2 System Description

2.1 Introduction

Skagit County is located in the northwestern part of Washington State, and stretches from Puget Sound to the crest of the Cascade Mountains. Also included are leeward islands of the San Juan Archipelago, together with the Skagit River delta and floodplain. The eastern two-thirds of Skagit County is dominated by the northern Cascade Mountains, which include Mount Baker, portions of North Cascade National Park, and Mount Baker National Forest. Mount Vernon is the largest city in Skagit County and the county seat. Other significant municipalities include Anacortes, Burlington, Concrete, Hamilton, LaConner, Lyman, and Sedro-Woolley.

Figure 2-1 is a general vicinity map of Skagit County.

As described in this chapter, the District operates the most expansive water system in the county with a total of over 23,000 active service connections. The majority of the District's services are within the Judy Reservoir System (Judy System), Washington State Department of Health (DOH) Public Water System Identification (PWSID) 79500E, which serves Mount Vernon, Burlington, and Sedro-Woolley and surrounding rural and suburban areas. Appendix B contains the District's Water Facilities Inventory for the Judy System, and Appendix C includes the most recent sanitary surveys of the Judy System and the water treatment plant. The District also operates remote water systems including the following:

- Fidalgo Island (PWSID 00932 Y)
- Alger (PWSID 01400 K)
- Cedargrove (PWSID 11917 4)
- Marblemount (PWSID AA642)
- Mountain View (PWSID 03774 Y)
- Potlatch Beach (PWSID 69034 L)
- Rockport (PWSID 73600 6)
- Skagit View Village (PWSID 96879 5)

As directed by DOH, this WSP focuses on the District's Judy Reservoir System because the satellite systems were addressed in the previous WSP update in 2007. See Chapter 12 for a statement on each remote system regarding coliform monitoring plans, CIP projects, sanitary survey corrections, and distribution system leakage (DSL). Figures 2-2 and 2-3 show District water systems and adjacent water purveyors in Skagit County.

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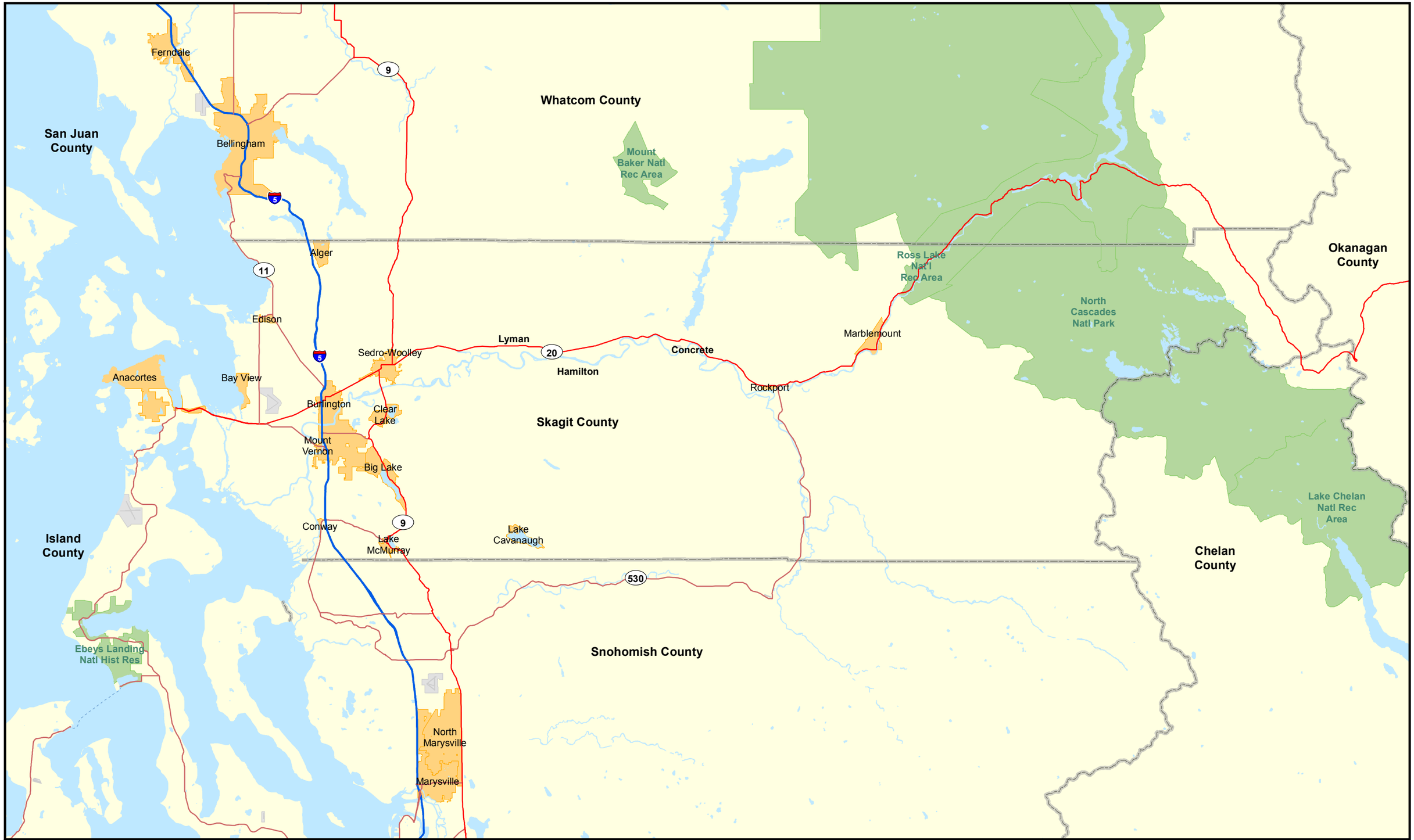
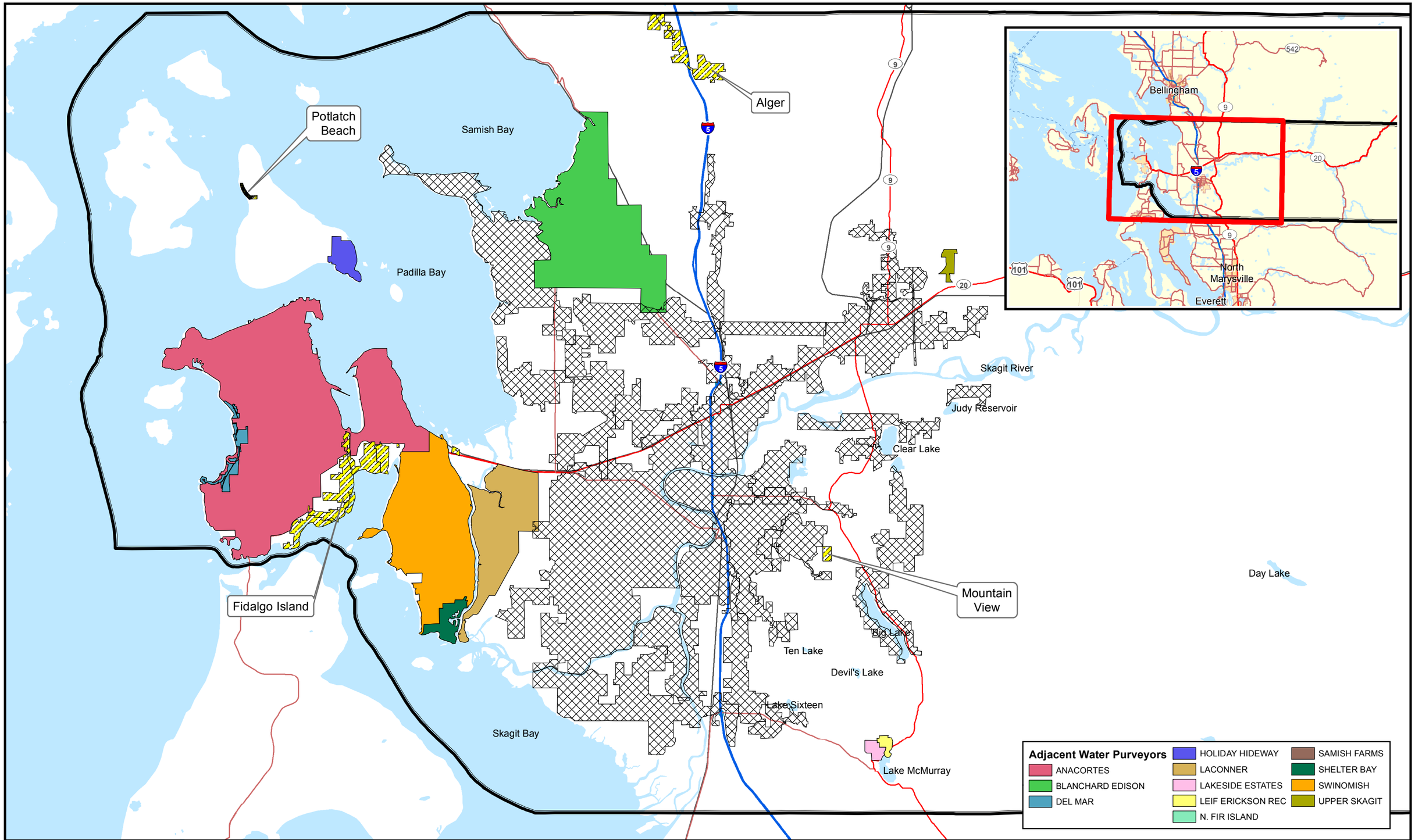


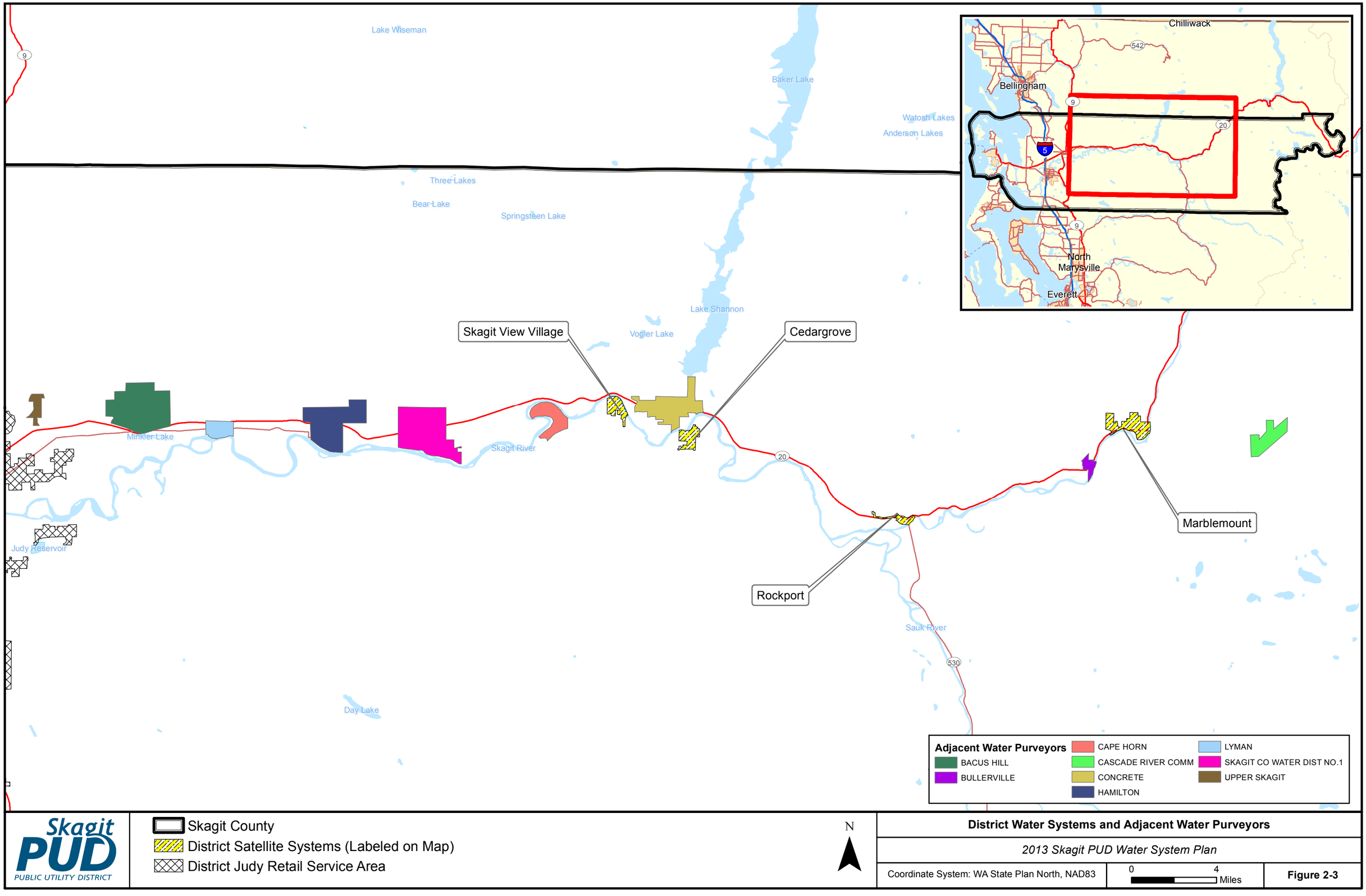
General Vicinity Map

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

Figure 2-1


Potlatch Beach
Samish Bay
Alger
Padilla Bay
Fidalgo Island
Skagit Bay
Skagit River
Judy Reservoir
Clear Lake
Mountain View
Day Lake
Big Lake
Ten Lake
Devil's Lake
Lake Sixteen
Lake McMurray
Bellingham
North Marysville
Everett
Adjacent Water Purveyors
ANACORTES
BLANCHARD EDISON
DEL MAR
HOLIDAY HIDEWAY
LACONNER
LAKESIDE ESTATES
LEIF ERICKSON REC
N. FIR ISLAND
SAMISH FARMS
SHELTER BAY
SWINOMISH
UPPER SKAGIT
District Satellite Systems (Labeled on Map)
Skagit County
District Judy Retail Service Area
N
District Water Systems and Adjacent Water Purveyors
2013 Skagit PUD Water System Plan
Coordinate System: WA State Plan North, NAD83
0
4
Miles
Figure 2-2


Lake Wiseman
Baker Lake
Watosh Lakes
Anderson Lakes
Three Lakes
Bear Lake
Springsteen Lake
Lake Shannon
Vogler Lake
Skagit View Village
Cedargrove
Minkler Lake
Skagit River
Judy Reservoir
Day Lake
Sauk River
Rockport
Marblemount
Chilliwack
Bellingham
North Marysville
Everett
Adjacent Water Purveyors
BACUS HILL
BULLERVILLE
CAPE HORN
CASCADE RIVER COMM
CONCRETE
HAMILTON
LYMAN
SKAGIT CO WATER DIST NO.1
UPPER SKAGIT
Skagit County
District Satellite Systems (Labeled on Map)
District Judy Retail Service Area
N
District Water Systems and Adjacent Water Purveyors
2013 Skagit PUD Water System Plan
Coordinate System: WA State Plan North, NAD83
0
4
Miles
Figure 2-3

2.2 Ownership and Management

The responsibilities and powers of the District are exercised through a Commission of three members, elected by the voters, having 6-year terms expiring in rotation so that one Commissioner is elected every 2 years. The Board of Commissioners, as authorized by law, employs a General Manager, a Treasurer, an Auditor, counsel, and such other officials and special services as may be required to conduct the affairs of the District. The General Manager, Auditor, and counsel are all independent entities employed by the Commission and work for the unified good of the District. There is no legal linkage between the District and Skagit County government, though there is a cooperative working relationship.

The General Manager is the chief administrative officer of the District and, assisted by the Treasurer, Auditor, Engineering Manager, counsel, and administrative and operations staff, carries out the policies set by the Board of Commissioners and all other duties as set forth in Revised Code of Washington (RCW) 54.16.100. To address the possibility that the General Manager could be absent or temporarily disabled, the General Manager has, with the approval of the Commission, designated the Auditor as Assistant Manager.

The day-to-day operations of the District's water systems are handled by various staff responsible for different aspects of the system. The Operations Manager is responsible for the piping, valves, reservoirs and pump stations, while the water treatment plant (WTP) is the responsibility of the Water Treatment Plant Superintendent. The mapping and data collection on the District's assets is handled by the Asset Manager. Figure 2-4 is a simplified organizational chart of the ownership and management of the District, with more detailed charts, including job descriptions, included in Chapter 9, Operations and Maintenance.

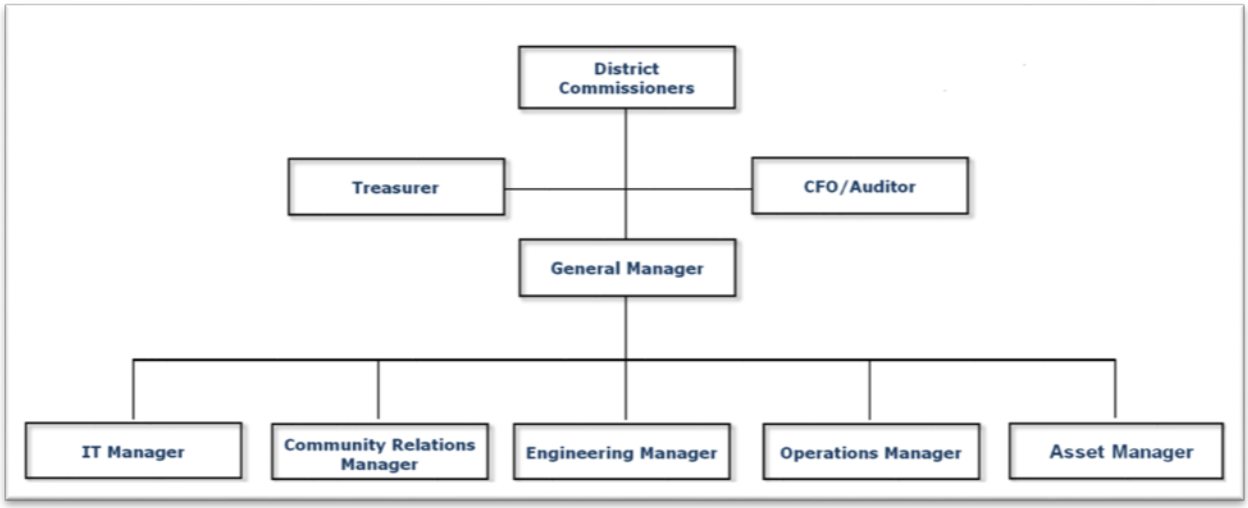


Figure 2-4. Simplified Organizational Chart

2.3 History of the Water System

The District is a municipal corporation of the State of Washington, established at the general election of November 3, 1936. The organizational meeting of the Commissioners of the District was held January 16, 1937. Since the District's organization, the Commissioners have observed regular meeting dates and, in addition, have held special meetings as circumstances dictated. Proceedings of each meeting of the Commission are recorded in an official minute book.

The water sources for the District have evolved over time, and the current water sources are the Skagit River and four creeks in the Cultus Mountains (Gilligan, Salmon, Turner, and Mundt creeks). Below is a summary of key milestones in the development of the District's water system.

1939 November 4. Purchased, by friendly condemnation, the water systems in the cities of Mount Vernon, Burlington, and Sedro-Woolley from the Peoples Water and Gas Company for the sum of $300,070. The water systems totaled 3,134 water services; 51.5 miles of pipeline; 3,940,000 gallons of distribution storage; 1.75 million gallons per day (MGD) in treatment facilities; and diversions on the Skagit River, local springs, and five creeks in the Cultus Mountains (East Fork Nookachamps, Rock Springs, Pigeon, Mundt, and Turner creeks).

1940 March 7. Purchased the Clear Lake Water Corporation for $8,330.29, complete with 180 water services; 11.5 miles of pipeline; 500,000 gallons of distribution storage; and diversions on three Cultus Mountain streams (Gilligan, Salmon, and Turner creeks).

1940 July 1. Purchased 1.8 miles of water line from the Avon Mutual Water System for $2,650.00.

1940 Integrated the entire system by laying a wood stave transmission line from Sedro-Woolley to Burlington and Mount Vernon; this line was completed that same year through support of the Works Progress Administration.

1947 Completed construction of impoundment dams in Janicki Basin, forming Judy Reservoir, capacity 450 million gallons, spillway at 435 feet above mean sea level (AMSL).

1954 Completed construction of a new Ranney well next to the Skagit River in northwest Mount Vernon.

1956 Acquired/constructed the Fidalgo Island water system at Similk Beach through Local Utility District (LUD) No. 2.

1958 Completed new overhead Skagit River pipeline crossing south of Sedro-Woolley, replacing failed 1951 submarine crossing.

1958 Replaced Gilligan and Salmon Creek diversions/pipeline to increase supply to Judy Reservoir.

1960 Extended Judy Reservoir System to Bayview through LUD No. 4.

1961 Expanded Fidalgo Island system to the Gibralter and Dewey Beach areas through LUD No. 5.

1961 Installed concrete cylinder pipe transmission line connecting Judy Reservoir to Mount Vernon.

1962 Acquired the Conway Water Company and connected it to the Judy Reservoir System.

1965 Raised Judy Reservoir from elevation 435 feet AMSL to 451 feet AMSL, increasing its impoundment capacity from 450 million gallons to 1,010 million gallons.

1967 Completed the transmission line loop with the installation of concrete cylinder pipe between Burlington and Mount Vernon.

1970 Replaced the wood stave transmission line between Judy Reservoir and the Sedro-Woolley Skagit River crossing with concrete cylinder pipe.

1977 Installed a concrete cylinder pipe transmission line parallel to the wood stave distribution line between Sedro-Woolley and Burlington.

1984 Transferred service from the wood stave line to the concrete cylinder transmission line between Burlington and Sedro-Woolley.

1990 Completed and put on-line the District's multi-media direct filtration water treatment plant at Judy Reservoir to serve the Judy Reservoir System.

1991 Acquired and reconstructed the remote public water system at Rockport through LUD No. 11.

1991 Extended the Judy Reservoir System toward Big Lake along Gunderson Road through LUD No. 12.

1992 Acquired and reconstructed the satellite public water system at Cedargrove through LUD No. 10.

1993 Extended the Judy Reservoir System around Big Lake through LUD No. 16 and to Lake Sixteen through LUD No. 18.

1994 Extended the Judy Reservoir System south of Mount Vernon around Britt Slough through LUD No. 17.

1995 Extended the Judy Reservoir System to the Hoogdal area north of Sedro-Woolley through LUD No. 19.

1996 Signed the Memorandum of Agreement Regarding Utilization of Skagit River Basin Water Resources for Instream and Out of Stream Purposes (MOA).

1996 Extended the Judy Reservoir System north of Judy Reservoir to the Panorama area through LUD No. 20.

1997 Extended the Judy Reservoir System to Big Rock through LUD No. 21.

1998 Acquired and provided a reverse osmosis water source to an existing satellite public water system on Guemes Island through LUD No. 23.

1999 Acquired and reconstructed a satellite public water system in the Alger area through LUD Nos. 22 and 24.

2000 Extended the Judy Reservoir System south of Mount Vernon to the Stackpole Road area through LUD No. 25.

2000 Completed enlargement of Judy Reservoir, increasing its impoundment capacity from 1.01 billion to 1.45 billion gallons and raising the spill elevation from 451 feet AMSL to 465 feet AMSL.

2001 Sewer Authority granted to the District through a ballot measure.

2004 Acquired and reconstructed a satellite public water system named Skagit View Village through LUD No. 27.

2006 Constructed a satellite public water system serving Marblemount through LUD No. 28.

2006 Extended the Judy Reservoir System north of the community of Bayview through North Bayview LUD No. 29.

2007 Started construction on the Skagit River Diversion Pump Station and pipeline to Judy Reservoir to provide a redundant water supply to the WTP by having the ability to transfer existing water rights to the Skagit River.

2007 Completed construction of the new 18-inch diameter ductile iron Cook Road transmission pipeline from Sedro-Woolley to Burlington to increase the geographical distribution, capacity, and reliability of a gravity feed from Judy Reservoir.

2008 Completed construction of Clearwell #3 at the WTP to add 3.25 million gallons of storage to the Judy System.

2008 Completed installation of new radio-read water meters at each metered service.

2009 Added Samish River Park, LUD No. 30, to the Judy System.

2009 Finished upgrades to the WTP. Added four new filter beds and expanded the treatment capacity of the plant from 12 MGD to 24 MGD.

2009 Installed Phase I of the new 36-inch-diameter ductile iron Judy Reservoir to Mount Vernon transmission pipeline, from Laventure Road to College Way. This pipeline provides an increase in capacity and a redundant source of supply to the existing 24-inch-diameter concrete cylinder pipeline.

2009 Completed construction of the Skagit River Diversion.

2010 Completed installation of a fiber optic backbone from Sedro-Woolley to the Town of Lyman.

2010 Utilized the new Skagit River Diversion for the first time.

2012 Completed construction of the new 18-inch-diameter ductile iron Josh Wilson Road transmission pipeline from Burlington to Bayview. This new pipeline allows a gravity feed from Judy Reservoir to serve the District's customers in Bayview, without purchasing water from an intertie with the City of Anacortes.

2013 Completed installation of a new fiber optic line in the Town of Lyman for business customers; project funded by Skagit County.

2013 Completed installation of the new 14-inch-diameter HDPE Fir Island Road pipeline to increase the hydraulic capacity to Fir Island and the far reaches of the Judy System.

2.4 Service Area

The District is authorized by RCW 54.04.030 to operate water systems within and without the limits of Skagit County, Washington. This gives the District county-wide service authority and sets the legal boundaries of the District at, but not limited to, the boundaries of the county. The District has agreed with other water utilities participating in the Skagit County Coordinated Water System Plan (CWSP) process on the designated service areas for each water system. The District's service area is essentially the entire county except for those areas already served by another public water system.

The District's Judy Reservoir System has a retail service area that includes Mount Vernon, Burlington, and Sedro-Woolley as well as surrounding communities such as Bow Hill, Bayview, Fir Island, Conway, Big Lake, and Clear Lake. Figure 2-2 shows the District's retail service area and the service area for the Judy System. The formal Service Area Agreement for Skagit County, from the CWSP, is included as Appendix D, along with the service agreements from the other contracts that the District has entered into for the purchase or sale of water.

The District also wholesales water to the North Fir Island Water Association and Samish Island Farms; these entities purchase water to serve their mostly residential customer base. The District has agreements with each of its wholesale customers, and those agreements are discussed in detail in Chapter 3, Related Plans, Agreements, and Policies. The location of each customer is shown on Figure 2-2.

As evidenced by the regionally agreed-upon 2000 CWSP, the District is generally recognized as the most capable regional water purveyor in Skagit County. As a protection for future water customers, the District will not limit its retail service area. It is not to the benefit of the District's current or future customers to reduce the District's retail service area to something less than what was regionally agreed upon in the 2000 CWSP, which has been subsequently applied to the District's Judy Reservoir water rights. If the District were to reduce its retail service area, providing service to any potential customers outside the service area boundary would require public review of an expansion of the District's retail service area. Delays and challenges to that process could lead the customer to abandon the project, because obtaining an exempt well is not a likely solution based on recent Washington State Supreme Court rulings within Skagit County regarding availability of water.

2.5 Satellite Management Agency

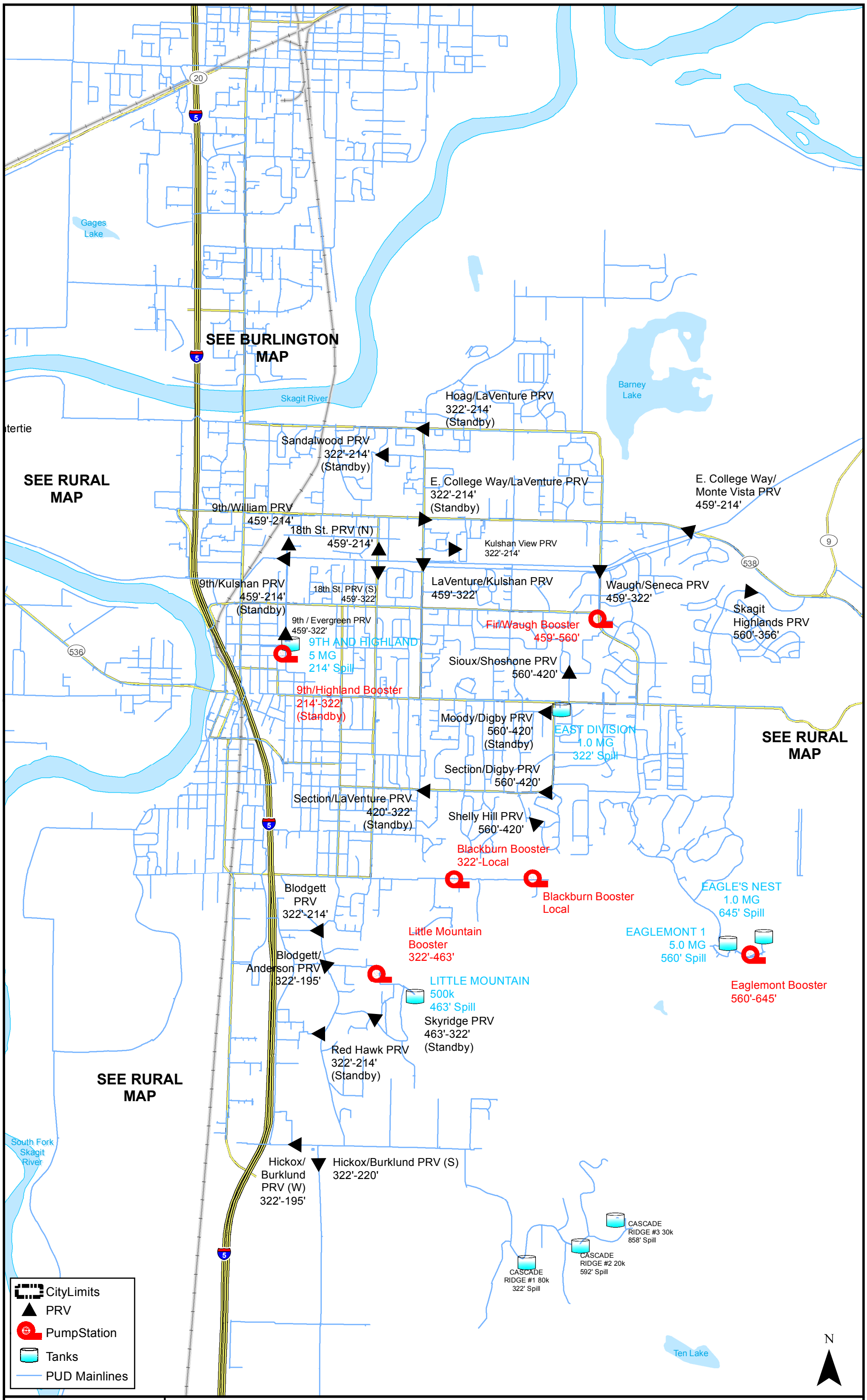
The District is the primary Satellite Management Agency for Skagit County (SMA #103) and, as identified in the CWSP, will work with any water system that is unable to provide service within or adjacent to its own designated service area, and will evaluate service to any new system in undesignated areas. The District will provide service whenever financially feasible and meeting the requirements of the District's Water Policy Manual, by line extension from an existing system or establishment of a new remote system. The Satellite Management Program is covered in greater detail in Section 12.

2.6 System Facilities

As mentioned above, this WSP focuses on the Judy System; this section provides details about the water system infrastructure that is a part of that system. The Judy System is comprised of the water sources, the WTP, transmission pipelines, and associated valves, booster stations, tanks, interties, and distribution pipelines. The major system facilities are listed below and are discussed in the sections that follow.

- Cultus Mountain stream diversions (Gilligan, Turner, Salmon, and Mundt)
- Skagit River diversion intake and pump station
- Judy Reservoir
- WTP at Judy Reservoir
- Transmission pipeline from the WTP to Mount Vernon
- Transmission pipeline from the WTP to Sedro-Woolley
- 22 reservoirs and 3 clearwells at the WTP
- 18 water booster stations
- 27 pressure zones
- 130 pressure-reducing valves

Figures 2-5, 2-6, and 2-7 show the facilities within each city, and Figure 2-8 shows the facilities in the rural areas. Specific details related to the piping are shown in separate figures and are discussed in Section 2.6.3.



Skagit PUD
PUBLIC UTILITY DISTRICT

District Facilities - City of Mount Vernon

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.5 1 Miles

Figure 2-5

N. Hill BLVD
PRV (S)
459'-214'

N. Hill BLVD
PRV (E)
459'-270'

SEE RURAL
MAP

Tina's Coma
PRV
506'-402'

Tina's Coma
Booster
270'-506'

Tina's Coma
230k
506' Spill

SEE RURAL
MAP

SEE RURAL
MAP

Gages
Lake

Skagit
River

SEE MOUNT
VERNON MAP

N

PRV
Tanks
PumpStation
CityLimits
PUD Mainlines

Skagit PUD
PUBLIC UTILITY DISTRICT

District Facilities - City of Burlington

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.25 0.5 Miles

Figure 2-6

SEE RURAL MAP

Hoogdal Road
100k
430' Spill

SR 9 & Kalloch Rd.
459'-430'
(Typ Bypassed)

SR 9 & Bassett
459'-340'

Fruitdale & Portabello
459'-350'

Dukes Hill
5 MG
214' Spill

Dukes Hill
459'-214'

Bassett/Longtime
459'-340'

SR 9 & Marie Pl.
340'-214'

Janicki
459'-214'

SEE RURAL MAP

Rhodes Rd.
459'-214'

1st & Nelson
459'-214'

Township/Dunlap
459'-214'

SEE RURAL MAP
(FROM JUDY WTP)

PRV
PumpStation
Tanks
CityLimits
PUD Mainlines

N

Skagit PUD
PUBLIC UTILITY DISTRICT

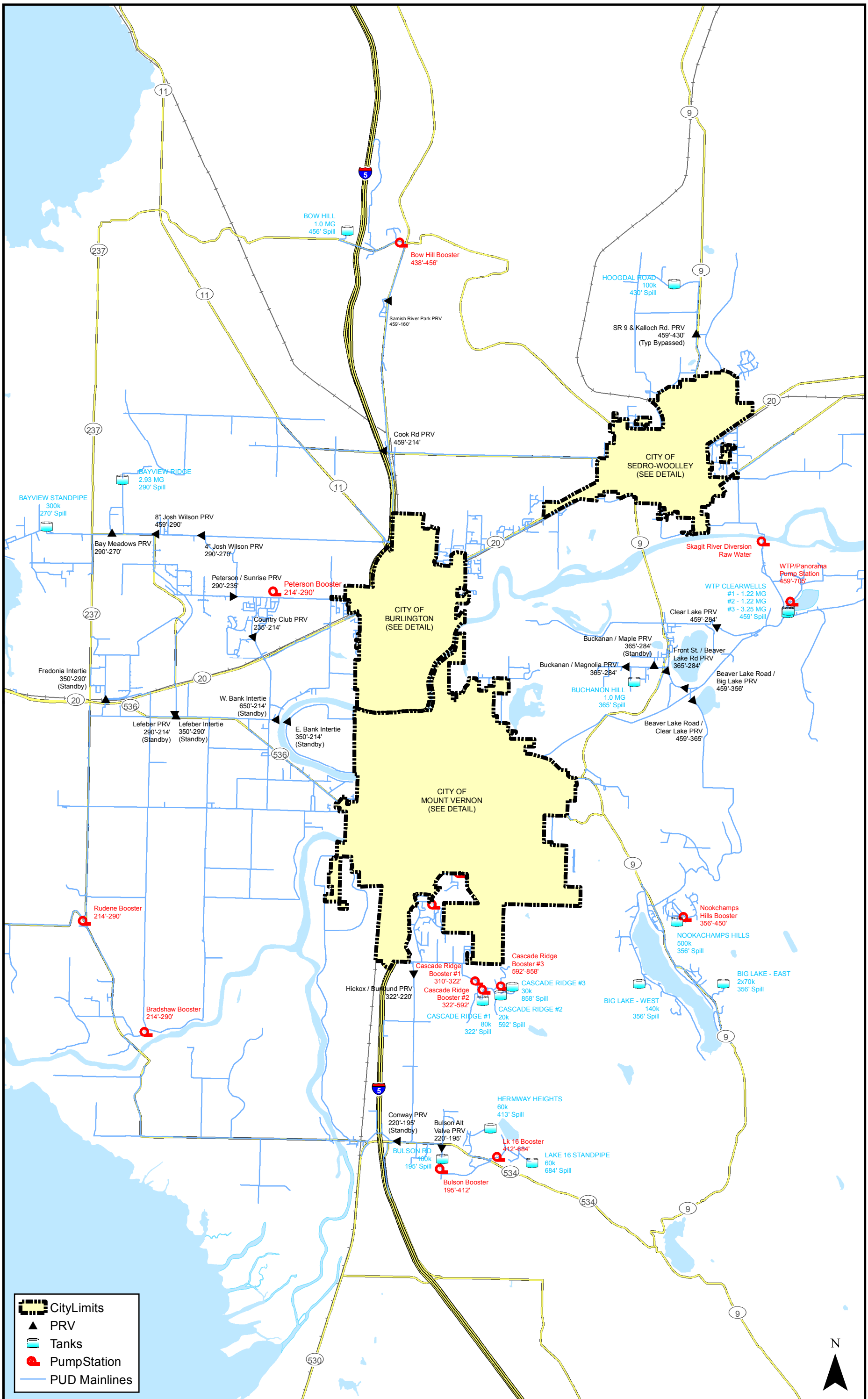
District Facilities - City of Sedro-Woolley

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.4 0.8 Miles

Figure 2-7



District Facilities - Rural Areas

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 1 2 Miles

Figure 2-8

2.6.1 Water Source Facilities

The Judy Reservoir System obtains its water from four streams tributary to the Skagit River in the Cultus Mountain Watershed (Gilligan Creek, Salmon Creek, Turner Creek, and Mundt Creek). The new Skagit River Diversion (SRD) pump station, which went "online" in 2011, can provide raw water to the WTP from the Skagit River as an alternative source to the streams. The Cultus Mountain Watershed is located approximately 2 miles east of the Town of Clear Lake. The watershed boundary and District facilities related to the watershed are shown in Figures 2-9 and 2-10. A Watershed Management Plan (WMP) was prepared for the Cultus Mountain Watershed and is discussed in Chapter 3 (Related Plans, Agreements, and Policies). The complete WMP was reviewed and approved by DOH under separate cover and its table of contents can be found in Appendix E. A watershed control plan was also prepared for the Skagit River in 1994, in coordination with the City of Anacortes. The Skagit River Watershed Control Plan was updated by the City of Anacortes in 2010 and is provided in Appendix F.

Water is collected from the four Cultus Mountain streams at diversion structures and transported to an impoundment (Judy Reservoir) through two collector pipelines. Minimum instream flows established by WAC 173-503 limit the diversion quantities available from each stream based on the month of the year. Chapter 7 (System Reliability, Water Rights, and Source Water Protection) discusses water rights and instream flows in greater detail. When the stream flows measured on a downstream stream gage do not meet these minimum flows, the District will divert water as needed from its supplemental point of diversion on the Skagit River up to the maximum water right.

Judy Reservoir lies in a natural basin, through which Janicki Creek once flowed. In 1947, Janicki Creek was diverted around the eastern edge of the basin and dams were constructed with a spill elevation of 435 feet AMSL and a capacity of 450 million gallons. The dams are "A" Dam to the southwest and "B" Dam to the northeast. "B" Dam is actually two dams on either side of a rock knoll. Dams "A" and "B" were raised in 1965 to increase the reservoir spill elevation to 451 feet AMSL and the capacity to 1,010 million gallons. The dams were raised again in 2001 to increase the reservoir spill elevation to 465 feet AMSL and the capacity to 1,450 million gallons. Janicki Creek continues to flow in a new channel along the east side of the reservoir. It meets Judy Reservoir's spillway at the northeast corner of the reservoir. The spillway empties below the dam into the existing bed of Janicki Creek, a tributary to the Skagit River.

The level of Judy Reservoir varies throughout the year. Inflows from the streams primarily occur between the months of October through June during the periods when stream levels regularly persist above minimum instream flows. Inflows from the Skagit River are managed by the District throughout the year based on recent and anticipated inflows from the streams compared to anticipated needs of the WTP. As a result of this operating scenario, the reservoir is managed to a target elevation at the end of a calendar year and reaches the highest elevations of the year during the winter as inflows from the streams increase and customer demands decrease. The reservoir elevation begins to decrease significantly in the late spring due to the District's decreasing ability to divert water from the streams and increasing customer demand, generally reaching the lowest levels

during the summer. Inflows from the Skagit River are managed throughout the spring, summer, and fall to return the reservoir to a target elevation at year's end and begin the cycle again. If the reservoir drops below forecasted elevations, inflows from the Skagit River can be increased to maintain adequate supply to the WTP.

The average daily elevation of Judy Reservoir from 2002 through 2012 was 455 feet, which equates to approximately 970 million gallons (MG) of storage. When compared to the 2012 average and maximum daily production requirements at the WTP, this elevation would provide approximately 123 days and 76 days of storage for the respective usage rates.

The District also obtains water for the Judy System from the City of Anacortes through interties on an as-needed basis. These interties are connected to the City's transmission line system, which starts from its water treatment plant adjacent to the Skagit River in Mount Vernon and extends westward to Anacortes on Fidalgo Island. Water is purchased from the City of Anacortes under the terms of a water contract. The City obtains water from the Skagit River through its own certificated water rights.

Each of the District's source water diversions and their pipelines are discussed below.

2.6.1.1 Skagit River Diversion Pump Station

Located 1 mile northwest of Judy Reservoir, the SRD pump station is used to supply source water from the Skagit River to the Judy System. Commissioned in 2009, the facility uses five 900-horsepower electric pumps to transfer water from the Skagit River to Judy Reservoir through a 36-inch-diameter underground pipeline. The intake structure is constructed of concrete and the surrounding riverbanks are protected with large riprap.

SRD has the capability to provide the full cumulative water right of 35.8 MGD to Judy Reservoir if stream diversions are suspended due to emergency events such as storm damage.

Sediment deposits from the Skagit River can accumulate inside of and on the top of the concrete intake structure at SRD. Periodic maintenance is required to remove these deposits and reduce operational difficulties related to the pump station.

2.6.1.2 Gilligan Creek Diversion

The diversion at Gilligan Creek was constructed in 1958. While minor changes have occurred over the years, the basic function of the diversion has remained consistent. An underground pipeline was constructed within bedrock to access an intake screen located along the bottom of the stream channel. Stream flows drop through the screen, into the pipeline, and enter a vertical box-shaped structure. By manipulating the volumes of water passing through this structure, operators manage the amount of water that enters the source water pipeline to Judy Reservoir.

The Gilligan Creek Diversion can be affected by winter storms, and a major storm in January 2009 resulted in significant damage and an extended loss of the ability to divert water to the reservoir. The screen is susceptible to blockages caused by rock and gravel transported by the stream. Access is difficult and maintenance activities usually require the use of an aerial work platform ("man lift"). The District is considering replacement of the screen with a design intended to minimize malfunctions due to debris and improve resistance to winter storms. These improvements could increase protection of a large portion of the source water provided to the Judy System, because 42% of these volumes were diverted from Gilligan Creek in 2012.

2.6.1.3 Mundt Creek Diversion

Similar in design to the Gilligan Creek Diversion, the Mundt Creek Diversion collects water through a screen located on the streambed. The diversion was constructed in 1967 along with the Turner Creek Diversion and the combined source water pipelines to Judy Reservoir.

Sediments and debris traveling through the stream system usually pass across the intake screen without causing significant damage or operational difficulties. Larger debris transported during major storms could damage exposed portions of the diversion, and the intake screen requires periodic cleaning to remove fine sediments.

2.6.1.4 Turner Creek Diversion

The Turner Creek Diversion includes a concrete structure that functions as a dam to divert water into the source water pipeline. Constructed in 1967, the diversion connects to the pipeline from Mundt Creek for eventual discharge to Judy Reservoir.

The Turner Creek Diversion is susceptible to operational difficulties if large amounts of sediments build-up behind the structure. This situation can inhibit diversion of water into the source water pipeline until the debris is removed.

2.6.1.5 Salmon Creek Diversion

The diversion at Salmon Creek was constructed in 1997. A steel structure is located across the stream channel and functions as a dam. A spillway is manipulated to control the amount of water that enters the source water pipeline to Judy Reservoir. Salmon Creek is a relatively low velocity stream and is not significantly affected by debris or storm damage.

2.6.1.6 Source Water Pipelines

Underground pipelines used to convey source water from the stream diversion facilities to Judy Reservoir are primarily located along public roadways or gravel logging roads. The existing concrete and ductile-iron pipelines were constructed in two phases in 1967 and 1990 with an average depth of 3 feet to the top of a pipeline.

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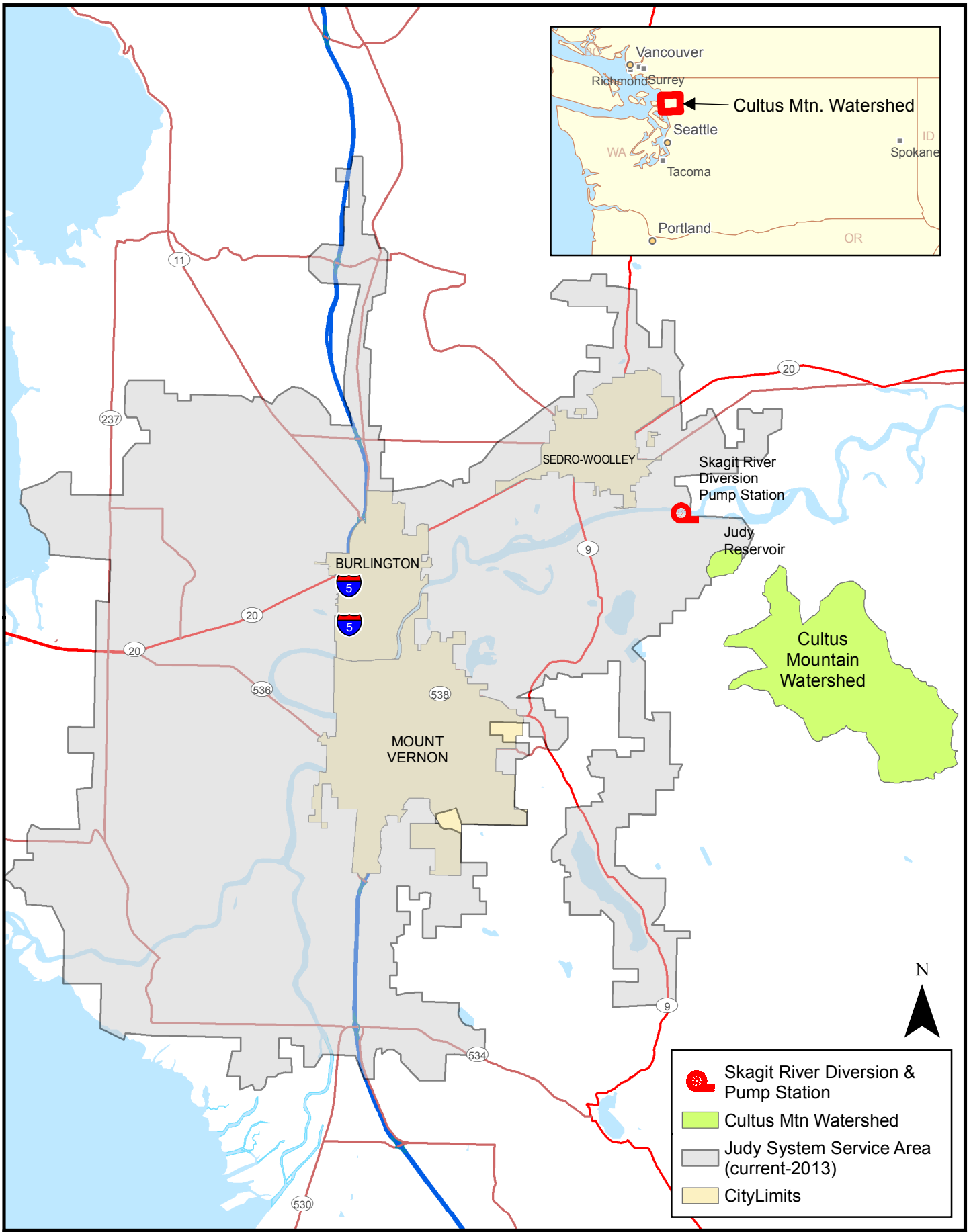


Skagit PUD
PUBLIC UTILITY DISTRICT

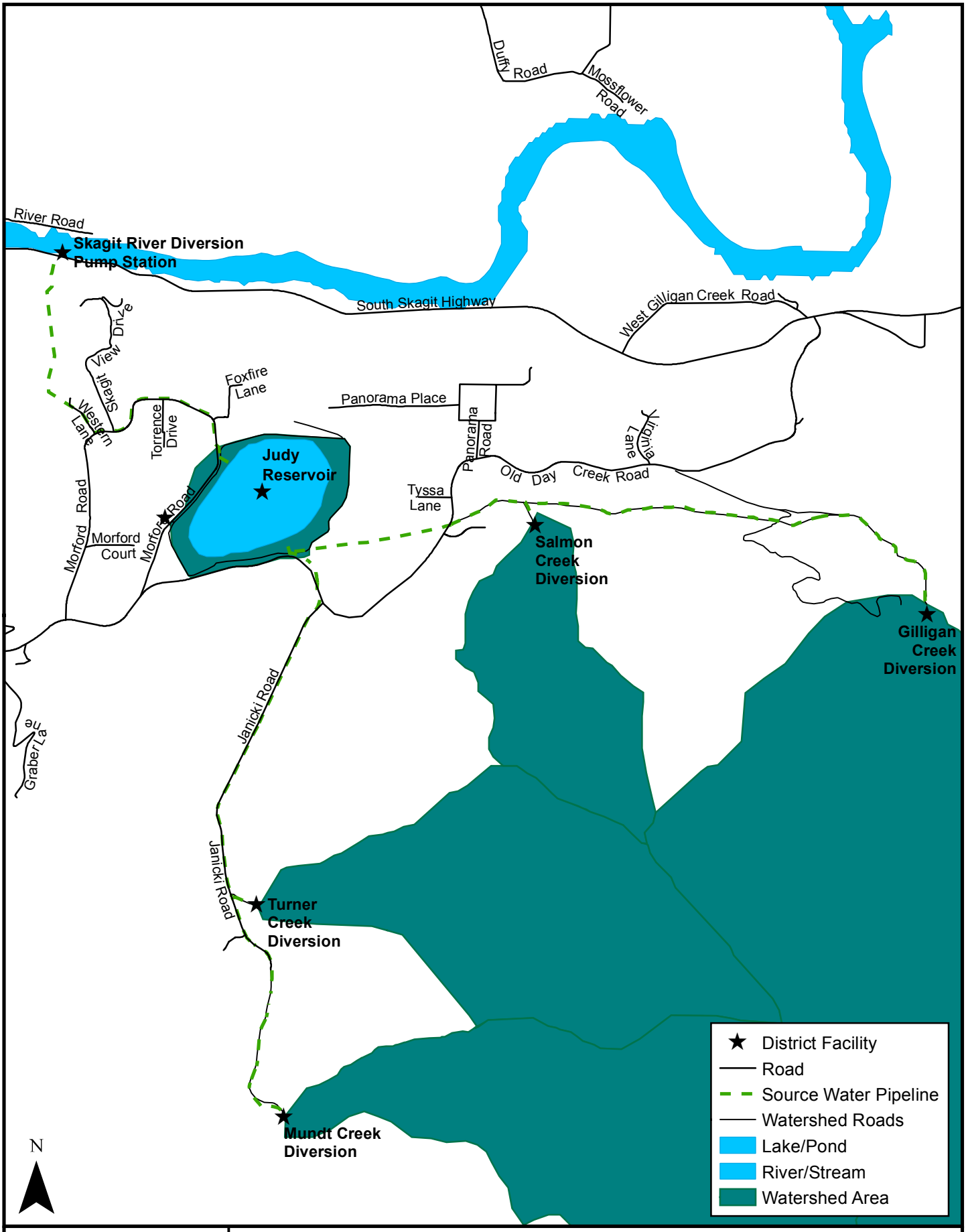
Location of the Cultus Mtn Watershed & Skagit River Diversion Pump Station

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 1 2 Miles

Figure 2-9



Skagit PUD
PUBLIC UTILITY DISTRICT

District Facilities Related to the Cultus Mountain Watershed

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.5 1 Miles

Figure 2-10

2.6.2 Treatment Facilities

Until 1990, raw water impounded in Judy Reservoir was disinfected and delivered unfiltered, directly from Judy Reservoir to the distribution system through transmission pipelines. In March 1990, the District's new multi-media direct filtration WTP was placed in service adjacent to Judy Reservoir. Raw water from the Judy Reservoir impoundment is pumped to the WTP and disinfected and filtered to meet current Safe Drinking Water Act (SDWA) requirements. Water is then served by gravity through transmission lines to the District's customers. The WTP capacity was increased to 30 MGD in 2006–2008 through the addition of new filters and a third clearwell.

The raw water flowing from Judy Reservoir is disinfected with chlorine dioxide and pumped up to the control building; carbon dioxide and coagulant aids are also added at this stage. The water flows through an in-line static flash mixer to four 2-stage flocculation basins. Then the water flows to the filter basins. There are eight filter basins, 500 square feet each, utilizing a high-speed filtration process through coal and sand filter media. The filtered water is disinfected again with chlorine and flows by gravity to the three finished water reservoirs (clearwells) near the WTP; these include one steel 3-MG tank and two steel 1.22-MG tanks. Caustic soda and ammonia are added before the clearwells to adjust pH and form chloramine residual. Finished water from the clearwells flows by gravity down the transmission lines to the distribution system and the District's customers.

The WTP currently has a treatment capacity of 24 MGD and a hydraulic capacity of 30 MGD. The hydraulic capacity means that the water flowing through the plant would not be treated. Actual peak flow rates at the WTP from 2003 through 2012 are shown in Table 2-1. A schematic of the process at the WTP is provided in Figure 2-11.

Table 2-1. Water Treatment Plant Peak Flow

Year	Peak Flow (MGD)
2003	14.2
2004	11.8
2005	13.2
2006	12.8
2007	16.0
2008	12.0
2009	13.4
2010	12.6
2011	12.0
2012	11.9

Finished water from the WTP flows by gravity to three storage reservoirs adjacent to the WTP. The reservoirs, typically referred to as the District's "clearwells", have a combined capacity of 5.69 MG and a spill elevation of 459 feet AMSL.

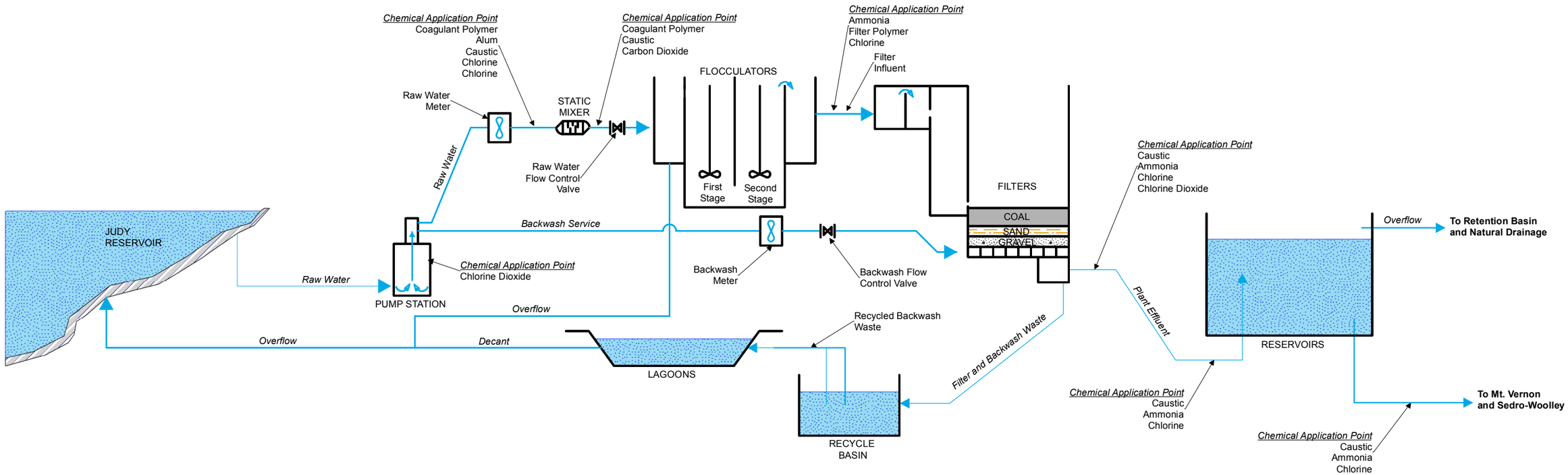
The water received through interties from the City of Anacortes is treated at the City's WTP, located adjacent to the Skagit River on Riverbend Road in Mount Vernon.

On May 15, 2007, the Skagit County Commissioners, acting as the Board of Health, passed resolution #R20070284 mandating that the District provide fluoridation at its Judy Reservoir WTP and at the east and west bank interties with Anacortes. This decision was put to a vote and did not pass. Therefore, fluoridation is not provided by the District at this time.

2.6.3 Transmission Facilities

Finished water from the clearwells at the Judy Reservoir WTP flows by gravity to District customers through a looped transmission pipeline system. The transmission pipelines leave the WTP at 459 feet Hydraulic Grade Line (HGL), so the typical working pressures are between 160 and 180 pounds per square inch (psi). However, in some areas, the pressure in the transmission pipeline is reduced to distribution pressure to serve customers. In those areas, the transmission pipelines act more as large-diameter distribution pipelines, but are still referred to as transmission pipelines because they are the backbone for the District's infrastructure. The transmission system is shown in Figure 2-12 and can be divided into four main components at this time:

- **Judy Reservoir to Sedro-Woolley Pipeline** – A 20-inch-diameter concrete cylinder pipeline that begins at the WTP and brings flow across the Skagit River to Sedro-Woolley.
- **Cook Road and Josh Wilson Road Pipelines** – Recently constructed 18-inch-diameter ductile iron pipelines that carry flow from Sedro-Woolley to the west to Burlington and Bay View.
- **Judy Reservoir to Mount Vernon Pipeline** – A 24-inch-diameter concrete cylinder pipeline that begins at the WTP and brings flow to the most populated area of the District's system in Mount Vernon.
- **Riverside Drive and Burlington Boulevard Pipelines** – A combination of 12-inch-diameter and 18-inch-diameter pipelines that are reduced in pressure and carry flow between Burlington and Mount Vernon.



Skagit PUD
PUBLIC UTILITY DISTRICT

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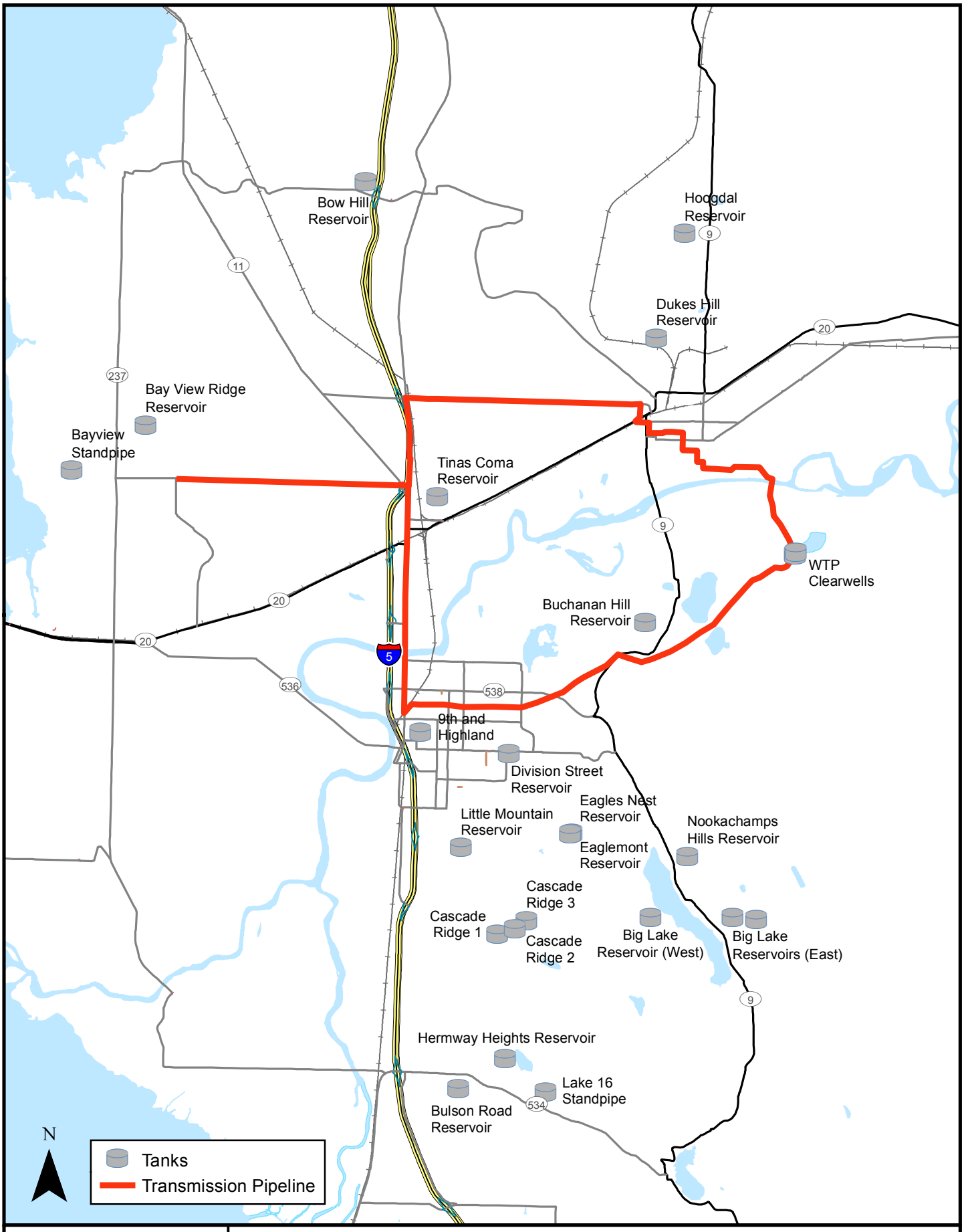
Water Treatment Plant Process Schematic

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83 | Not to Scale | **Figure 2-11**



Skagit PUD
PUBLIC UTILITY DISTRICT

Judy System - Transmission Pipeline Loop

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 1 2 Miles

Figure 2-12

2.6.3.1 Judy Reservoir to Sedro-Woolley Pipeline

The transmission pipeline to the north that crosses the Skagit River into Sedro-Woolley is a 20-inch-diameter concrete cylinder pipe constructed in 1970. The pipeline leaves the WTP at 459 feet HGL and goes down a steep bank between the Skagit River and Judy Reservoir. The pipeline crosses the Skagit River on a small suspension bridge and heads to Sedro-Woolley for distribution. The pipe size, material, and installation date of the various sections of this pipeline are provided in Table 2-2.

Historically, the transmission line loop was reduced to 214 feet HGL in Sedro-Woolley, and the lower pressure transmission pipeline continued west along State Route (SR) 20 into Burlington. However, with the recent construction of the Cook Road and Josh Wilson Road transmission pipelines, the pressure zone at 459 feet HGL has been extended farther to the west and the older concrete cylinder pipe on SR 20 serves as a redundant piece of the transmission pipeline loop.

Table 2-2. Size, Material, and Installation Date of Judy Reservoir to Sedro-Woolley Pipeline

Section	Pipe Size (Diameter)	Material	Installation Date
WTP to top of hill	30-inch	Concrete cylinder	1970
Top of hill to south side of Skagit River	20-inch	Concrete cylinder	1970
Skagit River crossing	24-inch	Ductile iron	1958
North side of Skagit River to Nelson & Walley	24-inch	Ductile iron	1977
Nelson & Walley to SR 9 and West State Street	24-inch	Concrete cylinder	1977
SR 9 crossing	16-inch	Ductile iron	1977
SR 9 and West State Street to BNSF	24-inch	Concrete cylinder	1977
BNSF crossing	16-inch	Concrete cylinder	1977
SR 20 to Hodgin Street	24-inch	Concrete cylinder	1977

There has been no history of leaks or problems with this pipeline, although no specific condition assessment has been performed. This pipeline is nearing capacity for the current peak demands in the system and is expected to reach capacity in approximately 2025.

2.6.3.2 Cook Road and Josh Wilson Road Pipelines

Both the Cook Road and Josh Wilson Road transmission pipelines were recently constructed with the goal of providing gravity-fed water from Judy Reservoir to District customers in Bay View. By doing so, the District is now able to serve those customers without purchasing water from the City of Anacortes through existing interties. The Cook Road pipeline starts at Hodgin Street in Sedro-Woolley and travels west on the shoulder of Cook Road to Old Highway 99. It then crosses under the BNSF Railway and proceeds south on Old Highway 99 to the Chuckanut Interchange on Interstate 5 (I-5). At this point, the Josh Wilson Road pipeline begins by going under I-5 and the Chuckanut Interchange in a 30-inch-diameter steel casing pipe. The pipeline then continues west on Josh Wilson Road to Higgins Airport Way, where a pressure-reducing valve (PRV) provides water to the Bay View area. The pipe size, material, and installation date of the various sections of this pipeline are provided in Table 2-3.

Table 2-3. Size, Material, and Installation Date of Cook Road and Josh Wilson Road Pipelines

Section	Pipe Size (Diameter)	Material	Installation Date
SR 20 & Hodgin Street to Old Hwy 99 & Cook Road	18-inch	Ductile iron	2007
Old Hwy 99 & Cook Road to Old Hwy 99 and Gear Road	16-inch	Ductile iron	1995
Old Hwy 99 & Gear Road to Josh Wilson Road & Higgins Airport Way	18-inch	Ductile iron	2012

The majority of this pipeline has been installed in the last 6 years and is expected to be in very good condition.

2.6.3.3 Judy Reservoir to Mount Vernon Pipeline

The transmission pipeline to the southwest that extends to Mount Vernon is a 24-inch-diameter concrete cylinder pipeline constructed in 1961. This high-pressure pipeline leaves the WTP at 459 feet HGL and goes down the hillside toward Clear Lake in an easement. The pipeline then goes through the Clear Lake area, through the North Fork of Nookachamps Creek, across SR 538 (College Way), and along the Kulshan Trail through Mount Vernon to Laventure Road. In 2009, a new 36-inch-diameter ductile iron pipeline was constructed from Laventure Road to College Way to provide additional capacity and redundancy to the water supply to Mount Vernon. The new pipeline was constructed within the same easement as the 24-inch-diameter pipeline. The 36-inch-diameter pipeline is planned to continue from College Way to the Judy Reservoir WTP. The pipe size, material, and installation date of the various sections of this pipeline are provided in Table 2-4.

Table 2-4. Size, Material, and Installation Date of the Judy Reservoir to Mount Vernon Pipeline

Section	Pipe Size (Diameter)	Material	Installation Date
WTP to Kulshan & Laventure	24-inch	Concrete cylinder	1961
Kulshan & Laventure to Alder Lane & Riverside Drive	20-inch	Concrete cylinder	1961
College Way to Kulshan & Laventure	36-inch	Ductile iron	2009

The Judy Reservoir to Mount Vernon 24-inch-diameter concrete cylinder pipeline has reached its hydraulic capacity for current peak demands on the system in terms of maximum acceptable velocity, and there is a need for additional capacity. In 2009, the redundant 36-inch-diameter ductile iron pipeline was constructed from College Way to Kulshan and Laventure. However, the remainder of the pipeline from College Way to the WTP was deferred for financial reasons. The continuation of this pipeline is vital to the District's ability to provide water to Mount Vernon during peak day demands, and is therefore in the District's Capital Improvement Plan (see Chapter 10) for completion prior to 2020, subject to financing.

2.6.3.4 Riverside Drive and Burlington Boulevard Pipelines

The high-pressure transmission pipeline from Judy Reservoir to Mount Vernon ends in Mount Vernon, but a lower pressure pipeline continues to the north along Riverside Drive at a pressure of 214 feet HGL. It crosses the Skagit River on the Riverside Bridge and continues north along Burlington Boulevard to Old Highway 99 to connect to the transmission pipeline near Josh Wilson Road. This pipeline completes the loop of the transmission system, which is vital to the reliability of the District's infrastructure. The pipe size, material, and installation date of the various sections of this pipeline are provided in Table 2-5.

Table 2-5. Size, Material, and Installation Date of Riverside Drive and Burlington Boulevard Pipelines

Section	Pipe Size (Diameter)	Material	Installation Date
Alder Lane & Riverside Drive to Pacific & Riverside	18-inch	Concrete cylinder	1967
Pacific & Riverside to Burlington Blvd & George Hopper	24-inch	Ductile iron	2001
Burlington Blvd & George Hopper to Burlington Blvd & Victoria	18-inch	Concrete cylinder	1966/1967
Burlington Blvd & Victoria to Alder & Victoria	24-inch	Concrete cylinder	1977
Alder & Victoria to Old Hwy 99 and Gear Road	16-inch	Ductile iron	1990/1992

The majority of this pipeline is over 30 years old, but there are no reports of any leaks or other issues.

The District serves Burlington, Mount Vernon, and Sedro-Woolley, and the Town of Clear Lake from the transmission pipeline loop. Distribution lines are gridded through these areas to provide the necessary domestic and fire flows. Remaining areas in the Judy Reservoir service area—such as Big Lake, Conway, Avon, Bay View, Allen, Samish Island, Bow Hill, and the rural areas around them—are served by a system of long distribution lines. Distribution lines are normally smaller than transmission lines, ranging from 4 through 12 inches in diameter.

2.6.4 Storage Facilities

The District has 22 water storage reservoirs and 3 clearwells within the Judy System. Table 2-6 provides the details about the reservoirs, showing a total nominal capacity of 29,881,000 gallons, of which 2,921,576 gallons is operational storage; 22,131,184 gallons is standby/fire storage; 3,690,614 gallons is equalizing storage; and 1,170,000 gallons is additional fire storage. The names and locations of the reservoirs within the Judy System are shown in Figures 2-5 through 2-8.

Table 2-6 Distribution Reservoirs for Judy System

DESCRIPTION	HGL	NOMINAL CAPACITY (GAL)	EQUALIZ. STORAGE (GAL)	STANDBY STORAGE (GAL)	FIRE STORAGE (GAL)	UNUSABLE STORAGE (GAL)	WALL HEIGHT (FT)	DIAM (FT)	SPILL ELEV (FT)	BASE ELEV (FT)	PUMP CALL ELEVATION (FT)	OPERATIONAL STORAGE (GAL)	GAL/FT EACH	YEAR PLACED IN SVC	MATERIAL	C.O.#
9th and Highland Reservoir	214	5,000,000	635,000	3,980,385	INCL	0	39	147	214	175	PRV *	384,615	128,205	1975	Welded Steel	2448
Bay View Ridge Reservoir	290	2,930,000		2,632,754			69	84	290	221	283	297,246	42,464	1999	Welded Steel	3812
Bayview Standpipe	270	300,000	15,000	71,000	70,000	135,000	100	23	270.75	170.75	PRV *	9,000	3,000	1971	Welded Steel	2244
Big Lake Reservoir (West)	356	140,000	21,000	59,517	45,000	0	29	30	356.5	327.5	PRV *	14,483	4,828	1993	Cylindrical Concrete	3427
Big Lake Reservoirs (East) 1	356	70,000	21,000	32,846	INCL	0	13	30	356.5	343.5	PRV *	16,154	5,385	1993	Cylindrical Concrete	3427
Big Lake Reservoirs (East) 2	356	70,000	21,000	32,846	INCL	0	13	30	356.5	343.5	PRV *	16,154	5,385	1993	Cylindrical Concrete	3427
Bow Hill Reservoir	456	1,000,000		862,069			87	45	456	369	444	137,931	11,494	1996	Welded Steel	3660
Buchanan Hill Reservoir	365	1,000,000	89,000	129,826	409,000	320,000	57.5	55	365.5	308	PRV *	52,174	17,391	1994	Welded Steel	3560
Bulson Road Reservoir	195	100,000	50,000	12,500	INCL	0	8	46	195	187	PRV *	37,500	12,500	1962	Cyl.Concrete;Wd Roof	1625
Cascade Ridge Reservoir #1	322	75,000		55,147	INCL		34	20	322	288	313	19,853	2,206	1994	Bolted Steel (Porc.)	3364
Cascade Ridge Reservoir #2	592	23,000		18,071	INCL		14	17	592	578	589	4,929	1,643	1994	Bolted Steel (Porc.)	3364
Cascade Ridge Reservoir #3	858	33,000		24,750	INCL		14	20	858	844	854.5	8,250	2,357	1994	Bolted Steel (Porc.)	3364
Division Street Reservoir	322	1,000,000	97,000	374,250	435,000	0	32	74	322.5	290.5	PRV *	93,750	31,250	1977	Welded Steel	2629
Dukes Hill Reservoir	214	5,000,000	809,000	3,722,250	INCL	0	32	166	214	182	PRV *	468,750	156,250	1994	Welded Steel	3460
Eaglemont Reservoir	560	5,000,000	889,000	3,076,517	INCL	0	29	174	560	531	554	1,034,483	172,414	1994	Welded Steel	3460
Eagles Nest Reservoir	645	1,000,000	46,000	180,027	211,000	477,000	110.5	39.5	644.5	534	635	85,973	9,050	1994	Welded Steel	3570
Nookachamps Hills Reservoir	356/450	500,000	34,000	440,576	INCL	0	59	38	356	297	PRV *	25,424	8,475	1992	Welded Steel	3287
Hermway Heights Reservoir	412	60,000	16,000	7,077	INCL	0	26	26	412.5	386.5	396.5	36,923	2,308	1985	Cylindrical Concrete	3092
Hoogdal Reservoir	430	100,000	26,000	58,211	INCL	0	19	29.5	430	411	PRV *	15,789	5,263	1994	Welded Steel	3460
Lake 16 Standpipe	684	60,000	7,000	41,462	INCL	0	52	14	684	632	674	11,538	1,154	1993	Welded Steel	3437
Little Mountain Reservoir	463	500,000	95,000	295,625	INCL	0	32	52	463	431	456	109,375	15,625	1968	Welded Steel	2050
Tinas Coma Reservoir	506	230,000		188,718			39	32	506	467	499	41,282	5,897	2000	Welded Steel	4044
WTP Clearwells #1	459	1,220,000	265,000	955,000	INCL	0	23	95	459	436			53,043	1990	Welded Steel	3234
WTP Clearwells #2	459	1,220,000	265,000	955,000	INCL	0	23	95	459	436			53,043	1990	Welded Steel	3234
3rd Clearwell	459	3,250,000	289,614	2,754,760	INCL	205,626	24.1	157	464	439.93			135,023	2006	Welded Steel	3234
TOTALS		**29,881,000**	**3,690,614**	**20,961,184**	**1,170,000**	**1,137,626**						**2,921,576**				

PRV * = tank are kept full as possible - a 3' operational storage is assumed.

DOH requires the District to have at least 2 days of Average Day Demand (ADD) for each equivalent residential unit (ERU), with a minimum of 200 gallons per day (gpd) per ERU. An ERU is a method of representing water use by non-residential customers as an equivalent number of residential customers. An ERU is the amount of water used by a single-family household. A storage analysis was completed for the entire Judy System, and for each pressure zone within the system, as described in Chapter 6. Table 2-7 provides a summary of the standby storage available for each regional area within the Judy System based on the number of services that it supplies. As shown in the table, the District is far above the standard requirement set forth by DOH.

Table 2-7. Judy Sub-Area Reservoir Standby Storage for 2014

Service Sub-Area	Standby Storage (gal)	# of ERUs	Gallons per ERU
Bay View	2,703,754	3,747	722
Big Lake	565,786	935	605
Burlington*	3,040,980	9,805	310
Clear Lake	129,826	476	273
Conway	61,038	257	238
Mount Vernon*	6,014,580	23,385	257
Sedro-Woolley	3,780,461	6,565	576
Water Treatment Plant	4,664,760	All Areas	N/A
	20,961,184	45,217	464

* 9th and Highland reservoir allocated half to Burlington and half to Mount Vernon via a transmission line

The District has a goal of providing at least 2 days of Maximum Day Demand (MDD) in standby storage for each ERU. Based on the District's current MDD of approximately 278 gallons per day per ERU (gpd/ERU), the standby storage goal for the District is 300 gpd/ERU, for a total of 600 gallons per ERU. This goal and the status of the system in relation to the goal are discussed in Chapter 6.

The majority of the District's domestic and commercial demands in the Judy System are east of I-5, supported by all but two of the system's storage reservoirs. The majority of the District's customers to the west (principally the Bay View area) are supported by the two remaining distribution storage reservoirs, backed up by interties with the City of Anacortes. The minimum design standards for the District are discussed in Appendix G, Water Policy Manual.

All storage reservoirs in the District's service areas are constantly drawn down and refilled throughout the day by customer demands. Once reservoirs have drawn down to a preset elevation,

the reduced static pressure triggers the controls of the supervisory control and data acquisition (SCADA) system, PRV, or pump station(s) supplying that pressure zone to replenish the storage.

2.6.5 Pump Stations

The District has installed booster pump stations at various locations around the Judy System as required to raise water pressure from a lower to a higher hydraulic grade and/or to compensate for frictional pipeline losses. Table 2-8 provides the details for the pump stations. The names and locations of the pump stations are shown in Figures 2-5 through 2-8, and the configurations of the pump stations between pressure zones can be seen in the hydraulic profile in Figure 2-13.

With few exceptions, these booster pump stations are low capacity and provide only domestic service. The exceptions are the Bow Hill pump station, the Fir-Waugh pump station, and the WTP pumps which are high capacity pump stations that have the capacity to provide limited fire flow without storage assistance, although storage is available in all three cases.

The high-capacity pump stations all have at least two pumps to provide station reliability and redundancy in the case of a pump failure. However, the smaller low-capacity stations do not always have a dual pump setup. In those cases, the District makes every effort to ensure that the pumps are a model similar to the model in other single booster pump stations. The District then keeps at least one spare pump in stock at the warehouse in the event that a failure occurs at any booster pump station. So even though there is not the immediate redundancy of a dual pump booster station, the District has an additional pump that can be installed in the place of a failed pump within hours.

2.6.6 Pressure-Reducing Valves

PRVs are used to reduce the water pressure from a higher pressure gradient to a lower pressure gradient, serving from transmission to distribution systems and from higher to lower distribution pressure zones. PRVs that serve distribution grids from the transmission line loop are usually set based on the spill elevation of storage reservoirs in the receiving pressure zone, to refill storage that may have been diminished by daytime demands. PRVs that serve between distribution pressure zones are usually set slightly below the static pressure of the receiving pressure zone, intended to open only for high-demand conditions such as fire flow.

The District has established its pressure zones to maintain an average range of 40 to 80 psi at the customers' services. Pressures above 80 psi can damage a customer's plumbing and hot water heater. The District advises its customers of the plumbing code requirements for installation of an individual PRV on each customer's service that has pressure greater than 80 psi. The District's major PRV stations have dual PRVs in parallel: a small PRV for average flow conditions and a larger PRV for peak flow and fire flow conditions. See Table 2-9 for a complete list of current PRVs. The names and locations of PRVs are shown in Figures 2-5 through 2-8, and the configurations of the PRVs between pressure zones can be seen in the hydraulic profile in Figure 2-13.

Table 2-8 Water Booster Pump Stations

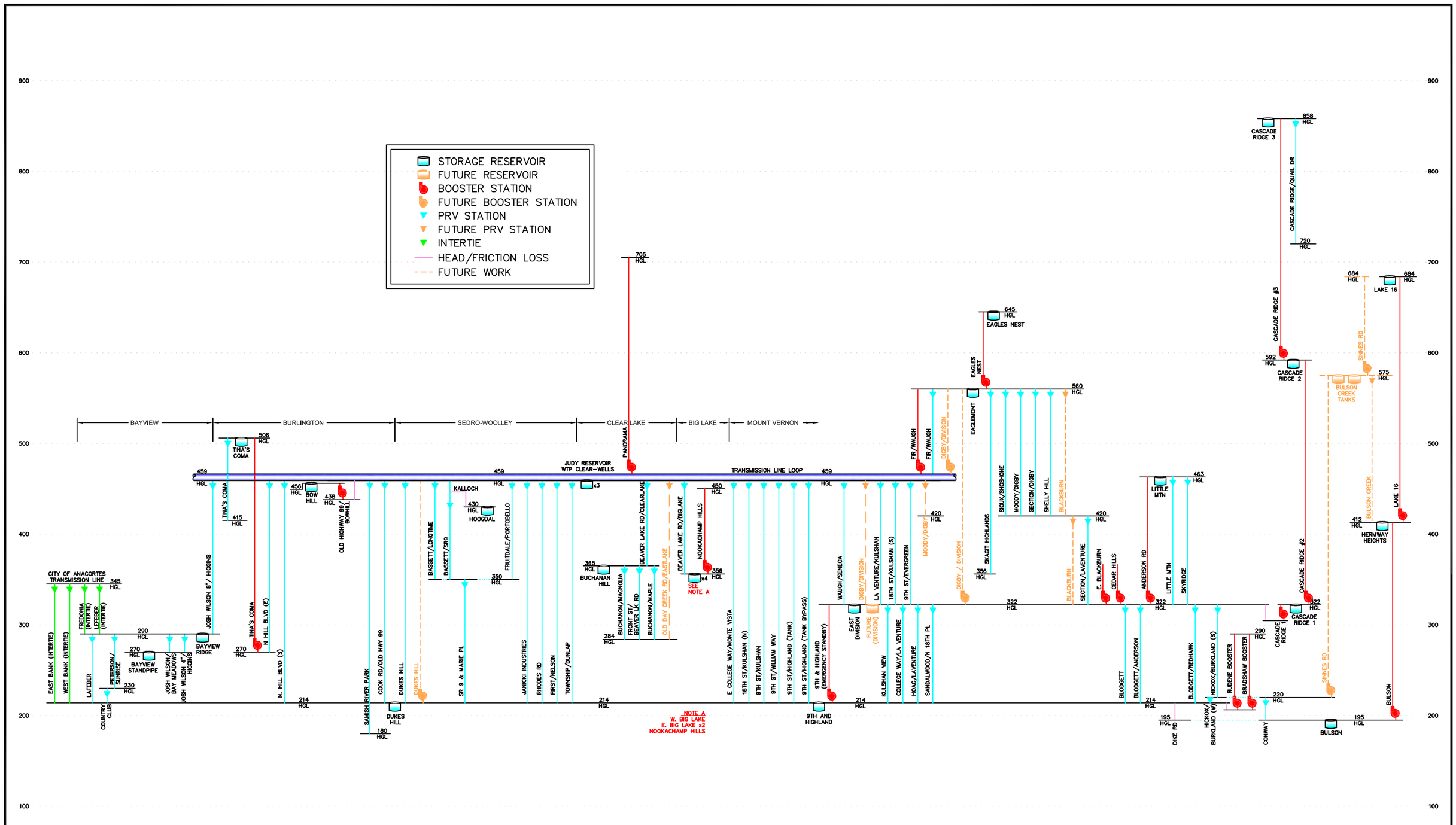
Pump Station	C.O. #	Install Year	Inlet Pressure Zone	Discharge Pressure Zone	Operation	Elevation (ft)	Pump Mfg	Pump Model	Inlet Pressure (psi)	Discharge Pressure (psi)	Flow (gpm)	TDH (ft)	Impeller Diameter	Impeller Trimmed	Suction Size	Discharge Size	Connection	Motor Mfg	VFD?	HP	Phase	Motor RPM
9TH and Highland Pump 1			214	322	Emergency		De Laval	I 5/4	20	80	1000	225	15	no	6	6	8 Bolt Flange	US Motors		75	3	3600
Anderson Road Pump 1			322	463	Continuous		Goulds	XVE215TCDR7012AP	60	133	200	180		no	3	2	4 Bolt Flange	U.S. Motors		15	3	3600
Blackburn Pump 1			322	423	Continuous		Berkeley	B1-1/2 ZPL	43	110			7.875	no	2	2	Threaded with Meter Flange	Marathon Electric		10	1	3465
Bow Hill Pump 1			214	459	Continuous		Goulds	3196 3X4-13	158	150	750		13	no	4	3	flange	US Motors	X	150	3	3450
Bow Hill Pump 2			214	520	Continuous		Goulds	3196 3X4-13	158	150	750		13	no	4	3	flange	US Motors	X	150	3	3450
Bulson Road Pump 1			220	412	Continuous		BURKS	150G9A- 1 1/2	15	100	60	300	8.37	no	1.5	1.25	Threaded	Emerson	X	15	3	3535
Cascade ridge #1 Pump 1			322	322	Continuous		Goulds	3A145	93.5	109			6	no	2"	1.5	Threaded	Baldor		5	3	3450
Cascade ridge #2 Pump 2			322	592	Continuous		Goulds	11A125	10.7	128			7.125	no	3	2	Flange	Baldor		30	3	3525
Cascade ridge #3 Pump 3			592	858	Continuous		Goulds	11A125	4.9	118			7.125	no	3	2	Flange	Baldor		30	3	3525
Cedar Hills Pump 1			322	392	Continuous		Goulds	3655 1.25X1.5	50	100	105		7.5	no	1.5	1.25	4 Bolt Flange	General Electric		5	3	3475
Eagles Nest Pump 1			560	645	Continuous		GOULDS	3196	8.5	42.2		660	11	yes	3	1 1/2	4 bolt flange	US Motors		10	3	1755
Eagles Nest Pump 2			560	645	Continuous		GOULDS	3196	8.5	42.2		660	11	yes	3	1 1/2	4 bolt flange	US Motors		10	3	1755
Lake 16 Pump 1			412	684	Continuous		Goulds 3196	Goulds 3196	45	160	100	300	8.9375	no	2	1	Flange	Leeson		25	3	3500
Lake 16 Pump 2			412	684	Continuous		Goulds 3196	Goulds 3196	45	160	100	300	8.9375	no	2	1	Flange	Leeson		25	3	3500
Nookachamps Hills Pump 1			356	450	Continuous		GOULDS SSV	5SVBK2	22	60	26	405	n/A	no	2	2	4 bolt flange	Baldor	X	10	3	3500
Nookachamps Hills Pump 2			356	450	Continuous		GOULDS SSV	5SVBK2	22	60	26	405	n/A	no	2	2	5 bolt flange	Baldor	X	10	3	3500
Peterson Road Pump 1			214	290	Continuous		Pacific Pumping Company	No tag			400	80		no	4	3	4 Bolt Flange	Century		10	3	1750
Rudene Road Pump 1			214	290	Backup		Goulds	3656	85	100	45		6	no	2	1.5	Threaded	Baldor	X	10	3	3450
Saratoga Pump 1			322				GOULDS	3656	40	170	60		8.125	no	2	1	THREADED	Baldor	X	10	3	3450
Bradshaw Pump 1			214		Continuous		GOULDS	VM3711T	80	110	150	225	n/A	no	2	2	4 bolt flange	Baldor	X	10	3	3450
Tinas Coma Pump 1			415	506	Continuous		GOULDS	3196	48	150	260		10	no	3	1.5	4 bolt flange	Leeson		40	3	3555
Tinas Coma Pump 2			415	506	Continuous		GOULDS	3196	48	150	260		10	no	3	1.5	5 bolt flange	Leeson		40	3	3555
Fir/Waugh Pump 1			459	560	Continuous		paco	11-60157-15822	110	150	1500	200	14.5	no	8	6	flange	Marathon Electric		125	3	1780
Fir Waugh Pump 2		2007	459	560	Continuous		Paco	11601571582xx	110	150	1500	200	14.5	no	8	6	flange	Baldor		150	3	1775

Table 2-9 Pressure Reducing and Control Valves

PWS	Area	Location	PRV Mfr	Control Valve Model	Size	HGL In	HGL Out	Pressure In	Pressure Static Out	Maximum gpm	Elevation (AMSL)	Normal Position	Date placed in service	C.O.#	Remarks
Judy	SW	Township / Dunlap at TL	Clayton	90	3	459	214	177	72	570	43	NO	1977	2609	
Judy	SW	Township / Dunlap at TL	Clayton	90	8	459	198	177	72	3900	43	NO	1977	2609	
Judy	SW	First / Nelson at TL	Clayton	90	6T	459	214	177	72	2250	49.2	NO	1977	2609	
Judy	SW	First / Nelson at TL	Clayton	90	12T	459	198	177	72	8600	49.2	NO	1977	2609	
Judy	SW	Rhodes Road	Clayton	90	6	459	214	168	72	2250	49	NO		4384	
Judy	SW	Rhodes Road	Clayton	90	12	459	198	168	72	8600	49	NO		4384	
Judy	SW	Janicki Industries	Clayton	90	6	459	214	170	67	2250	59	NC		4256	
Judy	SW	Janicki Industries	Clayton	50G-01B	4	237	0	170	80	1000	59	NC		4256	ReliefValve
Judy	SW	Fruitdale / Portabello	Clayton	90G-01	3	459	350	140	115	260	78	NO		4265	
Judy	SW	Fruitdale / Portabello	Clayton	90G-01	8	459	334	140	115	3900	78	NO		4265	
Judy	SW	Fruitdale / Portabello	Clayton	50G-01B	4	373	0	115	125	2250	78	NC		4265	ReliefValve
Judy	SW	Fruitdale / Portabello	Clayton		6	350	214				78	NC		4265	Checkvalve
Judy	SW	KallochRd / SR9 (Out of svc)	Clayton	90	8	459	430	O/S	pulled out	3900	240	-	1993	3555	Bypass open
Judy	SW	Hoogdal Reservoir	Clayton	210-3	6	430	430	9	9	2250	410	NO	1993	3555	Altitude Valve
Judy	SW	Bassett / SR9	Clayton	90	3	459	340	100	62	260	200	NO	1993	3555	
Judy	SW	Bassett / SR9	Clayton	90	8	459	334	100	62	3900	200	NC	1993	3555	
Judy	SW	Bassett / SR9	Clayton	50	3	373	0	59	69	570	200	NC	1993	3555	ReliefValve
Judy	SW	SR 9 / Marie Pl	Clayton	90	8	340	214	104	49	3900	100	NC	1994	3568	
Judy	SW	Bassett / Longtime	Clayton	90	1.5	459	340	96	46	160	200	NO		4137	
Judy	SW	Bassett / Longtime	Clayton	90	4	459	334	96	40	1000	200	NC	1993	4137	
Judy	SW	Bassett / Longtime	Clayton	50G-01B	2	373	0	46	56	260	200	NC		4137	ReliefValve
Judy	SW	DukesHill Reservoir	Clayton	210-G01ABS	6	214	214	65	10	2250	186	NO	1993	3555	Altitude Valve
Judy	SW	DukesHill Reservoir	Clayton	90-01	6	459	214	117	65	2250	186	NO	1993	3555	
Judy	R	Cook Rd / Collins Rd	Clayton	90	2	459	214	177	80	260				4384	
Judy	R	Cook Rd / Collins Rd	Clayton	90	6	459	230	177	80	2250				4384	
Judy	R	Cook Rd / District Line Rd	Clayton	90	2	459	214	175	80	260				4384	
Judy	R	Cook Rd / District Line Rd	Clayton	90	6	459	230	175	80	2250				4384	
Judy	R	Cook Rd / Gardner Rd	Clayton	90	2	459	214	175	80	260				4384	
Judy	R	Cook Rd / Gardner Rd	Clayton	90	6	459	230	175	80	2250				4384	
Judy	R	Samish River Park	Clayton	100-01	1.5	459	180	180	55	160	56	NO	2008	4595	
Judy	R	Samish River Park	Clayton	100G-01-83	4	459	171	180	50	1000	56	NC	2008	4595	
Judy	R	Samish River Park	Clayton	50A-01	2	206	0	55	65	260	56	NC	2008	4595	ReliefValve
Judy	Bur	Cook Rd. / Old Hwy 99	Clayton	90G-01	6	459	214	178	81	2250	26	NO		3671	
Judy	Bur	North Hill Blvd (S)	Clayton	90G-01	8	459	214	180	70	3900	26	Fireflow		4384	
Judy	Bur	North Hill Blvd (E)	Clayton	90G-01	2	459	270	180	100	260	26	Off		4384	Not Big Enough
Judy	Bur	North Hill Blvd (E)	Clayton	90G-01	6	459	254	180	105	2250	26	Flowing		4384	Not Big Enough
Judy	Bur	Tina's Coma / Hillcrest	Clayton	90-01ABS	2	506	415	100	50	260	282	Flowing		4044	
Judy	Bur	Tina's Coma / Hillcrest	Clayton	90-01	6	506	399	100	50	2250	282	Standby		4044	Fireflow/Standby
Judy	Bur	Tina's Coma / Hillcrest	Clayton	50-01B	4	438	0	100	120	1000	282	NC		4044	Relief Valve
Judy	Bur	Hillcrest			8	415	214				40	NC		4044	Checkvalve
Judy	BV	Josh Wilson / Higgins at TL	Clayton	90	8	459	290	126	62	3900	165	NC	2013	4636	
Judy	BV	Josh Wilson / Higgins at TL	Clayton	50-01	3	313	0	62	70	580	165	NC	2013	4636	ReliefValve
Judy	BV	Josh Wilson 4" / Higgins	Clayton	90-01	4	290	270	62	55	1000	160	NO	1992	3431	
Judy	R	Josh Wilson at old pump site	Wilkins		1	270	230	81	64	100	82	NO		1491	
Judy	BV	Josh Wilson / Bay Meadows	Clayton	90	4	290	270	56	48	1000	161	NO		4520	
Judy	BV	Peterson / Sunrise	Clayton	90-01AS	2T	290	230	72	58	260	111	NO	1994	3623	Moved in 2007
Judy	BV	Peterson / Sunrise	Clayton	90-01	6	290	214	72	60	2250	111	NO	1994	3623	Moved in 2007
Judy	BV	Peterson / Sunrise	Clayton	50G-01B	3	253	0	72	80	570	111	NC	1994	3623	ReliefValve
Judy	BU	Country Club	Clayton	90G-01	4	230	214	52	24	1000	59	NC		2010	
Judy	Bur	Lefeber PRV	Clayton	90G-02	4	290	214	115	79	1000	13	NO	2000	4346	
FI	R	LeFeber Intertie at ANA TL	Clayton	90G-01	6	345	290	140	122	2250	13	NC	2000	3812	Intertie
Judy	BV	Freedonia at ANA TL	Clayton	90	8	345	290	139	115	3900	10	NC	1983	3006	Intertie
Judy	BV	BayViewRidge Resrvr	Clayton	210-3	8	290	290	Alt		3900			1998		Altitude Valve
Judy	R	Bradshaw / Summer	Clayton	CKV		214	214	CKV		CKV	*18*	NC			Check Valve
Judy	CL	BeaverLakeRd / Clearlake	Clayton	90	2T	459	365	180	140	260	39	NO	1990	3560	
Judy	CL	BeaverLakeRd / Clearlake	Clayton	90	6T	459	349	180	140	2250	39	NO	1990	3560	
Judy	CL/BL	BeaverLakeRd / Biglake	Clayton	90	2T	459	356	180	150	260	39	NO	1990	3287	
Judy	CL/BL	BeaverLakeRd / Biglake	Clayton	90	6T	459	340	180	145	2250	39	NC	1990	3287	
Judy	CL	Buchanon / Maple St	Clayton	90	2	365	284	105	70	260	124.6	NC	2002	3560	
Judy	CL	Buchanan / Maple St	Clayton	CKV	6	284	284	105	70		124.6	NC	1995	3506	Check Valve
Judy	CL	Front St / Beaver LK Dr	Clayton	90	6	365	284	142	104	2250	49	NO		3560	
Judy	CL	Buchanan / Magnolia	Clayton	90	6	365	284	72	64	2250	195	NO		2620	
Judy	BL	BigLake Reservoir (W)	Clayton	CKV	8	356	356	13	13	3900	327	NO	1993	3427	Check Valve
Judy	BL	BigLake Reservoirs (E)	Clayton	CKV	8	356	356	5	5	3900		NO			Check Valve
Judy	BL	Nookachamps Creek Pump	Clayton	50G-01B	2	356	356	22	60	260					ReliefValve
Judy	MV	E CollegeWay / Monte Vista	Clayton	90	3	459	214	174	65	570	49	NO	1996	3746	
Judy	MV	E CollegeWay / Monte Vista	Clayton	90	8	459	198	168	60	3900	49	NO	1996	3746	
Judy	MV	E CollegeWay / Monte Vista	Clayton	50 g-01b	4	237	0	174	75	990	49	NO	1996	3746	ReliefValve
Judy	MV	18th St / Kulshan (N) at TL	Clayton	90	4	459	214	171	72	1000	55	NC	1979	2796	
Judy	MV	18th St / Kulshan (S) at TL	Clayton	90	4	459	322	171	110	1000	55	NC	1979	2796	
Judy	MV	9th / Kulshan	Clayton	90G-01	2	459	214	168	72	260	36	NO	2006	4383	
Judy	MV	9th / Kulshan	Clayton	90G-01	10	459	198	168	65	6150	36	NC	2006	4383	
Judy	MV	9th St / William Way	Clayton	90G-01	3	459	214	168	83	580	23	NO		3088	
Judy	MV	9th St / William Way	Clayton	90	6	459	198	168	83	2250	23	NC	1998	3088	
Judy	MV	9th St / Highland (Tank Bypass)	Clayton	90-01 AB	10	459	214	123	20	6150	164	NC	1975	2448	
Judy	MV	9th St / Highland (Tank)	Clayton	208	12	459	214	123	18	8720	164	NO	1975	2448	Qin=200gpmMAX
Judy	MV	Waugh / Seneca	Clayton	90	4	459	322	172	107	1000	65	NO	1979	2806	
Judy	MV	KulshanView	Clayton	90	8	322	214	106	55	3900	82	NC	1980	2894	
Judy	MV	LaVenture / Kulshan	Clayton	50-01B	4	345	0	109	109	580	75	NO	2000	4087	Relief Valve
Judy	MV	LaVenture / Kulshan	Clayton	90	8	459	322	165	109	3900	75	NO	2000	4087	
Judy	MV	College Way / LaVenture	Clayton	90	8	322	214	104	50	3900	85	NO	1996	3818	
Judy	MV	Hoag / LaVenture	Clayton	90	1.5T	322	214	99	78	190	95	NC	1978	2736	
Judy	MV	Hoag / LaVenture	Clayton	90	6	322	198	99	73	2250	95	NC	1978	2736	
Judy	MV	9th / Evergreen	Clayton	90	6	459	322	122	70	2250	157	NO	2001	2448	
Judy	MV	Sandalwood / N 18th Pl	Clayton	90	4	322	214	113	65	1000	62	NC	1978	2770	
Judy	MV	Skagit Highlands	Clayton	90G-01	2	560	356	134	35	260	259	NO	2007	4511	
Judy	MV	Skagit Highlands	Clayton	90G-01	6	560	340	134	40	2250	259	NO	2007	4511	
Judy	MV	Skagit Highlands	Clayton	50G-01B	3	379	0	40	45	570	259	NC	2007	4511	ReliefValve
Judy	MV	Fir / Waugh	Clayton	90G-01	8	560	459	170	120	3900	194	NC	2004	3320	
Judy	MV	Eagles Nest Pump	Clayton	81G-02	6	645	560	47.3	7.7	2250	534	NC	1995	3698	
Judy	MV	Eagles Nest Pump	Clayton	93EG-95	6	Pump	Ckv	11	47	2250	534	NC	1995	3698	Check Valve
Judy	MV	Sioux / Shoshone	Wilkins	90	1	560	420	140	65	68	270	NO	2002	4175	
Judy	MV	Sioux / Shoshone	Wilkins		1.5	560	404	135	65	160	270	NC	2002	4175	
Judy	MV	Sioux / Shoshone	Clayton		1	443	0	65	70	68	270	NC	2002	4175	Relief Valve
Judy	MV	Moody / Digby	Clayton	90G-02	2	560	420	120	56	260	285	NC		4097	
Judy	MV	Moody / Digby	Clayton	90G-01	6	560	400	120	48	2250	285	NC		4097	
Judy	MV	Moody / Digby	Clayton	50G-01B	3	443	0	56	66	570	285	NC		4097	Relief Valve
Judy	MV	Section / Digby	Clayton	90	3T	560	420	122	57	570	295	NO	1996	3714	
Judy	MV	Section / Digby	Clayton	90	8T	560	404	122	53	3900	295	NC	1996	3714	
Judy	MV	Section / Digby	Clayton	50	4	443	0	57	77	1000	295	NC	1996	3714	Relief Valve
Judy	MV	Shelly Hill	Clayton	PSV	4	560	420	64	32	1000	310	NC	1999	3909	
Judy	MV	Shelly Hill	Clow		8	560	420	32	64		310	NC	1996	3714	Check Valve
Judy	MV	Section / Laventure	Clayton	90	6	420	322	80	47	2250	206	NC	1996	3799	
Judy	MV	Blodgett	Clayton	90	1.5T	322	214	129	74	190	16	NO	1962	1641	
Judy	MV	Blodgett	Clayton	90	6T	322	198	129	74	2250	16	NO	1962	1641	
Judy	MV	Blodgett / Anderson	Clayton	90	6	322	214	127	74	2250	32.8	NO	1987	4728	Was Moved 3787

Table 2-9 Pressure Reducing and Control Valves

PWS	Area	Location	PRV Mfr	Control Valve Model	Size	HGL In	HGL Out	Pressure In	Pressure Static Out	Maximum gpm	Elevation (AMSL)	Normal Position	Date placed in service	C.O.#	Remarks
Judy	MV	LittleMountain	Clayton	90	8	463	322	130	74	2250	154	NC	1967	2079	
Judy	MV	LittleMountain	Clayton	50G-01B	2	463	463	140	130	260					Tank bypass
Judy	MV	Skyridge	Clayton	90	4	463	322	123	60	570	174	NC	1967	1969	
Judy	MV	Blodgett / RedHawk	Clayton	90	8	322	214	121	75	3900	39	NC	1998	3861	
Judy	MV	Hickox / Burkland (S)	Clayton	90	3	322	220	127	90	580	16	NO	1997	3828	
Judy	MV	Hickox / Burkland (S)	Clayton	90	8	322	198	127	85	3900	16	NO	1997	3828	Conway Svc
Judy	MV	Hickox / Burkland (W)	Clayton	90	6	220	214	138	78	2250	13	NC		4057	
Judy	CW	Conway and Hwy 534	Clayton	90G-01	2	220	195	88	80	260	6.5	NO	2003	1635	
Judy	CW	Conway and Hwy 534	Clayton	90G-01	6	220	179	88	80	2250	6.5	NC	2003	1635	
Judy	CW	Conway and Hwy 534	Clayton	50G-01B	4	218	0	80	85	1000	6.5	NC	2003	1635	Relief Valve
Judy	MV	CascadeRidge / Quail Dr	Clayton	90	6	858	720	121	61	2250	578	NO	1992	3364	
Judy	MV	CascadeRidge #1	Clayton	68	3	322	322	-	-	-	-	-	-	3364	Pump Control
Judy	MV	CascadeRidge #1	Clayton	68	3	322	592	-	-	-	-	-	-	3364	Pump Control
Judy	MV	CascadeRidge #2	Clayton	68	3	592	858	-	-	-	-	-	-	3364	Pump Control
Judy	MV	DraperValleyFarms	Clayton	90	6	459	-		PRIVATE	2250		NO	1985	3088	PRIVATE
Judy	MV	Lions park	Clayton	50G-01B	8	214	225	75	80	3900					ReliefValve
Judy	MV	Cedar Hills pump	Clayton	50G-01B	2	pump	bypass			260					Bypass
Judy	CW	Bulson Rd Tank	Clayton	90G-01	6	Alt	Valve	15	5	2250					Altitude Valve
Judy	CW	Bulson Rd Tank	Clayton	90G-02	4	412	220	120							Sustain valve
Judy	MV	East Bank Intertie	Clayton	90	2	345	214	150	On / Off	260	25	NC	1993	3463	Intertie
Judy	MV	East Bank Intertie	Clayton	90	10	345	214	150	On / Off	3250	25	NC	1993	3463	Intertie
Judy	MV	East Bank Intertie	Clayton	90	4	345	214	150	On / Off	1000	25	NC	1993	3463	Intertie
Judy	MV	West Bank Intertie	Clayton	90	8	345	233	139	90	3900	25	NO	1985	3135	Intertie
Judy	MV	17th St	Wilkins		1	322	290			100	80				



Skagit PUD
PUBLIC UTILITY DISTRICT

N

Judy Water System Hydraulic Profile

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83 | **Not to Scale** | **Figure 2-13**

2.6.7 Distribution Pipes and Related Components

The District's distribution pipes, generally 4 to 12 inches in diameter, provide for distribution of water to customers. The distribution system has grown over the years to serve the growing population base of the Judy System, both in terms of total numbers and in terms of geographical area. In addition, fire flow requirements for commercial and industrial buildings as well as increasing demands from residential customers have stressed the District's distribution system because of the need to provide adequate peak day water demands. Table 2-10 shows the growth of the District's overall piping for the Judy System.

Table 2-10. Growth of the District's Pipe Network

Year	Total Pipe (feet)	Total Pipe (miles)
2012	3,216,888	609.3
2010	3,184,165	603.1
2005	3,045,571	576.8
2000	2,793,749	529.1
1995	2,524,872	478.2
1990	2,450,519	464.1

Table 2-11 shows the total length of pipe, categorized by size and material, for the transmission and distribution systems. Service pipelines and abandoned pipelines are excluded from the table. The total current length of pipe in the system is 3,216,888 feet, or 609.3 miles.

Figures 2-15, 2-16, and 2-17 show the diameters of all of the piping in each city, and Figure 2-18 shows the pipe diameters in the rural areas.

Figures 2-19, 2-20, and 2-21 show the construction material of all of the piping in each city, and Figure 2-22 shows the pipe material in the rural areas. The District's current standard for pipe material is Class 50 ductile iron. Some of the pipelines that are asbestos cement or plastic are made such that their pressure class is limited, and thus allowable system pressures in those areas are limited to 100 psi.

Figure 2-14 shows the breakdown of the District's pipe network compared with the age of the pipe, and Table 2-12 provides this information in tabular form. Figures 2-23, 2-24, and 2-25 show the age of all of the piping in each city, and Figure 2-26 shows the pipe material in the rural areas.

Table 2-11. Pipe Inventory for Distribution and Transmission System

Diameter (inches)	Ductile Iron	PVC	Asbestos Cement	Plastic	Concrete	Cast Iron	Copper	ABS	Other	Total Length (feet)
2 and less	3,335	76,834	1,041	93,158		580	6,130	1,112	1,417	183,607
3	599	72,754	2,455	41,229				76	86	117,199
4	43,464	56,103	159,488	24,788		3,698		8	1,313	288,861
6	96,082	262,996	222,004	59,590		22,280		404	316	663,672
8	953,269	133,469	99,431	4,968		8,492	29	727		1,200,384
10	16,735	21,994	26,538	10,751		4,718			441	81,176
12	432,062	7,283	6,469	373	3,648	5,772		3,469	145	459,221
14	184		141							325
16	44,033				9,179	539				53,751
18	43,567				17,566					61,133
20			522		11,537	439				12,498
24	21,194				64,336					85,531
30	1,847				5,082					6,929
36	1,421									1,421
48	1,180									1,180
Total Length (feet)	1,658,975	631,432	518,088	234,855	111,348	46,518	6,159	5,796	3,718	3,216,888
Total Length (miles)	314.2	119.6	98.1	44.5	21.1	8.8	1.2	1.1	0.7	609.3
Percent	51.6%	19.6%	16.1%	7.3%	3.5%	1.4%	0.2%	0.2%	0.1%	100%

Table 2-12. Age of the District's Pipe Network

Year Installed	Total Pipe (feet)	Total Pipe (miles)
1920-1929	1,231	0.23
1930-1939	2,741	0.52
1940-1949	30,865	5.85
1950-1959	165,705	31.38
1960-1969	529,155	100.22
1970-1979	525,436	99.51
1980-1989	422,939	80.10
1990-1999	926,592	175.49
2000-2009	581,510	110.13
2010-Present	30,713	5.82

The District's transmission and distribution system is adequate for the majority of the District's service area during much of the year. The District began water service to customers in the cities and rural areas when population numbers were lower and less emphasis was placed on fire flow requirements. In recent years, city populations have increased, people have moved to areas of higher elevation, fire codes have increased the required fire flows, and rural demands have increased. This has resulted in many of the existing District water lines being undersized and incapable of providing adequate service. The District is endeavoring to establish a strong grid of arterial pipelines that is consistent with local land use projections and that will provide adequate domestic service and required fire flows into the future. These pipelines range in size from 8-inch diameter in rural areas to 24-inch diameter in urban areas, but they all serve to provide a strong network of pipelines to provide a redundant source of water to District customers.

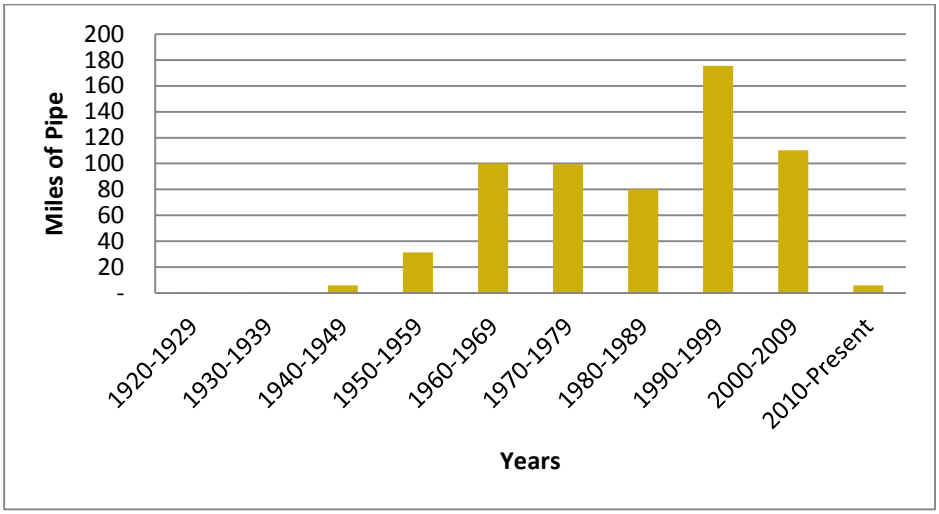


Figure 2-14. Age of District's Pipe Network

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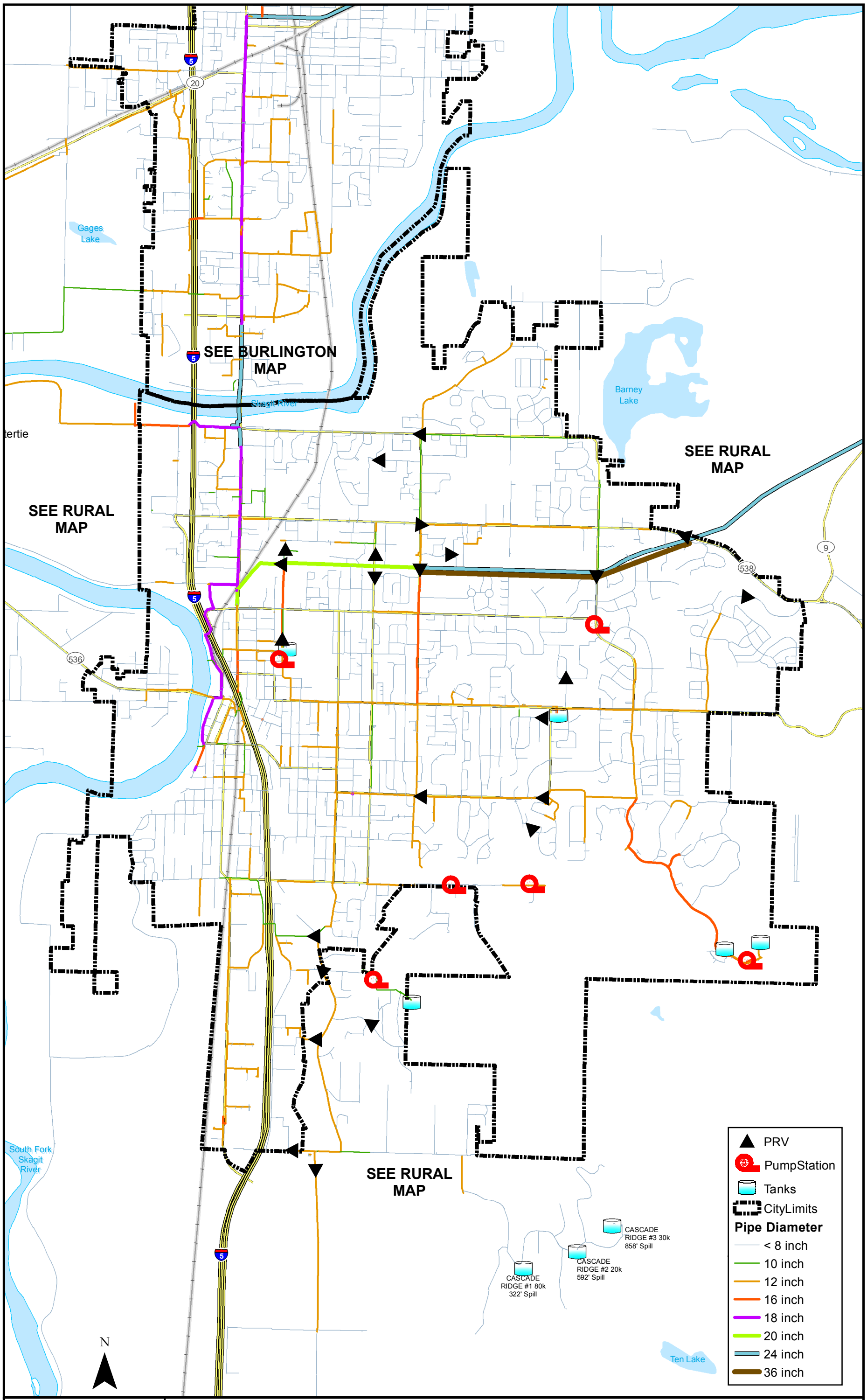


Skagit PUD
PUBLIC UTILITY DISTRICT

District Pipes Displayed By Diameter - City of Mount Vernon

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.5 1 Miles

Figure 2-15

SEE RURAL MAP

SEE RURAL MAP

SEE RURAL MAP

SEE MOUNT VERNON MAP

Gages Lake

Skagit River

PRV
Tanks
PumpStation
CityLimits
Pipe Diameter
< 8 inch
10 inch
12 inch
16 inch
18 inch
24 inch

N

Skagit PUD
PUBLIC UTILITY DISTRICT

District Pipes Displayed By Diameter - City of Burlington

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.25 0.5 Miles

Figure 2-16

SEE RURAL MAP

SEE RURAL MAP

SEE RURAL MAP (FROM JUDY WTP)

PRV
PumpStation
Tanks
CityLimits
Pipe Diameter
< 8 inch
10 inch
12 inch
16 inch
18 inch
20 inch
24 inch

N

Skagit PUD
PUBLIC UTILITY DISTRICT

District Pipes Displayed By Diameter - City of Sedro-Woolley

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.4 0.8 Miles

Figure 2-17

CITY OF SEDRO-WOOLLEY (SEE DETAIL)

CITY OF BURLINGTON (SEE DETAIL)

CITY OF MOUNT VERNON (SEE DETAIL)

CityLimits
PRV
Tanks
PumpStation

Pipe Diameter

- < 8 inch
- 10 inch
- 12 inch
- 16 inch
- 18 inch
- 20 inch
- 24 inch
- 30-48 inch

N

Skagit PUD
PUBLIC UTILITY DISTRICT

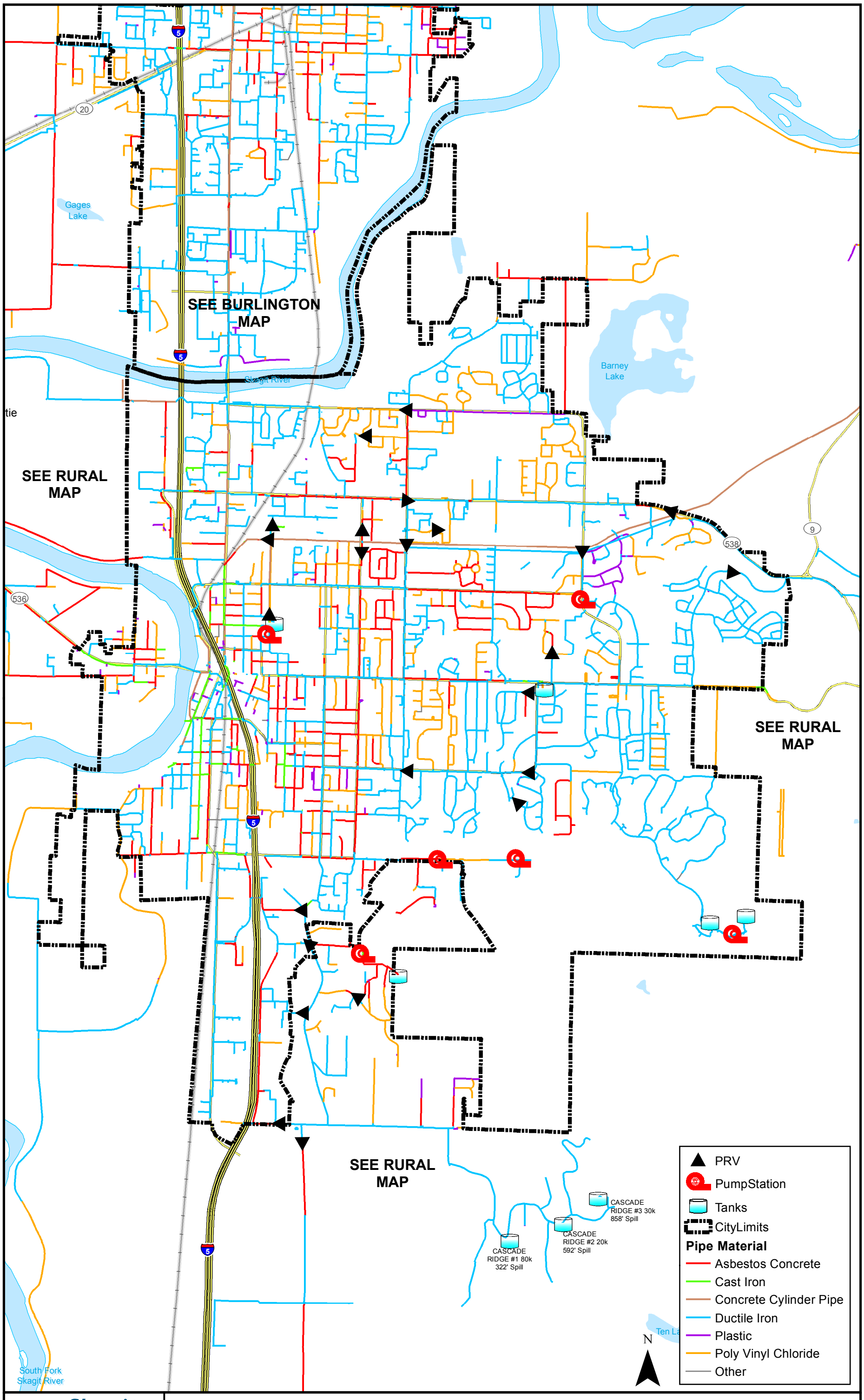
District Pipes Displayed By Diameter - Rural Areas

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 1.5 3 Miles

Figure 2-18



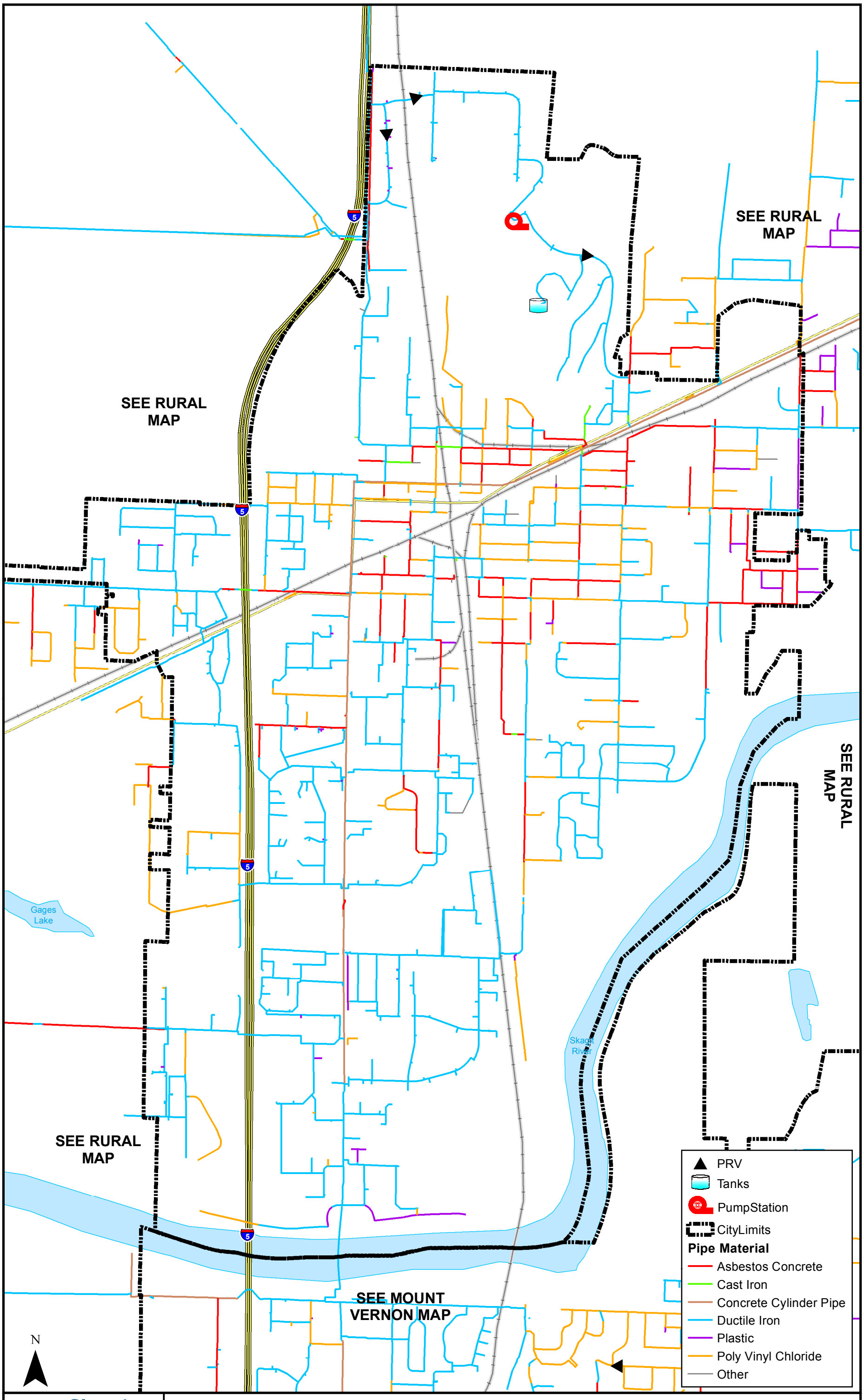
District Pipe Displayed By Material - City of Mount Vernon

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.5 1 Miles

Figure 2-19



Skagit PUD
PUBLIC UTILITY DISTRICT

District Pipes Displayed By Material - City of Burlington

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.25 0.5 Miles

Figure 2-20

SEE RURAL MAP

SEE RURAL MAP

SEE RURAL MAP (FROM JUDY WTP)

PRV
PumpStation
Tanks
CityLimits

Pipe Material

Asbestos Concrete
Cast Iron
Concrete Cylinder Pipe
Ductile Iron
Plastic
Poly Vinyl Chloride
Other

N

Skagit PUD
PUBLIC UTILITY DISTRICT

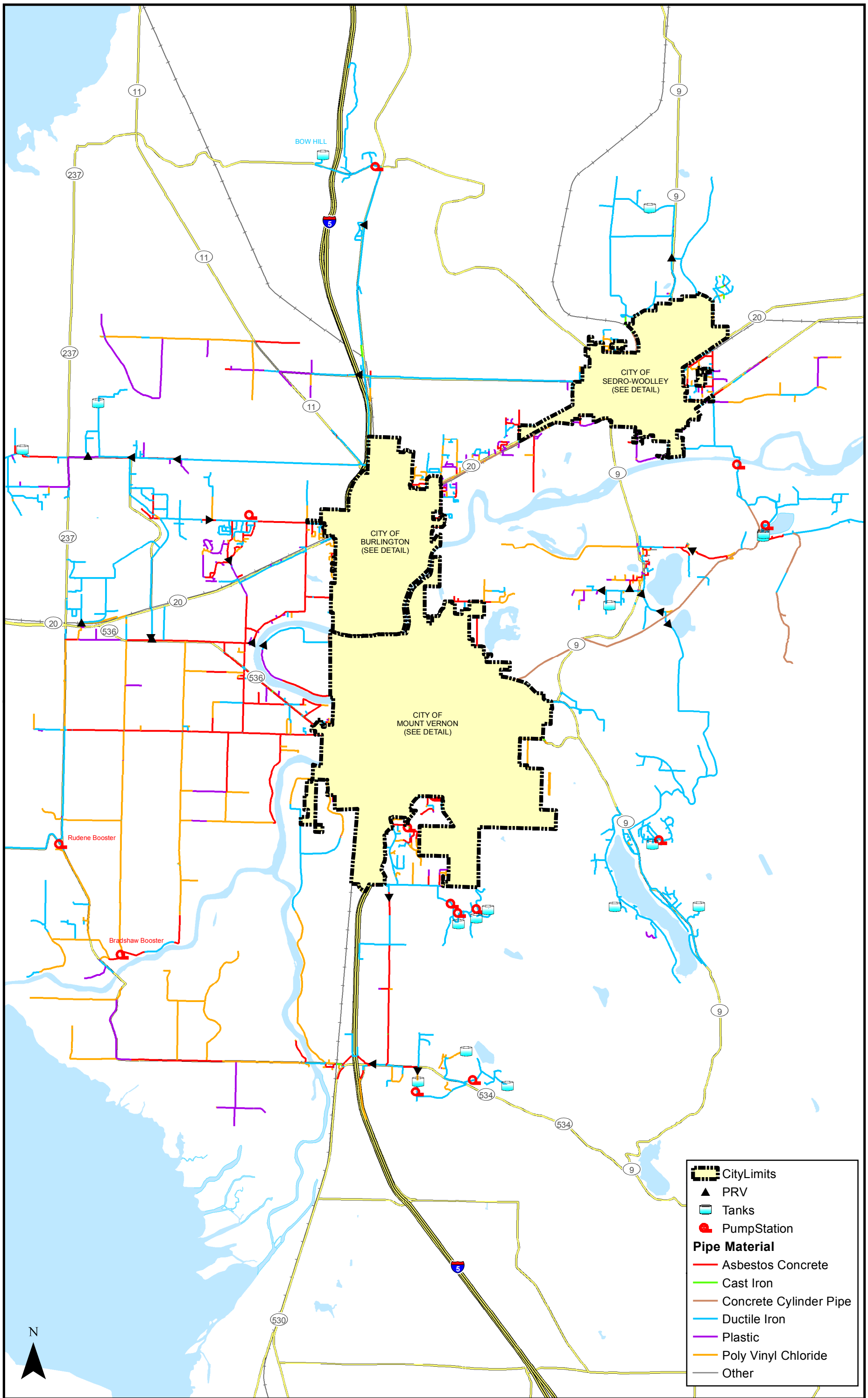
District Pipes Displayed By Material - City of Sedro-Woolley

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.4 0.8 Miles

Figure 2-21



Skagit PUD
PUBLIC UTILITY DISTRICT

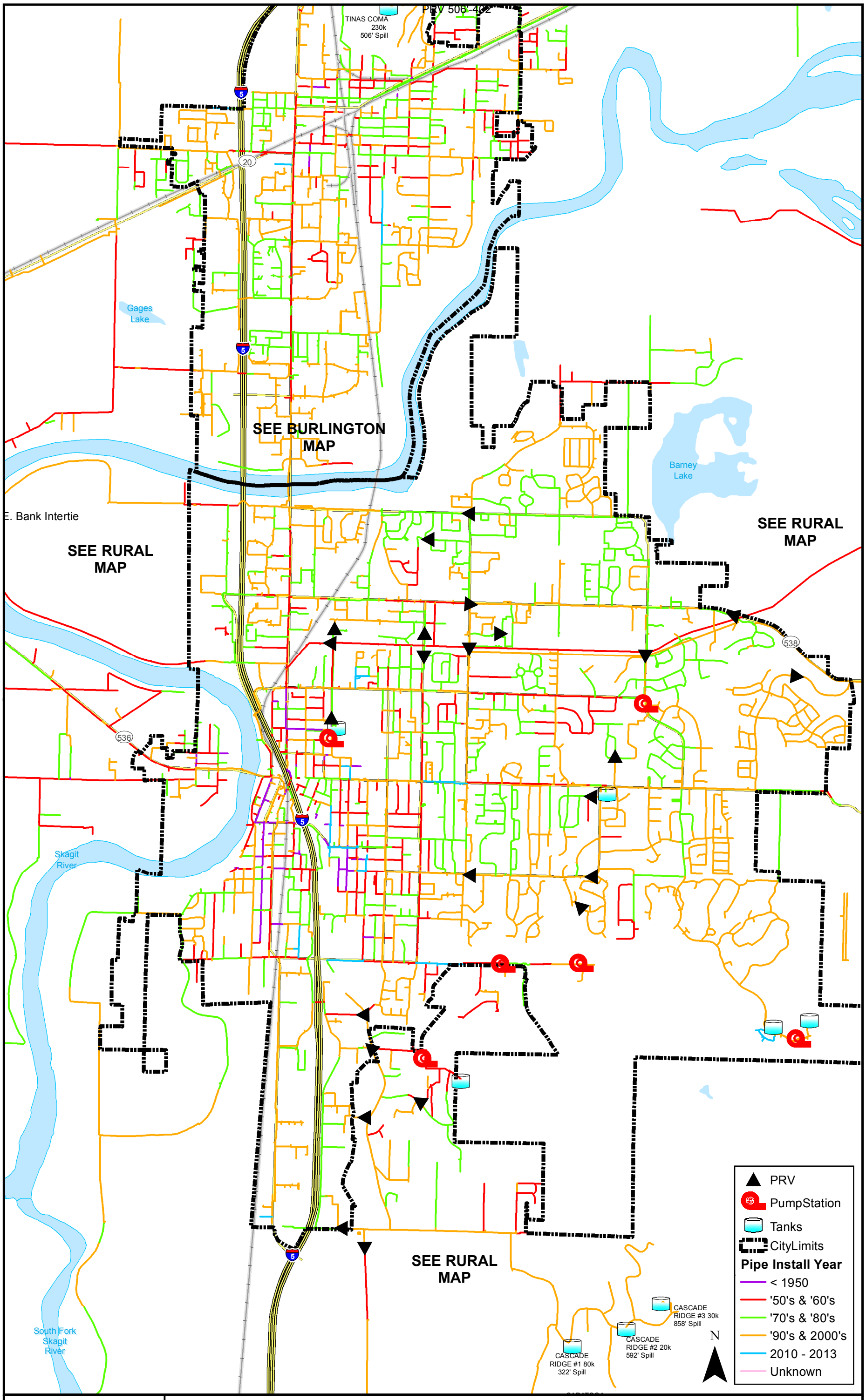
District Pipes Displayed By Material - Rural Areas

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 1.5 3 Miles

Figure 2-22



Skagit PUD
PUBLIC UTILITY DISTRICT

District Pipes Displayed By Installation Year - City of Mount Vernon

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.5 1 Miles

Figure 2-23

PRV
Tanks
PumpStation
CityLimits
Pipe Install Year
< 1950
'50's & '60's
'70's & '80's
'90's & 2000's
2010 - 2013
Unknown

SEE RURAL MAP

SEE RURAL MAP

SEE RURAL MAP

SEE MOUNT VERNON MAP

Gages Lake

Skagit River

N

Skagit PUD
PUBLIC UTILITY DISTRICT

District Pipes Displayed By Installation Year - City of Burlington

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.25 0.5 Miles

Figure 2-24

PRV
PumpStation
Tanks
CityLimits

Pipe Install Year

- < 1950
- '50's & '60's
- '70's & '80's
- '90's & 2000's
- 2010 - 2013
- Unknown

SEE RURAL MAP

SEE RURAL MAP

SEE RURAL MAP
(FROM JUDY WTP)

N

Skagit PUD
PUBLIC UTILITY DISTRICT

District Pipes Displayed By Installation Year - City of Sedro-Woolley

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 0.4 0.8 Miles

Figure 2-25

CITY OF SEDRO-WOOLLEY (SEE DETAIL)

CITY OF BURLINGTON (SEE DETAIL)

CITY OF MOUNT VERNON (SEE DETAIL)

YVIEW STANDPIPE

11 237 5 9 20 536 534 530

CityLimits
PRV
Tanks
PumpStation

Pipe Install Year

- < 1950
- '50's & '60's
- '70's & '80's
- '90's & 2000's
- 2010 - 2013
- Unknown

N

Skagit PUD PUBLIC UTILITY DISTRICT

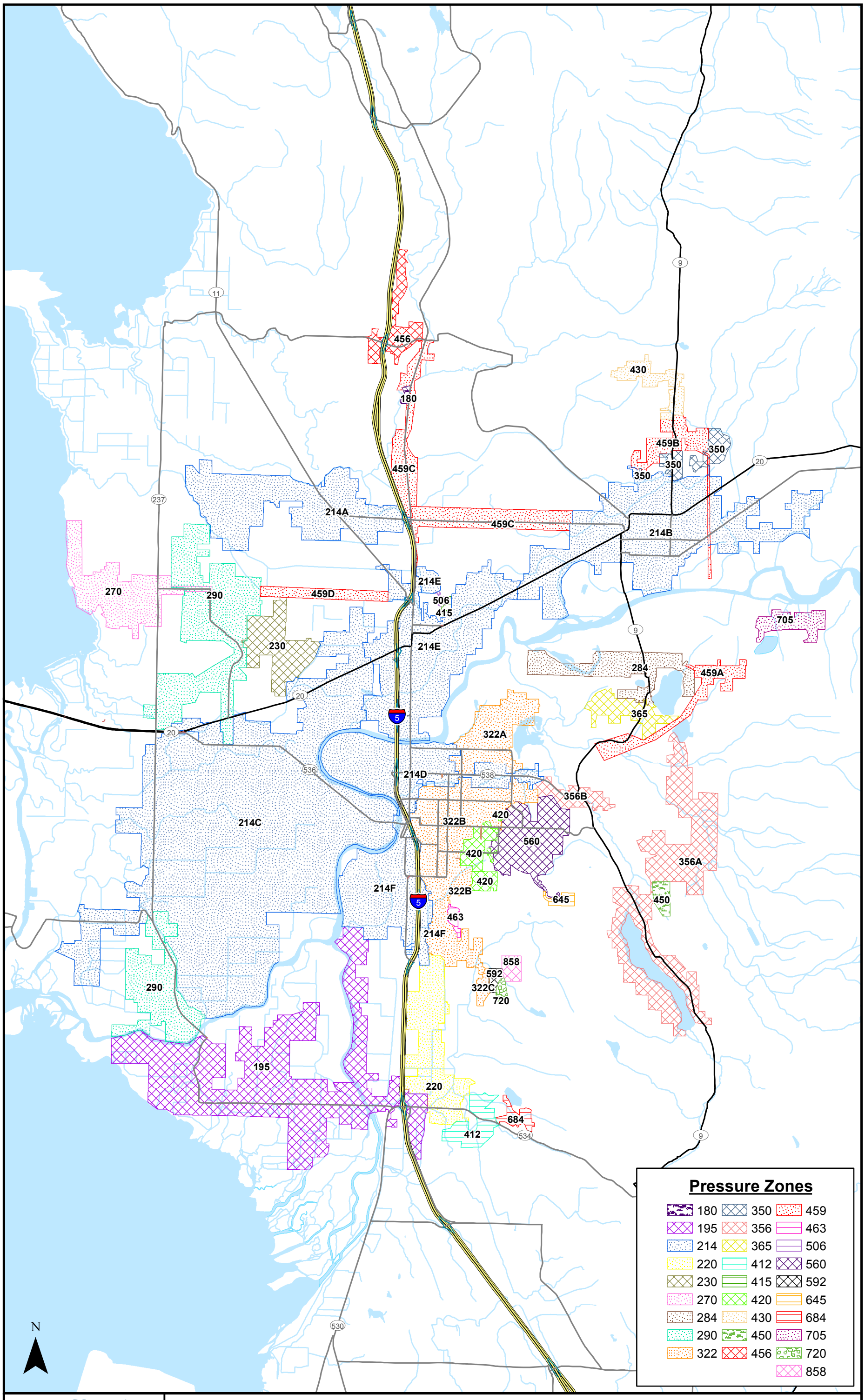
District Pipes Displayed By Installation Year - Rural Areas

2013 Skagit PUD Water System Plan

Coordinate System: WA State Plan North, NAD83

0 1.5 3 Miles

Figure 2-26


456
180
459C
214A
459C
214B
459B
350
350
350
430
214E
506
415
459D
270
290
230
214E
705
284
459A
365
322A
214D
356B
214C
322B
420
560
420
356A
420
214F
322B
645
450
463
214F
858
592
322C
720
290
195
220
684
412
Pressure Zones
180
195
214
220
230
270
284
290
322
350
356
365
412
415
420
430
450
456
459
463
506
560
592
645
684
705
720
858
N
Skagit PUD
PUBLIC UTILITY DISTRICT
Judy System - Pressure Zones
2013 Skagit PUD Water System Plan
Coordinate System: WA State Plan North, NAD83
0
1.75
3.5
Miles
Figure 2-27

2.6.8 Pressure Zones

The District has 29 pressure zones in the Judy System, and the configuration of the zones is shown in the hydraulic profile in Figure 2-13. The hydraulic profile shows the relationship between the different pressure zones in terms of the reservoirs that provide storage for each zone, the PRV and/or the booster station that feeds each zone, and the hydraulic grade of each pressure zone.

A plan view of the Individual pressure zones (hydraulic grade) for the Judy Reservoir System is shown in Figure 2-27. This figure shows the relationship of each pressure zone in terms of the areas of the system that it serves. These pressure zones are described in greater detail in the sections below.

2.6.8.1 180-Foot HGL (Samish River Park)

The 180-foot HGL pressure zone is supplied by a PRV station from the 459-foot HGL transmission line located on Old Highway 99 between Cook Road and Bow Hill Road. The pressure zone was created for the Samish River Park Division 1 plat; therefore, the demands are solely residential and there is no storage within the pressure zone. The system is made up of 6-inch-diameter ductile iron pipe with fire hydrants to provide fire flow. The demands for this small zone are included within the 459-foot HGL pressure zone.

2.6.8.2 195-Foot HGL (Conway – Fir Island)

The 195-foot HGL pressure zone is supplied from the 214-foot HGL supply along Dike Road, which is 6-inch and 8-inch diameter plastic and ductile iron pipe. There is no PRV to reduce the pressure from the 214-foot HGL to the 195-foot HGL; instead, the pressure zone is created due to hydraulic head losses within the system. This feed is projected to supply about half the average demand to the Conway area but less than half of the peak months' demands due to system hydraulics. Additional feed comes from the 220-foot HGL zone by way of a PRV station on the east side of I-5 at Conway. Because of the area's flat topography, the 195-foot HGL zone does not have a reservoir within the zone. The standby and equalizing storage for the zone comes from the Bulson tank, a 100,000-gallon storage reservoir on Bulson Road east of Conway. This tank provides support only during fire flow events because the Hickox Road PRV is set to a 220-foot HGL. The Bulson tank is re-supplied from the 322-foot HGL pressure zone in Mount Vernon by way of the Hickox Road PRV station in south Mount Vernon. Standby storage to this zone is also provided by the 9th and Highland tank in Mount Vernon.

The 195-foot HGL pressure zone serves the agricultural area south of Mount Vernon bordering Dike Road and the rural village of Conway, as well as Fir Island and North Fir Island Water Association, all west of I-5. The area is predominantly flat alluvial plain, and pipelines are predominantly asbestos cement (AC) and plastic. Fir Island is currently the most remote point in the Judy Reservoir System; however, water quality monitoring consistently provides satisfactory results. Demands are predominantly residential and agricultural, and peak during the dry summer months due to irrigation requirements.

Improvements planned for this area of the system will ultimately eliminate this pressure zone. Pipe replacement projects on Mclean Road, Best Road, and Fir Island Road will increase the hydraulic capacity of the pipelines feeding this area, allowing the 214-foot HGL to be extended throughout Fir Island and Conway. In addition, a new storage reservoir on Pleasant Ridge is planned to provide standby storage and fire flow to the area. This will allow the District to abandon the Bulson tank. See Chapter 10 for a description of these improvements.

2.6.8.3 214-Foot HGL (Skagit Valley Floor)

The 214-foot HGL pressure zone serves the cities of Sedro-Woolley, Burlington, and Mount Vernon and the rural areas adjacent to them. The 214-foot HGL pressure zone is served principally through the 5-MG Dukes Hill Reservoir in Sedro-Woolley, and the 5-MG 9th and Highland Reservoir in Mount Vernon. Both reservoirs have a regulated inflow from the 459-foot HGL transmission pipeline system, though their outflow is based strictly on demand. The reservoirs draw down and refill throughout the day as demands exceed inflow. Both reservoirs have an operating range of less than 5 feet.

For system analysis and discussion purposes, the 214-foot HGL pressure zone is divided into six sub-zones:

1. 214A – Custer

The 214-foot HGL Custer sub-pressure zone is located east of I-5 along Cook Road (Bradley Road), Allen West Road, and Benson Road, serving the farming and agricultural areas of Custer. It is fed by a PRV located on Cook Road and Old Highway 99 that takes water from the 459-foot HGL Cook Road transmission pipeline. Another feed into this sub-pressure zone is planned by completing a pipeline extension along SR 11 (Chuckanut Drive) that will help connect it to the 214E – Burlington sub-pressure zone and provide redundancy. The distribution system in this area is a mix of plastic, PVC, and ductile iron pipe ranging in size from 2-inch-diameter through 12-inch-diameter installed between 1960 and 2003.

The general condition of the system is good, but there are hydraulic issues because of the small-diameter piping, lack of a redundant feed, and lack of a storage tank. Once the connection to the 214E sub-pressure zone is complete through the new pipeline on SR 11, this area will be stronger and will be able to utilize the future storage tank that is planned for Burlington.

2. 214B – Sedro-Woolley

The 214-foot HGL Sedro-Woolley sub-pressure zone is primarily fed by the 5-MG Dukes Hill Reservoir, which is filled through the Dukes Hill PRV located on the 459-foot HGL transmission line. The reservoir is remotely located and is fitted with high- and low-level alarms to alert District staff through SCADA. The feed into this sub-pressure zone is supplemented by two PRV stations on the transmission lines; the station located at 1st and Nelson Streets helps to supplement normal high

demands, and the station at Township and Dunlap Streets is set to respond to unusually high demands such as fire flows.

Due to construction of the Rhodes Road PRV, the Dukes Hill Reservoir is no longer able to provide water to the City of Burlington. The Rhodes Road PRV was constructed as part of the Cook Road transmission pipeline and now takes water directly from the 459-foot HGL pressure zone to feed the City of Burlington along the 24-inch-diameter concrete cylinder pipe (CCP) on SR 20. The water storage for customers on the 24-inch-diameter CCP is now provided by the 9th and Highland Reservoir in Mount Vernon.

The piping network in and out of the Dukes Hill Reservoir was designed to allow the 214-foot HGL water to return to the 459-foot HGL system for any emergency situation requiring shutdown of the 459-foot HGL supply; this would provide minimum pressures and flows to local residents for survival purposes. As shown in Chapter 10, the District proposes to construct a new emergency booster station at the Dukes Hill site to serve the 459-foot HGL pressure zone from the 214-foot HGL pressure zone, using the 5 million gallons of storage as a source.

The 214B sub-pressure zone can receive supplemental water from one of the interties with the City of Anacortes water system. The Avon intertie can augment the supply into this area in the case of an emergency.

The majority of the existing distribution system in this area is a mix of 8- through 12-inch-diameter ductile iron pipe installed after 1980 and 3- through 8-inch-diameter AC and plastic pipe installed between 1960 and 1980. The distribution system is well gridded and providing adequate fire flow is typically not a problem. Some areas have experienced leaks and breaks on a routine basis, and those pipes will be replaced as part of the annual pipe replacement program.

3. 214C – County

The 214C – County sub-pressure zone serves a very large area in the rural part of the District's system, and in the weaker part of the system in terms of hydraulics. This area covers everything west of the Skagit River and south of SR 536. The primary feeds into this sub-pressure zone are from the 12-inch-diameter ductile iron pipe across the West Side bridge in Mount Vernon from 214D, and from 214E at Avon Allen Road and Bradshaw Road, including the Avon intertie with the City of Anacortes.

Parts of this sub-pressure zone located in Pleasant Ridge have trouble maintaining adequate pressure during periods of high demand. As a result, booster pump stations were constructed at Rudene Road and at Bradshaw Road to boost pressure for the 290-foot HGL Pleasant Ridge pressure zone. Improving the distribution pressure in this area is one of the District's objectives as part of the CIP identified in Chapter 10. New pipelines on Mclean Road and Best Road will help maintain system

pressures and eliminate the long-term use of the booster pump stations that were intended for temporary use.

The storage for this sub-pressure zone comes from the 9th and Highland Reservoir in Mount Vernon via the 12-inch line on the West Side bridge. There are plans to construct a new 290-foot HGL reservoir in Pleasant Ridge to provide better distribution pressure, fire flow, and standby storage, as identified in Chapter 10.

The majority of the existing distribution system in this area is a mix of 8- through 12-inch-diameter ductile iron pipe installed after 1980 and 3- through 8-inch-diameter AC, PVC, and plastic pipe installed between 1960 and 1980. Some areas have experienced leaks and breaks on a routine basis, and those pipes will be replaced as part of the annual pipe replacement program.

4. 214D – Mount Vernon

The 214-foot HGL Mount Vernon sub-pressure zone serves the City of Mount Vernon along SR 538 (College Way), the commercial area around the intersection of SR 538 and Riverside Drive, and the Riverbend area west of I-5. Normal demands in this area are served by PRV stations on the 459-foot HGL transmission line at East College Way and William Way in Mount Vernon, and from the 322-foot HGL pressure zone from PRV stations at the intersection of Hoag and Laventure Roads and at Blodgett Road in Mount Vernon. Additional PRV stations are set to respond to unusually high demands, such as from fire flows. These PRV stations are near Riverside Drive, Kulshan View, the intersection of 18th Street and Kulshan, and the intersection of Sandlewood and North 18th Street in Mount Vernon.

The storage for this sub-pressure zone comes from the 5-MG 9th and Highland Reservoir. The reservoir also provides water storage to 214C – County, 214E – Burlington, 214F – South Mount Vernon. As an emergency standby, water from the 214-foot HGL pressure zone can be boosted at the 9th and Highland Reservoir site to serve the 322-foot HGL pressure zone in Mount Vernon. The storage analysis completed for this area indicates that a new water storage reservoir will be required in the future. This project is discussed in Chapter 10.

Like other 214-foot HGL sub-pressure zones, 214D can also receive supplemental water from the City of Anacortes through an intertie. For Mount Vernon, the Riverbend intertie can augment supply south and east of the Skagit River. This intertie has not been used in recent years.

The majority of the existing distribution system in this area is a mix of 8- through 12-inch-diameter ductile iron pipe installed after 1980 and 3- through 8-inch-diameter AC and plastic pipe installed between 1960 and 1980. The distribution system is well gridded and providing adequate fire flow is typically not a problem. Some areas have experienced leaks and breaks on a routine basis, and those pipes will be replaced as part of the annual pipe replacement program.

5. 214E – Burlington

The 214-foot HGL Burlington sub-pressure zone covers a wide area both north and south of SR 20 from Bayview to Sedro-Woolley, and north of the Skagit River. The primary feeds into this zone are from the Rhodes Road PRV in Sedro-Woolley, the 24-inch-diameter ductile iron line across the Riverside Bridge, and the 12-inch-diameter ductile iron line across the West Side Bridge in Mount Vernon. There is a standby feed at North Hill Boulevard that can be used in special circumstances, and the Avon intertie with the City of Anacortes can also supply this area on an emergency basis.

The 9th and Highland Reservoir in Mount Vernon provides the water storage for this sub-pressure zone primarily via the 24-inch-diameter line on the Riverside Bridge. There are plans to construct a new 214-foot HGL reservoir for this sub-pressure zone to provide additional fire flow and standby storage, as identified in Chapter 10.

As mentioned above, there are plans to construct piping on SR 11 to complete a connection to the 214A – Custer sub-pressure zone, which will provide for another feed into this zone from the Cook Road and Old Highway 99 PRV.

The majority of the existing distribution system in this area is a mix of 8- through 12-inch-diameter ductile iron pipe installed after 1980 and 3- through 8-inch diameter AC and plastic pipe installed between 1960 and 1980. The distribution system is well gridded and providing adequate fire flow is typically not a problem. Some areas have experienced leaks and breaks on a routine basis, and those pipes will be replaced as part of the annual pipe replacement program.

6. 214F – South Mount Vernon

The 214-foot HGL sub-pressure zone in south Mount Vernon is located approximately south of Division Street to Hickox Road, and between I-5 and the Skagit River. The primary feeds into this area are the 18-inch-diameter CCP on Freeway Drive, the 10-inch-diameter cast iron pipe near 4th Street, a 6-inch-diameter ductile iron pipe on Kincaid Street, a 6-inch-diameter cast iron pipe on Section Street, and a 10-inch-diameter steel pipe fed by a PRV station on Anderson Road. The piping leaving this sub-pressure zone on Dike Road feeds the 195-foot HGL Conway-Fir Island pressure zone.

The 9th and Highland Reservoir in Mount Vernon provides the water storage for this sub-pressure zone.

The majority of the existing distribution system in this area is a mix of 3/4-inch through 18-inch-diameter pipe made of cast iron, ductile iron, concrete cylinder, steel, AC, PVC, and plastic pipe. The age of the pipe in this area ranges from the 1950s to 2008. The general condition of the system is good, and it can generally meet fire flow requirements.

2.6.8.4 220-Foot HGL (Hickox South, East Conway)

The 220-foot HGL pressure zone is supplied from the Hickox Road PRV on the south side of the Mount Vernon 322-foot HGL zone. The growth in the Conway area, especially in the foothills around Lake Sixteen, has prompted future plans to change the pressure zones in the area. Future plans include replacing much of the arterial line to the Conway area with new pipe to allow for the extension of the 322-foot HGL pressure zone. The District plans to remove the Hickox Road PRV station and increase the pressure, allowing the 322-foot HGL pressure zone to extend to Conway and serve the area. The Hickox Road PRV is normally set at about 80 psi, but can be boosted to 90 psi or more in the summer to overcome frictional head loss in the 4 miles of 6-, 8-, and 12-inch-diameter pipe from Mount Vernon to Conway due to increased summer demand flows.

The distribution system can currently meet fire flow requirements, as outlined in Table 6-1 for a rural area.

Future development in the Conway area will result in construction of a new reservoir with a spill elevation of 575 feet AMSL. This new reservoir will have the ability to serve the 413-foot Hermway Heights pressure zone through a new PRV. Therefore, construction of this new reservoir will allow for the future removal of the Bulson tank and the Bulson booster station. In addition, a new reservoir is planned within the City of Mount Vernon with a 322-foot spill elevation, which will supplement the new, extended 322-foot HGL pressure zone that will extend into the Conway area east of I-5.

The new extended 322-foot HGL zone will supplement the supply to the 214-foot HGL pressure zone, which will be extended to Conway and Fir Island and across the bridge on the North Fork of the Skagit River. Capital projects reflecting some of these improvements are presented in Chapter 10.

2.6.8.5 Bay View Ridge – 230-Foot HGL, 270-Foot HGL, and 290-Foot HGL

The Bay View Ridge area of the District's Judy System has historically been served through the Lefeber and Fredonia interties with the City of Anacortes system. The District would typically purchase about 250–300 MG per year from the City to serve the Bay View Ridge area because the District did not have the ability to provide Judy Reservoir water at the required HGL. In 2007, the District constructed the Cook Road transmission pipeline to bring 459-foot HGL water from Sedro-Woolley to Old Highway 99 in Burlington. In 2012, the District constructed the Josh Wilson transmission pipeline to convey the 459-foot HGL water from Old Highway 99 to Higgins Airport Way near the Port of Skagit County. A PRV was constructed at the intersection of Higgins Airport Way and Josh Wilson Road to reduce the pressure from the 459-foot HGL to the 290-foot HGL. Therefore, the District can now provide water from Judy Reservoir to serve customers in the Bay View Ridge area, reducing the need for the Lefeber and Fredonia interties to emergency supplies as required.

As part of the Cook Road and Josh Wilson Road projects, high pressure was extended north on Old Highway 99 to Bow Hill Road and south toward Burlington to support the transmission pipeline loop.

The Bay View Ridge area currently has three distinct pressure zones:

1. 290-Foot HGL (Port of Skagit County)

The Port of Skagit County and Bay View Business and Industrial Park are served from the Josh Wilson Road transmission pipeline. The system currently receives water through a solenoid-controlled PRV station, controlled through the District's SCADA system based on the level of the 2.9-MG Bay View Ridge Reservoir. When the reservoir draws down to a pre-set level, the SCADA system opens the Higgins–Josh Wilson PRV and refills the reservoir; when the reservoir is full, the SCADA system shuts off the PRV. During a power outage, the PRV would fail to an open position, which would refill the reservoir and then close the altitude valve. The PRV setting would prevent over-pressuring the 290-foot HGL pressure zone.

The Lefeber and Fredonia interties with the City of Anacortes provide backup supply in case of distribution system isolation, closure/failure of the Higgins–Josh Wilson PRV station, or any other emergency situation.

2. 270-Foot HGL (Bay View)

The rural village of Bay View on Padilla Bay is served a moderate inflow by a PRV station from the Bay View Ridge 290-foot HGL pressure zone. The 300,000-gallon Bay View standpipe, operating at 270-foot HGL, draws down during the day as demands exceed inflow from the PRV station, and refills at night as demands relax and supply exceeds demands. A seismic vulnerability assessment indicated that the Bay View Standpipe is inadequately anchored and recommended repairs.

3. 230-Foot HGL (Country Club)

The Skagit Golf and Country Club is also served from the Bay View Ridge 290-foot HGL pressure zone through a PRV station, and operates at about the 234-foot HGL. Until early 1994, the Country Club was served by the 214-foot HGL pressure zone. A seismic vulnerability assessment indicated that the local 214-foot HGL storage reservoir did not meet current seismic design criteria. With the pressure upgrade to the 234-foot HGL, the reservoir was demolished and the local pump station at Peterson Road was fitted with a PRV. In a situation where the water is unavailable from the 290-foot HGL pressure zone, the Peterson Road pump station can support the demands of the Country Club pressure zone from the 214-foot HGL pressure zone.

These three subsystems were separate in 1994, and a stated objective of the 1994 Water System Plan was to connect them into a single distribution system with a single storage reservoir. The Bay View Ridge Reservoir was completed and the subsystems linked in 1999.

2.6.8.6 290-Foot HGL (Pleasant Ridge)

The 290-foot HGL pressure zone is served from the 214-foot HGL pressure zone by two booster stations at Rudene Road and at Bradshaw Road. Undersized distribution piping, along with residential growth on Pleasant Ridge and increased irrigation consumption in the 214-foot HGL pressure zone to the north have caused low pressure problems in the Pleasant Ridge area, mostly during peak summer demands. The static pressure is normally about 40 psi at the highest service on Pleasant Ridge, but drops to approximately 20 psi during periods of peak summer demands. The District responded in mid-1994 by re-establishing a booster pump system to serve this area. The relocated booster system at Rudene Road serves a small, rocky knoll that rises about 100 feet above the alluvial plain. In 2009, an additional booster station was constructed at the intersection of Summers Drive and Bradshaw Road to increase pressures in the southern area of Pleasant Ridge. The distribution system is predominantly plastic with some ductile iron water lines. System demands are predominantly residential.

There is currently no storage on Pleasant Ridge, though construction of a storage reservoir is tentatively scheduled for this planning period. However, the new storage reservoir will be constructed at a lower hydraulic grade than the current booster stations, and so the local residents will see a slight drop in pressure after the reservoir is constructed. The booster stations are considered a temporary measure until water line replacements indicated in Chapter 10 are complete, improving system flows and stabilizing system pressures throughout the year. The booster stations operate year-round, with higher operating pressures during the summer months when demands are higher. Previously, the District discussed a water system connection with the Town of LaConner, which could also provide increased flows and pressures to the Pleasant Ridge area.

2.6.8.7 284-Foot HGL (Clear Lake North)

The 284-foot HGL pressure zone used to be served from the 500,000-gallon Clear Lake Reservoir located on a bench on the hillside northeast of the community of Clear Lake; however, the reservoir was recently taken out of service due to maintenance concerns. There are plans to construct a new PRV to supply this pressure zone directly from the 459-foot HGL Judy Reservoir to Mount Vernon transmission pipeline. In the meantime, the 284-foot HGL is served through PRVs from the 365-foot HGL Southwest Clear Lake pressure zone and the 1.0-MG Buchanan Hill Reservoir.

After the new PRV is constructed, the 284-foot HGL pressure zone will be able to provide water to the adjacent 365-foot HGL pressure zone through a check valve on Maple Street if the 365-foot zone loses its source and drops in pressure. Demands in the 284-foot HGL pressure zone are predominantly domestic with a few commercial services in town and agricultural services in outlying areas. The 284-foot HGL pressure zone serves the northeast three-quarters of Clear Lake and along Francis Road up to Nookachamps Creek.

The distribution system is predominantly 6-inch-diameter plastic and AC mains, and is adequate to meet both peak hour domestic needs and appropriate fire flows. Demands are mostly residential with a few commercial services.

2.6.8.8 322-Foot HGL

The 322-foot HGL pressure zone is located primarily within the City of Mount Vernon, but there is a small isolated zone on Cascade Ridge with the same HGL. This zone requires a small booster station to maintain the 322-foot HGL because of pressure losses through the system before the water gets there.

1. 322A and 322B – Mount Vernon

The 322-foot HGL pressure zone is served by the 1-MG East Division Reservoir at the corner of Digby Road and Division Street in Mount Vernon. The pressure zone is large, and demands are supplemented to the west and north of the Division Street Reservoir by PRV stations at 9th Street, 18th Street, Laventure Road, and Waugh Road from the 459-foot HGL transmission pipeline. The reservoir draws down during the day as demands increase and refills in the evening as demands subside. Demands are primarily single-family and multi-family residential, with various commercial and public services dispersed throughout the pressure zone.

The 322-foot HGL pressure zone also can supply water to and receive water from adjacent pressure zones. It can receive water from the 420-foot HGL pressure zone to the southeast by a PRV station at the corner of Section Street and Laventure Road. The Sioux/Shoshone pressure sustaining valve station can provide supply back from the 560-foot HGL pressure zone to the 322-foot HGL pressure zone at peak demands, though it is currently valved closed. The Skyridge pump station on east Anderson Road in south Mount Vernon serves the 463-foot HGL Skyridge area; the PRV stations at east Anderson Road and Skyridge Drive provide supply back to the 322-foot HGL pressure zone from the 463-foot HGL zone at peak demands. The 322-foot HGL pressure zone is the source for the East Blackburn and Cedar Hills booster/pressure tank systems, serving small subdivisions on the north foot of Little Mountain in south Mount Vernon. Both are considered temporary systems and are expected to be removed when a new 12-inch-diameter water main is installed down Blackburn Road, providing increased pressure and storage from the 560-foot HGL pressure zone to these subdivisions and to the 322-foot HGL pressure zone through new PRV stations.

The distribution system in the 322-foot HGL pressure zone is generally good. It is strong in the center of the zone with 16-, 12-, and 10-inch-diameter distribution mains on Laventure Road and 12-inch-diameter mains on Section Street, Division Street, Fir Street, 15th Street, and Waugh Road. The remaining grid is a mixture of 12-, 10-, 8-, 6-, and 4-inch-diameter mains that are adequate for the peak hour domestic demands and have the capacity to provide the appropriate fire flows.

The 322-foot HGL pressure zone formerly served a gradual slope in the eastern end of Mount Vernon, which experienced low peak hour pressures (35± psi). The District has transitioned this area into a 420-foot HGL pressure zone between the 322-foot HGL and 560-foot HGL pressure zones. The East Blackburn pressure system discussed earlier will be absorbed into the 560-foot HGL pressure zone; the Cedar Hills pressure system will be absorbed into the 420-foot HGL pressure zone. The 420-foot HGL pressure zone is served by PRV stations from the 560-foot HGL pressure zone and

provides service as required to the 322-foot HGL pressure zone at Section Street through a PRV station.

The 1.0-MG Division Street tank mentioned above has inadequate standby storage to meet the demands of the 322-foot HGL pressure zone. Currently, the 560-foot HGL tank at Eaglemont or the emergency pump station at 9th and Highland must support this zone in the event of an emergency where the source is lost. The District is currently in the design phase for construction of a new 6.0-MG tank, in the same location as the existing tank, to provide adequate standby storage for the 322-foot HGL pressure zone. The current 1.0-MG tank will be decommissioned. The project will also include construction of a booster pump station to provide a redundant supply to the 560-foot HGL pressure zone. Currently, the only supply to the 560-foot HGL pressure zone is the Fir-Waugh booster station.

2. 322C – Cascade Ridge #1

The Cascade Ridge area, a large residential development completed in 1992 in south Mount Vernon on Stackpole Road, is supplied by the 322A and 322B sub-pressure zones in Mount Vernon. However, due to hydraulic losses through the system, the first part of the development served by the 322C sub-pressure zone requires a booster station. There is also a 75,000-gallon storage reservoir to serve this area, plus two other booster stations and two other reservoirs for higher zones.

2.6.8.9 350-Foot HGL (Sedro-Woolley – Portabello)

The 350-foot HGL pressure zone is a small zone located in Sedro-Woolley that is served by a single PRV station from the 459-foot HGL transmission line on Fruitdale Road. It serves an area just north of SR 20, primarily the Sauk Mountain View Estates development and Northern State Hospital.

It is a small localized zone that does not have any storage reservoirs. Storage for this pressure zone is provided by the clearwells at the WTP. There are no current plans to expand this zone or to construct a storage reservoir.

2.6.8.10 356-Foot HGL (Clear Lake South and Big Lake)

The 356-foot HGL pressure zone is divided into two separate areas. Both of these zones are fed directly from PRV stations from the 459-foot HGL transmission line, and both are predominantly single-family residential demands with a few commercial, multi-family, and public services scattered throughout.

1. 356A – Clear Lake South and Big Lake

The 356A sub-pressure zone is located between Clear Lake and Big Lake along Beaver Lake Road, Gunderson Road, and Otter Pond Drive, and on both the east side and west side of Big Lake. This sub-pressure zone is served by four storage reservoirs. The 500,000-gallon Nookachamps Hills Reservoir serves Beaver Lake and Gunderson Roads, Otter Pond Drive, all the area south of Clear

Lake, and the north end of Big Lake. The distribution system on the east side of Big Lake is served by two reservoirs totaling 140,000 gallons. The distribution system on the west side of Big Lake is served by the 140,000-gallon West Big Lake Reservoir. All four of the reservoirs are served by a PRV station from the 459-foot HGL transmission line on Beaver Lake Road in Clear Lake. The PRV station is quite remote from the demands on the system and the reservoirs are not very big, so the District monitors the pressures in this area very carefully through SCADA and consistently makes adjustments to the PRV settings in order to keep the system pressures adequate.

The distribution system in this sub-pressure zone is predominantly of 12- and 8-inch-diameter ductile iron and is quite adequate and able to meet the appropriate fire flows.

A booster pump station located adjacent to the Nookachamps Hills Reservoir currently serves a small 450-foot HGL pressure zone. Development may expand this zone, and a storage reservoir will be required.

2. 356B – Skagit Highlands

The 356B sub-pressure zone is located at the east end of College Way (SR 538) on both the north and south sides of the road, including east of the intersection of College Way and SR 9, along Knapp Road. This sub-pressure zone is fed by a PRV station in the Skagit Highlands subdivision from the 560-foot HGL pressure zone. This is a small zone that does not have any storage, and there are no current plans to expand the zone or to add storage.

2.6.8.11 365-Foot HGL (Southwest Clear Lake)

The 365-foot HGL pressure zone is served by the 1-MG Buchanan Hill Reservoir, serving the southwest quarter of Clear Lake. It is also the current supply to the adjacent 284-foot HGL pressure zone through PRV stations on Buchanan Street at Maple Avenue and at South Front Street and Beaver Lake Road due to the removal of the Clear Lake Reservoir. The Buchanan Hill Reservoir is served by a PRV station from the 459-foot HGL transmission pipeline on Beaver Lake Road in Clear Lake (separate from the PRV serving the 356-foot HGL pressure zone). The PRV station is remote from the demands on the system, so the reservoir acts as the primary supply, and it draws down during the day as demands increase and refills at night when demands are low. Demands in this pressure zone are predominantly residential. The distribution system in the 365-foot HGL pressure zone is predominantly of 8-inch-diameter ductile iron pipe and is able to meet the appropriate fire flows. The 365-foot HGL pressure zone may also at some future date support the adjacent 356-foot HGL pressure zone south of Clear Lake by closing the main valve to the 459-foot HGL transmission line and installing a bypass at the 365-foot HGL PRV station. Both systems would then effectively operate at the 356-foot HGL and serve off their storage only.

2.6.8.12 412-Foot HGL (Hermway Heights)

The 412-foot HGL pressure zone east of Conway is served by the 60,000-gallon Hermway Heights Reservoir. The Hermway Heights Reservoir is filled from the 220-foot HGL pressure zone by the Bulson pump station on Bulson Road, next to the Bulson Road Reservoir. The pump station operates on a pressure setting to refill the reservoir when the water level gets below the set point. District operators keep track of the reservoir levels and adjust for periods of high demand. Demands on the 412-foot HGL pressure zone are predominantly single-family residential. The distribution system is adequately sized for present domestic use, with newer lines being 8-inch-diameter ductile iron and the remaining lines being 2- and 3-inch-diameter plastic. A hydrant on the larger line from the Hermway Heights Reservoir is sized to allow for rural fire flows. The 412-foot HGL pressure zone also serves as supply for the adjacent 684-foot HGL pressure zone, supplying the Lake Sixteen pump station through an 8-inch-diameter ductile iron main along SR 534.

Development in this area at the Bulson Creek Subdivision will result in construction of two additional 132,000-gallon reservoirs at the 575-foot HGL. The District contributed to the upsizing of one of the reservoirs and fully paid for construction of the second reservoir. The 575-foot HGL will serve the majority of the new development and a booster pump station will serve the houses at a higher elevation with a newly created 684-foot HGL. The District has reviewed the system hydraulics in concert with land use in the Lake Sixteen area and proposes to construct a new PRV at Bulson Creek to supply the Hermway Heights pressure zone. After these improvements are made, the District will be able to abandon the Bulson tank. However, the hydraulic gradient will be increased from the current 412-foot HGL to approximately the 485-foot HGL. The proposed 485-foot HGL pressure zone works well with the existing 684-foot HGL pressure zone and the proposed increase of the 195-foot HGL pressure zone to the 322-foot HGL. This increase from the 412-foot HGL to the 485-foot HGL will increase the service area without adding another pressure zone.

2.6.8.13 420-Foot HGL (Central Mount Vernon)

The 322-foot HGL pressure zone formerly served a gradual slope in the eastern end of Mount Vernon, which experienced low peak hour pressures (35± psi). The District transitioned this area into a 420-foot HGL pressure zone between the 322-foot HGL and the 560-foot HGL pressure zones. The 420-foot HGL pressure zone is served by PRV stations from the 560-foot HGL pressure zone and provides service to the 322-foot HGL pressure zone at Section Street through a PRV station as required. The Cedar Hills pressure system currently in the 322-foot HGL pressure zone will be absorbed into the 420-foot HGL pressure zone after completion of the new pipeline on Blackburn Road, which is currently not planned and will likely be a requirement of any development projects in the Eaglemont area.

The 420-foot HGL pressure zone does not have its own storage; the 5-MG Eaglemont Reservoir has sufficient storage capacity to also serve the 420-foot HGL pressure zone. Demands in the 420-foot HGL pressure zone are predominantly residential. The distribution system is a grid of 12-inch and 8-inch-diameter ductile iron pipe. Strategically-placed PRVs support average, peak hour, and fire flow demands, served from the 560-foot HGL pressure to the 420-foot HGL zone, through to the 322-foot

HGL pressure zone as required. Check valves have been located off the 322-foot HGL pressure zone at Laventure Road and off the 420-foot HGL pressure zone at the Maddox Creek Plat to provide emergency service back to the 420-foot HGL and the 560-foot HGL pressure zones, respectively, in case of pressure loss in those upper zones.

2.6.8.14 430-Foot HGL (Hoogdal)

The 430-foot HGL pressure zone north of Sedro-Woolley is served by the 100,000-gallon Hoogdal Reservoir. The reservoir is filled from the 459-foot HGL pressure zone by a PRV station at the intersection of Kalloch Road and SR 9. The PRV station is quite remote from the reservoir, so the reservoir acts as the principal supply. Demands in this area are predominantly residential. The distribution system is of 8-inch-diameter ductile iron and is adequate for peak hour demands; it also has the capacity to meet the appropriate fire flow demands. The PRV station is on a bypass from the main, and a mainline valve can be opened to allow the 430-foot HGL water to serve the 459-foot HGL pressure zone in emergency situations.

2.6.8.15 450-Foot HGL (Nookachamp Hills)

The 450-foot HGL pressure zone is a small zone located in the Nookchamp Hills subdivision in Big Lake that is served by a booster pump station at the Nookachamp Hills Reservoir. The booster pump station serves a higher area of the development that the reservoir cannot serve.

It is a small localized zone that does not have any storage reservoirs. There are no current plans to expand this zone or to construct a storage reservoir.

2.6.8.16 456-Foot HGL (Bow Hill)

The 456-foot HGL pressure zone at Bow Hill north of Burlington is served by the 1-MG Bow Hill Reservoir. The 456-foot HGL pressure zone serves the residential and commercial areas near the Bow Hill Road intersection with I-5. The Bow Hill Reservoir is filled from the 459-foot HGL pressure zone served by the Cook Road transmission pipeline and the high-pressure line on Old Highway 99. However, due to head losses in the pipelines, the Bow Hill booster station is required to boost the water to the 456-foot HGL into the reservoir. The booster station is controlled by the District's SCADA system based on reservoir level. Demands on the pressure zone are predominantly commercial and public authority, but include single-family residential. The distribution system of the 456-foot HGL pressure zone is all of ductile iron, primarily 12-inch diameter, and is adequate for both peak hour demands and appropriate fire flows.

2.6.8.17 459-Foot HGL (Transmission Line)

The 459-foot HGL pressure zone is served by the clearwells at the Judy Reservoir WTP east of Clear Lake. The clearwells are filled by the WTP and have a normal operating range of about 5 feet. The entire Judy System is primarily supplied by this pressure zone, though storage reservoirs in lower pressure zones serve most of the daily demands in their distribution systems. There are also some direct services from the 459-foot HGL pressure zone. If these direct services were mapped, they

would form a narrow band along the 459-foot HGL transmission line, mostly at higher elevations. There are three main segments of the 459-foot HGL pressure zone, as described below.

1. 459A – Judy Reservoir to Mount Vernon Transmission Line

The 459A sub-pressure zone of the 459-foot HGL transmission line runs southwest from clearwells, serving several customers along Old Day Creek Road and Clear Lake Reservoir, continuing southwest past Clear Lake (serving demands of the 356-foot HGL and the 365-foot HGL pressure zones at the PRV stations on Beaver Lake Road) to Mount Vernon. The 459-foot HGL transmission line serves demands in Mount Vernon to Draper Valley Farms, a large commercial chicken processing facility that takes full 459-foot HGL water through its own PRV stations; to the 560-foot HGL pressure zone via the Fir-Waugh pump station; to the 322-foot HGL pressure zone through PRV stations at Waugh Road, Laventure Road, 18th Street, and 9th Street; and to the 214-foot HGL pressure zone through PRV stations at East College Way, 18th Street, and 9th Street. This sub-pressure zone drops from the 459-foot HGL to the 214-foot HGL at the mainline PRV stations near 9th Street, where it continues north along Riverside Drive to meet the north leg of the transmission line loop at the Skagit River Bridge.

The piping for the 459A sub-pressure zone is predominantly concrete cylinder pipe, except for the new section of ductile iron pipe constructed in 2009 parallel to the existing concrete cylinder line to provide redundancy and additional hydraulic capacity. This line will eventually be continued to the WTP.

As indicated above, the clearwells provide distribution storage for a small number of domestic services in upper elevations of the Judy System, plus one large commercial customer in Mount Vernon; they also provide supplemental supply to replenish storage in the 214-, 284-, 322-, 356-, 365-, 430-, and 560-foot HGL pressure zones. Under special circumstances, a PRV installed near the Fir–Waugh pump station may be opened to feed water into the 459-foot zone from the 560-foot tank.

2. 459B – Sedro-Woolley

The 459B sub-pressure zone follows the transmission line north from the clearwells, serving several homes off Morford Road, through an overhead pipeline crossing the Skagit River, to Sedro-Woolley. The transmission line tees at Fruitdale Road, sending a 12-inch-diameter line north on Fruitdale Road and continuing the 24-inch-diameter line through Sedro-Woolley to the PRV station at the intersection of 1st and Nelson Streets.

There is a PRV at Rhodes Road in Sedro-Woolley that reduces the pressure from the 459-foot HGL to the 214-foot HGL, and this lower-pressure transmission line continues west along SR 20 to Burlington, then south along Burlington Boulevard to meet the south leg of the transmission line loop at the Skagit River Bridge.

The Fruitdale Road transmission line in Sedro-Woolley also acts as a distribution line for elevations above 200 feet AMSL. It serves Northern State Multi-Service Center through a PRV station, continues north along Fruitdale Road, west along Kalloch Road to SR 9 (where it serves the 430-foot HGL pressure zone to the north), south on SR 9 to Bassett Road (serving domestic customers), and west on Bassett Road to the Dukes Hill Reservoir site (serving domestic customers near the reservoir site).

The 459B piping is a mix of concrete cylinder, ductile iron, and welded steel pipe. The Skagit River crossing is welded steel, but most of the line from the WTP to the Rhodes Road PRV is concrete cylinder pipe.

3. 459C – Cook Road and Old Highway 99

The 459C sub-pressure zone runs through Sedro-Woolley and up to Cook Road, where the recently-constructed transmission line extends the 459-foot HGL pressure zone along Cook Road to Old Highway 99, where it interties with 16-inch-diameter pipelines that run north and south along Old Highway 99. In 2012, the 459-foot HGL pressure zone was extended to Bay View Ridge through the construction of the Josh Wilson transmission line. This line connects to the 16-inch-diameter pipeline on Old Highway 99 and ends at Higgins Airport Way. The Cook Road pipeline was constructed with PRV stations at Collins, District Line, and Gardner roads and Old Highway 99 to allow for future service connections. There are no connections at the present time. The Josh Wilson pipeline was not set up with any PRVs except for the one at Higgins Airport Way. Services are not planned for this portion of the line.

The newly-constructed portions of the 459C piping along Cook Road and Josh Wilson Road are ductile iron. A seismic vulnerability assessment completed for the District noted that unrestrained-joint concrete cylinder pipe in unconfined alluvial material is moderately vulnerable to damage during a seismic event. When replacing such portions of transmission pipeline, the District will use ductile iron or other seismically-sound material. In other respects, the transmission pipeline loop appears to be sound and serviceable, though there have been some small failures.

As noted earlier in this chapter and in Chapter 6, growth projections, hydraulic analyses, and waning transmission line lifespans have an effect on future serviceability of the transmission pipelines. Based on this, the District plans to complete construction of the redundant south leg of the transmission line from Mount Vernon to the WTP. Also, replacement of the north leg of the transmission line is also planned in approximately 15 years.

2.6.8.18 463-Foot HGL (Skyridge)

The 463-foot HGL pressure zone serves a small residential area accessed by Skyridge Drive in south Mount Vernon and is served by the 500,000-gallon Little Mountain Reservoir. The Little Mountain Reservoir is filled from the 322-foot HGL pressure zone by the Skyridge pump station on Anderson Road. Water can also be returned from the 463-foot HGL pressure zone to the 322-foot HGL pressure zone during peak demands through PRV stations on Anderson Road (at the pump station)

and at Skyridge Drive. The distribution system in the 463-foot HGL pressure zone is predominantly ductile iron and plastic, and has adequate capacity for peak hour demands as well as appropriate fire flow demands.

2.6.8.19 506/415-Foot HGL (Tinas Coma)

The 506-foot HGL pressure zone on Burlington Hill in north Burlington is served by the 230,000-gallon Tinas Coma Reservoir and serves a small residential area on the hill accessed from the north on Hillcrest Drive. There is a PRV station that feeds a small 415-foot HGL pressure zone in this area as well. The Tinas Coma Reservoir is filled from the 290-foot HGL pressure zone by the Tinas Coma pump station on north Hillcrest Drive. The distribution system in the 506/415-foot HGL pressure zone is predominantly ductile iron, and has adequate capacity for peak hour demands as well as appropriate fire flow demands.

2.6.8.20 560-Foot HGL (Mount Vernon)

The 560-foot HGL pressure zone in southeast Mount Vernon is served by the 5-MG Eaglemont Reservoir. The Eaglemont Reservoir is filled from the 459-foot HGL transmission line by the Fir–Waugh pump station, which is controlled by the SCADA system coordinated with the Eaglemont tank level. The 560-foot HGL pressure zone can return water to the 322-foot HGL pressure zone through the pressure sustaining valve (PSV) station at the intersection of Sioux and Shoshone in east Mount Vernon; this PSV station is currently valved-off. The 560-foot HGL pressure zone can also feed into the 459-foot HGL zone through a bypass PRV near the Fir–Waugh pump station. The 560-foot HGL pressure zone supplies water to the adjacent 645-foot HGL pressure zone through a pump station adjacent to Eaglemont Reservoir. The distribution system in the 560-foot HGL pressure zone is predominantly ductile iron and plastic, with some AC and plastic in the older, lower areas by Digby Road and Division Street. The entire distribution system in this pressure zone is adequate for peak hour demands, and the ductile iron and plastic distribution piping is adequate for appropriate fire flows. The older AC and plastic distribution lines in critical hydraulic legs are scheduled for replacement, as indicated in Chapter 10. An extension of Waugh Road across the Eaglemont development down to Blackburn Road has not yet been constructed, but a new pipeline along this alignment will serve to strengthen the District's distribution system in this area. It will also provide increased storage, flows, and pressures to the east Blackburn Road area and allow the retirement of three small booster/pressure tank systems, one on Cedar Hills and two on East Blackburn, in conjunction with the planned expansion of the 420-foot HGL pressure zone (as stated above).

This pressure zone also serves the irrigation demands of the golf course at the Eaglemont development (protected from the potable water system by a cross-connection control assembly) and the clubhouse for the golf course. An irrigation meter fills an adjacent irrigation pond, which is then pumped to meet actual irrigation demands. The District's water contract with the Eaglemont development allows it to withdraw irrigation water only during the 10 off-peak hours of each day to avoid overburdening the District's distribution or supply systems.

2.6.8.21 592-, 720-, 858-Foot HGL (Cascade Ridge)

Cascade Ridge is a residential development on a significant hillside south of Mount Vernon. The lowest portion of Cascade Ridge is served by the 322-foot HGL, including a pump station and a 75,000-gallon reservoir. A second pump station boosts water from the 322-foot HGL zone up the hill to a 592-foot HGL pressure zone and its 23,000-gallon reservoir. A third pump station boosts water from the 592-foot HGL reservoir up the hill to an 858-foot HGL pressure zone and its 33,000-gallon reservoir. The 858-foot HGL serves a small 720-foot HGL pressure zone through a mainline PRV. The distribution system is all made of ductile iron and has sufficient capacity for both Maximum Day Demands and fire suppression flows. The pump systems are interconnected with their supported reservoirs by a telemetry system, responding based on reservoir drawdown. The Cascade Ridge pressure zone may have the potential to support even higher pressure zones, should there be further development up the hillside, or farther south.

2.6.8.22 645-Foot HGL (Mount Vernon)

The 645-foot HGL pressure zone in southeast Mount Vernon is served by the 1-MG Eagles Nest Reservoir, adjacent to the Eaglemont Reservoir. The Eagles Nest Reservoir is filled from the 560-foot HGL pressure zone by the Eagles Nest pump station. The Eagles Nest Reservoir is approximately 110 feet tall and is on one of the highest points in the pressure zone, allowing it to provide a minimum of 40 psi to any point in the pressure zone. There are currently no domestic demands in this pressure zone because this area of Eaglemont has not yet been developed. The primary demand is from the Eaglemont Golf Course clubhouse.

The demands of the zone, once developed, will be primarily residential and irrigation. The pump station will refill the reservoir once drawn down to a specified level and will have telemetry alarms for the pump system and for both Eagles Nest and Eaglemont reservoirs. A PRV station in the pump station will supply water from the 645-foot HGL pressure zone to the 560-foot HGL pressure zone should the Eaglemont Reservoir be out of service for any reason. The distribution system in the 645-foot HGL pressure zone is all to be of ductile iron and will be adequate to serve both peak hour demands and meet the appropriate fire flow requirements.

2.6.8.23 684-Foot HGL (Lake Sixteen)

The 684-foot HGL pressure zone east of Conway is served by the 60,000-gallon Lake Sixteen Reservoir and serves the residential areas to the south of Lake Sixteen; the areas to the north of the lake can also be served up to elevation 584 feet AMSL. The Lake Sixteen Reservoir is filled from the 413-foot HGL pressure zone by the Lake Sixteen pump station near SR 534, controlled by the reservoir pressure transducer. Demands on the pressure zone are predominantly single-family residential. The distribution system of the 684-foot HGL pressure zone is all of ductile iron, primarily 8-inch diameter, and is adequate for both peak hour demands and appropriate fire flows.

Future development in this area is planned with an upper pressure zone of the 684-foot HGL. This new zone will eventually connect to the Lake Sixteen pressure zone to provide redundancy and additional storage.

2.6.8.24 705-Foot HGL (Panorama)

The 705-foot HGL pressure zone north and east of the WTP is served by the finished water pumps at the WTP. These pumps also serve domestic water to the plant including water for chemical feeds and filter backwash. As a result, when there is a large demand in the Panorama zone like a fire flow, the service to the WTP is affected. A separate booster station for this zone is required.

There is no water storage in this pressure zone. Demands on the pressure zone are predominantly residential with agricultural and livestock components. The distribution system of the 705-foot HGL pressure zone is made up of 6-inch and 8-inch-diameter ductile iron pipe, and is adequate for both peak hour demands and appropriate fire flows.

2.6.9 Interties

The District currently has four interties between the Judy System and the City of Anacortes water system. Tables 2-13 and 2-14 detail the historical water purchases from Anacortes as well as the specific purchases from 2012. Until recently, two of the interties at Lefeber and Fredonia provided the daily water supply for the District's customers in the Bay View Ridge area. But with construction of the Josh Wilson Road transmission pipeline to bring Judy Reservoir water to Bay View, all four interties are now in the capacity of emergency and peak demand supplies.

Table 2-13. City of Anacortes Purchases

Year	Yearly Water Purchases (gallons)
2004	349,782,632
2005	213,894,955
2006	379,012,399
2007	336,000,000
2008	348,668,807
2009	295,068,227
2010	283,569,156
2011	274,289,827
2012	283,613,976

Table 2-14. Judy Reservoir System and City of Anacortes Interties

Intertie Location	2012 Average Monthly Volume (gallons)	2012 Total Yearly Volume (gallons)
Avon – 17098 Bennett Road, Mount Vernon	0	0
Riverbend – 14423 Riverbend Road, Mount Vernon	0	0
Lefeber – 15377 State Route 536, Mount Vernon	19,226,376	230,716,515
Fredonia – 14245 McFarland Road, Mount Vernon	208,714	2,504,573

The District and the City have a water supply agreement in place that designates a committed volume of water per year for use by the District. This agreement expired in 2012 and is currently under negotiation, primarily due to the fact that the demand from the Lefeber and Fredonia interties has reduced considerably.

2.6.10 Fire Flow

The District provides water service to fire sprinkler systems in commercial structures, as well as to the many fire hydrants connected to its water mains, throughout its service areas. The District works regularly with the county and city fire marshals as well as the city fire departments and rural fire districts to ensure that adequate flow and pressure are available at these services and hydrants to support the required fire flow demands (see Chapter 6). Fire flow is one of the principal criteria the District uses to evaluate the adequacy of existing water mains in urban areas. The District evaluates fire flow availability by either flow testing existing hydrants or through hydraulic analysis using its computer model, or a combination of both. Developers may be required to replace existing water main(s) if the main(s) will not provide the flow required by the fire marshal at the District's design criteria. The District's Design and Construction Standards are discussed in Chapter 9.

Recent legislation by the State of Washington has granted authority for responsibility for fire hydrants to the utility that supplies the water. Therefore, the District will become responsible for the operation and maintenance of all the fire hydrants within its service area.

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