater than the MCL.

If contamination is found, the likely source of the contaminant is identified and a summary of any violations in monitoring, reporting or recordkeeping is included. The CCR can assist customers with special health needs to make informed decisions regarding their drinking water. Consumer Confidence Reports provide references and telephone numbers as to health effects data and available information about the water system in general.

Required content for the CCR includes:

- The type of water served (such as groundwater, surface water, water from another system) and the name and location of its source.
- Regulated and unregulated contaminants that have been detected in the water, their concentrations and the allowable federal or state standard.
- Disinfection byproducts or microbial contaminants, their concentrations and standards.
- Descriptions of possible health effects of contaminants in drinking water at concentrations greater than the federal or state health standard.
- Identification of the likely source of any contamination.
- Violations of any monitoring, reporting, treatment or recordkeeping requirements.
- Opportunities for public involvement and water system contact information.

The regulation also requires certain educational language and a specific table format for summarizing detected contaminants. The requirements are in Chapter 246-290-WAC Part 7, Subpart B. Utilities may include additional information to better acquaint customers with their particular operations.

TPUD distributes its annual Water Quality Reports *(Consumer Confidence Report)* prior to every July, as the rule requires.

8.8 New and Anticipated SDWA Regulations

8.8.1 Radon Rule

The American Water Works Association (AWWA) has issued a regulatory alert to utilities utilizing groundwater sources to begin monitoring for radon in preparation for an upcoming radon standard. The USEPA proposed a standard for radon in August 2000. Though a radon MCL was included in the originally proposed Radionuclide Rule, it was determined that a radon MCL would be issued as a separate rule. In November 1999, USEPA proposed a preliminary radon MCL of 300 picocuries per liter (pCi/L). If states or water purveyors implement a Multimedia Mitigation Program aimed at reducing household indoor-air health risks from radon gas from soil as well as tap water, USEPA is considering an alternative MCL of 4,000 pCi/L. USEPA expected the final publication of the Radon Rule in 2001, but the rule has not yet been published. The State of Washington has not yet adopted an MCL for radon.

8.8.2 Aldicarb Rule

Final MCLs for the pesticides aldicarb, aldicarb sulfone and aldicarb sulfoxide have been established under the Phase II Rule for SOCs and IOCs. However, the effective date for these MCLs was postponed when the USEPA agreed to reexamine the health effects data for aldicarb compounds. The USEPA is expected to propose MCLs of 7 µg/L for each

pesticide with a 9-μg/L composite total. These pesticides are also listed under Round 2 of the Unregulated Contaminate Monitoring Regulations, as described below.

8.8.3 Long Term Revisions to the Lead and Copper Rule

Lead in drinking water has long been known to present serious health risks which in part led to the adoption of the Lead-Copper Rule (LCR) in 1991. More recent water quality crises, most notably Flint, Michigan, has led to re-evaluation of the LCR and consideration of possible changes. While that work continues, the following recommended changes have been put forth and adopted by the National Drinking Water Advisory Council (NDWAC). NDWAC is a Federal Advisory Committee that supports EPA in performing its duties and responsibilities related to the national drinking water program. The NDWAC LCR Working Group was formed to provide advice to EPA in considering potential revisions to the LCR.

In December 2015, the NDWAC provided specific recommendations to the Administrator for LCR revisions including:

- Require proactive LSLR programs, which set replacement goals, effectively engage customers in implementing those goals, and provide improved access to information about LSLs, in place of current requirements in which LSLs must be replaced only after a lead action level exceedance (ALE);

- Establish more robust public education requirements for lead and LSLs, by updating the Consumer Confidence Report (CCR), adding targeted outreach to consumers with LSLs and other vulnerable populations (pregnant women and families with infants and young children), and increasing the information available to the public;

- Strengthen CCT, retaining the current rule requirements to re-assess CCT if changes to source water or treatment are planned, adding a requirement to review updates to EPA guidance to determine if new scientific information warrants changes;

- Modify monitoring requirements to provide for consumer requested tap samples for lead and to utilize results of tap samples for lead to inform consumer action to reduce the risks in their homes, to inform the appropriate public health agency when results are above a designated household action level, and to assess the effectiveness of CCT and/or other reasons for elevated lead results;

- Tailor water quality parameters (WQPs) to the specific CCT plan for each system, and increase the frequency of WQP monitoring for process control;

- Establish a health-based, household action level that triggers a report to the consumer and to the applicable health agency for follow up;

- Separate the requirements for copper from those for lead and focus new requirements where water is corrosive to copper; and

- Establish appropriate compliance and enforcement mechanisms.

MWS is advised of these potential changes to the LCR. For more information, TPUD should review the report provided by EPA at https://www.epa.gov/dwstandardsregulations/lead-and-copper-rule-long-term-revisions .

8.9 Recommendations for Water Quality Compliance

8.9.1 Coliform Compliance Recommendations

1. Coliform Monitoring Plan has been completed and is included in Appendix F.
2. Ensure that records of bacteriological data are kept for five years. Records must be available for inspection by WSDOH.
3. Continue to provide notification documentation to WSDOH Drinking Water Division within ten days of a positive coliform test, or by the end of the same business day when fecal coliform or E. coli are present.

8.9.2 IOC Compliance Recommendations

1. Uses sources such that blending of water reduces concentration of secondary contaminants.
2. During non-peak water demand periods, refrain from using the sources highest in secondary contaminants.

8.9.3 VOC Compliance Recommendations

1. Identify each well with a unique point of entry to the distribution system.
2. Ensure that each unique source is sampled separately.
3. Apply for waivers where applicable and cost savings justify.

8.9.4 Arsenic Compliance Recommendations

There are no recommendations at this time.

8.9.5 Radionuclide Compliance Recommendations

Collect radionuclide samples as directed by WSDOH (On-going).

8.9.6 Asbestos Compliance Recommendations

There are no recommendations at this time.

8.9.7 Lead and Copper Compliance Recommendations

1. Conduct materials surveys for the system.
2. Collect lead and copper samples as directed by WSDOH (On-going).

Table 8.6 Applicable Drinking Water Regulations

Rule	CFR	WAC 246-290	Affected Contaminants	Publication Date of Final Rule
Department of Health, Public Water Supplies Regulations	See below	Part 4	Bacteriological, IOC, VOC, SOC, Asbestos, Radionuclides, THMs, Lead/Copper, Phase II/V	In Effect 1993
Lead and Copper Rule	40 CFR 141.86 141.87 141.88	Part 4, -300 (4) and -310 (3)	Lead and Copper	In Effect January 12, 2000, compliance by January 2003
Radionuclide Rule	40 CFR 141.15 141.25 141.26	Part 4, -300 (9) and -310 (6)	Radionuclides	In Effect April 4, 1997
Arsenic Rule	40 CFR 141.23 141.24 141.16	Part 4, -300 (3) and -310 (3)	Arsenic	In Effect February 2002, compliance by January 23, 2006
Unregulated Contaminant Monitoring Regulations	64 FR 50556 65 FR 11372 66 FR 2273	Part 4, -300 (8)	Unregulated Contaminants	In Effect September 1999, updated every five years
Groundwater Rule	71 FR 65574	Part 5, -451	Fecal Contamination	January 8, 2007
Disinfection By-Products Rule (Stage 2)	71 FR 388	Part 4, -300	Byproducts of disinfection – TTHM & HAA5	January 2006

Table 8.7 Primary MCL for Inorganic Chemicals

Chemical	Primary MCL (mg/L)
Antimony (Sb)	0.006
Arsenic (As)	0.01
Asbestos	7 million fibers/liter (length > 10 microns)
Barium (Ba)	*2.0*
Beryllium (Be)	0.004
Cadmium (Cd)	0.005
Chromium (Cr)	0.1
Copper (Cu)	None Established
Cyanide (HCN)	0.2
Fluoride (F)	4.0
Lead (Pb)	None Established
Mercury (Hg)	0.002
Nickel (Ni)	0.1
Nitrate (as N)	10.0
Selenium (Se)	0.05
Thallium (Tl)	0.002

Table 8.8 Secondary MCL for Inorganic Chemicals

Chemical/Characteristic	Secondary MCL (mg/L)
Chloride (Cl)	250.0
Fluoride (F)	2.0
Iron (Fe)	0.3
Manganese (Mn)	0.05
Silver (Ag)	0.1
Sulfate (SO4)	250.0
Zinc (Zn)	5.0
Color	15 Color Units
Specific Conductivity	700 umhos/cm
Total Dissolved Solids (TDS)	500

Source: State Department of Health Drinking Water Regulations (246-290), effective April 1999.

Table 8.9 Regulated VOCs and SOCs

Organic Chemical	Federal Regulation	Primary MCL (mg/L)[1]	Organic Chemical	Federal Regulation	Primary MCL (mg/L)[1]
Volatile Organic Chemicals (VOCs)					
Vinyl Chloride	Phase I	0.002	Monochlorobenzene	Phase II	0.1
Benzene	Phase I	0.005	Ortho-Dichlorobenzene	Phase II	0.6
Carbon Tetrachloride	Phase I	0.005	Styrene	Phase II	0.1
1,2-Dichloroethane	Phase I	0.005	Tetrachloroethylene	Phase II	0.005
Trichloroethylene	Phase I	0.005	Toluene	Phase II	1
Para-Dichlorobenzene	Phase I	0.075	Trans-1,2-Dichloroethylene	Phase II	0.1
1,1-dichloroethylene	Phase I	0.007	Xylenes (total)	Phase II	10
1,1,1-Trichloroethane	Phase I	0.2	Dichloromethane	Phase V	0.005
Cis-1,2-Dichloroethylene	Phase II	0.07	1,2,4-Trichloro-benzene	Phase V	0.07
1,2-Dichloropropane	Phase II	0.005	1,1,2-Thrichloro-ethane	Phase V	0.005
Ethylbenzene	Phase II	0.7			
Synthetic Organic Chemicals (SOCs)					
Arochlor	Phase II	0.002	2,4,5-TP	Phase II	0.05
Aldicarb	Phase II (2)	0.003	Benzo(a)pyrene	Phase V	0.0002
Aldicarb sulfone	Phase II (2)	0.003	Dalapon	Phase V	0.2
Aldicarb sulfoxide	Phase II (2)	0.004	Di(2-ethylhexyl) adipate	Phase V	0.4
Atrazine	Phase II	0.003	Di(2-ethylhexyl) phthalate	Phase V	0.006
Carbofuran	Phase II	0.04	Dinoseb	Phase V	0.007
Chlordane	Phase II	0.002	Diquat	Phase V	0.02
Dibromochloro-propane	Phase II	0.0002	Endothall	Phase V	0.1
2,4-D	Phase II	0.07	Endrin	Phase V	0.002
Ethylene dibromide	Phase II	0.00005	Glyphosate	Phase V	0.7
Heptachlor	Phase II	0.0004	Hexachlorobenzene	Phase V	0.001
Heptachlor epoxide	Phase II	0.0002	Hexachloro Cyclopentadiene	Phase V	0.05
Lindane	Phase II	0.0002	Oxamyl (vydate)	Phase V	0.2
Methoxychlor	Phase II	0.04	Picloram	Phase V	0.5
Polychlorinated biphenyls (PCBs)	Phase II	0.0005	Simazine	Phase V	0.004
Pentachlorophenol	Phase II	0.001	2,3,7,8-TCDD (dioxin)	Phase V	3×10-8
Toxaphene	Phase II	0.003			

(1) 40 CFR 141.61(a) & (c); adopted by State Board of Health, effective April 1999.
(2) Delayed; as of the date of this report re-proposal of MCLs for Aldicarb compounds is expected sometime in the future per USEPA.

Table 8.10 Radionuclide MCLs

Radionuclide	MCL
Radium – 226[(1)]	3 pCi/L
Combined Radium – 226 and 228[(1)]	5 pCi/L
Uranium[(2)]	30 µg/L
Gross Alpha (excluding Uranium)[(1)]	15 pCi/L
Gross Beta[(1)]	50 pCi/L

(1) – See 40CFR 141.66 (b), (c) & (d) [(adopted by Reference 246-290-025 WAC, effective July 2003)]

(2) – See 40 CFR 141.66 (e) [(adopted by Reference 246-290-025 WAC, effective July 2003)]