CASCADE WATER ALLIANCE

Transmission and Supply Plan

DRAFT

December, 2011

HDR

In association with

CDM

Cascade Water Alliance
Transmission and Supply Plan

December 2011

Draft

Cascade Water Alliance Members

City of Bellevue

Covington Water District

City of Issaquah

City of Kirkland

City of Redmond

Sammamish Plateau Water & Sewer District

Skyway Water & Sewer District

City of Tukwila

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Certificate of Engineer

Cascade Water Alliance
Transmission and Supply Plan

This Transmission and Supply Plan for the Cascade Water Alliance has been prepared under the direction of the following Registered Professional Engineer.

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Acronyms

ADD	Average Day Demand
AOA	Asset Operating Agreement
ASR	Aquifer Storage and Recovery
BIP	Bellevue – Issaquah Pipeline
BKR	Bellevue-Kirkland-Redmond Pipeline
Cascade	Cascade Water Alliance
CERUs	Cascade Equivalent Residential Units
CIP	Capital Improvement Plan
CO	Contract Operator
CPA	Conservation Potential Assessment
CWSP	Coordinated Water System Plan
DOH	Washington State Department of Health
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
ERU	Equivalent Residential Unit
GMA	Growth Management Act
gpd	Gallons per day
LTP	Lake Tapps Pipeline
mgd	Million gallons per day
MIT	Muckleshoot Indian Tribe
MWD	Maximum Week Demand
O&M	Operations and Maintenance
OASIS	Lakehaven Utility District ASR Project
PSE	Puget Sound Energy
PSRC	Puget Sound Regional Council
PTI	Puyallup Tribe of Indians
RCFCs	Regional Capital Facilities Charges
RFP	Request for Proposals
RWSS	Regional Water Supply System
SEPA	State Environmental Policy Act
SMP	Shortage Management Plan
SPU	Seattle Public Utilities
SRRWA	Snohomish River Regional Water Authority
TCP	Tacoma – Cascade Pipeline
TPU	Tacoma Public Utilities
TSP	Transmission and Supply Plan
TSSP	Tacoma Second Supply Project
USACE	United States Army Corps of Engineers
WAC	Washington Administrative Code

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Executive Summary

Cascade Water Alliance is a public, non-profit corporation comprised of eight Member cities and special districts in King County, Washington. Cascade's primary role is to contract, plan and develop regional water supplies on behalf of its Members.

This Transmission and Supply Plan (TSP) fulfills Cascade's responsibility to submit a water system plan to the Washington State Department of Health. In addition, it supplements information on regional supply presented in each Member's individual water system plan.

Part I: Current Water Supplies, Facilities and Operations

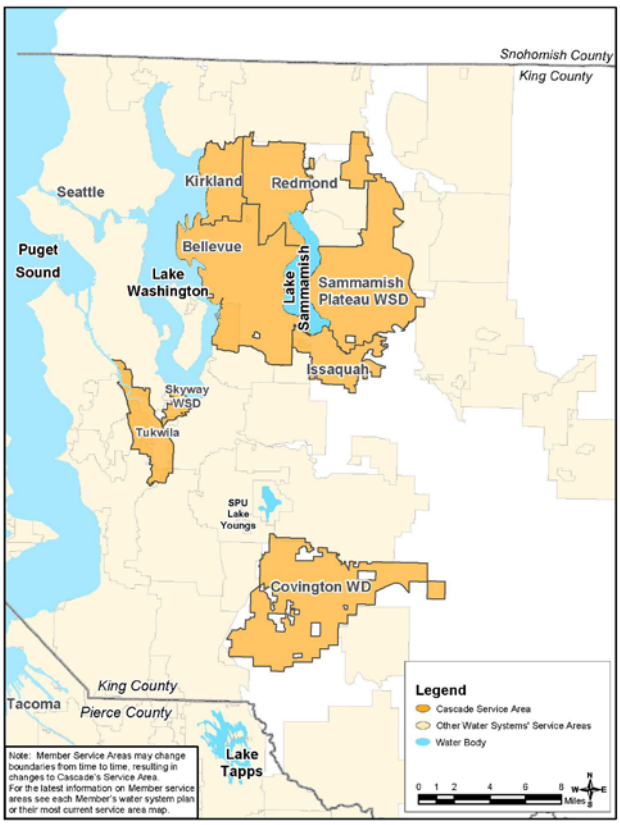
Cascade contracts with Seattle Public Utilities (SPU) for delivery of water to seven of the eight Cascade Members[1]. The SPU supply contract provides for a "declining block" of supply that will be reduced in five-year increments beginning in 2024. Under the Block Contract, SPU is responsible for maintaining and operating source, treatment, transmission and storage facilities needed to deliver the contracted supply, as well as regulatory compliance for those facilities.

At this time Cascade's existing capital facilities for delivery of municipal water supplies consist solely of the Bellevue-Issaquah Pipeline (BIP). No capital improvements have been identified for the pipeline, nor does Cascade have other capital projects coming up in relation to its current supplies (for future supplies, see Part II, below).

Individual Members of Cascade own, operate and maintain their own water distribution systems. This includes, as applicable, water treatment for their independent water sources; maintenance of water quality within their reservoirs and distribution piping systems; and local monitoring of water quality conditions (some monitoring is shared with SPU or other water systems). Five of the eight Cascade Members have their own independent supplies.

Cascade's regional water service area coincides with the individual service areas of the Members, as shown in Figure ES.1. In addition, Cascade may deliver contracted supplies to other water purveyors in King and Pierce Counties for use in their water service areas, as described in this Plan.

[1] Covington Water District meets all of its own needs from its own wells and from the Regional Water Supply System involving Tacoma, the District and two other partners.



ES.1: Cascade Service Area

Cascade anticipates that the current mix of SPU and independent supplies will meet all Member needs through 2023. Beginning in 2024 when the SPU block begins to decline, additional supplies will be needed.

Cascade also administers regional water conservation services on behalf of its Members. The 2008-2014 Conservation Program has a goal of achieving water savings of 1 million gallons per day (mgd) in terms of annual average consumption and 1.45 mgd during the peak season. By the end of 2010 the annual average goal had already been attained. From 2014 through at least 2020 Cascade anticipates continued conservation activities, with water savings continuing to increase at a rate similar to that achieved since 2008. This assumption has been built into the water demand forecast used in the TSP.

Part II: Long-Term Water Supplies and Infrastructure

Forecast of Water Needs

In recent years the downturn in housing and economic activity has affected demands for water throughout the Puget Sound region, and this effect is expected to persist for the next several years. This is a change from past planning efforts when rapid growth was occurring. Coupled with the conservation program, this means that demand for water in Cascade's service area is forecast to remain close to 40 mgd through approximately 2020. After 2020 demands are forecast to rise to begin rising again. Cascade is responsible only for a portion of this demand; as Member independent supplies meet part of the water supply need.

Water Supply Portfolio

For this TSP Cascade evaluated a wide range of water supply options to meet long-term needs. These included additional or expanded contracted supplies from existing sources within the Central Puget Sound region; new surface water supplies, new ground water supplies, reclaimed water and enhanced water conservation. From an initial list of 27 possible sources, a preferred supply "portfolio" was selected. The preferred supply portfolio includes the following sources:

- Continued production from Member supplies serving their respective service areas.
- Continued use of water from Seattle Public Utilities (SPU) under the Block Contract.

- Beginning in 2024, delivery of Green River supply contracted from Tacoma Public Utilities (TPU).
- Beginning in 2024, delivery of additional Green River supply from Covington Water District's share in the Regional Water Supply System (RWSS)[2] over and above water used within the District's own service area.
- Beginning in 2030 (or as needed), water from Cascade's White River - Lake Tapps Reservoir Project (Lake Tapps Project).

This sequence of supplies is shown in Figures ES.2 and ES.3. Conditions shown in Figure ES.2 are for "maximum week" which typically occurs in July or August of each year. Conditions shown in Figure ES.3 represent average conditions over the entire year. A range of projected demands is shown in the charts, for comparison with available supplies. Under the preferred portfolio, available supplies are expected to exceed Cascade's water demand throughout the 50-year planning period.

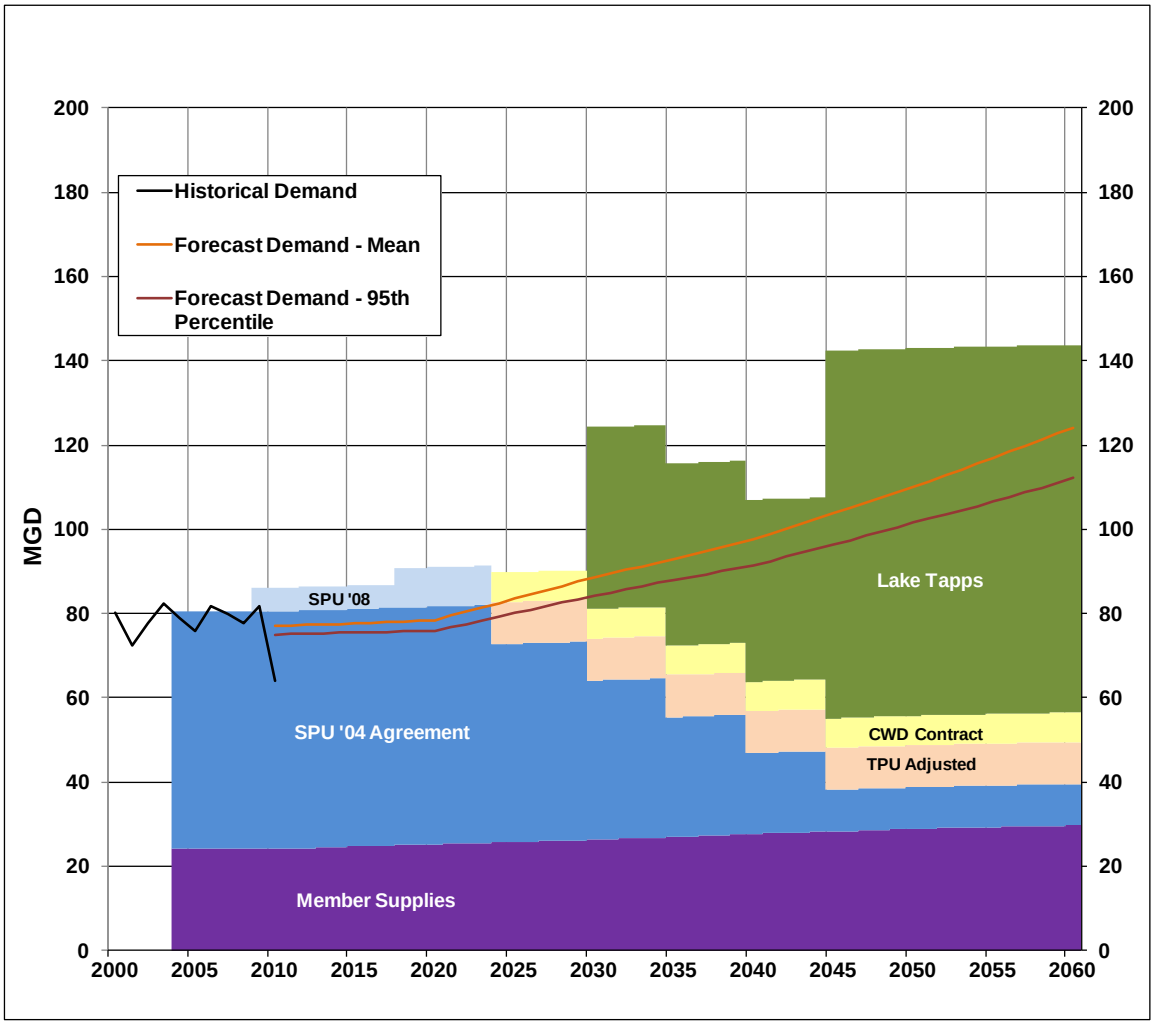


Figure ES.2: Cascade Supply Portfolio (Maximum Week)

[2] The RWSS was formerly known as the Tacoma Second Supply Project, or TSSP.

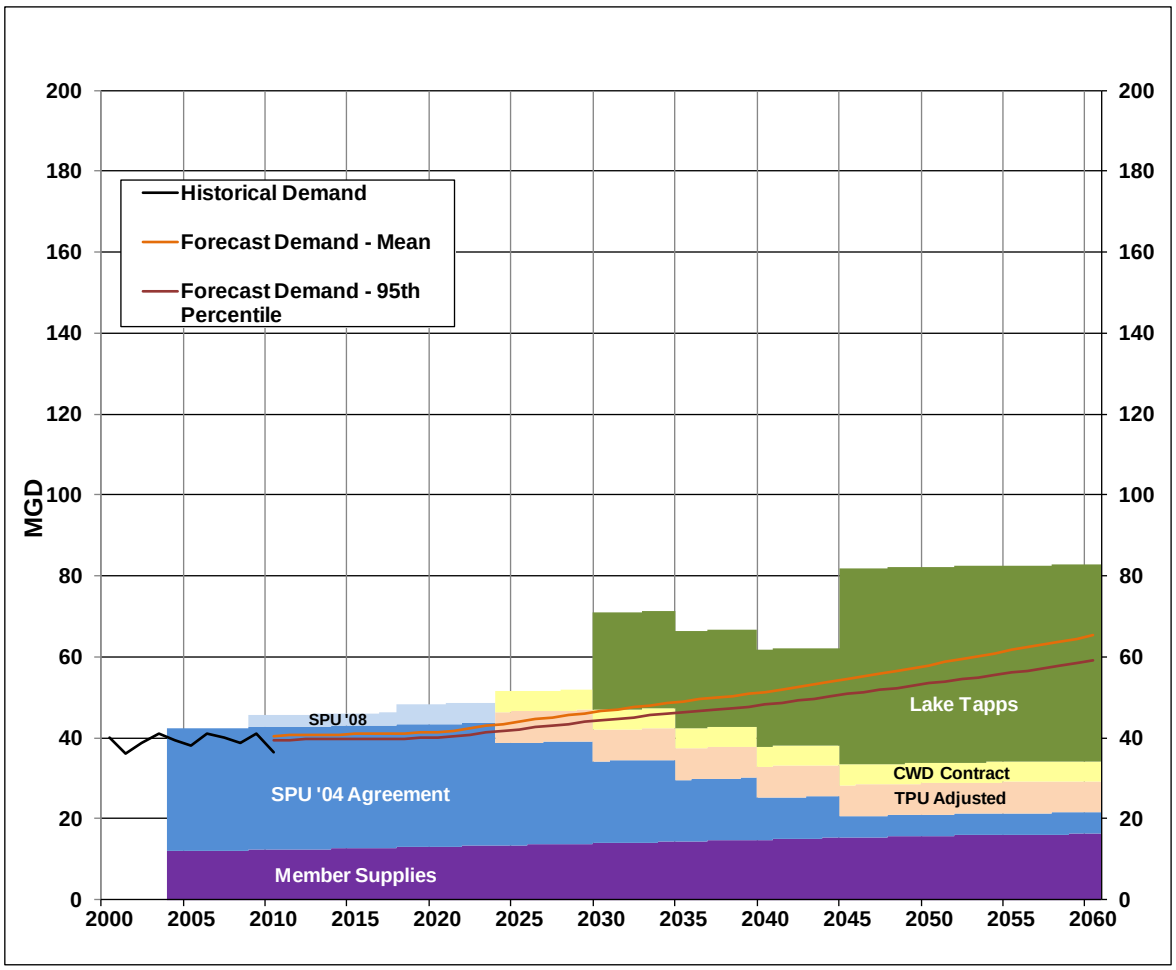


Figure ES.3: Cascade Supply Portfolio (Average Day)

Cascade's supply planning principles call for maintaining a high degree of flexibility to match available supplies with water needs as economically as possible. Investments in new water supplies will be made in stages based on actual growth in Cascade Member water demands over the coming decades. Therefore the exact quantities and timing of each new supply may change. In addition, Cascade anticipates renewed discussions with SPU and TPU from time to time regarding possible expansion of contracted supplies in the future. This could enable Cascade to delay construction of the Tacoma-Cascade Pipeline and/or the Lake Tapps Project. At a minimum Cascade will review and optimize the supply portfolio each time the TSP is updated at six-year intervals.

Lake Tapps Project

Lake Tapps is an off-channel reservoir in Pierce County that was created in 1911 to produce hydropower. In 2009 Cascade completed purchase of the lake and associated water rights and infrastructure from Puget Sound Energy with the intent of converting it to a municipal water supply project. In 2010 final water rights needed for this conversion were issued by the State of Washington. The water rights also provide for managing recreational water levels within the lake and for protection of flows in the White River.

Cascade plans to develop the necessary water treatment and delivery infrastructure in phases over time. The portfolio chart in Figure ES.2 reflects these assumptions. It shows Phase 1 of the Lake Tapps Project completed at year 2030 and Phase 2 at 2045. Phasing will respond to the timing of Cascade needs as well as any increases in other supplies over time. While Lake Tapps provides a critical resource for the long term, Cascade will seek opportunities to delay construction of both phases in order to spread the costs of infrastructure development over a longer period of time.

Infrastructure Needs and Costs

Cascade has developed a long-term Capital Improvement Plan (CIP) for development of the supply portfolio. Major projects include construction of the Tacoma-Cascade Pipeline by 2024 and construction of the Lake Tapps Project in two phases at 2030 and 2045. In addition, Cascade anticipates completion of a contract with Covington Water District to use a portion of the District's surplus supply from the RWSS. Improvements to the regional distribution system to serve Cascade Members located east of Lake Washington will also be needed eventually. These projects and their estimated costs are summarized in Table ES-1.

Table ES.1: Capital Costs of Supply Portfolio

Major Sources and Project Components	Capital Cost ($M) (2011 dollars)
Tacoma-Cascade Pipeline and Associated Costs (in service 2024)	89
Contracted Supply from Covington Water District (up front fee in 2012; in service 2024)	16
Lake Tapps Impoundment Improvements (2012-2023)	24
Lake Tapps Project, Phase 1 (in service 2030)	586
Lake Tapps Project, Phase 2 (in service 2045)	108
Regional Distribution in Cascade Service Area (in service 2040's)	119
Total 50-Year CIP ($M)	**942**

Anticipated sources of funding for infrastructure construction include revenue bonds and capital reserves, including income from Cascade's Regional Capital Facilities Charges (RCFCs) collected from Members over time. Cascade will also seek lower-cost sources of funding, such as grants and loans from State and federal sources. As discussed above, Cascade will continually seek opportunities to balance the costs of developing water supply infrastructure with ongoing growth in water needs; and will periodically review opportunities for the most economical mix of supply sources prior to building new infrastructure.

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Part I:
Current Water Supplies, Facilities and Operations

Cascade Water Alliance
Transmission and Supply Plan

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1. Cascade Mission, Membership, and Structure

Cascade Water Alliance (Cascade) is unique among Washington State water suppliers in that it serves exclusively as a wholesale supplier to its Member utilities. This section provides background information on Cascade and describes its membership, service area, governance, and organizational structure.

1.1. History and Purpose

Cascade was formed in 1999 by an Interlocal Contract with its eight Member cities and special districts. The Interlocal Contract, as amended, defines Cascade's roles and responsibilities (see Appendix A). Cascade is incorporated as a public, non-profit corporation.

Cascade's purposes are listed in the Interlocal Contract and generally include contracting with other regional water suppliers on behalf of its Members; developing and operating water supply facilities; providing regional water conservation services; and planning for the water needs of its Members (including long-range and short-term plans for emergencies or water shortages).

Water deliveries from Cascade began on January 1, 2004. Cascade delivers water to its Members entirely on a "wholesale" basis. Each Member is responsible for distributing water to its own residents, businesses, and other "retail" customers. Members own and operate their own local distribution systems for these purposes. Some Members also have their own independent water supplies and meet all or a portion of their needs separately from the wholesale supply provided by Cascade.

1.2. Membership and Service Area

Cascade currently has eight Members, all of whom participated in the original creation of the organization. The eight Members are shown in Table 1.1.

Table 1.1: Cascade Members

City of Bellevue	City of Redmond
Covington Water District	Sammamish Plateau Water and Sewer District
City of Issaquah	Skyway Water and Sewer District
City of Kirkland	City of Tukwila

Cascade's current service area for delivery of wholesale water supplies is contiguous with the water service areas of the eight Members, and is located entirely within the boundaries of King County, Washington. The service area may change from time to time, as Member water systems adjust their service area boundaries or if new Members join Cascade. The current

service area is shown in Figure 1.1. Portions of the service area are separated from one another, since not all Members are located adjacent to each other.

Five of the eight Members are cities. Besides those five cities, several other incorporated cities and towns are located within the Cascade service area, including Black Diamond, Covington[1], Hunts Point, Maple Valley, Medina, Sammamish, and Yarrow Point. Outside of the incorporated areas, lands served by Cascade Members are located in King County. Land within the service area includes a variety of urban and suburban land uses, from high-rise business districts, industrial parks, and shopping malls to quiet residential neighborhoods and semi-rural areas.

Based on data from the Puget Sound Regional Council, the combined population of the Cascade service area was estimated to be approximately 370,000 people in 2010. A breakdown of estimated households and employment is shown in Table 1.2. The table also displays Cascade Equivalent Residential Units (CERUs), which represent the quantity of water used in each Member service area in terms of the quantity of water use by a typical household.

Table 1.2: Housing Units, Employment and CERUs in 2010

Member	Housing Units[1]	Employment[1]	CERUs[1]
Bellevue	58,312	184,916	66,142
Redmond	23,917	55,592	30,634
Sammamish Plateau	18,178	6,671	21,289
Kirkland	17,384	33,958	17,847
Covington	19,488	5,712	17,276
Issaquah	5,336	18,780	11,012
Tukwila	3,450	42,774	8,577
Skyway	3,237	1,032	3,800
Total	**149,302**	**349,434**	**176,575**

CERUs = Cascade Equivalent Residential Units

Sources: Housing and employment data from analysis of PSRC data in CDM, "8 Member Demand Forecast 12-9-2010.xlsx"

CERU data from FCSG "Historical Comparison of Member Shares.xlsx" May 2011.

[1] Data may differ from information in individual Member plans, due to differences in sources and methodology.

As discussed in Section 5.6.4, in the future Cascade may provide water on a wholesale basis to one or more of the "Four Cities" (Auburn, Bonney Lake, Buckley and Sumner). This water will come from supplies Cascade has contracted from Tacoma Public Utilities. While the Four Cities are not currently Members of Cascade, deliveries to any of them would add their respective water service areas to Cascade's overall wholesale service area at the time water deliveries begin.

[1] The City of Covington is a municipal government and should not be confused with the Covington Water District. These two entities are separate and distinct from one another. However, the City of Covington is located within the service area of the Covington Water District.

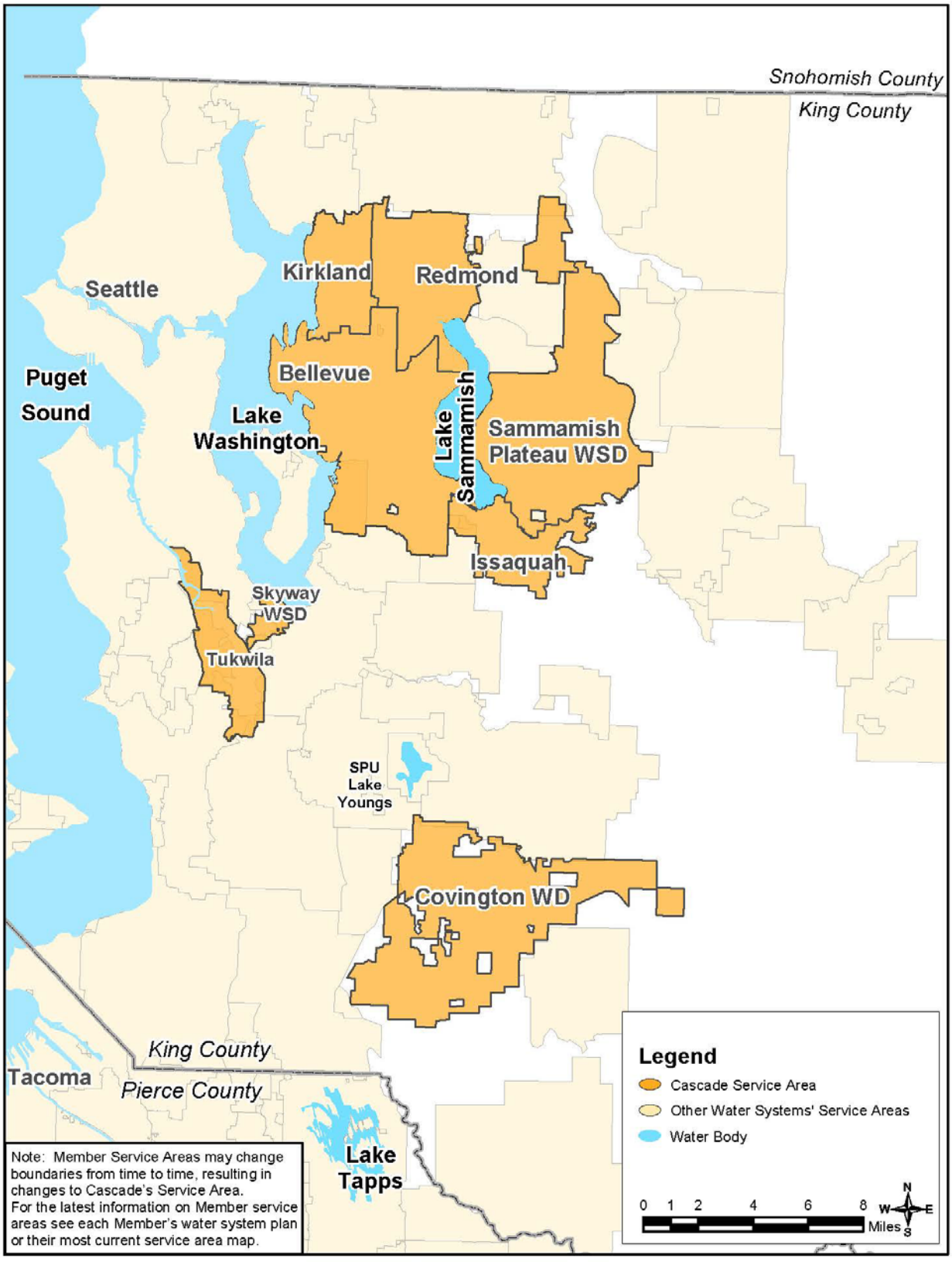

Figure 1.1: Service Area Map

1.3. Water Supply Policies

Cascade policies regarding service to its Members are defined in the Interlocal Contract. Article 5 of the contract includes the following policies:

- Cascade must provide a full supply commitment to each founding Member. (All eight of the current Members are founding Members.) This means Cascade must fully meet each Member's water needs, except for the portion met by the Member's independent supply, and subject to certain limitations (see below). No one Member has priority over any other Member in its right to the full supply commitment from Cascade.
- Full supply commitment is subject to water shortages, Cascade's ability to implement this TSP, and each Member's audited independent supply. If Cascade cannot fully meet its Members' needs during a shortage, the shortage shall be shared by all Members in accordance with Cascade's Shortage Management Plan (see TSP Section 2.9).
- Cascade must provide for expansion and extension of its supply system to meet the needs of additional water customers of Members, subject to consistency with applicable growth management plans and comprehensive plans, this Transmission and Supply Plan, orderly asset development, reasonable cost, and financing capacity.
- Cascade is not obligated to provide water for Member service area expansions, unless Cascade agrees to do so.
- Cascade is obligated to provide water within the entire service area of its Members, whether or not the service area lies within the Member's jurisdictional boundaries or within the current urban growth boundary. However, Cascade is not obligated to provide increased water supply if a Member's planning process or plans do not comply with the Washington State Growth Management Act.
- If loss of a Member's independent supply causes a water shortage, the other Members are not required to share in the resulting shortage initially. The Member experiencing a shortage may request additional supply and pay additional charges accordingly. Cascade will then have 15 years to supply the water needed to meet the increased commitment. At the end of the 15-year period, the shortage is subject to sharing among all of the Members. In the interim, if supply is available, Cascade may provide interruptible supply to the Member experiencing the shortage.
- For Members that join Cascade in the future, Cascade is required to provide a full supply commitment if the new Member joins with sufficient supply to meet its needs for at least 15 years. Cascade will be obligated to meet needs that exceed the new Member's independent supply after the 15-year period. For new Members that do not have sufficient supply to meet their needs for 15 years, Cascade may provide partial supply, interruptible or full supply, depending on availability of full supply at Cascade's defined reliability standards.
- The Cascade Board may authorize source exchange agreements with Members or non-members to replace all or a part of a public water system's existing water supply to improve stream flow or fish habitat, without serving growth or increasing that system's water supply.

Issues arise from time to time that are not addressed in the Interlocal Contract directly. One of these involves independent, small water systems located within the service area boundaries of Cascade's Members. From time to time, small water systems may request water supplies from

a Member, or may request a Member take over service to their customers. If this will require additional supply from Cascade, then the Member must seek Cascade's agreement prior to taking on the new service obligation.

1.4. Water Quality Requirements

Section 7.4 of the Interlocal Contract addresses water quality. It indicates that Cascade is responsible for meeting or exceeding all federal and state water quality requirements, at the point of delivery to each Member. Each Member is responsible for maintaining water quality within its local distribution system. Members are also responsible for any costs of making water from Cascade compatible with its internal system, including any independent supplies.

1.5. Governance and Organizational Structure

Cascade is governed by a Board of Directors consisting of one representative appointed by each Member. Members can also appoint alternates to the Board of Directors. Each Director and alternate must be an elected official of the Member organization, such as a City Council or Board member of the individual city or special district.

The Board has authority over all actions taken by Cascade. The Interlocal Contract defines voting procedures and also indicates certain actions that require ratification by the elected bodies of each Cascade Member.

Cascade's operations are overseen and informed by committees and a Chief Executive Officer appointed by the Board. The Interlocal Contract provides for an Executive Committee, consisting of a Chair, Vice Chair, Secretary, Treasurer, and the Chairpersons of Standing Committees. Standing Committees are established to oversee particular topics as determined by the Board. The Executive Committee includes only Board members; while Standing Committees can also include other personnel.

Currently, Cascade's Standing Committees include the following:

- Resource Management Committee
- Finance Committee
- Public Information Committee

Cascade staff positions are shown in the organizational chart in Figure 1.2. Staff members are employees of Cascade and are neither elected officials nor employees of the respective Cascade Members. Staff members carry out functions of the organization; coordinate with Cascade Member staffs; and oversee services provided by consultants, contractors, and other external service providers.

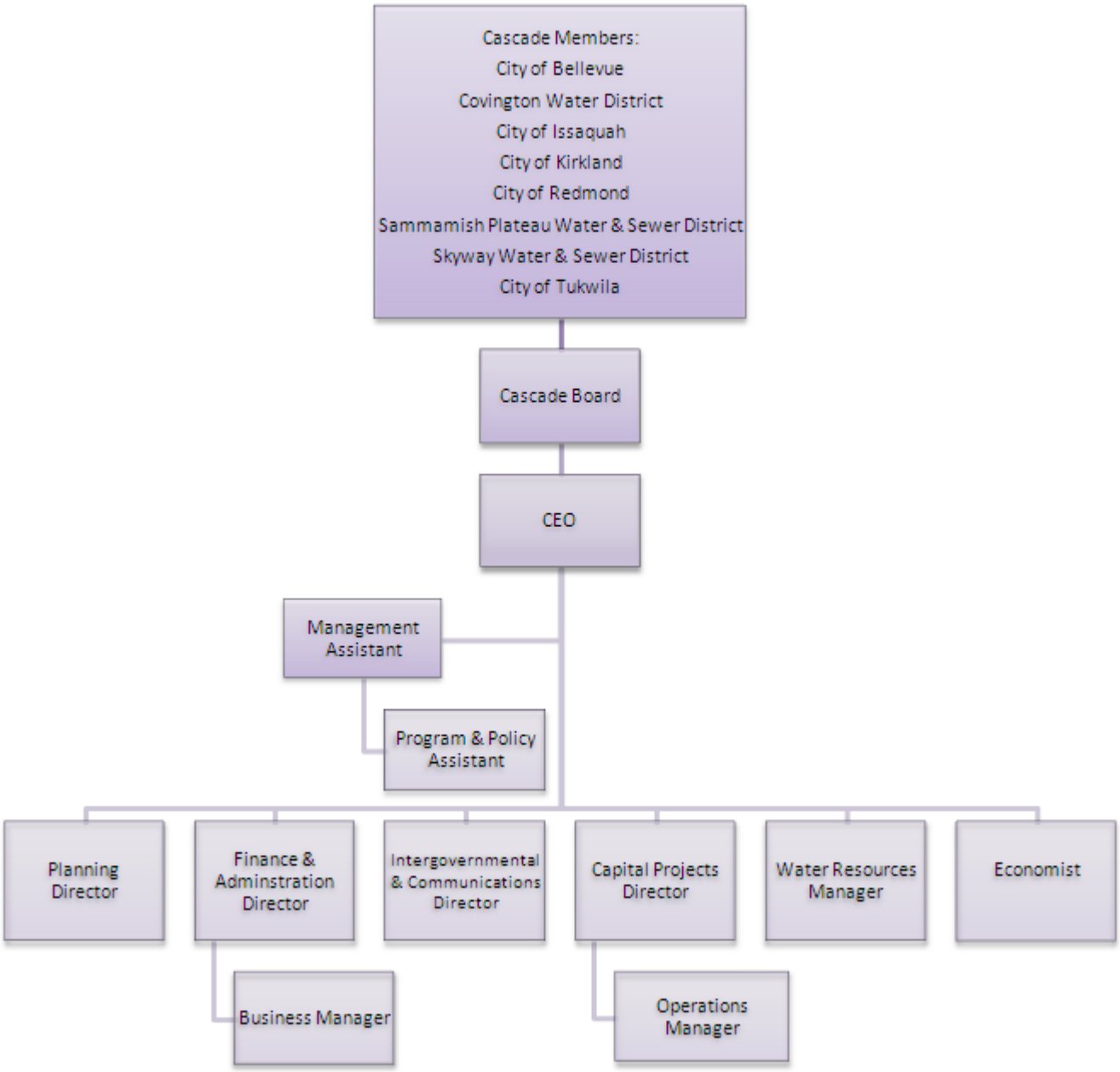

Figure 1.2: Organizational Chart

Since Cascade purchases its water from SPU and local distribution is handled by Cascade Members, Cascade's current functions do not include direct operation of municipal water supply facilities. Therefore, Cascade is not required to maintain operator certification for any of its employees under DOH regulations. However, Cascade's Operations Manager Joe Mickelsen does maintain certification as a Water Distribution Manager 4.

1.5.1. Potential Conversion to a Joint Municipal Utility Services Authority

With the passage of Washington State House Bill 1331, Cascade has been exploring the benefits and process for conversion to a Joint Municipal Utility Services Authority. This structure will provide Cascade with additional flexibility in certain operational areas and clearly establish Cascade as a public utility.

Cascade has prepared an outline of changes required to Cascade's Interlocal Contract, Bylaws, and Code that are required to carry out the conversion, as well as a draft mark-up of the Interlocal Contract, showing proposed amendments to convert Cascade to a Joint Municipal Utility Services Authority. This material has been reviewed by Cascade's Standing Committees and by the Committee of the Whole. The Board will consider conversion to a Joint Municipal Utility Services Authority early in 2012.

1.6. Regulatory Compliance by Cascade Members

Each Member of Cascade is responsible for complying with state, local and federal regulations regarding public water supply within its individual service area. Members delegate a portion of these responsibilities to Cascade, including water sources, treatment of water supplies, and regional storage and transmission facilities. Some of these responsibilities, in turn, are implemented through Cascade's contract for regional supply from SPU (see Section 2.1).

Cascade Members operate and maintain their own individual water distribution systems. This includes, as applicable, water treatment for their independent water sources, maintenance of water quality within their reservoirs and distribution systems, and local monitoring of water quality conditions (some monitoring is shared with regional water suppliers).

1.7. Relationship to Member Water System Plans

Each Cascade Member is responsible under State law to prepare a water system plan every six years. However, regional planning for water supply sources is delegated to Cascade, documented in this Transmission and Supply Plan, and summarized in the individual Member water system plans submitted to the State Department of Health.

Based on the requirements described in Chapter 246-290-100 Washington Administrative Code (WAC), this TSP provides the following specific elements relevant to water system plans prepared by Cascade Members:

- Description of current and future regional water supplies that are either delivered currently or planned for future delivery to Cascade Members
- Documentation of the water-use efficiency program administered by Cascade on behalf of its Members
- Source of supply analysis
- Documentation of Cascade's water rights
- Water shortage response plan as it relates to regional water supplied by Cascade

- Discussion of opportunities for use of reclaimed water from regional sources such as King County

- Discussion of capital improvements related to Cascade water supplies and facilities

Members may supplement the items listed above with further information in their individual water system plans.

Each Cascade Member is individually responsible for system-specific information in its water system plan, including but not limited to the following:

- Description of its water system
- Basic planning data for the Member service area
- Consistency with local land use plans and policies
- Local water service area policies
- System-specific demand forecast
- Documentation of water rights for independent supplies owned by Members
- Analysis of local source capacity (e.g., Member-owned wells)
- Analysis of local storage and distribution system needs
- Documentation of operations and maintenance practices for Member facilities
- Development of a system-specific capital improvement plan and financial plan

2. Current Water Supplies and Operations

This chapter summarizes Cascade's current water supplies and operational arrangements. Water supplies for future uses are covered separately, in Chapter 5.

2.1. Contracted Supply

Cascade contracts with SPU for delivery of water to seven of the eight Cascade Members[1]. The current contract ("Block Contract") became effective on January 1, 2004 and was amended in 2008 (Appendix B). The contract contains a "declining block" of supply that will be reduced in stages, beginning in 2024. It also includes a "supplemental block" that was added in 2008 and is available to Cascade from 2009 through 2023. Supply quantities are shown in Table 2.1.

Under the Block Contract, SPU is responsible for maintaining and operating source, treatment, transmission, and storage facilities needed to deliver the contracted supply, as well as regulatory compliance for those facilities. Water is delivered to individual Cascade Members at approximately 35 delivery points along SPU's various transmission pipelines, including portions of SPU's Tolt and Cedar transmission systems. Delivery points are identified in Exhibit II of the Block Contract (see Appendix B). SPU is required to provide water that meets state and federal drinking water quality standards at the delivery points.

Each of the delivery points has a wholesale meter that measures deliveries to individual Members. Both SPU and Cascade track total deliveries to Cascade Members on a monthly basis. Some of the water received by individual Members is "wheeled" through the Member distribution system to another Member. For example, some of the water delivered to Kirkland is wheeled to Redmond; and some of the water delivered to Bellevue is wheeled to Redmond and Issaquah.

[1] Covington Water District (CWD) meets all of its own needs from its own wells and the Tacoma Regional Water Supply System. There are no plans to deliver SPU supplies to the CWD within the 50-year planning period covered by the TSP.

Table 2.1: Supply Quantities in SPU Declining Block Contract (mgd)

Time Period	Original Block (2004)		Supplemental Block (2008)		Total	
	Average Day	Maximum Week	Average Day	Maximum Week	Average Day	Maximum Week
2004-2008	30.3	56.4	0	0	30.3	56.4
2009-2017	30.3	56.4	3.0	5.6	33.3	62.0
2008-2023	30.3	56.4	5.0	9.3	35.3	65.7
2024-2029	25.3	47.1	0	0	25.3	47.1
2030-2034	20.3	37.8	0	0	20.3	37.8
2035-2039	15.3	28.5	0	0	15.3	28.5
2040-2044	10.3	19.2	0	0	10.3	19.2
2045-2053	5.3	9.9	0	0	5.3	9.9
After 2053*	5.3	9.9	0	0	5.3	9.9

*After 2053, Cascade has the right to continue purchasing the amount shown, to serve Cascade Members that cannot be economically served by any other means.

The SPU supplies are drawn from the Cedar and Tolt River watersheds. Further information on SPU management of stream flow, fisheries resources, and aquatic habitat in the watersheds can be found in SPU's 2007 Water System Plan, Section 2.2.1, available on the Internet at: http://www.seattle.gov/util/About_SPU/Water_System/Plans/2007WaterSystemPlan/index.asp

An excerpt from Section 2.2.1 of SPU's water system plan is reprinted below:

> In operating its surface water supply sources, SPU is obligated to meet instream flow requirements on the Cedar and South Fork Tolt Rivers to protect fisheries resources and aquatic habitat. On the Cedar River, instream flow management is governed by the Cedar River Instream Flow Agreement (IFA), a component of the Cedar River Watershed Habitat Conservation Plan (HCP). The IFA specifies a guaranteed flow regime as measured at the USGS stream gage below the Landsburg Dam. This regime includes normal and critical minimum flow levels as well as additional supplemental flows or blocks of water at certain times of year that are linked to real-time hydrologic conditions and biological need. The agreement also specifies limitations for changing flow rates (i.e., "down-ramping") within certain flow ranges, and specifies minimum releases from Chester Morse Lake into a short bypass reach of the river between Masonry Dam and the Seattle City Light Cedar Falls hydroelectric facility. During many times of the year, stream flows exceed the levels required to meet the guaranteed flow regime and municipal diversions. The HCP provides funding for studies to help guide the management of this additional water in collaboration with the interagency Cedar River Instream Flow Commission, which oversees the implementation of the Cedar River instream flow management program.
>
> For the South Fork Tolt River, instream flow requirements are specified in the 1988 South Fork Tolt River Hydroelectric Project Settlement Agreement that was negotiated and committed to as part of the Federal Energy Regulatory Commission (FERC) licensing process for the Seattle City Light South Fork Tolt hydroelectric facility. This agreement specifies normal and critical minimum instream flow levels at the USGS stream gauge on the South Fork Tolt River near Carnation. Limitations on

downramping flow rates are also included in the agreement. The interagency Tolt Fisheries Advisory Committee oversees the implementation of the instream flow management program and associated mitigation projects.

SPU's performance in meeting this service level is tracked in semiannual and annual compliance reports. To date, SPU has almost always met its instream flow obligations; only a few minor noncompliance incidents have occurred, and actions have been taken to prevent reoccurrences.

2.2. Supply Interties

The SPU delivery points also represent "interties" in the context of Washington State requirements for water system plans. Table 2.2 lists these supply interties.

Some individual Members also have interties among themselves that are used to move a portion of the SPU supply from one Member service area to another. These are referred to as Member-to-Member interconnections. Cascade Members also have emergency interties with adjacent water systems to provide water in the event of emergency water shortages. These local interties are identified in the individual Members' water system plans.

2.3. Cascade Infrastructure

To perform its responsibilities for regional water deliveries, Cascade purchased the Bellevue-Issaquah Pipeline (BIP) from Bellevue and Issaquah in 2004 and 2006. Currently, the BIP is the only piece of infrastructure Cascade owns that is used to deliver municipal water supply. Its location is shown on Figure 2.1.

The ductile iron BIP conveys water from SPU's Tolt Eastside Supply Line and Eastside Reservoir to the City of Issaquah and the Sammamish Plateau Water and Sewer District. It is 24 inches in diameter, approximately 7.2 miles long, and extends from near the easterly city limits of Bellevue, along the south side of Interstate 90, and then continues through the City of Issaquah to its terminus at the Sammamish Plateau Water and Sewer District turnout. The portion of the BIP located within Bellevue was constructed in the 1960s. The remainder of the BIP was constructed in 2000 and became operational in 2006.

Transmission lines may experience leakage, particularly in older segments. Detailed information on leakage from the BIP is not available. There is no indication of substantial leakage. In the absence of specific data, Cascade estimates that leakage from the BIP is less than five percent of the flows through this pipeline.

Cascade also owns the White River - Lake Tapps Reservoir Project (Lake Tapps Project) in Pierce County. This resource is available for future production of municipal water supply and is discussed in Chapter 6.

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Table 2.2: Interties between Cascade Members and SPU

Meter Location / (SPU Identification)	Station Number	Cascade Member(s) Serviced By Meter [1]	Pipeline Segment Number	Size of Meter (in.)	Min. Hydraulic Gradient at Station Upstream of Meter (Feet NAVD-88 Datum)	Maximum Instantaneous Flow Rate Permitted by SPU (gpm)	
						Current Limit [2]	Proposed Limit [3]
Bellevue							
132nd Ave. SE & SE 26th Street	59	Bellevue	8	8	425	1300	1300
128th Ave. SE & Newport Way	56	Bellevue	8	8	435	850	800
Mercer Is. Pipeline & 108th Ave. SE	66	Bellevue	9	8	420	700	800
140th Ave. NE & 40th Street	65	Bellevue / Redmond	2	10	500	3500	3800
132nd Ave. NE & NE 14th St.(Bel Red Rd. & 132nd NE)	62	Bellevue	2	12	470	4500	4200
132nd Ave. NE & NE 24th Street (NE 24 NR 134th NE)	63	Bellevue	2	10	455	4500	3900
152nd Ave. NE & NE 8th Street	61	Bellevue / Redmond	2	24	460	3500	3000
145th Pl. SE & SE 28th Street	58	Bellevue	3	12	470	3000	2700
14509 SE Newport Way	60	Bellevue / Issaquah / Sammamish Plateau	3	10	525	4600	2300
14509 SE Newport Way	182	Bellevue	3	10	525	2900	5810
128th Ave SE & SE 56th ST	47	Bellevue	8	8	440	Backup to Sta. 55 [5]	
128th Ave SE & Newport Way (1)	55	Bellevue	8	6	435	800	300
120th Ave SE & SE 35th ST (3510 120th Ave. SE)	46	Bellevue	9	6	425	Backup to Sta. 124 [5]	
I-90 & Lake Washington Boulevard	50	Bellevue	9	6	425	Backup	
124th Ave SE & SE 38 PL (12417 SE 38th Pl)	124	Bellevue	9	8	425	1500	1400
128th Ave SE & SE 70th ST (4401 128th Ave. SE)	52	Bellevue	8	12	445	1020	1700
Kirkland							
132nd Ave. NE & NE 113th Street (11377 132nd Ave. NE)	74	Kirkland / Redmond	1	10	555	4500	3540
132nd Ave NE & NE 85th St (TESSL NE 85 & 132 NE)	75	Kirkland / Redmond	1	16	535	4080	4890
140th Ave. NE & NE 70th Street (6914 140th Ave. NE)	72	Kirkland / Redmond	2	12	520	1240	1430
Redmond							
160th Ave NE & NE 104th Street	165	Redmond	28	10	515	1,000 (combined with following planned new location)	2100
NE 172nd Street & Tolt Pipeline No. 2	185	Redmond	28	6	515		
Trlgy Pkwy NE & NE 125 St (12230 236th Ave. NE)	164	Redmond	26	10	610	2,000 (combined with following planned additional meter)	2900
Trilogy Parkway NE & NE 125 Street	186	Redmond	26	10	610		

Meter Location / (SPU Identification)	Station Number	Cascade Member(s) Serviced By Meter [1]	Pipeline Segment Number	Size of Meter (in.)	Min. Hydraulic Gradient at Station Upstream of Meter (Feet NAVD-88 Datum)	Maximum Instantaneous Flow Rate Permitted by SPU (gpm)	
						Current Limit [2]	Proposed Limit [3]
Tukwila							
39th Ave S & S 112 Street (3950 S. 112th St.)	11	Tukwila	15	10	460	Backup service	
S Center Pkwy & Tukwila Pkwy (CPRL 4 and 57th Ave. S.)	13	Tukwila	13	10	460	2200	800
W Valley Hwy & S 162nd St (000 S. 160yh 165 E, W. Valley Hiwy)	14	Tukwila	13	8	460	Backup emergency service	
Christensen Rd. & Baker Rd (16001 Christensen Rd)	15	Tukwila	13	8	460	480	440
3rd Ave S & S 160th Street	16	Tukwila	13	6	460	20	20
E Marginal Way & S 112th Street (3242 S. 112th St.)	168	Tukwila	15	12	445	810	800
51st Ave S & S Leo Street (1135 51st Ave. S.)	169	Tukwila	12	8	455	60	70
W. Marginal Place & s 102nd St. (10190 W Marginal Pl.)	170	Tukwila	5	12	300	80	300
47th Ave S & S Victor Street	173	Tukwila	12	6	425	Backup service	
Skyway							
84th Ave. S & S 134th Street (8400 S 134th St.)	1	Skyway	10	6	455	210	170
Beacon Ave S & S 124th Street (12400 Beacon Ave. S.)	5	Skyway	10	8	455	720	600
Cornell Ave S & S 112th Street	172	Skyway	4	6	375	Backup service	

Notes:

1. Currently, Issaquah and Sammamish Plateau do not receive water through meter #60 in Bellevue. It is anticipated and assumed for this TSP that both of these Members will be serviced by this meter in the near future.
2. Flow up to which the minimum hydraulic gradient is guaranteed.
3. Proposed changes through Management Agreements.

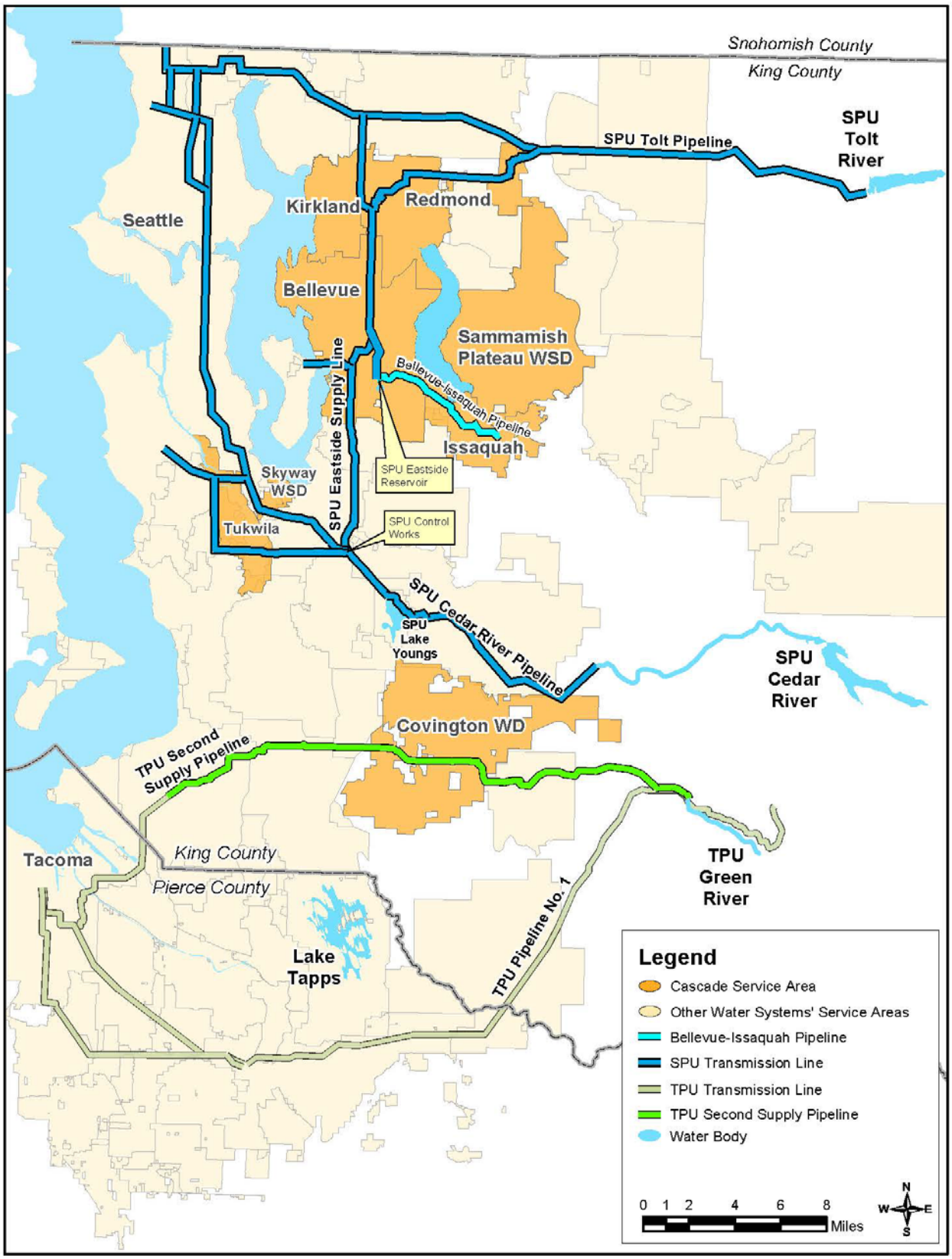

Figure 2.1: Regional Transmission Pipelines

2.4. Cascade Member Supplies

Five Members of Cascade have their own independent water supplies, and one of them, Covington Water District, meets all of its current needs with independent supply. These supplies are used only within the service area of the Member owning each supply (except as noted in Members' individual water system plans).

Members with independent supply are listed below:

- Covington Water District (wells and a share of Tacoma's Regional Water Supply Project)
- City of Issaquah (wells)
- City of Redmond (wells)
- Skyway Water and Sewer District (wells)
- Sammamish Plateau Water and Sewer District (wells)

Each of the independently-supplied Members has water rights or supply contracts, or both, separate from Cascade. These are documented in each Member's individual Water System Plan submitted to the Washington State Department of Health.

Bellevue and Tukwila have surface water rights which are used exclusively for irrigation in limited areas. Those sources are not discussed further in this TSP. Tukwila also receives reclaimed water from King County for irrigation at Fort Dent Park, street sweeping, and other uses. A delivery system has also been installed to the Foster Golf Links site for future use.

For purposes of planning long-range supplies for Cascade as a whole, Cascade accounts for the water supplies of the independently-supplied Members. Since Members face constraints on pumping in some places and at some times, the amount considered by Cascade is not always the same as the quantity authorized in Member water rights. Independent supply quantities used by Cascade in developing the 2010 TSP are listed in Table 2.3. These quantities come from Cascade audits of Member independent supplies in 2008. Except for Covington Water District, supply quantities shown in Table 2.3 are used in the supply portfolio analysis discussed in Chapter 5. More up-to-date information is used for Covington Water District.

Table 2.3: Member Independent Supply Capacity (mgd)

	Covington	Issaquah	Redmond	Skyway	Samm. Plateau	Total
Year Round Capacity - 2008	3.67	1.35	2.20	0.24	4.50	**12.0**
Max Week Capacity - 2008	8.60	3.33	3.51	0.57	8.89	**24.9**
Year Round Capacity - Ultimate	7.13	1.74	2.60	0.30	4.89	**16.7**
Max Week Capacity - Ultimate	18.30	3.33	3.51	0.57	8.89	**34.6**

Source: Adapted from Water Audits of Member Independent Supply, 2008. Maximum week generally estimated as 90 percent of maximum day quantity. Covington quantities account for expected usage of its combined sources.

2.5. Water System Analysis

Washington State Department of Health requires that a water system plan describe how the system was analyzed to identify infrastructure deficiencies. Since Cascade's supply is contracted from SPU and Cascade Members plan for and operate their own local distribution systems, Cascade does not independently perform system analysis. Information on SPU's water supply system, treatment facilities, and transmission lines can be found in SPU's 2007 Water System Plan. Analysis of each Cascade Member's local distribution system can be found in the Member water system plans.

2.6. Water Demand and Production

Water demand in the Cascade service area has been relatively stable since 2000, ranging from approximately 36 to 41 million gallons per day (mgd) despite growth in the service area. Table 2.4 shows total average-day demands, including both water purchased by Cascade and water produced as independent supply by Cascade Members.

Table 2.4: Total Cascade Demand, 2000-2010 (mgd)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Average Day Demand	40.1	36.2	38.8	41.2	39.5	38.0	40.1	39.9	38.9	40.9	36.5

Sources: Cascade records of water purchased from SPU 2004-2010; SPU records of deliveries to Cascade Members 2000-2003, and data provided annually by Cascade Members on their independent supply production.

Table 2.5 shows water purchased from SPU since Cascade began operating in 2003. Water purchased from SPU is less than the total water used, because five of the eight Cascade Members produce water from their own water sources.

Water use in the Puget Sound region varies sharply between the rainy winter months and the dry summer months. Table 2.6 and Figure 2.2 display the 2009 monthly variation in water produced, from both Member independent supplies and the Cascade regional supply contracted from SPU.

Table 2.5: Wholesale Deliveries from SPU, 2003-2010 (mgd)

	2003	2004	2005	2006	2007	2008	2009	2010	Average
January	19.4	20.3	19.6	20.1	20.7	21.0	20.7	21.3	**20.4**
February	18.3	19.7	19.9	20.2	20.5	19.7	22.9	20.2	**20.2**
March	19.2	19.3	20.4	20.6	20.5	21.3	22.4	22.2	**20.7**
April	20.2	21.1	20.6	20.9	21.4	21.5	20.9	20.7	**20.9**
May	21.7	26.2	22.5	25.4	24. 6	23.9	24.5	21.4	**23.8**
June	32.5	29.3	26.1	27.9	31.3	26.1	34.8	22.4	**28.8**
July	40.9	48.0	31.0	41.0	39.0	39.8	48.0	32.2	**40.0**
August	40.0	48.1	42.5	47.3	39.3	41.7	45.6	40.8	**43.2**
September	31.5	32.4	34.7	41.8	33.6	31.2	32.8	27.8	**33.2**
October	22.4	23.3	24.4	27.0	24.8	27.7	26.7	23.3	**25.0**
November	18.7	20.8	21.4	20.0	20.7	18.7	18.9	21.0	**19.9**
December	17.5	19.8	21.2	20.9	21.6	19.7	21.0	18.4	**20.2**
Annual Average	**25.6**	**27.5**	**25.5**	**27.8**	**26.8**	**26.6**	**28.7**	**24.3**	**26.9**

Table 2.6: Monthly Production in 2009 (mgd)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Members	9.6	9.7	9.2	9.8	11.6	16.8	21.8	18.9	12.8	10.2	10.7	10.8
Cascade	20.7	22.9	22.4	20.9	24.5	34.8	48.0	45.6	32.8	26.7	18.9	21.0
Total	**30.3**	**32.6**	**31.6**	**30.7**	**36.1**	**51.6**	**69.8**	**64.5**	**45.5**	**36.9**	**29.6**	**31.8**

Source: HDR peaking analysis, December, 2010.
Member supply is totaled from the five Members that have independent supply.

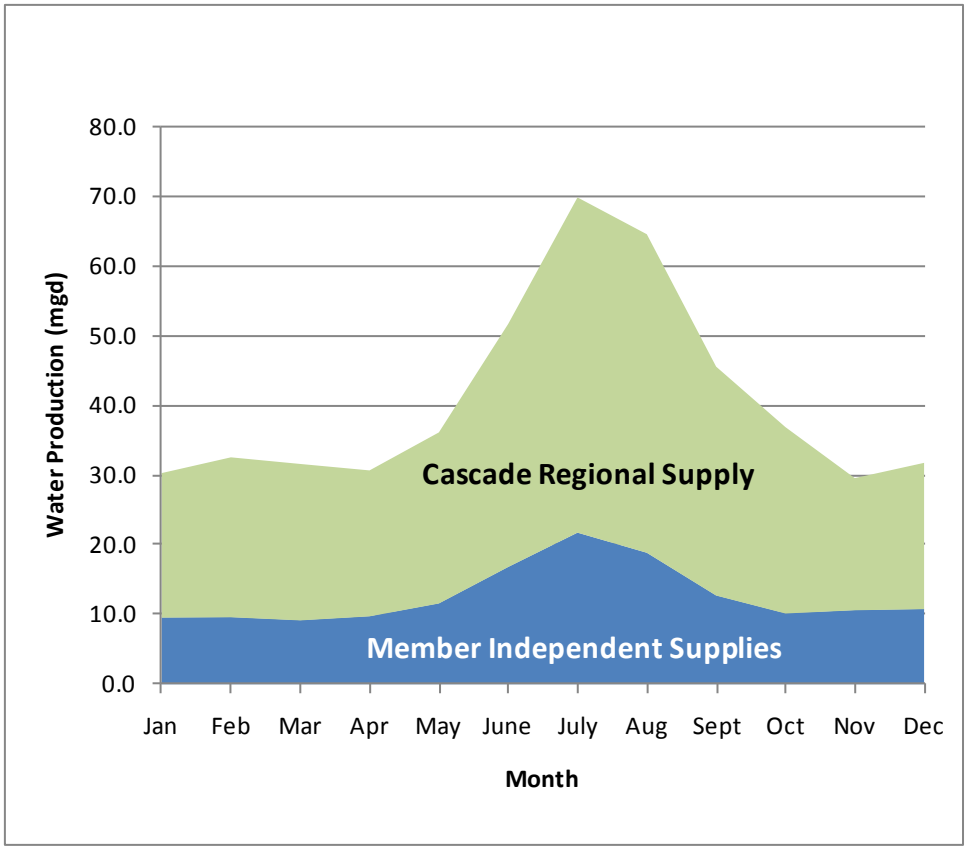

Figure 2.2: Monthly Production in 2009

Table 2.7 displays water supply peaking characteristics, based on production data from Cascade Members combined with water delivery data from SPU. Because Cascade operates at a regional scale, the peak week serves as the basis for evaluating supply adequacy. SPU meters are normally read once each month, but a weekly schedule of meter reads was employed in the summers of 2009 and 2010 to gather more detailed peaking data. Results for monthly and weekly peaking are shown in the table. The ratio of peak week to average day production was 2.01 in 2009 and 1.76 in 2010. In 2009 peak demands were affected by record high temperatures in the final week of July. In 2010 cool weather persisted throughout the summer months and water suppliers throughout the Puget Sound region experienced low demands during the peak season. In addition, both years were affected by the economic downturn.

Table 2.7: Peaking Profile 2009-2010

Year	Annual Average Demand in MGD	Peak Month Demand in MGD	Peak Month Ratio[a]	Peak Week Demand in MGD	Peak Week Ratio[a]
2009	40.7	69.8	1.71	81.9	2.01
2010	36.5	59.6	1.63	64.17	1.76

[a] Ratios represent demand during the peak period divided by annual average demand (expressed in mgd).
Source: HDR spreadsheet: "Peaking – Combined SPU&Members (v01).xlsx" Based on water production data acquired from Cascade Members and water delivery data from SPU.

Cascade uses the "Cascade Equivalent Residential Unit" (CERU) as a unit for tracking Member needs, growth, and financial obligations. The current value of a CERU is 250 gallons per day. This represents the usage of a typical single-family residence throughout the Cascade service area.

2.7. Water Quality Regulatory Compliance

As described in Sections 2.1 and 2.4, water supplies currently used by Cascade Members include a combination of independent supplies owned and operated by Members and regional supply contracted by Cascade from SPU.

For Member independent supplies, all water treatment, water quality monitoring, and associated reporting under State and federal drinking water regulations are the responsibility of the respective Members who own and operate the supply. In addition, all eight Members have responsibility for maintaining and reporting water quality within their local distribution systems.

Under the Interlocal Contract, Cascade is responsible to its Members for delivering water meeting State and federal standards at the point of delivery from Cascade to the Member. Currently, most of the points of delivery are taps along SPU transmission pipelines. Article V of Cascade's contract with SPU stipulates that SPU shall "…supply water to Cascade that meets or exceeds federal and state drinking water quality standards, as those standards may change from time to time" (see Appendix B). Cascade communicates regularly with SPU and Cascade Members regarding water quality conditions and monitoring. SPU performs all treatment, monitoring, and regulatory reporting of water quality conditions with regard to the regional supply.

There are some points of delivery where regional supply is "wheeled" within one Member's distribution system and then delivered to another Member's distribution system at a member-to-member interconnection. The Interlocal Contract also assigns Cascade responsibility for water quality at these interconnections. As a practical matter, the Members on the delivery and receiving ends of these wheeled supplies work closely with each other to ensure operational requirements are met on a daily basis, and this includes water quality considerations. Water quality monitoring and reporting is handled through the normal distribution system monitoring carried out by each Member. Cascade communicates with its Members regularly and is available to assist in resolving any water quality issues that may arise.

At this time, Cascade does not collect or test any water samples from the regional supply system or local distribution systems. Since SPU and Cascade Members handle reporting to regulatory agencies, Cascade does not prepare or submit separate reports. More information on water quality monitoring and reporting can be found in the respective water system plans of each Cascade Member as well as from SPU.

Cascade's regional supply from SPU originates from the Tolt and Cedar River sources owned and operated by SPU. SPU is responsible for watershed controls to protect water quality at the source, consistent with State and federal regulations. Watershed controls are described in Chapter 3 of SPU's 2007 Water System Plan.

Cascade does not have end-use customers (e.g., households or businesses) that would be the focus of cross-connection controls. Therefore, Cascade does not have a cross-connection control program. Cross-connection control by Cascade Members is described in their individual water system plans.

Similarly, Cascade Members track customer complaints as described in their water system plans. Cascade does not independently track complaints from end-use customers regarding water quality problems, pressures at the tap, or other local distribution system issues.

2.8. Reliability of Existing Supplies

Cascade's supply contracted from SPU originates from three separate sources: the Cedar River, the Tolt River, and the Highline Wells. The availability of all three sources contributes to system-wide reliability. Analysis summarized in SPU's 2007 Water System Plan indicates the firm yield of the SPU regional supply is 171 mgd, using a 98 percent reliability standard. This means the system is capable of producing this supply for municipal use in 98 out of 100 years. In the last four years (2007-2010), demand for the SPU regional system has ranged from 118 to 130 mgd, including Cascade and other wholesale customers. SPU projections of future growth in demand indicate that total system needs would not exceed the firm yield until at least 2060.

SPU's Water System Plan includes the following policy statement on supply reliability:

> Plan to meet full water demands of "people and fish" under all but the most extreme or unusual conditions, when demands can only be partially met.
>
> 1. Take into account reductions in demand resulting from demand management when forecasting water demands for people.
> 2. In forecasting water demands for fish, include water that is needed to meet regulatory requirements and provisions of legal agreements, and to maintain healthy ecosystems based on best available science that prove beneficial in a triple bottom line analysis.
> 3. Use a 98 percent engineering planning standard for determining long-term yield from water supplies, which differs from the approach used for evaluating available supplies on a year-to-year basis.
> 4. Include operational requirements associated with flood management, as well as increments in supply related to conjunctive use of SPU supply sources, when determining long-term yield.
> 5. As understanding of regional climate change and variability advances, continue to factor it into long-range demand and supply analysis.
> 6. Maintain a contingency plan that guides utility and customer actions during low water conditions in a way that strives to minimize impacts to people and fish.
> 7. Maintain backup supplies as a tool for managing supply in years with unusually low water conditions.

Water supplies from SPU could be disrupted in the event of an emergency that interferes with treatment or damages transmission infrastructure. SPU has developed a vulnerability assessment as well as contingency plans for rapid response to infrastructure damage from an emergency event. In addition, SPU and Cascade and its Members have developed water shortage contingency plans to deal with either drought conditions that may occur from time to time or emergency conditions that could disrupt supply.

Five of Cascade's Members also can use their local, independent supplies in the event of a supply shortage to supply at least a portion of their needs. One of these, Covington Water

District, fully meets its needs with its independent supplies, which includes several wells plus water from the Tacoma Regional Water Supply. In addition, each Cascade Member has emergency interties with other water systems that can provide water during a localized emergency.

2.9. Shortage Management Plan

Cascade's Shortage Management Plan (SMP) outlines how Cascade will respond to a shortage affecting its regional water supply. Cascade's primary role in the event of a water shortage is to coordinate responses among the Cascade Members that receive water from the regional supply and SPU as the source of the regional supply. Therefore, the SMP focuses on communication and coordination actions. The SMP is summarized here and a complete copy is included in Appendix C.

2.9.1. Stages of Curtailment

The SMP identifies four stages of water curtailment, reflecting increasingly severe shortage conditions that match the stages from SPU's Water Shortage Contingency Plan (WSCP). These are the Advisory Stage, Voluntary Stage, Mandatory Stage, and Emergency Curtailment Stage. For each stage of curtailment, Cascade's SMP identifies objectives, triggers, public messages, communication actions, and operating actions that are specific to Cascade. The SMP also identifies a range of actions that Cascade Members and their retail water customers can take to reduce water usage.

The SMP may be activated in response to actions by SPU or independently by Cascade. If SPU activates its WSCP, Cascade will take the following actions:

- If SPU initiates its **Advisory Stage**, Cascade will assess the situation to determine whether to activate its plan and recommend the same to its Members.
- If SPU activates its **Voluntary or Mandatory Stages**, Cascade (and its Members) should again assess the situation and consider whether to: a) activate their SMPs (if not already activated), and b) rely more heavily on non-SPU sources of supply, in the Member service areas where this is applicable.
- If SPU activates its **Emergency Curtailment Stage**, Cascade anticipates that Section 12.1 (Emergency Events) of the Seattle Block Contract would also be triggered (if it had not already been triggered at a previous stage). In the event of significant curtailment, Cascade and its Members would need to activate their SMPs to manage the situation effectively.

It is anticipated that SPU will communicate with its own retail customers, wholesale customers, large retail customers, regional stakeholders, state/federal resource agencies, and regional media. Cascade Members should communicate with retail customers, wholesale customers, local stakeholders, and local media. Cascade will help to coordinate and facilitate communications between the regional level and the local level.

2.9.2. Applicability to Cascade Members

Under the Interlocal Contract, Cascade Members "must respond to water shortages in a collective, shared fashion." The agreement allows the Cascade Board to impose penalty charges or a disproportionate reduction in supply on any Cascade Member who does not comply with the SMP during a shortage. However, the agreement also indicates that Members are not required to impose Cascade's SMP in areas not served by Cascade's regional supply and that Members with independent supply may decline to participate in Cascade's shortage management program without penalty if they cease taking Cascade water during the period of the emergency or shortage. Based on these provisions, shortage management applies to Cascade Members as follows:

- **Members receiving all of their water supply from Cascade:** Required to comply with Cascade's SMP.
- **Members receiving partial supply from Cascade:** Required to comply in portions of their service areas that receive regional supply; *or* to discontinue use of Cascade supply during the water shortage.
- **Members not receiving Cascade supply.** Not required to comply with Cascade's SMP. (Currently, Covington Water District does not receive water from Cascade, so would not be required to comply.)

Many Cascade Members have their own water shortage contingency plans. The SMP recommends that Members receiving water from Cascade review their plans for consistency with the SMP to support coordination during a water shortage.

2.9.3. Related Agreements

The SMP reflects relevant provisions of Cascade's Block Contract with SPU, and the 2009 *Agreement Regarding Lake Tapps* with the Lake Tapps Community. At such time as Cascade begins receiving regional water supply from Tacoma, the need to incorporate shortage response actions in coordination with Tacoma Public Utilities (TPU) will be reviewed.

2.10. Related Plans and Agreements

This section summarizes plans and agreements that affect Cascade's current supplies and operations. Select documents are attached as appendices to the TSP. The content of the respective plans and agreements is also discussed throughout this TSP, where relevant.

2.10.1. Agreements

Several agreements that affect Cascade's current supplies and operations are listed in Table 2.8. These are summarized as follows:

- The Cascade Interlocal Contract serves as the foundational agreement that created Cascade and guides its activities. A copy of this agreement is included in Appendix A.
- The 50-Year Declining Block Water Supply Agreement with Seattle provides for purchase of water on a wholesale basis, as described in Section 2.1. It includes the terms and conditions associated with this water supply.

- Member Water Supply Audits were developed to establish the quantity of local supplies that those Members having their own water supplies will produce. The Members that have local supplies are listed in Table 2.3. Each audit establishes a commitment by the Member to produce a certain quantity of water for its own needs.
- Cascade has agreements with two of its Members concerning operations and maintenance of the Bellevue-Issaquah Pipeline.
    - A 2006 agreement with the City of Bellevue provides that Bellevue shall operate and maintain a portion of the pipeline extending from the Eastside Reservoir to the intersection of 163rd Avenue and Newport Way in Bellevue.
    - A 2010 agreement with the Sammamish Plateau Water and Sewer District provides that the District will operate and maintain the BIP from 163d Avenue and Newport Way in Bellevue to a location at 1st Avenue Northeast in Issaquah, as well as an extension to the District's corrosion control facility and Well 9.

Cascade also has a water supply agreement with Tacoma Public Utilities (TPU). Since that is a future supply, it is discussed in Part II of the TSP (see section 5.6.3). Similarly, Cascade has an agreement to sell water to a group of four cities near Lake Tapps, which is described in Section 5.6.4.

Table 2.8: Agreements Affecting Current Supplies and Operations

Document	Date	Location
Cascade Water Alliance Interlocal Contract	December 2004	Appendix A
50-Year Declining Block Water Supply Agreement Between the City of Seattle and the Cascade Water Alliance	December 2008	Appendix B
Member Water Audits (Covington, Issaquah, Redmond, Sammamish Plateau, Skyway)	May 2008	Cascade Files
Agreement for Operations and Maintenance of Cascade Water Alliance Pipeline (Cascade/Bellevue)	May 2006	Cascade Files
Agreement for Operations and Maintenance of Cascade Water Alliance Transmission Facilities to Issaquah and Sammamish Plateau Water and Sewer District Connections (Cascade/Sammamish Plateau WSD)	March 2010	Cascade Files

2.10.2. Regional Wholesale Supplier Water Plans

SPU's 2007 Water System Plan outlines its programs to provide safe and reliable drinking water throughout its retail and wholesale service area. The plan identifies Cascade as a wholesale customer, and describes the 50-Year Declining Block Water Supply Agreement. The plan includes sections on SPU's water resources, water quality and treatment program, and the transmission system that delivers water to Cascade and other wholesale customers.

(Note: The Tacoma Public Utilities (TPU) water system plan is not discussed in this section, because Cascade does not currently receive water from Tacoma.)

2.10.3. Cascade Member Water System Plans

Each of Cascade's Members is a public water system that prepares its own water system plan to comply with Washington State requirements. The most recent water system plans submitted to the Department of Health by each Member is listed in Table 2.9. Each of these plans describes the Member's supplies and operations, including its relationship to Cascade. Seven of the eight Cascade Members currently receive water from Cascade. The eighth Member, Covington Water District, has its own sources of supply and does not currently receive water from Cascade.

Table 2.9: Water Plans Affecting Current Supplies and Operations

Document	Date	Location
City of Bellevue Water Comprehensive Plan	2006	Cascade and Member Files
Covington Water District Water System Plan Update	2007	
City of Issaquah Water System Plan Update	2002	
City of Kirkland Water Comprehensive Plan 2007 Update	2007	
City of Redmond 2011 Water System Plan	2011	
Sammamish Plateau Water and Sewer District 2010 Water Comprehensive Plan Update	2011	
Skyway Water and Sewer District Comprehensive Plan, Water and Sewer Systems	2004	
City of Tukwila 2005 Water System Plan Update	2005	

2.10.4. Coordinated Water System Plans

Coordinated water system plans (CWSPs) are designed to enable water systems that serve different communities within a county to resolve service area boundary issues, provide for smooth transition of service as development occurs, and coordinate planning for new sources of supply. CWSPs are not required but can be initiated under a state procedure. CWSPs affecting the Cascade service area include the East King County, South King County, and Skyway CWSPs.

The East King County CWSP was prepared in 1989 and updated in 1996. It identified water supply needs in the eastern part of the county and developed a list of supply options to potentially meet those needs. It addressed expected growth and development, design standards, service areas, satellite system management, and additional topics. Cascade Members in the area addressed by this plan include Bellevue, Issaquah, Kirkland, Redmond, and Sammamish Plateau. Each of these Members has established policies and design criteria that meet or exceed the requirements of this CWSP.

The South King County Coordinated Water System Plan was also prepared in 1989. The area it covers includes the Covington Water District. It addressed proliferation of small systems, water supply limitations, overlaps and conflicts in service areas, and land use and development policies. The Covington Water District has developed programs, policies, and design criteria that meet or exceed the requirements of this CWSP.

The Skyway Coordinated Water System Plan was prepared in 1988 and updated in 1999. It defines water service area boundaries in an area where Seattle, Tukwila, Renton Water District 125, and Skyway provide water to the public. It contains provisions for transferring service from one water system to another, reestablishing boundary lines, and resolving service area disputes. Service area changes are made from time to time but do not require an update or amendment of the plan.

2.10.5. Regional Water Supply Outlook

A group of water suppliers and local governments in King, Pierce, and Snohomish Counties known as the "Water Supply Forum" collaborated in 2001 and again in 2009 to develop the Regional Water Supply Outlook for the central Puget Sound area. The Outlook helps water utility managers and other decision makers to understand the needs and issues associated with providing water supplies to meet current and future needs throughout the region.

The Outlook planning area comprises all of King, Pierce, and Snohomish Counties. For this region, the Outlook provides a regional-scale forecast of municipal water needs by decade from 2010 through 2060 and extrapolates that need to 2110. It also documents existing water supplies within the region, along with future water supply options that may be available for development as needed. Where future needs exceed available supplies, the shortfalls are documented.

Cascade's water demand forecast for the TSP (see Chapter 4) was developed using the same source of demographic growth information as the 2009 Outlook and results are generally consistent with water needs documented in the Outlook. The uncertainty analysis and assessment of climate change impacts prepared by Cascade were also informed by the methods and data used in the Outlook. In addition, review of potential supply sources for Cascade relied, in part, on information that was developed for the Outlook. Finally, criteria used in evaluating potential supply sources for Cascade are consistent with those recommended by the Forum in the 2009 Outlook.

2.10.6. County and City Land Use Plans

County and city land use plans determine the extent and nature of development that can occur on lands within King County and its many cities. Land use plans also provide a means to implement provisions of Washington State's Growth Management Act (GMA). Each of the five cities that is a member of Cascade has a land use plan (comprehensive plan) as shown in Table 2.10. King County's land use plan regulates development in areas that are outside the various cities, including unincorporated lands within the water service areas of both cities and special districts. Three special districts, Skyway, Sammamish Plateau and Covington Water District, are Cascade Members. Some Cascade Members also serve smaller cities within their service areas that have their own land use plans.

Table 2.10: Land Use Plans Affecting Cascade's Service Area

Document	Date	Location
King County Comprehensive Plan	October 2010	King County Web Site/Files
Member Comprehensive Plans (for the five Members that are cities)	Dates vary by jurisdiction	Member Web Sites/Files
Other cities' comprehensive plans. Several small cities are located within the area served by a Cascade Member as listed in Section 1.2.	Dates vary by jurisdiction	City Web Sites/Files

The various land use plans have policies that guide how each Cascade Member responds to development activity in its own service area. For more information, see the Members' individual water system plans.

2.11. Capital Improvement Program for Existing Water System

Cascade's existing capital facilities used to deliver municipal water supplies consist solely of the BIP. No deficiencies or capital investments have been identified for this existing pipeline.

Acquisition of the Eastside Reservoir from SPU has been identified as a potential capital expense. This has been discussed with SPU, but no formal agreement has been reached nor has the timing of this potential acquisition been determined.

Apart from these facilities and payments for contracted water supply, investments in capital facilities with respect to Cascade's existing municipal supplies are not needed during the six-year period of this Transmission and Supply Plan.

Part II of this TSP addresses future needs and supplies. Therefore Cascade's investment in new, long-range infrastructure is described separately in Chapter 5 of this TSP.

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3. Water Conservation Program

Cascade and its Members have a long standing commitment to stewardship of water resources and have carried out water conservation activities for many years. As an extension of its Members, Cascade manages regional-scale conservation activities on their behalf. This section summarizes Cascade's conservation program goals and activities.

3.1. 2008-2013 Program

Cascade's current conservation activities are carried out under its 2008-2013 Conservation Program (Conservation Program). The program was developed using information from Cascade's *2005 Conservation Potential Assessment* (CPA) which evaluated a wide range of potential conservation actions in terms of water savings and cost-effectiveness. Cascade staff work in partnership with staff from each of the eight Cascade Members to implement the program.

In adopting the Conservation Program, Cascade's Board defined eight policies as follows:

- Implement the requirements of the Cascade Interlocal Contract.
- Provide the minimum number of conservation measures required for each of its Members to comply with Washington State's 2003 Municipal Water Law.
- Continue to promote efficient use of water.
- Give emphasis to reducing peak season demand.
- Provide conservation services to each Member in proportion to the amount of funding provided to the Conservation Program from each Member.
- Consider the cost-effectiveness of any water conservation measure as a primary criterion for adopting that measure.
- Provide an assortment of conservation measures sufficient to meet the need of its Members based on their unique demographics and demand characteristics.
- Allow flexibility in the implementation of specific conservation measures in each Member's service area.

3.2. Conservation Program Goal

The Cascade Board adopted the following water conservation goal in 2007 consistent with the Washington State Department of Health (DOH) Water Use Efficiency Rule:

> Cascade will dedicate resources necessary to achieve a cumulative combined Member savings of 1 million gallons per day on an annual basis and 1.45 million gallons per day during the peak season by 2014.

Each of Cascade's eight Members has adopted its own water conservation goal, in conjunction with the organization-wide goal listed above.

After 2014 Cascade anticipates continued achievement of water savings that will extend savings from the goal defined above (see Section 3.5). This assumption has been built into the water demand forecast described in Chapter 4.

Cascade recently updated analysis of a range of water conservation actions, and the Cascade Board plans to revisit policies, goals and objectives of the conservation program in 2012. If conditions warrant, the Board may elect to revise the goal in 2012, either upwards or downwards. Any revisions will comply with the State's Water Use Efficiency Rule (Chapter 296-290-830 WAC).

3.3. Conservation Program Actions

From 2008 through 2010, Cascade has carried out a wide range of conservation activities for its Members under the Conservation Program. These actions are summarized in Table 3.1. Each Member chooses whether and how to supplement these activities locally.

Significant accomplishments during this three-year time period included the following:

- **Toilet replacements:** Cascade provides rebates to homeowners throughout the eight Member service areas for installation of efficient toilets to replace older toilets that use more water. Cascade has transitioned from replacing older models with code-compliant toilets initially to distributing High-Efficiency Toilets that offer even more water savings. Cascade works with approximately 75 retailers and plumbers to promote the program. Customer surveys indicate very high satisfaction levels (96 percent and above).
- **Toilet Leak Detection.** Cascade distributes mailers annually to nearly 100,000 residences. The mailers provide dye strips and instructions to assist customers to find and repair toilet leaks.
- **WashWise.** Cascade has provided thousands of rebates to encourage customers to purchase high-efficiency clothes washers at the time their machines are replaced. Most retailers now primarily sell these machines.
- Commercial Projects. Cascade looks for opportunities to work with specific customers to improve efficiency of process applications requiring large volumes of water. For example, these have included installation of water-recycling equipment at a car wash in Issaquah and an improved cooling tower at Boeing's Tukwila facility.

Table 3.1: Conservation Measures Implemented during 2008-2010

Measures	Units Installed or Distributed	Estimated Water Savings (gpd)
Single Family Residences		
Clothes Washer Rebates	9,181	144,883
Toilet Replacements	7,716	189,494
Toilet Leak Identification	296,746	291,315
Irrigation Audits and Equipment	475	4,329
Other Measures	1,933	1,933
Multifamily Residences		
Showerhead Replacements	2,149	19,803
Bathroom Aerator Replacements	11,198	69,638
Toilet Replacements	1,272	28,396
Irrigation Audits and Equipment	14	89
Commercial Sites		
Clothes Washer Upgrades	12	1,848
Toilet Replacements	1,031	20,152
Urinal Replacements	178	20,737
Bathroom Aerators	4,410	189,630
Kitchen Spray Head Replacements	1,042	142,754
Commercial Dishwashers	13	2,600
Boilerless Steam Cookers	3	1,179
Irrigation Audits and Equipment	73	21,199
Other Commercial Projects	2	5,697
Other		
Miscellaneous Measures	N/A	67,777
Average Annual Water Savings (gpd – rounded)		**1,223,000**
Peak Season Water savings (gpd)		**1,274,000**[1]

gpd = gallons per day

[1] Peak season savings are calculated by multiplying the average irrigation savings by a factor of three and substituting those values for the average annual values. This reflects the seasonal pattern of these savings.

- **Outdoor irrigation audits, evaluations and equipment.** Cascade has worked with a wide variety of customers to assess irrigation efficiency, provided rain sensors to prevent automatic irrigation systems from watering during wet periods, and worked to improve irrigation systems to reduce water use.

- **Outreach Activities.** Cascade promotes conservation to customers and residents at community events, trade shows, stores, and schools within the eight Member service areas. This includes approximately 20 events per year. In 2010, Cascade also produced two videos aimed at assisting homeowners to manage their irrigation systems.

- **Industry Awards.** Cascade's conservation program has been recognized for excellence within the water industry. In 2010, Cascade received the U.S. Environmental Protection Agency's WaterSense Promotional Partner of the Year Award. Cascade has also received awards from the American Water Works Association, Pacific Northwest Section, on its video and mailer communications.

Cascade plans to continue implementing the water conservation program into the future. Program offerings will change from year to year to reflect new opportunities and areas of emphasis. For purposes of this TSP, Cascade anticipates that the program through 2020 will be similar in content and funding to the 2008-2013 program. However, Cascade plans to conduct a review of its water conservation program policies and activities in 2012. This may result in a modification to the program.

3.4. Budget and Staffing

Budgets for the Conservation Program ranged from $600,000 to $1.2 million during the first four years of implementation. The 2012 budget is $1.2 million. Cascade operates the program with 1.5 staff (FTEs), who work closely with Cascade Members' water system staffs to deliver programs throughout Member service areas that match customer and service area characteristics.

3.5. Water Savings

Cascade routinely tracks water savings from the conservation program by tabulating the number of water-saving devices and other actions and estimating savings per unit. Cascade has also carried out a detailed Conservation Potential Assessment using a spreadsheet model to evaluate water savings, costs, and cost-effectiveness for the current program and potential program variations.

Cascade estimates that water saved due to the water conservation program during 2005-2007 was 50,000 gpd in 2005; 100,000 gpd in 2006; and 120,000 gpd in 2007. The new 2008-2013 conservation program took effect after that. As shown in Table 3.1, activities during the first three years of 2008-2013 generated water savings of 1.22 mgd on an average basis and 1.27 mgd on a peak season basis.

Assumptions regarding future program savings were made to support Cascade's forecast of future water demand (see Chapter 4). Water savings assumptions were incorporated directly in the demand forecast. Baseline assumptions for water conservation use the 2008-13 program as a starting point. It is assumed that a similar investment will be made in each decade, but that water savings will accumulate more slowly in future decades as new savings become more difficult to achieve. These assumptions and projected water savings are shown in Table 3.2.

Table 3.2: Projected Reductions in Demand from Water Conservation

Time Period	Assumptions	Average Day Reduction from 2007 to End of Period (mgd)	Peak Season Reduction from 2007 to End of Period (mgd)
2011 - 2020	Savings to 2013 per prior adopted Cascade goal Additional savings 2014 to 2020 accumulate as in 2008 to 2013[1]	2.2	3.1
2021-2030	Annual growth in savings at 80% of the 2008-2013 rate	3.5	5.1
2031-2040	Annual growth in savings at 70% of the 2008-2013 rate	4.7	6.8
2041-2050	Annual growth in savings at 50% of the 2008-2013 rate	5.6	8.0
2051-2060	Annual growth in savings at 30% of the 2008-2013 rate	6.1	8.7

[1] Under the 2008-2013 Program, the annual increase in water savings is 168,300 gpd for the average day year-round, and 241,604 gpd for the average day during the peak season. All savings listed in the table accumulate beginning with the first year of the 2008-2013 Conservation Program.

3.6. Compliance with State Requirements

State rules at Chapter 246-290 Washington Administrative Code (WAC) require certain actions by municipal water systems with regard to water use efficiency. Each Member of Cascade is required to comply with these rules. Cascade's Conservation Program is designed to assist its Members meet the requirements as well as to achieve broader purposes of water supply and management.

Table 3.3 summarizes Cascade actions with respect to the specific provisions of the water use efficiency rules.

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Table 3.3: Compliance with Water Use Efficiency Rule Requirements

Category	WAC[1] Section	Compliance Date	Requirement	Cascade Compliance
1. Meters	246-290-496	Fully metered by January 22, 2017. Submit metering plan by July 1, 2008.	1. Meter all **sources.**	**Not applicable.** Currently, Cascade does not own or operate its own sources of municipal water supply. Sources owned by SPU and Cascade Members are metered, however, and delivery points from SPU to Members are also metered.
			2. Meter all **service connections**.	**Not applicable.** Cascade does not own or operate service connections to residences, businesses or other retail customers. Service connections of Cascade's eight Members are metered.
2. Data Collection	246-290-100	WSPs submitted after January 22, 2008.	1. Provide monthly and annual **production/purchase** numbers for each source.	**Yes**, data on Cascade's purchases of water from SPU are provided in Section 2.6.
			2. Provide annual **consumption** by customer class.	**Yes**, since Cascade's deliveries to its Members represents customer class consumption. These data are the same as production data.
			3. Provide "**seasonal variations**" consumption by customer class.	**Yes**, provided in Section 2.6. There is only one customer class.
			4. Provide annual quantity **supplied to other public water systems**.	**Yes**, provided in Section 2.6. Since all of Cascade's Members are public water systems, this is the same as production and consumption.
			5. Evaluate **reclaimed water** opportunities.	**Yes**, provided in Appendix D.
			6. Consider water use efficiency **rate structure**.	**Yes**. Cascade wholesale rates are based in part on demand shares, encouraging efficient use of water by Members. Retail rate setting is the responsibility of each Cascade Member.
3. Distribution System Leakage	246-290-820	First report completed by July 1, 2008. First compliance determination made by July 1, 2010.	1. **Calculate** annual volume and percent using formula defined in the Rule.	**Not applicable**. Cascade does not own or operate a water distribution system. Cascade Members address these requirements separately in their respective water system plans.
			2. **Report** annually: annual leakage volume, annual leakage percent, and, for systems not fully metered, meter installation progress and leak minimization activities.	
			3. Develop water loss control **action plan** (if leakage is over 10% for 3 year average).	
4. Goals	246-290-830	Goals established by January 22, 2008.	1. **Establish** measurable (in terms of water production or usage) conservation goals and re-establish every 6 yrs. Provide schedule for achieving goals.	**Yes,** measurable goals were established through a public process. See Section 3.2.
			2. Use a **public process** to establish the goals.	
			3. **Report** annually on progress.	**Not applicable.** Cascade's Members fulfill this responsibility directly.

1. WAC = Washington Administrative Code

Category	WAC[1] Section	Compliance Date	Requirement	Cascade Compliance
5. Efficiency Program	246-290-810	WSPs submitted after January 22, 2008.	1. **Describe existing** conservation program.	**Yes,** provided in Section 3.3.
			2. **Estimate water saved** over last 6 years due to conservation program.	**Yes,** provided in Section 3.5.
			3. Describe conservation **goals**.	**Yes,** provided in Section 3.2.
			4. Implement or evaluate **1-12 measures**, depending on number of connections.	**Not applicable.** Cascade does not own or operate connections to retail customers. Instead, it provides conservation services to its eight Members, who are individually responsible for meeting this requirement. The number of measures Cascade provides to its Members exceeds the requirement for each Member.
			5. Describe conservation **programs for next 6 years** including schedule, budget, and funding mechanism.	**Yes,** provided in Sections 3.3, 3.4, and 3.5.
			6. Describe how customers will be **educated** on efficiency practices.	
			7. Estimate **projected water savings** from selected measures.	
			8. Describe how efficiency program will be **evaluated** for effectiveness.	
			9. Estimate **leakage from transmission lines** (if not included in distribution system leakage).	**Yes,** provided in Section 2.3.
6. Demand Forecast	246-290-100	WSPs submitted after January 22, 2008.	1. Provide demand forecast reflecting **no additional conservation**.	**Yes,** see Section 4.4.
			2. Provide demand forecast reflecting **savings from efficiency program**.	
			3. Provide demand forecast reflecting **all "cost effective" evaluated measures,** if not implementing the minimum number of measures.	**Not applicable.** As noted above, Cascade does not have a minimum number of measures since it does not serve retail connections. Cascade does deliver more than the required number of measures to support compliance by each of its Members.
7.Performance Reports	246-290-840	First report completed by July 1, 2008.	1. **Develop** annual report including: goals and progress towards meeting them, total annual production, annual leakage volume and percent, and, for systems not fully metered, status of meter installation and actions taken to minimize leakage.	**Not applicable.** Each Member of Cascade fulfills the reporting requirement individually.
			2. **Submit annually** by July 1 to DOH and customers and make available to the public.	

1. WAC = Washington Administrative Code

Part II:
Long-Term Water Supplies and Infrastructure

Cascade Water Alliance
Transmission and Supply Plan

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4. Long-term Water Needs

This chapter summarizes Cascade's forecast of water needs from 2010 to 2060. This information is used as a basis for decisions on how Cascade should manage and develop available supplies over the next 50 years, as discussed in Chapter 5.

4.1. Development of Demand Forecast

The water needs forecast presented in this chapter was developed in two stages. An initial forecast was prepared for Cascade by CDM and HDR in mid-2009. A key driver of the forecast was the future growth in households and employment as projected by the Puget Sound Regional Council (PSRC) in 2006. This was the most recent set of projections available from PSRC at the time Cascade's demand forecast was prepared.

The recession that began in 2008 had a dramatic impact on growth trends in the Puget Sound Region, including the Cascade water service area. The annual growth in new service connections (water customers) for Cascade Members fell by approximately 50 percent between 2007 and 2010. In addition, the major regional suppliers in the Puget Sound Region reported that growth in water demand flattened out during the decade from 2000 to 2010. Available information on the national, state, and regional economies suggests that recovery from the recession may be slow and growth in water use may be affected for some time to come.

In response to these trends, adjustments were made to the demand forecast in the fall of 2010. The sections that follow describe how Cascade's 2009 forecast was developed, and how the forecast was adjusted downward in 2010 to reflect reduced expectations for growth in the demand for water.

This chapter summarizes the methods and results. The results presented include only the final, 2010 demand forecast. Additional information, including the earlier forecast results, is included in Appendix E.

4.2. 2009 Forecast of Long-term Water Needs

4.2.1. 2009 Baseline Forecasting Model

An econometric (statistical) modeling approach was used to forecast water needs. An econometric approach statistically correlates water demands with factors that influence those demands. It relies on regression analysis to describe how water use is influenced by a number of explanatory variables.

Cascade's water demand forecasting model was estimated based on water billing and production data, demographic and socioeconomic data, weather data, and information on water conservation. These elements were assembled in a comprehensive data base for the eight Cascade Members, organized into a monthly time series from January 1994 to December 2008. Specific data used in the forecasting model included the following:

- Water production
- Water billings
- Temperature
- Precipitation
- Number of households in service area
- Ratio of multifamily households to total households
- Household income
- Number of employees in service area
- Ratio of manufacturing employment to total employment
- Marginal price of water
- Passive conservation (code)
- Active conservation (programs)

Two models were developed:

1. **Residential water demand** (single-family and multifamily combined). The dependent variable in this model is the log of monthly residential water use, expressed in gallons per household per day.
2. **Non-residential water demand** (all non-residential uses combined). The dependent variable in this model is the log of monthly non-residential water use, expressed in gallons per employee per day.

For further details on the data used, econometric methods, and resulting models, see the Technical Memorandum: *Water Demand Forecast, Task 600* (CDM December 2009), included in Appendix E.

For forecasting purposes, CDM used projections of future households and employment issued in 2006 by the Puget Sound Regional Council (PSRC). The PSRC forecast covered the time period from 2000 to 2040. Cascade's planning period extends beyond 2040, so CDM extended the forecast by assuming linear growth trends to 2060.

The baseline forecast includes assumptions on future levels of active conservation. Extrapolating from Cascade's current conservation program (2008-2013 Program) and assuming diminishing returns over time, the levels of conservation shown in Table 4.1 were built into the baseline forecast:

Table 4.1: Conservation Program Savings in 2009 Baseline Forecast

Year	Average Day Water Savings (MGD)	Year	Average Day Water Savings (MGD)
2010	0.5	2040	4.7
2015	1.3	2045	5.1
2020	2.2	2050	5.6
2025	2.9	2055	5.8
2030	3.5	2060	6.1
2035	4.1		

4.2.2. 2009 Uncertainty Analysis

After the baseline models of future water need were developed, an uncertainty analysis was performed to generate a range of possible water needs in future years. A software package designed for modeling risk and uncertainty using "Monte Carlo" simulations was used. Ranges of possible future values were developed for six of the variables that were used in the econometric models:

- Number of households in service area
- Number of employees in service area
- Temperature
- Precipitation
- Marginal price of water
- Household income.

In addition, a sensitivity analysis was performed to assess how water needs would change under two additional conditions: a) climate change and b) regional contingency for water needs in addition to those of the current Cascade Members.

Bringing these elements together, CDM provided three distinct forecasts in 2009, each showing a range for uncertainty:

1. Baseline forecast
2. Forecast with climate change
3. Forecast with climate change and regional contingency

The uncertainty analysis generated three separate demand curves for each forecast: a 95 percent exceedance level, the mean forecast, and a 5 percent exceedance level. The 95 percent exceedance level represents a low-end curve with very high certainty that water needs will be at least this high. The mean forecast represents the expected value under normal weather conditions. The 5 percent exceedance level provides a high-end demand curve, with only a five percent chance that demand will exceed that value under normal weather conditions. See Appendix E for these curves from the 2009 forecast.

As discussed previously, the forecasts also include assumptions regarding future water savings from Cascade's water conservation program (Cascade and Member conservation).

The water needs forecast was reviewed with Cascade's Resource Management Committee in the fall of 2009. Two policy decisions were made at that time:

1. Cascade should use the demand forecast with climate change as its basis for long-range water supply planning; and
2. The uncertainty range from the 95 percent exceedance level (low forecast) to the mean should be used for long-range supply planning. This choice was made because of concerns that PSRC demographic forecasts tend to be higher than actual population growth. By selecting the lower "half" of the uncertainty range, Cascade believed this tendency could be offset.

The water needs forecasts used in the TSP follow these policy decisions by Cascade.

4.2.3. Climate Change Effects

In 2006, King County formed the Climate Change Technical Committee, comprised of participants from King County, Seattle Public Utilities, Cascade Water Alliance, and other organizations. A technical report was generated that summarized a process used to select a representative sample from a dozen global circulation models and carbon emission scenarios. This sample of climate change was also used for the 2008 Regional Municipal Water Supply Outlook. The three represented climate change scenarios are listed below:

a. GISS_ B1: "warm" regional climate change scenario with nearly the smallest increase in temperature and nearly the largest decrease in precipitation

b. ECHAM5_A2: "warmer" regional climate change scenario with mid-range increases in both temperature and precipitation

c. IPSL_A2: "warmest" regional climate change scenario with large increase in temperature and nearly the largest increase in precipitation

For the uncertainty analysis described in Section 4.2.2, these three scenarios were used in a Monte-Carlo simulation procedure to produce a range of estimates of possible future temperatures and precipitation levels.

The econometric model described in section 4.2.1 includes temperature and precipitation variables. By applying the future estimates of climate-change effects on temperature and precipitation to the model, it was possible to estimate how water demands may change due to climate change. The result was that climate change was estimated to add approximately 3 mgd to water needs in the Cascade service area by year 2060. This represents an increase of approximately 5 percent. This increase is embedded in the demand forecast results discussed in Section 4.4.

For further information on how climate change effects were forecasted, see the *Technical Memorandum: Water Demand Forecast, Task 600* (CDM December 2009) in Appendix E.

4.3. 2010 Forecast Adjustment

As described in Section 4.1, adjustments were made to the water needs forecast in 2010 to account for reduced growth in the Cascade service area that began during the 2008-2009 recession and flattening trends in water usage within the Puget Sound region. The adjusted forecast used the same econometric models as the 2009 Baseline Forecast. However, reduced projections of growth in households and employment were used.

An updated forecast of households and employment was not available from PSRC. In lieu of an updated regional forecast, Cascade's financial consultant FCSG summarized recent growth in Cascade Equivalent Residential Units (CERUs) from 2005 to 2009, and forecasted CERU values for 2010-2016 based on Member projections of new water service connections. The CERU data are summarized in Table 4.2.

Table 4.2: Recent and Forecast Growth in CERUs

Member Utilities	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Bellevue	63,107	64,353	64,622	65,169	65,519	66,142	66,281	66,461	66,662	66,873	67,114	67,388
Covington	14,036	14,904	16,243	16,578	17,141	17,276	17,325	17,396	17,516	17,959	18,475	19,060
Issaquah	9,117	10,105	10,119	10,514	10,961	11,012	11,137	11,219	11,289	11,337	11,393	11,456
Kirkland	17,000	17,299	17,558	17,712	17,773	17,847	17,936	18,157	18,182	18,208	18,234	18,260
Redmond	27,614	28,677	29,324	29,749	30,251	30,634	31,027	31,283	31,797	32,345	32,986	33,725
Sammamish Plateau	20,155	20,674	20,848	20,954	21,153	21,289	21,520	21,826	22,176	22,547	22,981	23,481
Skyway	3,761	3,773	3,782	3,790	3,800	3,800	3,805	3,812	3,820	3,828	3,838	3,849
Tukwila	8,459	8,473	8,503	8,538	8,567	8,577	8,593	8,615	8,639	8,665	8,694	8,727
Total	163,247	168,258	170,997	173,002	175,163	176,575	177,625	178,769	180,081	181,762	183,715	185,946
% Growth		3.1%	1.6%	1.2%	1.2%	0.8%	0.6%	0.6%	0.7%	0.9%	1.1%	1.2%

Note: data may differ from information in individual Member plans, due to differences in sources and methodology.

CDM used the growth rates from Table 4.2 to construct an adjusted forecast of households and employment through 2020. Growth rates from 2007 to 2016 used the results from Table 4.2. Growth rates from 2017 to 2020 gradually returned to the original forecast growth rates from PSRC. From 2020 to 2060, the original growth rates from the 2009 Cascade forecast were used (PSRC forecasts plus extrapolation to 2060).

In essence, this process reduced the forecast of households and employment for the period from 2010 to 2020, reflecting an extended effect of the 2008-2010 recession. For the period after 2020 the forecast of households and employment assumes growth rates will be similar to those used in Cascade's original 2009 baseline forecast. The demographic inputs, as adjusted, are shown in Table 4.3.

Table 4.3: Housing and Employment Projections, 2010 Adjusted Forecast

Date	Housing	Employment
2007	144,481	338,152
2010	149,302	349,434
2020	168,864	386,514
2030	193,918	440,216
2040	219,930	482,117
2050	250,299	537,684
2060	285,859	590,169

Additional future water savings expected from Cascade's conservation program were applied to the adjusted forecast using the same water savings levels as in the 2009 baseline forecast.

The uncertainty analysis was not performed again in preparing the 2010 adjusted forecast. However, results of the original uncertainty analysis from 2009 were applied, on a proportional basis. This included both the predicted effect of climate change and the range of projected demands from the Monte Carlo analysis. These adjustments were made on a proportional basis based on the uncertainty results from the 2009 analysis. As discussed in Section 4.2, the range of forecasts selected for use in the TSP extends from the low forecast (95 percent exceedance) to the mean forecast.

4.4. Results of 2010 Adjusted Forecast

Table 4.4 and Figure 4.1 show the 2010 Adjusted Forecast. Both Average Day Demand (ADD) and Maximum Week Demand (MWD) are shown. ADD is the average daily water use, averaged over an entire calendar year. MWD is the average daily water use during the seven-day period with the highest use each year. MWD typically occurs during hot, dry periods in either July or August. Both ADD and MWD are measured in millions of gallons per day (mgd).

Two curves are shown for each of these conditions. The higher curve for ADD represents the mean forecast and the lower curve represents the 95 percent exceedance forecast. For ADD, Cascade anticipates that actual demands will fall within the range defined by the two curves under normal weather conditions in any given year.

Similarly, the higher curve for MWD shows the mean forecast while the lower curve shows the 95 percent exceedance forecast. Actual MWD is expected to fall somewhere in the range defined by these two curves.

These forecasts account for possible increased demands due to climate change, as well as water savings due to continued, long-term implementation of Cascade's water conservation program. Cascade's water supply planning is aimed at providing adequate supply to meet needs within this range for both ADD and MWD. Chapter 5 shows how Cascade intends to use current and future supply sources to provide adequate water for the expected needs.

As the 2010 adjustment indicates, demand conditions have shifted in the Puget Sound region in recent years. After decades of rapid growth in population and water needs, all of the regional water suppliers in the Central Puget Sound area have experienced flat or even reduced demands during the past decade. With the effects of the recent recession and housing downturn possibly lingering for many years into the future, it is possible that even the adjusted forecast may overstate future demands.

For supply planning, this means that the risk equation has changed. In the past, suppliers in the region faced the risk of growth outpacing supply, but today an equally critical risk is that new water supply projects may be built too soon and burden ratepayers with unnecessary costs. Since the region as a whole currently appears to have an abundance of supply, Cascade will continue to seek partnerships among regional water suppliers to use existing supplies and infrastructure for as long as possible. If demand remains flat or grows only slowly, it may be possible to delay some of the projects that Cascade has shown in its supply portfolio, thereby spreading costs over a longer time and reducing rate impacts.

As required by the Department of Health, Table 4.5 and Figure 4.2 show the effects of water conservation on the demand forecast. Again, both ADD and MWD are shown. In each case, the lower curve is the mean demand forecast with conservation (same as the mean forecast in Table 4.4 and Figure 4.1). The higher curve shows what water needs would be expected if Cascade and its Members did not provide water conservation programs. Water savings from conservation are projected to reduce average day demand by approximately seven percent by year 2030 and eight percent by year 2060.

Table 4.4: Cascade Water Needs Forecast

Year	Mean Forecast		95% Exceedance Forecast	
	ADD	MWD	ADD	MWD
2010	40.50	76.95	39.44	74.93
2020	41.30	78.47	39.89	75.78
2030	46.60	88.54	44.33	84.23
2040	51.30	97.47	48.13	91.45
2050	57.90	110.01	53.43	101.51
2060	65.30	124.07	59.02	112.14

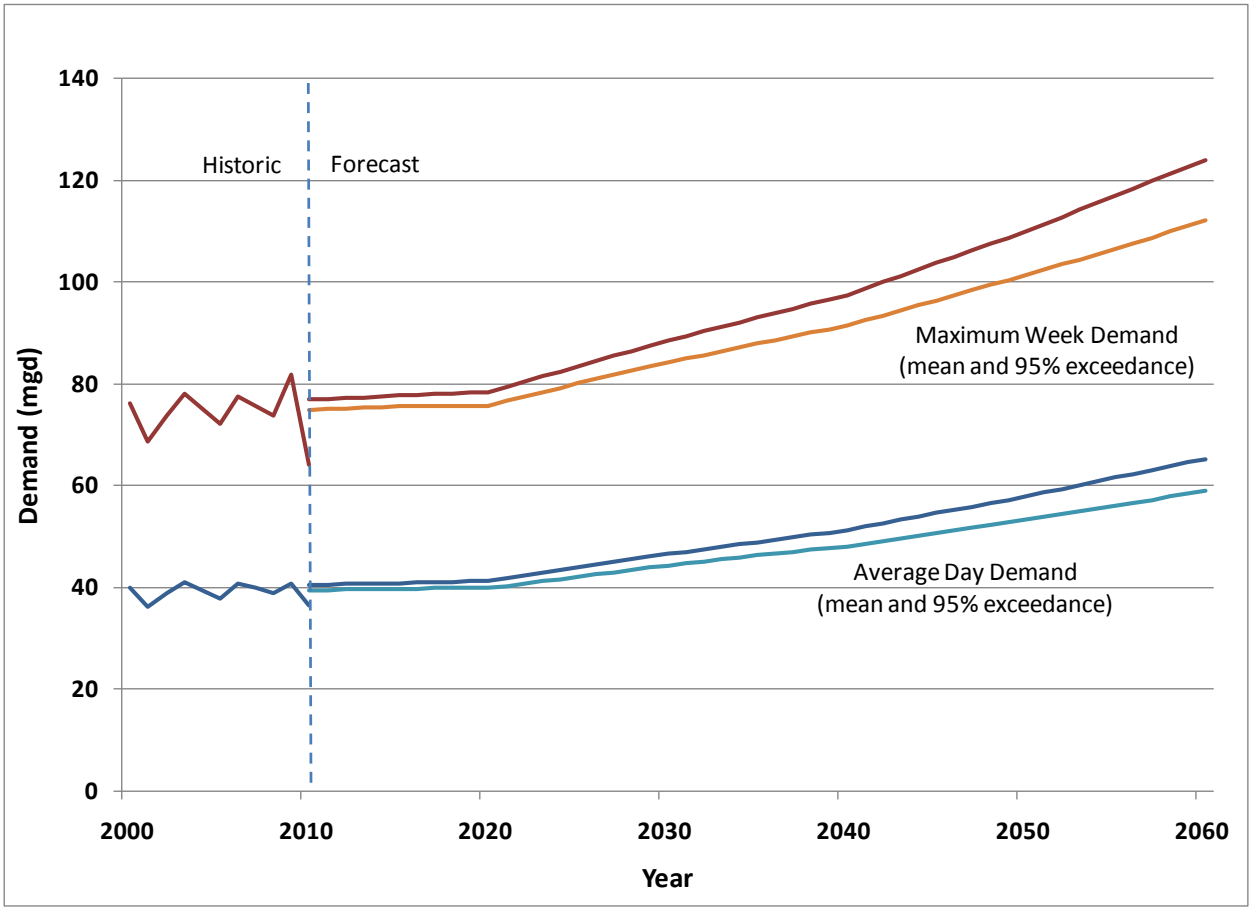

Figure 4.1: Long-range Forecast of Water Needs

Table 4.5: Effect of Water Conservation on Demand Forecast

Year	Mean Forecast with Conservation		Mean Forecast without Conservation	
	ADD	MWD	ADD	MWD
2010	40.50	76.95	41.00	77.91
2020	41.30	78.47	43.49	82.63
2030	46.60	88.54	50.13	95.26
2040	51.30	97.47	56.01	106.42
2050	57.90	110.01	63.45	120.56
2060	65.30	124.07	71.36	135.58

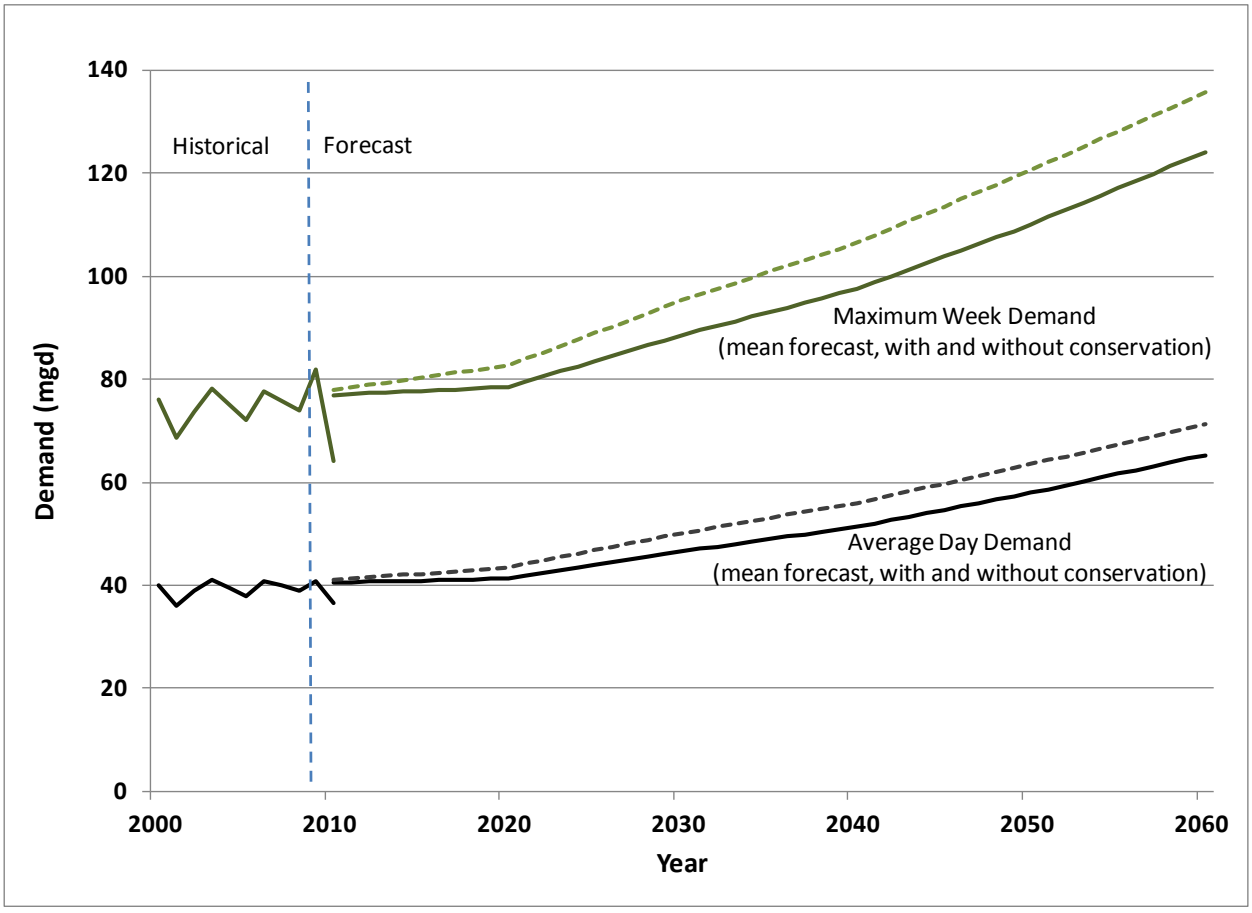

Figure 4.2: Effect of Water Conservation on Demand Forecast

4.5. Contingency for New Members and Other Needs

A variety of events in the future could increase the water needs served by Cascade. First, Cascade's Interlocal Contract allows for the addition of new Member water systems. If new Members join Cascade, then additional supplies may be needed to meet their water needs. The quantity needed would depend on the size of the new Member demands and the amount of independent supply, if any, owned by the new Member.

A second category of new needs involves potential loss of existing, independent supply from a current Cascade Member. If any Member's independent supply is lost due to groundwater contamination, groundwater depletion, regulatory action, or other causes, they may need to purchase additional supplies from Cascade to replace the supplies that are lost.

Finally, it is possible that other water systems in the Puget Sound region may request additional supply from Cascade on a wholesale basis, without becoming a Member. In this event, Cascade's Board would consider whether Cascade has sufficient supply to meet the request, and it is possible a wholesale supply arrangement could be developed.

The water needs forecast developed in 2009 included consideration of additional needs to be served by Cascade. While these needs cannot be predicted accurately, a contingency of 10 mgd was identified as providing a reasonable estimate of potential additional needs. This contingency would be in addition to the water needs forecast presented in Section 4.4. While not used in the supply planning presented in Chapter 5, Cascade remains alert to the possibility that any of these events could occur in the future.

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5. Long-term Sources of Supply

For the 2010 TSP Update, Cascade reviewed a wide range of potential water supply sources to meet the needs of its Members through at least the next 50 years. This chapter summarizes how this review was performed and identifies Cascade's preferred portfolio of water supplies to meet future needs to at least 2060.

5.1. Source Analysis Overview

The supply alternatives analysis was performed in stages, starting with a lengthy list of potential water supply sources and narrowing them to a preferred "portfolio" of supplies. Steps in the process are shown in Figure 5.1.

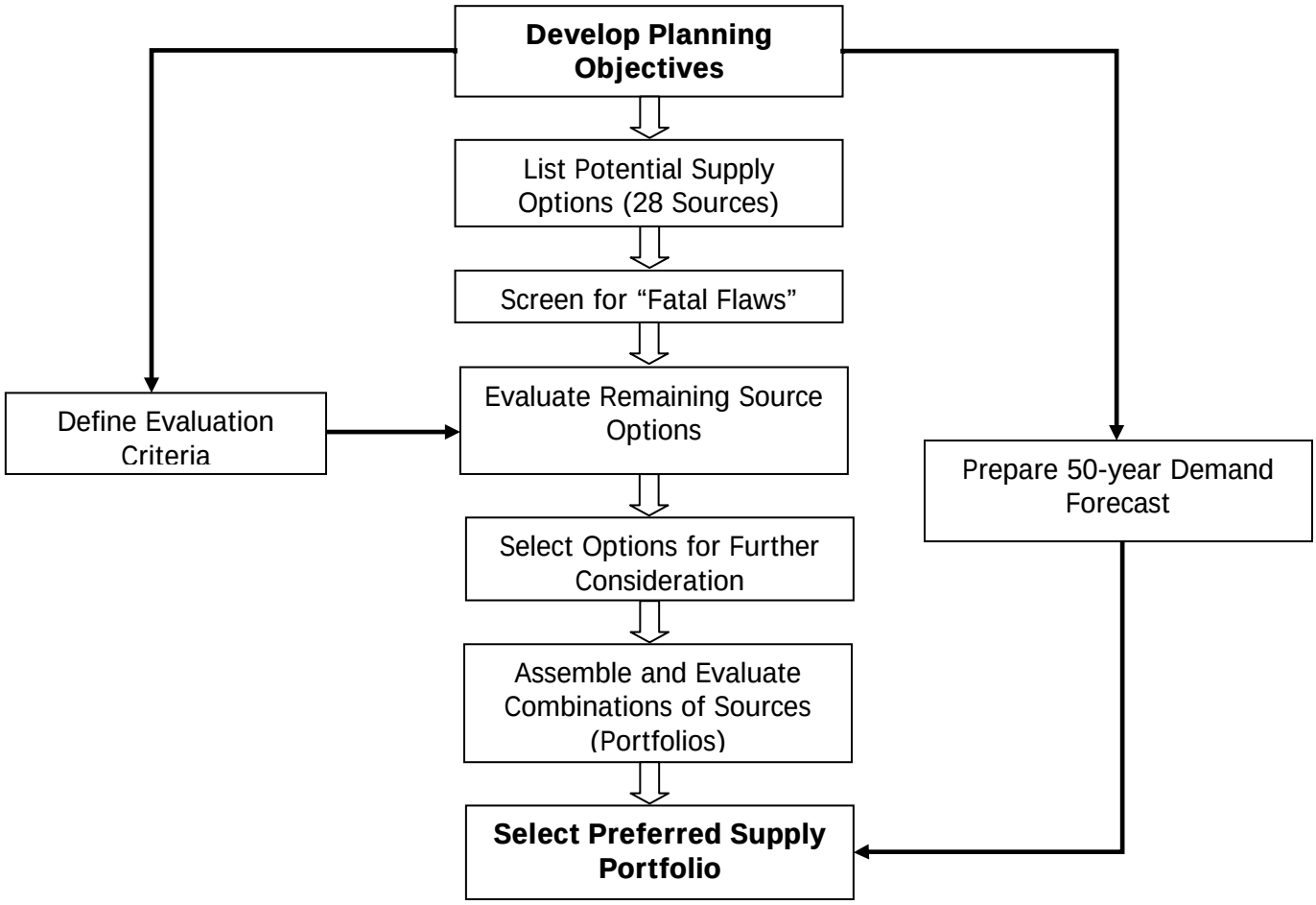

Figure 5.1: Source Analysis Overview

Cascade used the process described above to identify a combination of supplies for the period 2010 to 2060. Cascade reviewed data and results at each step with a stakeholder group formed to provide external input on the process. Information on the Cascade Connections Working Group is included in Appendix F.

Further information on the source analysis process and the specific sources selected is presented in the subsections that follow. Additional documentation of the source analysis is presented in two technical memoranda prepared for Cascade:

- *Supply Alternatives Assessment, Task 700*, December 2009 (CDM)
- *Supply Portfolio Analysis*, June 2010 (HDR)

5.2. Planning Objectives

Cascade held a Planning Objectives Workshop in February 2009. Participants included Cascade Board Members, Cascade Member staff, Cascade staff, and consultants. The following list of objectives was developed to guide the long-range planning process for the 2010 TSP:

- The TSP should identify a viable portfolio of water sources that can provide Cascade with secure and reliable supplies through at least 2050. A broad range of supply alternatives and project partnerships should be considered.
- The TSP should identify adequate supplies to at least serve the eight current Members of Cascade. It should also consider how investments in supply and infrastructure could serve additional water systems seeking new or replacement supplies and how these investments could improve reliability of supplies in the Central Puget Sound Region (King, Pierce and Snohomish Counties).
- The TSP should enable water rates to be managed at levels acceptable to water customers over the short and long terms.
- The TSP should provide flexibility to Cascade to adjust to changing circumstances or new opportunities. To this end, smaller supply projects, interim supplies, and phased development of larger supplies should be considered in the mix of source alternatives.
- The TSP should recognize the drop in current, contracted supplies at year 2024 and should outline a clear and viable path toward addressing Cascade's needs at that time.
- The plan should apply clear criteria and rationale for recommended actions. It should provide a sound basis for communication with elected officials, regulators, and water resource stakeholders in the Central Puget Sound Region.

These objectives guided decisions throughout the planning process. In addition, they served as the basis of a detailed set of criteria used to evaluate individual water supply options (see Section 5.4).

5.3. Identification and Screening of Potential Supply Sources

Several regional water studies have been carried out in the Central Puget Sound Region over the past 20 years. Cascade and its Members have participated in these studies and are familiar

with the range of water supply and management alternatives considered. An initial list of potential water supply options was developed based on the following sources:

- *Central Puget Sound Regional Water Supply Outlook* (2009).
- *East King County Coordinated Water System Plan* (1996).

Additional supply options were identified in workshops involving Cascade Members, Cascade staff, and the consulting team for the TSP. The resulting list of supply options considered in the initial screening step is shown in Table 5.1. Details on each option are presented in the Technical Memorandum *Supply Alternatives Assessment, Task 700* (December 2009).

Table 5.1: Initial List of Potential Water Supply Options

Existing Source Management	New Surface Water Options	New Ground Water Options	Reclaimed Water and Conservation
Tacoma "Light" TCP w/ Wheeling TCP w/ North Segment TCP Expanded SPU Expanded Block	Lake Tapps North Fork Tolt Everett- Sultan River Supply Expansion SRRWA – Snohomish River Supply Lake Washington Lake Sammamish Off-Stream Storage – Sammamish, Green River, Issaquah Creek Desalination	Chambers Creek Wells Snoqualmie Aquifer Deep Resource Aquifer Withdrawal (DRAW) OASIS Phases 1 & 2 OASIS Phase 3 Cascade Member ASR	Brightwater Reclaimed Water, South Segment South Treatment Plant Reclaimed Water, Tukwila Satellite Treatment Plants Reclaimed Water, King County Direct Potable Use of Reclaimed Water, Brightwater Enhanced Cascade Conservation 2 Stormwater Capture, Satellite Package Plants Rainwater Collection for golf courses Reduction in Regional Unaccounted-for-Water

ASR = Aquifer Storage and Recovery
OASIS = Lakehaven Utility District ASR Project
SPU = Seattle Public Utilities
SRRWA = Snohomish River Regional Water Authority
TCP = Tacoma-Cascade Pipeline

Six "fatal flaw" criteria were identified to eliminate any options that were clearly infeasible for Cascade to develop as regional sources. Failure on any one of these criteria led to removal of the option from further consideration. These criteria included the following:

- legal complications
- permitting/institutional complications
- water rights
- public acceptance
- quantity of supply yield (one million gallon per day threshold)

- location of supply (Sources outside Pierce, King and Snohomish County were not considered.)

Based on the fatal flaw criteria, eight sources were eliminated, as follows:

- North Fork Tolt
- Everett-Sultan River Supply Expansion
- Lake Sammamish
- Off-stream Storage
- OASIS Phases 1 and 2
- South Treatment Plant Reclaimed Water
- Rainwater Collection
- Reduction in Regional Unaccounted-for Water

Elimination of projects for purposes of the TSP does not mean these projects are not viable for local purposes or for development by other parties. For example, Tukwila uses reclaimed water from the South Treatment Plant, and either Tukwila or other water systems could expand local uses of that supply in the future.

5.4. Multi-criteria Evaluation of Supply Sources

The next step in the process was to further define and evaluate each of the remaining 20 supply options. Each of these projects is described in detail in the Technical Memorandum: *Supply Alternatives Assessment, Task 700*, December 2009 (CDM). The technical memorandum also provides details of the evaluation process.

Six criteria were defined to evaluate and compare the 20 source options. These criteria were developed at workshops with Cascade Members and staff held in March and April 2009. Each criterion was weighted so that more important criteria would have more influence in the evaluation. The criteria and weights are listed below:

- Financial considerations (26%)
- Supply reliability (weight: 22%)
- Operational considerations (18%)
- Environmental Considerations (16%)
- Implementation considerations (10%)
- Regional/intergovernmental considerations (8%)

The criteria were also discussed with the Cascade Connections stakeholder group that met periodically to provide input to Cascade's planning process. A separate weighting exercise was held with this group. Criteria weights assigned by the stakeholder group were similar to those assigned by Cascade.

Each criterion was further broken down into sub-criteria. For example, the reliability criterion was broken down into three sub-criteria: 1) availability of the supply; 2) variability of yield; and 3) vulnerability to emergency disruptions. All 20 sources considered in this step were then "scored" based on performance metrics defined for each sub-criterion.

Figure 5.2 displays the results of this procedure, using weighted scores from the highest ranked projects at the top to the lowest ranked projects at the bottom. The letters "I" and "P" designate interim supplies and permanent supplies, respectively. Water supply quantities shown are

expressed in million gallons per day (mgd) and represent approximate peak yield. Colors on the bars represent the weighted contribution from each major criterion.

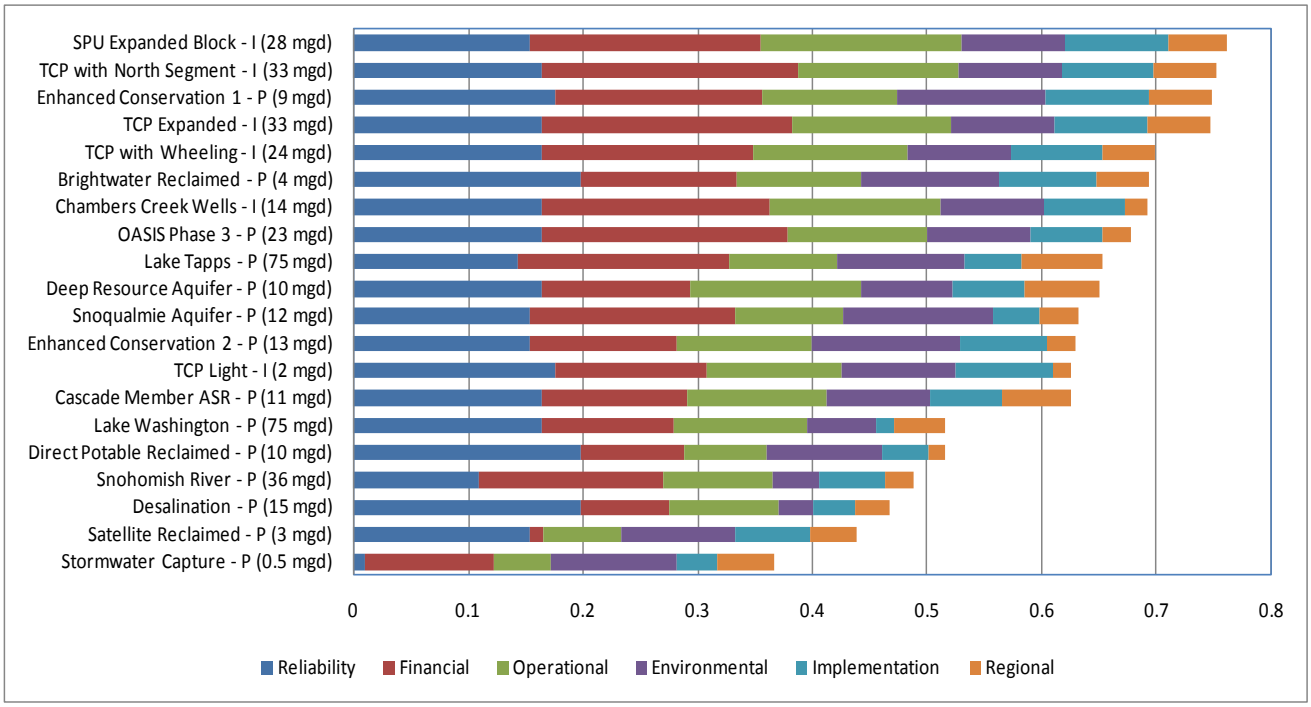

Figure 5.2: Results of Multi-criteria Evaluation

After reviewing the results of the multi-criteria analysis, the Cascade Resource Management Committee selected 11 of the 20 options for further consideration. However, three options representing water supply from Tacoma (TCP with wheeling, TCP north segment, and TCP expanded) were consolidated into a single option. The two options involving enhanced conservation by Cascade were also consolidated into a single option. This resulted in eight options carried forward into the next stage, as listed in Table 5.2.

Table 5.2: Water Supply Options Considered for Supply Portfolios

Existing Source Management	New Surface Water Options	New Ground Water Options	Reclaimed Water and Conservation
TPU Contract Supply* SPU Expanded Block	Lake Tapps	Deep Resource Aquifer Withdrawal OASIS Phase 3 Cascade Member ASR	Brightwater Reclaimed Water, South Segment Enhanced Cascade Conservation

* Includes alternative pipeline routes, wheeling, and/or a variation involving Covington Water District's share in the Tacoma Second Supply Project.

5.5. Development of Supply Portfolios

The next step of the supply evaluation was to examine how different water supplies could be combined into "portfolios" that could be developed in stages over a period of time to supply the projected needs of Cascade Members. The planning objectives described in Section 5.2 were

used to guide portfolio development. The portfolios include existing, developed sources of supply as well as the potential new supplies listed in Table 5.2.

A water demand forecast was prepared as described in Chapter 4 of this TSP. The demand curves were used to establish a range for the quantity of supply that will be needed year-by-year over the 50-year planning period.

Considerations used in assembling supply portfolios are listed below:

- Cascade's current Block Contract with SPU calls for the available supply to be reduced, in several stages between 2024 and 2045.
- Because of uncertainty in the long-term demand forecast, it is advantageous to include options that can delay the need for expensive infrastructure. Use of contracted supplies from one or a combination of sources (i.e., SPU, TPU, Covington Water District) can potentially make maximum use of existing regional supplies and infrastructure and reduce the need for new investments.
- At the same time, the White River - Lake Tapps Reservoir Project (Lake Tapps Project) provides a valuable future source of supply to Cascade and the region. If contracted supplies can be expanded in the future, Lake Tapps can serve as a long-term backstop supply for Cascade or its supply partners, or both. If contracted supplies cannot be increased at an economical cost, Lake Tapps can be used to supply Cascade's needs. Regional backstop supply will be particularly important in the event that climate change reduces water supplies that originate from the Cascade mountain range (SPU's Cedar and Tolt River sources and TPU's Green River source).
- Construction of one or more north-south transmission pipelines linking the Tacoma and Seattle regional supplies offers advantages not only to Cascade, but to both of these systems and their wholesale customers. A north-south link allowing water to flow in either direction could enhance reliability of the regional water supply system. These links would be constructed to deliver the Tacoma/Covington contract supplies and Lake Tapps Project supply.
- Of the larger sources of supply considered, the OASIS ASR project (Phase 3) appears less certain and more complex for Cascade participation. Therefore, OASIS was not built directly into the portfolios. However, this source remains a potentially viable supply option (in partnership with the project sponsor, Lakehaven Utility District) that could be substituted for another option.
- Four of the supply sources appear potentially viable yet are relatively small in terms of supply quantities available. These are: deep aquifer, Member ASR, reclaimed water, and enhanced conservation. Each of these sources also involves uncertainties and challenges for implementation. At the same time, the quantities of water available from these sources are highly flexible, and they can be developed more rapidly than large supplies requiring major infrastructure. For portfolio development, Cascade combined these supplies into a "small sources" category. While not directly included in the final portfolio, Cascade views the small sources as a menu of options that can provide additional flexibility if needed and can be activated in the event demands rise more rapidly than expected at any point during the planning period.

Cascade experimented with a variety of alternative portfolios. Three portfolios were reviewed and compared in a Technical Memorandum: *Supply Portfolio Analysis*, June 2010 (HDR). Briefly, these three portfolios are described below:

> **Portfolio 2:** Extension of the top block of SPU-contracted supply through 2030, activation of the Lake Tapps Project at 2030, and activation of small sources at 2055. (One variation of this portfolio also includes participation in Lakehaven's OASIS project [Phase 3] after 2060.)
>
> **Portfolio 4:** Activation of supply from TPU (and Covington Water District) at 2030, delaying the need for the Lake Tapps Project until 2045. Small sources used to fill supply gaps beginning in 2040 (or as needed at any time).
>
> **Portfolio 5:** Similar to Portfolio 4, but with additional extension of SPU supplies to defer the need for the Lake Tapps Project beyond 2060. This portfolio would also involve greater reliance on the menu of small sources.

The June 2010 Technical Memorandum presents appraisal-level cost estimates and results of a risk assessment for these three portfolios. In addition, the multi-criteria evaluation procedure described in Section 5.4 was applied to the three portfolios. The three portfolios received similar scores under the various criteria except for the financial criterion. The financial criterion ranked Portfolio 5 highest, then Portfolio 4, then Portfolio 3. This reflects the increased financial burden by constructing major infrastructure associated with the Lake Tapps Project, as opposed to deferring those costs by many years. Results were discussed in workshops and meetings held in 2010 with Cascade Members. Results were also discussed with the Cascade Connections Outreach Group.

5.6. Preferred Supply Portfolio

Cascade held extensive discussions with SPU and TPU aimed at increasing use of contracted supplies in a manner similar to Portfolios 2 and 4. However, at the time the Transmission and Supply Plan was prepared, these discussions had not led to updated agreements. While supply expansion from these sources remains a possibility for the future, Cascade determined the current TSP should treat existing contracts with SPU and TPU as fixed quantities.

Based on this outcome and the supply evaluation discussed earlier in this chapter, Cascade determined that the portfolio shown in Figures 5.3 and 5.4 (for maximum week and average day conditions, respectively) offers the best balance between supply and fiscal objectives, consistent with the planning objectives listed in Section 5.2. This preferred portfolio is similar to Portfolio 4 discussed above, though it does not include expanded use of water supply from SPU.

Figure 7.1 (see Chapter 7) displays the location of the larger supply elements included in this supply portfolio. More detailed information on the supplies and demands shown in Figures 5.3 and 5.4 is included in Appendix G.

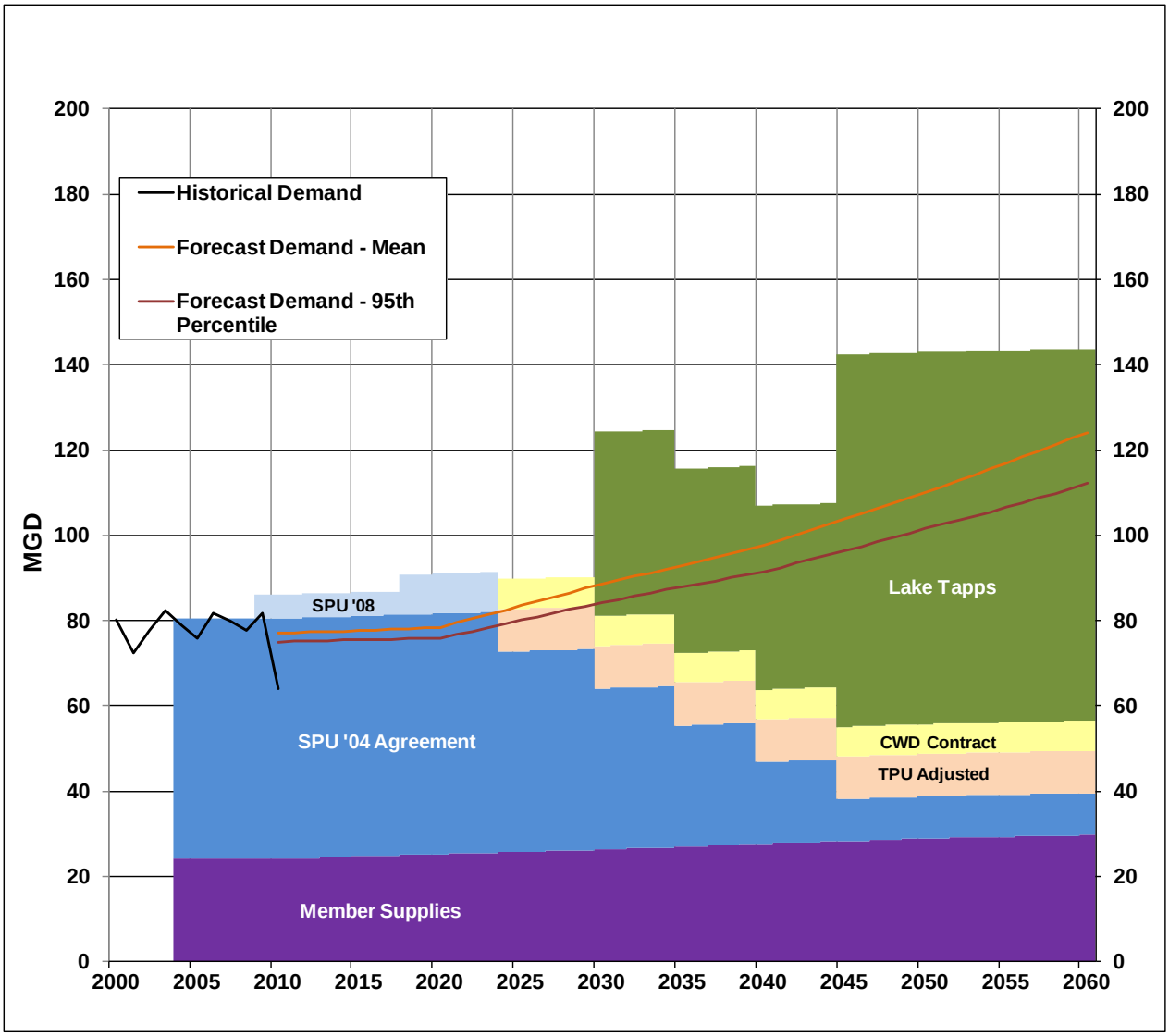

Figure 5.3: Cascade Supply Portfolio (Maximum Week Conditions)

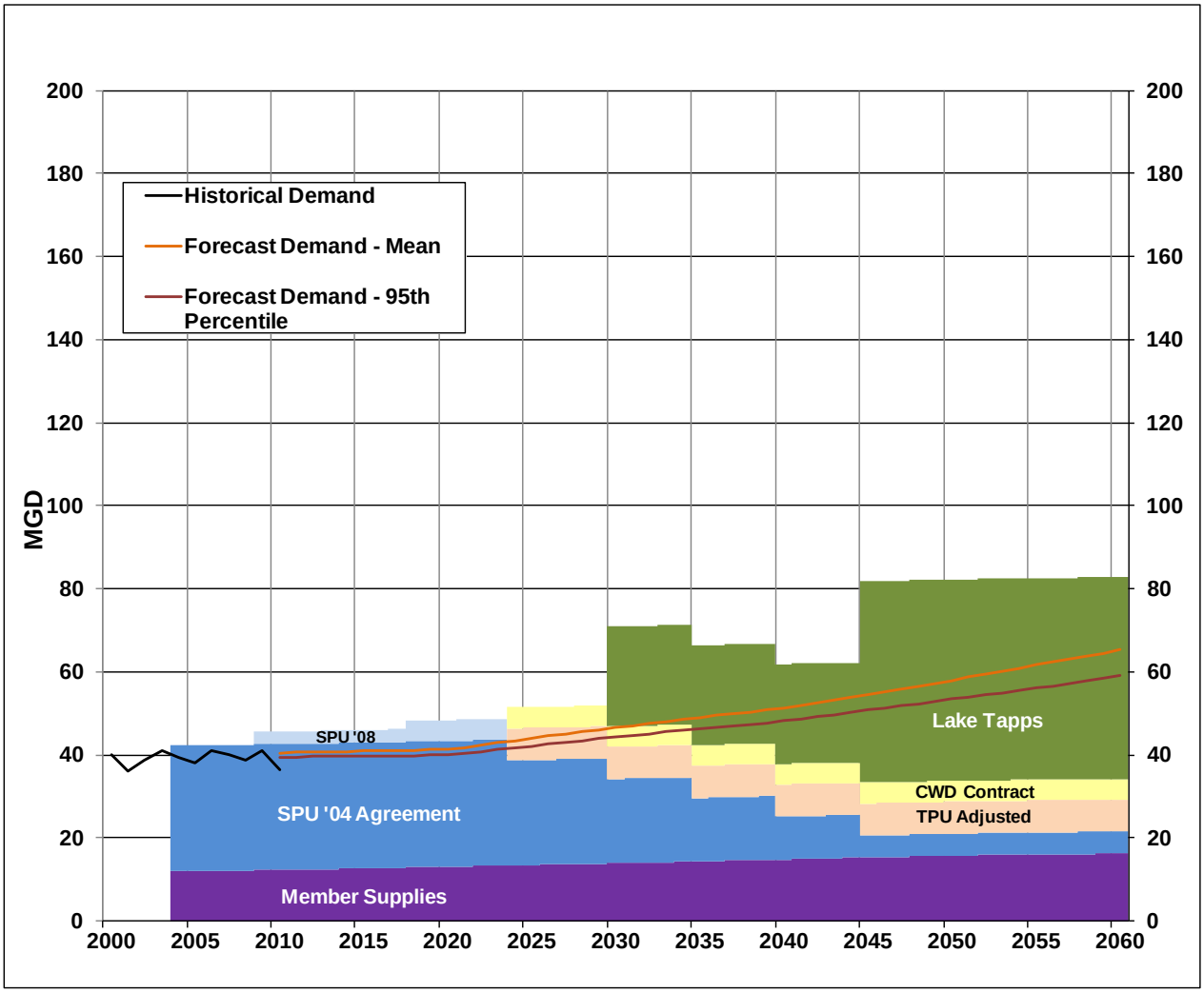

Figure 5.4: Cascade Supply Portfolio (Average Day Conditions)

Table 5.3 lists the various supply agreements that Cascade has with other water suppliers in the region to meet the long-term needs of Cascade Members.

Table 5.3: Agreements Affecting Future Water Supplies

Document	Date	Location
50-Year Declining Block Water Supply Agreement between the City of Seattle (SPU) and the Cascade Water Alliance	December 2008	Appendix B
Agreement for the Sale of Wholesale Water between the City of Tacoma, Department of Utilities, Water Division (TPU), and the Cascade Water Alliance	October 2005	Appendix H
Member Water Audits (Covington, Issaquah, Redmond, Sammamish Plateau, Skyway)	May 2008	Cascade Files
Lake Tapps Area Water Resources Agreement, with Auburn, Bonney Lake, Buckley and Sumner (Four Cities Agreement)	February 2010	Cascade Files

The exact quantities and timing of each supply may change, as supply investments will be made in stages based on actual growth in Cascade Member water demands over the coming decades. Cascade's supply planning principles call for maintaining a high degree of flexibility to match new supplies with water needs as economically as possible. For example, Cascade anticipates renewed discussions with SPU and TPU from time to time regarding possible expansion of contracted supplies in the future. It appears that both suppliers will have surplus supplies available for several decades, and access to these supplies on mutually-agreeable terms could potentially delay construction of the Tacoma-Cascade Pipeline or the Lake Tapps Project, or both, while reducing costs for all parties involved. Therefore, Cascade expects to review and optimize this portfolio each time the TSP is updated at six-year intervals.

The preferred supply portfolio includes the following sources:

- Continued production from Member supplies serving their respective service areas. (Five Cascade Members have their own sources of groundwater or contracted surface water supply).
- Continued use of water from SPU under the 2004 Block Contract, as amended in 2008.
- Beginning in 2024, Cascade's initial use of Green River supply from the contract with TPU.
- Beginning in 2024, Cascade's initial use of additional Green River supply from Covington Water District's share in the Regional Water Supply System (RWSS)[1] over and above water used within the District's own service area. A contract between Cascade and the District is under discussion to make this supply available.
- Water from the Lake Tapps Project, to be developed in the future using Cascade's water rights for Lake Tapps and the White River (see Chapter 6). The exact timing of this source will depend on growth in demand and any future increases in contracted supplies from SPU, TPU, and Covington contracted supplies.

Additional flexibility in the supply portfolio will be developed, if needed, from alternative sources such as further enhanced conservation, reclaimed water, deep groundwater supplies, aquifer storage, and recovery projects within Member service areas. These sources are collectively referred to as "small sources" in the Cascade supply planning process.

These sources are described in greater detail in the subsections below.

As discussed in Section 4.4, demand conditions have shifted in the Puget Sound region in recent years. After decades of rapid growth in population and water needs, all of the regional water suppliers in the Central Puget Sound area have experienced flat or even reduced demands during the past several years. For supply planning, this means that the risk equation has changed; in the past, suppliers in the region faced the risk of growth outpacing supply but today an equally critical risk is that new water supply projects may be built too soon and burden ratepayers with unnecessary costs.

Since the region as a whole currently appears to have an excess of supply, Cascade will continue to seek partnerships among regional water suppliers to use existing supplies and infrastructure for as long as possible. SPU and TPU currently have supplies that exceed their

[1] The RWSS was formerly known as the Tacoma Second Supply Project, or TSSP.

existing and near-term forecasted demands. During 2010 and 2011, Cascade actively engaged with both of these regional suppliers to discuss possible expansions or extensions of existing supply contracts. While mutually-acceptable terms and conditions have not yet been identified, Cascade anticipates returning to these discussions periodically in the future. If regional demand remains flat or grows only slowly, it may be possible to delay some of the projects that Cascade has shown in its supply portfolio, thereby spreading costs over a longer time and reducing rate impacts to Cascade Members.

5.6.1. Member Independent Supplies

In order to provide a complete picture of the supplies serving Cascade Members, the preferred portfolio includes supplies owned and operated by five of the eight Cascade Members (the other three Members meet all of their drinking water needs with Cascade supplies). These include groundwater supplies owned by Covington Water District, the City of Issaquah, the City of Redmond, Sammamish Plateau Water and Sewer District, and Skyway Water and Sewer District, as well as a share in the RWSS held by Covington Water District. Information on Member independent supplies is provided in Section 2.4 of this TSP. The quantities of supply projected are based on Independent Supply Audits issued by Cascade in 2008.

For purposes of the TSP, Covington's RWSS supply is partly included in the Member independent supplies category and partly in a separate category. The portion of the RWSS included as Member independent supply is the quantity needed to exactly serve Covington's projected growth in demand over time. The remaining water available to Covington from its share of the RWSS is shown separately as a source of supply that Cascade can contract from Covington. Because of this approach, the Member independent supplies appear to grow over time, while the Covington RWSS surplus supply appears to decline over time as more and more of the RWSS water is needed for Covington's own service area.

Other Member-specific factors also contribute to the gradual growth in the total quantity of their independent supplies from 2011 to 2060, and these factors are documented in the supply audits. Taking these factors and the Covington considerations into account, the total quantity of independent supplies rises from approximately 12 mgd in 2011 to 17 mgd in 2060 on an annual average basis. Supplies available to meet maximum week needs rise from 25 mgd to 33 mgd during the same time period.

More information on Members' independent supplies and associated water rights can be found in the Members' individual water system plans.

5.6.2. SPU Contracted Supply

As described in Section 2.1 of this TSP, Cascade has a contract with SPU for regional water supply, which is delivered to seven of Cascade's eight Members. The sources of this supply are SPU impoundments and treatment facilities on the Cedar and Tolt Rivers. Existing supplies are provided under the "Block Contract" executed in 2004, which is attached as Appendix B. Water supply quantities available under the Block Contract vary over time and are shown in Table 2.1 (see Chapter 2). These quantities are also displayed in Figure 5.3.

While developing the TSP, Cascade held extensive discussions with SPU regarding possible expansion of the supply quantity available to Cascade, or extension of the current "block" for a longer time period. At this time, neither of these options has been negotiated on terms

satisfactory to both parties. However, it appears that SPU will have surplus supply from its regional water supply system for many decades into the future. Cascade anticipates there may be renewed discussion of Block Contract modifications in the future, with an aim toward mutually-beneficial outcomes that make the best use of existing supply infrastructure. Specifically, this could offer the opportunity to delay construction of Cascade's planned Tacoma-Cascade Pipeline (TCP) or Cascade's planned water treatment plant and pipeline for the Lake Tapps Project, or both.

5.6.3. TPU-contracted Supply

Cascade and TPU executed an agreement for the Sale of Wholesale Water in October 2005, attached as Appendix H. The contract includes a permanent component and a reserved (temporary) component, as shown in Table 5.4.

Table 5.4: Contracted Supply from TPU

Time Period	Permanent Supply* (mgd)		Reserved Supply (mgd)		Total Supply (mgd)	
	Average Day	Maximum Week	Average Day	Maximum Week	Average Day	Maximum Week
2008-2026	4.0	5.32	6.0	7.98	**10.0**	**13.3**
2027	4.0	5.32	4.0	5.32	**8.0**	**10.64**
2028	4.0	5.32	3.0	3.99	**7.0**	**9.31**
2029	4.0	5.32	2.0	2.66	**6.0**	**7.98**
2030	4.0	5.32	1.0	1.33	**5.0**	**6.65**
2031 and beyond	4.0	5.32	0.0	0.0	**4.0**	**5.32**

mgd = million gallons per day

* Under the contract with TPU, "permanent" means until the date that Tacoma ceases making wholesale water sales to any water systems that resell water to end users.

At the time the 2004 TSP was prepared, Cascade anticipated rapid growth in its service area and a need to begin using the Tacoma supply as early as 2010. Since that time, growth has slowed sharply in the region and the annual growth in water use by Cascade Members has flattened out. Therefore, this updated TSP anticipates use of the TPU supply beginning in 2024 when supply under the SPU Block Contract begins to decline.

While developing the updated TSP, Cascade held extensive discussions with TPU regarding possible changes in the quantity and terms for supply available to Cascade. At this time, changes have not been negotiated on terms satisfactory to both parties. However, it appears that TPU will have surplus supply from its regional water supply system for many decades into the future. Cascade anticipates there may be renewed discussion of TPU contract modifications in the future, with an aim toward mutually-beneficial outcomes that make the best use of existing supply infrastructure. Specifically, this could offer the opportunity to delay construction of Cascade's planned water treatment plant and pipeline for the Lake Tapps Project.

The existing contract includes a permanent component and a reserved (temporary) component. However, it also permits conversion of the reserved component to permanent status under

certain conditions. Currently, Cascade anticipates it will request conversion as permitted by the contract and that the necessary conditions will be fulfilled. These assumptions appear valid based on current information. Therefore, the portfolio chart shown in Figure 5.3 includes the conversion to permanent status. All of the TPU supply, whether reserved or permanent, is shown as a single block of supply.

The TPU contract permits Cascade to begin taking water deliveries from TPU at any time after October 2008. However, in order to use this supply, Cascade will need to construct a transmission pipeline from the RWSS pipeline north to the vicinity of SPU's Lake Youngs Reservoir (see Figure 7.1 in Chapter 7) and execute an agreement to convey water through SPU's water transmission system. (If an agreement cannot be negotiated, the pipeline would be built to Issaquah instead).

5.6.4. Four Cities Agreement

Cascade has an agreement with the Cities of Auburn, Bonney Lake, Buckley, and Sumner (collectively, the "Four Cities") regarding the availability of a portion of Cascade's TPU supply to meet these Cities' needs in the future. Each City has an allocation that it can purchase from Cascade. The total for all four cities combined is 4.54 mgd on an average day basis and 6.65 mgd on a maximum week basis. At this time, it is not certain how much of this allocation will actually be purchased by the Four Cities. Only Auburn and Bonney Lake have requested specific supplies from their allocation, and the Auburn request is for a temporary supply that would end in 2026. Since the quantities that will ultimately be needed are uncertain, the portfolio chart shown in Figure 5.3 assumes the Four Cities will use only 50 percent of their allocated amounts. This is reflected in a reduction in the TPU supply quantity available to Cascade (TPU supply available to Cascade is assumed to be reduced by 2.27 mgd on an average day basis and 3.33 mgd on a maximum week basis).

Cascade has also analyzed a scenario in which 100 percent of the Four Cities allocation is used by the cities. Under this scenario, Cascade will still have adequate supply, assuming the surplus supply shown as contracted from Covington Water District Cascade is available (see Section 5.6.5).

Cascade is not responsible for financing or constructing infrastructure needed for the Four Cities to access their allocations.

5.6.5. Covington Supply from RWSS

Covington Water District is a partner with TPU, the City of Kent, and Lakehaven Utility District in the Regional Water Supply System (RWSS) that delivers water from the Green River. Covington expects it will be many years before Covington fully utilizes this supply. In the interim, Covington has expressed willingness to allow Cascade to contract for Covington's surplus RWSS water for use by other Cascade Members. This water could be delivered to the other Members once the Tacoma-Cascade Pipeline is built.

Covington's share of the RWSS is 18.47 mgd on an instantaneous basis and 3,889 acre-feet annually. An agreement for Covington to supply Cascade with 5 mgd annual average and 7 mgd peak season is currently under discussion. The supply from this proposed agreement is included in the portfolio chart in Figure 5.3.

Based on Covington's forecasted water needs, Cascade anticipates that a larger quantity (up to 14 mgd) of Covington's surplus supply may be available for use by other Cascade Members to meet maximum week demands in 2024. This surplus will decline gradually to approximately 10 mgd by 2060 as Covington requires more of the water for customers within its own service area. Cascade anticipates continued discussion with Covington in future years regarding potential interim use of this surplus supply. For example, if the Four Cities require larger shares of their available allocation than currently anticipated, the additional Covington supply could be needed.

5.6.6. Lake Tapps Project

Cascade's White River - Lake Tapps Reservoir Project is described in detail in Chapter 6 of this TSP. Cascade acquired Lake Tapps for future use as a municipal water supply. Water rights issued in December 2010 authorize Cascade to produce 87.25 mgd as a maximum quantity and 48.5 mgd as an annual average for municipal supply deliveries. This water right augments Cascade's supplies to meet its Members' long-range supply needs and also provides the opportunity to improve reliability of water supplies for the Central Puget Sound region as a whole, particularly in the context of climate change concerns.

Water from Lake Tapps is not currently used for municipal supply. Cascade plans to develop the necessary water treatment and delivery infrastructure in phases over time. The first phase will include construction of a water transmission line and partial development of water treatment capacity. Additional water treatment capacity will then be developed in a later phase of construction. The portfolio chart in Figure 5.3 reflects these assumptions. It shows Phase 1 of the Lake Tapps Project completed in 2030 and Phase 2 in 2045.

However, the ultimate phasing of Lake Tapps Project development will respond to the timing of Cascade needs, as determined by actual growth in demand as well as any increases in other supplies over time. Cascade will likely seek opportunities to delay construction of both phases of the Lake Tapps Project to spread the costs of infrastructure development over a longer period of time. For example, if the Four Cities take less than their nominal allotment, which seems likely, then a larger share of Cascade's TPU contract supply will be available for use by Cascade. In addition, there may be opportunities to contract for additional supplies from both SPU and TPU in the future. These developments or lower growth in demand, or a combination of these factors, could delay the need for the Lake Tapps Project well beyond 2030.

For more information on the Lake Tapps Project, see Chapter 6.

5.6.7. Additional Supply Sources

Section 5.5 discussed considerations used in assembling a range of supply portfolios that led ultimately to the preferred portfolio. The following four small, potential sources appear potentially viable, yet are relatively small in terms of supply quantities available:

1. Reclaimed water from King County's Brightwater Treatment Plant

2. Aquifer storage and recovery (ASR) projects that could be developed within Cascade Member service areas

3. Deep groundwater supplies that can potentially be accessed by wells within Member service areas

4. Enhanced water conservation programs to reduce consumption beyond levels achieved by the water conservation program embedded in Cascade's demand forecast.

Each of these sources involves uncertainties and challenges for implementation. At the same time, the quantities of water available from these sources are highly flexible, and they can be developed more rapidly than large supplies requiring major infrastructure. While not directly included in the final preferred portfolio, Cascade views these sources as a menu of options that can provide additional flexibility if needed and can potentially be activated in the event demands rise more rapidly than expected at any point during the planning period.

Information on each of these sources is summarized below. Additional information can be found in the Technical Memorandum: *Supply Alternatives Assessment, Task 700* (December 2009).

- ***Reclaimed Water*.** Reclaimed water is recycled municipal or industrial wastewater that has been treated to meet rigorous standards for reuse defined under Washington State regulations. Reclaimed water can be used for a variety of non-potable purposes, such as irrigation and industrial supply. King County's new Brightwater Treatment Plant will produce reclaimed water, and King County has been seeking communities able to use the water. King County pipelines will provide capacity to convey reclaimed water to the Sammamish River Valley, which passes through or near the water service areas of four Members of Cascade: the City of Redmond, City of Kirkland, City of Bellevue, and Sammamish Plateau Water and Sewer District.

  Potential users of reclaimed water within those communities include parks, golf courses, and commercial sites with large irrigated landscapes. It is anticipated that reclaimed water supply from Brightwater to the Sammamish River Valley would be approximately 1.6 mgd on an average annual basis and 4.0 mgd during the summer irrigation season. Installation of local distribution piping would be needed to deliver the water from King County's pipeline to individual user sites.

  Other options also exist to use water from King County's South Treatment Plant in Tukwila (where some of it is already used) or other communities, and to construct satellite plants to produce reclaimed water in outlying areas such as the Covington Water District. Cascade's 2004 Transmission and Supply Plan included an analysis of potential customer sites within Cascade Member service areas. That information is reproduced in Appendix D.

  The primary obstacle to using reclaimed water in Cascade Member service areas is the cost of installing distribution mains. Reclaimed water distribution mains are often "redundant" in that they duplicate the function of water lines that deliver potable water supplies to the same customers. Since reclaimed water can be used only for limited purposes, and since the main use is irrigation that occurs only during the summer months, it is more costly on a per-unit basis to deliver reclaimed water than potable water. Despite these limitations, reclaimed water is viewed as a viable element of the "small sources" category for Cascade's future needs.

- ***Member ASR Projects*.** Western Washington typically receives abundant rainfall from November through June and experiences dry conditions from July through October. One way of managing water supplies in response to this natural pattern is to take water during the winter months and store it for the summer. Where geologic conditions are

favorable, one way to do this is to store the water in underground aquifers. Storing water in aquifers to be pumped and used later is called Aquifer Storage and Recovery (ASR). ASR is a relatively new approach to managing scarce water supplies.

One Cascade Member, Sammamish Plateau Water and Sewer District, has experimented with an ASR system. Another water system in King County, Lakehaven Utility District, has extensively studied ASR and plans to develop an ASR project known as OASIS. It is reasonable to expect that ASR could be viable in other areas within King County, including some additional locations within Cascade Member service areas. If suitable geologic conditions are present, the primary infrastructure requirement is installation of injection and recovery wells. (Sometimes existing supply wells can be retrofitted.) Substantial investigation is required to validate the feasibility of ASR at specific locations and to obtain the necessary permits.

The Supply Alternatives Assessment performed as part of the TSP project assumed that up to 11 mgd could be produced during the peak season using ASR within Member service areas (4.6 mgd annual average). This is based on extrapolation of the production quantity already developed in the Sammamish Plateau service area to the other seven Cascade Members. Water injected into aquifers could potentially come from one or a combination of sources such as SPU, TPU, and Lake Tapps. The viability of ASR in specific areas and the quantities that are feasible will require further study to demonstrate feasibility.

- ***Deep Ground Water Resources*.** The State of Washington has a series of regulations designed to protect streams and lakes from being depleted by new water uses. As a result, many surface water basins within the state are "closed" to further appropriations for municipal or other uses. New uses of groundwater are also difficult to get permitted, because pumping groundwater can reduce water available to streams and lakes.

  The Central Puget Sound region has a productive, deep aquifer zone lying 300 feet to 500 feet below sea level. This is considerably deeper than most existing wells in the region. However, wells drilled on the Sammamish Plateau, and historically in Kirkland, Bellevue, Seattle, and Tukwila have penetrated this deep aquifer zone. Sammamish Plateau WSD taps this aquifer in 3 of its 12 production wells and one of these was permitted as recently as 1998.

  Water flowing through this zone likely feeds Puget Sound directly, rather than supporting freshwater streams that require protection under State law. If this is correct, it is possible that Cascade Members could acquire State permits to utilize this deep aquifer zone. Further study would be needed to validate the concept. Where feasible and assuming permits are issued, wells could then be constructed at various locations within Cascade Member service areas.

  The Supply Alternatives Assessment performed as part of the TSP project assumed that up to 10 mgd could be produced during the peak season (8 mgd annual average) from wells distributed across the eight Member service areas.

- ***Enhanced Water Conservation*.** Cascade and its Members administer water conservation programs to assist their customers in using water more efficiently. Assumptions regarding continued implementation of water conservation are built into Cascade's demand forecast, as detailed in Chapters 3 and 4 of this TSP. However, it

may be possible to achieve even larger reductions in water use, if more aggressive programs were implemented in the future. This element is based on the "Enhanced Conservation - 2" option from the technical memorandum titled *Supply Alternatives Assessment, Task 700* (December 2008). Under this option, three modifications would be made to the conservation assumptions built into the demand forecast:

1. Customers would be required to use the highest-efficiency plumbing equipment available, exceeding current (2010) State plumbing code requirements. This may occur from future actions by the state or federal government, or could be mandated by each local jurisdiction in the Cascade Member service areas.

2. There would be restrictions on landscape design and materials to limit the need for water and to improve efficiency of irrigation systems.

3. Metering requirements and rate structures would be modified to enhance customer incentives to save water. For example, this could include requirements for installation of irrigation meters, sub-metering at apartment complexes, and rate structures based on "water budgets."

The Supply Alternatives Assessment estimated that water saved by these actions could be up to 13 mgd during the peak season (8 mgd annual average), by full implementation at year 2060. This level of savings depends, in part, on the extent of population growth from 2010 to 2060.

Implementation of these enhanced conservation measures could not occur without actions taken by local governments within the Cascade Member service areas, and would be subject to considerable debate and discussion by the public. Therefore, there is considerable uncertainty regarding feasibility. However, it is likely that if needed, some degree of enhanced conservation savings above the levels built into the demand forecast could be achieved over the 50-year planning period.

Based on the assumptions used in the Supply Alternatives Analysis, all four small sources together could produce up to 38 mgd in the peak season (22 mgd annual average). However, there are considerable uncertainties associated with some of these sources and Cascade anticipates that actual, economically-viable production available from these supplies could be much lower, perhaps on the order of 20 to 30 percent of the nominal total. Cascade will continue to consider how use of one or more of the small sources could be combined with the preferred supply portfolio to provide increased flexibility in meeting water needs.

5.7. Supply Reliability

The preferred supply portfolio described in this chapter is expected to provide a high degree of reliability for Cascade and its Members. This is because the individual supply sources offer high reliability, plus the combination of multiple supplies will provide system redundancies in the event that one source becomes compromised due to emergency conditions.

5.7.1. Reliability of Future Cascade Supplies

Reliability characteristics of the individual Cascade supplies include the following:

- **Member supplies.** Five of the eight Cascade Members have independent supplies separate from Cascade's regional supply. Generally, these consist of groundwater sources. The Covington Water District also has access to a large surface water supply from the RWSS. These supplies and their reliability characteristics are described in the Members' respective water system plans. Groundwater supplies experience very different effects from surface water supplies under conditions that cause shortages. Moreover, local groundwater supplies do not depend on the extensive transmission system used for Cascade's existing surface water supply from SPU. It is very unlikely that emergency conditions would disrupt all of the groundwater sources for any one Member, let alone all five Members. Availability of the Member independent supplies, therefore, provides significant reliability benefits at least within the service areas of these five Members.
- **SPU Supply.** The SPU supply system includes two major surface water sources (Cedar and Tolt Rivers) in addition to a smaller groundwater resource. Treatment facilities and transmission pipelines deliver water to Cascade from both the Cedar and Tolt systems. SPU's 2007 Water System Plan discusses firm yield and supply reliability. The system can produce a firm yield of 171 mgd in 98 years out of 100. SPU's system-wide demand including Cascade and other wholesale customers has been less than 130 mgd over the past five years, meaning the likelihood of a source deficiency is extremely low. SPU has projected that future demands through at least 2060 will remain below firm yield (or beyond 2045 when accounting for high-end uncertainty in the SPU system-wide demand forecast). Cascade could be vulnerable to disruptions in SPU supply caused by emergency failures to SPU treatment facilities or transmission pipelines. SPU has contingency plans in place to repair damaged infrastructure. In addition, the SPU Water Shortage Contingency Plan and Cascade Shortage Management Plan are designed to enable both regional systems to respond appropriately in the event of a shortage caused by infrastructure failures.
- **TPU Supply.** Upon completion of the planned Tacoma-Cascade Pipeline (TCP), Cascade's regional supplies will be augmented by another major surface water source, TPU's Green River. This will further enhance reliability, both due to the source redundancy and the existence of separate treatment and transmission infrastructure. The addition of the TPU supply will coincide with reduction in supplies from SPU under the declining block structure of Cascade's supply agreement with SPU. This will greatly improve the diversity and balance of Cascade's supply, which is an important consideration in reliability.
- **Lake Tapps Supply.** Upon completion of the planned Lake Tapps Project, Cascade's regional supplies will again be augmented. As with the TPU supply, this will further enhance reliability by adding source redundancy and treatment and transmission infrastructure.

Even with a diverse and robust set of supplies, there will be risks of shortages due to a variety of events. As part of the supply source evaluation procedure described earlier in this chapter, Cascade carried out a risk assessment for the various sources and infrastructure elements included in the range of supply portfolios that were considered. The methods and results of this assessment are documented in the technical memorandum *Supply Portfolio Analysis* (June

2010). This included consideration of events that could impede development of Cascade's planned future supplies as well as events that could disrupt water supplies once they come on line. The risk assessment combined qualititative assessments of the probability and consequences of various events. Table 5.5 identifies the risk events that were considered to be the most significant, along with actions Cascade can take to mitigate negative consequences from these events.

Section 2-9 of this TSP discusses Cascade's Shortage Management Plan for supplies that currently provide municipal water supply to the Cascade service area. Whenever new supply sources are developed through implementation of the TSP, the SMP will be updated. In addition, Cascade has an Emergency Management Plan for Lake Tapps. At the time Cascade begins using Lake Tapps to provide municipal water supply, the Emergency Management Plan will also be updated to reflect the new use of this facility.

5.7.2. Enhancement of Reliability in the Central Puget Sound Region

Implementation of the TSP offers the potential to improve the reliability of other regional water systems besides Cascade. For example, construction of either the planned Tacoma-Cascade Pipeline (TSP) or the Lake Tapps Pipeline (LTP) could enhance reliability of both the SPU and TPU regional systems if desired. The north-south pipelines associated with either of these projects could potentially provide interties linking the SPU and TPU supply systems and allowing water to flow from one regional system to another in the event of emergency disruptions to the SPU or TPU systems. Cascade will continue to engage SPU and TPU on this opportunity in future years when Cascade begins to develop final designs for these pipelines.

In addition, when the Lake Tapps Project is completed, this will add a significant new source of water supply to the region. If connections are constructed among Cascade, TPU, and SPU that permit this water to be used regionally, either on a regular or emergency basis, it would help provide insurance against the possible effects of climate change on regional supply reliability.

Table 5.5: Risk Events and Mitigation Actions for High-scoring Risks

Supply/Feature	Risk Event	Mitigation
Broad Portfolio Risks or Mitigation (cross-cutting)		
All Surface Sources	Future federal water treatment standards become more stringent.	Monitor potential changes pending. Anticipate needs when new treatment plants are built.
Tacoma Supply		
Tacoma-Cascade Pipeline (or Lake Tapps Pipeline north of Tacoma SSP)	ROW acquisition problems, franchise, easements etc.	Lock up ROW with development conditions.
	Urban development complicates pipeline construction.	Lock up ROW with development conditions.
	Permitting or construction challenges delay construction and increase complexity	Long lead time for pipeline project.
	Damage due to seismic event.*	Intertie with other utilities to have emergency supplies.
Lake Tapps Supply		
Lake Tapps source	Regulatory risk on water right issuance.	Effective communication of regional value of the project (already done).
	Seismic impacts affect dikes or other facilities.	Prioritized rehabilitation of vulnerable facilities.
	Volcanic mud flow (lahar) damages White River facilities.	Contingency plan for short- or long-term replacement supply.
	USACOE does not maintain facilities as planned. *	Monitor Corps activities. Legal action if not compliant with agreements.
Lake Tapps Pipeline (portion south of Tacoma SSP)	ROW acquisition problems.	Lock up ROW with development conditions.
	Urban development complicates pipeline construction.	Lock up ROW with development conditions.
	Permitting or construction challenges delay construction	Long lead time for pipeline project.
	Damage due to seismic event or other disaster. *	Intertie with other utilities to have emergency supplies.
Other Cascade Facilities		
Cascade BKR pipeline	ROW acquisition problems (note alternative configurations)	Lock up ROW with development conditions. Or acquire ESSL.
	Urban development complicates pipeline construction.	Lock up ROW with development conditions. Or acquire ESSL.
	Permitting or construction challenges delay construction	Long lead time for pipeline project.
SPU Supplies (Existing Block Contract)		
SPU Transmission system	Aging pipelines deteriorate or fail.	Encourage replacement by SPU, or acquire lines and carry out replacement.
	Damage due to Seismic Event	Intertie with Tacoma for emergency supply.

* Included in summary due to relatively high severity score (low probability but high severity)

6. White River - Lake Tapps Reservoir Project

Lake Tapps is an off-channel reservoir located in Pierce County that was created in 1911 to produce hydropower. Cascade began negotiations with Puget Sound Energy (PSE) to acquire the lake in 2001 with the intent of converting it to a municipal water supply project. In 2009, Cascade completed purchase of the lake, associated infrastructure and all water rights from PSE.

Lake Tapps does not currently provide water for municipal supply. Cascade intends to develop the White River - Lake Tapps Reservoir Project (Lake Tapps Project) in the future to provide water supplies to its Members, while also preserving Lake Tapps as a recreational resource and meeting natural resource protection obligations in the White River watershed. This chapter provides information on the lake, Cascade's water rights, current operations, and plans for future development of the Lake Tapps Project.

6.1. Facilities

Lake Tapps Project facilities owned by Cascade include a diversion structure and fish screens on the White River, an 8-mile-long lake fill system, the Lake Tapps Reservoir and associated lands and dikes, and a 1.3-mile-long lake drawdown system that returns water to the White River. The distance along the White River between the diversion and return flow is approximately 21 miles.

A fully developed residential community is present on the shores of Lake Tapps, and the lake provides a valuable recreational resource to citizens of Pierce County for boating, swimming, and fishing.

6.2. Water Rights

In 2000, PSE filed three water right applications to the Washington State Department of Ecology (Ecology) to facilitate development of Lake Tapps as a municipal water supply. In 2003, Ecology published three Draft Reports of Examination (ROEs) and took public comment on the proposal. These ROEs were appealed by the Muckleshoot Indian Tribe, the Puyallup Tribe of Indians, the City of Auburn, the City of Buckley and others to the Pollution Control Hearings Board (PCHB). The 2003 ROEs were remanded back to Ecology when PSE announced that it was ceasing hydropower generation at the Project. In 2005, PSE submitted a change/transfer application for its pre-code water right claim. All of these applications were included in the Project assets Cascade acquired from PSE in December 2009.

In 2006, Ecology issued a Draft ROE (in response to the remand of the 2003 ROEs) and took public comment.

Cascade proposed adjustments and additional mitigation measures for the Project and Ecology issued new Draft ROEs for review and comment in 2010. Final ROEs approving the Project were issued in September 2010. Final water right permits providing for Cascade to divert water

from the White River store water in the Lake Tapps Reservoir and withdraw it for municipal supply purposes were issued in December 2010. The water rights also provide for managing recreational water levels within the lake and for protection of flows in the White River by prohibiting diversions when flows in the river fall below specified levels.

Cascade's water rights are listed in Table 6.1 and permits are included in Appendix I. The place of use for municipal supplies from the Lake Tapps Project is shown in Figure 6.1.

Table 6.1: Lake Tapps Project Water Rights Issued to Cascade in 2010

Permit No. S2-29920(A):	Authorizes diversion of up to 54,300 acre feet per year from the White River for municipal supply, including industrial and commercial purposes. Maximum flow rate varies seasonally from 150 to 1,000 cfs. Subject to minimum flows in the White River. Priority date: June 20, 2000.
Permit No. R2-29935	Authorizes storage of water from the White River in the Lake Tapps Reservoir, limited to 46,700 acre feet. Priority date: September 15, 2000.
Permit No. S2-29934	Authorizes withdrawal of up to 54,300 acre feet per year from Lake Tapps for municipal water supply, including industrial and commercial purposes. Maximum flow rate of 135 cfs. Priority date: September 15, 2000.
Claim No. 160822	Authorized withdrawal of 931,281 acre feet per year to provide recreational water levels in Lake Tapps, maintain the reservoir in the winter, and to protect and enhance fish and wildlife. Maximum flow rate of 1,988 cfs, subject to minimum flows in the White River. Priority date: 1895.
Permit No. S2-29920(B):	Establishes a Regional Reserved Water Program to be used by the Cities of Auburn, Bonney Lake, Buckley, and Sumner to mitigate impacts to the mainstem White River and Puyallup River in connection with future water right applications. Authorizes diversion of up to 5,060 acre feet per year from the White River for municipal water supply, including industrial and commercial purposes. Maximum flow rate of 10 cfs. Subject to minimum flows in the White River. Priority date: June 20, 2000 (but junior to Permit S2-29920[A]).

Significant steps in the issuance of the water rights are listed below:

- In September 2006, Ecology issued a Draft ROE for the Lake Tapps Project Application for public comment. While this 2006 Draft ROE was replaced by the water rights issued in 2010, this earlier issuance resulted in significant public involvement in the development of the Lake Tapps Project.
- In February 2008, Cascade published an Environmental Checklist and SEPA Mitigated Determination of Non Significance for the Lake Tapps Project.
- In June 2008, Cascade issued a Determination of Significance and Request for Comments on Scope of an Environmental Impact Statement.
- In February 2010, Cascade published the Draft Environmental Impact Statement (EIS) for the Lake Tapps Reservoir Water Rights and Supply Project for public comment. The Final EIS was published in June 2010.
- In May 2010, Ecology published draft ROEs of the project for public comment. Final ROEs approving Cascade's water right applications for the project were published in September 2010. The water right permits were issued in December 2010.

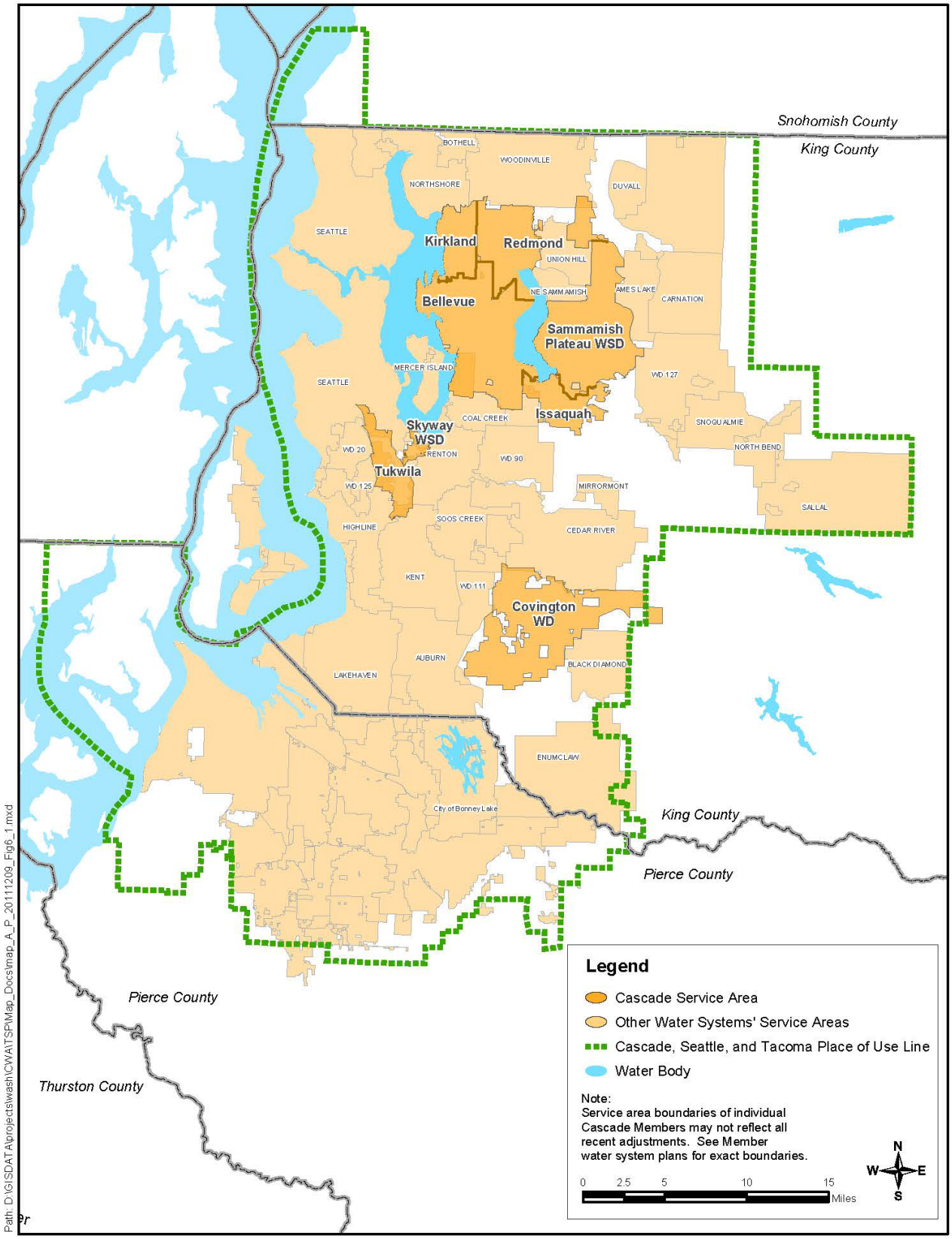

Figure 6.1: Water Right Place of Use

The authorized withdrawal from Lake Tapps under Application S2-29934 is 87.25 mgd during the maximum week and 48.5 mgd as an annual average. These quantities are used in the water supply portfolio discussed in Chapter 5.

The development schedule for Permit S2-29920(A) requires construction of municipal supply facilities to begin by December 31, 2040, and perfection (full use) of the water right to occur by December 31, 2060. In order to put the water right to use, Cascade anticipates construction of a water treatment plant, transmission pipelines, and associated facilities.

6.3. Related Agreements

In the course of acquiring the Lake Tapps Project and associated water rights, Cascade has executed agreements with several organizations that have interests in the lake and the natural resources and water supplies of the White River watershed. These agreements are summarized below:

Tribal Settlement Agreements. In August 2008, Cascade entered into the *2008 White River Management Agreement* (WRMA) with the Puyallup Tribe of Indians (PTI) and the Muckleshoot Indian Tribe (MIT), which established parameters related to management of White River flows. The WRMA Recommended Flow Regime for the White River was included in the municipal water rights issued by the Ecology in 2010. Since 2008, Cascade and the Tribes have worked closely on several projects including approval of the water rights, the 2010 Flowline Maintenance Outage (and associated fish recovery activities), the Barrier Dam repairs in 2011, lobbying the Corps of Engineers and Congress for continued funding of the Mud Mountain Dam Fish Passage Project (the permanent Barrier Dam replacement and improved/expanded fish trap facility), development of expanded water quality and stream flow monitoring programs (with the U.S. Geological Survey), and a donation of a portion of the Lake Tapps Claim to the State Water Right Trust Program. Since 2009, Cascade has had regular conference calls with the fishery and natural resources staffs of both Tribes and an annual meeting with the leadership of the Tribes.

In addition, Cascade entered into the *Natural Resources Enhancement Agreement* with the PTI and the *Lake Tapps Reservoir Water Rights Settlement Agreement* with the MIT. These individual settlement agreements with each Tribe provide for funding fishery enhancement activities in the White River Basin.

Lake Tapps Community Agreement. In May 2009, Cascade entered into the *2009 Agreement Regarding Lake Tapps Between Cascade Water Alliance and the Lake Tapps Community*. The 2009 Agreement includes Cascade's commitment to the maintenance of Lake Tapps Reservoir's surface level within a range of elevations called "Normal Full Pool during an extended Recreational Season" which were included in the municipal water rights issued by Ecology. Cascade's municipal supply is subject to maintenance of these recreational lake levels. The Lake Tapps community supported the municipal water rights and since 2009 has worked closely with Cascade on projects affecting Lake Tapps, including milfoil eradication and the development of a recreational management plan.

In November 2010, Cascade, Pierce County, the Cities of Auburn, Bonney Lake, Buckley and Sumner, and other key governments and jurisdictions who share responsibility for Lake Tapps, began a neutrally-convened public process with the Lake

Tapps community to develop the Collaborative Plan for Managing Lake Tapps (plan), to ensure that Lake Tapps remains a safe, clean, and enjoyable resource well into the future. The end of the five-month process culminated with the development of a plan that includes an overview of the lake's history, physical characteristics and current conditions; and provides information regarding existing rules and regulations. As part of the process, a list of roles and responsibilities was also developed and included in the plan.

Four Cities Agreement. In February 2010, Cascade and the Cities of Auburn, Bonney Lake, Buckley, and Sumner entered into the *2010 Lake Tapps Area Water Resources Agreement* that provides for the Regional Reserved Water Program for the Lake Tapps region. This program was included as a portion of Cascade's municipal water rights. It provides a mechanism for a portion of Cascade's water rights to be used by the Cities to mitigate White River impacts in connection with applications by the Cities for new water rights or changes to existing water rights. The Cities supported the municipal water rights and dismissed a lawsuit filed during PSE's ownership which was due to their uncertainty of the impact of the project on the Cities. Since that time, Cascade has assisted the Cities' efforts to optimize their existing water supplies and secure additional supplies.

6.4. Lake Tapps Project Contract Operator Transition

The Asset Operating Agreement (AOA) between Cascade and PSE provides for PSE to operate the Lake Tapps Project for up to five years (through 2014). In August 2011, Cascade issued a Request for Proposals (RFP) to private contract operators for project operation and maintenance. The RFP outlined a process whereby Cascade would select a Contract Operator (CO) to begin a transition operating phase (concurrent with PSE operations) in January 2012. The AOA with PSE would be terminated in April 2012 and the new CO would assume full operation and maintenance responsibility for the project. The AOA would be replaced with an "on-call" agreement under which Cascade and the new CO could receive assistance from PSE on an "as needed" basis through 2014.

Following review of proposals and interviews with qualified COs, the Cascade Project Team determined that Veolia Water North America - West, LLC was the top-ranked potential CO. Contract negotiations (based on the draft agreement attached to the RFP and comments submitted by Veolia as part of its proposal) were completed in December 2011.

The White River-Lake Tapps Reservoir Project Operations and Maintenance Agreement is structured as a five-year agreement with two phases and options for up to two additional periods of five years each. Compensation for the first year of operation and maintenance services (the Transition Phase) will be on a "time and materials" basis. During the Transition Phase, the CO will transition into full operation and maintenance responsibilities and develop an O&M Manual for the project. This task will be a "fixed price" task as bid in the proposal.

The O&M Manual will be the basis for the scope and budget for the Performance Phase of the Agreement, beginning in January 2013 and extending through 2016 (or longer if renewed). Compensation during the Performance Phase will be based on the approved budget and in accordance with the requirements of a Qualified Management Contract.

In the event that Cascade and the CO cannot agree on a scope and budget for the Performance Phase, the CO will be obligated to continue to operate the project, beginning in January 2013,

under a “Force Account” scenario, until Cascade is able to complete a process to replace the CO. Compensation will be on a “time and materials” basis, subject to certain limitations.

6.5. Watershed Management

As part of Cascade’s development of the Lake Tapps Project as a future drinking water supply, Cascade will develop, document, and implement a source water protection plan meeting the requirements for a filtered surface water source. Cascade is likely to begin active development of the Lake Tapps Project in 10 to 15 years, with the supply needed beginning in 2030 or later. The studies conducted to date are not sufficient to establish the level of treatment necessary to meet standards that may be applicable in 2030 when it is forecast that Lake Tapps will be utilized as a municipal water source. Further work on this topic will be conducted in the future.

In order to establish baseline water quality in Lake Tapps, Cascade has cooperated in a number of monitoring efforts since 2004. The Washington Department of Ecology conducted a study of Lake Tapps and the White River in 2004 - 2005 to document water-quality conditions soon after power generation had ceased and when flow through the Lake was reduced. Cascade, Pierce County Public Works and Utilities, the Muckleshoot Indian Tribe and the Puyallup Tribe of Indians also cooperated in collecting water quality data during the 2004–2007 time frame.

These studies indicate that Lake Tapps is oligotrophic and that phosphorus is the limiting nutrient for primary production (the Lake tends to function as a net sink for phosphorus). Reduced diversions from the White River and reduced releases from the Lake result in more settling of non-algal particles, including particles with adsorbed phosphorus, resulting in clearer water and lower total phosphorus concentrations.

The most recent and most comprehensive water quality monitoring since Cascade has taken over the Project was conducted from May to December 2010 and was designed by the US Geological Survey (USGS), in cooperation with Cascade and the Muckleshoot Indian Tribe and the Puyallup Tribe of Indians, to establish a baseline set of data collected under the flow regime in place from May to December 2010 (the flow regime contained in the Water Rights Permits) for selected reaches of the White River, White River Canal, Lake Tapps Diversion, and Lake Tapps. This report entitled *Quality of Water in the White River and Lake Tapps, Pierce County, Washington, May–December 2010* (due to be final in early 2012) presents and summarizes water-quality data collected by the USGS from May to December 2010 from a total of 13 sites—two on the White River (at the Headworks and at R-Street in Auburn), one on the White River Canal (flowline), one on the Lake Tapps Diversion (Tailrace returning flow back to the White River), and from nine sites on Lake Tapps. Three sites (at the Headworks, at R Street in Auburn, and the Tailrace) were equipped for continuous 15-minute recording of water-quality data. Discrete water samples were collected bi-monthly in July and August at the Headworks and White River Canal (flowline) sites. The Tailrace site was sampled bi-monthly in July and August and monthly in November and December. Discrete water samples were not collected at the R-Street site; only continuous water-quality data were collected. The nine Lake sites were sampled bi-monthly from July through October and monthly in November and December.

The water-quality data collected for this study consist of concentrations of nutrients, suspended solids, fecal-coliform bacteria, and turbidity in discrete water samples, and 15-minute values of water temperature, specific conductance, dissolved oxygen concentration, pH, and turbidity continuously measured by in-situ water-quality sondes. Water-quality data collected from the Lake sites consist of concentrations of nutrients, suspended solids, fecal-coliform bacteria, chlorophyll *a*, and turbidity, and vertical profiles of various water-quality and physical properties

through the Lake water column. In addition, a one-time sampling of water from three of the Lake sites was analyzed for suites of organic chemicals.

The following is a brief overview summary of the initial results of the 2010 effort:

- Discrete samples indicated that water from the White River, White River Canal Inflow, and Tailrace sites generally was turbid, warm, chemically dilute, and well-oxygenated. The quality generally was good and generally met the freshwater criteria designated by Washington State Department of Ecology for recreational and aquatic-life uses.
- Lake Tapps water near the surface was relatively clear, warm, and well oxygenated. Lake Tapps water is pH neutral and chemically dilute. Concentrations of nutrients and chlorophyll *a* in Lake Tapps were low. Lake Tapps generally fits within the oligotrophic classification and primary production is phosphorus limited.
- In addition to general water quality parameters, water samples collected at three sites were screened for the presence of 250 organic chemicals. A total of 14 compounds (mostly belonging to the group of wastewater indicator chemicals) were detected in trace amounts (or determined to be present) at one or more of the three sites. Compounds detected (or with verified presence) at all three sites included the herbicide 2,4-D, the insecticide and mosquito repellant DEET, the herbicide fluridone used for Eurasian watermilfoil eradication, and the herbicide prometon.

Lake Tapps is significantly different than the drinking water sources managed by SPU and TPU. While the Cedar, Tolt, and Green River sources are located in protected areas with controls over human activities, the watershed upstream of Lake Tapps is less protected, includes both undeveloped and developed areas, and has multiple uses. The land immediately adjacent to Lake Tapps has been developed for residential and commercial uses.

Lake Tapps is subject to two types of potential contamination: point and non-point sources. Point sources include permitted discharges to the White River and potential point sources, such as underground storage tanks. One facility has a permit to discharge to the White River upstream of Lake Tapps: Crystal Mountain Sewage Treatment Plant.

Ecology regulates other facilities in the area, including some underground storage tanks and hazardous waste generators. Contamination from these types of facilities could reach Lake Tapps only through an accidental release. In 2001, a review of these regulated facilities indicated that there are also some inactive and active clean-up sites and leaking underground storage tanks near the Lake Tapps Reservoir and the White River upstream of the diversion to Lake Tapps.

Non-point source contamination will potentially occur primarily via streamflow runoff and septic tank leaching and failure. The types of contaminants reaching Lake Tapps Reservoir vary according to land use within the basin. Table 6.2 presents a summary of typical land uses and related contaminant sources near the Lake Tapps Reservoir, near the White River Canal (which diverts water from the White River to Lake Tapps), and upstream of the diversion. The primary concerns associated with residential, incorporated, and agricultural uses are contaminants transported by stormwater runoff. Runoff from urban and moderate-density residential areas could carry eroded soil, pollutants that build up on impervious surfaces, pesticides and fertilizers, animal manure, bacteria, protozoa, and viruses. Stormwater runoff from agricultural land uses are likely to transport fertilizer, pesticides, and manure to Lake Tapps. These may

contribute turbidity, nitrogen, organic contaminants, bacteria, protozoa, and viruses to nearby surface waters.

A concern associated with rural and moderate density residential land uses is the presence of septic systems. The majority of the area around Lake Tapps Reservoir (except for incorporated areas), the White River Canal, and upstream of the diversion, is not connected to a sewer system. In 2001, the Tacoma-Pierce County Health Department estimated that 1,250 to 1,450 septic tanks may be located within 400 feet of Lake Tapps. A septic system has the potential to contribute nitrogen, phosphorus, suspended solids, bacteria (such as fecal coliform), protozoa (*Giardia lamblia* and *Cryptosporidium*), viruses, metals, and organic and inorganic chemicals to nearby surface water bodies and groundwater.

In addition to these sources of contaminants, recreational activities could also introduce contaminants to Lake Tapps. Recreational boat use can contribute gasoline, gasoline additives, other petroleum products, and metals to surface water. Boating and swimming can also introduce microbial contamination.

Table 6.2: Land Use near Lake Tapps and White River above River Mile 24.3

Land Use Category	Description	Estimated Percentage of Surrounding Area	Potential Contaminant Source
Lake Tapps			
Rural	Maximum of 1 dwelling per 5 acres	60	Septic tanks
Moderate Density Residential	2 – 6 single family dwellings per acre	15	Septic tanks Stormwater Runoff
Incorporated	Within incorporated city limits	20	Stormwater Runoff
Agricultural	Commercial agriculture, such as crops or dairies	5	Stormwater Runoff
White River Canal			
Rural	Maximum of 1 dwelling per 5 acres	80	Stormwater Runoff
Incorporated	Within incorporated city limits	10	Stormwater Runoff
Agricultural	Commercial agriculture, such as crops or dairies	10	Stormwater Runoff
White River Above Diversion			
Forested	Land managed for forestry purposes	Virtually All	Stormwater Runoff

Source: Lake Tapps Reservoir Water Right Feasibility Report – Technical Memorandum No. 3 Public Water Quality Analysis: Water Quality Monitoring and Evaluation. 2001.

To address the issues associated with watershed control, Cascade has developed a three-pronged approach for a proactive watershed management strategy that is integrated with development of drinking water treatment. This strategy recognizes the need for watershed monitoring and continued management of existing practices to meet current state requirements and guard against degradation of existing water quality. The watershed management strategy will have these three aspects:

- Coordination with and support of other public agencies in watershed management efforts. Cascade plans to work with other agencies, such as Ecology, Tacoma-Pierce

County Public Health Department, and the United States Forest Service to help ensure that water quality regulations are met.

- Implementation of public education to ensure local stakeholders have an understanding of Cascade's watershed objectives and planned efforts and are able to provide input into watershed management. Since the area surrounding Lake Tapps is developed for residential and commercial land uses, Cascade plans to join with the community to maintain and improve water quality. Cascade will work with Lake Tapps homeowners in a program to enhance public education on existing activities that affect the water quality of the Lake Tapps Reservoir and to meet regulations designed to prevent degradation of water quality. This ongoing program would assist in raising awareness that it is in everyone's best interests to comply with existing state law and to promote "good neighbor" use practices to protect the current uses of the Lake Tapps Reservoir.
- Water quality monitoring to:
    - provide baseline information on Lake Tapps water quality
    - support coordination with public agencies and public education efforts
    - shape planned treatment processes

As yet, water quality monitoring of Lake Tapps has consisted of efforts to assess environmental parameters. Only limited monitoring of drinking water parameters has been conducted.

This approach will be implemented in phases to prepare for design and construction of a drinking water treatment plant and operation of the Lake Tapps Project as a source of supply. Activities will be implemented in the following phases. It is assumed that the Lake Tapps Project will not be used as a source of supply prior to 2030 and that activities associated with each phase may be adjusted as preparation, design, and construction of the treatment plant progresses.

6.5.1. Phase I Baseline Monitoring and Coordination

The objective of this phase will be initiation of agency coordination and public education and implementation of a baseline monitoring program. Additionally, after monitoring has been implemented, Cascade, in cooperation with other agencies and stakeholders, will share monitoring data that will form a technical basis to help protect and improve water quality at Lake Tapps.

Baseline water quality monitoring will be conducted to capture seasonal variation and information on the quality of water in Lake Tapps. This baseline monitoring will occur over a several-year period to capture seasonal variation of key water quality and public health parameters. At a minimum, the monitoring will be conducted at the following locations: (1) near the inlet of Lake Tapps, and (2) at the proposed point of withdrawal to the conveyance facilities leading to a future treatment plant. After conducting this monitoring for about three years, the program will be reviewed and adjusted according to monitoring needs after this baseline information has been obtained. The monitoring will include parameters to assess:

- physical characteristics of the water
- levels of organic matter and solids
- presence or absence of microorganisms of concern
- presence or absence of regulated and unregulated inorganic and organic chemicals

Table 6.3 presents the proposed monitoring parameters and monitoring frequencies.

Table 6.3: Baseline Monitoring Program

Monitor Once Per Month	
pH	Total Dissolved Solids
Temperature	Total Suspended Solids
Turbidity	Total Organic Carbon
Color	Dissolved Organic Carbon
Conductivity	UV 254
Hardness	Fecal Coliform
Alkalinity	E. Coli
Nitrate	Algae
Nitrite	
Monitor Once Per Year	
Cryptosporidium	Giardia Lamblia
Regulated Inorganic Chemicals	Phosphate
Regulated Organic Chemicals	Silver
Chloride	Sodium
Fluoride	Sulfate
Iron	Zinc
Manganese	Geosmin
MIB (2-methylisoborneol)	
Monitor Once	
Contaminants Listed as Regulatory Priorities on EPA's Contaminant Candidate List	
Contaminants Monitored for under Unregulated Contaminant Monitoring Rule – List 1	
Pharmaceutical and Personal Care Products per USGS National Reconnaissance of Emerging Contaminants in US Streams.	
Radium-226	Beta/Photon Emitters
Radium 228	Uranium
Gross Alpha Activity	

6.5.2. Phase II Pilot-testing and Intensive Monitoring

The objective of this phase will be to carry out water quality monitoring tied directly to development and design of a treatment plant for the Lake Tapps Project. This monitoring will be more intensive than that described above. Additionally, this monitoring phase will be used to investigate any concerns that surface during Phase I. The monitoring program will be developed in conjunction with the pilot study associated with treatment plant design.

6.5.3. Phase III Ongoing Monitoring and Management

The objective of this phase will be to carry out continued monitoring, based on a program that will be developed specifically for continuing surveillance of the Lake Tapps watershed after the treatment plant comes on line. In addition to this monitoring, Cascade will initiate watershed management strategies deemed necessary based on the previous monitoring phases. This phase will also include ongoing coordination with other agencies and public education.

Cascade anticipates developing and implementing its source water protection program as part of Phase III monitoring and management. It is likely, however, that watershed management

strategies will begin within the two-year period prior to operation of a treatment plant at the Lake Tapps Project.

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7. Infrastructure Needs and Costs

Chapter 5 of this Transmission and Supply Plan described Cascade's long-term supply program. This chapter identifies future infrastructure needed to deliver water from the various supply sources. It also provides information on costs of developing and operating the Cascade supply system. Cost information is provided at a planning level, and will be refined in the future after additional design work is carried out.

Infrastructure requirements for Member Independent Supplies, SPU, TPU or Cascade wholesale customer supplies are not described here, but can be found in water system plans and other documents prepared by those organizations. Cascade does not incur costs for Member supplies. Costs of SPU and TPU supplies are paid through Cascade's wholesale rate payments to SPU and are therefore treated as annual operations and maintenance (O&M) costs in this chapter.

7.1. Infrastructure Needs

The supply portfolio described in Chapter 5 will require construction of new infrastructure over a period of several decades. Cascade anticipates that new infrastructure will need to come on line beginning in 2024, when the first step down occurs in the SPU Block Contract (unless this contract is modified in the future). Additional infrastructure will be needed in the years after that.

Cascade has developed a long-term Capital Improvement Plan (CIP) for development of the supply portfolio. Primary elements of the CIP include the following:

White River - Lake Tapps Reservoir Project Improvements.

Estimated date in service: Ongoing.

Cascade has owned the White River - Lake Tapps Reservoir Project (Lake Tapps Project) since December 2009, and during that time has begun taking a detailed inventory of facilities and equipment and assessing the need for improvements, repair or replacement to meet both Cascade's immediate and long-term operational objectives. For example, during the 2010 Flowline Outage, repairs were made to the Timber Flume, sediment was removed from the settling basins and upgrades made to the Fish Screen Facility. In 2010 and 2011, repairs were made to various Lake Tapps dikes.

The CIP includes funding for additional improvements, repair or replacement to Lake Tapps Project facilities through 2025. Cascade is still evaluating the condition and future operational needs of Lake Tapps Project facilities and decisions on specific projects and timing have not been finalized. Examples of the types of projects that might be undertaken are:

- Improvements or replacement of the Headgates
- Replacement of the Timber Flume
- Installation of fish screens at the intake from Lake Tapps and/or fish barriers in the tailrace to the White River;

- New deep water intake structure
- Improvement, replacement, or modification of the water conveyance facilities between Lake Tapps and the White River (i.e. tunnel, forebay, penstocks, surge tanks and overflow structures, power house valves and tailrace canal
- Improvements/repairs to Lake Tapps dikes

In addition to these activities, the US Army Corps of Engineers (USACE) is proceeding with a project to replace the Barrier Dam on the White River near Buckley. This facility, currently owned by Cascade, is integral to the USACE's ability to move listed fish species above Mud Mountain Dam. The proposal is for the USACE to obtain the existing structure and land from Cascade and construct a new Barrier Dam and Trap-and-Haul Facility. The final design is unknown at this time and Cascade is working with the USACE and other interested parties (Tribes and State and Federal fishery agencies) on this matter. As the design of the USACE structure and facilities is finalized, there may be opportunity to improve/replace Cascade structures (such as the Headgates or the Timber Flume) while the USACE project is underway.

Tacoma-Cascade Pipeline

Estimated date in service: 2024.

This transmission link (see Figure 7.1) will be needed to convey supply contracted from TPU and Covington Water District. Various configurations are possible for the Tacoma-Cascade Pipeline (TCP). The configuration presented in this plan involves constructing the pipeline from the Regional Water Supply System (RWSS) pipeline in the vicinity of the Covington Water District north to connect with existing SPU transmission lines at Lake Youngs Reservoir, and conveyance of treated TPU/Covington water through SPU transmission lines to a point near the Eastside Reservoir in Bellevue. The length of the TCP under this configuration is approximately 8.5 miles. The assumed pipeline diameter is 30 inches, which would be capable of conveying 20.3 mgd in peak week supply under anticipated hydraulic conditions. This would be sufficient to convey the contracted supplies from TPU and Covington Water District discussed in Section 5.6.

Cascade also anticipates a storage reservoir will be needed to balance deliveries through the TCP. This need could be addressed either by acquiring the existing Eastside Reservoir from SPU or by constructing a new reservoir. Rights of way and some land acquisition would also be required. In addition a wheeling (conveyance) agreement with SPU will be needed (or additional pipeline construction will be needed if wheeling is not permitted by SPU).

Lake Tapps Project, Phase 1

Estimated date in service: 2030.

Development of the Lake Tapps Project for water supply will require construction of a water treatment plant and 30-mile pipeline from Lake Tapps north to the vicinity of Bellevue (see Figure 7.1). It is assumed the water treatment plant will use membrane filtration plus granular activated carbon and chlorination. The 66-inch-diameter pipeline would be sized to convey the peak flow of 87.5 mgd associated with the Lake Tapps Project water right. The pipeline must be fully constructed in Phase 1. However, the water treatment plant can be

constructed in phases to spread out the cost of construction. For purposes of the TSP, two phases are assumed. Phase 1 would provide 43 mgd of water treatment capacity (half of the ultimate maximum week capacity of 87.25 mgd). Phase 1 will also include construction of a storage reservoir near the north end of the pipeline and a booster pump station in the Kent Valley. Rights of way and some land acquisition would be required. However, Cascade already owns the Lake Tapps impoundment and the adjacent land needed for the water treatment plant.

Lake Tapps Project, Phase 2

Estimated date in service: 2045.

Phase 2 would complete the Lake Tapps Project by adding an additional 44 mgd of water treatment capacity at the water treatment plant. This would enable full use of the Lake Tapps water right for municipal water supply.

Regional Distribution Pipelines and Eastside Connections

Estimated date in service: 2040s.

Water delivered to the northerly portions of the Cascade service area is currently conveyed through SPU's Tolt Pipeline and Tolt East Side Supply Line. As SPU water is replaced by water from TPU and Lake Tapps, and as growth continues at the north end of the service area, Cascade will need additional transmission capacity between Bellevue and Redmond. For purposes of the TSP, it is assumed that a new pipeline will be constructed, known as the Bellevue-Kirkland-Redmond (BKR) Pipeline. A number of new connections to Cascade Member systems east of Lake Washington are also included. The need for the BKR and new connections will be re-evaluated closer to the time of construction, It is also possible that Cascade will offer to acquire from SPU the existing transmission lines along the east side of Lake Washington.

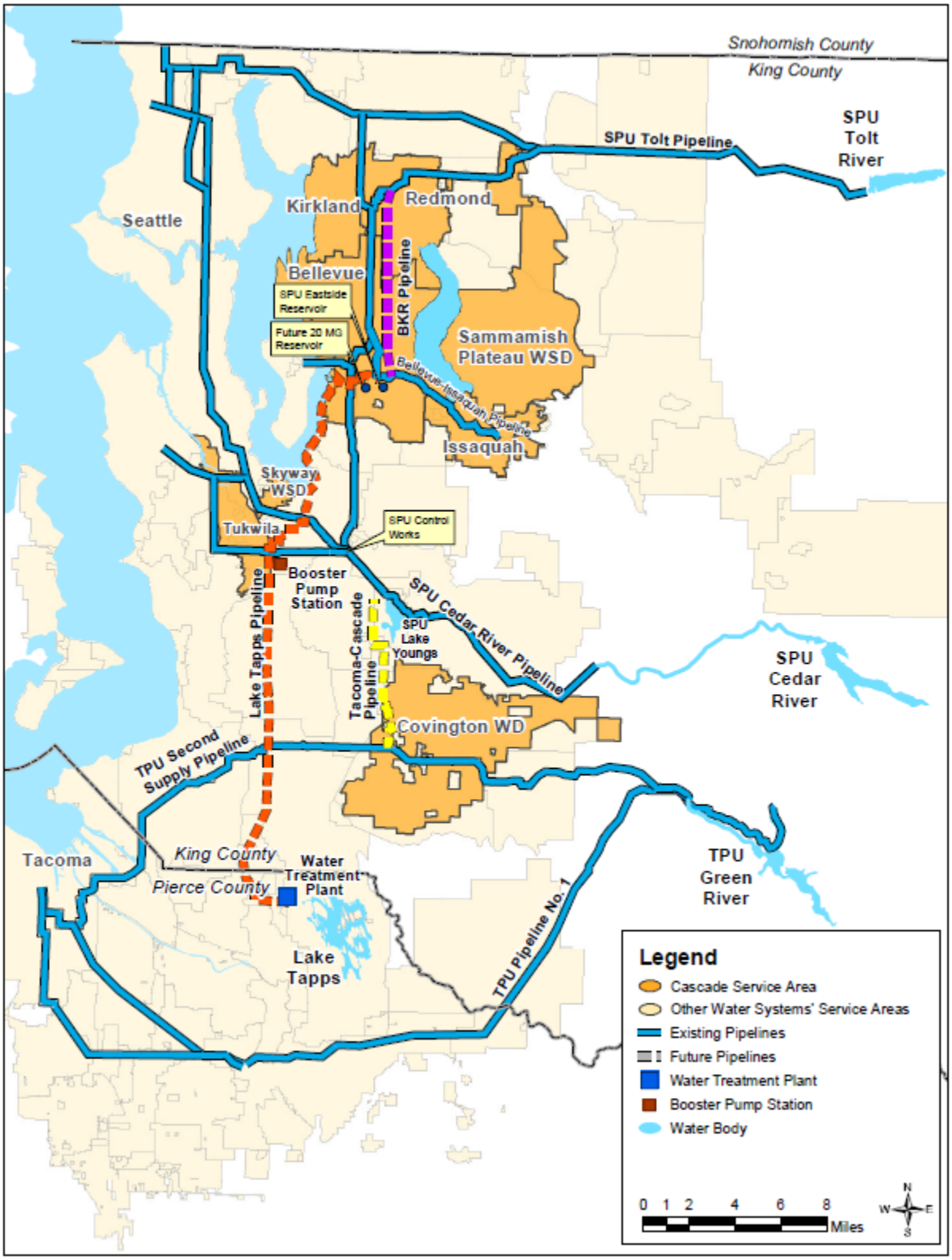

Figure 7.1: General Locations of Planned Infrastructure

7.2. Cost Estimation Methods

Planning-level costs were developed for the various infrastructure projects needed to implement the preferred water supply portfolio described in Chapter 5. The cost estimation approach was documented in a technical memorandum: *Opinion of Probable Cost Summary and Financial Analysis* (December 2011). Costs were estimated for each distinct component of the supply projects, and include all project life cycle costs associated with each supply. These include costs of contracted wholesale supplies, capital costs for infrastructure projects like pipelines and storage reservoirs, and O&M costs for the various supplies. In some cases, assumptions had to be made about the costs of supply agreements or land or infrastructure acquisitions in the future.

Costs were not estimated for Member Independent Supplies. Those costs are borne by individual Cascade Members and, therefore, are not considered in this TSP.

Construction costs were estimated for each supply project using a standard template and unit prices developed from various sources adjusted to 2011 dollars. Costs developed in prior years were escalated to 2011 dollars, using Engineering News Record cost indices. Once construction costs were estimated, allied costs were applied resulting in a complete project estimate. Standard percentages were applied to develop the allied costs.

Projects included in the portfolios range from those that are essentially conceptual at this time to those that have received substantial attention to engineering design. For example, the Bellevue-Kirkland-Redmond pipelines are conceptual in nature, while the proposed Tacoma-Cascade Pipeline (Central Segment) has been designed to the 90 percent level. A construction cost contingency was developed to address varying degrees of uncertainty among the supply projects. This contingency was based on the Cost Estimate Classification System, 2005, by the Association for the Advancement of Cost Engineering International. This system includes five classes of cost estimates based on differing levels of project definition (Table 7.1). Each class has its own cost range to express uncertainty, as follows:

Table 7.1: Contingency Ranges for Cost Estimation

Class	Level of Project Definition	Cost Range
5	Concept screening level, no design completed	-20% to +50%
4	Study or feasibility level (well defined project with no design completed)	-15% to +40%
3	Budget, authorization or control (well-defined project with preliminary design completed [20-30%])	-10% to +30%
2	Control or bid (well defined project with final design completed [75 – 90%])	-5% to +10%
1	Check estimate or bid tender (100% design completed, ready for advertisement)	-3% to +5%

Each supply project in the supply portfolio was evaluated as to its level of development, and the appropriate cost range from Table 7.1 was assigned accordingly.

Cascade's supply portfolio has an additional source of uncertainty. Some of the projects identified will not be constructed for decades. Many factors may change over that time, including regulatory requirements, the extent of urban development in areas to be crossed by transmission pipelines and other factors. A standard inflation percentage was used to address normal inflation. However, a time-dependent risk contingency was also included in the cost estimation methodology for project components subject to the risk of above average increases in cost over time.

Operation and maintenance costs were calculated based on estimated costs or typical percentages for all major elements of the supply portfolio. These elements included water treatment, storage, transmission, pump stations, and appurtenances. Costs included in the O&M category included: fixed institutional costs, energy and chemical costs for water treatment, energy costs for pumping, and the cost of repair and replacement of facilities.

7.3. Costs of Supply Portfolio

Cascade has estimated planning-level capital costs to implement the supply portfolio, as listed in Table 7.2. These include capital costs and up-front costs of contracted supplies. To be conservative, capital costs represent the high end of the contingency ranges discussed in Section 7.2.

Costs for Member Independent Supplies are the responsibility of individual Members and, therefore, are not included.

Only one of the capital cost items listed in Table 7.2 would occur during the six-year planning period prior to preparation of Cascade's next TSP update. This is the expected up-front cost of contracting with Covington Water District for delivery of surplus supply from Covington's share in the Tacoma Second Supply Project. The cost of this up-front payment is assumed to be on the order of $16 million.

Other capital costs will not begin until Cascade starts construction of the Tacoma-Cascade Pipeline. Those costs are expected to start in year 2020, to enable delivery of supplies through the pipeline by 2024.

Many of the projects listed in Table 7.2 will be constructed over a period of several years. A projected 50-year schedule of capital costs is displayed in Figure 7.2.

Expected O & M costs associated with Cascade supply sources during the six-year planning period prior to preparation of Cascade's next TSP update include only the following items:

- Charges paid to SPU under the Block Contract
- Minimum-volume charges paid to TPU under the Water Supply Contract
- Projected O&M costs for maintenance of the Lake Tapps Impoundment

Chapter 8 provides information on Cascade's financial program, to generate revenues needed to pay for the costs of contracted supplies, capital projects, and O&M.

Table 7.2: Capital Costs of Supply Portfolio

Major Sources and Project Components	Capital Cost ($M) (2011 dollars)
Tacoma-Cascade Pipeline and Associated Costs	
Tacoma-Cascade Pipeline (TCP)	50
Storage Capacity (acquire from SPU or build new facility)	23
TPU Contract Expand Permanent Supply (assumed up-front cost in 2025)	16
Subtotal:	**89**
Contracted Supply from Covington Water District (deliver through TCP)	
Assumed Up-front Fee - 2012	16
Subtotal	**16**
Lake Tapps Project (In Service 2030)	
Lake Tapps Pipeline (all segments)	367
Storage Reservoir	45
Booster Pump Station	25
Water Treatment Plant – Phase 1	136
Water Treatment Plant – Phase 2	108
Lake Tapps Impoundment Improvements	24
New Deep Water Intake at Lake Tapps	13
Subtotal:	**718**
Regional Distribution in Cascade Service Area (2040s)	
Bellevue-Kirkland-Redmond (BKR) Pipeline	97
Eastside Connections	22
Subtotal:	**119**
Total 50-Year CIP ($M)	**942**

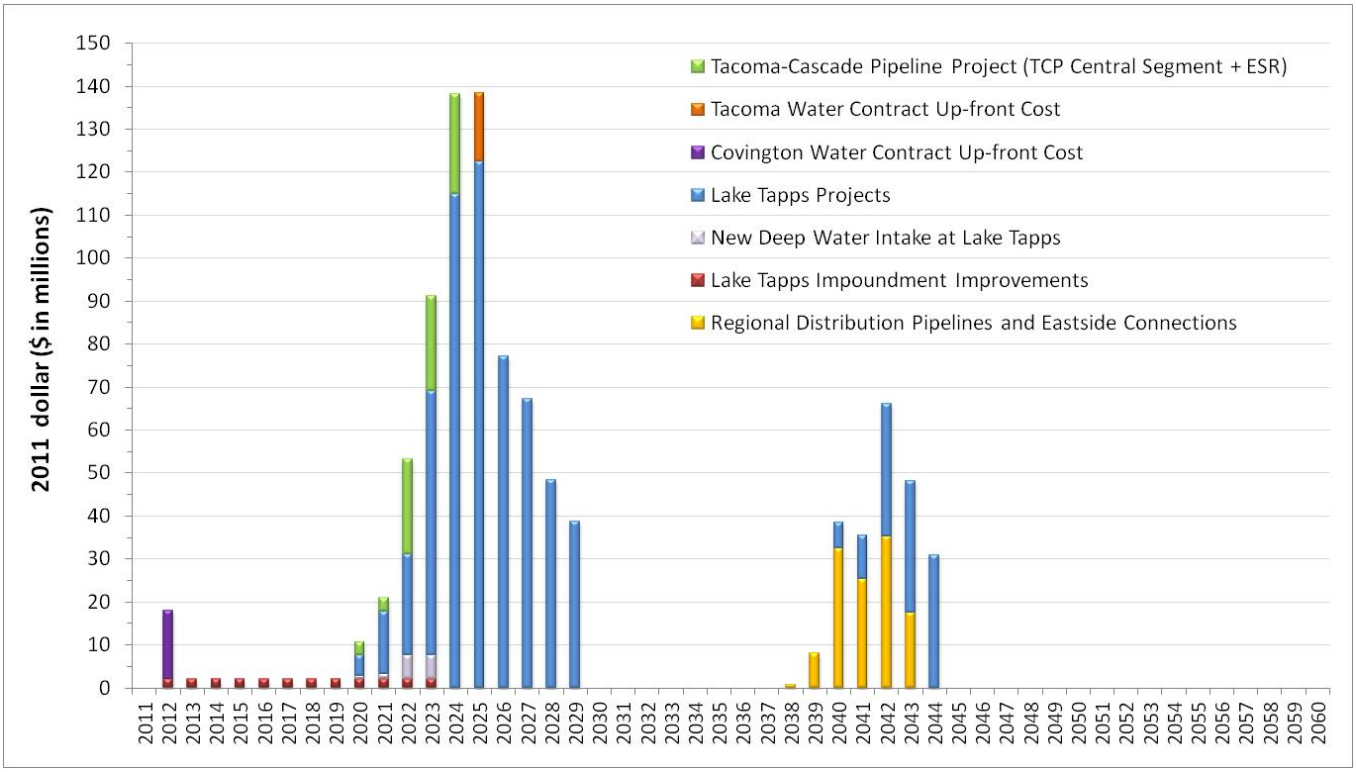

Figure 7.2: Projected Schedule of Capital Expenditures

7.4. Flexibility in Cascade's Infrastructure Program

As discussed in previous chapters, there are several factors that may lead to changes in the timing of particular infrastructure projects. Growth in Cascade's water demand has been flat in recent years, and it is difficult to tell whether the robust growth trends from prior years will return. SPU and TPU have seen similar effects in terms of their water demands, suggesting that substantial surplus supplies could be available from these regional suppliers at least into the 2030s. Cascade plans to re-engage with SPU and TPU periodically to determine whether the existing supply contracts can be expanded or extended. Similarly, the amount of supply available from the Covington Water District's share in the RWSS could be more or less than assumed. Finally, the small sources discussed in Section 5.6.6 may offer additional opportunities to defer large infrastructure projects.

All of these factors suggest a need for flexibility in the water supply and infrastructure program. No new infrastructure needs to be on line until 2024, providing approximately eight to ten years for decisions to be made on the timing and configuration of the Tacoma Cascade Pipeline and Lake Tapps Project. Cascade will periodically evaluate opportunities for expanded supply contracts and other alternatives, to determine whether they can provide an economical means to defer the costs of major infrastructure.

In summary, Cascade has a secure portfolio of supply sources through at least 2060, but will continue to evaluate the exact timing of supply development to meet its Members' needs, manage rate impacts, and maximize the use of existing regional infrastructure. This topic will be reviewed again six years from now in the next update to Cascade's TSP.

8. Financial Program to Support the TSP

This section addresses the financial condition of Cascade and its ability to fund supply system development. Beginning with a review of Cascade's financial history, it evaluates Cascade's current financial condition and financial management policies, as well as the revenue sources available to pay for Cascade's capital needs. Revenues and expenses are projected through 2030, a twenty-year forecast, including the level of rate revenue increases needed.

General principles, listed below, guide this section and provide the basis for this analysis.

- ***Adherence to Financial Policies*** - Cascade has a set of specific rules and procedures that guide its financial management. It periodically reviews and refines these policies to maintain a viable financial program responsive to Members' needs.

- ***Conservative Analysis*** - This analysis contains various assumptions regarding customer growth, capital costs, operating costs, and a number of other factors. The projections in this analysis aim to be financially conservative to facilitate sensible financial planning. While conservatism in planning is achieved by planning for substantial growth in demands, financial conservatism is achieved by planning for low growth and primary reliance on existing sources of revenue.

8.1. Cascade's Recent Financial Performance and Condition

Cascade's financial history reflects initiation of capital expenditures and the dominance of operating expenses by wholesale purchases. Table 8-1 shows Cascade's statement of revenues and expenses for 2006 through 2010. Cascade's fiscal policies incorporate a rate-smoothing policy that spreads rate increases over a 5-year period in anticipation of cost trends. This tends to create cycles of moderate surplus and deficit managed through use of the rate stabilization reserve.

Cascade's balance sheet is summarized in Table 8-2 for 2006 through 2010. It is characterized by the accumulation of debt related primarily to the acquisition of supply assets, including the White River - Lake Tapps Reservoir Project (Lake Tapps Project), and a contractual supply commitment from Tacoma.

Table 8.1: Statement of Revenue and Expenses and Changes in Net Assets

	2006	2007	2008	2009	2010
Water sales	$18,241,038	$20,298,751	$22,465,785	$24,083,868	$25,799,469
Administrative dues	715,781	1,139,257	1,247,488	1,337,898	1,269,289
Conservation program	631,009	706,732	733,086	812,351	1,049,648
Total Operating Revenue	**$19,587,828**	**$22,144,740**	**$24,446,359**	**$26,234,117**	**$28,118,406**
Cost of water sold	$14,464,094	$15,081,172	$16,508,432	$20,719,555	$20,842,438
Other operating costs	2,031,418	2,921,107	3,149,247	4,832,026	9,367,557
Total Operating Expenses	**$16,495,512**	**$18,002279**	**$19,657,679**	**$25,551,581**	**$30,209,995**
Operating (Loss) Income	**3,092,316**	**4,142,461**	**4,788,680**	**682,536**	**(2,091,589)**
Non-operating expenses	(159,736)	(240,657)	14,867	(822,145)	(1,075,993)
Capital contributions	6,019,577	8,859,354	8,544,479	2,844,401	3,797,144
Increase in Net Assets	**8,952,157**	**12,761,158**	**13,348,026**	**2,704,792**	**629,562**
Net Assets, Beginning of Year	32,596,509	41,548,666	54,309,824	67,657,850	69,596,551
Cumulative effective of change in accounting principle				$(766,091)	
Adjusted net assets, beginning of year	32,596,509	41,548,666	54,309,824	66,891,759	69,596,551
Net Assets, End of Year	**$41,548,666**	**$54,309,824**	**$67,657,850**	**$69,596,551**	**$70,226,113**

Table 8.2: Balance Sheet

	2006	2007	2008	2009	2010
Current assets	$11,566,596	$19,838,646	$27,489,607	$33,303,242	$39,996,322
Net capital assets	64,163,066	72,199,283	84,292,091	152,740,663	156,979,238
Other assets	26,600,970	22,254,355	12,919,407	46,784,489	28,116,127
Total Assets	**$102,330,632**	**$114,292,284**	**$124,701,105**	**$232,828,394**	**$225,091,687**
Current liabilities	$4,295,857	$4,690,108	$3,196,635	$12,213,679	$27,559,578
Long-Term liabilities	56,486,109	55,292,352	53,846,620	151,018,164	127,305,996
Total Liabilities	**$60,781,966**	**$59,982,460**	**$57,043,255**	**$163,231,843**	**$154,865,574**
Invested in capital assets, net of related debt	$7,958,066	$17,450,837	$30,751,038	$23,005,382	$15,777,306
Restricted	25,256,417	21,618,078	12,310,206	20,630,437	17,658,596
Unrestricted	8,334,183	15,240,909	24,596,606	25,961,232	36,790,211
Total Net Assets	**$41,548,666**	**$54,309,824**	**$67,657,850**	**$69,597,051**	**$70,226,113**
Total Liabilities and Net Assets	**$102,330,632**	**$114,292,284**	**$124,701,105**	**$232,828,894**	**$225,091,687**

Table 8-3 summarizes year-end fund balances held by Cascade for each of the last five fiscal years, 2006 through 2010. Cascade currently meets or exceeds all internal policy standards (e.g., working capital) and external requirements (e.g., bond covenants) for fund balances.

Table 8.3: Fund Balances

	2006	2007	2008	2009	2010
Operating	$3,435,892	$5,531,725	$5,709,894	$8,724,335	$10,815,939
Construction	16,124,933	11,854,815	1,593,738	32,076,178	26,544,174
RCFC	5,366,539	8,108,233	14,482,839	11,733,111	5,307,211
Bond	9,712,456	10,123,712	10,580,187	18,045,647	19,220,583
Rate Stabilization	950,000	2,034,317	6,356,112	6,590,647	2,725,811
	$35,589,820	**$37,652,802**	**$38,722,771**	**$77,169,919**	**$64,613,719**

RCFC = Regional Capital Facilities Charges

8.2. Existing Rates and Charges

Cascade serves Member agencies on a wholesale basis. As such, its rates and charges do not include retail rates. Cascade's charges to Members reflect the fixed nature of much of Cascade's costs, whether currently under block supply contracts or as anticipated with debt service related to financing of the capital program. As a means of mitigating financial risk, Cascade's rate structure is primarily fixed in nature. Member agencies pay for wholesale supply and transmission through a common structure of charges based primarily on their growth (Cascade Equivalent Residential Units, or CERUs) and historical demand (Demand Shares).

***Cascade Equivalent Residential Units* (CERUs)**: The CERU was established as a means of standardizing Cascade's Member base, given potential variations in the way that each Member defines an Equivalent Residential Unit (ERU). Each Member's CERU count is based on the number of retail connections that it serves (see Table 4.2 for the historical CERU counts) and the size of those connections. Industry-accepted meter flow factors provide the basis for the CERU conversion.

Demand Shares: While the CERU provides a means of estimating average capacity requirements, it does not address levels of actual usage of regional water by each Member or variations of usage patterns among Members. Cascade uses a three-year rolling history of regional demand to define Demand Shares as a basis for Member charges, with adjustments to this history for special cases as defined by the Cascade Board. A Member's Demand Share is established as the greater of:

- Average daily demand (in mgd) from Cascade during the peak season, defined as June through September; or
- Average daily demand (in mgd) from Cascade for the entire calendar year; or
- An amount determined by the Cascade Board to address special circumstances such as those involving new Members or Members relying on Cascade investments in system facilities to extend or expand service.

Cascade's basic charges are described below:

- ***Administrative Dues*** - Cascade's administrative costs are allocated to Members on a CERU basis. The amount generated from this charge in any given year is limited by contract to 9 percent of total revenues. For 2012, the annual administrative charge is $15.26 per CERU and collects roughly $2.7 million.

- ***Conservation Charge*** - This charge recovers the costs associated with administering Cascade's conservation program. Like administrative dues, the conservation charge is based on an allocation of costs to Members on a CERU basis. For 2012, the conservation charge is $7.74 per CERU for the year and collects roughly $1.3 million.
- ***New Water Surcharge*** - The new water surcharge is an interim "phase-out" volume charge of $0.75 per ccf imposed on wholesale water usage in excess of a baseline level. It expires after 2011 and after that will no longer be applicable.
- ***Demand Share Charges*** - All remaining revenue requirements are recovered through the demand share charge. In 2012, roughly 85 percent of revenues are generated through the demand share charge. In 2012, there are 36.4 demand shares (in mgd) with a charge of roughly $776,000 per demand share, collecting approximately $28.3 million.
- ***Regional Capital Facilities Charges*** - The regional capital facilities charge is imposed as a one-time charge to Members for new connections to their systems. As a growth-based charge, this is the most volatile revenue source of Cascade. It is currently $6,005 per CERU, and funds generated are used for capital and debt service, with some funds accumulated in reserve for major capital projects scheduled in the future. In 2012, this charge is projected to generate approximately $7.2 million.

8.3. Cascade's Near-term Financial Forecast

Table 8-4 summarizes Cascade's forecasted financial activity for 2012 through 2016. Cascade adopts a biennial budget preceding odd-numbered years, and will adopt a 2-year budget in late 2012 for the 2013-14 biennium.

Cascade is shown to be accumulating funds during this short-term period, consistent with objectives related to providing cash funding toward future major capital investments.

Table 8.4: Near-term Financial Forecast

Sources & Uses	2012	2013	2014	2015	2016
Beginning Fund Balance	**$44,797,191**	**$35,545,596**	**$38,502,036**	**$43,063,365**	**$46,267,558**
Annual Member Charge Increase	***6.00%***	***4.00%***	***4.00%***	***4.00%***	***4.00%***
Sources:					
Member Charges (Excluding RCFCs)	$32,396,255	$33,692,105	$35,039,789	$36,441,381	$37,899,036
Member Charge Adjustments	(1,283,756)	(1,150,000)	-	-	-
RCFCs and SDCs	7,364,089	7,839,224	9,036,913	10,655,283	13,129,067
Interest Earnings	895,944	1,060,368	1,137,324	1,262,428	1,346,817
Debt Proceeds	3,156,762	19,063,665	2,223,836	-	-
Federal BABs Reimbursement Payments	1,284,637	1,267,621	1,246,509	1,221,102	1,221,102
Other Operating Revenues	706,479	912,895	928,546	944,665	961,269
Total	$44,520,410	$62,685,879	$49,612,917	$50,524,858	$54,557,290
Uses:					
SPU Water Purchases (Including Wheeling)	$19,338,799	$19,479,050	$19,879,050	$20,475,422	$21,089,684
TPU Water Purchases	2,976,208	2,932,212	2,882,897	3,959,179	3,932,313
Other Operating Expenses	8,450,401	8,526,755	8,670,007	9,230,107	9,317,416
Existing Debt Service	10,145,179	10,127,365	10,104,097	10,079,806	10,083,609
New Debt Service	78,919	681,943	1,214,131	1,303,199	1,629,617
Capital Outlays	12,782,500	17,982,113	2,301,406	2,272,952	2,346,823
Total	$53,772,006	$59,729,438	$45,051,588	$47,320,665	$48,399,462
Ending Fund Balance	**$35,545,596**	**$38,502,036**	**$43,063,365**	**$46,267,558**	**$52,425,386**

8.4. Cascade Capital Funding Strategy

As summarized in Chapter 7, Cascade plans major system improvements over the next 20 years. The capital improvement plan considered in the financial analysis includes the following major elements:

- Capital improvements needed to maintain the Lake Tapps Project prior to its use for municipal water supply;
- Construction of the Tacoma-Cascade Pipeline to convey Tacoma and Covington Water District supplies north to Cascade, including storage;
- Development of the Lake Tapps Project as a municipal supply, including transmission, storage and treatment;
- Completion of regional distribution elements needed to deliver future sources to Cascade Members.

The financial analysis considers the financial impacts of these projects. For that analysis, project costs are escalated to year of construction using an escalation factor of 3.25 percent per year (2011 base). Further, as discussed in Section 7.2 each project is assigned a time-related contingency factor to reflect the cost impact of changing conditions. This factor adds 0.075 percent to 0.15 percent per year to the escalation factor on a project-specific basis. Figure 8-1 summarizes the projected capital expenditures for 2012 through 2030, including anticipated sources of funding:

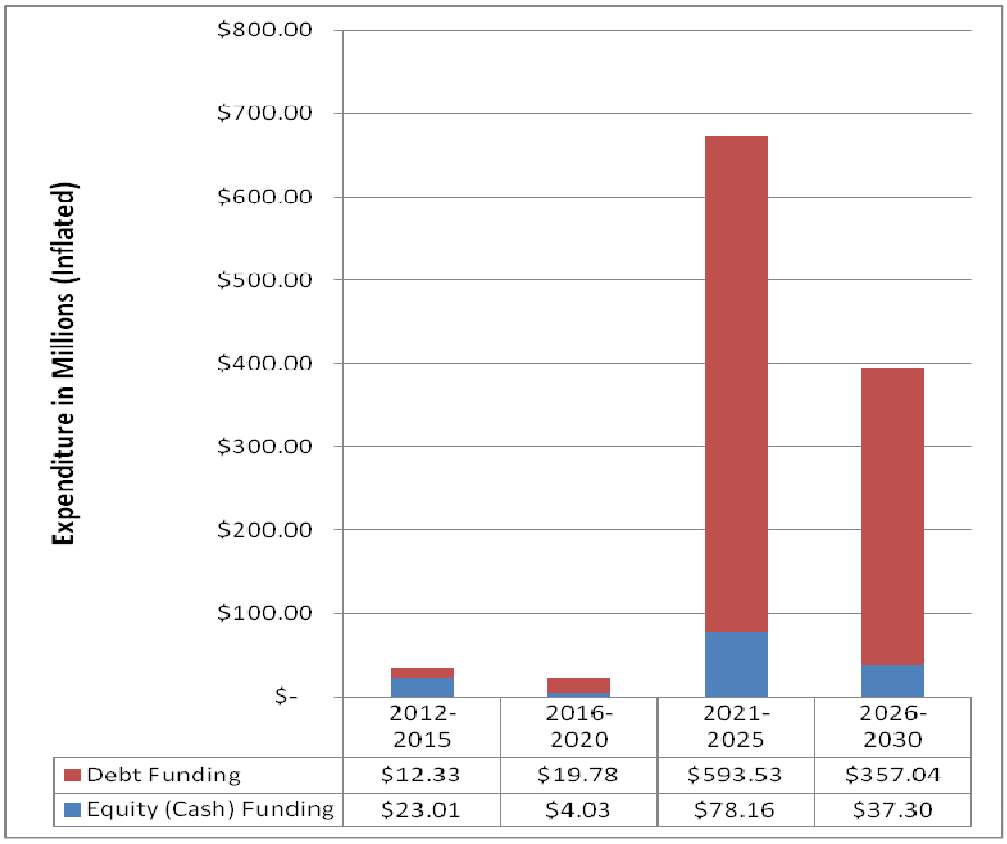

Figure 8.1: Summary of Cascade Capital Improvement Funding

In addition to revenue bonds, Cascade will monitor and pursue lower-cost funding sources, such as grant and loan programs, as projects are prepared for execution.

8.5. Projected Cascade Member Charges

The projection of Cascade Member charges is based on the capital and operating needs of the system. Figure 8-2 summarizes the forecast of Cascade's annual revenue requirements for the period 2012 through 2030, showing total requirements as broken down among major operating and debt service components. This figure does not show capital costs directly, but does show the impacts of those expenditures as well as operating and maintenance costs on Member charges. The annual revenue requirement increases by an average of 5.8 percent during this period, relative to an assumed inflation rate of 3.0 percent, reflecting the substantial capital investment planned for this period. Looking at the longer-term forecast (not shown), subsequent increases are projected to average well below inflation, with the cumulative increase for 2012 through 2050 below 4 percent. This is indicative that near-term cost increases, especially during the capital intensive period after 2020, could be managed to some degree by debt structure and perhaps by refined capital project scheduling.

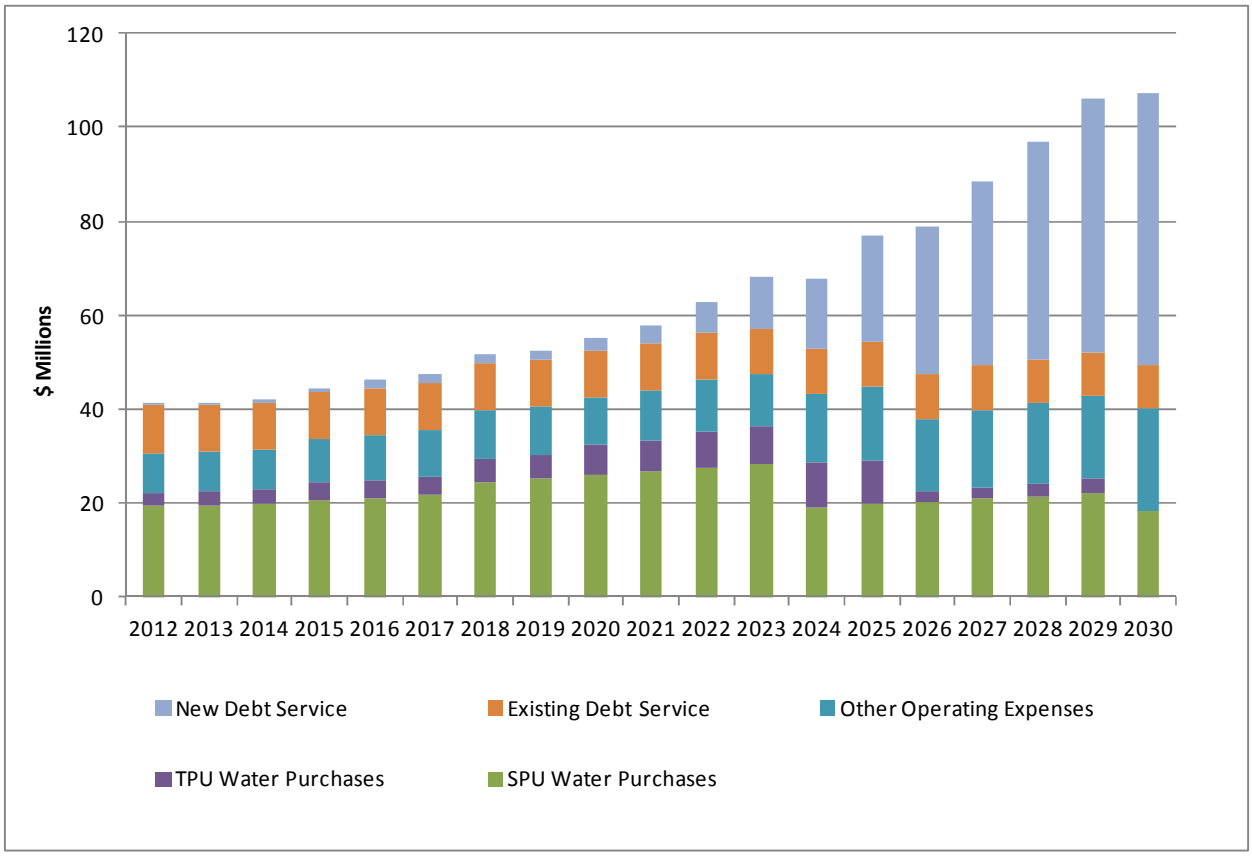

Figure 8.2: Summary of Cascade Revenue Requirements by Expenditure

Figure 8-3 summarizes the breakdown of Member payments by agency for the same timeframe of 2012 through 2030. This forecast assumes that no new Members are added and that no major new service areas are added by existing Members.

As discussed in Chapters 5 and 7, Cascade intends to continue seeking flexibility in its supply arrangements that may permit deferring either the Tacoma-Cascade Pipeline or the Lake Tapps Project, or both of these. There appear to be opportunities for expanded contract supplies from one or more sources, i.e., SPU, TPU, or Covington Water District. Expanded supplies from SPU could allow Cascade to defer both the TCP and the Lake Tapps Project. Expanded supplies from TPU or Covington could allow deferral of the Lake Tapps Project until after the TCP is constructed. Any of these options would favorably affect the financial picture and reduce financial burdens on Cascade Members and their ratepayers.

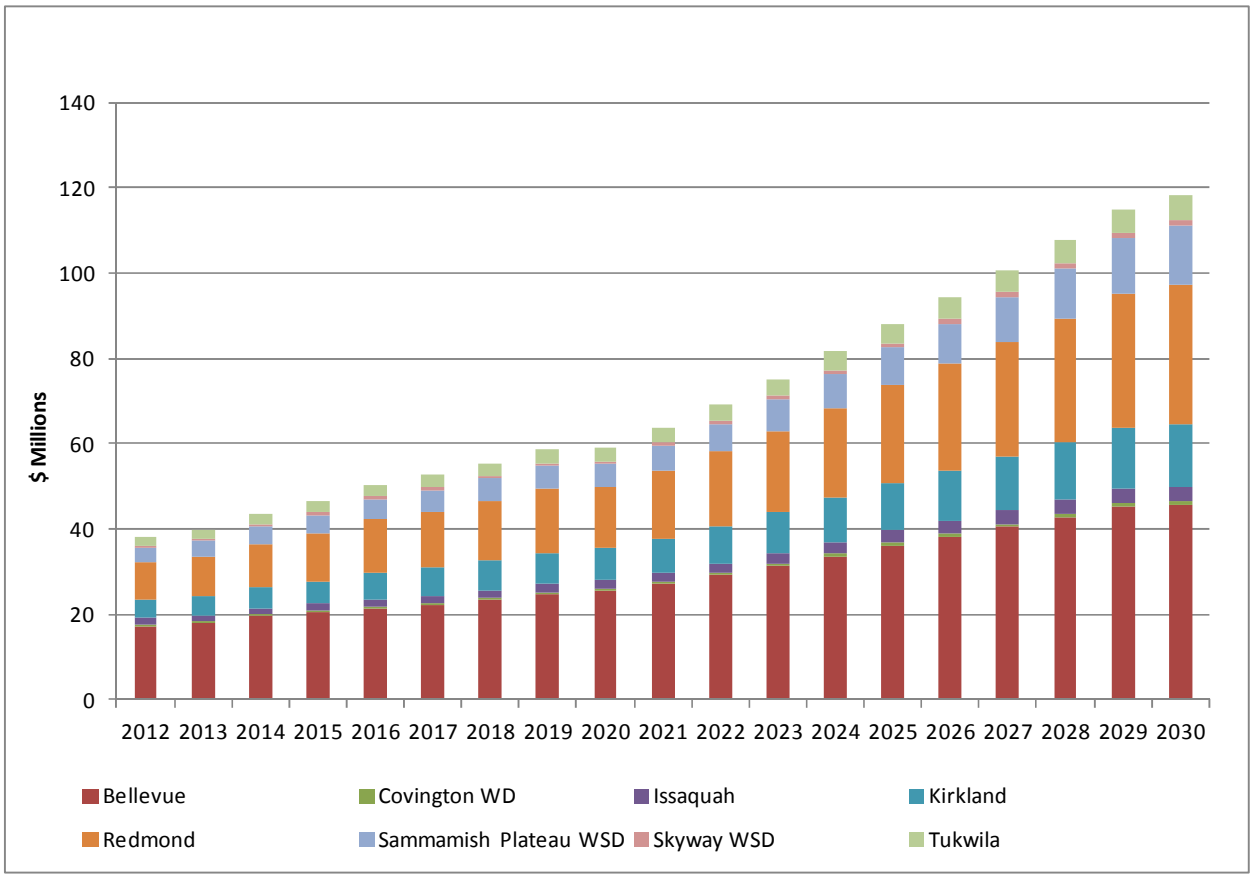

Figure 8.3: Summary of Cascade Projected Charges by Member

8.6. Qualitative Assessment of Sensitivity to Assumptions

Cascade continuously monitors and analyzes both near-term (5 years) and long-term (up to 70 years) financial forecasts and evaluates supply and transmission strategies in the context of projected financial and economic impacts. Sensitivity and risk analysis are a part of that evaluation process.

The strategy incorporated in this plan is highly sensitive to growth and demand assumptions. Lower growth would enable resource strategies to "bridge" supplies from current resources to Lake Tapps, allowing a moderated capital schedule and related rate and financial impacts. For example, a relatively small reduction in forecasted peak demands would allow extension of the Lake Tapps Project development schedule by five years, to about 2035, providing attenuation of financing needs and increased time for accumulation of equity funding, reducing net rate

requirements. Short-term extensions of existing supply commitments could help provide similar flexibility in scheduling with commensurate reductions in financial impacts.

At the same time, higher growth within moderate bounds does not necessarily require acceleration of capital projects, instead providing added sources of funding through regional capital facilities charges and a larger customer base over which to spread capital development costs. This is particularly true with an active conservation and demand management program, including targeting peak system demands as a critical constraint. The strategy of incremental supply acquisition and demand management also offers short-term opportunities to maintain or even extend development schedules, providing reduced financial impacts on Cascade and its Members.

Cost escalation also introduces risk in terms of both operating and capital program costs. At the same time, inflationary pressures tend to be broad-based and relatively neutral in terms of customer impact when measured in real terms.

Finally, Cascade's projected high level of reliance on debt financing introduces market risk in terms of the cost of debt financing. Current uncertainty regarding tax treatment of municipal debt, limited funding available for grant and loan programs, and risk of inflationary pressures with related upward pressure on interest rates are outside of Cascade's ability to control. However, near-term funding decisions and fiscal policies can target measures that can mitigate this risk, for example through accumulation of funds for future projects and issuance of near-term bond issues with shorter maturities. Cascade continues to actively explore these and other options for mitigating projected financial impacts and risks.

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