Seattle Public Utilities

2013 Water System Plan

Our Water. Our Future.

Volume II Appendices
July 2012

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VOLUME II: Appendices

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2013 WATER SYSTEM PLAN

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

A. WATER RESOURCES

APPENDIX A-1

OFFICIAL YIELD ESTIMATE AND LONG-RANGE WATER DEMAND FORECAST

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2013 Water System Plan
Official Yield Estimate and
Long-Range Water Demand Forecast

Inputs and Assumptions for the Firm Yield Estimate

Firm yield of the water supply system is estimated using a simulation model developed by Seattle Public Utilities called the Conjunctive Use Evaluation (CUE) model. Additional details of the model and inputs are documented in the final report titled *Firm Yield of Seattle's Existing Water Supply Sources*, November 2011, prepared by Seattle Public Utilities.

Model Inputs and Assumptions

⇨ Firm yield is based on the **98% reliability standard**—one shortfall occurs in the 81 years of historic record.

⇨ **Historic weekly inflows** reconstructed for water year 1929 through 2009 are used.

⇨ **Total system demand** is shaped on a monthly demand pattern based on the average of actual deliveries from calendar year 2005 through 2009.

⇨ **Sources of supply are operated conjunctively as a single system.**

⇨ **Operational assumptions include:**

- Cedar River System:
  Meet Cedar River Habitat Conservation Plan instream flow commitments below Landsburg, assuming flashboards in place on Overflow Dike.
  Fixed rule curve for Cedar Reservoir of 1550' for October-February and 1563' for May-August.
  Minimum levels for Chester Morse Lake: 1532'; Masonry Pool: 1510'
  Meet diversion limits specified by the 2006 Agreement with the Muckleshoot Indian Tribe.

- South Fork Tolt System:
  Meet instream flows from 1988 Tolt Settlement Agreement (with treatment project).
  Fixed rule curve 1754' for October-January; 1765' for March-August.
  Minimum level for South Fork Tolt Reservoir: 1710'
  Treatment/Transmission capacity: 120 MGD

- Seattle Well Fields:
  10 MGD withdrawn for 14 weeks as needed from July-December.
  5 MGD recharged for 14 weeks from January-March.

Results

Based on the above, **the system-wide firm yield is 172 million gallons per day**.

Inputs and Assumptions for the Water Demand Forecast Model

Seattle Public Utilities (SPU) is using the same basic water demand forecast model that was developed for the *2007 Water System Plan*. Following a literature review of demand forecast models used by other utilities, SPU settled on a "Variable Flow Factor" approach. As with simpler fixed flow factor models, current water demand flow factors are calculated by sector (single and multi- family residential, non-residential) for Seattle and each individual wholesale customer. However, like an econometric model, the Variable Flow Factor model reflects the impacts of variables such as price, income, and conservation on water flow factors for each sector over time. This approach takes advantage of past econometric analysis to provide estimates of how some of the variables (price and income) affect demand. SPU's Conservation Potential Assessment (CPA) Model and new Passive Savings model are then used to estimate the impacts of programmatic and passive conservation on the flow factors over time. The structure of the model is summarized in the flow chart on the next page while the model inputs and assumptions are outlined, below.

The structure of the water demand forecast model is represented in the flow chart on the following page. Intermediate steps and final results are shown as rectangles. Model inputs are shown as ovals with the gray shaded ovals indicating which inputs are subject to uncertainty and modeled using Monte Carlo simulations. The only real change in the flowchart since 2007 is the addition of household size as a factor affecting residential flow factors over time.

Model, Inputs and Assumptions

⇨ **Weather adjusted base year consumption:**

By sector

- single family residential
- multifamily residential
- manufacturing non-residential
- non-manufacturing non-residential

By service area

- Seattle-inside city limits
- Seattle-outside city limits
- Individual wholesale customers

Base Year

- 2010

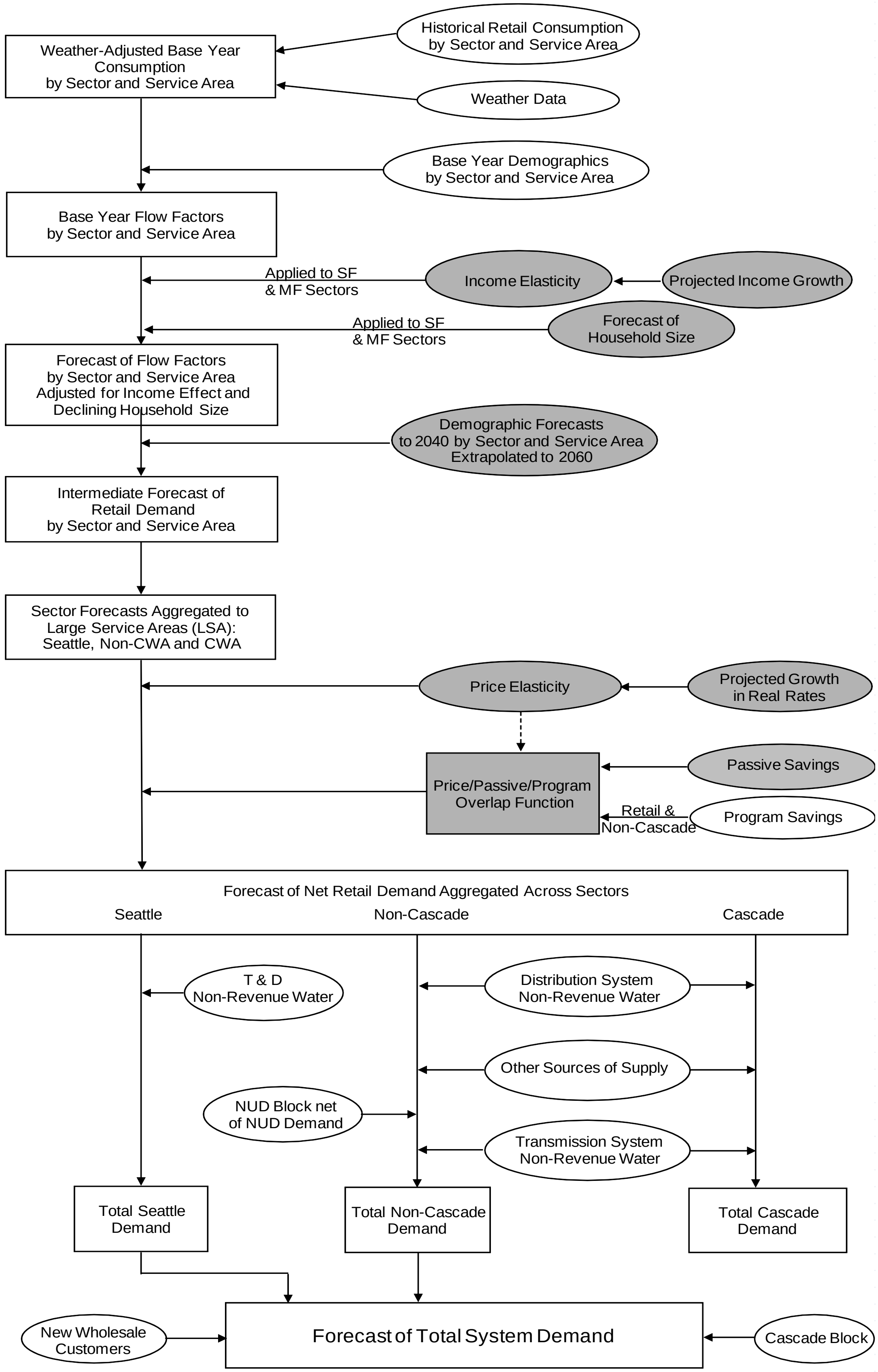
Weather

- Sea-Tac Airport monthly average daily temperature and total precipitation

Sources: SPU billing data, Annual Purveyor Surveys, NOAA

⇨ **Demographics: Current and projected single- and multi-family households and employment:** The model uses Puget Sound Regional Council (PSRC) 2006 TAZ-level forecasts of population, households and employment to 2040 apportioned to Seattle and individual wholesale service areas. (These are the most recent forecasts available.) A straight line extrapolation of average annual growth between 2010 and 2040 is used to forecast beyond 2040. Household and population data from the 2010 Census and PSRC 2010 employment estimates are used to calibrate the PSRC demographic forecasts to current conditions.

WATER DEMAND FORECAST MODEL STRUCTURE



In the first table below is displayed PSRC's forecast of population, households, and employment in King County. The tables that follow contain these forecasts as they have been apportioned into water service areas. Separate tables are provided for all of King County, SPU's retail service area, and the service area of Full and Partial Contracts (F&P) wholesale customers.

Actual[1] & PSRC Forecasts of Population, Households, & Employment

King County

		Households			
	Population	Single Family	Multifamily	Total	Employment
2000	1,737,034	453,437	257,479	710,916	1,196,043
2010	1,892,999	489,880	298,423	788,303	1,144,022
2020	2,075,426	532,658	362,451	895,109	1,498,043
2030	2,234,775	568,799	428,527	997,326	1,664,780
2040	2,401,521	605,712	501,095	1,106,807	1,830,535
2010-2040					
Growth	508,522	115,832	202,672	318,504	686,513
% Change	27%	24%	68%	40%	60%
Annual %	0.8%	0.7%	1.7%	1.1%	1.6%

As Apportioned to SPU's Retail Service Area[2]

		Household			
	Population	Single Family	Multifamily	Total	Employment
2000	618,323	151,741	128,450	280,191	555,410
2010	663,680	157,260	145,645	302,905	506,396
2020	710,784	161,471	175,775	337,246	608,178
2030	753,028	164,415	205,960	370,375	692,684
2040	801,169	167,267	240,078	407,345	781,846
2010-2040					
Growth	137,489	10,007	94,433	104,440	275,450
% Change	21%	6%	65%	34%	54%
Annual %	0.6%	0.2%	1.7%	1.0%	1.5%

As Apportioned to the Full and Partial Contracts Wholesale Service Area

		Household			
	Population	Single Family	Multifamily	Total	Employment
2000	381,658	103,318	40,032	143,351	156,737
2010	410,755	111,054	45,427	156,481	165,834
2020	447,193	121,192	54,608	175,800	187,930
2030	477,889	129,587	64,380	193,967	212,578
2040	511,852	138,012	76,427	214,439	241,712
2010-2040					
Growth	101,097	26,958	31,000	57,958	75,878
% Change	25%	24%	68%	37%	46%
Annual %	0.7%	0.7%	1.7%	1.1%	1.3%

[1] Census data used for 2000 and 2010 population and households. 2010 employment is based on latest (2011) PSRC estimate of 2010 employment.
[2] SPU's retail service area includes the City of Seattle and portions of the cities of Shoreline, Lake Forest Park and Burien, as well as portions of unincorporated King County south of the City of Seattle.

Household size is calculated for single and multifamily households in Seattle and for wholesale customers over the forecast period based on PSRC projections of single and multifamily households and population. Since the number of households is expected to grow faster than population through 2040, household size is projected to decrease over the next 30 years. The estimates of household size are as follows:

	Seattle		SWP Wholesale Customers	
	Single Family	Mutlifamily	Single Family	Mutlifamily
2010	2.41	1.93	2.76	2.25
2020	2.32	1.89	2.59	2.19
2030	2.24	1.85	2.50	2.13
2040	2.16	1.81	2.41	2.08
2050	2.16	1.82	2.40	2.09
2060	2.15	1.82	2.40	2.10

A straight-line extrapolation of average annual growth between 2010 and 2040 is used to forecast population beyond 2040. However, projections of the number of households beyond 2040 are based on the assumption that household size will stabilize and growth in the number of households will slow to about the rate of population growth. Per household flow factors are then reduced each year by the percent change in household size times the elasticity of demand with respect to household size. This elasticity is estimated to be 0.38 based on data from an end-use study conducted by the Seattle Water Department in the mid-1990s.

⇨ **Base Year Flow Factors:** Base year flow factors are obtained by dividing the weather-adjusted base year consumption for each sector (e.g. single family residential) and service area (e.g. Bothell) by the corresponding number of households or employees in the base year.

⇨ **Elasticity of residential demand to changes in real (inflation adjusted) household income:** Household income is generally expected to have a positive effect on water demand. A review of the literature revealed a range of estimated income elasticities. An elasticity value of **0.27**, representing the middle of this range, was chosen. (This means that a 10% increase in household income would be expected to cause a 2.7% rise in residential demand.)

Source: Results of literature review

⇨ **Forecast of annual growth in real median household income:** Mean household income was used in the 2007 WSP but on further reflection, median income appears to be the more appropriate concept. The past 40 years has seen a widening gap between growth in mean and median income. Both national and local time series on real per capita personal income show average annual rates of growth of about 2.0%. However after adjusting for inflation, median household income Washington State and King County is now slightly less than it was in 1989. The growth rate has been essentially zero. There is additional evidence that this is not just true for the median household but for most households except those at the very top of the income distribution. A recent analysis by economists Saez and Piketty based on 90 years of IRS data reveals that *average* household income for the bottom 90% of households has had zero real growth since 1970. Over the same 4 decades, the top 10%, 1%, 0.1%, and 0.01% of households has seen their real incomes increase twofold, threefold, fivefold and eightfold, respectively. If the present trend continues with all income growth going to the top 10%, median income – in fact, the income of the bottom 90% – will remain flat in real terms. More optimistic scenarios would have the increasing skewness in the income distribution slow down, stop, or even reverse. Those conditions would correspond to rates of median income growth greater than zero but less than the average growth rate, equal to the average growth rate, or greater than the average growth rate. For the demand forecast, it is assumed that household income will grow at **0.9%** per year based on the median or about half the historical growth rate in per capita personal income based on averages.

Sources: U.S. Bureau of Economic Analysis, U.S. Census Bureau, Washington State Office of Financial Management, Dick Conway & Associates, Emmanuel Saez of UC-Berkeley.

⇨ **Elasticity of demand to changes in real water rates (prices):** A considerable body of literature has developed concerning the effect of price upon water demand and the inverse relationship predicted by economic theory is now well established. However, a number of complications summarized in the literature review (complex rate structures, conservation impacts, etc.) have made it difficult to estimate price elasticity with much confidence. As a result, there is a wide range of estimates in the literature but as with the income elasticity, values towards the middle of the range have been chosen for this model. These are shown below. (The value of -0.20 for single family households means that given a 10% increase in water prices, demand would be expected to decline by 2%.)

	Single Family	Multifamily	Non-Residential
Price Elasticity	-0.20	-0.10	-0.225

Sources: Results of literature review, Seattle's 1992 econometric model.

⇨ **Forecast of annual growth in real water rates (prices)**: Seattle and its wholesale customers have different water rates and different rate structures. Most customers face different marginal rates depending on whether they're residential or non-residential, what consumption block they fall in and what season it is. There is no single price of water. However, the model abstracts from all these complexities by using the average price of water, i.e., revenue requirements divided by billed consumption.

The model takes into account the significant increases in water and sewer[3] rates already adopted or anticipated through 2014. After that point, the SPU 20-year rate model forecasts that growth in inflation-adjusted retail water rates will slow to less than half a percent per year on average. The rates charged to SPU's wholesale customers are expected to increase even more slowly. However, wholesale customers have their own system costs to recover from their retail customers and these are likely to increase on a per ccf basis as well. The demand forecast model assumes the following growth rates:

[3] Because sewer bills in Seattle are based on metered water consumption, both water and sewer rates are assumed to impact water demand in the model. This is only the case for the retail service area, however. Many different cities and sewer districts provide sewer service in Seattle's wholesale water service area, each with different sewer rates and rate structures. Unlike Seattle's sewer rates that are entirely volume based, most other sewer providers have large fixed charges with much less of their revenue generated by volume rates. For that reason, as well as lack of information on past, current and anticipated sewer rates in the wholesale service area, the demand model for wholesale customers does not include sewer rates.

Annual Growth in Average Water Rates

	Seattle Retail*	Wholesale Customers
2010-2015	5.1%	2.0%
2016-2060	0.4%	0.4%
2030-2060	0.4%	0.4%

* Reflects anticipated increases in water and sewer rates

These are less than the average historical rate of growth of about 2.7% since 1974 but are consistent with the financial forecast used elsewhere in this Plan.

Sources: Historical rate and consumption data, SPU 20-year rate models for water and wastewater, King County Financial Plan dated June 27, 2011.

⇨ **Conservation - Reductions in Water Use due to Passive Savings:** Some conservation savings occur each year without SPU intervention due to federal and state plumbing codes setting efficiency standards for showerheads, toilets, aerators, and clothes washers. As old fixtures and appliances are replaced with new ones in existing buildings and new fixtures and appliances are installed in new construction, water use efficiency improves and conservation savings accrue. In addition, fixtures and appliances available from the market at competitive prices often become increasingly more efficient than is required by codes, especially as more years have passed since the codes were updated. "Passive savings" is made up of this phenomenon – referred to as "market transformation" – together with "code savings." A new model was developed to estimate these savings through 2060.

The model takes account of federal fixture and appliance codes adopted in 1992, 2002 and 2007. In addition, the impact of new clothes washer codes scheduled for adoption in 2011[4] to become effective in 2015 are also included. The model also reflects the current proportion of fixtures and appliances sold in the market that meet the more stringent Energy Star, Water Sense, and Consortium for Energy Efficiency (CEE) standards, as well as how those proportions are expected to continue shifting in the direction of higher efficiency over time. The model assumes that aerators, showerheads, clothes washers and toilets are, on average, replaced every 5, 10, 12 and 30 years, respectively.

Passive Savings in MGD

	Single Family	Multi-family	Non-Residential	Total
2020	2.5	1.7	0.6	4.9
2030	5.6	4.0	1.2	10.8
2040	7.5	5.8	1.7	15.0
2050	8.5	7.0	2.1	17.7
2060	9.0	7.8	2.4	19.2

Sources: Conservation Potential Assessment (CPA) model, U.S. EPA Office of Water, Alliance for Water Efficiency, Al Dietemann (personal communication)

[4] The US Department of Energy has proposed a two phase clothes washer efficiency standard with the first phase effective March 7, 2015, and the second, more stringent phase, effective for Janunary 1, 2018. This federal proposal has yet to be adopted as a final rule.

⇨ **Conservation - Reductions in Water Use due to Programmatic Savings:** Based on the January 2006 decision by the Seattle Regional Water System Operating Board, the forecast includes **15** mgd of combined price-induced and programmatic conservation savings between 2011 and 2030, by assuming that demand is reduced evenly by 0.75 mgd each year over the 20-year period. Depending on what is assumed about the growth rate in water and sewer prices, more or less programmatic savings are required to meet this target. The price assumptions described above are estimated to produce a 7 mgd reduction in demand by 2030 leaving **8 mgd** to be achieved through programmatic conservation, assuming no price/conservation overlap (described below). This is equivalent to 0.4 mgd per year. These conservation savings only apply to Seattle and other members of the Saving Water Partnership. As is explained below, the Cascade Water Alliance has a block contract with SPU which limits its demand from the Seattle system. While Cascade is expected to pursue its own conservation programs, that doesn't affect the forecast of its demand from SPU which is assumed not to exceed the block. There is assumed to be no additional programmatic conservation after 2030.

⇨ **Price/Passive/Programmatic Conservation Overlap:** Total conservation savings is adjusted downwards to account for the overlap between the different types of conservation. It is assumed that half of the price effect overlaps with passive and programmatic savings as long as the total amount of overlap represents less than half of total passive and programmatic conservation (as is the case over the forecast period). However, if the price effect exceeds combined passive and programmatic conservation, the amount of overlap is capped at 50%. The overall effect of the overlap function is to reduce total gross price/passive/programmatic savings by about 14%. For accounting purposes, the amount of overlap is deducted from the estimate of passive savings.

⇨ **Non-Revenue Water:** Combined transmission and Seattle distribution system non-revenue water is assumed to start at **8** mgd in 2010 and increase uniformly to **10** mgd by 2060. This increase is expected to be caused by a growing number of leaks that will probably occur as the distribution system ages.

⇨ **Wholesale Customer Demands:**

- Wholesale customer distribution system non-revenue water is assumed to be a constant **6%** of retail water demand in the wholesale service area over the forecast period. This is added to the forecast of wholesale customers' retail demand.

  Source: Annual Surveys of Wholesale Customers, 1994-2010.

- Water that full and partial contract wholesale customers expect to obtain from other sources of supply is subtracted from their demand from the SPU system. This amount is currently about **16** mgd and is projected to reach **18.5** mgd by 2020.

  Sources: 2010 Survey of Wholesale Customers, direct communication with individual wholesale customers.

- Contract with the Cascade Water Alliance (Cascade). Under the Cascade contract, Seattle will provide a fixed block of **33.3** mgd to Cascade through 2017, and then the block will be increased by 2 mgd to **35.3** mgd in 2018, reflecting the supplemental block from the 2008 contract. The block will then be reduced by 10 mgd in 2024 and by another 5 mgd in 2030. Additional 5 mgd reductions will occur every 5 years thereafter through 2045, leaving a final block of **5.3** mgd. This has been incorporated into the forecast by subtracting the projected demand of Cascade members that are currently Seattle wholesale customers, and adding the Cascade block. The following cities and districts are members of Cascade:

- Bellevue
- Covington
- Kirkland
- Issaquah
- Redmond
- Sammamish Plateau
- Skyway
- Tukwila

- Block contract with Northshore Utility District. Northshore Utility District also has a block contract under which Seattle will reserve a fixed block of **8.6** mgd for Northshore through the contract period which terminates in 2060. This has been incorporated into the forecast by subtracting Northshore's projected demand and adding the Northshore block. Note that current Northshore demand is about 3 mgd less than its block. By 2060, actual Northshore demand is expected to have grown to 7.3 mgd, still less than its block by more than 1 mgd.

- Forecasts of demand from potential new wholesale customers are based on data provided by them on their projected demand and existing supplies. Potential new wholesale customers included in the forecast are Ames Lake Water Association and City of Carnation. Demand from Ames Lake is expected to begin at zero ramping up to **0.5** mgd by 2033 and remaining constant thereafter. Carnation purchases from SPU are also expected to start at zero, ramp up to **0.5** mgd by 2028, and then remain constant. The City of Snoqualmie is also considered a potential new wholesale customer, but no specific demand is included in this forecast.

  Sources: Ames Lake Water Association, City of Carnation, City of Snoqualmie.

- Historically, Renton's water purchases from SPU have been negligible, but that is expected to change over time under the new contract as its demand begins to exceed its peak day capacity. Renton has provided a forecast of its estimated requirements from SPU ramping up to **0.9** mgd by 2060.

- Edmonds and Lake Forest Park are no longer included as wholesale customers. They do not purchase water from SPU nor do they have supply contracts after 2011 for regular supply.

Results

Given the assumptions described above, the water demand forecast is considerably lower than the last official forecast, particularly in the outer years, and remains considerably below SPU's current firm yield of 172 mgd through at least 2060. The demand forecast starts out at **133** mgd, higher than actual demand in 2010 because the forecast includes the Cascade and Northshore blocks that currently exceed the actual demand of those customers by 12 mgd. Total demand is forecast to remain relatively flat through 2023 at which point the Cascade block begins to step down. Over the following two decades, water demand is forecast to decline as the periodic reductions in Cascade's block more than offset what would otherwise be a modest amount of growth in demand. Once the Cascade block has been reduced to its minimum level in 2045, water demand is forecast to begin rising again, finally returning to **133** mgd by 2060.

The major changes in the forecast relative to the *2007 Water System Plan* forecast are summarized below:

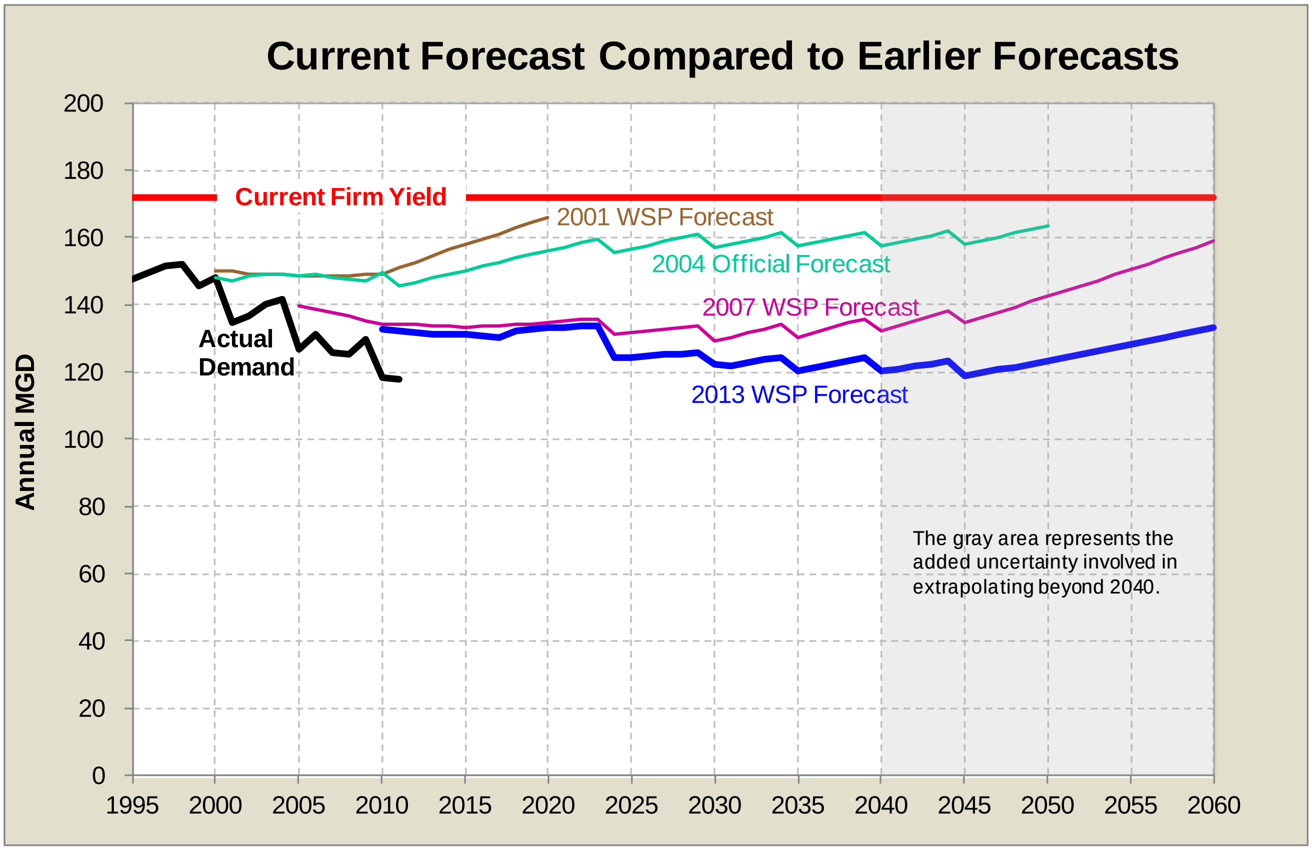
1. The new forecast is calibrated to 2010 actual consumption, adjusted for weather. Starting flow factors average just slightly lower than was projected for 2010 in the 2007 WSP forecast.
2. The Cascade block is higher, starting at 33.3 mgd rather than 30.3 mgd and then increasing to 35.3 mgd in 2018 before returning to original block path (25.3 mgd) in 2024, reflecting the supplemental blocks in the 2008 contract.
3. New PSRC forecasts (2006) of households, population and employment out to 2040 are used.
4. The model adjusts for what is now forecast to be a significant decline in household size.
5. The estimate of passive savings is 8 mgd more than the old forecast of code savings by 2060. Passive savings includes impact of codes implemented since 1993, new codes that are expected to be adopted in the near future, and the extent to which fixtures and appliances actually available in the market exceed current and anticipated codes.
6. Projected growth in median rather than mean household income is now used in the forecast. The assumption is that median income will grow at an average rate of 0.9%, about half as fast as mean income, as a disproportionate share of real income gains continue to accrue to the top 5% of households. Compared to the 2007 WSP forecast, this decreases 2060 demand by 11 mgd.
7. In the long-term, water rates are now projected to increase at about half the rate assumed in the 2007 WSP. This increases the 2060 forecast of demand by 3 mgd.
8. The forecast of non-revenue water has been reduced: 10 mgd in 2060 compared to 15.5 mgd in the 2007 forecast.
9. Renton has been added as a partial-requirements customer, which adds about 1 mgd to the forecast by 2060.
10. Highline purchases 2 mgd from Lakehaven beginning in 2016, reducing demand from SPU.
11. Potential new wholesale customers now include Ames Lake and Carnation, with total demand ramping up to 1 mgd by 2033.

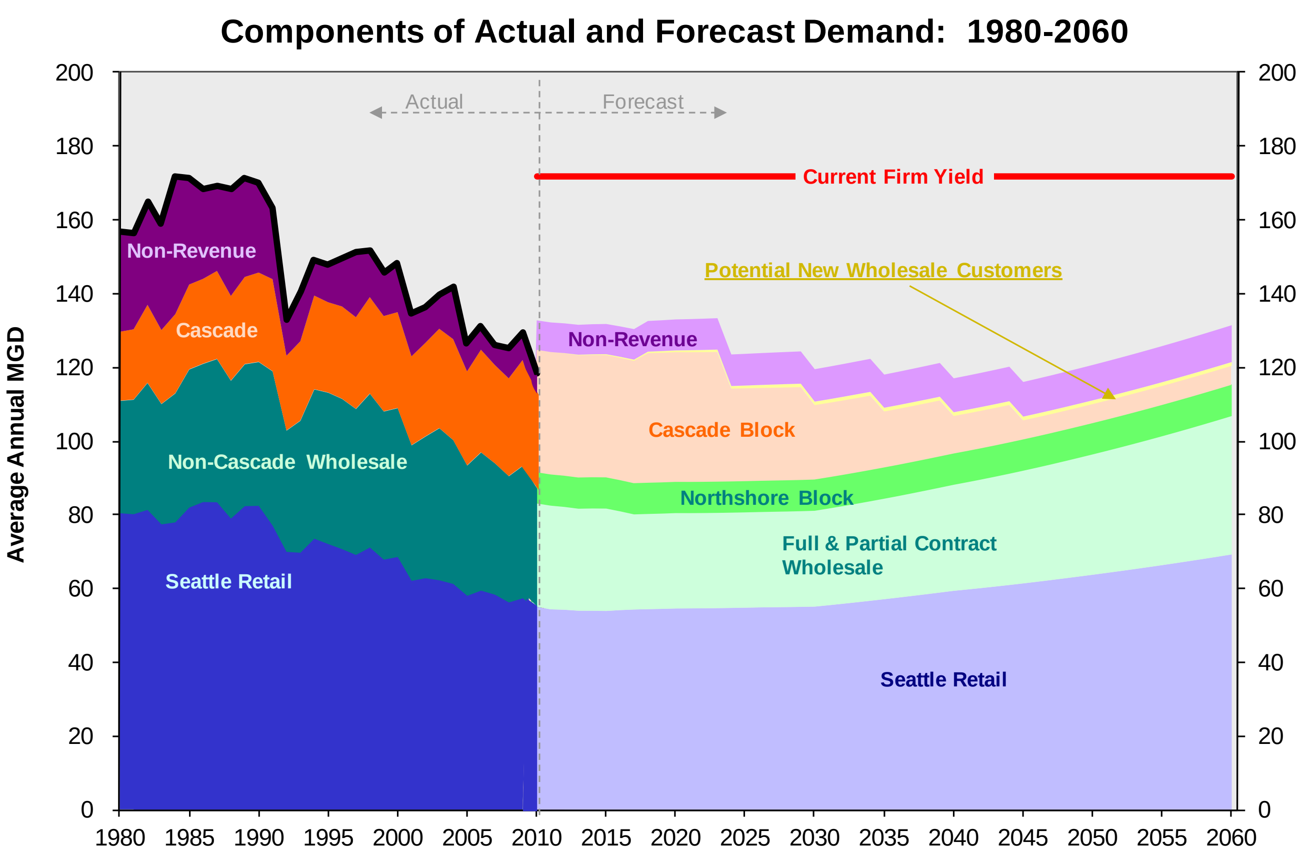
The *2013 Water System Plan* (WSP) demand forecast broken down by sector is shown in the table and graphs below. The first graph shows the forecast of demand and supply out to 2060 along with previous WSP forecasts. The gray area between 2040 and 2060 represents the additional uncertainty involved in forecasting out more than 30 years The second graph shows the various components that add up to the total demand forecast: Seattle retail, full and partial contract wholesale customers, the amounts specified in the Northshore and Cascade block contracts, potential new wholesale customers, and non-revenue water.

Components of Actual and Forecast Water Demand
All figures in millions of gallons per day (MGD)

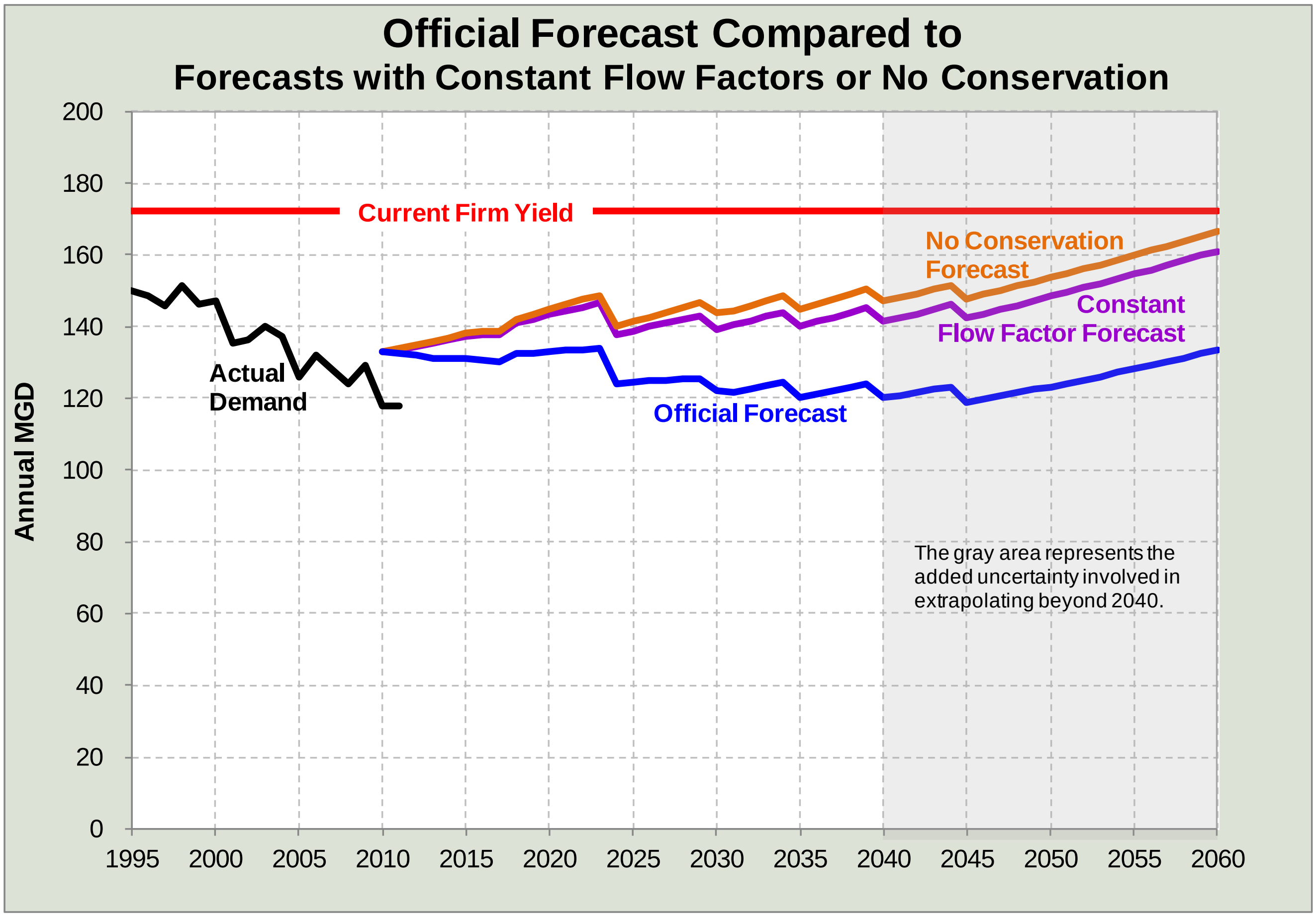
	Year	Billed Demand								Non-Revenue Water	Total System Demand	
		Seattle Retail				Wholesale					Annual Average[4]	Peak Day[5]
		SF Res	MF Res	Non-Res	Subtotal	F&P[1]	Block[2]	New[3]	Subtotal			
	2000	26.9	14.5	27.7	69.1	34.3	31.7	-	66.0	13.2	148.2	241.9
	2001	24.0	13.7	24.6	62.3	30.0	30.8	-	60.7	11.6	134.6	204.0
A	2002	24.8	13.1	24.9	62.8	32.9	31.0	-	63.9	9.8	136.5	222.6
C	2003	24.9	12.8	24.6	62.3	35.6	32.7	-	68.2	9.4	139.9	250.2
T	2004	24.2	12.5	24.6	61.3	33.1	33.3	-	66.4	14.0	141.7	246.8
U	2005	22.6	12.2	23.2	58.0	29.6	31.4	-	61.0	7.7	126.7	210.4
A	2006	23.5	12.3	23.7	59.5	32.0	33.4	-	65.4	6.3	131.2	236.8
L	2007	22.6	12.0	23.6	58.3	28.7	33.7	-	62.5	5.2	125.9	227.6
	2008	22.0	11.8	22.5	56.3	28.8	32.0	-	60.8	8.2	125.3	202.0
	2009	23.1	11.6	22.6	57.3	30.6	34.1	-	64.8	7.5	129.5	241.9
	2010	21.3	11.4	21.6	54.3	26.5	29.6	-	56.1	8.0	118.4	197.9
	2010	21.9	11.4	21.6	55.0	28.0	41.9	0.0	69.9	8.0	132.8	265.7
	2011	21.5	11.5	21.2	54.2	28.2	41.9	0.0	70.1	8.0	132.3	264.7
	2012	21.2	11.6	21.0	53.8	28.1	41.9	0.1	70.0	8.1	131.9	263.8
F	2013	20.9	11.6	20.8	53.3	27.9	41.9	0.1	69.9	8.1	131.3	262.6
O	2014	20.7	11.7	20.7	53.0	28.1	41.9	0.2	70.1	8.2	131.2	262.5
R	2015	20.4	11.7	20.6	52.8	28.1	41.9	0.2	70.2	8.2	131.2	262.3
E	2016	20.3	11.8	20.9	53.0	27.3	41.9	0.3	69.4	8.2	130.6	261.3
C	2017	20.2	11.8	21.1	53.2	26.5	41.9	0.3	68.6	8.3	130.1	260.1
A	2018	20.1	11.9	21.3	53.3	26.6	43.9	0.4	70.8	8.3	132.4	264.8
S	2019	19.9	12.0	21.5	53.4	26.8	43.9	0.4	71.0	8.4	132.7	265.5
T	2020	19.7	12.0	21.7	53.5	26.9	43.9	0.5	71.2	8.4	133.1	266.2
	2021	19.5	12.1	22.0	53.6	26.9	43.9	0.5	71.3	8.4	133.3	266.7
	2022	19.3	12.1	22.3	53.7	27.0	43.9	0.6	71.4	8.5	133.6	267.2
	2023	19.1	12.1	22.6	53.9	27.0	43.9	0.6	71.5	8.5	133.9	267.7
	2024	18.9	12.2	22.9	54.0	27.1	33.9	0.7	61.6	8.6	124.1	248.3
	2025	18.7	12.2	23.2	54.2	27.1	33.9	0.7	61.7	8.6	124.5	248.9
	2026	18.5	12.3	23.5	54.3	27.2	33.9	0.8	61.8	8.6	124.8	249.5
	2027	18.3	12.3	23.8	54.5	27.2	33.9	0.8	61.9	8.7	125.1	250.1
	2028	18.1	12.4	24.1	54.6	27.3	33.9	0.9	62.0	8.7	125.4	250.7
	2029	18.0	12.5	24.3	54.8	27.4	33.9	0.9	62.1	8.8	125.7	251.3
	2030	17.8	12.5	24.6	54.9	27.5	28.9	0.9	57.3	8.8	121.0	241.9
	2031	17.7	12.7	25.0	55.4	27.8	28.9	1.0	57.6	8.8	121.8	243.6
	2032	17.7	12.9	25.4	55.9	28.1	28.9	1.0	57.9	8.9	122.7	245.4
	2033	17.6	13.0	25.8	56.4	28.4	28.9	1.0	58.2	8.9	123.6	247.1
	2034	17.6	13.2	26.1	57.0	28.7	28.9	1.0	58.5	9.0	124.4	248.9
	2035	17.6	13.4	26.5	57.5	29.0	23.9	1.0	53.9	9.0	120.3	240.7
	2036	17.5	13.6	26.9	58.0	29.3	23.9	1.0	54.2	9.0	121.3	242.5
	2037	17.5	13.8	27.3	58.6	29.7	23.9	1.0	54.5	9.1	122.2	244.4
	2038	17.5	13.9	27.7	59.2	30.1	23.9	1.0	54.9	9.1	123.2	246.4
	2039	17.5	14.1	28.1	59.7	30.4	23.9	1.0	55.3	9.2	124.2	248.3
	2040	17.5	14.3	28.5	60.3	30.8	18.9	1.0	50.6	9.2	120.2	240.3
5	2045	17.6	15.2	29.4	62.2	32.5	13.9	1.0	47.4	9.4	119.0	237.9
	2050	17.8	16.1	30.4	64.3	34.6	13.9	1.0	49.4	9.6	123.3	246.5
Y	2055	18.0	17.3	31.4	66.6	36.8	13.9	1.0	51.7	9.8	128.1	256.2
R	2060	18.2	18.6	32.4	69.2	39.3	13.9	1.0	54.1	10.0	133.4	266.8

1. F&P refers to Full and Partial contracts wholesale customers.
2. The forecast of demand from Cascade Water Alliance (Cascade) and Northshore is equal to their blocks while the historical consumption data reflects water actually purchased from SPU by Cascade members and Northshore. The blocks exceeded actual water purchases from SPU of Cascade members and Northshore by 12 mgd in 2010.
3. Potential new wholesale customers
4. The forecast of Total System Demand includes the Northshore and Cascade blocks while the historical consumption data reflects SPU water actually purchased by Northshore and Cascade.
5. The forecast of peak day demand is based on a peak day factor of 2.0, the ratio of peak day to average annual demand in 2009 with a 5% allowance for hot, dry weather. The forecast of average annual demand under average weather conditions is multiplied by the peak day factor to estimate peak day demand with hot, dry weather.

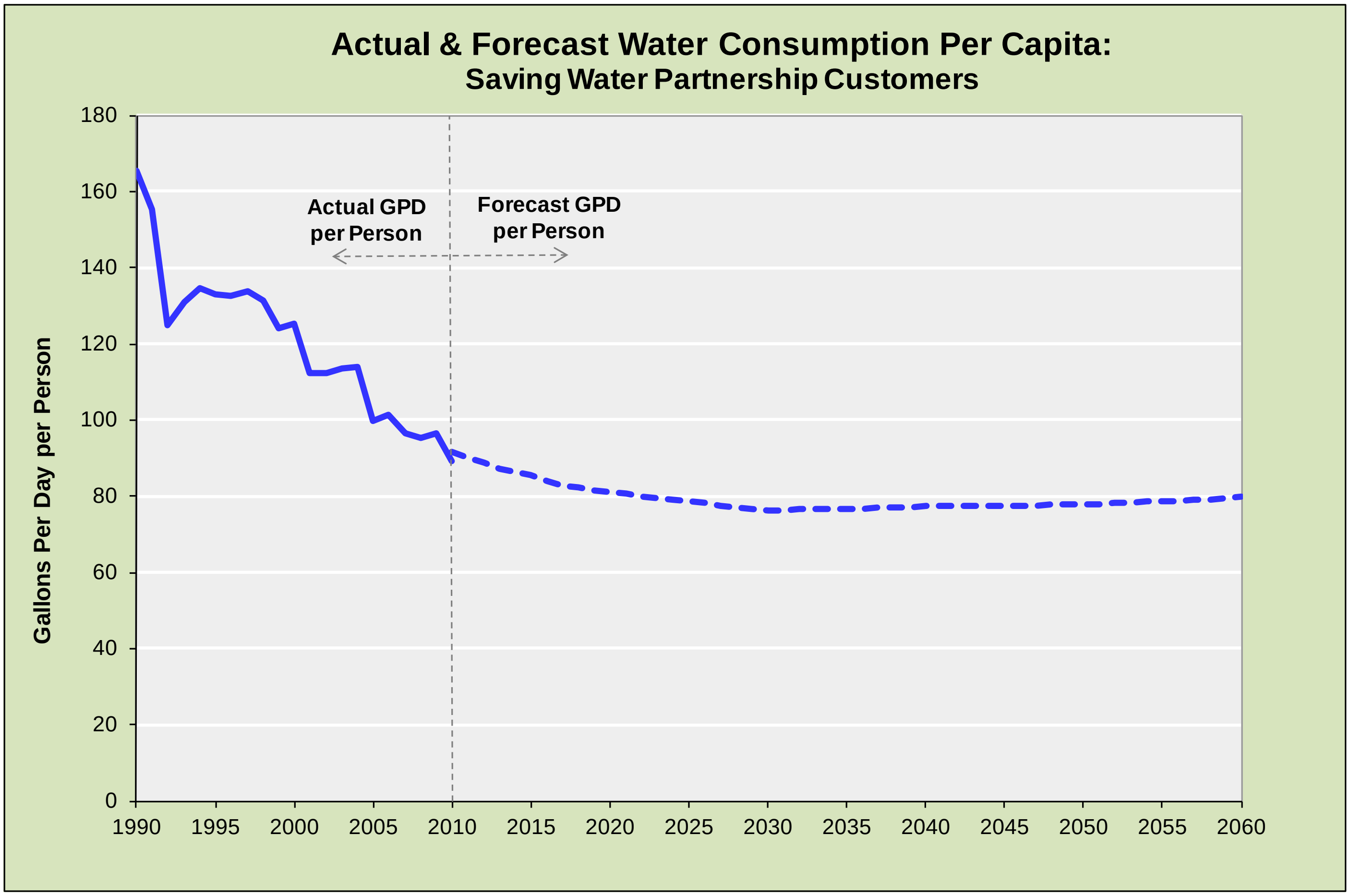

Current Forecast Compared to Earlier Forecasts
Annual MGD
Current Firm Yield
2001 WSP Forecast
2004 Official Forecast
2007 WSP Forecast
2013 WSP Forecast
Actual Demand
The gray area represents the added uncertainty involved in extrapolating beyond 2040.


Components of Actual and Forecast Demand: 1980-2060
Average Annual MGD
Actual
Forecast
Current Firm Yield
Non-Revenue
Cascade
Non-Cascade Wholesale
Seattle Retail
Potential New Wholesale Customers
Non-Revenue
Cascade Block
Northshore Block
Full & Partial Contract Wholesale
Seattle Retail

The graph below contrasts the official demand forecast with what it would be with constant flow factors and with no future conservation of any kind (i.e., no price effect, no passive savings, and no programmatic savings). Note that the forecast with "no conservation" is higher than the forecast holding water flow factors constant over time because the "no conservation forecast" includes the impact of income growth and changes in household size, which net to an increase in flow factors. For the 2013 WSP forecast, all sources of conservation are estimated to produce a total reduction in water demand of more than 30 mgd by 2060.



Finally, the implications of the new demand forecast for total system per capita water consumption are shown in the graph below. Due to anticipated programmatic conservation, passive savings, and water and sewer rate increases, per capita consumption is forecast to continue declining over the next 20 years though at a slower rate than in the past. By 2030, per capita consumption is expected to level off at about 80 gpd (compared to 90 gpd currently). In contrast, between 1990 and 2010, total and per capita water consumption for Seattle and its non-Cascade wholesale customers declined 46% from 166 gallons per day (gpd) to 89 gpd. The demand model does not imply ever-decreasing per capita consumption.



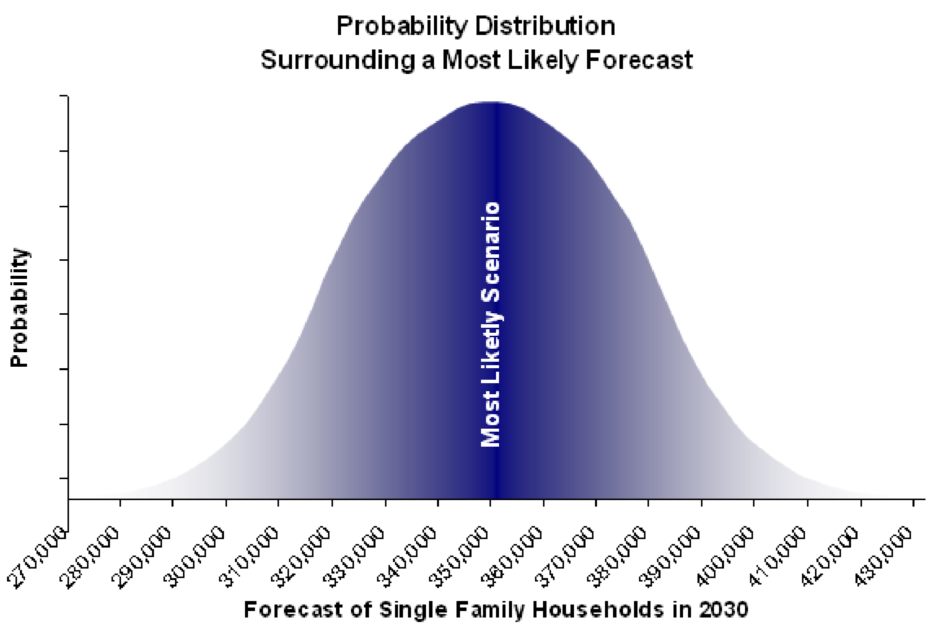
Forecast Uncertainty

What is most certain about a forecast out to 2060 is that it will be wrong. Actual demand in 2040 or 2060 is highly unlikely to be exactly what was forecast back in 2012. The official water demand forecast is itself based on forecasts of income, water prices, households and employment – all subject to uncertainty. Additional uncertainty surrounds the forecast model's assumptions about price and income elasticities, future conservation, wholesale customers' other sources of supply, and whether SPU will gain new customers and/or lose existing customers.

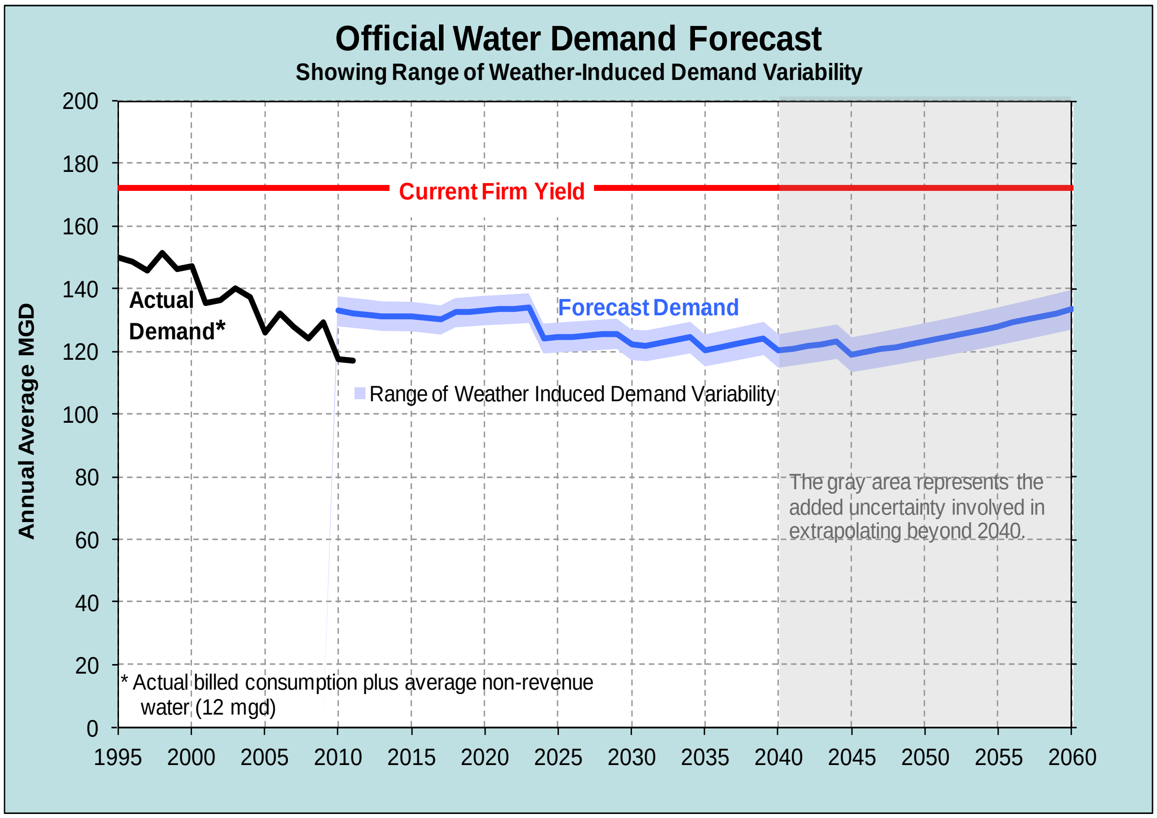
The Official Demand Forecast represents both SPU's policy intentions and its expectations of the future. However, it is prudent, especially in long-term planning, to consider the many uncertainties that could cause demand to be different from what's projected in the official forecast. These uncertainties fall into two categories – discrete and continuous – and are handled in two different ways.

The first category refers to those uncertainties that result from discrete events that produce significant and sometimes abrupt changes in customer demand. Discrete uncertainties represent occurrences that either happen or don't. They're on or off, yes or no (though there can be more than two conditions). An example of a discrete uncertainty is the block contract with Cascade Water Alliance. This and other discrete uncertainties are thought to be best handled by running individual "what-if scenarios" through the demand forecast model.

The second category consists of the continuous uncertainty that surrounds the various inputs to the model. An example would be the forecast of household growth. Actual growth over the forecast period could turn out to be lower or higher than forecast. These types of uncertainties can be represented by a continuous probability distribution around a mean or most likely value as illustrated below.



Weather-Induced Demand Variability: Another source of "fuzziness" in the forecast is weather-induced demand variability. However, this is not really a matter of uncertainty because there's no doubt that summer weather will continue to vary from year to year, and that this variation will cause water demand to fluctuate around the trend. Because base year flow factors are calculated from weather-adjusted consumption data, the forecast represents demand under average weather conditions. Analysis of daily consumption data back to 1982 shows a maximum variability of about plus or minus **5%**. In other words, an extremely hot dry summer would be expected to increase annual consumption *in that year* by up to 5% above the average trend. An extremely cold wet summer would be expected to do the opposite, reducing that year's annual consumption by about 5% below the average trend. The amount by which actual demand is expected to be higher or lower than forecast due to variation in summer weather is shown as the blue band around the forecast in the graph below.



This does not explicitly account for the potential impact of climate change on future demand. While higher summer temperatures are anticipated over the next century due to climate change, most climate model/emission scenario combinations do not project average temperatures to rise above what has already been experienced in hot years. Therefore, the impact of climate change on future demand is not expected to increase the average-weather forecast beyond the range of weather-induced demand variability. SPU's analysis of the impact of climate change on future demand and supply is summarized in the main text of the *2013 Water System Plan*.

Modeling Continuous Uncertainty

A number of model inputs were identified as being subject to continuous uncertainty. (These are shown in the model structure flowchart on page 2 shaded in gray.) They include forecasts of single and multi-family households and employment; average annual growth rates for water prices and household income; price and income elasticities; the impact of passive savings; and the extent to which price-induced conservation overlaps with passive and programmatic conservation. Each uncertainty was modeled by specifying a probability distribution around the mean value of each variable. Many sources were consulted to define the range of uncertainty[5] and the shape of the distributions. The sources and assumptions used to characterize continuous uncertainties are outlined below.

Forecasts of Households and Employment: Two different sources were consulted to establish uncertainty ranges around the forecasts of long term demographic growth. In 2007, the Washington State Office of Financial Management (OFM) produced high and low forecasts of population by county based on historical variability in net migration rates. Dick Conway and Associates developed high and low alternatives around the 2002 PSRC long term regional forecasts of population and employment (but not households) based on optimistic and pessimistic scenarios for the local and national economies[6]. The greater geographical specificity of the OFM forecasts was combined with the more rigorous methodology and wider range between low and high provided by Dick Conway's analysis. The OFM uncertainty ranges are calibrated to 2005 and the Conway uncertainty ranges are calibrated to 2000. Both were brought forward and calibrated to 2010 so that low, medium and high forecasts all start of from the same point in 2010. The ranges of uncertainty around the projections of households, employment and population used in the demand forecast model are shown in the table, below. The forecast number of multifamily households in 2060, for example, is 28% less than the baseline forecast in the low growth scenario and 47% higher in the high growth scenario.

Uncertainty Ranges Around Mean Values
Associated with High and Low Demographic Growth Scenarios

	2030		2060	
	Low	High	Low	High
Single Family Households	-6%	9%	-10%	18%
Multifamily Households	-16%	26%	-28%	47%
Employment	-7%	12%	-14%	24%
Population*	-11%	17%	-21%	35%

* The number of single and multifamily households rather than population is used in the demand forecast model.

The ranges around single and multi-family households were derived from the reported high and low population values and the assumption that variability around the single family forecast is less than for the forecast of multifamily households. Note that the potential variation from forecast values is expected to be greater on the high side than on the low side.

Growth in the Price of Water: System water rates are obtained by dividing each year's projected revenue requirement by projected demand. Uncertainty about future water prices derives from variability in both of these terms. The baseline assumption is that after significant increases in water and sewer rates already adopted or anticipated through 2014, growth in inflation-adjusted retail water rates will ramp down to 0.4% per year by 2020 and remain there through the forecast period. This is slower than the average historical rate of growth but is consistent with the 20-year rate model forecast used elsewhere in this Plan. The range of uncertainty around this is skewed very much on the high side, **minus 50% to**

[5] Each range is characterized by a high and low value representing two standard deviations from the mean.
[6] Scenarios developed by DRI-WEFA (now known as Global Insights, Inc.)

plus 350%, resulting in projected annual growth rates in real prices of between **0.2%** and **1.8%**.

The model handles the impact on price of different levels of projected demand in a different way. Given the same set of revenue requirements, lower demand results in higher water prices and vice versa. That means that price effects would be expected to amplify swings in demand. For example, higher-than-projected demographic growth would cause demand to be higher than the official forecast, resulting in reduced prices and an additional boost in demand. The amount of the boost is determined by the price elasticity of demand and the amount by which prices fall. Incorporating this demand-price-demand-etc. feedback loop explicitly into the model isn't feasible because, as is explained in more detail below, the uncertainty analysis involves running 10,000 iterations of the demand model. However, the feedback loop has been approximated by widening the range of uncertainty around growth in households and employment. The amounts by which the ranges have been increased are **5.2%** on the high side and **5.3%** on the low side[7].

Price Elasticity: The uncertainty ranges around price elasticity represent a synthesis of the various estimates of price elasticity reported in the literature review. These are **plus or minus 50%** for single and multi-family elasticities and **plus or minus 33%** around the non-residential elasticity.

Uncertainty Ranges Around Mean Price Elasticities

	Single Family	Multi-Family	Non-Residential
Low	-0.10	-0.05	-0.15
Mean	-0.20	-0.10	-0.225
High	-0.30	-0.15	-0.30

Growth in Real Household Income: There is some uncertainty about future growth in average income but much more uncertainty around the distribution of that growth. As explained above, there has been a decoupling of average and median income growth over the past 4 decades. While overall per capita income has averaged 1.8% annual growth since 1970, median income and in fact, the income of the bottom 90% of households has grown very little if at all in real terms. Practically all the growth in national income has gone to households at the very top of the income scale in the last 40 years - the top 10%, 1%, 0.1%, and 0.01% of households seeing their real incomes rise twofold, threefold, fivefold and eightfold, respectively. The baseline assumption in the demand forecast is that median income will grow at **0.9%** annually, about half the rate expected for average income. This scenario represents a slowing of the rate at which the distribution of income gets worse. The continuation of present trends with all income growth going to the top 10% and **zero** income growth for median households is the most pessimistic scenario in the uncertainty analysis. At the high end is the assumption that income grows proportionally across all households and the increasing skewness in the income distribution comes to a halt. Here, annual growth in average income equals that for median income equals **1.8%.**

Income Elasticity: As with price elasticity, the uncertainty band around income elasticity was derived from the various estimates of income elasticity in the literature review. A range of income elasticities from **0.19** to **0.35** (i.e., **plus or minus 30%**) around the mean value of 0.27 was chosen.

[7] These percents were obtained by calculating the percent changes in 2060 water prices that would result from the high and low growth scenarios relative to the baseline scenario and multiplying them by the average price elasticity.

Passive Savings: Passive savings could be more or less than modeled. If the new clothes washer codes scheduled to go into effect in 2015 are reversed and market transformation towards fixtures and appliances that exceed code occurs slower than anticipated, passive savings could be less than estimated for the baseline forecast. Alternatively, if additional codes are passed in the future, market transformation takes place more quickly, and green buildings become the norm for new construction, passive savings could be more than estimated for the baseline forecast. A range of passive savings from **11.5** to **26.9 mgd** (i.e., **plus or minus 40%**) around the mean value of 19.2 mgd was chosen.

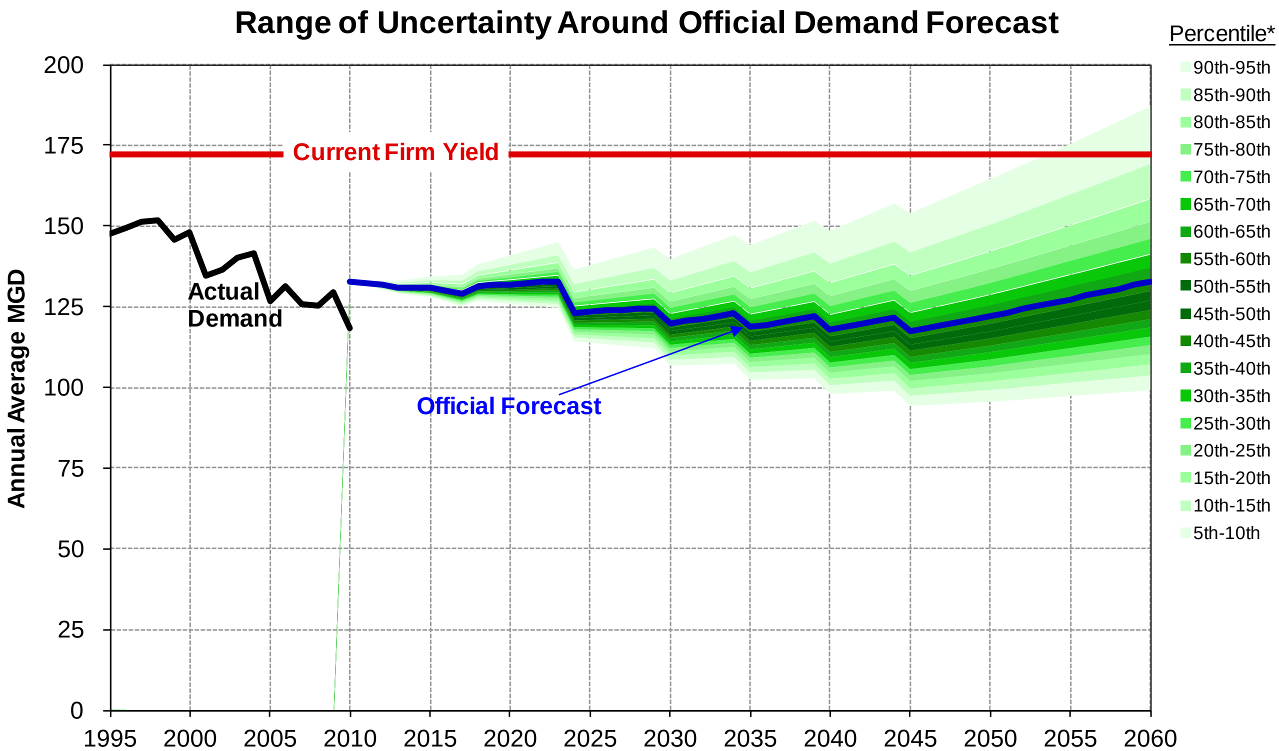
Conservation Savings: The price/code/programmatic conservation overlap function is used to introduce an element of uncertainty to overall conservation savings. The baseline assumption is that 50% of the price effect overlaps with code and programmatic conservation. Assuming a higher level of overlap produces a smaller amount of total conservation savings, and vice versa. A range of conservation savings are obtained in the model by varying the overlap parameters between **25%** and **75%**.

Modeling Uncertainty with @Risk: The uncertainty ranges described above are assumed to have normal or log-normal distributions,[8] with the endpoint values representing two standard deviations from the mean. These probability distributions become inputs to an aggregate uncertainty model using @Risk software (an add-in to Excel) which employs Monte Carlo simulation to characterize uncertainty around the official demand forecast. During each individual run of the Monte Carlo simulation, a value is randomly selected for each input variable based on the probability density function specified for that variable[9]. Then, the complete set of input values for that iteration is used to produce a water demand forecast. The simulation procedure performs a large number (10,000) of independent iterations, each generating a separate demand forecast. These forecasts are then pooled to obtain a probability distribution of forecast water demand through 2060.

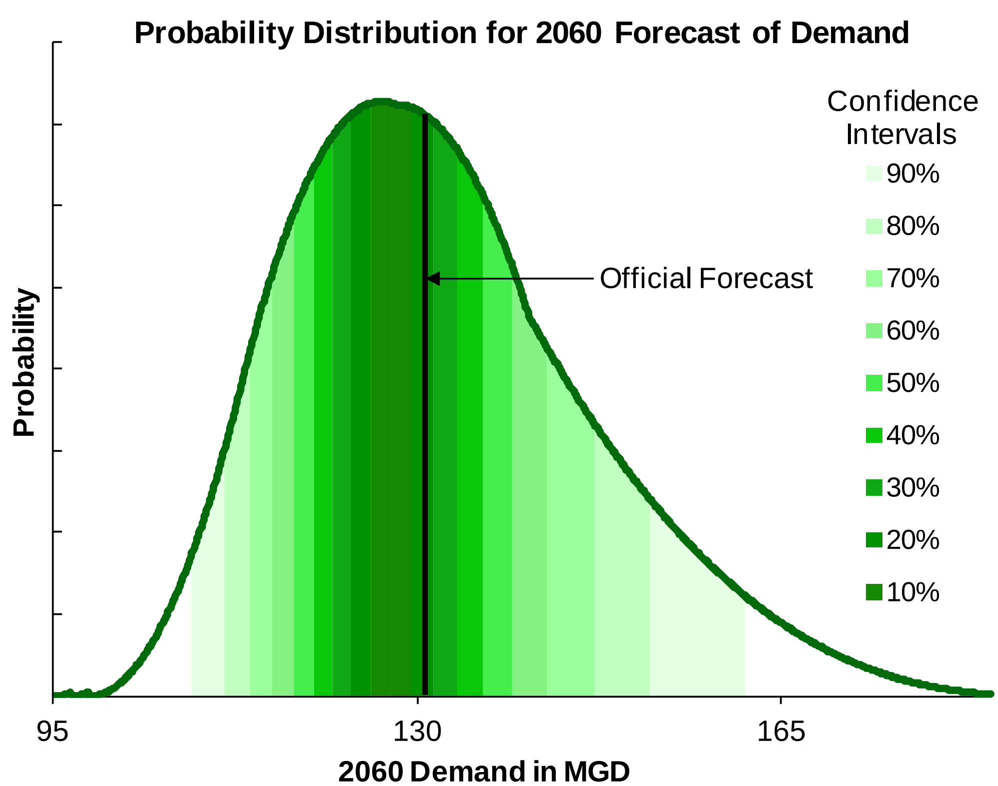
The results of the Monte Carlo simulation are displayed in the graph on the next page. The green bands indicate the range of uncertainty around the official forecast with each band representing a 5% change in probability. For example, the bottom of the lowest band represents the 5th percentile. That means it's estimated there's a 5% chance actual demand will be below that point (and, thus, a 95% chance it will be above). The top band is the 95th percentile which corresponds to an estimated 95% probability that actual demand will be below that point. Taking a cross-section of the graph at 2060 produces the probability distribution around the official forecast shown below.

8 Log normal distributions are used for the uncertainty around household and employment growth and average annual rate of growth in water prices because the high and low ranges exhibit positive skewness (i.e., the highs are higher than the lows are low).

9 All variables with uncertainty are assumed to be independent except for growth in households and employment. These are linked in the model because they would be expected to move together.



* Percentiles represent the probability that demand is less than the value shown. Ranges reflect uncertainty in projected household, employment, price and income growth; price and income elasticities; and conservation. Note that the Official Forecast is at about the 58th percentile.



The uncertainty model represents a significant refinement over simply compounding all the high or all the low assumptions to create extreme high and extreme low scenarios. In the extreme high scenario, everything that could possibly cause demand to be higher than forecast is assumed to happen at the same time. The extreme low scenario is just the opposite with all low side assumptions applied simultaneously. These extreme scenarios overstate the actual uncertainty surrounding demand because they represent two highly unlikely combinations of events with essentially zero probability of occurring. The Monte Carlo simulation provides narrower bands of uncertainty and information about their estimated probabilities.

Implications: Given the current firm yield estimate for SPU's existing supply resources and the official demand forecast, a new source of supply will not be needed until well after 2060. Taking demand uncertainty into consideration, there's still more than a 90% probability that a new source will not be necessary before 2060. This analysis does not explicitly calculate the possible impact of the "discrete" category of uncertainties mentioned in the introduction. However, none of the discrete uncertainties that have been identified (e.g. changes in the Cascade contract) would shift the forecast of demand beyond the range calculated for continuous uncertainties and shown in the graph, above.

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

A. WATER RESOURCES

APPENDIX A-2
WATER RIGHTS EVALUATION

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Water Rights Evaluation
Table 1 - Existing Water Rights Status

Permit Certificate or Claim #	Name of Rightholder or Claimant	Priority Date	Source Name/ Number	Primary or Supplemental	Existing Water Rights		Existing Consumption		Current Water Right Status Excess (positive)/Deficiency (negative)	
					Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Certificates										
1. R-206	City of Seattle Water Department	7/14/1936	South Fork Tolt Reservoir	Primary	N/A	Storage 57,830 acre feet	N/A	Storage 57,830 acre feet	N/A	Storage 0 acre feet
Permits										
1. S1-25929	City of Seattle Water Department	8/17/1990	Cedar River: Temporary Pumping Plant	Supplemental (Term Permit)	390 cfs (252 mgd)	102,746 acre-feet Note 1				
2. S1-25330P	City of Seattle Water Department	8/22/1988	Cedar River: Aquifer Storage and Recovery (ASR)	Primary	10 cfs (6.5 MGD) (Oct thru May)	4,800 acre feet (1,564 mg)	3.5 cfs (2.3 MGD) Note 3	1,170 acre feet Note 2	6.5 cfs (4.2 MGD)	3,630 acre feet
3. 10602	City of Seattle Water Department	7/14/1936	South Fork Tolt Diversion	Primary	280 cfs (181 MGD)	168,000 acre feet (150 MGD)	263 cfs (170 MGD) Note 5	58,251 acre feet (52 MGD) Note 4	17 cfs (11 MGD)	109,749 acre feet
4. S1-28477	City of Seattle Seattle Public Utilities	1/30/2007	Rainwater	Primary	N/A	23,150 acre-feet (Not in totals)	Note 19	Note 19		
Temporary Permits										
1. G1-24619	City of Seattle Water Department	3/7/1985	Boulevard Park Well Field	Primary	4000 gpm (5.8 MGD)	To be determined Note 6	2,900 gpm (4.18 MGD) Note 7	764 acre feet Note 8	1,110 gpm (1.6 MGD)	To be determined
2. G1-24621	City of Seattle Water Department	3/7/1985	Riverton Well Field	Primary	4000 gpm (5.8 MGD)	To be determined Note 9	6,300 gpm (9.07 MGD) Note 10	2,422 acre feet Note 11	-2,292 gpm (-3.3 MGD) Note 12	To be determined
Claims										
1. 068624	City of Seattle Water Department	1888	Cedar River and Chester Morse Lake	Primary	Note 17	336,650 acre feet (300 MGD) Note 13	350 cfs (226 MGD) Note 14	161,312 acre feet (144 MGD) Note 15	115 cfs (74 MGD)	175,338 acre feet (156 MGD) Note 13
2. 068623	City of Seattle Water Department	1926	Lake Youngs	Primary	N/A	Storage 33,770 acre feet	N/A	Storage 33,770 acre feet	N/A	Storage 0 acre feet
Interties - Note 18										
TOTAL - Note 16	*********	*****	*******	***********	Note 17	504,650 acre feet (450 MGD)	638 cfs (412 MGD) Note 16	222,749 acre feet (199 MGD) Note 16	Note 17	281,901 acre feet (251 MGD)

Notes:
1. Not included in water rights calculations. Pumping plants operated under Cedar River claim when needed. Term permit has expired, and is considered "inactive" by Ecology (March 14, 2012).
2. Maximum volume recharged to date: January 1993 to May 1993 during demonstration project; recharge period is October through May.
3. Per Integrated Water Resource Management System (IWRMS) average rate over 24 hours recorded 1/3/95.
4. Tolt Pipeline 24-hour volumes from IWRMS (1985-1999); highest occurred in 1994.
5. Flow diverted from South Fork Tolt River and measured by Seattle City Light at powerhouse on 6/3/1996.
6. With June 2005 ASR application, City requested Qi of 2900 and Qa of 1200 acre-feet at Boulevard Well Field, based on this permit and application G1-24825
7. Per Seattle Well Field, O&M Manual; Maximum range of normal operations.
8. Maximum well field use occurred between June and December 1992.
9, With June 2005 ASR application, City requested Qi of 6300 and Qa of 3200 acre-feet at Riverton Well Field, based on this permit and application G1-24824
10. Per Seattle Well Field, O&M Manual; Maximum range of normal operations.
11. Maximum well field use occurred between June and December 1992.
12. The installed pumping capacity exceeds the Qi specified in the existing temporary permit.
13. Agreement with Muckleshoot Indian Tribe (MIT) (June 2006) limits average annual diversion from Cedar to 105 MGD until 2020, 110 MGD from 2021 to 2030, and 124 MGD beginning in 2031.
14. Per IWRMS data 226 mgd was recorded 6/23/96 (7:00 am reading).
15. Landsburg diversion calendar year 1990: 144 mgd, 52,560 mg, 161,312 ac-ft.
16. Peak instantaneous and peak annual demand occurred at different times on individual sources, so sums do not represent system wide peaks. Emergency source, ASR recharge water diversion, and storage not included.
17. Cedar Claim and MIT agreement do not specify a Qi.
18. SPU does not use interties as a normal supply source.
19. No rainwater harvesting systems have been installed under this permit.

Wate Rights Evaluation
Table 2 - Pending Water Rights Status

Water Right Application	Name on Permit	Date Submitted	Source Name	Primary or Supplemental	Pending Water Rights: Maximum Instantaneous Flow Rate (Qi) Requested	Pending Water Rights: Maximum Annual Volume (Qa) Requested
1. S-4254	City of Seattle Water Department	Filing date 07/14/36 being held in abeyance	North Fork Tolt River	Primary	280 cfs (181 MGD)	203,000 acre-feet
2. Gl-24620	East King County Regional Water Association and City of Seattle Water Department	1/19/1994	Snoqualmie Aquifer	Primary	41,600 gpm (60 MGD)	To be determined
3. S1-27877	East King County Regional Water Association and City of Seattle Public Utilities	1/29/1998	Snoqualmie River	Primary	100 cfs (65 MGD)	To be determined
4. G1-24620	City of Seattle Water Department	3/7/1985	Glacier Well	Irrigation or other non-potable use only	To be determined	To be determined
5. G1-24824 (Note 1)	City of Seattle Water Department	4/14/1986	Riverton Well Field: (Note 3)	Primary	4000 gpm (5.8 MGD)	To be determined
6. G1-24825 (Note 2)	City of Seattle Water Department	4/14/1986	Boulevard Park Well Field (Note 3)	Primary	4000 gpm (5.8 MGD)	To be determined
7. R1-28168	City of Seattle	6/29/2005	Seattle Well Fields ASR (Note 3)	Primary	N/A	1500 acre-feet

Notes:
1. With June 2005 ASR application, City requested Qi of 6300 and Qa of 3200 acre-feet at Riverton Well Field, based on this application and temporary permit G1-24621
2. With June 2005 ASR application, City requested Qi of 2900 and Qa of 1200 acre-feet at Boulevard Well Field, based on this application and temporary permit G1-24619
3. Since the last WSP update, the Highline Well Field has been renamed Seattle Well Fields (Riverton Well Field and Boulevard Park Well Field)

Water Rights Evaluation
Table 3 - Projected Water Rights Status

Permit Certificate or Claim #	Name of Rightholder or Claimant	Priority Date	Source Name/ Number	Primary or Supplemental	Existing Water Rights		Forecast Water Demand for 2040		Forecast 2040 Water Right Status Excess (+) / Deficiency (-)	
					Maximum Instantaneous Flow rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)	Maximum Instantaneous Flow Rate (Qi)	Maximum Annual Volume (Qa)
Certificates										
1. R-206	City of Seattle Water Department	7/14/1936	South Fork Tolt Reservoir	Primary	N/A	Storage 57,830 acre feet				
Permits										
1. S1-25929	City of Seattle Water Department	8/17/1990	Cedar River: Temporary Pumping Plant	Supplemental (Term Permit)	390 cfs (252 mgd)	102,746 acre-feet Note 1				
2. S1-25330P	City of Seattle Water Department	8/22/1988	Cedar River: Aquifer Storage and Recovery (ASR)	Primary	10 cfs (6.5 MGD) (Oct to May)	4,800 acre feet (1,564 mg)				
3. 10602	City of Seattle Water Department	7/14/1936	South Fork Tolt Diversion	Primary	280 cfs (181 MGD)	168,000 acre feet (150 MGD)				
4. S1-28477	City of Seattle Seattle Public Utilities	1/30/2007	Rainwater	Primary	N/A	23,150 acre-feet Note 1				
Temporary Permits										
1. G1-24619	City of Seattle Water Department	3/7/1985	Boulevard Park Well Field	Primary	To be Determined - Note 2					
2. G1-24621	City of Seattle Water Department	3/7/1985	Riverton Well Field	Primary	To be Determined - Note 3					
Claims										
1. 068624	City of Seattle Water Department	1888	Cedar River and Chester Morse Lake	Primary	Note 5	336,650 acre feet (300 MGD) Note 4				
2. 068623	City of Seattle Water Department	1926	Lake Youngs	Primary	N/A	Storage 33,770 acre feet				
Interties - Note 7										
TOTAL - Note 8	*********	*****	*******	***********	Note 5	504,650 acre feet (450 MGD)	668 cfs - Note 6 (431 MGD)	131,200 acre feet (117.1 MGD)	Note 5	373,450 acre feet (332.9 MGD)

Notes:
1. Not included in water rights calculations; pumping plants operated only for testing or under conditions of extreme drought.
2. With June 2005 ASR application, City requested Qi of 2900 and Qa of 1200 acre-feet at Boulevard Well Field, based on this permit and application G1-24825
3, With June 2005 ASR application, City requested Qi of 6300 and Qa of 3200 acre-feet at Riverton Well Field, based on this permit and application G1-24824
4. Agreement with Muckleshoot Indian Tribe (June 2006) limits average annual diversion from Cedar to 105 MGD until 2020, 110 MGD from 2021 to 2030, and 124 MGD beginning in 2031.
5. Cedar Claim and MIT agreement do not specify a Qi.
6. Flow rate listed is maximum capacity of raw water pipelines.
7. SPU does not use, and does not project to use, interties for normal supply.
8. Emergency source, ASR recharge water diversion, and storage not included. Forecast demand not divided by source.

February 2012

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

A. WATER RESOURCES

APPENDIX A-3

GROUNDWATER ELEVATIONS AT SEATTLE WELL FIELDS

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Groundwater Elevations at Seattle Well Fields

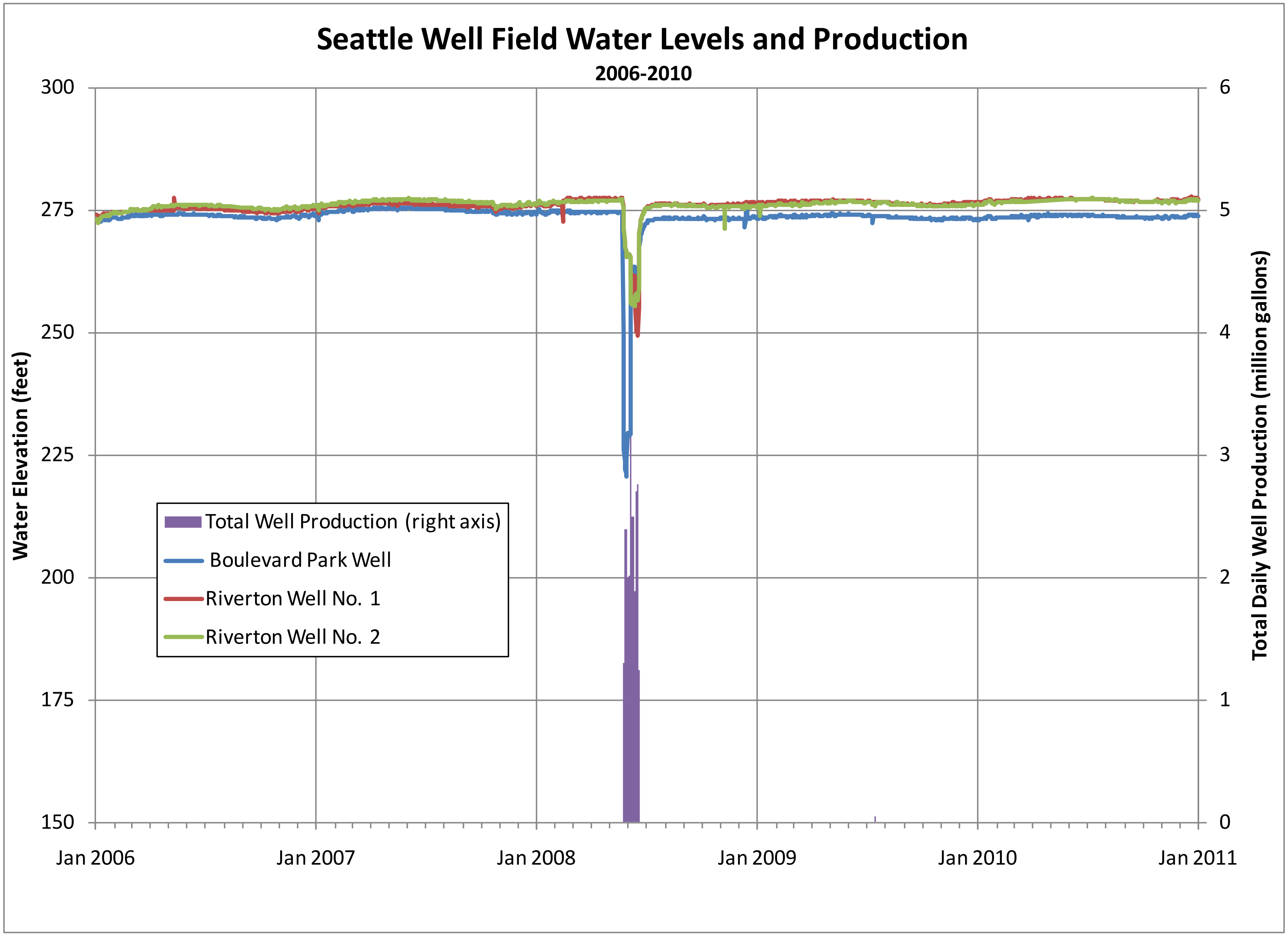
November 2011

SPU monitors groundwater levels in the vicinity of the Riverton and Boulevard Park Well Fields as part of its management of this supply source. Underlying the area are three water-bearing, sand and gravel formations now known as the Shallow, Intermediate and Deep Aquifers. The aquifers are arranged in layers and separated by much less pervious silt and clay layers which act as aquitards. At the land surface, over much of the area, is a highly compacted layer composed of glacial till. SPU has three production wells tapped into the Intermediate Aquifer.

In addition to the production wells, SPU has a network of six monitoring wells in the Well Fields. Three of these wells can monitor water levels in the intermediate aquifer, two in the shallow aquifer, and one in the deep aquifer. Data loggers collected continuous elevation data from the monitoring wells from late 1991 through late 1999, primarily during and immediately after the ASR demonstration project. Routine collection of water level data from the observation wells was suspended in early 2000. In the absence of recharge operations, it was felt that levels recorded continuously in the three production wells by the SCADA system would adequately track trends in the intermediate aquifer. Data are available from this system starting in January 2003 and from SPU's I-SCADA IMS Data Portal starting in April 2005.

The graph below shows the groundwater elevations from the SCADA system at the Riverton and Boulevard Park productions wells from January 2006 through December 2010. Also shown in the graph is total daily production from the three wells. No long-term trends appear in the data. Short-term declines occurred in May and June 2008 when the wells were used for 24 days, but levels quickly recovered when pumping ceased.

SPU will continue to monitor the elevations in the production wells for any trends, and will re-activate the monitoring well network if recharge operations are undertaken.



Seattle Well Field Water Levels and Production
2006-2010
Water Elevation (feet)
Total Daily Well Production (million gallons)
300
275
250
225
200
175
150
6
5
4
3
2
1
0
Jan 2006
Jan 2007
Jan 2008
Jan 2009
Jan 2010
Jan 2011
Total Well Production (right axis)
Boulevard Park Well
Riverton Well No. 1
Riverton Well No. 2

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

A. WATER RESOURCES

APPENDIX A-4

KING COUNTY RECLAIMED WATER CHECKLIST

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For questions, call Kristina Westbrook,
King County Reclaimed Water Program Manager at (206) 296-5279
www.kingcounty.gov/reclaimedwater

King County

Water Reclamation Evaluation Checklist
For Systems with 1,000 or more Connections

The County and State recognize that changing conditions could initiate a need to respond in new ways to future water quality standards, wastewater discharge requirements, take advantage of advances in treatment technologies and/or allow our region to be positioned to respond to changes associated with climate change and population growth.

In 2003, Chapter 90.46 of the Revised Code of Washington (RCW) was amended to require public water systems serving 1,000 or more connections to evaluate opportunities for reclaimed water when completing their water system plans. Please use this checklist to meet King County consistency requirements in responding to this legislation.

Please use this checklist, including the inventory template, to ensure that your water system plan includes sufficient information about opportunities for reclaimed water and your system's efforts to develop those opportunities. If a question is not applicable or the information is unavailable, then answer, "unknown" or "n/a." King County will consider the checklist completed if each answer is filled in with the best available information, even if the utility states that it is not aware of any reclaimed water opportunities within its service area.

Water System Name: Seattle Public Utilities
Date: December 2011
PWS ID# 77050 Y
Contact: Joan Kersnar

1. **Identifying Potential Future Demand for Reclaimed Water:** King County maintains a database and map of potential reclaimed water users for evaluating future projects. Please use the template below, or similar table, to provide information to assist King County in further researching these potential uses.
   - **Large Utility Water Users** (choose one):
     - ☐ Attached is an inventory of twenty large (above 20,000 gallons/month on average), non single-family residential, water users served by our utility that have a potential for reclaimed water use, or
     - ☑ Attached is an inventory of our utility's top twenty water users, or
     - ☐ The information requested is unknown or not available.

       Additional Comments: ______
   - **Large Self Suppliers** (choose one):
     - ☐ Attached is an inventory of large, self-supplied water users within our water utility's service boundaries - especially those near wastewater treatment plants, mainlines, outfalls, and pump stations or similar reclaimed water facilities), or
     - ☑ The information requested is unknown or not available.

       Additional Comments: See SPU, "An Economic Analysis of the North Seattle Reclaimed Water Project," September 2010.
   - **Other** (choose one):
     - ☐ Attached is an inventory of other water users (such as those that are clustered near one another and could be served by a single system) that may be likely candidates for reclaimed water use, or
     - ☑ The information requested is unknown or not available.

       Additional Comments: See SPU, "An Economic Analysis of the North Seattle Reclaimed Water Project," September 2010.

2. **Environmental Commitment**: Are you a city/town, or providing water service to a city/town, that has made commitments within resource management plans, salmon recovery plans, or other environmental initiatives for which there is a potential opportunity for using reclaimed water to assist in meeting commitments? (choose one)

☐ Yes, here are plans that have potential for reclaimed water use in our service area to meet the above commitments:
____
____

☑ The information requested is unknown, not available.
Additional Comments: ____

3. **Identifying Areas of Potential Use of Reclaimed Water for Environmental Benefit:**
Below are ***examples*** of uses of reclaimed water ***that comply with State, Federal and other reclaimed water environmental, health and safety standards***. All of these uses are currently in effect somewhere in Washington State. To the best of your knowledge, are any of these potential uses for reclaimed water applicable to your area?

River Augmentation (choose one):

☐ Yes, our water rights are limited by instream flows. For more information, King County may contact:
____
____

☐ The information requested is unknown, or not available.
Additional Comments: There is adequate water supply with existing instream flow conditions being met.

Groundwater Recharge (choose one):

☐ Yes, we withdraw water from an aquifer that is in a groundwater management area, or from a declining aquifer, where water levels may need to be replenished or to maintain aquifer storage. For more information, King County may contact:
____

☐ The information requested is unknown, or not available.
Additional Comments: Not applicable.

Water Rights Mitigation (choose one):

☐ Yes, our area is pursuing, or planning to pursue, new or additional water rights, and there may be an opportunity to use reclaimed water for mitigation of those new water rights. For more information, King County may contact:
____

☑ The information requested is unknown, or not available.
Additional Comments: ____

Potential Areas of Environmental Need (choose one):

☐ Yes, parts of our service area include potential environmental enhancement locations, such as wetlands enhancement, aquifer recharge, stream flow augmentation, that might be candidates for reclaimed water use. For more information, King County may contact:
____

☑ The information requested is unknown, or not available.
Additional Comments: ____

4. **Local Reclaimed Water Legislation**: If water reclamation is mandated for this water system through local government agreement, contract, local regulations, ordinances, or other mechanisms, please provide a copy of the governing mechanism (choose one).

☐ Yes, local legislation exists in our area in support of reclaimed water use. The following relevant legislation is attached (please list titles of documents):

____

____

☑ No water reclamation legislation exists, or is known to exist, at a local level in our service area.

5. **Coordination with Local Wastewater Utility:** Include a brief description of your interactions with any wastewater or reclaimed water utility (King County or other) adjacent to your service area to evaluate any potential opportunities to develop reclaimed water (choose one).

☑ Describe if applicable:
Coordination with King County occurs through ongoing participation in the MWPAAC, development of the Reclaimed Water Comprehensive Plan, and evaluation of potential opportunities such as described in SPU,

☐ None. Additional Comments: "An Economic Analysis of the North Seattle Reclaimed Water Project," September 2010.

Template for
Inventory of Water Users and Identification of Potential Reclaimed Water Users

Site Owner or Site Name	Site Address (for general mapping purposes)	Estimated Annual Water Use	Water uses not requiring potable water[1]	Is this a Potential Reclaimed Water Customer?
SEE NEXT PAGE				

[1] See Washington State Reclamation and Reuse Standards, September 1997, Section 1, Articles 1-5 for allowable uses of reclaimed water.
http://www.ecy.wa.gov/PROGRAMS/WQ/reclaim/standards.html

Seattle Public Utilities
Inventory of Water Users and Identification of Potential Water Users

Site Owner or Site Name	Site Address (for general mapping purposes)	Estimated Annual Water Use (Total 2010)	Water uses not requiring potable water[1]	Is this a Potential Reclaimed Water Customer?
PORT OF SEATTLE (SeaTac Airport)	2011 S 160TH ST	284,935 ccf	Possible landscape irrigation, fire fighting and protection, cooling water make-up, pavement washing, toilet and urinal flushing.	Unknown
UNIVERSITY OF WASHINGTON	2235-45 NE 45TH ST	114,859 ccf	Possible landscape irrigation, fire fighting and protection, cooling water make-up, pavement washing, toilet and urinal flushing.	Unknown
SEATTLE STEAM COMPANY	1319 WESTERN AVE	110,965 ccf	Possible industrial boiler feed, fire fighting and protection, pavement washing, and toilet and urinal flushing.	Unknown
NUCOR STEEL SEATTLE	4001 28TH AVE SW	105,020 ccf	Possible industrial process, cooling water make-up, dust control, fire fighting and protection, pavement washing, and toilet and urinal flushing.	Unknown
UNIVERSITY OF WASHINGTON	3780 15TH AVE NE	96,002 ccf	Possible cooling, landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
CERTAINTEED GYPSUM	5931-37 E MARGINAL WAY S	87,082 ccf	Possible cooling water make-up fire fighting and protection, pavement washing, and toilet and urinal flushing.	Unknown
UNIVERSITY OF WASHINGTON	4000 15TH AVE NE	78,962 ccf	Possible cooling water make-up, landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
DARIGOLD	4058 RAINIER AVE S	74,006 ccf	Possible landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
PEPSI BOTTLING GROUP	2300 26TH AVE S	72,500 ccf	Possible landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
PORT OF SEATTLE	2031 W HALLADAY ST	69,129 ccf	Possible cooling water make-up, ship ballast, fire fighting and protection, toilet and urinal flushing.	Unknown
SEATTLE STEAM COMPANY	1319 WESTERN AVE	66,346 ccf	Possible cooling water make-up, industrial boiler feed, fire fighting and protection, pavement washing, and toilet and urinal flushing.	Unknown
KING COUNTY FACILITIES MANAGEMENT	500 5TH AVE	64,418 ccf	Possible cooling water make-up, landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
HOSPITAL CENTRAL SERVICES	1300 E COLUMBIA ST	59,015 ccf	Unknown	Unknown
SWEDISH MEDICAL CENTER	801 BROADWAY	51,129 ccf	Unknown	Unknown
SEAFREEZE LTD PARTNERSHIP	200 SW MICHIGAN ST	50,318 ccf	Possible cooling water make-up, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
WOODLAND PARK ZOOLOGICAL SOCIETY	5500 PHINNEY AVE N	49,334 ccf	Possible landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
UNIVERSITY OF WASHINGTON	3900 MONTLAKE BLVD NE	37,887 ccf	Possible cooling water make-up, landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
SHOREWOOD APTS	3209 SHOREWOOD DR, MERCER ISLAND	35,977 ccf	Possible landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
R C HEDREEN LLC (ELLIOTT GRAND HYATT)	721 PINE ST	35,651 ccf	Possible cooling water make-up, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown
UNIVERSITY OF WASHINGTON	4208 15TH AVE NE	35,042 ccf	Possible cooling water make-up landscape irrigation, fire fighting and protection, pavement washing, toilet and urinal flushing.	Unknown

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

APPENDIX B

WATER SYSTEM INVENTORIES

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

B. WATER SYSTEM INVENTORIES

APPENDIX B-1

WATER FACILITIES INVENTORY FORM

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WATER FACILITIES INVENTORY (WFI) FORM

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

ONE FORM PER SYSTEM

Quarter: 1
Updated: 11/29/2011
Printed: 2/22/2012
WFI Printed For: On-Demand
Submission Reason: Annual Update

RETURN TO: Northwest Regional Office, 20435 72nd Ave S STE 200, Kent, WA, 98032

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
77050 Y	SEATTLE PUBLIC UTILITIES	KING	A	Comm

6. PRIMARY CONTACT NAME & MAILING ADDRESS

WILLIAM B. WELLS [WQ & T MANAGER]
PO BOX 34018
SEATTLE, WA 98124-4018

STREET ADDRESS IF DIFFERENT FROM ABOVE

ATTN SEATTLE PUBLIC UTILITIES
ADDRESS 700 5TH AVE # 4900
CITY SEATTLE STATE WA ZIP 98124

7. OWNER NAME & MAILING ADDRESS

SEATTLE, CITY OF
DAVE HILMOE
PO BOX 34018
SEATTLE, WA 98124-4018

8. Owner Number 005246

TITLE: DIRECTOR

STREET ADDRESS IF DIFFERENT FROM ABOVE

ATTN SEATTLE PUBLIC UTILITIES
ADDRESS 700 5TH AVE # 4900
CITY SEATTLE STATE WA ZIP 98124

9. 24 HOUR PRIMARY CONTACT INFORMATION	10. OWNER CONTACT INFORMATION
Primary Contact Daytime Phone: (206) 684-0221	Owner Daytime Phone: (206) 684-7414
Primary Contact Mobile/Cell Phone: (425) 241-5484	Owner Mobile/Cell Phone:
Primary Contact Evening Phone: (xxx) xxx-xxxx	Owner Evening Phone: (xxx) xxx-xxxx
Fax: | E-mail: XXXXXX	Owner Fax Phone: | E-mail: XXXXXX

WAC 246-290-420(9) requires that water systems provide 24-hour contact information for emergencies.

11. SATELLITE MANAGEMENT AGENCY - SMA (check only one)

- [x] Not applicable (Skip to #12)
- [ ] Owned and Managed
- [ ] Managed Only
- [ ] Owned Only

SMA NAME: ______ SMA Number:

12. WATER SYSTEM CHARACTERISTICS (mark all that apply)

- [ ] Agricultural
- [x] Commercial / Business
- [x] Day Care
- [x] Food Service/Food Permit
- [ ] 1,000 or more person event for 2 or more days per year
- [x] Hospital/Clinic
- [x] Industrial
- [x] Licensed Residential Facility
- [x] Lodging
- [x] Recreational / RV Park
- [x] Residential
- [x] School
- [ ] Temporary Farm Worker
- [ ] Other (church, fire station, etc.): ______

13. WATER SYSTEM OWNERSHIP (mark only one)

- [ ] Association
- [x] City / Town
- [ ] County
- [ ] Federal
- [ ] Investor
- [ ] Private
- [ ] Special District
- [ ] State

14. STORAGE CAPACITY (gallons)

398,000,000

- SEE NEXT PAGE FOR A COMPLETE LIST OF SOURCES -

WATER FACILITIES INVENTORY (WFI) FORM - Continued

1. SYSTEM ID NO.	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
77050 Y	SEATTLE PUBLIC UTILITIES	KING	A	Comm

15	16 SOURCE NAME	17 INTERTIE	18 SOURCE CATEGORY										19 USE			20	21 TREATMENT						22 DEPTH	23	24 SOURCE LOCATION			
Source Number	LIST UTILITY'S NAME FOR SOURCE AND WELL TAG ID NUMBER. Example: WELL #1 XYZ456 IF SOURCE IS PURCHASED OR INTERTIED, LIST SELLER'S NAME Example: SEATTLE	INTERTIE SYSTEM ID NUMBER	WELL	WELL FIELD	WELL IN A WELL FIELD	SPRING	SPRING FIELD	SPRING IN SPRINGFIELD	SEA WATER	SURFACE WATER	RANNEY / INF. GALLERY	OTHER	PERMANEANT	SEASONAL	EMERGENCY	SOURCE METERED	NONE	CHLORINATION	FILTRATION	FLUORIDATION	IRRADIATION (UV)	OTHER	DEPTH TO FIRST OPEN INTERVAL IN FEET	CAPACITY (GALLONS PER MINUTE)	1/4, 1/4 SECTION	SECTION NUMBER	TOWNSHIP	RANGE
S01	CEDAR RIVER									X			X			Y		X		X	X	X		12500	SW SE	19	22N	07E
S02	TOLT RIVER									X			X			Y		X	X	X		X		83280	NW SW	32	26N	09E
S03	RIVERTON HTS #1				X									X		Y		X		X		X	275	3200	NE NW	21	23N	04E
S04	BOULEVARD		X											X		Y		X		X		X	293	2000	NW NW	16	23N	04E
S05	RIVERTON HTS #2				X									X		Y		X		X		X	280	1800	NE NW	21	23N	04E
S06	RIVERTON HTS WF			X										X		Y		X		X		X	275	5000	NE NW	21	23N	04E

WATER FACILITIES INVENTORY (WFI) FORM - Continued

1. SYSTEM ID	2. SYSTEM NAME	3. COUNTY	4. GROUP	5. TYPE
77050 Y	SEATTLE PUBLIC UTILITIES	KING	A	Comm

	ACTIVE SERVICE CONNECTIONS	DOH USE ONLY! CALCULATED ACTIVE CONNECTIONS	DOH USE ONLY! APPROVED CONNECTIONS
25. SINGLE FAMILY RESIDENCES (How many of the following do you have?)	0	157463	Unspecified
A. Full Time Single Family Residences (Occupied 180 days or more per year)	157463		
B. Part Time Single Family Residences (Occupied less than 180 days per year)	0		
26. MULTI-FAMILY RESIDENTIAL BUILDINGS (How many of the following do you have?)			
A. Apartment Buildings, condos, duplexes, barracks, dorms	13330		
B. Full Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied more than 180 days/year	0		
C. Part Time Residential Units in the Apartments, Condos, Duplexes, Dorms that are occupied less than 180 days/year	0		
27. NON-RESIDENTIAL CONNECTIONS (How many of the following do you have?)			
A. Recreational Services and/or Transient Accommodations (Campsites, RV sites, hotel/motel/overnight units)	0	0	
B. Institutional, Commercial/Business, School, Day Care, Industrial Services, etc.	13399	13399	
28. TOTAL SERVICE CONNECTIONS		170862	

29. FULL-TIME RESIDENTIAL POPULATION

A. How many residents are served by this system 180 or more days per year? 668400

30. PART-TIME RESIDENTIAL POPULATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many part-time residents are present each month?												
B. How many days per month are they present?												

31. TEMPORARY & TRANSIENT USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. How many total visitors, attendees, travelers, campers, patients or customers have access to the water system each month?												
B. How many days per month is water accessible to the public?												

32. REGULAR NON-RESIDENTIAL USERS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A. If you have schools, daycares, or businesses connected to your water system, how many students daycare children and/or employees are present each month?												
B. How many days per month are they present?												

33. ROUTINE COLIFORM SCHEDULE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
* Requirement is exception from WAC 246-290	189*	189*	189*	189*	189*	189*	189*	189*	189*	189*	189*	189*

35. Reason for Submitting WFI:

☐ Update - Change ☐ Update - No Change ☐ Inactivate ☐ Re-Activate ☐ Name Change ☐ New System ☐ Other ________________

36. I certify that the information stated on this WFI form is correct to the best of my knowledge.

SIGNATURE: ____
DATE: ____________________________

PRINT NAME: ____
TITLE: ____________________________

WS ID	WS Name
77050	SEATTLE PUBLIC UTILITIES

Total WFI Printed: 1

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

B. WATER SYSTEM INVENTORIES

APPENDIX B-2

WATER SYSTEM MANAGEMENT AND OPERATOR CERTIFICATION

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Water System Management and Operator Certification

December 2011

Seattle Public Utilities (SPU) reorganized its organizational structure since the *2007 Water System Plan*. An explanation of the management structure and personnel at SPU is provided here, followed by a description of SPU's current operator certifications and training programs.

Management and Organizational Structure

An organizational chart for SPU, which shows the current departmental structure, is provided as Exhibit 1. A brief explanation of the role of the Director's Office and each SPU branch is provided below.

Director's Office

The Director's Office includes the Director of Seattle Public Utilities and the Corporate Strategies and Communications (CS&C) Office. The Director is responsible for making sure the utility carries out the mission adopted for SPU. The Director has responsibilities typical of a water superintendent, such as developing budgetary requirements, assuring effective performance of the water system, and implementing City ordinances and utility policies regarding water service.

The CS&C Office assists the SPU Director to design and execute policy, strategy, analyses, internal and external communications, in order to maintain, improve, and explain service delivery, programs and projects, and to manage assets effectively and efficiently. The Office focuses on issues, initiatives, and agreements involving multiple disciplines, branches, departments, governments, and public constituencies. Groups comprising the Office consist of Community Relations Development, Corporate Policy and Performance, Asset Management and Economic Services and Communications Services.

Utility Systems Management Branch

Utility Systems Management (USM) provides overall management of each SPU utility system, including SPU's drinking water, sewer, drainage, solid waste programs and associated assets. USM also includes Watershed Services and Laboratory Services, which primarily support the drinking water system.

The Drinking Water Division Director serves as of the main contact for drinking water system-related issues. The Business Area Managers, who report to the Division Director, plan for projects and programs in their business area. For Drinking Water, these business areas are: Major Watersheds, Water Resources, Water Quality and Treatment, Transmission and Distribution.

Field Operations & Maintenance Branch
Field Operations and Maintenance strives daily to provide outstanding customer service by professionally operating, maintaining and improving SPU's drinking water, sewer, drainage, solid waste programs, and infrastructure investments which protect public safety, public health and the environment. The Branch includes the Water System Operational Planning and System Control section responsible for running day-to-day operations from the Control Center and includes certified water system operators.

Project Delivery Branch
The Project Delivery Branch (PDB) provides a variety of engineering and engineering support services to clients within and outside of SPU. PDB provides project management, engineering, design, survey, drafting, basemapping, construction specification and contract preparation, project cost estimating, geotechnical, materials testing, construction inspection, and contract payment services. Registered professional engineers and land surveyors reside in this Branch, as well as elsewhere in SPU. PDB executes SPU capital projects from start to completion, and provides specific services as appropriate on projects developed by other City departments, other agencies, and developers. PDB applies asset management principles and practices to achieve the triple bottom line goals of customer satisfaction, environmental protection/enhancement and cost efficiency.

Customer Service Branch
The Customer Service Branch is responsible for providing support and assistance to all residential, commercial and key SPU customers receiving water, sewer, drainage and solid waste services. The services this branch provides include: 1) Customer Billing Service, including meter reading; 2) Utility Service Teams, including water inspectors for new taps/lines, repairs, leaks, backflow assembly testing, cross connection control and water quality complaints; 3) Customer Response comprised of the Call Center; and 4) Customer Programs & Contracts Management, which includes water conservation program staff. This branch includes several water quality inspector positions which have Backflow Assembly Tester (BAT), and Cross Connection Control Specialist (CCS) certification requirements.

Finance and Administration Branch
The Finance and Administration Branch provides financial, accounting and information technology services to all sections and employees of SPU.

Human Resources & Service Equity Branch
The Human Resources Division provides the resources, consultation and assistance to enable SPU to recruit, develop and support a diverse workforce. Human Resource Operations & Data Management Division provides payroll support and employee records management for SPU. The Environmental Justice and Service Equity Division focuses on eliminating barriers to ensure all people of the City of Seattle receive equitable services and access to SPU's decision-making processes.

Operations Planning and Scheduling (OPS)

SPU's regional water supply system has multiple objectives that must be met and operational risks that must be actively managed:

- water resource management for people and for fish
- water quality source to tap
- pressure and flow in the transmission and distribution system
- system outages – called 'clearances' - for construction and major maintenance
- flood management and hydropower generation

In 2008, SPU established an Operations Planning and Scheduling (OPS) function that is supported by a core team. The OPS core team membership consists of:

- OPS Team Lead (as assigned)
- System Control Center Manager
- System Control Center Supervisor
- Clearance Work Order Process and Transmission and Distribution Operations representative
- Water Resources/River and Reservoir Operations representative
- Transmission and Distribution Business Areas representative(s)
- Water Quality and Treatment Business Area representative(s)

The OPS Team meets each week so establish a weekly web-based Water System Operating Plan (WSOP). OPS is responsible for developing, deconflicting and communicating (via the WSOP) the plan and schedule for operation of the water system to meet all of the objectives for the regional water system. OPS also reviews, approves, and schedules construction and major maintenance ('clearances') that affect system operations, as well as maintains a schedule of clearances (received, approved and scheduled, in-progress). The System Control Center, which operates 24/7, is responsible for operating the regional water system according to the WSOP, using best judgment where there are no specific instructions and responding to unusual and emergency situations. In addition, the System Control manages the configuration of the system, detects and directs response to water system emergencies, and coordinates and approves all construction and maintenance activities that require access to water system facilities (headworks, treatment, pump stations, gate houses, etc) or that may have an impact on water system.

Operator Certification

SPU is committed to meeting the requirements of the Water Works Operator Certification Program administered by the Washington State Department of Health (DOH) in conjunction with the Water and Wastewater Operator Certification Board of Examiners under the authority of Chapter 70.119 RCW and the comprehensive program regulations contained in Chapter 246-292 WAC. Under this program, water systems must employ certified operators to carry out various water system functions as part of treatment and distribution systems.

Certification Requirements

SPU is classified as a "Group A" public water system. The Group A classification requires that SPU have certified operators in charge of all active, daily, and technical operations of the water system. In meeting this requirement, SPU maintains certified personnel throughout the utility for a variety of water system operations. This certification includes water treatment plant operators at the Tolt and Cedar Water Treatment Facilities, which are operated and maintained by private entities under contract by SPU. Required Classifications include Water Distribution Manager (WDM) Levels 3 and 4, Water Treatment Plant Operator (WTPO) Levels 3 and 4, and Cross Connection Control Specialists (CCS) depending on the requirements of specific positions. Table 1 shows the current listing of mandatory water works operator positions and required certification levels for SPU as they relate to the organizational structure of the utility. This list is updated on an annual basis for utility staff and submitted to DOH for their review. Additionally, SPU also has internal SPU certification requirements for lower level positions (involving level 1, and 2 certifications), that are not detailed out here.

Certified operators are either on-site or on call for all critical water system operations. SPU also ensures that certified operators are in charge of all segments of the water system as appropriate. Certified operators staff the Control Center, and the two primary water treatment plants, 24 hours a day. Also, Water system operations and pipe district managers for the Water Transmission & Distribution Operations Division of SPU's Field Operations & Maintenance Branch maintain necessary Water Distribution Manager certifications.

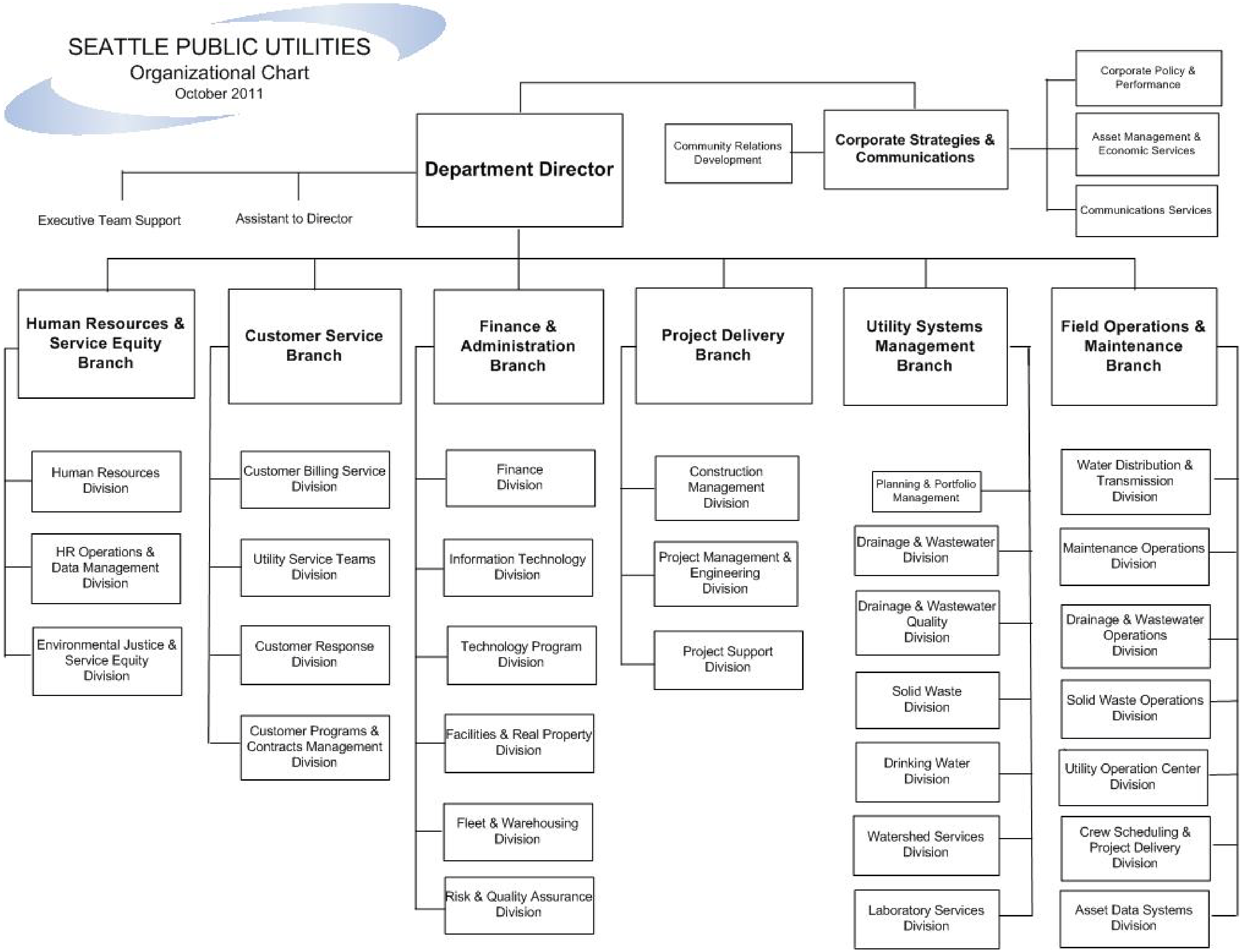
<table>
<tr><th colspan="4">Table 1
Mandatory Waterworks Personnel Certifications</th></tr>
<tr><th>Branch</th><th>Division</th><th>Position</th><th>Required Certification</th></tr>
<tr><td rowspan="7">Utility Systems Management</td><td>Drinking Water</td><td>Drinking Water Director</td><td>WDM 4</td></tr>
<tr><td rowspan="6">Contract Treatment Operations</td><td>Tolt Facility Manager</td><td>WTPO 4</td></tr>
<tr><td>Tolt Chief Operator</td><td>WTPO 3</td></tr>
<tr><td>Tolt Operator (multiple positions)</td><td>WTPO 3</td></tr>
<tr><td>Cedar Project Manager</td><td>WTPO 4</td></tr>
<tr><td>Cedar Operations Supervisor</td><td>WTPO 3</td></tr>
<tr><td>Cedar Operator (multiple positions)</td><td>WTPO 3</td></tr>
<tr><td>Customer Service</td><td>Utility Service Teams</td><td>Utility Service Inspection Manager</td><td>WDM 3, CCS</td></tr>
<tr><td rowspan="8">Field Operations and Maintenance</td><td rowspan="8">Water Transmission & Distribution Operations</td><td>Water Transmission and Distribution Director</td><td>WDM 4</td></tr>
<tr><td>Water Maintenance Manager</td><td>WDM 3</td></tr>
<tr><td>Water Supply Operations Manager</td><td>WDM 3</td></tr>
<tr><td>Water System Supervisor</td><td>WDM 3</td></tr>
<tr><td>Water Transmission Manager</td><td>WDM 3</td></tr>
<tr><td>Water Pipe Distribution Manager - North End</td><td>WDM 3</td></tr>
<tr><td>Water Pipe Distribution Manager - South End</td><td>WDM 3</td></tr>
<tr><td>Water Pipe Distribution Manager -All City</td><td>WDM 3</td></tr>
</table>

Training

All certified personnel for SPU renew their certificates on an annual basis and enhance their professional growth in the field by accumulating at least three college-related credits or continuing education units (CEUs) every three years. Personnel meet the CEU requirements through a combination of external and internal training opportunities. External opportunities include State-sponsored classes through the Washington Environmental Training Resource Center (WETRC). Examples of classes offered through this program include “Chlorination System Operation and Maintenance” and “Basic Electrical.” Internally, SPU takes advantage of a wealth of expertise from a variety of professional staff to offer CEU approved classes. Examples of classes offered through this internal training include:

- National Incident Management System (NIMS)
- Cross Connection Control
- Operations Math
- Corrosion Protection
- Watermain Installation and Print Reading
- Successful Watermain Shutdowns

Exhibit 1


SEATTLE PUBLIC UTILITIES
Organizational Chart
October 2011
Department Director
Executive Team Support
Assistant to Director
Community Relations Development
Corporate Strategies & Communications
Corporate Policy & Performance
Asset Management & Economic Services
Communications Services
Human Resources & Service Equity Branch
Human Resources Division
HR Operations & Data Management Division
Environmental Justice & Service Equity Division
Customer Service Branch
Customer Billing Service Division
Utility Service Teams Division
Customer Response Division
Customer Programs & Contracts Management Division
Finance & Administration Branch
Finance Division
Information Technology Division
Technology Program Division
Facilities & Real Property Division
Fleet & Warehousing Division
Risk & Quality Assurance Division
Project Delivery Branch
Construction Management Division
Project Management & Engineering Division
Project Support Division
Utility Systems Management Branch
Planning & Portfolio Management
Drainage & Wastewater Division
Drainage & Wastewater Quality Division
Solid Waste Division
Drinking Water Division
Watershed Services Division
Laboratory Services Division
Field Operations & Maintenance Branch
Water Distribution & Transmission Division
Maintenance Operations Division
Drainage & Wastewater Operations Division
Solid Waste Operations Division
Utility Operation Center Division
Crew Scheduling & Project Delivery Division
Asset Data Systems Division

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

B. WATER SYSTEM INVENTORIES

APPENDIX B-3

WATER TREATMENT CHEMICALS

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Water Treatment Chemicals
February 2012

Facility	Chemical
Tolt Water Treatment Facility	Liquid Oxygen
	Carbon Dioxide
	Chlorine
	Ferric Chloride
	Hydrofluorosilicic Acid
	Lime
	Cationic Polymer
	Anionic Polymer
	Sodium Bisulfite (has not been used)
	Sodium Hydroxide
Cedar Water Treatment Facility	Liquid Oxygen
	Chlorine
	Lime
	Sodium Bisulfite
	Sodium Hydroxide
Landsburg Diversion & Pre-Treatment Facility	Chlorine
	Hydrofluorosilicic Acid
Seattle Wells*	Sodium Hypochlorite
	Sodium Hydroxide
	Hydrofluorosilicic Acid
In-Town Reservoir Treatment Facilities	Sodium Hypochlorite
	Salt (used for on-site hypochlorite generation)
	Chlorine

Notes:

* Indicates the facilities are only used seasonally during the high demand period. Chemicals may not be stored on site during the off season.

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

B. WATER SYSTEM INVENTORIES

APPENDIX B-4

ASSET INVENTORIES

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Table 1 Tolt Water Treatment Facility Design Parameters	
Type:	Direct Filtration with Raw Water Ozonation
Capacity:	120 mgd
Ozone Generation	
Type:	LOX Feed
Number of units:	Two duty, one standby
Capacity:	2,388 lbs/day each
Applied dose:	2.9 mg/l (average)
	4.8 mg/l (maximum)
Production	1,651 lbs/day (average)
	4,775 lbs/day (maximum)
Ozone Contacting	
Type:	Fine bubble diffusion w/baffled contactor
Number of units:	Two parallel trains
Capacity:	60 mgd each
Contact time:	31.6 minutes (theoretical)
Flocculation	
Type:	Hydraulic flocculation w/baffled serpentine flow
	Pumped jet flash mix for chemical addition
Number of units:	Two parallel trains
Capacity:	60 mgd each
Detention time:	26.5 minutes (theoretical)
Filtration	
Type:	Anthracite mono-medium, with air/water backwash
Number of units:	Six (each with two bays)
Capacity:	24 mgd each
Rate:	12 gpm/sq ft
Bed depth:	72 inches
Clearwell	
Type:	Baffled concrete, cast-in-place
Number of units:	One (two equal halves)
Total volume:	7.4 MG
Washwater Recovery	
Type:	Settling/drying basins
Number of units:	Four
Capacity:	1.385 MG each
FTW/Equalization Basin	
Volume:	1.485 MG
Treatment Chemicals	
Ferric chloride:	Primary coagulant
Cationic polymer:	Primary coagulant/coagulant aid
Anionic/nonionic polymer:	Filter aid and washwater solids settling aid
Gaseous chlorine:	Disinfectant residual
Carbon dioxide:	pH and alkalinity adjustment
Lime:	pH and alkalinity adjustment
Hydrofluosilicic acid:	Fluoride addition
Sodium bisulfite:	Excess ozone quenching

Source: Process Design Criteria (February 2001), CDM PHILIP, SPU updated in 2006 and 2011

Notes:

FTW = Filter to Waste

gpm/sq ft = gallons per minute per square foot

lbs/day = pounds per day

LOX = Liquid Oxygen

mgd = million gallons per day

mg/L = milligrams per liter

MG = million gallons

Table 2 Cedar Water Treatment Facility Design Parameters	
Landsburg	
Chlorination	
System	Chorine Gas
Goal	Minimze entry of nuisance and invasive species at Lake Youngs
Fluoridation	
System	Hydrofluosilicic Acid
Target Residual	0.8 mg/L
Lake Youngs	
Plant	
Type:	Raw Water Ozonation and Ultra Violet Disinfection
Capacity:	180 mgd
Intake and Raw Water Pump Station	
Pump type	Submersible
Number of units:	7
Size	2 @ 20 mgd, 5 @ 40 mgd
Ozone Generation	
Type:	LOX Feed
Number of units:	2
Design concentration of ozone	6 - 12 %
Capacity:	825 lbs/day @ 12 % each (nomimal)
	1250 lbs/day @ 6 % each (peak)
Applied ozone dose	0.3 - 0.6 mg/L (typical) 0.8 mg/L (peak)
Ozone Contacting	
Type:	Fine bubble diffusion
Flow direction	Counter-current
Contactor type	Pipeline
Number of units:	Two parallel trains
Volume	0.61 MG
Contact time:	9.8 min @ peak capacity
Ultra Violet Disinfection	
Design basis	3-log Cryptosporidium
Method	Medium pressure
Dosage	40 mJ/sq cm
Contactor type	Closed vessel
Number	13 total
Capacity:	18.4 MGD each
Clearwell	
Type:	Pre-stressed Concrete
Number of units:	2
Total volume:	20 MG
Treatment Chemicals	
Gaseous chlorine:	Disinfectant residual
Lime:	pH and alkalinity adjustment
Sodium Bisulfate	Excess ozone quenching

Source: Design Criteria (Updated July 12, 2004), CH2MHILL; SPU updated in 2006 and 2011

Notes:

lbs/day = pounds per day
min = minutes
LOX = Liquid Oxygen
mJ/sq cm = millijoules per square centimeter
mgd = million gallons per day
mg/L = milligrams per liter
MG = million gallons

Table 3 Seattle Well Fields Treatment Facilities		
Disinfection	System	Sodium Hypochlorite
	Target Dosage	1.0 to 1.4 mg/L
Fluoridation	System	Hydrofluosilicic Acid
	Target Dosage	0.8 mg/L fluoride*
Corrosion Control	System	NaOH Addition
	Target pH	8.2

* Historically, fluoride dose has been 1.0 mg/L. Reduction made in early 2011.

Source: Updated by SPU in October 2011

Table 4
Reservoir and Well Chlorination Facilities

	Year [1] Chlorination Facility Constructed	Type of Chlorination	Target Chlorine Residual (mg/l)	Redundancy	Condition
Outlet (Primary) Disinfection					
Roosevelt Reservoir	1996	Sodium Hypochlorite	1.1 - 1.3	One main storage tank, one day tank, and peristaltic pumps for sodium hypochlorite injection.	Treatment equipment is in good condition.
Volunteer Reservoir	1954	Chlorine gas 150-lb cylinders	1.2 - 1.3	Has one chlorinator and no sodium hypochlorite injection equipment or storage tanks.	Treatment equipment is in good condition.
Residual Maintenance (Secondary) Disinfection					
Beacon Reservoir	1987	Sodium Hypochlorite	1.0- 1.2	Two peristaltic pumps. Only one main storage tank.	Upgraded in 2000. Began operation as covered reservoir in 2009.
Bitter Lake Reservoir	2001	On-site Hypochlorite Generation	0.9	Backup pumps available. Can add sodium hypochlorite as a back up method.	Treatment equipment is in good condition.
Boulevard Park Well	1987	Sodium Hypochlorite	1.0 - 1.4	Backup pumps available. Well can be shut down if a disinfection equipment failure occurs.	Treatment equipment is in good condition.
Eastside Reservoir	1987	Sodium Hypochlorite	0.8	Backup pumps available. Can add sodium hypochlorite as a back up method of disinfection.	Treatment equipment is in good shape.
Lake Forest Park Reservoir	2002	On-site Hypochlorite Generation	0.9 - 1.1	Two peristaltic pumps. Can add sodium hypochlorite as a back up method of disinfection.	Treatment equipment is in good shape.
Lincoln Reservoir	2004	On-site Hypochlorite Generation	1.0 - 1.3	Two peristaltic pumps. Can add sodium hypochlorite as a back up method of disinfection.	Treatment equipment is in good condition.
Maple Leaf Reservoir	1996	Sodium Hypochlorite	1.0 - 1.3	One main storage tank, one day tank, and peristaltic pumps for sodium hypochlorite injection.	Reservoir is out of service for reconstruction (covering). Treatment equipment is in good condition.
Myrtle Reservoir	2007	On-site Hypochlorite Generation	0.9 - 1.0	Two peristaltic pumps. Can add sodium hypochlorite as a back up method of disinfection.	Treatment equipment is in good shape. Began operation as covered reservoir in 2008.
Magnolia Reservoir	1994	Sodium Hypochlorite	0.8 - 1.0	Two storage tanks and two metering pumps.	Condition of the equipment is good.
Riverton Well	1987	Sodium Hypochlorite	1.0 - 1.4	Backup pumps available. Well can be shut down if a disinfection equipment failure occurs.	Condition of the equipment is good.
West Seattle Reservoir: Inlet/Outlet and Trenton Outlet	1998	Sodium Hypochlorite	1.0 - 1.2	One main storage tank, one day tank, and peristaltic pumps for sodium hypochlorite injection.	Treatment equipment is in good condition.

Source: Reimer, 1999; Capron, 2011; Green, 2011; Nilson 2011

[1] In some cases, the year constructed is approximate. Some facilities have had equipment upgrades.

Table 5
Transmission Pipelines

Pipeline Name	Material Type	Largest Diameter (inches)	Length (feet)
430 Pipeline	Cast Iron	30	178
	Concrete Cylinder	42	1,849
	Steel	42	22,643
550 Pipeline	Steel	72	41,006
8th Ave S Pipeline	Concrete Cylinder	24	4,462
Bel Red Road	Concrete Cylinder	24	2,718
	Steel	12	30
Cedar East Side Supply Line	Cast Iron	36	134
	Concrete Cylinder	36	53,499
	Steel	72	637
Cedar River Pipeline 1	Steel	72	85,796
Cedar River Pipeline 2	Concrete Cylinder	51	10,053
	Ductile Iron	52	11
	Steel	60	71,235
Cedar River Pipeline 3	Ductile Iron	48	38
	Steel	72	86,749
Cedar River Pipeline 4	Concrete Cylinder	60	3,428
	Reinforced Concrete	72	31,687
	Steel	72	18,530
Contactor Pipe Line 4	Steel	78	3,675
Contactor Pipe Line 5	Steel	78	3,730
Des Moines Pipeline	Cast Iron	20	14
	Concrete Cylinder	24	18,197
Finished Pipeline 4	Steel	78	13,720
Finished Pipeline 5	Cast Iron	24	17
	Concrete	84	333
	Steel	78	2,991
Lake Youngs Bypass 4	Steel	78	3,006
Lake Youngs Bypass 5	Steel	78	2,999
Lake Youngs Supply Line 4	Steel	92	35,712
Lake Youngs Supply Line 5	Steel	78	35,612
Lake Youngs Tunnel	Concrete	96	11,302
	Steel	96	6
Lake Youngs Tunnel Connection	Cast Iron	24	6
	Steel	72	233
Landsburg Tunnel	Concrete	96	10,129
Maple Leaf Pipeline	Steel	54	26,164
Mercer Island Pipeline	Cast Iron	20	1,384
	Concrete Cylinder	30	9,659
	Steel	30	5,094
	Unknown	20	21
NE 24th St	Cast Iron	16	2,273
NE 8th Pl	Concrete Cylinder	24	3,783
	Ductile Iron	24	174
	Steel	20	30
Olive St Pipeline	Cast Iron	30	2,055
	Concrete Cylinder	36	337
	Ductile Iron	30	374
Ozonation Overflow Line	Steel	54	875
Reg Basin Bypass	Concrete Cylinder	66	3,026
	Steel	66	6
S 146th St Pipeline	Concrete Cylinder	30	5,209
	Ductile Iron	30	32
	Steel	24	65
S 154th St Pipeline	Ductile Iron	36	6,203
	Steel	36	13
Soos Reservoirs 640 Zone	Cast Iron	14	5,470
	Ductile Iron	24	16,555
	Steel	48	1,785
South Fork Tolt Pipeline	Concrete	72	841
	Steel	72	25,820
Tolt East Side Supply Line	Concrete Cylinder	48	52,557
	Steel	54	1,221
	Unknown	16	8
Tolt East Side Supply Line Extension	Concrete Cylinder	48	7,657
	Ductile Iron	24	614
	Steel	48	5,441
Tolt Pipeline 1	Concrete Cylinder	66	56,300
	Ductile Iron	54	17,769
	Steel	81	54,379
Tolt Pipeline 2 Ph I	Steel	60	12,302
Tolt Pipeline 2 Ph II	Steel	60	21,498
Tolt Pipeline 2 Ph III	Steel	81	20,950
Tolt Pipeline 2 Ph IV	Steel	60	32,127
Tolt Pipeline 2 Ph VIa	Steel	87	8,598
Tolt Tieline	Steel	44	7,913
Tolt Treatment Facility Inlet	Steel	90	2,711
Transmission Connection	Steel	60	1
West Seattle Pipeline	Steel	54	25,591
Total		**96**	**1,021,247**

Source: Mantchev, 2012, based on SPU GIS

Pipeline lengths are from Arc_lngth field, and include both raw and treated water pipelines.

Excludes all pipelines in the Northwest Subregional System and some pipelines in the Southwest Subregional System which are also Seattle distribution mains.

Table 6 Treated Water Reservoirs						
Reservoir	**Year Constructed**	**Total Capacity (MG)**	**Number of Cells**	**Overflow Elev. (feet)[1]**	**Under- Drain**	**Construction Type**
Regional and Sub-Regional Reservoirs - Covered						
Eastside	1989/90	31.9	1	560	Yes	Reinforced concrete tank. Below grade.
Lake Forest Park	1961/62	60	2	550	Yes	Hyplon-lined, reinforced concrete slab. Floating cover added in 2003.
Maple Leaf	see note 2	60	2	430	Yes	Reinforced concrete tank. Below grade.
Riverton Heights	1979/80	20.1	1	460	Yes	Reinforced concrete tank. Part below grade.
Soos North	1989/90	6.5	1	640	Yes	Reinforced concrete tank. Above grade.
Soos South	1989/90	6.5	1	640	Yes	Reinforced concrete tank. Above grade.
West Seattle	2010	30	1	440	Yes	Reinforced concrete tank. Below grade.
Distribution System Reservoirs - Covered						
Bitter Lake	1956/57	21.3	1	509	Yes	Reinforced concrete slab. Hypolon liner and floating cover added in 2001.
Beacon	2009	50	1	326	Yes	Reinforced concrete reservoir. Below grade.
Lincoln	2006	12.7	1	326	Yes	Reinforced concrete reservoir. Below grade.
Magnolia	1993/94	5.5	1	330	Yes	Reinforced concrete tank. Part below grade.
Myrtle	2008	5	1	498	Yes	Reinforced concrete reservoir. Below grade.
View Ridge	1977/78	2.5	1	276	Yes	Reinforced concrete tank. Below grade.
Distribution System Reservoirs - Open						
Roosevelt[3]	1910	50.3	1	326	Yes	Unreinforced concrete slab. HDPE liner.
Volunteer[3]	1901	20.5	1	430	No	Unreinforced concrete slab.

Updated 2011

1. Nominal elevation based on North American Vertical Datum (NAVD 88).
2. Under construction; planned for completion in 2012.
3. Roosevelt and Volunteer Reservoirs are planned to be removed from service following the completion of Maple Leaf Reservoir. Roosevelt Reservoir is planned to be test-decommissioned between 2012 and 2014, when a final decision will be made about decommissioning. Although modeling shows that the emergency scenarios can be met without storage at Volunteer, a decision to decommission the reservoir site has not been finalized. The decision requires further operational experience to determine the importance of the reservoir to normal system operations. If a new, covered reservoir is constructed, the likely size would be 10 million gallons.

Table 7 Standpipes and Elevated Tanks									Interior Coating		Exterior Coating		
	Year Const.	Capacity (MG)	Base Elev. (feet)[1]	Overflow Elev. (feet)[2]	Diameter (feet)	Tank Height on Riser (feet)	Tank Material	Date of Last Inspection	Type[a]	Date Applied	Type[b]	Date Applied	Seismic Upgrade (or Date Scheduled)
Regional and Sub-Regional System													
Elevated Tanks													
Beverly Park	1959	2.0	460	585	105	35	Welded Steel	Oct 98	CTE/epoxy	1985	Zn/Alkyd	1985	To be determined
Myrtle #2	1946	1.0	506.5	585	84.25	NA	Riveted Steel	Jan 99	CTE/epoxy	2010	Lead base[3]	2010	2003
Richmond Highlands #2	1958	2.0	488.5	590	86	35	Welded Steel	Nov 98	CTE	1958	Lead base[4]	1981	N/A
Others													
Control Works NE Tank	1925	0.3	437	512	NA	-	Riveted Steel	Oct 97	polyurethane	1994	epoxy/urethane[5]	1994	1994
Control Works SW Tank	1925	0.3	437	512	NA	-	Riveted Steel	Nov 97	polyurethane	1994	epoxy/urethane[5]	1994	1994
Distribution System													
Standpipes													
Charlestown	1996	1.3	424	498	58	-	Welded Steel	Feb 99	epoxy	1996	epoxy/urethane	1996	Not needed
Queen Anne	2008	1.9	460	530	75	-	Welded Steel	N/A	epoxy	2007	urethane / epoxy / acryclic polyurethane[6]	2007	N/A
North Trenton	1932	1.2	296	330	92	-	Riveted Steel	Jan 98	Vinyl	1979	Lead base[7]	1990	Not needed
South Trenton	1932	1.2	296	330	92	-	Riveted Steel	Oct 98	Vinyl	1979	Lead base[7]	1990	Not needed
Volunteer Park	1907	0.9	460	530	50	-	Masonry/Riveted Steel	Apr 99	Vinyl	1981	Lead base	1981	To be determined
Elevated Tanks													
Magnolia Bluff	1947	1.0	369	480	86	25	Welded Steel	Mar 99	epoxy	1988	Zn/Alkyd[8,9]	1988	1993

Updated 2011

a CTE = Coal Tar Enamel; p-urethane = Monolithic polyurethane lining

b epoxy = NSF epoxy primer and intermediate coats; and a polyurethane top coat; Zn/Alkyd = Zinc yellow primer and silicone alkyd enamel top coat

1. Top of concrete base, based on North American Vertical Datum (NAVD 88).
2. Nominal elevation based on North American Vertical Datum (NAVD 88).
3. Myrtle #2 has an intermediate layer of aluminum or SS flake alkyd paint.
4. 1993 seismic upgrade added all new steel to legs and riser, and coated legs and riser with a non-lead alkyd enamel paint system. The bowls still have the lead based primer as noted.
5. Base of tank in building. Above the roof: epoxy prime coat and polyurethane top coat (in 1994); Inside the bldg: moisture cured polyurethane primer and top coats (in 1998).
6. Exterior coating consists of zinc-rich urethane primer then epoxy followed by acrylic polyurethane top coat.
7. Trenton tanks were power tool cleaned and overcoated with an urethane/epoxy/urethane paint system in 1990.
8. Magnolia Bluff was commercially blasted and coated with a non-lead alkyd system. Some lead remains on the tank.
9. 1993 seismic upgrade added all new steel to legs and riser, and coated legs and riser with a non-lead alkyd enamel paint system. The bowls still have the lead based primer as noted.

Table 8

Decommissioned Standpipes and Elevated Tanks[d]

	Year Taken Off-Line	Year Const.	Capacity (MG)	Base Elev. (feet)[e]	Overflow Elev. (feet)[f]	Diameter (feet)	Tank Height on Riser (feet)	Tank Material	Date of Last Inspection	Interior Coating: Type[a]	Interior Coating: Date Applied	Exterior Coating: Type	Exterior Coating: Date Applied	Improvements Needed If Returned to Service	Current Uses
Regional and Sub-Regional System															
Standpipe															
Foy	2013[b]	1933	1.0	495	590	46	-	Riveted Steel	Feb 98	Vinyl	1980	Lead base	1980	Internal recoating, including coal tar removal, and installation of a mixing system.	Communications tower
Elevated Tanks															
Myrtle #1	2013[c]	1919	0.5	506.5	584.5	46	-	Riveted Steel	Feb 96	Vinyl	1982	Lead base Touch-up	1983 2009	Internal recoating.	
Richmond Highlands #1	2013[b]	1954	1.0	492.5	590	86	25	Welded Steel	Nov-99	CTE	1954	Lead base[g]	1981		
Distribution System															
Standpipes															
Barton	2012[b]	1927	1.4	277	326	80	-	Riveted Steel	Jan 98	CTE	1960	Lead base	1981	Internal recoating, roof repairs, drain improvements (air gap), and reconnection.	
Woodland Park	2003[h]	1925	1.0	356	430	50	-	Riveted Steel	Oct 98	Vinyl	1984	Lead base	1980	Reconnection	
Elevated Tanks															
Maple Leaf	2009	1949	1.0	431	530	84.25	25	Welded and Riveted	Jan 98	epoxy	1988/95	Lead base[i] Touch-up	 2011	Internal recoating and reconnection.	Communications tower

Source: Capron 2011, Mantchev 2012

a CTE = Coal Tar Enamel
b Per current schedule.
c WDOH approval pending.
d Decommissioned facilities have been disconnected from the water system, but not demolished, and can be returned to service after the improvements shown are made.
e Top of concrete base, based on North American Vertical Datum (NAVD 88).
f Nominal elevation based on North American Vertical Datum (NAVD 88).
g Richmond Highlands: 1993 seismic upgrade added all new steel to legs and riser, and coated legs and riser with a non-lead alkyd enamel paint system. The bowls still have the lead based primer as noted.
h Disconnected and decommissioned in 2009.
i Maple Leaf has some remaining red lead primer then coated with moisture cured urethane primer and top coats.

Table 9
Regional and Sub-Regional System Pump Stations

	Pump #	Manufacturer	Model	Design Flow (gpm)	Head (feet)	Speed (rpm)	Horse-Power	Comments
Augusta	1	Aurora	411 BF	300	102	1,750	15	Pumps 1 and 2 are continuous
	2	Aurora	411 BF	300	102	1,750	15	duty; alternating daily
	3	Aurora	411 BF	1,200	102	1,750	40	
	4	Aurora	411 BF	2,400	113	1,750	100	Fire flow only
Bothell Way	1	De Laval	T36/30	38,200	80	450	900	
Burien	1	Allis Chalmers	209-648-501	2,000	180	1,760	125	Emergency pump connections
	2	Allis Chalmers	209-732-501	3,000	180	1,760	200	for diesel pump.
	3	Worthington	10-LNHS-18	6,000	180	1,775	350	
Control Works	1	De Laval		1,200		1,760	25	Standby use only
Eastgate	1	Byron Jackson	18-KXH-1-STG	4,250	145	1,770	200	
	2	Byron Jackson	18-KXH-1-STG	4,250	145	1,770	200	
	3	Byron Jackson	18-KXH-1-STG	4,250	145	1,770	200	
Fairwood	1	Aurora	411 BF	750	220	1,750	75	Emergency pump connections for
	2	De Laval	A0615L	2,000	215	1,750	150	diesel pump.
Foy	1	Ingersoll Rand	10 LR 18A	6,000	165	1,785	300	
	2	Ingersoll Rand	8 LR-18S	4,440	165/290	1,778	400	165 ft. head with 15.43";
	3	Ingersoll Rand	8 LR-18S	4,440	165/290	1,778	400	290 ft. head with 18" impeller
Highland Park	1	Worthington	10 LNH 18	5,500	175	1,775	300	
	2	Worthington	10 LNH 18	5,500	175	1,775	300	
	3	Ingersoll Rand	6 AFV	1,400	140	1,770	60	Small pump can be powered by diesel generator
Lake Hills	1	Peerless	8AE17A	5,000	160	1,780	250	New 1999 Emergency pump connections
	2	Peerless	8AE17A	5,000	160	1,780	250	New 1999 for diesel pump
Lake Youngs	1	Fairbanks Morse	7000 AW	7,700	182	1,185	500	
	2	Fairbanks Morse	7000 AW	7,700	182	1,185	500	
Maple Leaf	1	Patterson	18X14 MAC	10,300	156	1,180	500	Can be powered by diesel generator
	2	Patterson	18X14 MAC	7,200	156	1,180	350	
Maplewood	1	Worthington	20 LN 28	17,750	108	720	600	Standby use only, low hours
North City	1	Worthington	12 LN 14	6,500	113	1,775	250	
	2	Worthington	12 LN 14	6,500	113	1,775	250	
Trenton	1	De Laval		1,000	225	1,845		Water Turbine Powered
	2	De Laval		3,000	225	1,200		Water Turbine Powered
TESS	1	Worthington	8 LP 13	1,600		1,770	100	
	2	Aurora		3,500	272		100	Diesel pump

Source: Capron 2011, Goodman 2011

Notes:

gpm = gallons per minute

rpm = revolutions per minute

Vert. = vertical

Table 10
Distribution System Pump Stations

	Pump #	Manufacturer	Model	Design Flow (gpm)	Head (feet)	Speed (rpm)	Horse-Power	Comments
Bitter Lake	1	Gould	3405	4,000	162	1,775	200	
	2	Gould	3405	4,000	162	1,775	365	Diesel standby use only
	3	Gould	3405	4,000	162	1,775	200	
Broadway	1	Fairbanks Morse	2844C	4,700	245	1,781	400	
	2	Fairbanks Morse	2844A	2,800	237	1,784	250	
	3	Fairbanks Morse	K65226	4,000		1,150	300	
Dayton Ave.	1	De Laval	56064	1,400	110	1,750	50	
	2	MP		100	100	3,450	5	
First Hill[(1)]	3	Fairbanks Morse	2824C	2,800	180	1,775	200	
	4	Fairbanks Morse	2824C	4,900	190	1,775	350	
Green Lake	1	De Laval	98851	900	331	1,750	93	Water Turbine Powered
Interbay	1	Worthington	10 LN 18	3,500	110	1,185	125	Low service
	2	Worthington	8 LA 4	3,500	230	1,785	300	High service
Lincoln	1	Worthington		3,900	117	1,540	125	Water turbine powered
Northgate	1	Allis Chalmers	205-603-502	5,500	182	1,760	300	
	2	Allis Chalmers	205-603-501	5,500	182	1,760	300	
Queen Anne	1	Berkeley	B2TPMS	170			5	Variable frequency drive
	2	Berkeley	B2TPMS	170			5	Variable frequency drive
	3	Berkeley		450			15	Variable frequency drive
	4	Berkeley		2,400			40	
Roosevelt	1	Allis Chalmers	201-052-501	3,000	110	1,760	100	
	2	Allis Chalmers	201-052-501	3,000	110	1,760	100	
Scenic Heights	1	Aurora	411 BF	450	95	1,750	20	
	2	Aurora	411 BF	450	95	1,750	20	
	3	Aurora	411 BF	1,100	100	1,750	40	
	4	Aurora	411 BF	1,100	100	1,750	40	
SW Spokane	1	Allis Chalmers	207-52-510	4,000	290	1,760	400	New starters and transfer switch in
	2	Allis Chalmers	207-52-510	4,000	290	1,760	400	1997; can be powered by diesel gen.
Viewridge	1	Layne		2,500		1,750	100	To 326 zone
	2	Layne		3,500		1,750	350	To 530 zone
Volunteer	1	Allis Chalmers	201-194-502	4,000	108	1,760	125	
	2	Allis Chalmers	201-194-501	4,000	108	1,760	125	
Warren Ave.	1	Allis Chalmers	207-521-510	4,000	265	1,770	350	Can be powered by diesel generator.
	2	Allis Chalmers	207-521-509	4,000	265	1,770	350	
West Seattle	1	Ingersol Rand	10 AFV	4,500	62.3	1,750	100	One pump can be powered by diesel
	2	Ingersol Rand	11 AFV	4,500	62.3	1,750	100	generator

Source: Capron 2011, Goodman 2011

Notes:

(1) First Hill pump station has two pumps, they are labeled 3 and 4. The pumps work in conjunction with pumps 1 and 2 and the Broadway pump station.

Notes:

gpm = gallons per minute

rpm = revolutions per minute

Vert. = vertical

Table 11
Metered Connections by Classification and Size

CLASSIFICATION	CONNECTION SIZE (inches) 3/4	1	1-1/2	2	3	4	6	8	10	12	16	20	24	TOTAL
Residential [1]	143,514	16,751	1,263	439	1	1	1	1	-	-	-	-	-	161,971
Commercial [2]	6,902	5,244	3,634	4,578	497	725	334	115	36	6	-	2	-	22,073
Fire Service	83	1	2	610	29	1,526	1,262	728	28	9	-	-	-	4,278
RETAIL SERVICE TOTAL[3]	150,499	21,996	4,899	5,627	527	2,252	1,597	844	64	15	-	2	-	188,322

Source: City of Seattle, Consolidated Customer Service System, Meter Count By Connection Size Report, Run Date: 08-JAN-2011.

[1] Includes single-family residences, duplexes, and other residential services.

[2] Includes mulit-family residences, commercial properties and municipal services.

[3] Includes 10,871 services in Shoreline, 383 services in Lake Forest Park, and 4,780 other services outside the City of Seattle.

Table 12
Interties From Seattle Public Utilities to Other Purveyors
As of November 2011

Purveyor and SPU Meter No.	SPU Station	Meter Size (inches)	Service Location	Comments/Notes
CITY OF BELLEVUE				
2-533677-460238	47	8	128th Ave SE & SE 56th ST	
2-533677-460240	55	6	128th Ave SE & Newport Way	
2-533686-461091	56	8	128th Ave. SE & Newport Way	
2-533679-461120	58	12	145th Pl. SE & SE 28th Street	
2-533678-461098	59	8	132nd Ave. SE & SE 26th Street	
2-533900-460746	60	10	14509 SE Newport Way	
2-533880-461005	61	24	152nd Ave. NE & NE 8th Street	
2-533882-460302	62	12	132nd Ave. NE & Bel-Red Road	
2-533677-461245	63	10	132nd Ave. NE & NE 24th Street	
2-533675-461109	65	10	140th Ave. NE & 40th Street	
2-533680-460237	66	8	Mercer Is. Pipeline & 108th Ave. SE	
2-533677-461321	124	8	124th Ave SE & SE 38 PL	
2-533900-460746	182	10	14509 SE Newport Way	
CITY OF BOTHELL				
2-533588-461020	95	10	TRPL R/W - 104TH NE	
2-533591-460241	96	8	NE 180TH & 88TH NE	
2-533638-461029	99	6	TRPL & 96TH NE STA 1335	
CEDAR RIVER WATER AND SEWER DISTRICT				
2-533703-461103	30	8	141st Ave SE and SE 171st Way	
2-535998-460956	166	10	19201 SE Petrovitski Road	
2-533875-962982	187	10	FWPL4 at NE corner of Control Works property	
COAL CREEK UTILITY DISTRICT				
2-533690-461094	48	8	129th Ave SE & SE 73rd ST	
2-533689-461092	52	12	128th Ave SE & SE 70th ST	
2-533692-461099	54	4	132nd Ave SE & SE 96th ST	Meter not used, for backup only.
CITY OF DUVALL				
2-533661-461012	111	4	TOLT RIVER PIPELINE	
2-533885-461023	112	6	TRPL - STA 657 + 29	
CITY OF EDMONDS				
2-533584-460571	110	10	SE Corner N 205TH & Fremont AV	Emergency Intertie only

Table 12
Interties From Seattle Public Utilities to Other Purveyors
As of November 2011

Purveyor and SPU Meter No.	SPU Station	Meter Size (inches)	Service Location	Comments/Notes
HIGHLINE WATER DISTRICT				
2-534019-460587	41	12	Des Moines Way S & S 207th Street	
2-534079-460743	42	16	160th Ave S & Military Road S	
2-534018-460748	43	12	Des Moines Way S & S Normandy Road	
CITY OF KIRKLAND				
2-533676-460249	72	12	140th Ave. NE & NE 70th Street	
2-533668-460245	74	10	132nd Ave. NE & NE 113th Street	
2-533883-461006	75	16	132nd Ave. NE & NE 85th Street	
LAKE FOREST PARK WATER DISTRICT				
2-533597-971083	188	8	Tolt Pipeline ROW & NE 195th St	Emergency Intertie only
CITY OF MERCER ISLAND				
2-533669-461336	67	12	SE 43rd Street & 89th Ave SE	
2-533673-461333	68	6	SE 40th Street & 97th Ave SE	
2-539472-460740	171	10	E Mercer Way & Mercer Island Pipeline Right-Of-Way	Mercer Crest Water Association was taken over by City of Mercer Island.
CITY OF NORTH BEND				
2-1492723-971210	190	8	101 R @ SCL PP "RT 1-73"	
NORTHSHORE UTILITY DISTRICT				
2-533594-461018	81	6	Tolt Pipeline ROW & 119th Ave. NE	
2-533587-461026	83	10	Tolt Pipeline ROW & 112th Ave. NE	
2-533589-461024	85	6	Tolt Pipeline ROW & 104th Ave. NE	
2-533643-461014	86	20	88th Ave. NE & NE 180th Street	
2-533595-461205	89	6	64th Ave. NE & NE 185th Street	
2-533596-461206	90	6	64th Ave. NE & NE 185th Street	
2-533582-461004	92	6	40th Place NE & NE 195th Street	
2-533585-461013	93	12	Tolt Pipeline ROW & NE 195th Street	
2-533666-460246	94	10	132nd Ave. NE & NE 132nd Street	
OLYMPIC VIEW WATER AND SEWER DISTRICT				
2-533592-461242	107	8	8th Ave. NW & NW 205th St.	
2-533647-459418	108	8	Fremont N. & N. 205th St.	
2-533646-459419	109	8	Fremont N. & N. 205th St.	
2-533592-978166	192	6	24th Av NW & NW 205th St.	

Table 12
Interties From Seattle Public Utilities to Other Purveyors
As of November 2011

Purveyor and SPU Meter No.	SPU Station	Meter Size (inches)	Service Location	Comments/Notes
CITY OF REDMOND				
2-540865-460251	164	10	Trilogy Parkway NE & NE 125th Street	
2-533903-461057	165	10	160th Ave NE & NE 104th Street	
2-540865-951406	185	6	NE 172nd Street & Tolt Pipeline #2	
2-540865-460250	186	10	Trilogy Parkway NE & NE 125th Street	
CITY OF RENTON				
2-533998-460263	33	6	9602 S 160TH ST	
2-533707-460581	34	8	CRPL 4 - ST HWY 5 - C	
2-533708-460260	36	6	7TH - JONES ST - PL R/W	
2-533709-460281	37	3	PLAT RENTON	
2-533711-460578	38	6	CRPL & 84TH AV S	
2-533705-460573	39	10	CRPL RW & LK YOUNG WY	
2-533697-460257	179	10	Logan St & 2nd	Formerly SPU direct service to Boeing Renton plant
2-533698-460256	180	10	Logan St & 2nd	Formerly SPU direct service to Boeing Renton plant
2-533698-461130	196	8	7501-8001 S 153rd Pl	Serves Boeing/Longacres
SHORELINE WATER DISTRICT				
2-533579-480005	101	10	8th Ave NE & NE 160th Street	
2-533581-472896	102	10	16th Ave NE & NE 192nd Street	
2-533583-459353	103	6	32nd Ave NE & NE 195th Street	
2-533580-461207	104	8	8th Ave NE & NE 185th Street	
2-533580-975611	191	8	NE 195th St & 47th Pl NE	
2-533580-978151	193	8	NE 185th & 5th Ave NE	
2-533580-979000	194	8	NE 185th & 8th Ave NE	
SKYWAY WATER AND SEWER DISTRICT				
2-533712-471173	1	8	84th Ave. S & S 134th Street	
2-533720-457667	5	8	Beacon Ave S & S 124th Street	
2-533893-460571	172	6	Cornell Ave S & S 112th Street	
SOOS CREEK WATER AND SEWER DISTRICT				
2-533702-461124	27	10	148th Ave SE and SE 192nd Street	
2-533704-461155	28	10	SE 164TH Street and 132nd Ave SE	
2-533706-460576	29	8	SE 160TH Street and 114th Ave SE	
2-539118-461441	181	6	147th Ave SE and SE Petrovitski Road	

Table 12
Interties From Seattle Public Utilities to Other Purveyors
As of November 2011

Purveyor and SPU Meter No.	SPU Station	Meter Size (inches)	Service Location	Comments/Notes
2-539118-971209	189	10	SE 164th & 132nd SE (next to Sta.28)	
CITY OF TUKWILA				
2-534002-460582	13	10	South Center Parkway & Tukwila Parkway	
2-534001-461149	14	8	West Valley Hwy & S 162nd Street	
2-534004-457795	15	8	Christensen Rd. & Baker Rd	
2-534003-461363	16	6	53rd Ave S & S 160th Street	
2-536983-459031	183	12	E Marginal Way & S 112th Street	
2-536984-458373	168	12	7749 E Marginal Way S	
2-537357-460018	169	8	51st Ave S & S Leo Street	
2-539200-458356	170	12	W. Marginal Place & S 102nd St.	
2-537646-458802	173	6	47th Ave S & S Victor Street	
WOODINVILLE WATER DISTRICT				
2-533887-461022	53	8	TPL1 at pipeline station 1120	
2-533891-461021	57	6	TPL1 at pipeline station 1061	
2-533586-461027	76	4	TPL1 at 124th Ave NE	
2-533667-461096	77	6	132nd Ave NE & NE 140th Street	
2-533662-461019	78	8	TPL1 at Welcome Road Valve Station	
2-533904-461016	79	8	TPL1 at Avondale Road	
2-533665-461028	80	8	TPL1 at 168th Ave NE	
2-533663-461011	123	6	TPL1 at pipeline station 1197	
2-533870-460564	125	6	TPL1 at pipeline station 1049	
2-535993-461097	167	6	15002 132nd Ave NE	
TBD	195	6	132nd Ave NE & NE 144th Street	To be completed and operational in 2012.
KING COUNTY WATER DISTRICT #20				
2-534031-459065	19	16	12th Ave S & S 112th Street	
2-534044-461108	23	6	14th Ave SW & SW 149th Street	
2-534034-461419	126	8	8th Ave S & Aqua Way	
2-534030-461063	127	6	Des Moines Memorial Dr. & S 112th Street	
2-534029-460742	128	6	Military Road & S 125th Street	
2-534028-461093	129	6	Military Road & S 128th Street	
2-534032-461061	130	6	14th Ave S & S 112th Street	
2-534037-461329	132	8	4th Ave SW & SW 108th Street	

Table 12
Interties From Seattle Public Utilities to Other Purveyors
As of November 2011

Purveyor and SPU Meter No.	SPU Station	Meter Size (inches)	Service Location	Comments/Notes
2-534038-461330	133	10	4th Ave SW & SW 128th Street	
2-534039-460273	134	4	Ambaum Blvd SW & SW 132nd St.	
2-534011-460591	135	6	14th Ave S & S Director Steet	
2-534025-461422	136	10	8th Ave S & S 146th Street	
KING COUNTY WATER DISTRICT #45				
2-534036-461060	20	8	4th Ave SW & SW 108th Street	
2-534036-909301	176	6	12th Ave SW & SW 106th Street	
2-534036-479202	184	6	8th Ave SW & SW 99th Street	
KING COUNTY WATER DISTRICT #49				
2-541232-460590	25	8	16800 DesMoines Wy S	
2-534043-461052	139	10	10TH AV SW - SW 149TH	
2-536055-461420	140	12	DesMoines Way S. & 160th Ave S	
2-534042-461424	142	8	8TH AV SW - SW 146TH	
2-534017-460585	143	10	DESMOINES WY & AMBAUM	
KING COUNTY WATER DISTRICT #90				
2-533693-460274	45	10	132ND AV SE & SE 128TH	
KING COUNTY WATER DISTRICT #119				
2-533659-460940	116	4	ODELL STA 612 THRU 36 30	
2-533660-461010	117	6	34801 TOLT PL RW	
KING COUNTY WATER DISTRICT #125				
2-533717-460574	8	6	CRPLs 1,2 & 3 and S 131st Street	
2-534014-461335	9	6	42nd Ave S & S 160th Street	
2-534015-461148	10	8	Pacific Highway S & S 160th Street	
2-534024-461421	17	10	8th Ave S & S 146th Street	
2-533868-461089	119	6	CRPLs 1,2 & 3 and S 124th Street	
2-534006-466490	120	8	E Marginal Way & S 115th Street	
2-534027-461102	121	4	Military Road & S 135th Street	
2-535981-459141	174	10	2400 S 146th Street	Boeing Fire Service
2-535982-459140	175	10	2400 S 146th Street	Boeing Fire Service

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN
APPENDIX C

POLICIES, PROCEDURES AND STANDARDS

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

C. POLICIES, PROCEDURES AND STANDARDS

APPENDIX C-1

COMPREHENSIVE DRINKING WATER QUALITY MONITORING PLAN

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Seattle Public Utilities
Comprehensive Drinking Water Quality Monitoring Plan

February 2012

1.0 Overview

Providing public health protection is a primary concern in the operation and maintenance of a public drinking water system. Determining the adequacy of this protection is accomplished with a comprehensive monitoring program that covers the source of supply, treatment systems, the distribution system, and customers' taps. Sampling requirements are established by federal regulations, such as the Safe Drinking Water Act (SDWA), which are in most cases adopted by the state. Seattle Public Utilities (SPU) conducts monitoring in accordance with the Safe Drinking Water Act and Washington State Department of Health requirements, Chapter 246-290 WAC.

This monitoring plan addresses the following:

- Monitoring requirements under state and federal drinking water regulations;
- Future regulations, which are currently under development at the federal level;
- Non-regulatory monitoring, which SPU conducts for informational purposes and to assist in operating the water system;
- Sampling procedures;
- Laboratory Information Management System (LIMS); and,
- All parameters, locations, and frequency of monitoring conducted by SPU. Monitoring locations include source, treatment, transmission and distribution system, and customer taps.

A summary of SPU's monitoring requirements is shown in Table 1. This table includes source water and distribution system monitoring required by regulation. Monitoring of treatment operations required by the Surface Water Treatment Rule or Lead and Copper Rule is not included in Table 1, but is discussed below, and is reflected in Table 2.

Table 2 is a summary of the monitoring currently conducted by SPU and is organized by sampling locations, frequencies, and parameters. This table includes monitoring required by regulations, and monitoring conducted for operational or informational purposes (non-regulatory). All monitoring shown is directly related to the drinking water supply. Monitoring related to special studies, customer inquiries, disinfection of new mains, construction of facilities, environmental compliance when dewatering facilities, wellhead protection, aquifer recharge, source development, treatment chemicals, or other monitoring conducted for purposes other than drinking water quality compliance is not included in this document.

DOH has the authority to grant waivers for certain parameters, depending on vulnerability and previous sampling results. If a system is considered to have low vulnerability to contamination from a certain chemical or group of chemicals, the State may waive the requirements for sampling, or reduce the amount of samples required. The State issued waivers for SPU for Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs) for the 2008 to 2010 monitoring period. SPU will apply for waivers for the 2011 to 2013 monitoring period. There are also several area-wide waivers in effect for several of the SOCs. These waivers apply to all systems within the designated area.

SPU operates its own State-certified laboratory for a majority of the parameters monitored. This includes total coliform, fecal coliform, HPC, most inorganic chemicals, trihalomethanes, haloacetic acids, lead, copper, VOCs, and all SWTR parameters. Samples for SOCs, asbestos, some inorganics, and *Cryptosporidium* and *Giardia* are sent to other laboratories certified by the state or EPA for the analysis.

Adjustments to monitoring are often required based on operational considerations, detection of organic chemicals, construction projects, or as required by the state based on a public health concern. SPU will work with the State to determine appropriate changes to the monitoring program to address any concerns that may arise.

2.0 Monitoring Requirements

The following summarizes the monitoring requirements for existing and future regulations. Existing regulations include those finalized by EPA and published in the Federal Register under 40 CFR Part 141. Any regulation the state has adopted into Chapter 246-290 WAC with changes or additions are also discussed under existing regulations. Future regulations include those currently proposed by EPA.

2.1 Existing Regulations

The existing regulations discussed below are organized by their common name with a reference to the appropriate federal and state section numbers.

Total Coliform Rule (40 CFR 141.21 and WAC 246-290-300 (3))

SPU collects and analyzes coliform samples from representative points throughout the direct service area as outlined in SPU's Coliform Monitoring Plan (attached without appendices). These samples are collected at designated sample stands according to established routes assigned by the Senior Water Quality Analyst or designee. Routes are designed to cover both the Cedar and Tolt service areas each day; with most sample stands being sampled weekly. To meet regulatory requirements, SPU must collect at least 189 coliform samples from its direct service area each month. The chlorine residual is also analyzed in the field at the time of coliform sample collection as required by state regulations. Temperature is also measured, although not required.

For any sample found to be positive for total coliform, or invalidated, follow-up action is taken according to state and federal regulations, as described in SPU's Coliform Monitoring Plan. This follow-up action may include additional sample collection, additional analyses such as fecal coliform, *E. Coli*, or HPC, and notification to the state. SPU's Coliform Monitoring Plan lists all sample locations, schedules, test methods used, follow-up sampling requirements, and notification requirements.

Surface Water Treatment Rule (40 CFR 141.70-75 and WAC 246-290 Part 6)

The Surface Water Treatment Rule (SWTR) requires a significant amount of monitoring for SPU's filtered surface water supply, the South Fork Tolt River. This includes raw water, treated water, and distribution system water monitoring as follows.

Raw Water Monitoring – Continuous monitoring of turbidity at the inlet to the Tolt Water Treatment Facility occurs as required by the SWTR. Samples analyzed for fecal coliform density are collected at the inlet to the Tolt Water Treatment Facility daily, for at least 19 days a month.

Treated Water Monitoring – Treated water monitoring for the SWTR consists of monitoring required to determine the effectiveness of the disinfection process. This includes monitoring to determine log reduction of *Giardia* cysts and viruses. To determine the log reduction for virus, the pH, chlorine residual, temperature, clearwell volume, and peak hourly flow rate must be recorded. For the Tolt system, this monitoring is continuous, but is reported once a day at peak hourly flow. To determine the log reduction for *Giardia*, the pH, ozone residual at multiple locations along the contact chamber, temperature, and peak hourly flow are recorded. CT is calculated for each section of the ozone contact chamber. Ct is reported to the state for both the peak hourly flow and at minimum daily CT.

In addition, continuous chlorine residual monitoring for water entering the distribution system occurs at the outlet of the Tolt Water Treatment Facility. Turbidity is also monitored continuously at each individual filter unit and from the combined filter effluent.

Additional monitoring is conducted at the treatment plant to meet the requirements of the Service Agreement with the DBO contractor. This monitoring is summarized in Table 3.

Distribution System Monitoring – Residual disinfectant concentration is measured at the same time and location that a routine or repeat coliform sample is collected within the distribution system.

Limited Alternative to Filtration (WAC 246-290-691)

Beginning in November 2004, the Cedar water supply system was designated a Limited Alternative to Filtration status. As such, the source and treated water monitoring requirements are slightly different than an unfiltered surface water source subject to the SWTR. This includes raw water, treated water, and distribution system water monitoring as follows.

Raw Water Monitoring – Continuous turbidity monitoring occurs at the Cedar Water Treatment Facility for the raw water coming from Lake Youngs (or Landsburg during by-pass operations).

Fecal coliform samples are also collected at this location once per day for a minimum of 19 days a month.

Treated Water Monitoring – Treated water monitoring consists of monitoring to determine inactivation of Giardia, Cryptosporidium, and viruses. This monitoring is conducted continuously for the ozonation system, UV treatment, and chlorination. For ozone inactivation of Giardia and viruses, monitoring includes temperature, initial ozone concentration, ozone decay, and flow rate. For inactivation of Giardia and Cryptosporidium with UV, monitoring consists of flow rate through each reactor, UV transmittance, UV dose, lamp power, and lamp hours. For inactivation of viruses with chlorine, monitoring includes flow rate, clearwell volume, pH, chlorine residual, and temperature.

Finished water entering the system is continuously monitored for chlorine residual, temperature and pH. Daily samples are also analyzed for coliform, although this is not required by regulation. Additional monitoring is required to meet the Service Agreement with the DBO contractor. Service Agreement monitoring is summarized in Table 3.

Distribution System Monitoring – Residual disinfectant concentration is measured at the same time and location that a routine or repeat coliform sample is collected within the distribution system.

Disinfectants/Disinfection By-Products Rules (40 CFR 141.130-135, 141, 142) and WAC 246-290-300 (6)

Current regulations (Stage 1) require trihalomethane (THMs) and haloacetic acids (HAAs) monitoring in the distribution system. SPU is required to collect two samples each quarter at existing sample stands within the direct service area under an approved reduced monitoring schedule. One of these stands is generally served by Cedar water and one is generally served by Tolt water. These two samples are collected at sample stands that are considered to represent the maximum residence time in the system for each source. Currently, sample stands G2 and B4 are considered to represent the maximum residence time for the Cedar and Tolt, respectively. SPU elects to collect two additional THM and HAA samples each quarter for informational purposes. The other two sites used are J-3 and A-3. These are considered average residence time and generally represent higher HAA levels.

Monitoring for chlorine residual currently conducted at total coliform sample sites in the direct service area are reported under the Stage 1 rule. Bromate and bromide monitoring are conducted for the Tolt and Cedar supplies now that ozonation facilities for each supply are in operation. The monitoring for bromate is conducted monthly at the entry to the distribution system. The bromide monitoring was conducted monthly for the source water prior to any treatment during the first year of operation of the Tolt and Cedar Water Treatment Facilities.

Stage 2 DBP Rule was finalized in January 2006. This new rule will require increased monitoring for DBPs. Following the completion of the Initial Distribution System Evaluation in 2008, twelve sites were selected based on the criteria in the Stage 2 rule. Stage 2 DBP monitoring will begin at these 12 sites in the second quarter of 2012. Compliance under the

Stage 2 Rule will be based on locational running annual averages instead of system wide running annual averages.

Lead and Copper Rule (40 CFR 141.80-91)

SPU has conducted monitoring for lead and copper at customers' taps according to the regulations and a Bilateral Compliance Agreement with DOH. Two rounds of samples were collected at 375 homes in 2003 and 2004 after completion of a corrosion control optimization study for the Tolt. Two more rounds of samples were collected at 400 homes in 2005. These homes were selected based on criteria in the Lead and Copper Rule. For the last two rounds, the homes were divided into sub regions. One hundred samples were collected from the Seattle direct service area, 100 were collected from Bellevue, 100 were collected from the participating wholesale providers receiving water from the Cedar supply, and 100 were collected from the participating wholesale providers receiving water from the Tolt supply. Compliance was based on the 90^{th} percentile for each sub-region. Based on previous rounds, each sub-region qualifies for reduced monitoring, which requires 50 samples per sub-region. Each sub-region is currently required to collect 50 samples once every three years. Monitoring requirements would change if the lead or copper action levels were exceeded. The Cedar wholesale provider group will collect samples in 2012, Seattle direct service area will collect samples in 2013, and the Tolt wholesale provider group will collect samples again in 2014.

Water quality parameter monitoring at the treatment plants and within the distribution system is also now required for the lead and copper rule. Monitoring of pH is required at the Cedar Water Treatment Facility and both pH and alkalinity is required at the Tolt Water Treatment Facility. The distribution system monitoring currently includes collecting 10 samples each month and analyzing the samples for pH and alkalinity. The 10 locations are distributed throughout the direct service area and Cedar and Tolt wholesale sub-regions that are part of the regional monitoring program.

Inorganic Contaminants, VOCs, SOCs (40 CFR 141.23-23, 40 and WAC 246-290-300 (4) and (7))

Primary and Secondary inorganic contaminants (IOCs), volatile organic chemicals (VOCs), and synthetic organic chemicals (SOCs) are monitored according to state and federal requirements. IOCs for the Cedar and Tolt supplies are monitored on an annual basis and VOCs are monitored once every three years, with the samples collected from the entry point to the distribution system, after treatment. This frequency assumes a state waiver has been granted for VOCs. The Riverton and Boulevard Park Wells are sampled once every three years (or when in operation) for IOCs and VOCs at the entry point to the distribution system prior to the first customer. SOCs are monitored as directed by the state, and the frequency is dependent on waiver status. SOCs were last collected in 2008. The year 2011 marks the beginning of a new three and nine year monitoring period. State waivers have not yet been issued for this monitoring period.

Radionuclides (40 CFR 141.26 and WAC 246-290-300 (8))

The new radionuclides rule (effective December 2003) requires monitoring for gross alpha, radium 226, radium 228, and uranium. This monitoring is conducted for each source at the entry point to the distribution system. Frequency is dependent on results. Two consecutive quarterly samples were collected before December 2007 for initial monitoring. After initial monitoring, samples will likely be required once every 9 years.

Fluoride (WAC 246-290-460)

As required by state regulations, fluoride is monitored daily at each point of fluoride addition and a report is submitted to the state monthly. For process control purposes, fluoride concentration is monitored continuously with an online instrument. In addition to fluoride monitoring at the treatment plants, a grab sample is collected daily and analyzed at SPU's Water Quality Laboratory as a check. Results for one monthly check sample are submitted to the state.

Unregulated Contaminants Monitoring Rule (40 CFR 141.35, 40)

The Unregulated Contaminants Monitoring Rule requires additional monitoring for SPU's source waters. For UCMR 2, four quarterly samples were collected at the entry point to the distribution system in 2009. The next projected UCMR monitoring (UCMR 3) is projected to occur between 2013 and 2015.

Groundwater Rule (40 CFR 141.400 - 405)

This regulation was finalized in late 2006, with an effective date of December 1, 2009. Only the Riverton and Boulevard Park Wells are subject to this regulation. SPU has decided to use triggered source water monitoring for the compliance strategy. This means a source water E. Coli sample will need to be collected from the wells any time the wells are in operation, and a TCR compliance sample from the area fed by the wells is positive. The sample must be collected within 24 hours notice.

Cryptosporidium Monitoring for LT2SWTR (40 CFR 141, Subpart W)

SPU currently conducts quarterly source water monitoring for *Giardia* and *Cryptosporidium* for the Cedar and Tolt supplies. This monitoring is currently voluntary. Monthly monitoring to determine compliance with LT2SWTR was completed in 2007. The results of *Cryptosporidium* monitoring are reported in the annual Drinking Water Quality Report sent to customers each year. Currently, samples are collected from two locations: Tolt Regulating Basin outlet (TPR-4), and Lake Youngs outlet (C1-Raw) prior to treatment. The next round of monthly monitoring for LT2SWTR compliance is required six years after completion of the previous round (possibly 2013 or 2014).

2.2. Future Regulations

The future regulations discussed below are organized by their currently accepted common name (may change in the future). *Federal Register* citations are provided for rules which have been published, either in draft or final form.

Revisions to Total Coliform Rule

Proposed RTCR regulations were published on July 14, 2010. Based on the proposed changes, there should not be any significant impact to the current coliform monitoring conducted in SPU's distribution system.

Fluoride Target

In January 2011, the U.S. Department of Health and Human Services (HHS) and the U.S. Environmental Protection Agency (EPA) announced a proposed recommended level of fluoride in drinking water of 0.7 part per million. A final recommendation on the fluoride level was expected in the late summer or early fall of 2011. The treatment target for Seattle supplies was lowered from 1.0 to 0.8 mg/L to match the minimum currently allowed by state regulation. SPU will continue to work with the Washington Department of Health and Public Health Seattle and King County in preparation for a final federal recommendation on fluoride levels.

2.3. Non-Regulatory Monitoring

Non-regulatory monitoring discussed below includes monitoring performed for informational purposes or to assist in making operational decisions. This monitoring is not required by regulation at this time, but may be required at some time in the future.

Limnology

Bi-weekly, monthly and quarterly monitoring of various limnological parameters is conducted at Lake Youngs, Chester Morse Lake, the Tolt Reservoir proper and reservoir tributary streams, and the Cedar River. In addition, samples are collected occasionally from the Tolt Regulating Basin. This data is collected for informational purposes, and is not required by state or federal regulations. Sample collection occurs at multiple locations and depths in Lake Youngs, Chester Morse Lake, and the Tolt Reservoir. The parameter list includes temperature, dissolved oxygen, transparency, turbidity, conductivity, alkalinity, calcium, pH, phosphorous, iron, manganese, ultra-violet light absorption, total organic carbon, phytoplankton, zooplankton, taste and odor, geosmin, MIB, and more.

Taste and Odor

Taste and Odor are analyzed on a weekly or bi-weekly basis for each of SPU's large in-town open reservoirs, the treated source waters, and other locations as needed. This monitoring is used to make operational decisions, but is not currently required by state or federal regulations. It is anticipated that all of SPU's open reservoirs will be covered or removed from service in the near future. Once completed, taste and odor testing for those locations will discontinue.

Reservoir Protection

Each of SPU's in-town open reservoirs, and several closed reservoirs, currently have chlorination at the outlet or within a mixing system, prior to entry to the distribution system. The chlorine residual is monitored continuously to ensure adequate treatment occurs at all times. In addition, weekly check samples are collected and analyzed by laboratory staff for chlorine, total coliform, fecal coliform, *E. Coli*, pseudomonas, phytoplankton, pH, and HPC from the reservoir outlet and mid-reservoir. Treatment staff check each open reservoir treatment system daily. As required by WAC 246-290-470, SPU maintains and operates the open reservoirs according to a DOH approved Open Reservoir Protection Plan. In addition, DOH has approved SPU's Reservoir Covering Plan, which will replace, cover, or abandon all open reservoirs by 2018.

Treatment Processes

Existing source water treatment consists of ozonation, UV light, chlorination, fluoridation, and corrosion control on the Cedar supply. Treatment for the Tolt supply consists of ozonation, coagulation, flocculation, filtration, corrosion control, chlorination and fluoridation. Each of these processes is monitored continuously to ensure adequate treatment is maintained at all times. Portions of this monitoring are required by the regulations discussed above. Significantly more monitoring is required to meet the requirements of the Service Agreements for each DBO contractor operating the treatment plants. This monitoring is summarized in Table 3.

2.4 Sampling Procedures

Proper sample collection is important for accurate results. All laboratory assistants and other staff collecting samples in the field are trained in appropriate sample collection techniques based on parameter. Written sample collection procedures for bacteriological analyses such as total coliform are included in SPU's Coliform Monitoring Plan. Sample collection methods for all regulatory compliance samples follow standard procedures or methods listed in *Standard Methods*. In addition, training for laboratory staff conducting the analyses occurs on a regular basis.

2.5 Laboratory Information Management System (LIMS)

Beginning in 2006, SPU's Water Quality Laboratory implemented a new Laboratory Information Management System (LIMS). All water quality samples analyzed at the lab, or samples analyzed by outside laboratories for SPU's drinking water are entered into LIMS. This system provides the means to track sample status, record and validate results, and produce reports. Data from LIMS can then be extracted to other computer programs for long-term storage, analysis, or report formatting.

Table 1
Summary of Drinking Water Quality Monitoring Requirements (Regulatory) - Seattle Public Utilities

Dated: November 18, 2011

Parameter	Locations	Frequency	Monitoring Year	Lab Used	Waivers	Comments
Inorganic Chemicals						
Antimony	SO1 at CLT-5	Annually for Cedar and Tolt	Every Year for SW	SPU		EPA and State allow waivers.
Arsenic	SO2 at TPT-3			SPU		SPU not likely to apply for IOC waivers.
Barium	SO4 at BPW-T	Once every three years for wells	2011 for GW or when	SPU		
Beryllium	SO6 at RHW-T		operating	SPU		
Cadmium				SPU		
Chromium				SPU		
Copper				SPU		No MCL, AL = 1.3 mg/L
Cyanide				Outside		
Fluoride				SPU		
Lead				SPU		No MCL, Al = 0.015 mg/L
Mercury				Outside		
Nickel				SPU		
Selenium				SPU		
Sodium				SPU		Health Advisory Level = 20 mg/L
Thallium				SPU		
Nitrate Nitrite	CLT-5, TPT-3, RHW-T, BPW-T	Annually for SW and GW	Every Year, wells if operated	Outside		Sample during quarter with previous highest result (SW).
Asbestos	B-2 for Tolt, M-1A for Cedar	Once every nine years	Once before end of 2018	Outside		Seattle no longer has AC pipe.
Radionuclides						
Gross Alpha Emitters Radium 226 Radium 228 Uranium	CLT-5, TPT-3, RHW-T, BPW-T	Took 2 initial samples in 2007 for Cedar and Tolt. Once every 9 years thereafter.	Once before end of 2019 Next time Wells are used.	Outside		
Organic Chemicals						
VOCs	CLT-5, TPT-5, RHW-T, BPW-T	Wells once every three years. SW once a year without waiver.	Sampled S01 & S02 in 2011. Wells next time used.	Outside	Yes	State waivers for some
SOCs (Includes herbicides, general pesticides, & insecticides)	CLT-5, TPT-3, RHW-T, BPW-T	2 samples every 3 year monitoring period.	2011 to 2013	Outside	Yes	Waiting for waiver status from state
Dioxin, endothall, Diquat, Glyphosate, EDB & other Soil Fumigants						State waivers
Bacteriological						
Total Coliform Rule	64 distribution system sample stands	189 samples per month	sampling conducted daily	SPU		Reduced monitoring for SPU
Chlorine Residual	Same locations as coliform	189 samples per month	sampling conducted daily	SPU		
Lead and Copper						
Lead Copper	At 50 customer taps in DSA	Once every three years	2013	SPU		Wholesale customers have 3 subregions: Cedar, Tolt, and Bellevue each take 50 samples once every 3 years
Water Quality Parameters	T-FINISH, C1-FIN, C2-FIN, 10 dist sites	Treatment: daily; Distribution: weekly		DBO, SPU		Cedar TF: pH only. Tolt TF & Distribution: pH & alkalinity
Disinfection By-Products						
Trihalomethanes	G2, J3 for Cedar, A3, B4 for Tolt	Quarterly	Every Year	SPU		One sample is from extreme end of each source.
HAAs (future)	G2, J3 for Cedar, A3, B4 for Tolt	Quarterly	Every Year	SPU		Stage 2 monitoring begins in 2nd quarter 2012 at 12 sites.
Secondary Contaminants						
Chloride	CLT-5, TPT-3, RHW-T, BPW-T	Annually for Cedar and Tolt	Every Year for SW	Outside		
Color		Once every three years for wells	Next time Wells are used.	SPU		
Fluoride				SPU		
Hardness				SPU		
Iron				SPU		
Manganese				SPU		
Silver				SPU		
Specific Conductivity				SPU		
Sulfate				Outside		
Total Dissolved Solids				SPU		Only required if conductivity > 700 μmhos/cm
Zinc				SPU		
Surface Water Treatment Rule (Tolt)						
Turbidity	TPR-5S 5N, T-CFE, individual filters	Continuous				All Part of DBO Contract
Fecal coliform	TPR-5S 5N	Daily, at least 24 days per month		SPU		
Chlorine Residual	T-FINISH	Continuous				
CT Complaince	Ozone contactors and clearwell	Continuous				For Giardia and Virus inactivation
Limited Alternative to Filtration (Cedar) - LAF						
Turbidity	C1-RAW	Continuous				All Part of DBO Contract
Fecal coliform	C1-RAW	Daily, at least 24 days per month		SPU		
Chlorine Residual	C1-FIN, C2-FIN	Continuous				
CT Complaince	Ozone contactors, UV units, and clearwell	Continuous				For Crypto, Giardia, and Virus inactivation

Table 2
Seattle Public Utilities
Drinking Water Quality Monitoring Conducted – by Parameter
Required and Optional

Parameter	Source	Monitoring Frequency and Location: Continuous	Daily or M-F	Weekly or Biweekly	Monthly	Quarterly	Annually
Turbidity	Cedar	CPR-1, C1-RAW, C1-FIN, C2-FIN, security sites	CPR-1, CT-2	GL-1, GLR, VO-1, VOR, C1-Raw, CPT-05, WS-1, 2 sites on LY, Masonry Dam	4 sites on CMR, 3 sites on Lake Youngs	CLT-5, M-1A	
	Tolt	TPR-5S 5N, T-FINISH, T-CFE, each Filter at plant, reclaimed water, Reg Basin Inlet	TPR-4, TT-1, 2		5 sites Tolt Reservoir	TPT-3, B-2, 9 Tolt Streams	
pH	Cedar	C1-RAW, C1-CWI, C2-CWI, C1-FIN, C2-FIN	CPR-1, CLT-4, 5, CT-1, 2, 3,	GL-1, GLR, VO-1, VOR, RVR-1, 30 TCR sites, Masonry Dam, 2 sites on LY, C1-Raw, CPT-05, WS-1	CT-4, 4 sites on CMR, 3 sites on LY, 12 TCR sites, Soos Res.	4 DBP sites	
	Tolt	TPR-5S 5N, T-FINISH, T-CWI, TPL1 at Welcome Rd.	TT-1, 2, 11	TT-3, TT-22,	TPR-4, 5 sites Tolt Reservoir	9 Tolt Streams	
Conductivity	Cedar	Security sites	CPR-1, CLT-4, 5, CT-1, 2, 3,	GL-1, GLR, VO-1, VOR, RVR-1, 32 TCR sites, Masonry Dam, 2 sites on LY, C1-Raw, CPT-05, WS-1	CT-4, 4 sites on CMR, 3 sites on LYS, 13 TCR sites, LNR	CLT-5, M-1A	
	Tolt		TT-1, 2, 11	TT-3, TT-22,	TPR-4, 5 sites Tolt Reservoir	TPT-3, B-2, 9 Tolt Streams	
Fluoride	Cedar	CPT-00	CPT-00, CT-2	6 sample stands, T-FINISH, RVR-1	TT-3, A-4, J-3	8 QTR sites	
	Tolt	T-FINISH, T-CWI	TT-1, 2				
Chlorine Residual	Cedar	CPT-00, 4 locations at CTF, 8 reservoirs	CLT-4, 5, CT-1, 2, 3, CPT-04	Closed tanks, standpipes, and reservoirs, open reservoirs and checkpoints, TT-3, WSP-1, CT-4, all TCR sites DSA	10 PBCU sites	4 DBP sites, QTR sites	
	Tolt	T-FINISH, T-CWI, LFP, BLR	TT-1, 2, 11				
Total Coliform - PA	Cedar		CLT-4,5, CT-1, 2, 3, C1 and C2-FIN	Closed tanks, standpipes, and reservoirs, open reservoirs and checkpoints, CT-4, TT-3, WSP-1, all TCR sites DSA			
	Tolt		T-FINISH, TT-1, 2, 11				

Table 2
Seattle Public Utilities
Drinking Water Quality Monitoring Conducted – by Parameter
Required and Optional

Parameter	Source	Monitoring Frequency and Location					
		Continuous	Daily or M-F	Weekly or Biweekly	Monthly	Quarterly	Annually
Total Coliform – QT	both		CPR-1, C1-RAW, TPR-5S	Open Reservoirs, Masonry Dam	3 sites LYR, 4 sites CMR, TPR-4, TW-10, 2 sites Tolt Reservoir		
Fecal Coliform	Cedar		CPR-1, C1-RAW, C1-FIN, C2-FIN	Open Reservoirs			
	Tolt		TPR-5S				
HPC	Cedar		CPR-1, C1-RAW, CLT-4, 5, C1-FIN, C2-FIN, CT-2	Closed tanks, standpipes, and reservoirs, open reservoirs and checkpoints, WSP-1	5 Sites CMR, 3 sites LY, 4 sites Tolt, average of 10 TCR sites per month		
	Tolt		TPR-5S, TT-1, 2, 11, T-FINISH				
Temperature	Cedar	C1-RAW, Control Works	CPR-1, CLT-4, 5, CT-1, 2, 3, C1-FIN, C2-FIN, C1-RAW	Closed tanks, standpipes, and reservoirs, open reservoirs and checkpoints, CT-4, TT-3, T-CFE, WSP-1, CPT-04 05, TPR-4, all TCR sites	10 Pb/Cu sites, TT-22	DBP sites, 8 quarterly sites, 9 Tolt streams	
	Tolt	TPR-5S, 5N	TT-1, 2, 11, TPR-5S 5N, T-FINISH				
UVA	Both	CPR-1	CPR-1	TPR-5S, T-CFE, CPT-05, C1-RAW, Masonry Dam, 2 LY sites	5 CMR sites, 5 Tolt Res sites, 3 LY sites, TPR-4	9 Tolt streams, 8 quarterly sites	
TOC	Both			CPR-1, TPR-5S, T-CFE, CPT-05, C1-RAW, 2 LY sites, Masonry Dam	5 sites CMR, 4 sites Tolt Res, 3 sites LY, TPR-4	9 Tolt streams	
Taste and Odor	Both			CPT-05, CT-2, C1-RAW, C1-FIN, C2-FIN, T-FINISH, open reservoirs			
Giardia/Crypto	Both					C1-RAW, TPR-4	
Alkalinity	Both		T-FINISH	CPT-05, CPR-1, C1-RAW, 2 LY sites, T-FINISH	10 Pb/Cu sites, TT-3, TPR-4, TW-10, LY7-B, 5 CMR sites	8 QTR sites, 9 Tolt streams	

Note: Sampling for Riverton and Boulevard Park Wells is not included in this table.

Table 3
Seattle Public Utilities
Drinking Water Quality Monitoring Conducted by DBO Contractors
Continuous Monitoring

Parameter	Tolt Water Treatment Facility					
	Reclaimed Water	Raw Water	Ozone Contactors	Filter Effluents	Combined Filter Effluent	Clearwell Effluent
Turbidity	X	X		X	X	X
Temperature		X				X
pH		X			X	X
Particle Count		X		X(1)	X	
Ozone Concentration			X			
Chlorine Residual					X	X
Fluoride					X	X

Parameter	Cedar Water Treatment Facility					
	Raw Water	Ozone Contactors	UV Reactors	Clearwell Influent	Clearwell Effluent	Finished Water
Turbidity	X					X
Temperature	X				X	
pH	X			X	X	X
Ozone Concentration		X				
UV Transmittance, UV Dose			X			
Chlorine Residual				X	X	X

Tolt grab sample parameters include coliform, alkalinity, bromate, iron, sodium, taste and odor, TTHMs and HAAs SDS, Color, TOC, and UVA.
Cedar grab sample parameters include coliform, bromate, iron, chlorophyll, sodium, and taste and odor.

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

C. POLICIES, PROCEDURES AND STANDARDS

APPENDIX C-2

DESIGN STANDARDS AND GUIDELINES – WATER INFRASTRUCTURE

SPU Design Standards and Guidelines, Chapter 5

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Chapter 5 WATER INFRASTRUCTURE

This chapter presents Design Standards and Guidelines (DSG) standards and guidelines for Seattle Public Utilities (SPU) water infrastructure. Standards appear as underlined text.

Facilities included here are transmission and distribution pipelines, storage tanks, standpipes, and reservoirs. The information in this chapter should be used in conjunction with other DSG standards. For water service connections, see *DSG Chapter 17*.

The primary audience for this chapter is Seattle Public Utilities (SPU) engineering staff.

Note: This DSG does not replace the experienced engineering judgment of a registered professional engineer. All design for upgrade, repairs, and new infrastructure should be done under the supervision of an experienced licensed engineer.

5.1 KEY TERMS

The abbreviations and definitions and given here follow either common American usage or regulatory guidance. Definitions for key elements of the SPU water system are given near the beginning of section for that element. For standard City of Seattle abbreviations for construction drawings, see section 1-01.2 of the City of Seattle Standard Plans.

5.1.1 Abbreviations

Abbreviation	Term
AC	asbestos concrete
ANSI	American National Standards Institute
AREMA	American Railway Engineering and Maintenance-of-Way Association
ASTM	American Society for Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
BNSF	Burlington Northern Santa Fe
CDF	controlled density fill
CI	cast iron
CIP	Capital Improvement Program
CSO	combined sewer overflow
DI	ductile iron
DIP	ductile iron pipe
DIPRA	Ductile-Iron Pipe Research Association
DOH	Department of Health
DPD	Department of Planning and Development
DV	district valve
ECA	environmentally critical area

Abbreviation	Term
fps	feet per second
ft	foot or feet
gpm	gallons per minute
HDD	horizontal directional drilling
HPA	Hydraulic Project Application
HPC	heterotrophic plate count
IBC	International Building Code
ID	inside diameter
LOB	line of business
mgd	million gallons per day
NACE	National Association of Corrosion Engineers
NPDES	National Pollution Discharge Elimination System
NSF	National Sanitation Foundation
O&M	operations and maintenance
OD	outside diameter
OSHA	Occupational Safety and Health Administration
PR	pressure regulating valve
PRV	pressure relief valve
psi	pounds per square inch
psig	pounds per square inch gauge
QA/QC	Quality assurance/quality control
RE	Resident Engineer
ROV	remotely operated vehicle
ROW	right-of-way
SCADA	Supervisory Control and Data Acquisition
SDOT	Seattle Department of Transportation
SDWA	Safe Drinking Water Act
SMT	Seattle Municipal Tower
Spec	specification
SPU	Seattle Public Utilities
Std	standard
TC	total coliform
USM	Utility Systems Management
WAC	Washington Administrative Code
WISHA	Washington Industrial Safety and Health Administration

5.1.2 Definitions

Term	Definition
anode	Location where metal is corroded.
cathodic protection	A means of providing a sacrificial material (usually a metal) to become the point where corrosion occurs. Cathodic protection is a technique used to provide corrosion control to buried or submerged metallic materials. Cathodic protection shifts the electrical potential off anodic sites in a pipeline or other structure. See also anode.
Capital Improvement Program (CIP)	Administered by SPU through its Capital Planning Committee (CPC) to plan, budget, schedule, and implement capital improvement projects, including flooding and conveyance improvements, protection and enhancement of water quality and habitat, protection of infrastructure, and drainage improvements within projects of other City agencies
Customer Service	The section within SPU through which customers purchase all new water services and receive notification of planned outages.
engineering	Generic term for SPU staff responsible for plan review and utility system design for CIP

Term	Definition
	projects.
guidelines	Advice for preparing an engineering design. Design guidelines document suggested minimum requirements and analysis of design elements in order to produce a coordinated set of design drawings, specifications, or life-cycle cost estimates. Guidelines answer what, why, when and how to apply design standards and the level of quality assurance required.
O&M	Generic term for SPU staff responsible for Field Operations and Maintenance.
resistivity	The resistance of an environment (either water or soil) to promote electrical current flow.
standards	Drawings, technical or material specifications, and minimum requirements needed to design a particular improvement. A design standard is adopted by the department and generally meets the functional and operational requirements at the lowest life-cycle cost. It serves as a reference for evaluating proposals from developers and contractors: For a standard, the word must refers to a mandatory requirement. The word should is used to denote a flexible requirement that is mandatory only under certain conditions.
Water Quality	A section within SPU that takes water samples and performs drinking water quality tests on new and existing water mains and inspects construction projects to assure pipe work is kept clean.

5.2 GENERAL INFORMATION

SPU water facilities supply water to more than 1.3 million people in the Seattle area, including wholesale customers (purveyors). The Tolt and Cedar watersheds supply most of the drinking water. The Seattle well fields serve as a supplemental water source during droughts and emergencies. Large transmission pipelines deliver water to treatment plants, and from the plants to in-town storage facilities such as tanks and reservoirs. Smaller water pipelines distribute water from in-town storage facilities to the public. Valves control water and isolate sections in the distribution mains, which are monitored by Supervisory Control and Data Acquisition (SCADA). Water services and fire hydrants are connected to distribution mains. Purveyors are connected to transmission mains.

In the SPU system, most water flows via gravity from the watersheds to storage facilities in Seattle. Storage facilities are set at high elevations to supply water via gravity to customers. Where necessary, pumps are used to lift water to higher elevation storage facilities or to increase water pressure. The system is managed by SPU Facility Operations and Maintenance and monitored through SCADA.

5.2.1 Policy

The guiding policy document for water infrastructure is the SPU 2007 Water System Plan. See Chapter 4 of the plan for SPU policy on water transmission. See Chapter 5 of the plan for SPU policy on water distribution.

5.2.2 System Maps

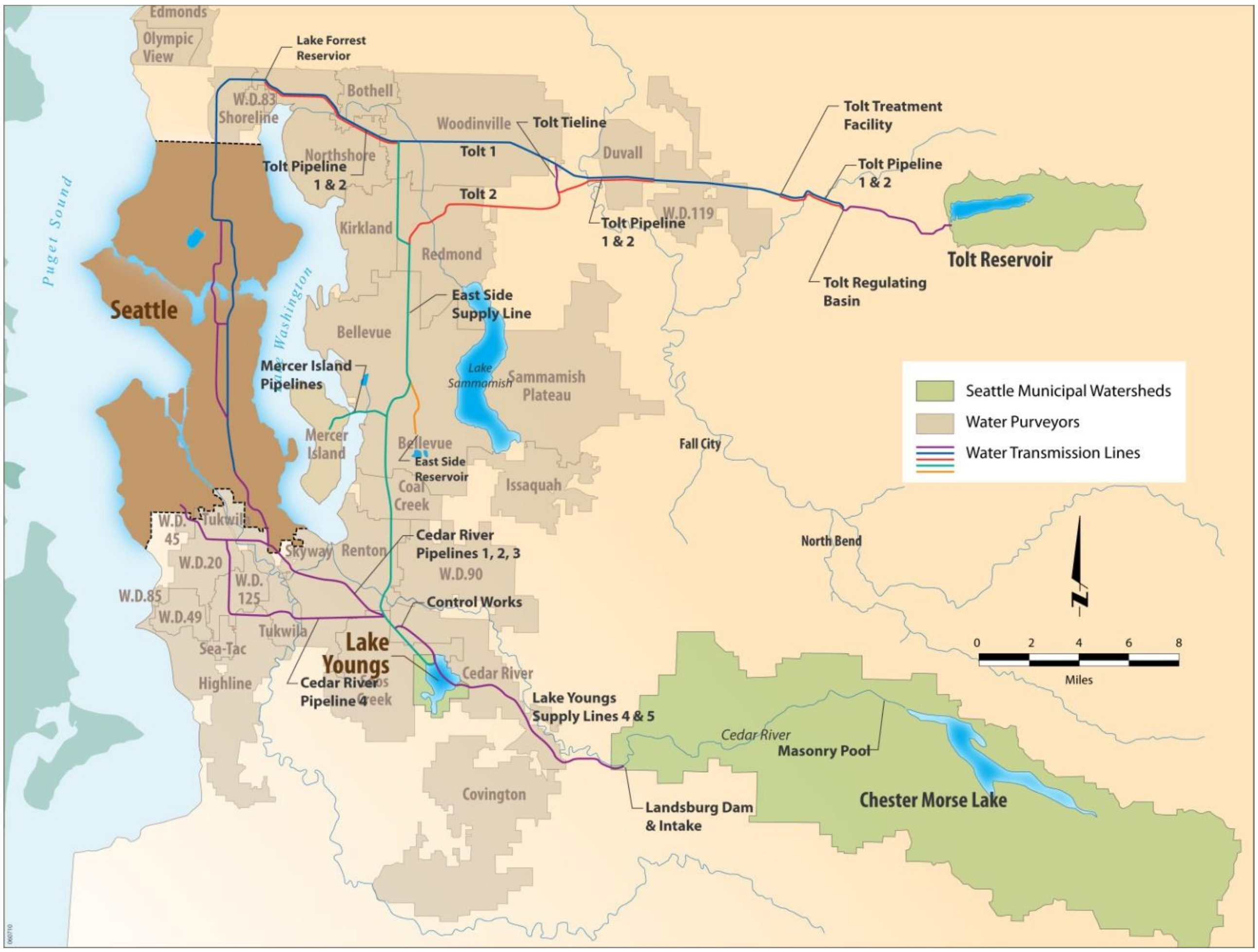
SPU's water maps are available at the following locations:

- Base Maps
- Customer Service Water GIS (software program). Contact SPU IT Service Desk
- Printed 400' Water System Map books
- SPU GIS Mapping Counter (SMT 47th floor)

5.2.3 Water System

The SPU Water System is comprised of transmission and distribution pipelines, and storage facilities and pressure zones. The system extends far beyond the Seattle city limits (Figure 5-1).

Figure 5-1
SPU Water Transmission System



5.2.3.1 Transmission System

The SPU regional and sub-regional water transmission system includes 189 miles of 16- to 96-inch steel, ductile iron or concrete pipeline. Some of the large transmission pipelines are the following:

- Lake Youngs supply lines 4 and 5
- Cedar River pipelines 1 through 4
- Tolt pipelines 1 and 2
- Eastside supply line
- Mercer Island pipeline
- West Seattle pipeline

The major supply transmission pipelines from the Cedar and Tolt sources deliver water to wholesale customer master meters and intertie locations, such as the City of Tukwila.

Transmission pipelines deliver water to various tanks, standpipes, and reservoirs throughout the system and on occasion directly to the distribution system. Twelve reservoirs and 14 tanks comprise the in-town storage facilities. Water from the in-town facilities is distributed to customers via the distribution system.

5.2.3.2 Distribution System

The SPU water distribution system contains more than 1,690 miles of water mains. These mains vary in diameter from 4 inches to greater than 30 inches. Most SPU water mains are unlined or mortar-lined cast iron, ductile iron, or steel pipe.

Seattle's water distribution system also includes 15 pump stations and more than 180,000 water service lines and meters serving residential and non-residential properties. Generally, both transmission and distribution mains passing under railroads or similar facilities are encased. Most pipelines do not have corrosion protection. See *Chapter 6, Cathodic Protection*.

See *DSG Chapters 11 and 17*, respectively, for standards for pump stations and water service connections.

For more information on the history and condition of the water distribution system, see the 2007 Water System Plan.

5.2.3.3 Valves

SPU owns about 21,500 valves of various types that support the SPU Water System. SPU installs most valves where needed for ease of operation and system redundancy. District valves are installed on the distribution system to separate pressure zones. Pressure valves regulate flow between pressure zones. Both transmission and water mains have blow-off valves at low points to drain pipelines and air valves at the high points. Air valves either release trapped air from the pipelines when under pressure or allow air into the pipelines while being drained to prevent a vacuum in the pipeline. Some blow-off valves are installed at dead ends for water quality flushing. Inside major facilities, SPU uses blow-off valves for dewatering and flushing operations. Other valves function as bypass, altitude control, or pump control.

5.2.3.4 Infrastructure Elements

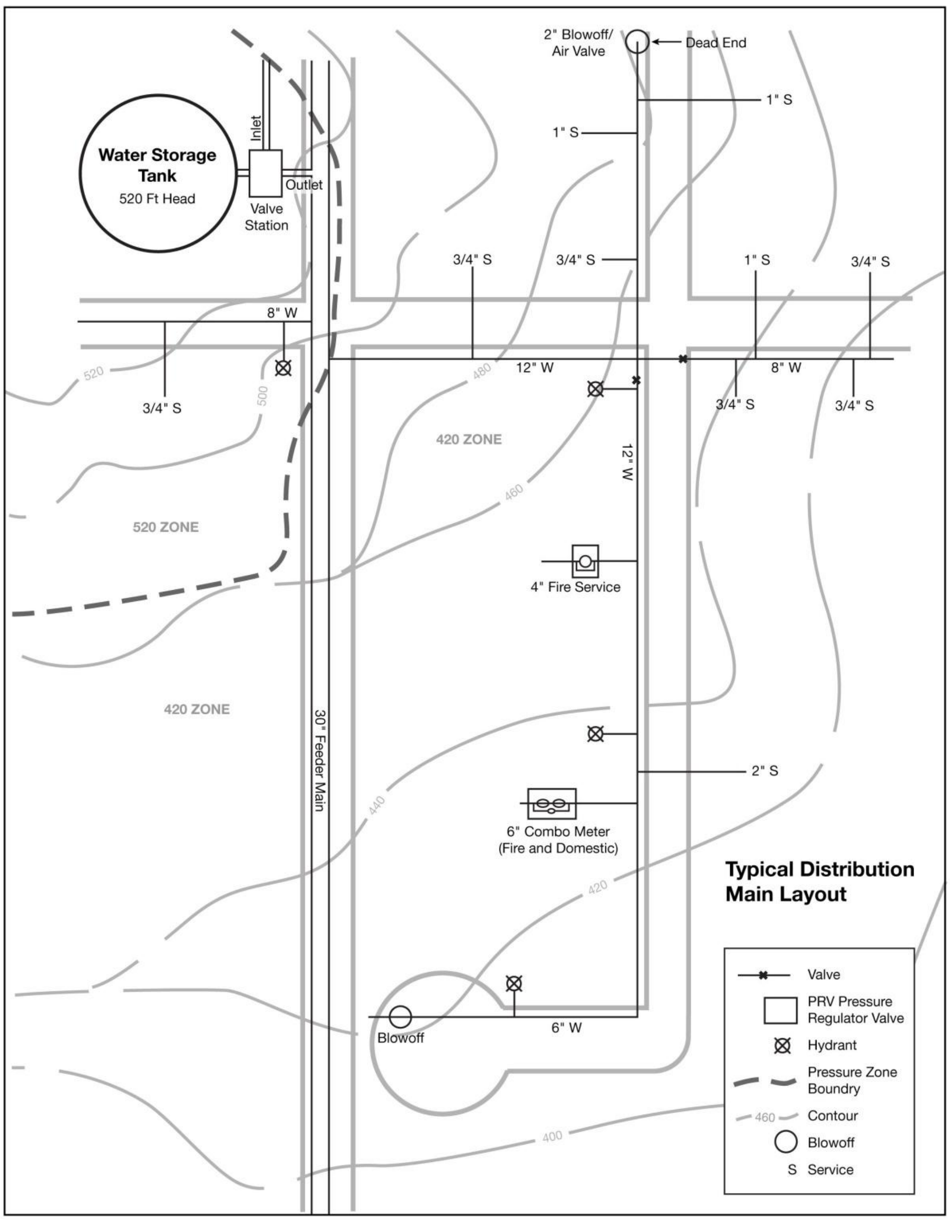
The following are key components in SPU water system infrastructure:

Infrastructure	Description
Water Main	
transmission main	Large diameter (generally >3 ft) pipeline that transfers water from source to feeder mains or storage tanks. There are no service connections on transmission lines, except for purveyors.
feeder main	Smaller diameter pipeline (generally <3 ft). The backbone of SPU distribution mains. Taps are allowed on feeder mains. Feeder mains may cross through multiple pressure zones. When crossing between zones, no services are allowed.
distribution main	Small to mid-sized pipeline (<2 ft) used to distribute water from a feeder main to a local service area. Distribution mains have service connections to adjacent properties.

Infrastructure	Description
Storage Facility	
standpipe	An aboveground, supported pipe with a height that is generally greater than the diameter. Used where additional height is needed to provide additional pressure without pumping.
reservoir	Tank that is at or below ground level with a diameter or footprint that is typically greater than the height. Reservoirs are usually large in size and storage capacity. SPU is currently covering all open reservoirs or will be removing them from service.
elevated tank	Elevated tanks have a supporting structure that elevates the lower operating elevation of water in the tank to a level above ground elevation.

Typical layout of SPU water system infrastructure is shown on Figure 5-2.

Figure 5-2
Typical Layout of SPU Water System Infrastructure



5.2.4 DSG Design Resources

DSG design resources include technical or material specifications developed specifically for and found only in the DSG. They include drawings, standard specifications, and other technical guidelines not available from other sources:

- **Drawings.** DSG standard drawings for an Access Port are in **Appendix A**:
  - DSG-5-01 24” Access port
  - DSG-5-02 24” Access port detail
- **Settlement Monitoring Requirements**. Settlement monitoring requirements for water mains are in Appendices B and C:
  - *Settlement Monitoring Requirements for Cast Iron Mains* (**Appendix B**)
  - *Settlement Monitoring Requirements for Ductile Iron Mains* (**Appendix C**)

5.3 GENERAL REQUIREMENTS

The design engineer must be familiar with water industry standards and code requirements.

If industry standards and City of Seattle requirements or regulations conflict, the design engineer must discuss the discrepancy with the line-of-business (LOB) owner, Facilities Maintenance and Operations manager, specifier and the owner of this DSG chapter through the formal resolution process.

5.3.1 Industry Standards

Water facilities must be designed to American Water Works Association (AWWA) standards. In addition, water facilities must meet Seattle-King County and Washington State Department of Health (DOH) standards.

Water storage facility design standards for SPU must also meet standards set forth in the Water Research Foundation's Maintaining Water Quality in Finished Water Reservoir.

5.3.1.1 American Water Works Association

AWWA standards and specifications must be followed, except when superseded by more strict requirements set forth in this DSG and City of Seattle Standard Plans and Specifications.

Table 5-1 lists relevant AWWA standards and specifications, organized by subject and intended as minimum requirements. Most of the specifications listed below may be found in the SMT 45th floor library. It is the design engineer's responsibility to use the latest version of these standards.

Table 5-1
AWWA Standards and Specifications for SPU Water Facilities

Designation	Title
Ductile-Iron Pipe:	
C104/A21.4	Cement Mortar Lining for Ductile Iron (DI) Pipe and Fittings for Water
C116/A21.16	Protective Fusion-Bonded Epoxy Coatings Interior or Exterior Surface DI
C105/A21.5	Polyethylene Encasement for DI Pipe Systems
C111/A21.11	Rubber-Gasket Joints for DI Pressure Pipe and Fittings
C115/A21.5	Flanged DI Pipe with Ductile Iron or Gray Iron Threaded Flanges
C150/A21.50	Thickness Design of Ductile Iron Pipe
C151/A21.51	DI Pipe; Centrifugally Cast, for Water or Other Liquids
C153/A21.53	DI Pipe; Compact Fittings for Water Service
Steel Pipe	
C200	Steel Water Pipe 6" and larger
C207	Steel Pipe Flanges for Waterworks Service Sizes 4"-144"
C216	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipes
C206	Field Welding of Steel Water Pipe
C215	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
C217	Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines
C210	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
C225	Fused Polyolefin Coating Systems for the Exterior of Steel Water Pipelines
C223	Fabricated Steel and Stainless Steel Tapping Sleeves

Designation	Title
C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot-Applied
C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4" and Larger, Shop Applied
C208	Dimensions for Fabricated Steel Water Pipe Fittings
C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
C218	Coating the Exterior of Aboveground Steel Water Pipelines and Fittings
C219	Bolted, Sleeve-Type Couplings for Plain-End Pipe
C220	Stainless-Steel Pipe, ½" and Larger
C221	Fabricated Steel Mechanical Slip-Type Expansion Joints
C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
C224	Nylon-11 Based Polyamide Coating System for the Interior and Exterior of Steel Water Pipe and Fittings
C226	Stainless Steel Fittings for Waterworks Service, Sizes ½"-72"
Valves/ Hydrants:	
C517	Resilient-Seated Cast-Iron Eccentric Plug Valves
C512	Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
C561	Fabricated Stainless Steel Slide Gates
C563	Fabricated Composite Slide Gates
C560	Cast-Iron Slide Gates
C502	Dry-Barrel Fire Hydrants
C504	Rubber-Seated Butterfly Valves
C507	Ball Valves, 6"- 48"
C508	Swing-Check Valves for Waterworks Service, 2"- 24" National Pipe Size (NPS)
C509	Resilient-Seated Gate Valves for Water Supply ductile iron only
C510	Double Check Valve Backflow Prevention Assembly
C511	Reduced-Pressure Principle Backflow Prevention Assembly
C513	Open-Channel, Fabricated-Metal, Slide Gates and Open-Channel, Fabricated-Metal Weir Gates
C515	Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service (Does not meet City Spec, but can be used in special cases)
C540	Power-Actuating Devices for Valves and Slide Gates
C550	Protective Epoxy Interior Coatings for Valves and Hydrants
Pipe Installation:	
C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
C602	Cement-Mortar Lining of Water Pipelines in Place—4" and Larger
C606	Grooved and Shouldered Joints
Disinfection	
C651	Disinfecting Water Mains
C652	Disinfection of Water-Storage Facilities
Storage	
D104	Automatically Controlled, Impressed-Current Cathodic Protection for the Interior of Steel Water Tanks
D110	Wire- and Strand-Wound, Circular, Pre-stressed Concrete Water Tanks
D100	Welded Carbon Steel Tanks for Water Storage
D102	Coating Steel Water-Storage Tanks
D103	Factory-Coated Bolted Steel Tanks for Water Storage
D115	Tendon-Pre-stressed Concrete Water Tanks
D120	Thermosetting Fiberglass-Reinforced Plastic Tanks
D130	Flexible-Membrane Materials for Potable Water Applications

Table 5-2 lists relevant AWWA design manuals for water supply practice. The list is not inclusive. Some of these manuals are available on SMT 45th floor. The manuals most frequently used by SPU are M11 (Steel Pipe Design), M41 (Ductile Iron Pipe Design) and M22 (Sizing Water Service Lines and Meters).

Table 5-2
AWWA Design Manuals for Water Supply Practice

Designation	Title
M1	Principles of Water Rates, Fees and Charges
M2	Instrumentation and Control
M3	Safety Practices for Water Utilities
M4	Water Fluoridation Principles and Practices
M5	Water Utility Management
M6	Water Meters: Selection, Installation, Testing, and Maintenance
M7	Problem Organisms in Water: Identification and Treatment
M9	Concrete Pressure Pipe
M11	Steel Water Pipe: A Guide for Design and Installation
M12	Simplified Procedures for Water Examination
M14	Recommended Practice for Backflow Prevention and Cross-Connection Control
M17	Installation, Field Testing, and Maintenance of Fire Hydrants
M19	Emergency Planning for Water Utilities
M20	Water Chlorination/Chloramination Practices and Principles
M22	Sizing Water Service Lines and Meters
M25	Flexible-Membrane Covers and Linings for Potable-Water Reservoirs
M27	External Corrosion: Introduction to Chemistry and Control
M28	Rehabilitation of Water Mains
M29	Water Utility Capital Financing
M31	Distribution System Requirements for Fire Protection
M32	Computer Modeling of Water Distribution Systems
M33	Flow meters in Water Supply
M36	Water Audits and Leak Detection
M41	Ductile Iron Pipe Fittings
M42	Steel Water-Storage Tanks
M44	Distribution Valves: Selection, Installation, Field Testing, and Maintenance
M48	Waterborne Pathogens
M49	Butterfly Valves: Torque, Head Loss, and Cavitation Analysis
M51	Air-Release, Air/Vacuum, and Combination Air Valves
M52	Water Conservation Programs-- Planning Manual
M55	PE Pipe--Design and Installation

5.3.2 Regulations

All water facilities must be built to the applicable City of Seattle, King County, Washington State and federal guidelines.

5.3.2.1 City Standards

The City of Seattle Standard Plans and Specifications are available online or from the Engineering Records Vault. The sections that apply to water systems are Standard Specifications

Sections 7 and 9, and Details Section 300. These standards are primarily based on AWWA industry standards.

5.3.2.2 King County

All water system works are subject to the provisions and requirements of Title 12 of the King County Board of Health Code.

5.3.2.3 Washington State Department of Health

The Washington State Department of Health (DOH) is the regulatory agency that ensures that water systems comply with system capacity requirements of the federal Safe Drinking Water Act (SDWA). Authority to regulate the public water supply system is granted under Washington Administrative Code (WAC), Chapter 246-290 "Public Water Supplies," also known as the Public Water System Rule. A key term under the rule is *system capacity*, which is defined as having the technical, managerial, and financial capacity to achieve and remain in compliance with all applicable local, state and federal regulations.

A. Water System Plan

The public water system rule (WAC 246-290) includes the Washington State Legislature-approved Municipal Water Law and the federal law, Long Term 2 Enhanced Surface Water Treatment Rule. DOH requires water purveyors to submit a Water System Plan to ensure water quality and protection of public health (WAC 246-290-100 and WAC 246-291-140, respectively). SPU's Water System Plan was last updated in 2007.

Water systems plans must be updated every 6 years. If a purveyor installs distribution lines or makes other improvements and the project requires State Environmental Protection Act (SEPA) analysis, a water system plan amendment is required (WAC 246-03-030[3][a]) before construction.

B. Water System Design Manual

The Washington State DOH Water System Design Manual (December 2009) provides guidelines and criteria for design engineers to use for preparing plans and specifications for Group A water systems, such as SPU, to comply with the Group A Public Water Supplies (chapter 246-290-WAC). This manual delineates mandatory requirements of the WAC that must be adhered to by SPU. Design engineers may use design approaches other than those in this manual as long as they do not conflict with chapter 246-290 WAC. DOH will expect the design engineer to justify the alternate approach used and the criteria that apply.

5.3.2.4 Other

Recommended Standards for Water Works (10-States Standards) – Part 7, Finished Water Storage is a source for water storage design.

5.3.2.5 Federal Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) protects public health by regulating the nation's public drinking water supply. The law requires many actions to protect drinking water and its sources. SDWA does not regulate private wells that serve fewer than 25 individuals. SDWA authorizes the

U.S. Environmental Protection Agency (EPA) to set national health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants.

5.4 BASIS OF DESIGN

For this DSG, basis-of-design documentation communicates design intent primarily to plan reviewers and future users of a constructed facility. For SPU, this documentation consists primarily of a basis-of-design plan sheet. By documenting the basis of design and archiving it with project record drawings (as-builts), future staff will have easy access to design decisions.

5.4.1 Basis-of-Design Plan Sheet

The basis-of-design sheet is a general sheet that shows a plan overview and lists significant design assumptions and requirements for major design elements (Figure 5-3). The following are SPU standards for this sheet:

- The design engineer must include a basis-of-design plan sheet in the plan set.
- The sheet must be archived with the record drawings (as-builts).

Figure 5-3
Basis-of-Design Plan Sheet Data for Water Infrastructure

Basis-Of-Design Plan Sheet

WATER---
Type of Main (Transmission, Distribution, Feeder)
Design Flow Rate: ____________________
Flow Velocity: __________________________
Typical Pressure: _____________________ Pressure Zone(s):_______________________
Working Pressure: ____________________ Surge Pressure: ________________________
Pipe Materials:
____
(type, lining, coating, joints, pressure class minimum slope, buoyancy safety factor, minimum cover [roads, non-roadway], deflection lag factor, construction tolerance, steel deflection limit)
Bedding Compaction:
____
(roadway, non-roadway, bedding constant, modulus of soil reaction [E'])
Appurtenances:
____
(isolation valves, blow-offs/drains, line valves, air-vacuum and air-release valves, valve limit settings for control valves, design criteria for all valves)
Access Ports:
_______________________________Datum:__________________________________
Basis of HVAC Design:____
Basis of Process Control:____
Project Specific/Special Information:

The basis-of-design plan sheet is not intended for construction and should not be included with the bid set. The sheet is inserted after the project has begun. See *DSG Chapter 1, Design Process*.

5.4.2 Design Criteria List

The design engineer may use a design criteria list to develop a basis-of-design plan sheet. The design criteria list is a shortened version of the most important design requirements (Table 5-2). For water system infrastructure, this information includes how key design criteria were selected, including working pressure, flow rate, and types of joints.

The list shows information that may be shown on the basis-of-design plan sheet. However, the list is not intended for construction and should not be included with the bid set. If included with the bid set, the design criteria list should be labeled "Informational Only."

Typically, the design criteria list is completed with the preliminary engineering report as a concise summary. However, that report can provide a much lengthier description of design requirements.

Table 5-3 is an example of what a design criteria list might contain for a water facility design.

Note: Table 5-3 is only an example. It is not intended to explain technical concepts.

Table 5-3
Design Criteria List for a Typical Water Facility Design (Example)

Description	Design Criterion/Design Data	Comments
General:		
Design Flow Rate	19,100 gpm (27.5 mgd)	Year 2040 peak flow rate in a 36-inch pipeline
Flow Velocity	6.02 fps	Year 2040 peak flow rate in a 36-inch pipeline
Typical Operating Pressure	120-180 psi	
Design Working Pressure, Pw	250 psi	
Design Transient (Surge) Pressure, Pt	332 psi	Based on 133% of working pressure and allowable stress of 66.7% of yield stress
Minimum D/t ratio	240	
Pipe Materials:		
Pipe Type	Mortar-Lined and Polyurethane Coated Welded Steel Pipe, AWWA C200	
Lining	Cement Mortar, AWWA C205	
Coating	Polyurethane Coated, AWWA C222	
Joints	Restrained Joint	Double lap-welded joint provides thrust restraint at bends, seal testing, and seismic restraint. Maximum joint length and resulting joint location is 60 ft. for steel pipe. Consider thermal expansion and fittings to allow movement, specifically with exposed pipe. Example: pip supported by hangers under bridges.
Pressure Class	250 psi	40,000 psi yield strength steel
Minimum Slope	0.001	
Pipe Buoyancy Safety Factor	1.1	
Minimum Cover – Roads	3 ft	
Minimum Cover – Non-Roadway	4 ft	
Pipe Loading – Traffic	HS-20 AASHTO	
Traffic – Trench Condition	HS-20 AASHTO "Prism Trench" design condition assumed	
Separation from Utilities	12 inch vertical, 10 ft horizontal	See Std Plan 286
Deflection Lag Factor, Dl	Minimum 1.25	
Construction Tolerance	½-inch from specified line and grade	Tolerances during tunneling higher as specified
Steel Deflection Limit	2.25% of Diameter	
Bedding Compaction – Non-Roadway	90% of Modified Proctor	
Bedding Compaction – Roadway	95% of Modified Proctor	
Bedding Constant	0.10	
Modulus of Soil Reaction (E')	700 psi	See Geotechnical Report
Appurtenances:		
Isolation Valves	Butterfly Valves, 250 psi rating	Located at tie-ins and interties to existing mains
Blow-offs/drains	6-inch size. Provide at all low points in pipeline	Used double valves, one for isolation and one for throttling.
Line Valves	2,000 ft	
Combination Air-Vacuum and Air Release Valves	4-inch size. Provide at all high points in pipeline	Also located at abrupt downward grade breaks

Description	Design Criterion/Design Data	Comments
Access Ports	24-inch	Located every 1,000 feet along pipeline and at both ends of tunneled crossings

5.5 DESIGN PROCESS

See *DSG Chapter 1, Design Process*. The design process for water infrastructure does not differ from that described in Chapter 1.

5.6 DISTRIBUTION AND FEEDER MAIN DESIGN

This section describes distribution and feeder main design. Distribution mains are smaller diameter (<3ft) pipes that carry water from a source (reservoir or tank) to a local service area (neighborhood or city block). Feeder mains are similar to transmission mains except that service connections are allowed.

5.6.1 Modeling and Main Sizing

When designing a water main that is 12 inches of larger in diameter, a hydraulic network modeling analysis must be completed (for sizing minimum sizing criteria see Section 5.6.3.1). SPU Utilities System Management (USM) maintains the models of the water distribution and transmission system and works with SPU engineering on modeling analyses. The modeling analysis will determine the capacity of the main to provide peak hourly demand and fire flow. In some cases, field hydrant flow tests will be required to verify modeling results.

5.6.1.1 Pressure Zones

The SPU water distribution system is divided into approximately 45 pressures zones that operate within a pressure range of about 30 to 130 psi. Individual zones are separated by closed line valves (district valves or DVs), pressure regulators, and control valves. Pressure zone boundaries are shown in the 400-foot map books and in GIS. USM specifies the pressure zone to which new water mains and service connections will be added.

5.6.1.2 Maximum and Minimum System Pressure

SPU Policy on Distribution System Water Service Pressure (SPU-RM-006) establishes SPU's pressure standards. Minimum pressure criteria for new water mains are 30 pounds per square inch (si) under peak hour demand (PHD) conditions, and 20 psi when flows are a combination of average maximum day demand (MDD) and required fire flow. In no cases shall pressure at the customer's meter be less than 20 psi. Pressures within distribution mains are not limited to a set maximum. All new services with static pressure above 80 pis require a pressure reducing valve (PRV) per plumbing code requirements.

5.6.1.3 Fire Flow Rate and Duration

The City of Seattle, City of Shoreline and King County have adopted the International Fire Code (IFC). Site specific fire flow requirements as determined by the appropriate Fire Marshall are used when issuing Water Availability Certificates and sizing of new water mains.

5.6.2 Location

Distribution mains are typically located within the right-of-way (ROW) in a standard location at a standard depth. See City of Seattle Standard Plan 030. Standard locations allow Field Operations and Maintenance to easily access the mains while keeping the ROW available to other utilities. SPU does not allow build-overs on water mains.

SPU may install or allow installation of water mains in private streets or easements. Location of the mains is determined case-by-case in easements less than 20 feet.

5.6.2.1 Separation from Other Utilities

Standard horizontal and vertical separations may not always be feasible in highly developed urban corridors. Special construction methods can be used to provide equivalent levels of protection to the standard separation criteria. Separation distances to provide structurally sound installations depend on the available working space for construction and soils and groundwater conditions at the site. See Standard Plans 286A and 286B.

For height, the design engineer must look for overhead power and maintain a safe distance to the power lines and structures. The distance depends on the power line voltage and the distance to a structure. Consult with the electrical utility to determine the project-specific safety distances and with the Department of Planning and Development (DPD) for any structural permit requirements.

Where standard pipeline separations cannot be achieved, an engineered design must be developed for adequate separation. The Washington State Departments of Health and Ecology jointly publish the Pipeline Separation Design and Installation Reference Guide. The design engineer must use this guide to design pipeline separations whenever standard SPU criteria are not feasible.

5.6.2.2 Geotechnical Investigations and Test Holes

Geotechnical (subsurface) investigations and test holes are typically not as critical for distribution lines as they are for transmission mains. The design engineer must review DSG section 5.8.2.2 (Geotechnical Report) and consider the necessity of subsurface information for the project.

5.6.2.3 Alternative Locations

For some projects, space may not be available to locate the water main in the standard location shown on Standard Plan 030. Other controlling factors such as water supply require that an existing water main be kept in service while a new main is installed in a non-standard location.

5.6.3 Materials

This section describes standard materials used in SPU water distribution system projects.

5.6.3.1 Minimum Pipe Size

The standard water distribution main size is:

- 8-inch-diameter pipe for residential areas
- 12-inch diameter pipe for industrial and commercial areas

Dead-end distribution mains typically include fire hydrants and must be at least 8-inches in diameter. Typically, feeder mains are 16- to 30-inch diameter pipes. Some SPU feeder mains are more than 30 inches in diameter. Pipes more than 30 inches in diameter must not have service connections.

5.6.3.2 Material Types

All new or replaced water pipe in the City of Seattle must meet the standard material types shown in Table 5-4.

Table 5-4
Standard Materials for SPU Distribution and Feeder Mains

Structure	Material
Pipe	• 2-inch diameter pipe must be Type K copper (when allowed by SPU). • 4-inch diameter and larger pipe must be ductile iron pipe, class 52 or thicker, cement lined-double thickness. • Feeder mains larger than 20-inch diameter must be ductile iron or steel.
Bends and Fittings	• Typically, bends and fittings must be the same material as the pipeline. • Fittings for 2-inch copper soft coil must be brass, either flared or compression.
Joints	• Joints for ductile iron water mains must be restrained joint, slip joint, or mechanical joint. • Joints on steel casing pipe must be welded and conform to AWS D1.1 Structural Welding Code, Section 3, Workmanship.
Casing	• Whether installed above- or below-grade, casing pipe must be smooth steel, with the diameter and wall thickness specified in the drawings. • All joints must be welded by qualified operators. Steel casing pipe is discussed in Std Spec 9-30.2. • Casing seals and spacers must be per Std Spec 9-30(15). • If specified in the contract, the space between the carrier pipe and casing pipe must be filled with sand, grout, or some other material.

Non-standard mains less than 8 inches in diameter and approved by SPU, must be ductile iron, except for 2-inch pipe, which must be Type K copper.

5.6.3.3 Pipe Cover

Depths of cover for water mains are shown on Standard Plan No. 030. The depths vary depending on size of pipe. Mains larger than 12 inches in diameter typically use butterfly valves. Butterfly valves require less cover due to their shape and allow large mains to be buried at shallower depths. Generally, SPU attempts to bury the pipes as shallow as feasible for ease of installation and maintenance, but no less than 35 inches deep except in special cases as directed by SPU. The depth to the pipe invert should be kept to less than 6 feet to reduce the need and cost for excavation and shoring.

5.6.3.4 Bedding and Backfill

The design engineer must require sand bedding for water mains unless another agency dictates otherwise. Sand bedding creates a less corrosive environment around a pipe than does native soil. Sand bedding also eliminates point loads on the pipe caused by stray rocks. Sand bedding is typically Class B, Sand Mineral Aggregate Type 6 or 7 unless otherwise specified. *Note: Type 9 is for transmission mains.*

Backfill is either suitable native material, Mineral Aggregate Type 17, or other material as approved by the design engineer. For suitable native backfill material, see Standard Specification 7-10.3(10) for requirements. For requirements for Mineral Aggregate Type 17, see Standard Specification 9-03.16.

For more information on bedding and backfill, see Standard Specifications 7-10.3(9), 9 03.12(3) and 9-03.16.

A. Standard Trench Section

For requirements for a standard trench section, see Standard Plan 350.

B. Controlled Density Fill

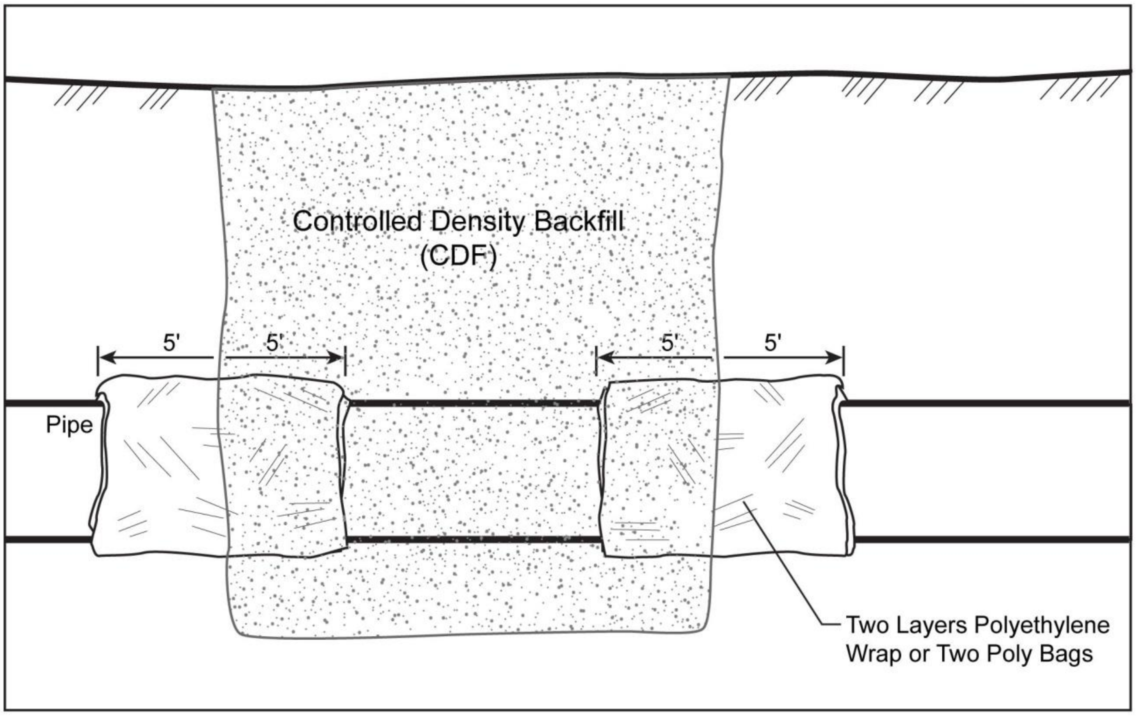
Sometimes an outside agency, time constraints, or compaction will require that a water main be bedded and backfilled in controlled density fill (CDF). When this requirement outweighs the benefit of using sand bedding, a metallic water main must be coated both where embedded in CDF and for some distance beyond the CDF encasement. Typically, SPU uses either two layers of 5-foot-wide visqueen or two polyethylene bags over the main to keep it separated from the CDF (Figure 5-4).

When CDF is used near the metallic pipe, a corrosion specialist should be consulted because CDF can create a corrosion cell.

The CDF used to encase the water main must be the weaker (diggable) CDF mix. All CDF must be ⅓ sack mix, less than 200 psi, and preferably less than100 psi. SPU has approved various types and uses of CDF. CDF can be used as a trench plug, trench backfill, or for grouting an annular space. Each use has a different mix ratio. The design engineer must reference the City Standard Plans and Specifications for each CDF use. See Standard Specification 9-01.5.

When CDF is used to fill pipe and the annular space between two pipes, it must have 100 psi strength at 28 days. See Standard Specification 9-05.15.

Figure 5-4
Controlled Density Fill



5.6.3.5 Line Pressure

Distribution water mains must be designed to withstand both external loads and test pressure according to Standard Specification 7-11.3(11)A1.

Most distribution lines serve a portion of the city, and are within a designated pressure zone. In cases where there is an extreme pressure differential (e.g. downhill pipeline), it may be advisable to change material thicknesses along the pipeline route and/or install a pressure reducing valve. Test pressure is measured at the downhill end of the pipe run. Before considering installation of a pressure reducing valve, the design engineer must coordinate with USM to ensure the valve will not negatively affect the system.

If a pressure regulating valve (PR) is used, an emergency pressure relief (PRV) must be installed and set to relieve pressure at 80 psi or maximum zone pressure.

Note: Some current City zones have pressures up to about 120 psi. These zones lie at the bottom of steep hillside areas. If the site is steep, do not put a PRV where it might cause unstable soil conditions (i.e. landslides).

Tip: *It is best to install both PRVs and PRs at the lowest point possible. However, sites in environmentally critical areas (ECAs) may not allow for that.*

5.6.3.6 Pipe Supports

A licensed civil or structural engineer must design the pipe supports and review pipe loads and potential deflections caused by lateral and vertical movement. AWWA M11 (Steel Pipe Design) and AWWA M41 (Ductile Iron Pipe Design) manuals provide some explanation on how to properly design pipes on supports. The Ductile Iron Pipe Research Association (DIPRA) also publishes a computer program for selecting supports and spacing of ductile iron pipes.

A. Pile Supports

Pile supported pipelines are rare in the SPU water system. However, in some locations, such as crossing a wetland or in loose soils, pile-supported pipelines may be necessary. A licensed civil or structural engineer must design the pile support and calculate pipeline thickness. Because pipelines installed on piles are typically not continuously supported, they present unique design challenges. Among the issues are additional stresses placed on the pipeline due to the lack of support. Such design issues must be investigated and modeled by a licensed structural engineer.

i Above Grade Pile Support

For an above-grade exposed pile support, the design engineer should consider the pipeline and pile coating system. In most cases, both the pile and pipe will require a coating, and cathodic protection must be considered. Additionally, pipeline insulation may be needed to protect the line from freezing temperatures and in no-flow situations.

ii Buried Support

If the pipeline is on piles and buried, a qualified licensed civil or structural engineer must carefully review the connection to the piles to ensure the pipe and piles operate as one entity during seismic and uplift conditions.

B. Aerial/Bridge Supports

SPU owns and operates a few aerial (aboveground) pipelines in its water system. A structural engineer licensed in Washington State should be involved in aerial pipeline design. Like pipelines on piles, aerial pipelines are not continuously supported, and therefore present unique design challenges.

Aerial pipelines can either be supported from above, by hanging the pipe, or cradled in a utility corridor under the bridge. In either case, the pipe supports place additional loadings on the pipe wall.

The following are special considerations for aerial design:

- Where possible, aerial pipelines should be avoided for security and vibration concerns.
- When pipes are hung under existing bridges, roadway clearance design must consider the potential for damage from trucks traveling above the legal height limit. Additional protection should be considered such as line valves or structural modifications to the bridge.
- With an exposed pipe design, the design engineer must consider the pipeline coating system. Additionally, pipeline insulation may be needed to help control thermal expansion of the pipeline, and keep the line from freezing temperatures and no flow situations. AWWA Manual M11 provides an analysis method to determine if freezing is a concern.

- The design engineer must carefully review the buried-to-aerial transition to ensure the pipeline will be able to handle ground movement from earthquakes. In most cases, a restrained joint with both rotational and expansion capabilities (e.g. a double ball expansion joint fitting) is recommended. See also DSG section 5.8.4, Seismic Design.
- Freeze protection design must be considered. Potential options include one or more of the following:

  1. Insulation of the pipe;
  2. Heat tape.
  3. In case of a temporary change in the way the pipe is used resulting in low flows consider installation of a system to allow a release of a small volume of water to a location that does not cause an environmental impact or safety hazards

C. Temporary Supports during Construction

Supporting existing utilities during construction can be difficult, but is necessary to ensure no damage occurs to the existing pipelines. Typically, the construction contractor is responsible for supporting all existing utilities throughout construction. The contractor must provide a support plan that is stamped by a Professional Engineer licensed in Washington State. SPU engineering and Field Operations and Maintenance will review temporary supports in the field and notify the contractor of deficiencies. SPU Water Operations staff does not direct repairs.

The following is a list of cautions contractors must take to avoid damage to pipelines:

- Contractors must not use chains to move or support any pipe materials because it will damage the pipeline.
- Contractors must not rest the pipe on any sharp or pointed objects, including the bucket of any equipment, single point supports, or rods.
- Pipelines must not be unsupported for a length longer than one stick of pipe or one joint.
- If the joints are not restrained, the contractor must ensure crew safety by restraining the pipe from movement, which could separate the joints.
- Pipelines must be supported in cradles or on wide support beams sufficiently spaced so the pipeline does not sag and cause undue stress on the joints or pipeline wall. This is especially important for cast iron with lead joints.
- Do not expose more than one unrestrained joint.
- Lead joint cast iron water mains must not be allowed to deflect while they are exposed.

5.6.3.7 Casing

Water mains are installed in casings to protect the mains from excessive loads and to provide a means of replacing the pipe beneath structures such as rail road tracks. Casings also reduce the damage to facilities over the water main in the event of a leak or main break. Sometimes casings are required by other entities (e.g. railroads) where SPU utilities cross over or under them. Casings can be installed via open cut if there are no obstacles.

Casing materials must follow Standard Specifications 9-30.2 (14) and 9-30.2(15).

A. Jacked Casings

Casings installed under the railroad are often jacked into place. When designing jacked casings, adequate space is required for the casing and pipe jacking pit. Jacking pit size can vary depending on the lengths of casing or pipe. Restrained joint pipe must be used through the casing and beyond to a logical location to terminate the restrained joint pipe. Keep in mind that the cased length of pipe offers no thrust resistance via skin friction as does a buried pipe. Access must be provided for the pipe to be cut and connected to a new pipe. SPU preference is to have the jacking pit located on each side of the casing.

Note: Jacking casing is dependent on pipe size. The larger the pipe size, the larger the jacking pit is. Keep the casing as far as practical from the other utilities to allow future access for pipe removal.

B. Other Utility Crossings

The design engineer must determine where casings are needed at locations where an SPU transmission main is crossing either over or under other utilities. For separation requirements between water mains and other utilities, see Standard Plans 286A and 286B. All pipes in casings must be restrained joint. See Standard Specifications 7-11 3(6)D and 7-11.3(7)C-D2.

C. Railroad Crossings

Where water mains cross under a rail system (e.g. street car, light or heavy rail, or other as determined by SPU), the main must be placed inside a casing. The casing must extend such a distance from the tracks that maintenance can be performed from the side without affecting the rail. For cathodic protection for pipes crossing a rail line, see *DSG Chapter 6, Cathodic Protection,* Test Procedure (TP) 31 – Light Rail and Street Car Cooperative Interference Testing.

i Heavy Rail

- When crossing beneath heavy rail, a casing must extend from ROW line to ROW line unless the main is more than 25 feet from the track centerline. If the railroad agrees, the casing must extend a minimum of 25 feet from the track centerline. See the American Railway Engineering and Maintenance-of-Way Association (AREMA) Design Guideline before designing a heavy rail crossing.
- Pipelines parallel to heavy rail must be encased if they are 40 feet or less from the track centerline.

ii Light Rail

Light rail does not impose the extreme loading on pipelines that heavy rail does. However, light rail imparts some loading and causes significant pipeline access issues and stray current corrosion concerns.

Water mains crossing beneath Sound Transit Central Link light rail tracks are encased a minimum distance of 12 feet perpendicular to the centerline of the track. The tracks have a 5.5 foot minimum separation between the top of the rail and the top of the casing. See the Sound Transit Design Criteria Manual.

Casings crossing a light rail line must be electrically isolated from the carrier pipe. A permanent test station should be installed to perform future isolation checks. See *DSG Chapter 6, Cathodic Protection*, Test Procedure (TP) 31 – Light Rail and Street Car Cooperative Interference Testing.

iii Street Car

The presently used street car designs have the least impact on buried pipelines of the three types of rail. Street cars are smaller and lighter, but still limit pipeline access and generate stray current.

The design engineer must consider depth of cover, pipeline size, age, thickness, material, importance, and access.

The design engineer should consider various pipeline protection methods ranging from do nothing to casings and protective concrete slabs.

D. Parallel Rail Installations

For worker safety, parallel mains should not be closer than 15 feet from the rail center line. However, rail installation will likely have to be considered case by case.

5.6.3.8 Permanent Restraint Systems

Restraining of forces due to internal pressure at fittings, valves, or dead ends is a major consideration in pipe installation. Thrust restraint is by welded or mechanically restrained joints or poured in place concrete thrust blocks depending on pipe size and type.

All bends, fittings, and line valves must be restrained by a joint restraint system compatible with the pipe type.

A. Thrust Restraint Calculations

For all projects requiring thrust restraints beyond that required by Standard Plans 330a, 330b, 331a, and 331b, the design engineer must calculate the thrust restraint.

Restrained joint pipe is self-restrained. The restrained length for pipe and fittings depends on the test pressure, backfill, depth, soil characteristics and pipe coating. The design engineer must calculate the restrained length for both pipe and fittings.

B. Connecting to the Existing System

In the SPU water system, most connections to existing (non-steel pipe) are unrestrained. A difference in outside diameters of various materials can create a force imbalance at the connection similar to that of a reducer.

For example, a 100-year-old cast iron, 20-inch-diameter water main could be ½-inch greater in outside diameter than a new 20-inch-diameter ductile iron main. This force imbalance must be accounted for at the connection, especially if corrosion preventative isolation couplings are used to make the connection. At 100 psi, this difference in outside diameter creates a force imbalance of more than 3,000 lbs in a 20-inch-diameter pipe connection. The connection coupling can be restrained by using tie-backs, wedge restraint glands, or welded tabs on the smaller pipe, or some combination. The idea is to keep the connection coupling from sliding off the larger pipe and onto the smaller pipe due to the force imbalance.

Be very careful with restraint for new valves near connections to existing pipe, especially when new restrained joint pipe is connected with unrestrained pipe. When closed and under pressure only from the existing side, the valve will tend to collapse the new flexible restrained joints and pull away from the unrestrained connection. This effect is usually overcome with a concrete thrust collar on the new pipe that is fixed rigidly to the new valve.

5.6.3.9 Types of Pipe Restraints

This section describes the types of pipe restraints used in the SPU water distribution system. Typically, ductile iron pipe is joined by a non-restrained bell and spigot joint. Some steel pipe is also joined in this manner. Thrust blocks are the SPU standard for restraining pipe when non-restrained bell and spigot joints are used. The design engineer should use Standard Plans 330A, 330B, 331A, and 331A and the AWWA Manual M41 to design thrust blocks. Some situations will not allow space for concrete thrust blocks. In those situations, use a pipe with a built-in restrained joint, or pile supported thrust restraint systems.

A. Concrete Blocking

Concrete thrust blocks are the most common joint restraint in the SPU system. Thrust blocking relies on the surface area of the block being in contact with undisturbed soil to counteract the pressure acting on the pipeline fitting. Conditions may require a pile-supported thrust restraint system. The soil conditions are a very important factor in concrete thrust block design.

In concrete thrust block design, excavations or disturbance of soils behind thrust blocks should be avoided. An assessment should be performed by a qualified engineer to determine if there is a safe distance away from the thrust block that an excavation could be performed.

NOTE: During design consider future disturbance of thrust blocks

i Horizontal Thrust Block

Horizontal thrust block sizing calculation must follow either Standard Plan 331 or AWWA Manual M-41.

ii Vertical Thrust Block

In some cases, vertical thrust blocks may be needed. Vertical thrust block must follow Standard Plan 330.

B. Concrete Thrust Collars

Concrete thrust collars are occasionally used as a method of thrust restraint. Typically, thrust collars are used to restrain large valves in chambers and valves near casings or connections to existing pipe. Collar refers to the section of concrete formed around the pipe to counteract thrust forces. Collars withstand thrust force by both passive soil pressure and friction on the bottom surface of the block. To keep the pipe from sliding within the collar, the concrete needs to interface with the pipe. The wedge restraints on ductile iron pipe should be wrapped in polyethylene so the concrete does not seep into the wedges of the wedge restraint gland and stop it from working.

i Steel Pipe

If using concrete collars on a steel pipe, a factory integrated thrust ring must be welded around a pipe section, then embed in concrete.

ii Ductile Iron Pipe

If using concrete collars on ductile iron pipe, a factory ring must be installed on a pipe section. An alternative is to install two wedge style restraints face-to-face to act as a thrust ring.

iii Poor Soil Conditions

Design should consider the potential settlement impact the concrete thrust collar could have on the pipe.

iv Pipe Anchors/Tie Backs

Pipe anchors consist of a large mass of concrete usually on one side of a pipeline. The concrete is attached to the pipeline by steel rods. Anchors act like vertical thrust blocks (except in a horizontal plane) to restrain the pipe at a bend. Typically, pipe anchors are only installed for temporary service because the rods can corrode.

C. Rigid Restrained Joints

Flanges, welded joints, and threaded couplings are types of rigid restrained joints. Flanges can be used on both ductile iron and steel pipes. SPU does not use threaded couplings in water mains.

i Flanges

SPU does not recommend burying flanges in soil. Flanged fittings are used where joint flexibility is not needed and are typically found in vaults associated with valves or other appurtenances. Flanged pipe must be installed perfectly to fit up and offers no flexibility. A dismantling joint must be used to allow disassembly and repairs. Flanged valves are usually used in the installation of a large run of flexible restrained joint pipe. Each flanged valve will have a short flange by flexible restrained joint adapter on each side of it.

Manufacturers can weld a flange to the steel pipe. See AWWA Manual M-11 for the class of flange rating. Consult with the manufacturer to ensure the flanged connection can be provided. An electrical isolation kit may be necessary if joining the steel pipeline to a ductile iron appurtenance. Steel and ductile iron are dissimilar materials that can corrode.

ii Welded Joints

Steel pipe can be assembled with welded joints, making the pipeline fully restrained. Field-welded joints provide restraint against the unbalanced hydrostatic and hydrodynamic forces acting on the pipe. There are several styles of welded joints. The most common are the lap-weld, butt-weld, and butt strap joints. Refer to AWWA Manual M-11 for a photo of each type of joint:

- **Lap-Weld Joint.** In general, SPU prefers a lap-weld joint because they are easy to install. Lap-welded pipe is a bell and spigot pipe with the bell welded to the spigot where they overlap. The design engineer can select an interior only weld, exterior only weld, or double lap weld (interior and exterior). SPU recommends the double lap weld. It provides an added safety factor at each joint, but can only be done in larger diameters because it requires a welder to make an interior weld. Also, each joint can be checked for leakage with an air test. With a lap-weld joint, small deflections can be made at each joint before welding. Given the geometry of the double welded lap joint, it experiences twice as much strain as the pipe wall when post-construction forces (settlement) cause pipe movement.
- **Butt-Weld Joint.** Butt-weld joints are made by aligning the ends of two pipe sections and welding at the point of "near-contact" of the two ends. To complete a butt-weld joint, both ends of the pipe must be the same size. A butt-weld joint is more difficult in the field because the pipes must be near perfectly aligned. This style weld eliminates the geometric strain that can be induced at a lap-weld joint. SPU has used butt-welded joints for pipelines designed for higher levels of seismic loading. The butt-weld joint is also used in horizontal directional drilling (HDD) applications, where having a bell shape on the pipe is not recommended. A full penetration butt-welded steel pipe is one of the best choices for seismic protection.
- **Butt-Strap Joint.** A butt-strap joint consists of a strip of steel that overlaps two plain end pieces of pipe by several inches. The butt strap is joined to each pipe by an exterior weld (and an interior weld if the pipes have sufficient diameter). The two pipe ends do not have to have identical outside diameters, but they must be relatively similar. Typically, a butt-strap joint is used to join a new steel pipe to an existing steel pipeline.

SPU follows the recommendations of the American Welding Society (AWS) Structural Welding Code.

D. Flexible Restrained Joints

Flexible restrained joints allow some deflection and movement of the joint, but restrain the joint while under pressure. These joints are the standard restrained joints used by SPU. All ductile iron pipe manufacturers make a boltless restrained joint ductile iron pipe that uses a restraining ring and locking lugs to restrain joints yet provide flexibility. Check the manufacturer's literature because products vary.

The use of flexible restrained joint pipe systems should be used when special site or system conditions are present and the use of concrete thrust blocks is not appropriate. Flexible restrained joint pipe systems are required when site/project needs have the following characteristics:

- The water main is to be located in an area of liquefiable soils.
- The area is defined to have soils with a poor bearing capacity.

- The area is on a steep slope and particularly if the water main is to be in an area determined to be a slide area.
- If the site is congested with underground utilities or other facilities such that concrete thrust blocks are unfeasible.
- To provide flexibility in shutdown areas and avoid using temporary thrust restraints.
- In areas where excavations, soil settlement or subsidence is anticipated, restrained joint pipe should be considered.
- In pipelines critical to the functioning of the water supply system after a major seismic event.

i Wedged Restraints

Other examples of flexible restrained joints are a wedge restraint gland type device or a restrained gasket type of pipe. Wedge restraint glands must follow Standard Specification 9-30.5(5)B. Wedge restraint glands are typically used on mechanical joint pipe and fittings and grip the pipe, which forces a lug with teeth to imbed into the pipe. Most wedge restraint systems remain flexible after installation.

ii Gasket Restraint

The restraint gaskets are readily available and can be installed on field-cut push-on joint pipe. The restraining gaskets have stainless steel teeth imbedded in them that grip the pipe for restraint. The restraint gaskets are only pseudo-flexible restrained joints. Once assembled, they offer little or no deflection capability. They also require special tools to disassemble.

Note: SPU has used the restraint gaskets on occasion, but found they do not save costs. The AWWA M41 Manual or DIPRA computer program can be used to calculate ductile iron pipe restraint requirements.

Restrained joint pressure ratings for each type and pipe size must be verified with the manufacturer. The length of pipe in casings on any run of ductile iron pipe does not count towards its overall restraint length, unless the casings are filled with grout after the pipe is installed. When using restrained joint pipe, all pipe in each individual system must be restrained joint. In addition to pipe joint restraint, concrete thrust blocks must be provided unless site-specific conditions do not allow.

Note: Field cutting and modifying a factory restrained joint pipe is difficult and time consuming. The pipe must be ordered specific to the project site. Contractors must submit and receive approval of a 3-D lay plan before ordering pipe.

iii Grooved Restraint

Grooved restraint couplings can be used to restrain ductile iron and steel pipe. These couplings are uncommon in the SPU system but can be found on some blow-off facilities. Grooved restraint couplings are generally not used in buried service.

The standard grooved restraint coupling engages a groove that is cut on the exterior of the full circumference of the pipe. Thicker pipe must be used for these couplings.

Grooved restraint couplings can also be used with a rolled groove in thin wall steel pipe and with a welded end ring on both ductile iron and steel pipe. Flexible steel restrained joints come in the form of a coupling that connects two pipe sections. The restraint is obtained by grooves on the coupling engaging a steel rod that is welded to the outside of the pipe. These couplings are custom designed to each project and can be ordered with some minor expansion capability. While quick and easy to install, grooved restraint couplings are expensive. One manufacturer is Victaulic brand.

For how to design restrained joint pipe systems without concrete blocking, see the Ductile Iron Pipe Research Association (DIPRA) program.

E. Flexible Single-Ball and Double-Ball Expansion Joints

For projects where extreme flexibility is needed, several manufacturers offer river crossing pipe that has restrained, ball joints that provide a high flexibility in alignment. Another flexible product is a single or double-ball expansion joint, which is very expensive. The double-ball expansion joint can rotate, extend, contract, and adjust in any direction, yet will not separate. However, improperly installed expansion joints can expand unintentionally under pressure. The design engineer should use care in designing expansion joints in the pipe system.

At a location on each side, the pipe must be fixed by a thrust collar or other means to keep the expansion joint from moving.

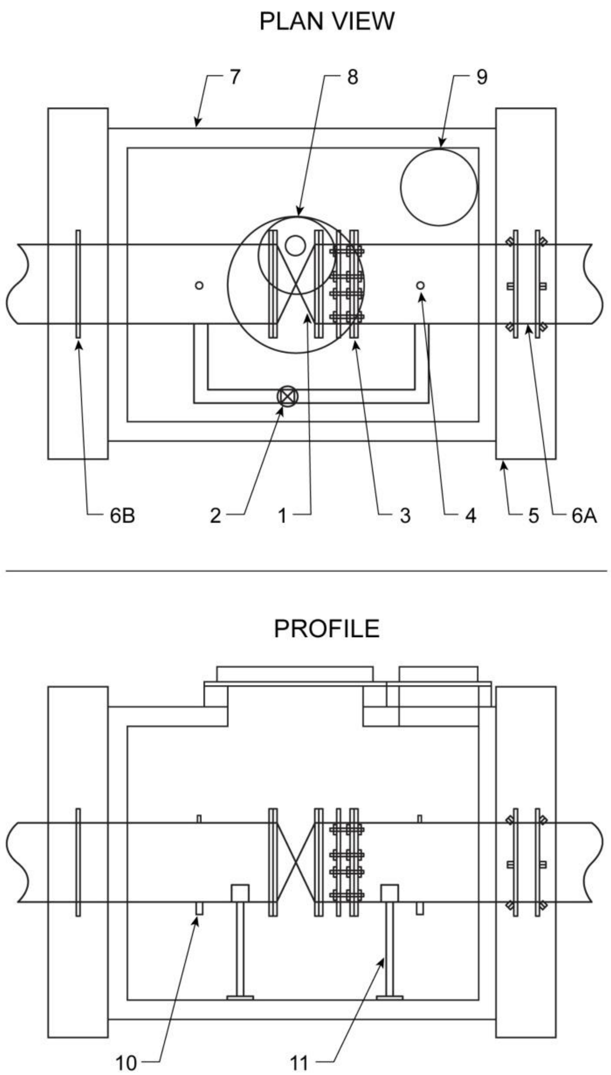
5.6.3.10 Temporary Restraint

Temporary restraint is sometimes required during construction to restrain pipe thrust forces usually where the pipe has been cut and capped and a dead end is created. Temporary restraint can come in many forms, and usually is installed before other work so that the pipe can be cut, capped, and turned back on in a single outage. In smaller diameters, a precast concrete block (Ecology block) is usually placed in front of the cap to act as a thrust block. In larger diameters, a tie-back system is usually used where steel rods connect the cap to an anchor (usually two precast concrete blocks) and sometimes piles. Often, the contractor must provide temporary restraint and submit a design stamped by a licensed engineer to SPU for approval.

5.6.3.11 Vaults

Vaults are used to provide access to appurtenances (Figure 5-5). Vaults are required for line valves 16 inches or larger in diameter and air, complex blow-off, pressure reducing, pressure relief, check, and district valves. These vaults require sumps and sump pumps with drains when there is electrical equipment inside. Vaults should not be located in the roadway and should provide hatch doors for ease of access. Provide enough space inside the vault to accommodate required electrical clearances and work space. For detail on aboveground pipe supports and standard vaults, see *DSG Chapter 4, General Design Considerations*.

Figure 5-5 Typical Layout of a 16-inch or Larger Line Valve



NOTES:

1. 16"-30" LINE VALVE (SHOWN AS FLXFL)
2. BYPASS VALVE (GENERALLY 4") W/ VALVE BOX. CAN GO OUTSIDE VAULT
3. FLXFL DISMANTLING JOINT
4. AWWA X IPT CORP ONE EACH SIDE OF VALVE, TOP OF PIPE
5. REINFORCED CONCRETE THRUST COLLAR (GENERALLY NOT NECESSARY ON WELDED STEEL PIPE)

6A. BACK TO BACK OPPOSING WEDGE RESTRAINT GLANDS POLY BAGGED (OPTION A) (NOT APPLICABLE TO WELDED STEEL PIPE)

6B. WELDED STEEL COLLAR (OPTION B) (GENERALLY NOT NECESSARY ON WELDED STEEL PIPE)

7. PRECAST OR CAST IN PLACE VAULT. IF CAST IN PLACE, THRUST COLLARS CAN BE INTEGRAL TO VAULT.
8. 42" RING AND COVER WITH 24" INNER COVER. CENTER 42" COVER OVER VALVE AND 24" COVER OVER VALVE OPERATOR.
9. 24" RING AND COVER FOR ACCESS
10. AWWA X IPT CORP ONE EACH SIDE OF VALVE, BOTTOM OF PIPE
11. PIPE SUPPORT STAND TYPICAL OF 2.

GENERAL NOTES:

A. DESIGNS WILL VARY DEPENDING ON PIPE TYPE (DUCTILE VS STEEL) AND JOINT TYPE.

B. SIZES OF ALL VALVES SHOWN CAN VARY DEPENDING ON LINE VALVE SIZE AND USE.

C. VAULT SIZE AND PIPE ALIGNMENT WITHIN THE VAULT WILL VARY DEPENDING ON SITE CONDITIONS.

D. FOR CLARITY, NOT ALL PIPE JOINTS ARE SHOWN. A PIPE JOINT SHOULD BE INSTALLED OUTSIDE THE VAULT WITHIN A FEW FEET OF THE THURST COLLARS WHEN USING FLEXIBLE JOINT PIPE.

5.6.4 Appurtenances

Pipeline appurtenances (line valves, access ports, blow-off/drains, and air release/air vacuum valves) must be provided along the pipeline as needed to support the pipeline function and operation. Appurtenance locations should be determined during design and consider conflicts with other structures, vehicular traffic, and existing utilities. Appurtenance locations should avoid areas most vulnerable to damage or vandalism.

5.6.4.1 Valves

When selecting a valve for a distribution main, pay close attention to the type of valve, whether a bypass is required, clearance for future maintenance, and purpose of valve (sacrificial, throttling, isolation). The types of valves used in the SPU water system are shown in Table 5-5. For more information on valves, see Standard Specification 9-30.3.

Table 5-5
Valve Uses within SPU Water System

Use	Type	Function	Size (in inches)	Comments
Line Valve	Gate, C509 resilient	On/Off	4" – 12"	Typically used for smaller line valves
	Gate, C500 double disc	On/Off	4" – 12"	• No longer commonly used • Much larger sizes in system
	Butterfly	On/Off	4"-12"	• No longer commonly used • More head loss than others
		On/Off	16"-84"	• Typically used for line valves • More head loss than others
	Ball	On/Off, throttle	4"-48"	• Costly • Low head loss
District Valve	Gate	On/Off	4"-12"	In chamber, generally closed, locked out
Backflow Prevention	Check Valve	Prevents backflow	4'-12'	Only allows flow in one direction
Air Relief, Air Vacuum, Air Release	Stand Pipe, Air Valve, Combo Air Valve	Allows air in and/or our of pipe	2"-16"	• Air release allows trapped air to escape pipeline and improve flow characteristics • Air vacuum allows air into pipe to prevent collapse during draining. • Largest likely future need is 8"
Pressure Regulating/ Pressure Relief Valve	Control Valve	Maintain system pressure	2"-16"	Maintains a constant downstream pressure
Sacrificial/ Throttling	C500 Gate	Limit discharge	4"-8"	Typically the "Throw away valve" in double valve setup
	C515 Gate	Limit discharge	4"-8"	Typically the "Throw away valve" in double valve setup
	C509 Gate	Limit discharge	4"-8"	Typically the "On/Off valve" in double valve setup
	Ball	Limit discharge	4"-8"	Long-term high head throttling valve
	Plug	Limit discharge	4"-8"	Long-term high head throttling valve

A. Types of Valves

The following are types of valves used in the SPU Water System

Valve	Use in SPU Water System
Line	Line valves are typically either gate or butterfly valves, depending on pipeline size. Ball and plug valves may be used in the following situations: high pressure (±250 psi), significant throttling under high flow rates, control of pressure surges, or where throttling of high pressure differentials may be required.
Gate	Gate valves are preferred where possible. They completely exit the flow path when fully open and allow drained water mains to fill without bypasses. Gate valves require space for a valve bonnet above or to the side (laydown valves) of the pipeline. Cover over water main may be critical. In cases where substandard cover is allowed, the gate valve operating nut must be below the bottom of the paving. This is particularly sensitive for concrete pavement, which tends to be thick. Gate valves are typically more expensive than butterfly valves. Laydown valves must be operable from the street surface and require a sealed right angle gearbox. (See Std Plan 030 for standard cover requirements.)
Butterfly	Butterfly valves are frequently used on larger pipelines. All valves 16-inches and larger should be full-size inline butterfly valves and be installed in vaults. Valves under 16-inches can be either gate or butterfly valves. Standard practice is to use gate valves. Butterfly valves 16" or larger must be installed with a bypass to allow a drained pipe to fill without throttling the butterfly valve seats. Throttling of large-diameter butterfly valves with pressure differentials of over 50 psi is a primary reason seats have been destroyed after only one or two usages. Make provision for replacement of butterfly valves in the vault design. Include a dismantling joint, or similar, to enable disassembly of the pipe.
Distribution	Distribution line valves should be placed at interties and roadway intersections located at street margins. The valves should be spaced to provide operational flexibility and redundancy to the water system and reduce impacts of shut down blocks.
District	District valves are typically gate valves and separate different pressure zones. They require the valve to be installed in a chamber with a special lock-out tag or cover on the operator to prevent accidental operation.
Check	Check valve is a special valve that only allows flow in one direction through the valve. Check valves are usually installed in vaults. Several styles are available. Check the valve's coefficient value (C) and slam characteristics before finalizing check valve design.
Pressure Relief and Pressure Regulating	Control valves (pressure reducing, pressure sustaining, etc) typically are installed at the interface between pressure zones. They are sized based on anticipated fire flow at projected peak hour demand conditions. Control valve stations should be below-grade in a concrete vault, and include a mainline meter and a bypass to the main waterline.
Air Relief, Air Vacuum, Air Release	Air valves are most commonly found on transmission pipelines and large feeder mains. They are not common on small-diameter distribution mains. There are two general types of air valves: air and vacuum valves and air release valves.
Air and Vacuum	Air and vacuum valves are large-orifice valves used to allow large volumes of air to flow into or out of the pipe during filling and draining and to prevent a vacuum from valve operations, rapid draining, column separation, or other causes. Without air vacuum valves, a vacuum can cause the pipe to collapse from atmospheric pressure. Fire hydrants can be used to release air at the high points of the distribution system and between isolation valves while filling water mains.
Air Release	Air release valves are small orifice valves that may be required at pipe high points or at significant changes in pipe grade to release small amounts of slowly accumulating air buildup in the pipeline. Air is dissolved or entrained in water from many sources including naturally occurring surface waters, at open reservoirs and while filling the pipeline at locations of cascading flow in a partially filled pipe to name a few. Entrained air may be dissolved into the water as pipeline pressure increases (decreasing pipe slope). Entrained air may collect at the top of the pipe at abrupt downward changes of pipe grade. Dissolved air may come out of solution many miles from the air source as the pressure decreases, especially at high points. Air may bubble out of solution where there is significant increase of flow velocity caused by changing pipe diameters (Bernoulli principle) and increasing pipe slope, and changes in pipeline elevations and reduced pressure. Reducing the accumulation of air within a pipe decreases head loss in the pipeline.

Valve	Use in SPU Water System
Combo Air Release/ Air Vacuum	Combination air release/air vacuum valves are air valves that have both large orifices and small orifices and provide the combined functions of both types of valves. These valves must comply with the requirements of ANSI / AWWA C512. They are sized per AWWA M51 based on 2-psi pressure differential for filling and draining. Air release valve orifice sizes are chosen based on water main operating pressure and air release rate, which must be selected to avoid abrupt pressure surges. Air vacuum and air release valves must be equipped with isolation valves and be installed in vaults. Discharge from all air valves must be plumbed to the surface. Washington State DOH regulations for cross connections do not allow discharge into the vault. On large pipelines, open air stand pipes are sometimes used in lieu of a combination valve.

B. Bypass Requirements

Bypass assemblies are used on larger valves to ease valve opening. When a line has been closed, and one side of the pipeline drained, pressure on the valve becomes unbalanced making it very difficult to open the valve. A bypass line allows water to backfill the unpressurized side of the valve, which equalizes pressure on the valve allowing it to open more easily. Bypass assemblies also allow the operator to fill an empty pipe more precisely. Bypass assemblies must be installed on all valves 16-inches and larger in diameter. A typical bypass assembly is included in the standard line valve vault detail. Typically, SPU will use a hydrant or an adjacent active line with a PRV and temporary piping to do this. See Figure 5-5 Typical Layout of a 16-inch or Larger Line Valve.

C. Valve Turns

The number of turns to close a valve is very important. Rapidly closing a valve can create a surge pressure wave in the pipeline and damage the line and appurtenances. See Standard Specification 9-30.3(4).

D. Valve Spacing and Location

Line valves are to be located at grid junctions in the distribution system, such that each of the converging main segments can be independently isolated. Additional intermediate valves may be required between grid connections, such that any single shutdown segment will be no more than one block (approximately 300 to 500 feet) in length within commercial/multi-family residence zones.

On primary distribution mains and feeder mains larger than 12 inches in diameter, valves are to be located where these mains intersect with other mains larger than 12 inches, such that each of the converging large diameter main segments can be independently isolated. Additional intermediate valves may be required between large diameter pipe junctions, such that any shutdown segment of a main larger than 12 inches in diameter will be no more than 1,300 feet in length. The actual number and positioning of intermediate line valves on a main larger than 12 inches in diameter is to be guided by an analysis of secondary outage impacts associated with the isolation of individual segments of mains larger than 12 inches in diameter. As a general guideline, the total outage area resulting from the isolation of any one main segment including all of its subordinate dead-end systems (if any), should include no more than 130 accounts or 20 fire hydrants or 200 gpm of average daily consumption. Placement of line valves will typically be at the margins of the street intersection that contains a grid junction and also intermediate line valves at street margin of the desired location.

E. Clearances

Clearances around a valve are very important to operations and maintenance of the valve. When placing a valve in a vault, the design engineer should ensure that maintenance staff will have access to all valve parts for maintenance and enough space for wrenches and other tools. Typically, a minimum of 1-foot space is needed around all valves. SPU prefers a 3-foot space.

F. Valve Restraint Systems

All valves in chambers and those installed on a restrained joint pipe should be fully restrained. There are several options for restraining valves, including flanges and a mechanical joint with a wedge restraint gland. The system chosen should be consistent with other SPU designs and consistent across the project.

G. Valve Replacement

The design engineer should pay close attention to removal of the valve. Valves 16-inch and larger should have an access hatch directly over the valve, adequately sized to remove the valve.

Another consideration for valve removal is a dismantling joint. When flanged valves are installed, the pipeline is extremely tight. If the valve needs to be replaced, unbolting it may not provide sufficient space to slide the valve out. A dismantling joint has a special sleeve that can be retracted a few inches. This allows enough extra space to remove the valve. The dismantling joint also provides some adjustment if a different brand or style of valve is installed in the future. SPU standard practice is to install a dismantling joint on valves 16-inch and larger in diameter.

5.6.4.2 Access Ports

SPU installs access ports only on large-diameter (24” or greater) pipelines.

Access ports provide access during construction and to Field Operations and Maintenance staff. Typical access port sizes are 24-inches in diameter. Typical spacing for a large transmission main is 1,200 feet except in low areas subject to high groundwater tables. Because access ports typically only extend 1 to 2 feet above the pipeline surface, they can be buried or encased in a maintenance hole that extends to the surface. If the access port is fully buried, it should be well documented on the record drawing (as-built) so future O&M staff can find it. If possible, a waterline marker should be installed over the access port.

SPU typically installs all access ports vertically. In certain cases, a side-mounted access port may be necessary given space restrictions. See the DSG standard access port details (**Appendix A**).

5.6.4.3 Air Gap Structures

Air gaps, also known as goosenecks, are required to prevent cross connections between the domestic water supply and any other liquid. The ultimate function of this air gap is similar to that of a check valve. Typically, air gap structures are located on facilities (e.g. tanks) or equipment (e.g. pumps) connected to the system. <u>The gooseneck discharge must be a minimum of two discharge pipe diameters aboveground or receiving water surface</u>. Floodwater surface levels may need to be considered when designing air gap height. Air gaps are usually found at the end of the discharge line on pipeline and tank blow-offs.

5.6.4.4 Blow-offs

Blow-offs are outlets located at low points in a pipeline profile. They consist of a tangential outlet off the bottom of the pipeline with an isolation valve and riser located in an access vault opening to grade. Blow-off valves are used when pipelines need to be drained or flushed for repairs. Drain rates are limited by the receiving utility or water body. A tap to add sodium thiosulfate or ascorbic acid for dechlorinating water can be provided at the blow-off, but is not common.

All blow-off outlets must have an air gap between the pipeline discharge point and the ground (or surface water elevation of the receiving body) equal in length to a minimum of two discharge pipe diameters. See example plans in the Virtual Vault 776-227 and 776-203. Both show examples with sacrificial throttling valves. Example plan 776-203 also shows a pipeline-to-pipeline pumping connection.

For detail on design of small blow-off valves, see Standard Specification 7-10.2(11) and Standard Details 340a and 340b.

Fire hydrants can also be used as blow-offs on dead-end mains.

5.6.4.5 Flow Meters

Flow meter selection is covered in more detail in *DSG Chapter 10, Instrumentation & Control*. When selecting a flow meter, make sure to follow the upstream and downstream clearances requested by the manufacturer. In general, there should be smooth straight pipe (no appurtenances, bends, fittings, etc) for the equivalent length of 10 pipe diameters upstream of the meter and the equivalent length of 5 pipe diameters downstream.

5.6.4.6 Fire Hydrants

Fire hydrant installations must be in accordance with the Standard Specification 7-14 and Standard Plans 310a, 310b, 311a, 311b, 312, 313, and 314.

Hydrants must be located in areas that are accessible and approved by the Seattle Fire Department or other fire departments with jurisdiction.

5.6.5 Rehabilitation of Existing Mains

SPU rehabilitates existing water distribution main either through slip-lining the pipe or re-lining the large diameter pipe. Additionally, cathodic protection can be used to prevent further corrosion of the buried exterior. For detailed information on cathodic protection, see *DSG Chapter 6*.

5.6.5.1 Slip-lining

In slip-lining, a pipe of smaller diameter is installed within the original larger pipe. Usually slip-lining is performed on distribution or feeder main pipes 30-inches or larger in diameter. The existing pipe becomes the casing for the new pipe. It is often a cost-effective no-dig alternative to traditional open-cut installation of pipe. Typically, slip-lining is used as a structural repair. However, it cannot be used if there is substantial damage (crushed or misaligned joints) to the pipe. The annular space between the two pipes is sometimes filled with grout. The design engineer should carefully consider the hydraulic implications of reducing the pipeline diameter.

5.6.5.2 Relining

If video inspection of the pipeline interior shows significant deterioration of the lining, relining of the pipe may be possible. Pipes are relined by thoroughly cleaning the existing pipe interior then using a machine to spray-coat new cement mortar lining inside the pipe. The method used depends on pipe size. The relining can be designed to strengthen the pipe through use of a structural mesh embedded in the spray-coated cement mortar lining.

5.6.5.3 Cathodic Protection

Cathodic protection is one method SPU uses to rehabilitate existing water pipelines. For more detail on cathodic protection for distribution and feeder mains, see DSG section 5.6.8 and *DSG Chapter 6, Cathodic Protection.*

5.6.6 Emergency Pump Connections

In some emergencies, a connection between two nearby pipelines may be needed. If the pipelines operate in different pressure zones, then a pump may be needed between the two lines. If possible, use an existing interconnection. If no inter-connecting pipe structure is available, SPU recommends using a nearby blow-off location and installing a pump between the two pipelines.

5.6.7 SCADA

See *DSG Chapter 10, Instrumentation & Control*, for SCADA system design. The design engineer should consider whether any monitoring or controls are needed and if the controls should be linked to the system wide SCADA system.

5.6.8 Corrosion Control

Corrosion control of SPU pipelines comes from both active and passive protection systems. Bare metal steel or ductile iron pipe will rust when exposed to corrosive soils or water if no protection system is installed. The rate of corrosion depends on the corrosivity of the environment (typically soil or water). The rate of corrosion is mostly a function of how well the environment conducts electrical current.

Resistivity plays a key role in corrosion control of pipelines. Resistivity refers to the resistance of the environment to promote electrical current flow. When the resistivity of water or soil is high, less current can flow through that environment and the rate of corrosion is lower. For internal corrosion (inside of pipes), water resistivity is constant. For external corrosion (exterior surfaces of pipes), soil resistivity is highly variable. SPU GIS maps show the results of tests taken to date for soil resistivity. SPU staff can test for specific areas for soil resistivity.

The internal corrosion of pipes is managed through a combination of water chemistry adjustments and the use of internal linings..

SPU controls external (on the soil-pipe interface) corrosion through one of three methods:

1. Testing the soil environment for resistivity

2. Applying external bonded coatings or polyethylene film encasements (unbonded film)
3. Using a cathodic protection system

See *DSG Chapter 6, Cathodic Protection*, for detailed discussion of that protection method.

5.6.8.1 Soil Resistivity

Resistivity refers to the resistance of the environment to promote electrical current flow. It is the inverse unit measurement used to determine conductivity/corrosiveness of the internal or external environment in contact with the pipe surfaces. By selecting appropriate backfill (soil) or modifying chemical properties of the water being carried within the pipe, resistivity can be adjusted. When resistivity is adjusted, the corrosion rate on pipe surfaces is reduced. See *DSG Chapter 6, Cathodic Protection*, Tables 6-9, 6-10, and 6-11.

For the soil pipe interface, adjusting soil resistivity is usually neither possible nor practical. Providing select backfill has a short-term effect. Over time, constituents in the soil surrounding the pipe will degrade the backfill and resistivity will approach that of the surrounding material.

Soil corrosivity is based on resistivity measurements of the soil in the pipeline location. Typically, several measurements are taken and an average value is determined. Where soils are very near a classification break point, engineering judgment is required to classify the soil (Table 5-6). Where resistivity tests in one area vary, greater weight is given to the lower values found.

Table 5-6 Corrosion Protection Requirements for Water Piping Systems*

Soil Resistivity (ohm/cm)	Soil Corrosivity Classification
0 – 900	Severely-corrosive
901 – 3,000	Very-corrosive
3,001 – 10,000	Moderately-corrosive
10,001 – 50,000	Mildly-corrosive
> than 50,000	Non-corrosive

*Large projects may have several soil classifications and will need to accommodate each type appropriately.

Table 5-7 shows SPU requirements for water pipelines where coating is dictated by resistivity.

Table 5-7 SPU Corrosion Protection Requirements for Corrosive Soil

Soil Classification	Corrosion Protection Requirements
Severely-corrosive	approved bonded coating joint bonding - #2 AWG insulating coupling or flange kit @ connections full dielectric covering on service lines to meter setter electrolysis test station class b bedding (sand) magnesium anodes @ 18' intervals (17 lbs high potential magnesium anodes)
Very-corrosive	[same as above – except anodes are spaced @ 36' intervals]
Moderately-corrosive	[same as above – except anodes are spaced @ 100' intervals]
Mildly-corrosive	- polyethylene encasement – 8 mil - class b bedding (sand)
Non-corrosive	- no protection required unless organic or clay materials are encountered - additional soil tests may be required for proper recommendation
Notes:	

- All steel pipe must have bonded coating for all soil conditions
- Additional corrosion protection may be required where stray current is present (i.e. rail transit)
- If bonded coating cannot be provided where required, pipe can be installed bare and additional anodes supplied at SPU engineer's direction; impressed current cathodic protection may be required.

5.6.8.2 Coatings

Coating refers to products applied to the outside of pipes. Steel and ductile iron pipelines have different coating requirements. Before selecting a coating system, soil sampling (resistivity testing) should be completed to determine the corrosive nature of the soil.

A. Steel Pipe Coatings

All steel pipes must be coated. Several different coating options are available. The design engineer should use best judgment in deciding among coatings. Table 5-8 lists coating types found in the SPU water system in order of use and preference.

Table 5-8 Steel Pipe Coating Types for SPU Water System

Coating	Description
Polyurethane Coating	SPU standard for steel pipe coating. This is a thin film bonded dielectric coating with both water and chemical resistance. It is typically factory-applied and thickness is customized to a specific application. Surface preparation and curing process is very critical.
Fusion Bonded Epoxy (FBE)	FBE is typically applied at the factory on the pipe, and field applied on the joints. Applied by heating the steel pipe, then blowing epoxy in powder form on the heated pipe. Generally considered one of the most durable coatings. Typically most costly.
Paint Coatings	Paint systems work well with cathodic protection systems. Resilient and extremely abrasion resistant. Paint coatings are applied according to AWWA C210 and C218. Commonly used where there is minor damage to the existing coating or the extent of damage is small.
Heat Shrink Wrap Sleeve	Tubular sleeves that can provide effective coating protection around field-welded joints. It is field-applied. Known to be reliable and effective against thermal, chemical, and environmental attack. Economical due to ease of application and no need for primer.
Tape Coating	Most commonly specified dielectric coating systems. Has a good performance record at reasonable cost. Typical application includes 80-mil cold-applied plastic tape in three layers over a properly prepared steel surface.
Cement-mortar Coating	No longer used, but may be encountered on existing pipes. Chemically protects pipe from corrosion by providing an alkaline environment where oxidation of steel is inhibited. Can be applied in various thicknesses. Provides mechanical protection against handling and installation damage. Typical application thickness is 1inch.
Coal-tar Enamel Coating	One of oldest methods to provide corrosion protection for steel pipelines. Coal-tar enamel is applied over a coal tar or synthetic primer. Application includes cleaning, priming, application of hot enamel, and covering of a fiberglass matte and/or felt outer wrap. Recommended application includes 7/32-inch coal tar with fiberglass reinforced mineral felt with heat-shrinkable cross-linked polyolefin sleeves at joints.

B. Ductile Iron Pipe

Due to its thickness, ductile iron pipe does not always need a coating. It generally only needs coating when soil conditions warrant. Soils should be tested to identify that need.

For ductile iron pipe, the standard factory coating is an asphaltic coating approximately 1-mm thick. This coating minimizes atmospheric oxidation, but provides no in-ground protection.

Ductile iron pipe must conform to Standard Specification 9-30.2(1).

Table 5-9 lists ductile iron pipe coating options. SPU requires a double cement mortar lining thickness for ductile iron pipe. See AWWA C104 for more detail on cement mortar linings for ductile iron pipe.

Table 5-9 Ductile Iron Pipe Coating Types for SPU Water System

Coating	SPU Preference
Thermoplastic Powder Coating	SPU standard coating for ductile iron (DI) pipe in a corrosive environment. See Standard Spec 9-30.1(6)C. Can also be used on steel pipe.
Wax Tape system	When used with appropriate primer and a fiber reinforced outer wrap, this coating can protect any buried metal surface, bolts, nuts, rods, copper, ductile, steel, etc.
Polyethylene film encasement (un-bonded film)	Common application for corrosion control. Acts as an environmental barrier to prevent direct contact between pipe and corrosive soils. Not watertight; groundwater can seep beneath the wrap. Integrity depends on proper installation, careful handling by contractor, and inspection by owner. Polyethylene encasement must be per Standard Spec 9-30.1(6) D. SPU has limited success using this product.
Fusion-Bonded Epoxy, Polyurethane, and Tape Coatings	Can be considered as an alternative coating system. Manufacturer has been unwilling to apply bonded coating at factory. Design engineer should recognize potential invalidation of pipe warranty if this is field applied.

C. Linings

Lining refers to a product used to protect the inside of a pipe from corrosion and improve performance and service life. SPU requires a lining for all pipelines. All linings must be National Sanitation Foundation (NSF) 61-approved.

Ductile iron pipe is typically supplied with a double thickness Portland cement-mortar lining unless otherwise specified. See Standard Specification 9-30.1(1).

Welded steel pipe is furnished with two primary lining options: cement-mortar or polyurethane. Cement mortar is a nominal thickness of ¼- to ½-inch. For interior linings, polyurethane thickness is typically around 20-mils. See Standard Specification 9-30.1(1).

D. Cathodic Protection

Cathodic protection is a means of providing a sacrificial material to become the point where corrosion occurs.

For a pipeline, cathodic protection provides a separate metal known as a sacrificial anode to be the point where corrosion occurs. This anode protects the pipeline from corrosion. By use of either an impressed current rectifier or materials that are galvanically active (zinc or magnesium), the pipeline becomes the cathode and corrosion is transferred to the anode.

See DSG Chapter 6, Cathodic Protection, for standards for cathodic protection systems.

E. Environmental Modifications

SPU employs corrosion control techniques such as modifying the pH at its water treatment plants to reduce internal corrosion of water pipelines. This practice is controlled by federal regulation under the Safe Drinking Water Act and EPA's Lead and Copper Rule and is a water quality operational methodology beyond the scope of this DSG.

Other engineering practices such as selecting less corrosive soils for pipelines are design considerations for corrosion control.

5.7 WATER SERVICE CONNECTIONS

For standards and guidelines for water service connections, see *DSG Chapter 17, Water Service Connections*.

5.8 TRANSMISSION MAIN DESIGN

This section describes transmission main design. Transmission mains are major (16- to 64-inch diameter) pipelines within the SPU water system. They convey or transport water from a source to a reservoir and typically do not have any service connections. This section covers the types of materials used, appurtenances, and restraint systems used in transmission main design. For detailed information on water storage tanks, standpipes and reservoir design, see DSG section 5.9.

This section of the DSG frequently directs the user to DSG section 5.6, Distribution Main Design. Many of the elements of transmission main design are identical to those for distribution mains.

5.8.1 Modeling and Main Sizing

See DSG section 5.6.1 for distribution mains. SPU's contracts with its wholesale customers specify the minimum hydraulic gradient or head at each wholesale service connection. The newer wholesale service contracts also specify the maximum flow rate at a given hydraulic gradient that would be provided for each service connection. Any modification to the transmission system should consider these hydraulic criteria. While these hydraulic criteria may be modified if beneficial to the regional system, SPU may make these modifications only once during any 15 year period provided that 4 years advance written notice is given. At a minimum, transmission mains must be sized to maintain a pressure of 5 psi or more, unless the mains are directly adjacent to the storage tanks.

5.8.2 Location

SPU transmission mains are primarily located in the right-of-way (ROW). However, their design is based on least conflict with other utilities and cost of easements. SPU transmission mains within Seattle are not moved for other utilities. Outside of Seattle, SPU generally owns the transmission pipeline ROWs and mains are typically not moved. An exception is some holdings that belong to WSDOT.

5.8.2.1 Separation from Other Utilities

See DSG section 5.6.2.1.

5.8.2.2 Geotechnical Report

With a new or major refurbishment to transmission main, a geotechnical engineering study must be done for the proposed route (alignment) and documented in a geotechnical report. Consult the SPU Materials Lab for recommendations on what the report should cover. The Materials Lab geotechnical staff must review findings on all projects, even when an outside consultant completes the geotechnical evaluation.

5.8.3 Materials

Transmission mains must be designed to withstand internal working pressure, external loads, and transient pressures. Design should minimize the use of pump stations.

5.8.3.1 Minimum Pipe Size

Transmission mains must be sized to carry the designed peak flow required including fire flow without exceeding the design velocities or head losses.

5.8.3.2 Material Types

A. Pipe

Water transmission mains are typically constructed of steel or class 52 ductile iron. Both ductile iron pipes and steel pipes are to be cement mortar lined in most instances. For more detail on materials for water transmission mains, see Standard Specification 9-30.

Note: ductile iron pipe is only manufactured up to 48-inch diameter. SPU does not use pre-stressed concrete cylinder. Large diameter steel pipe (>48-inches), fittings, and structures housing valves and appurtenances should be designed or overseen by a licensed engineer.

See DSG section 5.6.7.

B. Casing

See DSG section 5.6.3.7.

5.8.3.3 Pipe Cover

Transmission mains are subject to special pipe strength design considerations and analysis by the design engineer. The minimum depth of cover for water transmission mains is given in the contract for each project. Use AWWA M11 or other applicable design manual to meet the requirements of the project. SPU typically buries transmission mains with 4 feet of cover to allow smaller utilities to cross over the pipeline and to reduce live-load on the pipe.

5.8.3.4 Bedding and Backfill

See DSG section 5.6.3.4.

A. Standard Trench Section

For detail on a standard trench section, see Standard Plan 350.

B. Controlled Density Fill

See DSG section 5.6.3.4B.

5.8.3.5 Line Pressure

Pipelines must be designed to withstand the required internal working pressure, external loads, and transient pressures.

A. Standard Conditions

Transmission lines do not have a typical operating pressure, but rather operate at the pressures required by the system. The design engineer should review the modeling results to determine the maximum operating pressure in the pipeline and design the pipeline system for that pressure. Transmission mains must not be designed for less than 100 psig. In cases where there is an extreme pressure differential (e.g. downhill pipeline) it may be necessary to change pressure capacity of the pipeline along the pipeline route.

B. Transient Conditions

Transient pressures result from sudden velocity changes in the water flowing through a pipeline. These transient (or surge) pressures can propagate from closing a valve rapidly, an electrical power failure at a pumping facility that causes a sudden pump shut down, large or abrupt fluctuations in water demand from major users along the pipeline, or a sudden release of entrapped air from the pipeline. Methods to control transient pressures are standpipes, surge tanks, pressurized tanks, surge anticipator valves, vacuum relief valves, regulated air release valves, and optimizing main size and alignment. Valve operator speed controls can also mitigate valve-related surge events.

Each pipeline material has a standard allowance for surge conditions (typically at 1.5 times the pipeline design pressure for steel or 100 psig for ductile iron). The design engineer should consult AWWA Manuals to determine pipeline surge allowance. Those allowances should then be compared with the maximum surge pressure from the modeling results to ensure the pipeline can withstand the surge pressure. In the SPU water system, surges of 100 to 150 psig have occurred, particularly in commercial and industrial areas.

5.8.3.6 Pipe Supports

Transmission lines should rarely be allowed to run aboveground. If that occurs, the design mechanical engineer should evaluate temperature differences between the pipe and atmosphere that will affect expansion and contraction at the joints. The issue should be addressed either through HVAC temperature controls, pipe insulation, or design pipe supports to allow movement.

5.8.3.7 Casing

See DSG section 5.6.3.7.

5.8.3.8 Trenchless Technology

Trenchless technologies such as bore and jacking, micro-tunneling, horizontal directional drilling, and pipe ramming are alternative methods of construction to the more typical cut-and-cover. Typically, trenchless technology is considered to avoid environmental or construction impacts. Before considering trenchless technologies, the design engineer should rule out alternatives.

Every trenchless project is unique and requires custom evaluation and analysis. Items to consider include topography, soil conditions, regulatory issues, and site constraints.

A. Bore and Jacking

Bore and jack installation (also called horizontal auger boring) consists of installing a casing by jacking and concurrently auguring the soils out through the casing. Alignment is fairly accurate with bore and jacking. However, there can be potential problems with high ground water and excessive lengths. Once the casing pipe is installed, the carrier pipe is installed with spacers to support the pipe. The gap can be filled, typically with blown sand or a non-shrink grout.

B. Micro-tunneling

Micro-tunneling is typically a closed-face pipe jacking process. Micro-tunneling requires both launching and receiving shafts, which are typically constructed out of slurry walls. Micro-tunneling machines are laser controlled remotely from the surface. Micro-tunneling installs a casing pipe, and then a carrier pipe is installed. Because this process allows precise grade control, it is frequently used in water and sewer applications.

C. Horizontal Directional Drilling

Horizontal directional drilling (HDD) consists of drilling progressively larger diameters from ground surface to ground surface in an arch under the obstruction. No shafts are constructed with HDD construction. Typically, the first pass of a drilling operation creates the route. The pipeline route is then increased in diameter by forward and back reaming the drill path. The hole is kept open with drilling fluids, typically a bentonite slurry. During drilling, various methods are used to track the drill bit and determine the route. Recent history has shown HDD pipeline installation to be relatively accurate. Once the desired diameter is achieved, the carrier pipe is pulled through the drilled path. No casing pipe is used in HDD applications.

D. Pipe Ramming

Pipe ramming consists of using a hydraulic hammer to push the pipe through the soil. Once the casing pipe is installed, the center channel is removed, typically by an auger method or compressed air. With small diameters, the carrier pipe may be rammed with a closed end. Frictional forces can limit the overall length of the pipe ramming, and there is no line or grade control.

5.8.3.9 Restraint Systems

See DSG section 5.6.3.9.

5.8.3.10 Vaults

See DSG section 5.6.3.11.

5.8.3.11 Appurtenances

Pipeline appurtenances, such as line valves, access ports, blow-off/drains, or air release/air vacuum valves should be provided along the pipeline as needed to support the transmission main function and operation. Appurtenance locations should be determined to avoid conflicts with other structures, vehicular traffic, existing utilities, and locations vulnerable to damage or vandalism. See DSG section 5.6.3.12.

5.8.3.12 Line Valves

Each transmission main project should examine the proposed route for the best location of isolation line valves. Consideration should be given to future operational issues such as draining the pipeline and isolating a mainline break. SPU recommends placing isolation valves at least every 2,000 ft and at every intertie location. All line valves should be installed within a vault per the standard line valve vault detail in the DSG (see Figure 5-5 in section 5.6.3.11).

5.8.4 Seismic Design

This section describes seismic requirements for water system design.

5.8.4.1 Critical Needs Assessment

The purpose of a critical needs assessment is to establish design requirements to provide for the highest level achievable for continuity of service, i.e. for the transmission pipeline to function within its design limits with as little service interruption as possible. A critical needs assessment of the proposed new or refurbished transmission main and associated facilities should be completed as part of the basis of design. From the critical needs assessment, design criteria should be clearly established for the following:

- Design operational life of the transmission main.
- Maximum length of time that the transmission main can be out of service for repairs or maintenance without negatively affecting the water demand requirements. Identify seasonal considerations that affect the length of time the main can be out of service.
- Redundancy of critical components or functions, such as line isolation valves.
- Accessibility for the transport of repair and maintenance equipment.
- Access to the interior of pipes, vaults, and other structures for inspections and repairs.
- Impacts from geologic events (landslides, erosion) and seismic events (ground movement), including:
  - Foundation and backfill requirements
  - Drainage and control of or protection against groundwater
  - Allowable pipe movement
  - Allowable joint leakage (if any)
  - Need for and location of seismic valves

5.8.4.2 Seismic Joints and Connections for Pipe Movement

This section describes potential design issues when SPU water pipes must cross settlement prone areas, faults, liquefaction zones, slides, or where two types of pipe with different restraint characteristics must be connected. In both cases, design must allow pipe movement.

A. Cast Iron Pipe

Much of the SPU Water System piping is non-restrained, inflexible cast iron pipe with lead joints. No matter how robust a system design may be for crossing a given fault or landslide zone, if a connection to the existing pipe is faulty it will fail when the ground moves. Either of two methods will stabilize the structure within the zone:

1. Extend flexible restrained joint pipe a significant distance beyond the fault/slide zone.
2. Install some immovable structure on the new flexible restrained pipe near its connection with the existing pipe.

B. Ductile Iron Pipe

Where smaller (≤24") diameter pipes cross movement prone areas, they are usually ductile iron. The options are:

- **Standard Flexible Restrained joint pipe with expansion fitting(s) such as a restrained telescoping sleeve**. A telescoping sleeve allows axial elongation of the piping system.
- **Restrained Ball Joint pipe with expansion fitting(s) such as a restrained telescoping sleeve**. Ball joint pipe is the most flexible and the most expensive pipe available. The balls must be encased in polyethylene bags to keep dirt out of the ball.
- **Standard Flexible Restrained joint pipe with double ball expansion joints placed where the most differential movement is expected**. Flexible Single/Double Ball Expansions Joints are discussed in DSG section 5.6.3.9.E. Currently these fittings are only available up to 48-inch diameter and one size beyond at 72 inches. The large-diameter sizes are extremely expensive.

See **Appendix C** for the allowable ductile iron deflections. In all of the options above, shorter sections of pipe with extra joints can be used to provide more pipeline flexibility.

C. Steel Pipe

Where larger (≥24") diameter pipes cross movement prone areas, they are generally steel. Steel pipe is somewhat flexible and the nature of the material allows it to yield and elongate significantly before failure. Some studies indicate that good welds can elongate 20% before failure. However, bending and buckling of the steel pipe can be a problem when the settlement trough is not smooth. Best options for steel pipes are:

- **Full penetration butt welded steel for heavier wall thickness than normal**. See DSG section 5.6.3.9B1. Steel pipe with no special fittings works well for long smooth settlement troughs. See Virtual Vault plan set 774-569 for an example of a 24-inch butt welded steel pipe with several design features included to increase seismic survivability of the system in a liquefiable zone.
- **Full penetration butt welded steel with expansion fittings.** Large-diameter steel expansion sleeves are available, but offer little expansion or deflection capability. If possible, double ball joint expansion fitting(s) should be installed if large differential ground movements are expected. Due to their current limited

range of available sizes, steel pipe size may need to be reduced in the immediate vicinity of the ball joints. See Virtual Vault plan set 785-38 for an example of an 89-inch OD steel pipe crossing a slide plane with a 48-inch double ball expansion joint.

Where fault crossings/slide planes are encountered, a double ball expansion joint should be installed right at the fault crossing as shown in Virtual Vault plan set 785-38. If this is not possible, the thickest pipe wall and strongest steel should be used, with some flexibility built in elsewhere if possible.

Design considerations such as predicted ground movement, installation cost, cost of failure, and reliability must be analyzed. It may be cheaper to install an inexpensive pipe system and replace it every 10 years than to install a system that will last 100 years. Some SPU pipelines are extremely critical and must be designed to withstand the largest expected ground movement.

5.8.4.3 Seismically Actuated Valves

Seismically actuated valves automatically close during an earthquake to prevent the uncontrolled drainage from water storage tanks due to broken downstream pipelines. Many factors must be determined for each valve installation: sensitivity, speed to close, battery life requirements, power availability, and SCADA.

The seismic actuator must be properly matched to the valve it protects.

All valves must have a manual operator for emergency operation.

5.8.5 Inter-Connection of Parallel Mains

In some cases, pipelines may be installed parallel, or a new line may be installed near an existing main. The design engineer should consider whether a connection between the two pipelines is possible and beneficial. A primary reason to consider the interconnection is draining of the pipelines. Typically, when a pipeline is drained, millions of gallons of water are wasted. Pumping from pipeline to pipeline allows for much faster draining than can normally be achieved by draining to the water system. If parallel or nearby pipelines are interconnected, water from the pipeline to be drained can be pumped into the other pipeline, thus not wasting water.

The interconnection between mains will likely require room for a pump. If possible, route an interconnection line from each pipeline into a single vault, leaving a gap for a pump and the final connecting piping. The size of the interconnection should be based on flow calculations and an acceptable amount of time to drain the line. A good location for an intertie is at the blow-off.

5.8.6 Rehabilitation of Existing Mains

See DSG section 5.6.5.

5.8.7 Emergency Pump Connections

See DSG section 5.6.6.

5.8.8 SCADA

See DSG section 5.6.7.

5.8.9 Corrosion Control

See DSG section 5.6.8.

5.9 WATER STORAGE TANKS, STANDPIPES AND RESERVOIR DESIGN

This section describes water storage facility design. Water storage facilities primarily function to provide adequate flow and pressure for all design conditions where the transmission and distribution system cannot otherwise maintain the flow or pressure required. Water storage tanks, stand pipes, and reservoirs are critical infrastructure that directly influences public health and safety. These SPU facilities must be designed and operated to prevent cross-contamination of water and degradation of water quality. For more detail on SPU reservoirs, see *DSG Chapter 13, Dam Safety*.

5.9.1 Planning

USM determines the need for a new or refurbished water storage facility. This planning includes determining the facility's general characteristics, size, location, and a timeline for service based on hydraulic modeling and demand projections. If approved by SPU management, a storage facility project is incorporated into the Capital Improvements Program (CIP) plan.

5.9.1.1 Service Life

A. Concrete Reservoirs

For new concrete water storage reservoirs, service life must meet the specific project requirements. Most water utilities use a typical service life of not less than 50 years for concrete structures. For refurbished existing concrete water storage reservoirs, the design service life will be established case-by-case based on the specific conditions and requirements for the reservoir.

B. Steel Storage Tanks

For new steel water storage tanks, most water utilities use a design life of 75 or more years, assuming that the coatings are well maintained. An economic analysis of coating and cathodic protection systems should be done to determine the most cost-effective method for preventing corrosion. For refurbished existing steel water storage tanks, design service life is established case-by-case based on specific conditions and requirements for the tank.

5.9.1.2 Hydraulic and Capacity Requirements

Generally, the size of a finished water storage facility must provide sufficient capacity to meet both domestic demands and any requirements for fire flow.

Specific capacity requirements must meet the applicable elements of the Washington State Department of Health Water System Design Manual or SPU's system reliability criteria under defined emergency scenarios, whichever is less. Storage facilities are expensive to construct, operate and maintain, plus they increase the water age and as such should not be unnecessarily oversized.

Capacity must be established and documented by an engineering study using the following basic criteria:

- The planning horizon for demand projections must be not less than 20 years. For new facilities, the planning horizon should be 50 years or more.
- Volume should be sufficient to deliver design peak hourly demand at 30 psi to the pressure zone(s) served. This volume requirement may be reduced when the source water facilities have sufficient capacity with standby power for pumping to the reservoir and/or when another storage reservoir can be used to supplement peak demands of the zone(s). During fire flow conditions, the combination of storage and delivery system capacity must be adequate to provide water at the required flow rate and a minimum 20 psi in the main.
- To determine the emergency /standby storage component, identify the reasonable emergencies, define the duration and level of service during the emergency, then apply SPU's reliability criteria as described in the current WSP.
- Water quality impact of storage and design considerations to enable regulatory compliance throughout the life of the facility.

5.9.1.3 New or Modifications/Expansions of Existing Storage Facilities

A. General Considerations for New Facilities

The following are general considerations for planning and preliminary design of new storage facilities or for modifications, expansions of existing facilities, retirements of facilities or downsizing facilities:

- Hydraulic grade line of the water supply system
- Pressure zones served by the storage facility
- Sizes and capacities of transmission or feeder mains and, where applicable, booster pumping stations, that supply the storage facility (existing and future)
- Sizes and capacities of distribution mains in the pressure zones served by the storage facility (existing and future)
- Availability and type of discharge points for overflow and drain-down water from the storage facility
- Geotechnical and seismic characteristics
- Vehicle access for all anticipated vehicle and equipment types
- Security
- Fire services (fire flow, emergency engine fill points post-earthquake)
- Land ownership and future use by City of Seattle departments
- Environmental impacts to adjacent properties

- Multi-use site considerations (e.g. public access, recreation, memorandum of agreement addressing maintenance and use on reservoir sites and sites adjacent to reservoirs)
- Anticipated future development of adjacent properties

B. Communications Equipment

Antennas and other communications equipment can be mounted on a separate towers on the site or on a storage facility. If antennas or communications equipment are mounted on the storage facility, proposals must include structural and wind-load engineering calculations demonstrating the tank can safely accommodate the additional weight of equipment and cables. SPU Real Property is the lead for communicating with tenants and issues the permits for use of SPU property.

Calculations must factor in other equipment already installed on the tank. Equipment should be clamped to the facility rather than welded when possible, to avoid damage to interior and exterior coatings.

Note: It is extremely important to ensure that the interior coating of the tank is undamaged either by welding or by an activity that may jeopardize the interior lining or the exterior coating. The cost of such damage is significant.

C. Location of New Facilities

Location of new storage facilities should consider site features and constraints that affect the sanitary and structural integrity of the facility:

- Drainage of site and structure
- Locate storage facilities at least 50 feet from the nearest potential source of contamination
- For above-grade facilities: foundations should be at least 3 feet higher than the 100-year flood elevation
- For below-grade facilities:

At least 50% of reservoir or tank should be above highest point of groundwater table Accessible vents and hatches should be at least 2 feet above normal ground surface. Grade should slope away from the reservoir. Access points and vents are located above the 100-year storm elevation

- Proximity to closest sanitary sewer and storm drainage mains
- Overflow route

D. Green Stormwater Infrastructure and Flow Control for New Facilities

The City of Seattle requires green stormwater infrastructure (GSI) on all new facilities. Flow control may be required. For detailed information on GSI and flow control requirements, see *DSG Chapter 8 section 8.7.8*.

5.9.1.4 Operations and Maintenance (O&M) Requirements

A. Routine Operations

At a minimum, each water storage facility must follow water supply and quality goals for operational procedures common to all facilities as shown on Table 5-10.

Table 5-10 Sample Requirements for Routine Operation of Water Storage Facilities

Parameter	Requirement	Comments
Pressure Maintenance to Zone(s) Served:	30 psi	Maintain 30 psi under peak hourly demand conditions Maintain 20 psi under fire flow conditions
Minimum	20 psi	
Drawdown and Filling	Typical draw between 8AM and 5PM Typical fill between 8PM and 5AM	Draw and fill cycles for some storage facilities may vary from this objective to meet other requirements. Note: These times are a starting point. Drawdown occurs during day and fill overnight as a general rule
Water Age (turnover rate)	3 – 5 days	Longer water ages may be acceptable for some storage facilities based on chlorine residual data, water mixing systems and ease of chemical injection
Operational Volume	As required to meet seasonal demands, pressure requirements, and water age targets	Operational volumes will vary seasonally for many of the storage facilities
Sample Collection	Easily accessible sample port enclosed in cabinet	Sampling may be required at different elevations within the tank
Supervisory Control and Monitoring	Water elevation Overflow indication Inlet and outlet metering	

B. Emergency Operations

The following are minimum design requirements for operation of water storage facilities under emergency conditions that can result in loss of power or a water quality condition that could be harmful to health:

- Maintain at least one storage cell on-line if facility has two or more storage cells. If the facility is a single cell, maintain at least 50% of the volume online
- Fill all storage cells
- Draw from at least one storage cell to meet emergency demands for at least (as required) hours
- Hydraulically isolate all storage cells from the supply and distribution system
- Complete drain-down of a storage cell as specified in the basis of design
- Inject a solution of treatment chemical
- Collect a water quality sample from an easily accessible collection point

5.9.2 Water Storage Facility Structures

The following are the primary structural functions of a water storage facility:

- Remain as water tight as achievable for the design seismic, geotechnical, and thermal conditions over its design life
- Survive the design seismic event so that its operational purpose (fill, storage, and draw of potable water) is maintained
- Maintain the sanitary integrity of the tank so that its water quality is not compromised.

The following are general design requirements for structural and material design elements of storage facilities to meet the above requirements. <u>All elements must be evaluated and addressed to establish the basis of design for every new or refurbished storage facility</u>.

5.9.2.1 Geotechnical and Seismic Requirements

The following are SPU standards:

1. <u>A geotechnical study must be performed before design of any new or structurally refurbished storage facility</u>. <u>Soils and groundwater characteristics for each site are unique, so the geotechnical study must be tailored accordingly</u>.
2. <u>The methods, findings, and recommendations of the geotechnical study must be documented in a geotechnical report</u>.
3. <u>The structural design requirements of storage facilities must address specific seismic criteria for Essential Structures per the Seattle Building Code (SBC) and AWWA D-100</u>.

The following are guidelines for the geotechnical report:

- Identification of previous geotechnical work for the storage facility site and the key observations and conclusions from the previous work.
- A detailed description of subsurface soils and groundwater conditions.
- Identification and descriptions of known geologic hazards, including seismic, steep slopes and landslides, erosion, and contaminated soils hazards
- Identification of locations for additional field explorations/borings, if needed.
- Conclusions and recommendations for design, including geologic hazards, seismic criteria (e.g. probabilities of peak ground acceleration), excavation and shoring, dewatering, foundation and backfill requirements, erosion and sedimentation control measures, and hazardous materials.

5.9.2.2 Structural Materials

A. Concrete Reservoirs

<u>Two primary issues for concrete storage reservoirs must be addressed in design</u>:

1. Corrosion of exposed reinforcing steel and corrosion caused by use of dissimilar metals, such as stainless steel ladders adjacent to mild steel, either coated or embedded.
2. Foundation failure due to settlement or leaks causing undermining of the foundation.

The low alkalinity and pH of cement materials can cause deep cracking on the interior of the facility and may expose the reinforcing steel to air and moisture, resulting in corrosion. As reinforcing steel corrodes, the integrity of the structure will weaken and eventually fail if not repaired.

Cracking in walls roofs and floors, failed expansion joints, failed water stops, are also common concerns with concrete reservoirs that should be addressed in design.

<u>For concrete reservoirs, the following AWWA standards must be applied</u>:

- D110 – Wire- and Strand-Wound, Circular, Pre-stressed Concrete Water Tanks
- D115 – Circular Pre-stressed Concrete Water Tanks With Circumferential Tendons.

B. Steel Tanks

The structural integrity of steel storage tanks is primarily affected by corrosion. Corrosion can attack specific portions of the tank and cause significant structural problems.

<u>For steel tanks, the following AWWA standards must be applied</u>:

- D100 – Welded Steel Tanks for Water Storage
- D103 – Factory-Coated Bolted Steel Tanks for Water Storage.

5.9.2.3 Coatings

<u>For steel tanks, the following AWWA standards must be applied</u>:

- D102– Coating Steel Water Storage Tanks

5.9.2.4 Liners

<u>For liners and floating covers in contact with potable water, the following AWWA standards must be applied</u>:

- D130 – Flexible-Membrane Materials for Potable Water Applications.

5.9.2.5 Corrosion Control Systems

<u>If used for steel tanks, the following AWWA standards must be applied</u>:

- D104– Automatically Controlled, Impressed-Current Cathodic Protection for the Interior of Steel Water Tanks.

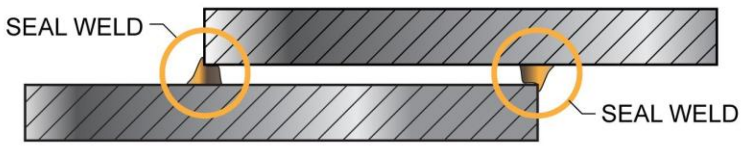
The design engineer should consult with a corrosion control specialist and evaluate the following:

- Conditions above and below the water level

- Fasteners and appurtenances located within the tank.

Surfaces exposed to fluctuating water levels and the undersides of roofs are particularly at risk, yet they receive little benefit from cathodic protection. Proper coating systems are critical for these surfaces. Do not use dissimilar materials inside the tank (e.g. steel structure and stainless steel ladders).

Seal weld all adjacent metal to avoid corrosion between the plates (see illustration).



For more detail on corrosion control systems, see *DSG Chapter 6, Cathodic Protection*.

5.9.2.6 Demolition

Demolition of other structures or buried utilities adjacent to or below a water storage facility's foundation or footings requires careful consideration to avoid damaging the foundation, footings, or yard piping associated with the facility. Before design of demolition, geotechnical and structural analyses should be done to determine potential impacts of the proposed demolition to establish a basis of design for their protection. For information on demolition permit requirements, see *DSG Chapter 2, Design for Permitting and Environmental Review*.

5.9.2.7 Configuration and Control for Service Reliability

The configuration and control for service reliability should consider the number of cells and flow control.

A. Number of Cells

To the extent practicable, new or refurbished facilities should have two or more cells to provide for greater reliability/redundancy.

If it is determined that a single cell meets the project requirements, it should be a dual outlet system. The lower outlet typically uses an earthquake/seismic valve.

B. Flow Control

The following are the minimum flow control requirements for storage facilities:

- Isolation valves on inlet and outlet lines that can be controlled locally and via SCADA
- Piping and valves to provide for the bypass and drainage of the storage cell

5.9.3 Hydraulic Mixing for Water Age and Water Quality Control

To prevent hydraulic dead zones and excessive water ages within a storage tank or reservoir, there must be a means for complete hydraulic mixing throughout the entire volume of the storage cell. The configuration and sizes of inlet and outlet pipes to the cell have a direct impact on the degree of hydraulic mixing achievable.

Each storage cell should have a volume in which water age (hydraulic detention time) is not more than 5 days at projected average water demands when the reservoir operates at full capacity. The goal is to keep total water age through the reservoir to no more than a 5-to-7-day range.

The Water Research Foundation publication, *Maintaining Water Quality in Finished Water Storage Facilities*, describes design considerations and features for controlling water quality in storage facilities.

5.9.3.1 Inlet and Outlet Pipes

Generally, a separation of the inlet and outlet points within a storage cell will enhance mixing and help avoid water quality problems associated with dead zones and short circuiting. For ground tanks, this is done by locating the inlet discharge near the perimeter of the cell with an upward bend. The tank outlets are then placed into the center of the tank floor. In elevated tanks, inlet an outlet points are separated one of two ways:

- Bring separate inlet and outlet lines up through the tank
- Split the line in the riser and use check valves to introduce water into the center of the tank near the top of the water column. In this option, the outlet pipes are placed at the tank perimeter with a vertical separation to the inlet elevation of not less than about ½ the total cell height.

Proprietary pipe and valve systems for storage facilities can be specifically designed based on the momentum mixing principle. The Red Valve Company system has gained widespread use.

For smaller tanks (less than 0.5 million gallons), the inlet and outlet may not need to be separated. Smaller tanks have smaller volumes, which allow adequate momentum for mixing.

A. Inlet Pipe

The inlet pipe should be as small as practicable to maximize inlet velocity to provide for adequate momentum mixing throughout the storage cell to preclude hydraulic short-circuiting. Reductions of inlet diameter have also been retrofitted on existing SPU tanks during tank renovation by using a reducer on the discharge end of the inlet pipe.

B. Outlet Pipe

In ground level reservoirs, each storage cell should have two outlet pipes, one near the mid-level and the other near the bottom of the cell. Both outlets should have isolation valves. The mid-level and lower outlets remain open for normal operation. The lower outlet should have a seismic valve that closes automatically during an earthquake to prevent the cell from draining past the mid-level.

5.9.3.2 Sizing Inlet Nozzles for Momentum Mixing

The inlet pipe and nozzle to each reservoir cell should be sized to provide a velocity of the entering water to enable complete hydraulic mixing throughout the entire cell. Typical time to mix the cell should be 4 to 6 hours at the designed inlet flow rate for lower-demand periods.

5.9.3.3 Mechanical Mixing Systems

If adequate momentum mixing cannot be achieved using inlet jet velocity (due to flow rates in relation to reservoir cell size), consider enhancing using a mechanical method. The following are three mechanical mixing methods:

1. **Pumped recirculation.** The only form of reservoir mixing SPU currently uses is pumped recirculation. This system features a pumped recirculation loop with the suction line from the reservoir and the discharge line entering the reservoir through a single or multiple ports.
2. **Mechanical mixers within the reservoir**
3. If higher-pressure water is available, consider a **gravity hydraulic mixing system** that pipes the higher pressure water to the tank and mixes through a series of nozzles attached to a riser pipe in the tank.

A. Recirculation

- Recirculation systems should be designed for continuous pumping. A general estimate for recirculation pump sizing is 1 hp per million gallons of storage volume.
- Provide at least two pumps for full redundancy.
- To the extent practicable, select pump sizes and types that are compatible with recirculation pumps at other reservoirs so that pumps are interchangeable and can be used as replacements or spares.
- The recirculation grid size depends on the size of the storage cell, but should extend to cover all areas of the cell. Pipe sizes for these grids are typically 4 to 6 inches in diameter.
- Orifice sizes and spacing are designed to achieve the velocities necessary for adequate localized momentum mixing. Typically, the range of velocity needed is 8 to 10 fps at the orifice discharge.
- Provide an easily accessible sample collection point on the recirculation piping.
- Provide an easily accessible chemical injection point on the recirculation piping.

5.9.4 Water Level and Flow Measurement

- Each storage cell must have provisions for online measurement and recording of water levels between lowest anticipated operating and overflow levels.
- Provide a totalizing meter on the outlet side to accurately measure demand from the reservoir.

- Provide positive online indication of overflow.

5.9.5 Mechanical Appurtenances and Equipment

This section describes mechanical appurtenances and equipment for water storage facilities.

5.9.5.1 Location

To the extent practicable, mechanical appurtenances such as valves, pumps, and controls should be located in clusters. If applicable, they should be located in mechanical rooms or vaults for ease of maintenance and security.

5.9.5.2 Penetrations to Storage Cells

Penetrations for pipes, hatches, vents, and sensors into storage cells require special design considerations to preclude the intrusion of contaminants. The following are general considerations for mechanical appurtenances and equipment that penetrate storage cells:

- Materials and coatings of appurtenances should provide for high resistance to corrosion.
- Open ends of vents and overflow lines should be oriented downward and provided with 24-mesh, corrosion resistant screens.
- Wall and roof penetrations are welded on steel tanks and equipped with seep rings on concrete reservoirs.
- Valve stem penetrations must be sealed to prevent entry of contaminants.
- Materials used at penetrations must be selected to avoid creating galvanic currents between dissimilar metals.

5.9.5.3 Vents

- Vents should be located at least 2 feet above finished grade or the 100-year flood elevation, whichever is greater.
- Vents must be sized to allow for adequate air intake during rapid drawdown of the water level such that the maximum pressure drop within the storage cell does not impose structural stresses. The acceptable maximum pressure drop is a function of structural materials and configuration of the storage cell. Acceptable maximum pressure drop must be established by a design engineer or manufacturer.

5.9.5.4 Overflows

The following are SPU standards for overflow pipes:

1. Overflow pipes must be sized to accept flow rates equal or greater to the maximum inflow rate to the storage cell.
2. Overflow pipes must terminate 1 to 2 feet but a minimum of two pipe diameters above grade to provide an air gap, and should be easily visible to O&M staff. Provide a minimum of two pipe diameters gap.

3. The surface below the air gap must slope away from the storage cell and direct the flow to a sump or catch basin from which the flow is conveyed to the designated discharge point.

The following are guidelines for overflow pipes:

- If the overflow water enters a sewer, check sewer pipe hydraulics for any constraints to accepting the design overflow rate.
- If the overflow water can enter a natural stream or pond directly from the discharge point, a passive dechlorination system should be installed. For example, a passive dechlorination system is a catch basin within which bags of a dechlorination chemical (ascorbic acid or sodium thiosulfate) are placed. The overflow water is passed through the dechlorination structure before discharge to the receiving water body.
- In addition to a screen, consider installing a flap gate or duckbill valve at the end of the overflow pipe to prevent animal access.

Note: Overflows usually go to a reservoir's dedicated storm drain line. This line must also be capable of the flow rate. The receiving water body must likewise be able to receive this flow rate.

5.9.5.5 Connections

Connections between the storage cell structure and pipes external to the structure (either exposed or buried pipes) should allow for longitudinal expansion and lateral movement that occurs during earthquakes and through long-term differential settlement. Pipes located under ground-level reservoirs should be encased in reinforced concrete to minimize future maintenance.

5.9.5.6 Hatches

The following are SPU standards for water storage hatches:

1. All access hatches not bolted to the main structure must be lockable and provide intrusion switches linked to the SCADA system.
2. Hatch lids must be designed to prevent drainage runoff from entering interior of the hatch and/or accumulating next to the hatch area. This also provides protection from ice damage. For hatches with raised curbs or frames, the lid should overlap the curb/frame.

The following are guidelines for hatches:

- For accessible ground-level hatches to concrete reservoirs, the hatch should be designed either to lock or to accommodate a 600-lb block or lid on top.
- Hatches manufactured by LW Products or Bilco have typically met SPU requirements.
- Hatches installed in graveled areas should be raised above grade to prevent gravel from becoming lodged and jammed between the frame and the lid, or becoming lodged in the locks.

5.9.5.7 Access Ladders and Catwalks

- Fall protection equipment must be provided and used before accessing structure

- Select material and coatings to provide for high resistance to corrosion and graffiti
- For above grade facilities, entries to ladders or catwalks should be elevated at least 10 feet above grade and have a lockable gate or door. The gate or door must be designed to allow for safe access from a "cherry-picker" man-lift.
- For elevated stairwells inside of storage cells, the steps should be solid plates with raised edges to help prevent dirt from entering the water.

5.9.5.8 Mechanical Rooms and Vaults

- Provide for proper interior drainage within the valve vault or chamber, including floors sloped to drains and/or sumps.
- Provide for perimeter drainage.
- Top of chamber should be at least 1 foot above finished grade.
- For access hatches and vents to valve chambers, see DSG section 5.9.5.6.

5.9.5.9 Storage Cell Drainage Equipment and Features

- Cell drain pipes must not be cross-connected to a storm or sanitary sewer line. They also need an air gap or backflow prevention device.
- The floor of a storage cell should be sloped to enable drainage to a single sump.
- If feasible, the sump should have a pipe that drains via gravity to the designated cell drain point with an air gap. The sump should be sized to accommodate a portable sump pump, even if there is no drain pipe.
- Size drain pipes to accept flow rates such that the cell can be drained in the minimum amount of time without exceeding the capacity of the vents. The maximum drain line capacity should approach the maximum operational inflow rate to the storage cell.
- Control valves for drain pipes should be easily accessible. Wherever possible, the location of drain valves should be within the valve chamber for the storage facility.
- Provide a removable mud/silt stop at the entry to the drain pipe.

A. Roof Drains

- Roofs must be water tight and sloped for drainage.
- Roof drains must be connected to a permitted drainage system.
- Roof downspouts must be external and not mounted within the storage cell. None of the drain system should be within the storage cell.
- Domestic water and stormwater must not co-mingle.
- SPU requires certain Green Stormwater Infrastructure (GSI) elements be incorporated into structural design of new projects. For more information on GSI, see *DSG Chapter 8, section 8.7.8*.

5.9.6 Standby Power

Consideration should be given to the need for dedicated standby power and in some cases standby power may be required for some types of projects/facilities for continuous operation. Alternatives to dedicated standby power may be considered by the reviewing authority with proper justification. At a minimum, a power receptacle to the switchgear is required for the connection of a portable generator. Powered equipment and controls critical for water storage facility operation should be capable of using standby power. For more detail on standby power, see *DSG Chapter 9, Electrical Design*.

5.9.7 Multi-Use Facilities

Where a storage facility is to be integrated with other recreational uses (e.g. tennis or basketball courts), grass-covered recreational areas, or parking lots special consideration should be given to physical and sanitary security issues. Storage facility design should address the following:

- Locate hatches to storage cells and valve chambers that are physically separate and secure from public areas, but visible from adjacent streets to enable observation by law enforcement or security personnel.
- Provide physical security to intrusion for hatches, tank ladders and doors to valve chambers or other enclosures.
- Provide appropriate signs that clearly indicate areas that are for authorized personnel only.
- Provide lighting fixtures and features that give the necessary level of lighting for security without negative impacts to adjacent public areas. Lighting fixtures should be designed so that the wiring and/or bulbs are not exposed or easily accessed to preclude inadvertent damage or vandalism.

Refer to the current agreement between Seattle Parks and Recreation and SPU for specific items associated with multi-use reservoir sites. Contact Kim Serwold at kim.serwold@seattle.gov.

5.9.8 Landscaping and Weed/Pest Control

For detailed information on landscaping and weed and pest control, see *DSG Chapter 4, General Design Considerations*.

5.9.9 Access and Security

For detail on site access and security, see *DSG Chapter 15, Physical Security*.

5.9.9.1 General

The following are general considerations:

- Include SPU Security Plan requirements for general security and security design requirements for water facilities.
- If the storage facility site is not open for public use, provide a means of controlled access around the entire perimeter. If the site will be open for public use, provide a means of controlled perimeter access around the hatches, vents and vaults.

- Provide security alarms at access doors or hatches tied into the SCADA system.
- To the extent practicable, do not allow site features where unauthorized persons or materials can be easily concealed, such as structures, trees, or vegetation.

5.9.9.2 Personnel Access and Safety

A. Access

The design of access features for storage facilities should address the following:

- Vehicular access to hatches and ladders is required and must be sized to accommodate the size of the vehicles normally used in maintenance or inspection of the facility.
- Ladders, stairways, and catwalks designed to conform to OSHA requirements.
- Hatches placed to facilitate ease of maintenance and cleaning.
- Hatches sized to accommodate access for personnel with tools, inspection divers, and remotely operated vehicle (ROV) inspection/cleaning equipment. For larger facilities, this requirement typically results in one or more large equipment hatches, through which field equipment can be lowered, and one or more personnel access hatches.
- Provide ladders or stairways inside of storage cells.
- Ladders should be caged and have climbing or fall protection.

B. Egress and Emergency Escape

The following are egress and emergency escape features:

- Provide internal and external restraint support/safety equipment.
- Ensure unobstructed clearances to access/egress points.
- Provide any other features necessary to meet requirements associated with confined-space entries.

5.9.9.3 O&M

A. Lighting

- Permanent lighting fixtures should be provided to light hatch doors into storage cells and vaults and to provide visibility to the local work area perimeter.
- Permanent lighting fixtures should be provided to provide a minimum acceptable level of lighting within storage cells and vaults for routine inspections and maintenance.
- Power outlets should be easily accessible to all hatches for the operation of temporary lights within storage cells and vaults.
- Convenience outlets should within 6 feet of all mechanical equipment.

B. Ventilation

- Hatches to storage cells and vaults should be located to accommodate temporary ventilation equipment, including points for the introduction and exhaust of ventilation air.
- To the extent practicable, power outlets should be easily accessible to all hatches to better enable the operation of temporary ventilation equipment.
- Permanent ventilation system should be capable of eight exchanges per hour at all times.

C. Communication System

- Determine the methods of communication to be used by personnel during facility maintenance (e.g. radio, wire intercom) and provide appropriate equipment or appurtenances for their use.
- At a minimum, provisions for antenna mounts are one mount for every two communications lines. If there is only one communications line, then one mount is needed. Locations of the mounts are site specific. Roundup spare conduits for future installation should be considered.

5.9.10 Water Quality Monitoring/Sampling

At a minimum, water quality should be monitored weekly in open storage reservoirs. For closed reservoirs, water quality should be monitored every 2 weeks. At chlorine injection locations, remote monitoring should continuous. The following should be continually monitored:

- Chlorine residual
- pH
- Temperature
- Total coliform (TC)
- Heterotrophic Plate Count (HPC)

Other parameters may be measured case-by-case, depending on operational circumstances.

5.9.10.1 Sampling Points

<u>At a minimum, design must provide sample points for withdrawal of water for continuous online measurement of chlorine residual, pH, and temperature at the following locations</u>:

- Inlet to each storage cell
- Outlet from each storage cell

Provide sample ports from which to obtain manual grab samples for any type of analyses at the following locations:

- Inlet to the storage cell
- Outlet from the storage cell
- From varying depths of the storage cell, at a minimum from the top (75% level), middle (50% level), and bottom (20% level) of the cell

- If possible, in the center of the storage cell. (Center point sample line installation may require adding a small support structure to keep the lines from breaking.) The in-tank sample lines can be used to collect coliform samples after tank disinfection.
- If the extent of the horizontal footprint of the storage cell is large relative to the vertical height, add one or two additional locations across the cell in addition to the center point.

Sample ports should be easily accessible without the need to open hatches to the storage cell. Where practicable, the pipes from all sample ports should terminate at a single sampling station within a lockable cabinet at or near ground level outside the storage cell or within the valve chamber.

5.9.11 Disinfection and Dechlorination

SPU uses portable ascorbic acid dechlorination units for all dechlorination operations. The drain-down pipe from each storage cell must have a liquid chemical injection station for direct injection of ascorbic acid.

5.9.11.1 Booster Disinfection

Historically, SPU water storage facilities have received booster disinfection (chlorination). Booster chlorination may need to be considered for some existing storage facility sites should chlorine residual maintenance become a problem or a potential problem. Booster chlorination should be incorporated for new storage facilities located near the periphery of the distribution system where water demands may be initially low.

The following are major design considerations for booster chlorination at storage facilities:

- Footprint space for the chlorination storage and feed system facility
- Access and security for the chlorination facility
- Injection point(s) for the chlorine
- Post-treatment chlorine residual monitoring equipment and sampling points
- Point of diversion of potable water for the chlorine feed system
- Type of chlorination system: liquid commercial strength (12.5%) hypochlorite or on-site generation of hypochlorite. <u>Gaseous chlorination systems must not be used</u>.

5.9.11.2 Emergency Disinfection

Regardless of whether provisions are installed for booster chlorination, provide for facilities to apply emergency chlorination to each storage cell, to include the following:

- Hatches on top of each storage cell that can be used to introduce chlorine
- Sample withdrawal points from within the storage cell and on the outlet of the cell to measure chlorine residua.
- Minimum of two valves between the storage cell and the distribution system that can be closed during disinfection

5.9.12 Removal from Service

The following are key design features for the isolation and removal from service:

- Isolation valves on inlet and outlet lines
- Piping and valves to provide for bypass of the storage cell

5.9.12.1 Drain-Down Features

Note: This section was not completed for the 2010 edition of the DSG.

5.9.12.2 Drain-Down Discharge Points

A. Sewers

To the extent practicable, the discharge point for drain-down water should be the same point used for overflow water discharge. Whenever possible, the point of discharge should be a sanitary or combined sewer because dechlorination of the drain-down water is not required. If neither a sanitary or combined sewer is available, a storm sewer may be used, but dechlorination is required.

The maximum allowable drain-down water discharge rate to sewers should be based on the following:

- The hydraulics and sizes of the receiving sewer mains must be checked for any constraints and the maximum allowable dry-weather sewer capacity established.
- The acceptable minimum rate of discharge that meets operational requirements. If the operational minimum exceeds the maximum allowable dry-weather sewer capacity, the local sewer system may need to be modified, such as increase main sizes, re-lay mains to steeper grades, and/or add mains.
- The discharge flow rate design criteria must clearly establish the operational limits for the design flows, e.g. drain-down operations are limited to dry-weather conditions to preclude sewer surcharging, etc.

B. Open Water Bodies

The discharge of drain-down water to an open water body such as a lake, pond, stream, or salt water, should be avoided to the extent practicable and only if there are no sewers available or suitable for receiving the discharge. Provisions for dechlorination must be made with guidance from the SPU Water Quality Lab on a project-by-project basis. Some standard methods such as for hydrant testing are available but they are subject to change. To get the most current methods contact the SPU Water Quality Lab.

The rate of discharge to an open water body is highly case-specific. Discharge flow rates to streams will typically be the most limited to preclude scouring and sediment mobilization. It should be assumed that a permit will be necessary for stream discharges, such as a Hydraulic Project Approval (HPA) and/or an NPDES Water Treatment Plant General Permit. Therefore, the permits required must be determined before design. The specific requirements of the permit(s) are the basis for the maximum allowable design discharge rate.

For more detail on permits, see *DSG Chapter 2, Design Considerations for Permitting.*

5.9.12.3 Washdown Equipment

The following are SPU standards for washdown equipment:

1. The source of water to hose bibs must be potable water from the distribution system.
2. The washdown water piping system must be separated from the distribution system with an approved backflow prevention device.

The following are guidelines for washdown equipment:

- Provide hose bibs or washdown system connections at or near access hatches used for maintenance to each storage cell. Hoses may be permanently stored at or near a hose bib, depending on maintenance and security requirements. However, washdown hoses should never remain permanently attached to the bib to avoid the potential for cross connections. Bibs and hoses should have quick-disconnect fittings for ease of maintenance.
- For larger facilities, provide washdown hose connections in a pattern such that any part of the facility can be washed using a 100-foot-long hose.

5.10 CONSTRUCTION

The section describes design considerations for construction of water system infrastructure.

5.10.1 Requirements for Protecting Water Mains and Appurtenances

Any work on, connecting to, or near existing water mains must monitor and take steps to reduce construction impacts.

5.10.1.1 Conditions Requiring Protection and Protective Measures

Projects that involve roadway construction or repaving, utilities construction, or deep excavations for structures often create conditions that can affect existing water mains (Table 5-11). Pipe with lead joints, particularly bell and spigot joints in older mains, is susceptible to leaking and at high risk of failure if exposed to these activities.

Table 5-11 Common Construction Conditions and Protection Measures for Water Mains

Condition	Occurs When and Where	Pipe Protection Measure
Excessive loads	Haul routes for heavy construction equipment crossing over pipes Construction site entrances/exits Paving construction where excavations have reduced the cover over pipes	Steel plates in roadway Concrete pad Temporary cribbing Bridging Pipe relocation
Settlement	Dewatering of soils with higher water content around or adjacent to pipes Trench excavations adjacent to water pipes, e.g. excavations for sewer mains or duct banks that result in soil loss Tunneling and other large open excavations	Temporary pipe supports Shoring of adjacent deeper trenches, as applicable Use drilling methods for the installation of shafts / columns instead of vibratory methods to the extent practicable

	Excavations for other utilities below water pipes Vibration from construction equipment, e.g. driven piles, sheet piles, or stone columns Excessive loads Landslides	Establish clear tolerances for acceptable pipe settlement and provide field monitoring for settlement
Thrust restraint	Excavations behind thrust blocks (loss of bearing surface behind the thrust block) Excavation and exposure of water pipes that are under pressure (loss of pipe surface friction component of thrust restraint)	Locate thrust blocks prior to construction Avoid disturbing thrust blocks to extent practicable Use temporary thrust blocks or collars Avoid exposing pipes that are under pressure Avoid placement where future excavation may occur behind the thrust block. The clear area behind the thrust block should be determined with the consultation of a geotechnical engineer.
Contamination	Exposed water pipe joints w/in trench excavations that can fill w/ runoff or ground seepage water, particularly if main is depressurized Exposed water pipe joints within common trench excavations that have an active sewer main, particularly if water main is depressurized	Control runoff water to trench Sump pumps

5.10.1.2 Settlement

The water system must be protected from vibration and settlement to achieve its full, expected life. Vibration and settlement can cause joints to pull apart and leak or pipes to crack and catastrophically fail. Vibrations and settlement also reduce the flexibility of pipe joints, which can allow ground movement during an earthquake.

A. Monitoring and Protection

When a large project such as building construction, deep excavation, or tunneling takes place near the water system, SPU's main concerns are vibration and settlement of water mains. Any time a large project of this type is planned near an SPU facility, the design engineer should consider requiring settlement monitoring devices be installed on the facility before construction.

Various types of pipe have differing thresholds for both vibration and settlement. Cast iron lead joint pipes have the most stringent protection requirements. Some larger cast iron mains have virtually no allowable settlement.

See **Appendices B and C**, respectively, for standard requirements for settlement monitoring of cast iron and ductile iron pipe.

During construction, anytime a design engineer suspects settlement impacts near existing water mains, it should be brought to the attention of the Resident Engineer.

B. Liquefaction Zones

Allowable settlements should also consider liquefaction and landslide zones. Settlement from construction is more critical in liquefaction or environmentally critical areas (ECAs), where settlement has a higher potential. Within these zones, SPU has set strict limits. Only 50% of the settlement/deflection is allowed in liquefaction or ECA zones as compared with other locations.

C. Mitigation of Damaged Water Mains

When vibration monitoring is required, SPU will perform a pre- and post-construction acoustic leak survey of the existing water lines near the construction activities. If damage or leaking increases and is determined to be caused by the construction activities, the RE will send a written request to the contractor to restore damaged or destroyed property to its original condition. The contractor, not the owner or City of Seattle, must pay for and the repair or replacement of the pipe according to City Standard Specifications.

5.10.2 Removal and Abandonment of Existing Water Mains and Appurtenances

The following are SPU standards:

1. Where required for water main projects, removal of existing water mains and appurtenances must meet the requirements of Standard Specification 2-02.3(7)B.
2. All ends of abandoned water mains must be plugged. Pipes 12 inches or larger in diameter must be abandoned and filled in accordance with Standard Specification 2-02.3(5).
3. Water pipes designated on project drawings to be abandoned and filled must be filled with pumpable, flowable cement slurry that completely fills the pipe (Standard Specification 9-05.15).
4. After the record drawings (as-builts) have been incorporated into GIS, the design engineer must check that the abandoned pipe is properly shown.

5.10.2.1 Considerations for Disposal of Hazardous Materials

The design and specifications of projects that remove or abandon water facilities must identify pipes that are known to have or may have hazardous materials. The contractor needs this information to calculate the costs for special handling and disposal. The most commonly found hazardous materials in SPU's water system and considerations for their mitigation or removal are described in Table 5-12.

Table 5-12 Hazardous Materials associated with SPU Water System

Material	Prevalence in System	Mitigation/Removal
Asbestos Cement Pipe	Commonly used in water mains installed in 1940s and 50s. Uncommon now	Avoid removal and abandon in-place where possible. If removal is necessary, containment and filtration requirements must follow OSHA and WISHA
Lead Joints	Almost all joints in older cast iron pipe have lead seals. Most of SPU's distribution system is cast iron w/ lead joints and can be expected to have decades useful service if not physically disturbed	Recycled by crews for other crew work
Coal Tar-Lined and Coated Steel Pipe	SPU has coal tar coatings and or linings in the Cedar River Pipeline System as well as a few other steel pipes	If removed, disposal to a licensed hazardous waste landfill. Working and handling of coal tar materials must follow OSHA and WISHA standards.

5.10.3 Construction, Startup and Acceptance Procedures

The design and specifications of transmission and distribution water mains must address the potential impacts of construction and repair activities on the hydraulic and sanitary conditions of the water system. Such activities pose the greatest risk of microbiological contamination of new and existing water mains. Appropriate design and specification requirements are major elements to achieving hydraulic requirements and sanitary conditions after construction or repair of water mains.

See the following Standard Specifications for construction (installation), startup, and acceptance of new and repaired water mains and appurtenances:

- Section 7-11 Pipe Installation for Water Mains
- Section 7-12 Valves for Water Mains
- Section 7-14 Hydrants

For further information on design and operational practices to prevent contamination of water mains, see the Water Foundation publication, *Practices to Prevent Microbiological Contamination of Water Mains*.

5.10.3.1 Connections to City Water Mains

All connections of new or repaired water mains to the SPU water system are made by SPU Water Operations. See Standard Specification 7-11.3(9)A and Standard Plans 300a, 300b, and 300c.

5.10.3.2 Shutdown of Water Mains

Shutdown and isolation of new and existing water mains must be addressed as part of design. There are three major considerations for the shutdown and isolation of mains:

1. Provide adequate numbers of valves for the isolation of the new or repaired mains to minimize impacts to water service in the distribution grid
2. Work with SPU Water Operations to provide a means to depressurize and dewater the main for a shutdown
3. Consideration of which customers will be out of water and for how long. For customer impacts and service disruptions, see DSG section 5.10.4.

5.10.3.3 Construction and Repair Practices for Sanitary Control

The following section describes construction and repair practice for sanitary control.

A. Pre-installation Materials Storage and Handling

Proper handling and storage practices (Standard Specification 7-11.3[2]) are key elements for achieving sanitary conditions in water mains.

SPU requires a pre-installation taste and odor testing of water pipe (Standard Specification 7-11.2[2]) of non-approved pipe sources. Request a current list from the SPU Water Quality group.

B. Pipe Installation and Repairs

Controlling water and soil from entering pipes is a critical factor for achieving sanitary conditions in water mains. See Standard Specifications for sanitary control practices for water main construction and repairs:

- Section 7-11.3(2)A Handling of Pipe – General
- Section 7-11.3(5) Cleaning and Assembling Joints

5.10.3.4 Post-Construction or Repair Startup and Acceptance

A. Acceptance

After water main construction or repair, the following requirements must be met before SPU will accept the connection to the water system and place it into service:

- Hydraulic and structural integrity, as demonstrated by hydrostatic pressure testing
- Sanitary conditions, as provided by flushing, disinfection, and verified by water quality testing

B. Hydrostatic Pressure Testing

Water mains and appurtenances, including extensions from existing water mains greater than 18 feet, hydrants, and hydrant runs must meet the requirements of Standard Specification 7-11.3(11).

C. Cleaning and Flushing

After a water main installation has passed the hydrostatic pressure tests, cleaning and flushing must be completed per the requirements of Standard Specification 7-11.3(12)B.

D. Disinfection

The following Standard Specifications address water main disinfection procedures:

- Section 7-11.3(12)C Required Contact Time
- Section 7-11.3(12)D Form of Applied Chlorine
- Section 7-11.3(12)E Chlorine Dosage
- Section 7-11.3(12)F Point of Application for Liquid/Gas Disinfection
- Section 7-11.3(12)G Backflow Prevention Requirement
- Section 7-11.3(12)H Rate of Application
- Section 7-11.3(12)K Disinfection of Connections to Existing Water Systems

E. Water Quality Testing and Criteria

Following chlorine disinfection contacting, samples for bacteriological analysis must be taken per the requirements of Standard Specification 7-11.3(12) A.

All samples must meet the bacteriological criteria. If any sample does not meet the criteria, the installation must be flushed, and re-tested until acceptable bacteriological results are achieved as required by Standard Specification 7-11.3(12)M.

Post-installation taste and odor testing may also be required as described in and Standard Specification 7-11.2(3).

F. Dechlorination

Chlorinated water from the disinfection of water mains must be dechlorinated before discharge.

Depending on discharge location, water drained from pipelines before shutdown must also be dechlorinated.

Typically, SPU uses an ascorbic acid (vitamin C) injection system for dechlorination. The chlorine concentration acceptable for discharge may vary depending upon the type and point of discharge. Discharges to a combined sewer may have some chlorine residual. Discharged water that may enter the environment, either through direct discharge to the ground for infiltration or via a storm drain, should have zero chlorine residual. The design engineer should clearly establish the acceptable points of discharge and chlorine residual criteria in the contract specifications. On most projects, dechlorination of disinfection water is the contractor's responsibility.

5.10.4 Customer Impacts and Service Disruptions

The design engineer or project manager should coordinate with SPU’s Communications and Customer Service Branch to determine timelines associated with water main shutdowns.

5.10.4.1 Customer Impacts

All known or potential impacts to customers associated with construction or repair of water system facilities must be identified. Community notification requirements vary depending on the following:

- Length or size of the project area
- Number of customer services impacted, including anticipated service disruptions
- Number and type of streets and street intersections in the project area
- Extent of work outside of public ROW, such as work within temporary or permanent easements
- Access to project area, including points of access, types of construction vehicles/equipment, and frequency of construction vehicle trips
- Length of time and schedule constraints of the project
- Work hours (day, night, weekends) needed to meet the project schedule and/or minimize community impacts

- Type of environmental impacts to the local community, including noise, dust, mud, and light

5.10.4.2 Service Disruptions

Service disruptions (water outages) are the impact of most concern to customers. Specific requirements for service disruptions must be established for each project. These requirements can vary depending on type of work, construction constraints, and schedule.

5.11 O&M

This section describes O&M elements common to all SPU water infrastructure. See the appropriate sections of this chapter for O&M design issues specific to the infrastructure under design consideration.

5.11.1 Water Easements

An easement gives SPU specific property rights on land that it does not own. These property rights may be temporary or permanent. Permanent rights typically include, the right to restrict activities or improvements by the land owner and gives SPU the right to install, operate, maintain, replace and have access to SPU utility infrastructure, such as pipes, fire hydrants, or valves. Easements must be project specific. Construction easements may differ from standard utility O&M easements because they are temporary and typically need a larger area. Table 5-13 lists SPU minimum width requirements for water main easements. This table is a guideline. Engineering judgment and future expansion may require larger easement areas. The size of the easement area for water infrastructure is also subject to the specifics of the site.

Note: SPU prefers to purchase property and own the land where facilities are installed. However, SPU realizes this is not always possible.

Table 5-13 SPU Minimum Water Easements

Inside Pipe Diameter or Nominal Pipe Diameter (inches)	Minimum Easement Width (feet)
<8 to 24	20
30 to 92	30

5.12 RESOURCES

Documents

1. Burlington Northern Santa Fe (BNSF) Utility Accommodation Policy, August 21, 1998
2. Burlington Northern Santa Fe (BNSF) Design Guidelines for Industrial Track Projects, October 21, 2001

3. Sound Transit Design Criteria Manual. Contact Joe Herold, joe.herold@seattle.gov or 206.386.9857
4. American Water Works Association (AWWA) Design Manuals for Water Supply Practices
5. American Water Works Association (AWWA) Pipe Materials Selection Manual
6. American Water Works Association (AWWA) Potential Techniques for the Assessment of Joints in Water Distribution Systems
7. American Water Works Association (AWWA) Maintaining Water Quality in Finished Water Storage Facilities
8. American Welding Society (AWS): D1.1 Structural Welding Code, Section 3; Workmanship
9. Washington Administrative Code (WAC); Chapter 246-290, Cross-Connection Control Public Water Supplies
10. Washington State Department of Health; Division of Drinking Water; Water System Design Manual.
11. Washington State Department of Health; Pipeline Separation Design and Installation Reference Design Guide
12. Seattle Parks Department; agreement on multi-use reservoir sites. Contact Kim Serwold, kim.serwold@seattle.gov or 206.733.9340
13. Seattle Public Utilities; Water System Plan – 2007. Contact Joan Kersnar
14. Trenchless Technology: Pipeline and Utility Design, Construction, and Renewal. Najafi, Mohammad, PhD, PE. WEF Press, 2004

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

C. POLICIES, PROCEDURES AND STANDARDS

APPENDIX C-3

DESIGN STANDARDS AND GUIDELINES – PLAN REVIEW

SPU Design Standards and Guidelines, Chapter 18

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Chapter 18 PLAN REVIEW

This chapter of the Design Standards and Guidelines (DSG) describes the engineering plan review function at Seattle Public Utilities (SPU). Plan review at SPU covers a wide range of activities related to the review of plans for private development and public Capital Improvement Program (CIP) projects.

Standards are shown as underlined text.

The primary audience for this chapter is plan reviewers for SPU's Project Delivery Branch in the Project Management and Engineering Division.

18.1 KEY TERMS

The abbreviations and definitions given here follow either common American usage or regulatory guidance.

18.1.1 Abbreviations

Term	Abbreviation
CIP	Capital Improvement Program
DPD	Department of Planning and Development
DR	Director's Rule
Field Ops	Field Operations
FOM	Field Operations and Maintenance Branch
GSI	Green Stormwater Infrastructure
MOA	Memorandum of Agreement
MUP	Master Use Permit
PAR	Preliminary Assessment Report
PAT	Preliminary Assessment Tool
PDB	Project Delivery Branch
PMED	Project Management and Engineering Division
PRD	Plan Review Database
SDOT	Seattle Department of Transportation
SIP	Street Improvement Plan
SMC	Seattle Municipal Code
SPU	Seattle Public Utilities
USM	Utility Systems Management Branch
WAA	Water Availability Approval
WAC	Water Availability Certificate
WAI	Water Availability Inquiry

18.2 GENERAL INFORMATION

This section describes the authority for and general organization of the plan review function within SPU.

18.2.1 Authority

For plan review of projects, SPU exercises authority granted by the Seattle Municipal Code (SMC). Director's Rules (DR) further clarify this authority. SPU has a Memorandum of Agreement (MOA) with the Department of Planning and Development (DPD) and an MOA is pending with the Seattle Department of Transportation (SDOT) to exercise this authority and review projects on behalf of SPU through various development permits and a Public Works Contract.

SPU documents roles, responsibilities and financial agreements with SDOT and DPD through Memoranda of Agreement (MOA), which are typically updated every other year. The sections of the SMC, which authorize SPU's role in plan review, are described in SPU Client Assistance Memos(CAM's). These CAM's are delineated in Table 18-8 of DSG Section 18.6.4.

The SPU Plan Reviewer staff review plans to ensure that the SMC requirements for drainage, wastewater, water, and solid waste are met in project design. SPU provides plan review to ensure:

- Protection of SPU's infrastructure and the ability to serve current and future customers.
- Assurance that development by private developers and other agencies meet the requirements of the SMC that SPU enforces and design standards to protect existing SPU infrastructure and the construction of new SPU infrastructure.
- Assurance that plans for City construction meets design standards.

18.2.2 Organization

SPU works collaboratively with other departments and government agencies to protect City of Seattle (public) infrastructure. The SPU PMED Division will often need to rely on DPD, SDOT, or other municipalities or agencies to identify and refer to SPU those projects that may impact SPU facilities. SPU interests include protecting and managing the capacity and operability of its infrastructure. DPD and SDOT (via MOA's) work on SPU's behalf to protect SPU interests on private property and in the ROW.

Other work groups within SPU also become involved with plan review to protect SPU property, infrastructure, and related interests (Table 18-1). The SPU Plan coordinator will route plans to these other groups if specific triggers are attained or specific questions arise. Additionally, these SPU groups receive plans to review from other City of Seattle departments.

Table 18-1 SPU Sections Involved with Plan Review

Organization	Involvement
SPU PMED	Conducts more complex water, drainage and wastewater plan reviews
SPU Materials Lab	May review detailed plans to assure appropriate products or materials will be used
SPU Real Property	Reviews detailed plans for projects near SPU property or easements to assure SPU interests are protected. Obtains easements if SPU facilities are proposed on private property. Coordinates with jurisdictions in which SPU facilities are located. Main SPU point of contact in the street vacation process.
SPU Customer Service	Manages relationships with SPU customers, including establishing new water services and

Organization	Involvement
Branch	billing.
SPU Solid Waste Division	Reviews detailed plans to assure new construction allows for safe access to solid waste containers by property owners, citizens, and waste disposal employees and vehicles.
SPU Survey	Reviews plans for work in the ROW to protect City property. SPU Survey may also conduct or review surveys for SPU or other City projects.
SPU Field Operations and Maintenance Branch	Reviews plans to ensure that installed improvements can be operated and maintained using standard procedures. Reviews to ensure that planned improvements will not negatively affect the ability to operate and maintain existing SPU facilities. Coordinates plans and construction by SPU crews.
SPU Utility Systems Management Branch (USM)	Advises on complex policy issues that are escalated by SPU PMED.

18.3 TYPES OF PLAN REVIEW

The SPU PMED Division is involved in four general types of plan review: private development, CIP projects, other agency projects, and property-related reviews. The degree of SPU involvement may vary greatly depending on type of permit and project specifics.

18.3.1 Private Development Projects

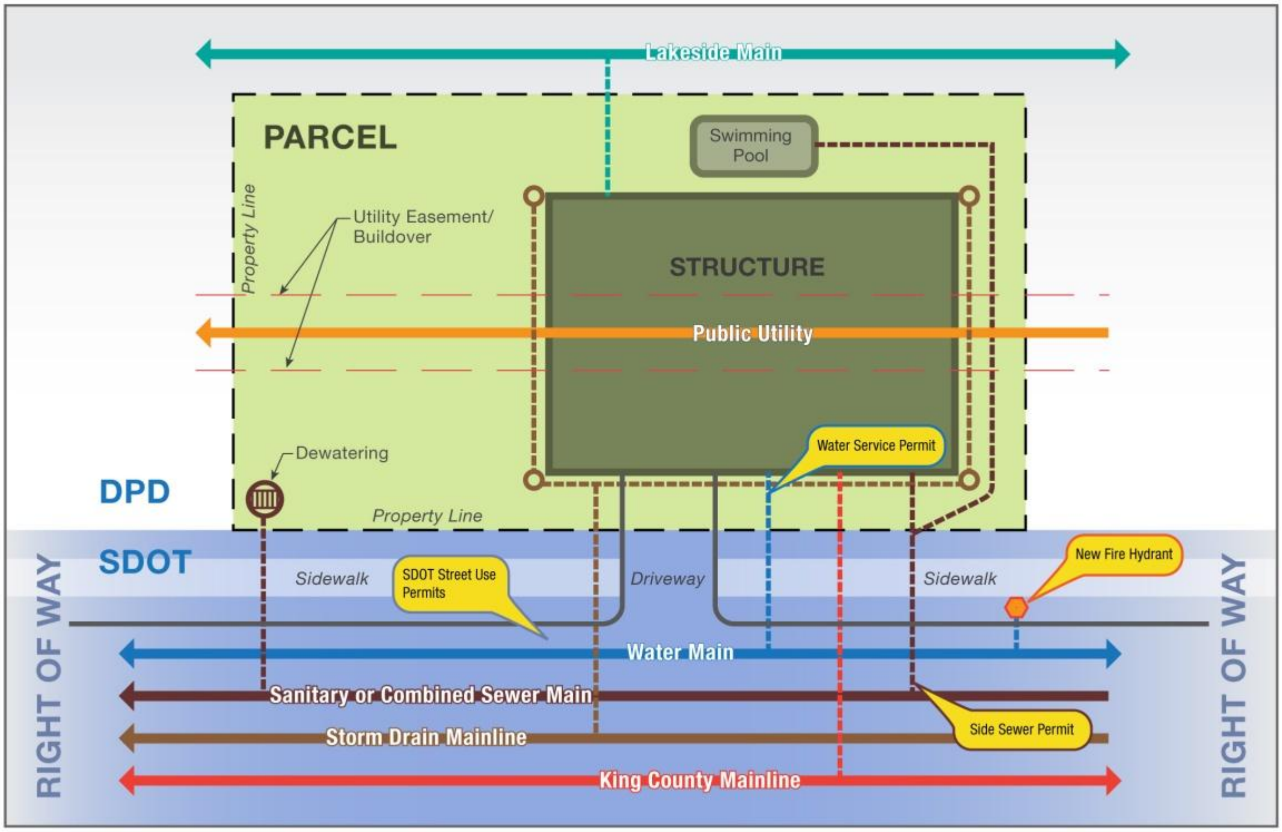
Private development refers to projects that are constructed by private parties and modify, build, or impact public water, stormwater, wastewater, or solid waste systems. The SMC regulates private development and requires development permits for most private development. Examples of private development include a new commercial building, subdivision of property, or redevelopment of a block.

City of Seattle development permitting is organized into two primary categories (Figure 18-1):

- **Parcel.** This development or redevelopment is on private property either owned by a private party or a public agency. DPD manages parcel based permitting through the Master Use, Building, and Side Sewer Permits and the plans are reviewed, approved, and inspected through the DPD permit process.
- **Right-of-Way (ROW).** This development or redevelopment is within the public ROW. SDOT manages ROW permitting through its Street Use Permit Process. Infrastructure review is managed by SDOT, however SPU Plan Review staff has an active role in the 30%, 60% and 90% design phases, as well as preliminary design guidance. ROW work can be conducted by a variety of entities including SDOT, SPU, SCL, Franchise Utilities, and private developers.

As shown on Figure 18-1, some permits may cross boundaries. For example, a Side Sewer Permit (a type of construction permit) is issued by DPD, although part of the permitted work occurs in the ROW. Similarly, permitting issues may cross boundaries because drainage or wastewater discharges from developed parcels can impact adjacent wetlands or SPU infrastructure.

Figure 18-1
Development Permit Boundaries for Plan Review



18.3.1.1 Preliminary Assessment

DPD administers a process called Preliminary Assessment, which provides private developers with a general set of requirements for their project. This is called the Preliminary Assessment Report (PAR). The PAR is completed prior to the Master Use Permit application intake (or Building Permit application, if no MUP is required) to notify developers of costly requirements that could affect their project. Each department is required to input information into an electronic tool called the Preliminary Assessment Tool (PAT).

18.3.1.2 Master Use Permit Review

DPD issues a general private development project approval called a Master Use Permit (MUP). SPU provides Preliminary Assessment comments during the MUP pre-submittal phase, but is not routed plans for review. This permit is issued before the detailed architectural and engineering plans are developed and submitted with the Building Permit application. DPD staff review development proposals for compliance with land-use regulations and SMC[1]. SPU plan reviewers do have the ability to attend DPD pre-submittal conferences for MUPs. SPU can request invitation to the meeting through the Preliminary Assessment Tool (PAT), or the applicant can

[1] The Seattle Land Use Code, Seattle Shoreline Master Program, SEPA, and the Environmental Critical Areas (ECA) Ordinance.

request that SPU attend.

DPD issues Building Permits (a type of Construction Permit), which are required for most construction in Seattle. DPD staff, i.e. planners, plans examiners, site development staff review private development proposals for compliance with Seattle's Land Use, Building and Drainage Codes (see previous page footnote).

18.3.1.3 Side Sewer Permit

DPD issues Side Sewer Permits (a type of Construction Permit). These permits are generally processed after the Building Permit has been approved and construction is underway. If work is proposed in the ROW, the Side Sewer Permit must be issued to a Registered Side Sewer Contractor, Anyone can apply for a Side Sewer Permit if work is solely on private property. Side Sewer Permits may be issued independently of a Building Permit e.g. side sewer repair.

SPU has contracted with DPD to review Side Sewer Permit plans on SPU's behalf, and to inspect the work after the permit has been issued. As-builts (record drawings)are provided to SPU for inclusion in GIS. SPU is not normally involved in the side sewer permitting process. SPU reviews and confirms the point of discharge during the Preliminary Assessment and DPD must consult with SPU in situations where SPU expertise is required. A triggers list has been developed to provide guidance to DPD on what types of issues SPU requires to be coordinated.

18.3.1.4 Side Sewer Permit for Temporary Discharge (SSPTD)

SPU Plan Review staff reviews temporary discharge requests. The reviewers:

- Confirm that the proposed Point of Discharge is to the correct system (drainage vs. sanitary)
- Ensure that the Point of Discharge is acceptable (i.e. the connection is not allowed directly to a manhole)
- Review proposed discharge rate for infrastructure capacity impacts

The Plan Reviewer must balance SPU's infrastructure needs with the project needs. If the proposed discharge rates are higher than the standard maximum rate allowed, the Plan Reviewer must determine that risks to the infrastructure are within acceptable range.

For proposed permanent and/or temporary discharges to the sanitary or combined sewer system, SPU may coordinate with King County Industrial Waste Section (KCIW) to confirm the allowed discharge flow rate. The Plan Reviewer communicates the allowed discharge flow rate to the project contact, and coordinates with the KCIW staff to have SPU conditions written into the King County Industrial Waste Permit.

Once SPU and KC are satisfied, the SPU Plan Reviewer informs the project contact and the DPD Plan Reviewer that the Side Sewer Permit for Temporary Discharge may be applied for and issued.

Note: At the time of publication, a new Dewatering Director's Rule is being finalized and the corresponding processes may change.

18.3.1.5 Street Use Permit

SDOT issues Street Use Permits, which are required for many activities in the public ROW, including construction projects. Types of Street Use Permits that may impact SPU infrastructure include Street Improvement Permit, Utility Permit, Shoring and Excavation Permit, and Street Tree Permits.

A. Street Improvement Permit (SIP)

The SIP plan is the most common plan SPU reviews because SPU infrastructure is generally located within the ROW. SDOT issues Street Improvement Permits (SIPs) for work as required by the Seattle Land Use Code, which is enforced by DPD and/or Street Improvements as required by the Right of Way Improvement Manual, which is enforced by SDOT. If DPD or SDOT requires street improvements, then a SIP is required and reviewed by SPU Plan Reviewers if facilities that SPU will own are constructed or existing infrastructure is impacted. SPU has the opportunity to review preliminary plans and attend design guidance meetings for SIP's at the 0-60% design phase and to provide formal review and comment at the 90% design phase.

B. Utility Permits

SDOT issues Utility Permits for the installation of underground utility mains, overhead wires and services in the public ROW. They include public utilities such as water, sewer, drainage mains and Green Stormwater Infrastructure; franchise utilities such as power, communication, gas, steam; and privately-owned facilities such as oil pipelines. This permit is one that SPU both reviews as an approver, and also requests from SDOT as an applicant. Many SPU projects need to obtain this permit. See **DSG Chapter 2, Design for Permitting and Environmental Review**

C. Shoring and Excavation Permits

Shoring and Excavation Permits are issued for excavations in or near a public ROW that could potentially affect the integrity of the ROW or utilities in the ROW. SDOT leads the review and may engage SPU to ensure SPU infrastructure is protected.

18.3.2 Other Projects

The SPU PMED reviews plans for SPU and other City departments Capital Improvement Program (CIP) projects.

18.3.2.1 SPU CIP Projects

Plan reviews of SPU CIP projects have many similarities to private development plan reviews, but are not part of the formal plan review process. The Plan Review section gets involved in SPU CIP projects based on their expertise, knowledge of a specific basin, or complexity of the project. Examples of SPU CIP projects include construction of a new water main, reservoir undergrounding, or installation of a new pump station.

18.3.2.2 Other City Department CIP Projects

The SPU Plan Review staff reviews plans for other City department CIP projects. For these projects, other City departments are the developer. As with the SPU CIP projects, these reviews have many similarities to private development plan reviews, but are part of different processes. If development or redevelopment is parcel based, then the DPD MUP and Building Permit process is followed. If in the ROW, the plans are routed to SPU PMED Plan Coordinator to be assigned to a Primary Reviewer. Examples of other City plan review are construction of: a new Fire Station and related infrastructure; a new street with water, sewer and storm mains plus Green Stormwater Infrastructure (GSI); or a new facility that the Parks Department is building on Parks property that needs full frontage improvements including new water, sewer and storm mains extended. In particular, SDOT street reconstruction projects can have impacts on SPU infrastructure, especially drainage facilities.

18.3.3 Other Agency Projects

The SPU PMED reviews plans for work done in other municipalities or by other government agencies, where SPU interests are involved. Examples of this would be Sound Transit's Light Rail project or a project in Bellevue potentially impacting a SPU water transmission pipeline. These types of projects are categorized as either Major or Non-Major. For Major Interagency Projects (MIP) of high complexity, SPU typically assigns a project manager who assembles an in-house team for plan review.

18.3.4 SPU Property Related Projects

Property related plan review usually involves SPU property, easements or other property rights, street vacations, and proposed sales of City property. SPU must approve any actions that may threaten SPU property or property rights. The SPU PMED must determine the potential impact of property related action on any existing or planned SPU infrastructure. Usually, SPU Real Property coordinates these reviews, which involve SPU PMED only in more complex or higher risk situations. For many ROW actions, such as street vacations, SDOT leads review and SPU Real Property is the main point of contact for SPU.

18.4 SPU PLAN REVIEW PROCESS

SPU reviews plans either through informal coordination with other staff or through the formal plans routing process. *Coordination* refers to a simple conversation, email, or a meeting between an SPU plan reviewer and another City branch or department (or private development applicant) in which plans are reviewed or discussed. *Plans routing* is a more formal process by which SPU receives hardcopy or electronic plans for review.

18.4.1 Review Process with Routed Plans

The following is the SPU Plan Review Process:

1. The Plan Review Coordinator receives and logs plans into the Plan Review Database (PRD). A Primary Reviewer is assigned.
    a. Upon assignment, the Primary Reviewer screens to see if the project triggers the need for Conditional Reviewer(s) to review plan.
    b. If workload balancing or special skills are required, the Plan Review Coordinator consults with Primary Reviewer to assign Conditional Reviewer(s).
2. Primary Reviewer or Plan Review Coordinator will coordinate for plan to be reviewed by the Conditional Reviewer.

3. The Conditional Reviewer enters comments and corrections into the PRD and returns the marked up drawings to Primary Reviewer.
4. If workload balancing or special skills are required, Plan Review Coordinator consults Plan Review Supervisor.
5. If not, the Primary Reviewer screens to see if the project triggers the need for a Conditional Reviewer to review plan.
6. The Primary Reviewer arranges for plan to be reviewed by the Conditional Reviewer.
7. The Conditional Reviewer enters comments and corrections into PRD and returns marked up drawings to Primary Reviewer.
8. The Primary Reviewer reviews plans, resolves conflicts and issues, and enters final comments into the PRD.
9. The Plan Review Coordinator compiles final comments and sends them to the Point of Contact per plan review request.
10. The Plan Review Coordinator tracks and reports performance measures relating to the Plan Review process.

Note: For more information, the SPU Plan Review Folder includes detailed process information, checklists, process diagrams, and other useful information. (J:\PDB\WS480\Public\Plan Review).

18.4.2 Coordination

SPU has regularly scheduled meetings to foster communication and coordination with other groups within SPU and other City departments:

- Representatives from SPU PMED, Operations and USM meet weekly to discuss drainage and wastewater utility issues that have come up during plan review. These issues have implications for policy, operations, or maintenance. During the meeting, the SPU reviewer consolidates branch comments onto a single set of plans.
- USM, Real Property Services, and SPU PMED hold monthly Build-over Meetings where they evaluate private proposals to build over SPU infrastructure.
- DPD, SDOT, and SPU PMED hold weekly meetings for both pre-submittal coordination and side sewer permitting. These meetings are used to discuss drainage and wastewater issues for projects seeking DPD or SDOT permits.
- SDOT holds semi-weekly meetings, which includes all reviewing departments. Pre-design guidance and 0%-90% design issues are discussed. SPU participates in these meetings by communicating requirements and coordinating water, drainage and wastewater concerns for projects seeking SPU approval on DPD or SDOT permits.
- SPU PMED attends monthly coordination meetings with SDOT to collaborate on SDOT's CIP program.

18.4.3 Master Use Permit Plan Review

SPU reviews preliminary MUP applications and communicates requirements using the Preliminary Assessment Tool (PAT). DPD takes input from SPU and other City departments and uses it to condition MUP decisions so that the applicant has information and approval to develop project plans for the building permit phase. Currently, SPU PMED receives MUP plans for water infrastructure reviews more often than for drainage or wastewater infrastructure. SPU PMED engineers return any comments directly to DPD. The SPU Solid Waste Division does not generally have any input to a MUP plan.

If the DPD reviewer observes issues or has questions on the following, they should coordinate with the SPU Plan Reviewer:

- System capacity
- Impacts to sensitive areas and public infrastructure
- Compliance with comprehensive plans and land use or drainage/sewer codes
- Resolution of unusual conditions, nonstandard designs, or exception requests

Generally, DPD staff split their project review workload into North of Denny review staff and South of Denny review staff. These DPD reviewers consult on triggered issues with the two SPU PMED review staff contacts, who are the north or south regions.

18.4.4 Preliminary Assessment Review

For this review, SPU plan reviewers focus on water, drainage and wastewater infrastructure. Applying for a Preliminary Assessment automatically triggers a Water Availability Certificate (WAC) review. SPU plan reviewers are assigned reviews on a weekly rotational basis. The SPU plan reviewer is responsible for projects forwarded from SDOT from 10 AM the previous day to 10 AM the designated day. A maximum of four projects is assigned per day.

18.4.4.1 Preliminary Assessment Review Process

SPU plan reviewers follow these steps to review Preliminary Assessments:

1. Access preliminary application information through Hansen Web Tools.
2. Select “Complete” button to route the project to DPD Administration who sends the Report to the applicant.
3. Use Route Back options as necessary. Occasionally, it may be best to contact the reviewer outside of the PAT via email or telephone. If a DPD build-over or main extension requirement is waived, then a comment is written in the internal comment field and the project must be routed back to the DPD Site Team.
4. DPD, SDOT and SPU meet biweekly to evaluate appeals of requirements that have been identified during the Preliminary Assessment.

Review City resources for each pertinent item on the Preliminary Assessment Resource List.

Table 18-2 Information Included in the Preliminary Assessment Tool (PAT)

Utility	Information to be provided in the Preliminary Assessment Tool
Water	The WAC is automatically triggered in PAT.
Drainage and Wastewater (D/WW)	Verify the following information input by DPD Site Team – Locations of existing public infrastructure (sanitary sewer, storm sewer or combined) and pipe sizes – Preliminary drainage control requirements including flow control, WQ treatment and/or green stormwater infrastructure (GSI) if required – Preliminary drainage water quality treatment requirements if required Waive or Concur with the following DPD-identified requirements: – If drainage or sewer main extension is required – If a build-over process is required Other additional areas of investigation: – If more than one possible connection point, the reviewer may suggest preferred pipe and location of connection – Potential capacity issues

18.4.4.2 Preliminary Assessment Performance Measures

The SPU service level agreement is to complete the Preliminary Assessment review within 48 hours of receipt from SDOT. If route backs are required, then an additional 48 hour window is allowed once the project enters SPU's queue a second time.

18.4.5 Water Plan Review

SPU reviews Water Utility plans as part of four related processes:

- Water Availability Certificate (WAC)--The Water Availability Certificate (WAC) is the most common process by which SPU confirms there is adequate domestic water flow and pressure for a new development. The developer may be required to pay SPU to perform hydrant flow tests and/or system model calibration in order to assure the water system can serve the project and surrounding area.
- Water Availability Inquiry (WAI)—Similar to a WAC, but is not related to a specific project.
- Water Availability Approval (WAA)--The Water Availability Approval (WAA) allows a developer to obtain a Building Permit for new development without obtaining a WAC from SPU. SPU has a MOA with DPD that allows DPD to issue the WAA in lieu of a WAC for certain smaller projects that will not require increased water services.
- Detailed Water Infrastructure and Water Service Plan Review.

18.4.5.1 Water Availability Certificate (WAC)

The Water Availability Certificate (WAC) is the most common process by which SPU confirms there is adequate domestic water flow and pressure for a new development. The WAC reviewer performs analysis and applies SPU water policy in determining the need for any water system improvements. The WAC reviewer estimates fire flow in determining requirements, but this is subject to confirmation by the Seattle Fire Department. Under most circumstances, the SPU WAC Administrator completes these Certificates within five business days. DPD requires an approved WAC before it will issue a building permit for new development.

Not all projects require a WAC. DPD or SPU will determine whether a WAC is required based on a seven-item WAA checklist. If a developer meets all criteria listed on the checklist, DPD issues a Water Availability Approval without requiring a WAC from SPU. If project conditions change, DPD's Water Availability Approval can be invalidated. If so, SPU requires a WAC.

A. WAC Process

Normally the WAC is obtained during Preliminary Assessment, which automatically requests it. However, a developer can request assurance at any time that there is sufficient water available for a proposed new development. Or, at any time, a developer can complete a WAC request form and submit it to DPD. The SPU plan reviewer should follow the WAC process .

Tip: *DPD routes WAC requests with a site or utility plan to SPU for plan review. While the WAC typically indicates if a project needs to upgrade or build a new water main, SPU water policy can be unclear as to the best application of this requirement. If so, consult with the SPU Plan Review Supervisor.*

B. WAC Appeal

The developer can appeal WAC conditions by submitting a WAC Customer Appeal to the plan review supervisor. The appeals go through the following process:

1. Plan review supervisor conducts a bi-weekly meeting that includes the following:
    a. Engineering plan reviewer who developed the WAC
    b. Water lead
    c. Engineering Plan Review Manager
    d. USM Water Business Area Manager
    e. Customer Service (not at all meetings)
2. Meeting attendees decide whether to approve or deny the appeal, or possibly negotiate alternatives with the developer. On occasion, site visits or follow-up research may be required.
3. Engineering plan reviewer prepares and sends the developer a letter stating the decision.

The entire process should be completed within two weeks. Applicants who receive a denial letter may re-appeal if new information is presented that was not previously considered. When all appeals have been heard, if the applicant still believes the decision was in error, they can elevate the issue to the Project Management and Engineering Director in the Project Delivery Branch at SPU.

C. Water Availability Inquiry (WAI)

The Water Availability Inquiry (WAI) follows the same steps as the WAC process, but is based on a preliminary understanding of proposed land use. Under most circumstances, it is completed in

5 working days. If an SPU plan reviewer is unable to meet this goal, the reviewer should contact the plan review supervisor. The SPU plan reviewer follows these steps to prepare a WAI:

1. Checks project type and WAC policy to determine overall requirements.
2. Reviews the City's GIS to identify the size of the main. If the water system is substandard, City staff will indicate the process for required mitigation.
3. The WAI informs developer that fire flows are determined by the Fire Department and may require additional upgrades to water system.

D. Water Availability Approval (WAA)

The Water Availability Approval (WAA) allows a developer to obtain a Building Permit for new development without obtaining a WAC from SPU. SPU has a MOA with DPD that allows DPD to issue the WAA in lieu of a WAC for certain smaller projects that will not require increased water services.

18.4.5.2 Water Plan Review Procedure

SPU PMED may need to perform detailed plan reviews for new development projects that may impact SPU water infrastructure, examples are water main extensions and large water meter installations. See DSG Chapter #17 for Water Services.

The Water Plan Review procedure can be required for both private developments within City limits and within jurisdictions that SPU-owned systems are located.

The following resources may be useful in performing a detailed water plan review:

- For new and existing water mains, water project review is covered in the 2007 Water System Plan.
- For non-standard or complex issues or if the code is unclear, get additional assistance in the bi-weekly water appeal meeting.

Meetings with outside jurisdictions in SPU's water service area such as Shoreline, Tukwila, Bellevue, Kirkland, Mercer Island, Burien, Normandy Park, King County, and WSDOT may be scheduled as needed.

The SPU Primary Reviewer should follow the Drainage, Wastewater and Water Plan Review procedure in Appendix A.

18.4.6 Drainage and Wastewater Plan Review

This section describes general guidance for reviewing private development wastewater and drainage plans.

18.4.6.1 Stormwater Code Compliance

The SPU plan reviewer uses a number of established thresholds to determine Stormwater Code requirements for public and private development or redevelopment projects. There are 13 minimum requirements for all projects.(V.III, Chapter 2, page 2-30) Of these the requirements to maintain natural drainage patterns, amend soils, implement GSI, protect wetlands, ensure capacity, and comply with the Side Sewer Code are most often encountered by the reviewer.

Two additional minimum requirements (flow control and water quality) vary depending on project type and where the site ultimately drains. A tool was developed to assist the reviewer in identifying flow control requirements.

Additional system requirements may be identified. Drainage and wastewater thresholds for improvements and extensions within the City of Seattle are triggered by code (often a lack of available main in abutting ROW). If there is no sewer or combined main or if the sewer or combined main may be under capacity for the improvements, the SPU PMED Plan Reviewer may need to coordinate with USM and to determine the following:

- Delineation of service area
- Possible downstream hydraulic constraints
- Point of discharge (POD)
- Evaluation of service alternatives
- Determination of benefit of new or upgraded main to SPU

18.4.6.2 Review Procedure

The SPU Primary Reviewer should follow the Drainage, Wastewater, and Water Plan Review procedure in Appendix A.

18.4.6.3 Green Stormwater Infrastructure (GSI) Plan Review

Green Stormwater Infrastructure (GSI) is required under current Stormwater Code for projects with >2,000SF new and replaced impervious surface or >7,000SF total land disturbing activity. GSI limits the negative impacts of stormwater runoff by redesigning streets to take advantage of plants, trees, and soils to clean runoff and manage stormwater flows. Vegetated swales (biofiltration swales), permeable pavement, amended soils, and specific trees and vegetation allow soils to absorb water, slowing flows and filtering out many contaminants. SPU has coordinated with SDOT to develop general guidelines, plans, and specifications for GSI Design in the ROW. GSI options for ROW applications are included in the ROWIM. Additional resources and updated information are included on SPU's GSI website.

18.4.6.4 DRAINAGE AND WASTEWATER APPEALS

Applicants can appeal requirements or decisions relating to drainage or wastewater reviews. Appeals are sent to the Plan Review Coordinator who then schedules the appeal meeting and ensures that the package is complete and ready for the meeting. Appeals often involve ROW issues. The meeting generally includes representatives from SDOT, DPD, USM and PMED. Decisions are sent to the applicant within two weeks of the initial submittal. On occasion, follow-up investigation can be required either by the applicant or internally, which can delay the decision.

18.4.7 Survey Requirements and Monuments

City of Seattle survey and monument requirements are described in CAMs 1401 and 1402, respectively. CAM 1401 explains when a survey is required and general information regarding survey. CAM 1402 explains how to locate and identify a survey monument, the developer's responsibility in verifying and protecting monuments, and how a developer gets approval to disturb a monument.

The SPU PMED Survey Plan Reviewer performs survey reviews as a service to SDOT. Through this review, street alignments, rights of way, and horizontal and vertical survey control data are verified.

The Survey Plan Reviewer uses City Survey records, City quarter section (engineering) maps, City ordinance records, County records, superior court cause documents, State and County survey control data bases, and occasionally field verification to confirm that the submitted plan or base map is a reasonable representation and interpretation of survey control.
The Survey reviewer may also be asked to review new plats, short plats and lot boundary adjustments submitted to SDOT. In the case of new plats, geometry, ROW, and control of re-aligned streets are checked, and ties to control outside of the plat are reviewed.

If the survey is incorrect, inadequate, or unverified, the reviewer may return the plan to the developer to correct before design review.

Survey review is also performed for SPU and SDOT CIP alignments.

18.4.8 Solid Waste Plan Review

The SPU Solid Waste Division in USM reviews Building Permit plans for larger multi-family, commercial and industrial projects to assure the following:

- Garbage trucks have sufficient access to dumpsters
- There is sufficient storage available for solid waste dumpsters
- Dumpsters can be safely moved from their storage location to the pickup location

Note: At the time of DSG publication, DPD identifies when Solid Waste should be involved and routes plans directly to the Solid Waste Division.

18.4.9 Build-overs

SPU may allow a developer to construct a permanent structure over an existing sewer or storm main located in an easement on private property subject to site specific engineering and maintenance requirements. If any or all of the requirements can't be met SPU reserves the right to reject the proposed build-over. SPU prefers re-routing the existing main around the proposed build-over if the longitudinal grade allows it to maintain the minimum velocity or less.

Real Property Services (RPS) is the primary point of contact and they work with the Plan Reviewer to determine that the City's rights and facilities are adequately protected. The developer must agree to pay the administrative costs plus excess future costs due to the project's construction. For detailed information on build-overs, see CAM 507.

Note: Build-overs are generally only approved for drainage or wastewater mains. Build-overs are almost never approved for water mains.

18.4.9.1 Build-over Review

The SPU plan reviewer must confirm:

1. That the casing pipe inside diameter is larger than the outside diameter of the bell of the sewer/storm main. The proposed pipe must be sized to convey the design flows for the entire basin under full "build-out" for the corresponding zoning.
2. The minimum steel casing thickness shall be ¼-inch. External loading may require thicker and stronger casing. Casing shall extend at least 5 feet beyond the edge of building foundation 1:1 influence line. Steel casing pipe is preferred, although ductile iron pipe may be used in certain circumstances. Use of any HDPE, PVC or any other plastic pipe is not allowed.
3. The sewer/storm main must be restrained joint within the casing pipe.
4. No private side sewer or storm connections are allowed within the casing pipe.
5. Casing spacers must be stainless steel to maintain line and grade of pipe and to prevent floatation. Place at bell ends with 9 feet maximum spacing.
6. An unobstructed 10 x 20 foot minimum access area (unobstructed) located on both sides of the building is preferred. If that is not feasible, SPU may allow one access area for future trenchless maintenance or repair. Larger diameter pipes may require larger access areas and easement widths.
7. A removable end cap or a 1 foot deep concrete plug must be included in order to seal the space between the casing the main.
8. Additional MHs may be required, as necessary.
9. The Seattle City Council must approve any easement legislation required prior to issuing the permit for construction.
10. Final as built plans must be filed in the SPU Records Vault.

18.4.9.2 Build-over Process

The following are the steps for a developer to request a build-over:

1. Real Property Services (RPS) circulates the owner's proposal to the SPU Plan Reviewer and to Field Operations for preliminary evaluation.

Participants discuss proposal in a scheduled build-over meeting

a. If necessary, RPS coordinates a meeting with the property owner or their agent.
b. RPS, after consulting with Plan Review and FOM, will advise if SPU can grant consent.

The Plan Reviewer conducts preliminary review and sends recommendations to RPS.

RPS sends letter to property owner with site specific requirements for modifying the wastewater/storm drainage main or denying the build-over request.

RPS includes an estimate of fee for processing of the request.

Developer signs and returns letter to RPS including the following:

a. Payment of fee for administrative costs in excess of the deposit.

b. Revised design document incorporating SPU preliminary comments prepared by a licensed engineer.

c. Three sets of finalized plans and profiles showing impact details on wastewater/stormwater mainline.

2. RPS routes revised plans to the Plan Reviewer.
3. SPU Plan Reviewer coordinates comments to the property owner.
4. RPS drafts a Consent Agreement for developer review, approval and acceptance.
5. Developer submits a copy of signed Consent Agreement and approved plans to RPS.
6. Once all changes are made and staff accepts the proposal, RPS schedules the build-over for City Council review and action.
7. Upon City Council approval, the Developer submits a copy of signed Consent Agreement, approved plans and payment of current fees to DPD to obtain a sewer permit
8. DPD and/or SDOT inspects construction of relocated or replaced drainage/wastewater main and obtains red-lined drawings. Before building occupancy, DPD must obtain SPU PMED final approval.

18.5 PLAN REVIEW ROLES AND RESPONSIBILITIES

Plan review at SPU is performed by a team as shown in Table 18-3. .

Table 18-3 SPU Project Management and Engineering Plan Review Team

SPU Position	Responsibilities
Engineering Plan Review Manager	Manages SPU PMED Plan Review Section
Plan Review Supervisor	Workload management and project assignment Preliminary Assessment Management Deals with exceptions
Plan Review Coordinator	Organizes and distributes plans for review Compiles comments and transmittals Provides general support Tracks and reports performance measure data
Primary Reviewer	Engineering plan review and project management Reviews projects for adherence to SPU DSG, City Standards, SMC and relevant DR's.
Conditional Reviewer	Supports Primary Reviewer by performing specialized reviews, as necessary for adherence to SPU DSG, City Standards, SMC and relevant DR's..

Other City of Seattle departments and groups within SPU share responsibilities for plan review. Table 18-4 shows an overview of the role of other City departments and SPU groups in plan review.

Table 18-4 Plan Review Roles and Responsibilities

Organization	Group	Role	Responsibilities
DPD	Multiple	Issue permits	Issues MUP, Building, Grading. and Side Sewer Permits Review to protect SPU interests when issuing permits Involve SPU as needed or agreed in the permitting process
SCL	Plan Review Team	Review	Assure customer service levels are met Protect citizens health and safety Review plans as needed to assure SCL interests are protected
SDOT	Street Use Operations	Issue permits; Review	Administers the Street Use Process Protect SPU interests when issuing permits Protect SDOT interests when reviewing plans Involve SPU as needed or agreed in permitting process
SPU	Customer Service	Authorize new water service	Assure WAC is issued before accepting new water service applications Accept plans from developers for water service review
SPU	USM	Conditional Review	Review plans as agreed with SPU PMED for projects with complex policy issues
SPU	Solid Waste	Conditional Review	Review building permit plans to assure safe access to dumpsters for residents and garbage trucks.
SPU	Survey	Conditional Review	Assure plans reviewed meet City survey standards Assure planned projects meet City ROW monumentation and future grade requirements.
SPU	Materials Lab	Conditional Review	Assure appropriate products and materials are used in construction projects involving SPU infrastructure.
SPU	Real Property Services	Conditional Review	Assure SPU and City property are protected Assure easements and other legal documents protect City property and interests
SPU	Field Operations & Maintenance	Conditional Review	Assure proposed projects do not negatively impact Operations' ability to operate or maintain SPU infrastructure
King County	Dept of Natural Resources (Wastewater Treatment Division)	Review	Protect King County wastewater interests Review plans for wastewater concerns as requested by SPU, Industrial Waster, Construction and Real Property are Sections where coordination takes place.

18.5.1 Coordination

Coordination with other Branches, Divisions, and Departments is critical to successful projects. Table 18-5 lists examples of when coordination is needed with other SPU groups and DPD. The list is not exhaustive.

Table 18-5 Plan Review Coordination and Conditional Reviewers

Department/Branch	Issues for Coordination
Field Operations and Maintenance	Access points to casing pipes Safety platforms for deep maintenance holes Inside drop vs. outside drop for MH's Access to public facilities in difficult to reach locations Confirming access locations in drive aisles, roads, & private property with SPU facilities Bends required in lines Backwater valves

	Pipe slopes less than or greater than allowable standards Project with limited overhead or horizontal clearance due to trees, overhead utilities, underground utilities, walls etc. Utility infrastructure to be decommissioned Other unique issue creating non-standard installation Non-standard location or complex/non-standard work by crews Connections & maintenance of water quality facilities such as storm filters or wet vaults Utility conflicts Proposed trees over/near mainline Opportunistic replacement of plastic or galvanized water services
Real Property Services	RPS initiates review for projects requiring an easement or Build-over Agreement. SPU coordinates with RPS easement issues with a build-over. RPS coordinates with outside jurisdictions and SPU facilities needs.
Materials Lab	Point load on pipes due to proposed adjacent improvements Angle of repose for trench adjacent to ex structures or utilities Use of epoxy for water proofing utilidor Casing pipe inspections Pipe bedding/support Trenchless installations Mix designs for porous pavements and structural inspections Review of non-standard products or materials Soil compaction tests
USM	SPU PMED and USM have a MOA that outlines areas the two branches must coordinate. This MOA includes a "Triggers" list that shows SPU PMED plan reviewers what types of project issues require coordination with USM
Construction Management	Casting surveys Constructability review Inspection services
DPD	SPU PMED and DPD have a MOA that outlines areas of coordination. This MOA includes a "Triggers" list that shows DPD Site Reviewers what types of project issues require coordination with PMED Plan Reviews. Coordination includes: Interpretation of the drainage code for on-site drainage review Side Sewer Permitting Main extension Temporary Construction Discharge Build-over or relocation inspections permitted by DPD Projects that may have significant impacts on SPU system capacity.
Customer Service	Review of large water services Review for Customer Service issues
Solid Waste	Review for access issues regarding large containers
Survey	Professional survey issues that are elevated by the Developer

18.6 RESOURCES

This section contains information available to SPU plan reviewers.

18.6.1 Codes and Authority

Table 18-6 describes relevant Authority for Plan Review Staff.

Table 18-6 Relevant Codes and Authority for Plan Review Staff

Code	Authority
Side Sewer Code (2010) SMC Chapter 21.16	Regulates construction/ use of service drains and side sewers in Seattle

Stormwater Code(2009) SMC Chapter 22.800	Regulates stormwater, flow control, water quality, temporarily during construction and permanently after construction.
Water Code (2007) SCM Chapter 21.04	Regulates current and future water demands, ensures high quality drinking water, and establishes rates for purveyors and customers.
King County Code KCC Title 28	Regulations for the disposal of industrial waste into the sewerage system and establish the fees and rules.

18.6.2 Director's Rules

Table 18-7 describes relevant Director's Rules (DR's) for Plan Review Staff. Director's Rules are administratively approved and signed by City Department Directors. They are legally binding rules that clarify how SMC will be implemented and enforced. Most DR's related to plan review are joint DPD and SPU Director's Rules, and can be located in Table 18-7 or on DPD's web site.

Table 18-7 Relevant Director's Rules for Plan Review Staff

DR Number	Description
2010-002*	Requirements for Design and Construction of Side Sewers(Drainage and Wastewater Discharges
2010-003*	Side Sewer Code Enforcement
2010-005**	Groundwater/Dewatering
2009-003	Vol. I Source Control Technical Requirements Manual
2009-004	Vol. II Construction Stormwater Control Technical Requirements Manual
2009-005	Vol. III Stormwater Flow Control and Water Quality
2009-006	Vol. IV Stormwater Code Enforcement Manual
2009-007***	Green Stormwater Infrastructure to the Maximum Extent Feasible (GSI to the MEF)

*Note: As of DSG publication date, this DR is slated for approval and implementation in early 2011.

**Note: As of DSG publication date, this DR is slated for approval and implementation in 2011.

***Note: As of DSG publication date, this DR is in active discussion with DOE. Best info available is the Draft dated Dec. 2009

18.6.3 Memoranda of Agreement and Understanding

Memoranda of Agreement and Memoranda of Understanding are binding documents between a minimum of two parties. Often two or more Departments or Branches/Divisions within a Department will have a MOA or MOU. There is an Agreements Library located on PMED's SharePoint site.

18.6.4 Client Assistance Memos

Table 18-8 describes relevant Client Assistance Memos (CAM's) for Plan Review Staff. Client Assistance Memo's are general in nature and aid the public in applying regulations.

Table 18-8 Relevant Client Assistance Memos for Plan Review Staff

Client Assistance Memo	Description
CAM 502	Grading Regulations in Seattle
CAM 503	Side Sewer Permits in Seattle
CAM 504	Side Sewer As-Built Plan Requirements
CAM 505	High Point Impervious Surface Calculation
CAM 506*	Side Sewer Permits for Temporary Dewatering on Construction Sites
CAM 507	Side Sewer Permits for Build-Over Agreements
CAM 509	Green Parking Lots
CAM 520	Rainwater Harvesting for Beneficial Use - Green Building CAM
CAM 1101	Drainage and Wastewater: Regulation of Development
CAM 1102	Sewer Submeter Program
CAM 1180	Design Guidelines for Public Storm Drain Facilities
CAM 1201	Water Availability Certificate
CAM 1202	Water Service Application
CAM 1301	Solid Waste: Information for Developers
CAM 1302	Building Material Salvage and Recycling
CAM 1401	SPU Survey Requirements
CAM 1402	What are Survey Monuments?

*To be updated with DR 2010-005 in 2011.

18.6.5 Administrative Procedures

18.6.5.1 Plan Review Billing Codes

Plan reviewer staff use Activity Codes to track their time:

Table 18-9 Plan Review Timesheet Codes

N480305	DPD Engineering Support
N480306	Other Plan Review
N480307	General Engineering
N480308	Water Availability Certificate
N480340	Design Standards and Guidelines
N480341	Code Development, Director's Rules and CAM's

18.6.5.2 SDOT Projects

Projects billed to SDOT are charged to one of three Activity Codes:

NS09029	Design Guidance
NS09030	Plan Review
NS09031	Inspection

When completing the timesheets, the Plan Reviewer enters the permit number in the Doc # field and a brief description of work performed in the Comment box on the HRIS timesheet. After each pay period, SPU Finance sends a report that includes this information, and the Primary Reviewer reviews to ensure that all charges are appropriate before approving. SPU Finance then sends the approved billing to SDOT for processing.

Refer to the Plan Review billing process map SPU internal CIP projects with an assigned SPU project Manager have Activity Codes that Start with a C. (e.g. C305501)

18.6.5.3 DPD Projects

Currently, projects originated from DPD are billed to N480305 DPD Engineering Support.

18.6.6 Technology

The City uses a variety of software to manage and track plan review. To access these systems, the SPU plan reviewer should contact the appropriate IT department (Table 18-10).

Table 18-10 Technology Tools for Plan Review Staff

Software Name	Description	IT Dept.
Hansen Web Tools (HWT)	HWT provides a web based view of DPD's Hansen permitting application data, and other permitting application data (e.g.: GIS, EDMS.). HWT also provides additional functionality supporting interdepartmental permitting. This tool allows the reviewer to view project information and details from other City reviewers. Access to this system must be requested from DPD	DPD
Preliminary Assessment Tool (PAT)	PAT is an application within HWT that supports determination of Code requirements. It is used by DPD Land Use, DPD Site Team, SCL, SDOT and SPU. Access must be requested from DPD. PAT is used in the preliminary application process by Review Staff to provide early guidance and Code Requirements for all new private parcel development projects.	DPD
Plan Review Database (PRD)	PRD is an MS Access database used to track plans, archive comments & decisions for projects reviewed by SPU PMED. It is used for SDOT Street Use Permit plan review, for other Dept CIP plan review, and for other reviews that occurs in the Plan Review Section. Write access is requested from the Plan Review Supervisor, who then contacts the SPU IT service desk. Read access is available to all SPU staff and can be accessed through	SPU
Field Operations Mapping System (FOMS)	FOMS is a tool to graphically see Maximo work orders, O&M truck locations, and work order status and expeditiously gain O&M information. O&M truck locations are real time locations using GPS to locate them.	
Virtual Vault	Virtual Vault is a desktop tool to access to SPU infrastructure as-built information	
Maximo	Maximo is a desktop tool that enables access to O&M crew scheduling, work activities, and costs	

18.6.7 SPU Library and Storage Area

The SPU Library is located on SMT 45th floor. The library contains copies of industry standards to which SPU subscribes. It also contains engineering textbooks, City standards, and other technical engineering publications.

Physical copies of plans received by SDOT are stored in the PRD portion of Central Files on SMT 45th floor while plan review is in progress. At regular intervals, completed projects are packaged and sent for off-site archiving.

18.6.8 Mapping

Table 18-11 lists resources SPU plan reviewers and developers use to obtain property information. Physical maps are housed on the west side of SMT 45th Floor.

Table 18-11 Property Resources for Plan Review Staff

Resource Name	Description (if applicable)	Link/Location (if applicable)
General		
DPD CAM 233	(Sources for Property Information)	CAM 233
City GIS (Public)	Public Information	City GIS
City GIS (Internal Use)	Internal Access Information	ArcView & Utiliview
Microfilm Library	Public Information	Seattle Map Counter Public Resource Center SMT 20th Floor
City of Seattle Vault	400 Scale Water Maps and limited record water system drawings (as-builts). Limited wastewater and stormwater record drawings (as-builts). Sewer Cards (also available on-line) Reviewers have access to more accurate detailed information from the internal SPU on-line system.	Virtual Vault 700 Fifth Avenue SMT 47th Floor Seattle, WA 98104 (206) 684-5132 Hours: 8:00 AM to 4:30 PM, M-F
CAM 107 (DPD Public Records)	The CAM includes brief descriptions of records maintained by DPD along with locations and hours of operations, copy fees, and documents exempt from public disclosure.	CAM 107
Plat Maps	Official document that portrays subdivision boundaries, easements, restrictions, and legal descriptions.	KC Dept of Records & Elections and DPD Drainage/WW Desk in the ASC SMT 20th Floor
Water		
Water System Map Book	Public Information	Seattle Map Counter Public Resource Center SMT 20th Floor
SPU Customer Service Branch	Public Information General Index Cards (GI cards for historical info)	Water Service Account Executive (206-684-3000), M-F 8:00 AM to 5:00 PM 810 Third Avenue, Suite 600 Seattle, WA 98104
Drainage and Wastewater		
Sewer Cards	Historic mapping information (updated until 2001)	Map Information City of Seattle Vault Sewer and Drainage counter at DPD
SPU Engineer's Maps		See base maps
Sewer & Drainage Infrastructure Map Sheets		Seattle Map Counter Public Resource Center SMT 20th floor

If plan reviewer notes a discrepancy on GIS maps or sewer cards, verify using the mapping resources listed above, and then once confirmed that a correction is needed, complete a GIS change request to correct discrepancies. The depository is in the Plan Review Section currently on the west end of SMT 45th floor.

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

C. POLICIES, PROCEDURES AND STANDARDS

APPENDIX C-4

STANDARD, CONNECTION, AND ADMINISTRATIVE CHARGES RULE AND WATER RATES

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Seattle Public Utilities

Director's Rule

Title	Number	Rev. no.
Standard, Connection and Administrative Charges—Water Services	FIN-210.2	0
Responsibility	**Supersedes**	**Pages**
Finance Division	DR-2010-001	19
SPU Director's Approval	**Effective Date**	
Ray Hoffman	April 1, 2012	

1. PURPOSE

To set fees for special recurring and nonrecurring water services provided by Seattle Public Utilities.

2. DEFINITIONS

Site-specific costs: For certain services, SPU will determine the cost related to that service based on the site. This site-specific cost will include labor, material, equipment, and any other cost related to that site and that service. Cost will vary between sites.

Time and materials: The cost of a service as calculated by SPU, including labor, equipment, materials, applicable permit fees and taxes, pavement restoration, overhead costs and any similar costs incurred by SPU while performing the service.

Normal hours: Times from Monday through Friday from 7:30 a.m. to 4:00 p.m., excluding those holidays observed by the City of Seattle.

Extended hours: Times from Monday through Friday from 4:00 p.m. to 9:00 p.m., from April through October, excluding those holidays observed by the City of Seattle.

After hours: Times other than normal or extended hours.

3. NEW WATER INSTALLATIONS AND MISCELLANEOUS SERVICE CHARGES

3.1 STANDARD CHARGES FOR INSTALLATION OF NEW SERVICE (EXCLUDING STREET-RESTORATION CHARGES) AND CONNECTION CHARGES

Domestic Services

Size (inches)	Installation Fee	
	Residential	*Arterial*
¾	**$2,167**	**$2,558**
1	**$2,283**	**$2,682**

Connection Charge
$920
$1,564

1 ½	**$5,152**	**$5,821**		**$3,036**
2	**$5,491**	**$6,361**		**$4,876**
3	**Cost ***	**Cost ***		**$10,120**
4	**Cost ***	**Cost ***		**$15,640**
6	**Cost ***	**Cost ***		**$30,360**

Fire Services

Size (inches)	**Installation Fee**			**Connection Charge**
	Residential	*Arterial*		
2	**$7,576**	**$10,508**		**$1,950**
4	**Cost ***	**Cost ***		**$6,256**
6	**Cost ***	**Cost ***		**$12,144**
8	**Cost ***	**Cost ***		**$19,504**

* All services 3 inches and larger will be based on a site-specific cost.

Plus, as required, Street Restoration charges as stated below.

Arterial streets include every street, or portion thereof, designated as such in Exhibit 11.18.010 of the Seattle Municipal Code.

The new service connection charge is based on the Connection Charge Unit Rate of **$920**. For application of connection charges, see policy/procedure SPU-DR-02-03, Connection Charge. Fire-only services are based on 40 percent of the corresponding new service connection charge. If a domestic service and a fire service are purchased together, contact an SPU Account Executive at 206-684-5800 to determine the applicable connection charge. The connection rate for meters 8 inches and larger is based on the unit rate of **$920**, multiplied by the appropriate meter equivalency factor:

- 8 inches **$48,760**
- 10 inches............................ **$70,840**
- 12 inches............................ **$95,680**
- 16 inches.......................... **$154,560**
- 20 inches.......................... **$224,480**
- 24 inches.......................... **$303,600**

If new service is being installed with developer water main, see section 4.6.

Any service request deemed by SPU to be nonstandard will be based on a site-specific cost.

Combination Fire/Domestic Services

Combination fire/domestic services are available in 4-, 6- and 8- inch sizes. These services require approval from the SPU Director or designee.

- All combination fire/domestic services will be based on a site-specific cost.
- Subject to the Connection Charge in section 3.1.
- Plus, as required, Street Restoration charges under section 3.1.

Other New Service Installation Standard Charges

- Pre and post-inspection............ **$327** per job site
- Street saw cutting..................... **$497** per job site
- Arterial installations for 2-inch and smaller meters will be charged **$569** for traffic control if required. For 3-inch and larger meters, costs for traffic control will be considered in the site-specific cost.

All required City, County, and/or State, and other permits and fees are in addition to the standard charges listed above.

Within Seattle City Limits

- Permit Fee **$146**
- Traffic Control Plan Review.. **$172 per hour**
- Street Use Inspection Fee (initial and final) **$172**
- Premium Street Use Inspection (minimum 4 hours) .... **$344 per hour**

Unincorporated King County

- Permit Fee **$140**
- Inspection Fee .... **$150 per site**

City of Shoreline

- Permit Fee (one-day project)...................................... **$299**
- Inspection Fee (additional days)................................. **$ 74.75 per day**

City of Lake Forest Park

- Permit and Inspection Fee (flat fee)............................ **$200**

City of Burien

- Permit Usage Fee **$200**
- Inspection Fee (minimum 2 hours per site)................. **$ 75 per hour**

For ¾-inch and 1-inch services installed in conjunction with new water main construction, if ordered 30 days prior to estimated start of construction: **$533** reduction from standard charges.

For multiple ¾-inch and 1-inch services installed with a manifold: **$533** reduction from standard charges for each additional service.

For 2-inch and smaller domestic services installed concurrently with fire services in a common trench: **$533** reduction from standard charges.

Time and materials, but not less than the applicable standard charge, for all purveyor services, for all services tapped on transmission mains or for special circumstances as determined by the SPU Director or designee.

Contractor Standby Charge when site/contractor not ready as previously scheduled: **$562** per event

Isolation valve, if required:

- 8-inch **$7,749**
- 10-inch **$11,552**
- 12-inch **$15,713**
- 16-inch .... site-specific cost

- Isolation valve installation is subject to the Street Restoration charges under section 3.1.

Ring and cover casting, if required:

- For new or existing ¾-inch, 1-inch and all fire service: **$314** additional
- For new or existing 1½-inch or 2-inch domestic services: **$683** additional

Automated meter reading equipment, if required by meter installation standards:

- 2 inches or smaller meter .... **$239** additional
- 4 inches or larger, single-register, with fire service .... **$239** additional
- 4 inches or larger, two-register, domestic or combo................................ **$422** additional
- 4 inches or larger, three-register, with fire service .... **$602** additional in the same chamber

Service Conversions

All service size conversions will be based on a site-specific cost.

Note: Service conversions are subject to the Connection Charge in section 3.1.

Street Restoration

Street restoration costs are in addition to the above charges and will be assessed based on street paving type and condition. Charges will be based on a jobsite pre-installation inspection and in accordance with the requirements of the Seattle Department of Transportation's (SDOT) Street and Sidewalk Opening and Restoration Director's Rule 5-2009.

If the customer chooses to have street restoration work arranged by SPU, the fee for street restoration will be collected from the customer at the same time the fee for the new water service is collected. If the customer chooses a private contractor to perform the street restoration work, the customer must: (1) obtain SDOT approval of the contractor and the applicable SDOT permit; and (2) submit the SDOT permit number to SPU at the same time the customer submits payment to SPU for the new water service.

Street restoration costs for SPU water service work in Washington State Department of Transportation right-of-way, City of Burien, Skyway, City of Shoreline, City of Lake Forest Park and unincorporated King County are based on agreements with these cities or state agencies. Charge will be determined by jobsite pre-installation inspection by SPU and street restoration agreement with these jurisdictions.

3.2 SERVICE SIZE INCREASE

To increase service size of existing 2 inches and smaller service in the same location (within 30 inches of existing service) at customer request, applicable new service installation charge will be made (see section 3.1). No charge for meter removal or retirement will be made. Subject to limitations established by SPU Director or designee.

Exception: To renew and increase ½-inch or ¾-inch steel or plastic service to 1-inch copper service in same location (within 30 inches of existing service) at customer request: **$278**.

Size-increase request at a location exceeding 30 inches from existing service will also be subject to a new service installation charge (section 3.1) and service retirement charges (section 3.6) for the existing service.

Service size increases are subject to the Connection Charge and Street Restoration charges under section 3.1.

3.3 SERVICE SIZE REDUCTION (WITHIN 30 INCHES OF EXISTING SERVICE)

2 inches and under, when reduced to smaller size: **$308**

All other sizes: Site-specific cost

Service size decreases are subject to the Street Restoration charges under section 3.1.

3.4 METER TEST (AT REQUEST OF CUSTOMER)

Charge will be waived if tested meter is found to be over-registering.

Tests conducted at the meter shop:

- Meter shop test of 1 ½ inches and under **$378**
- Meter shop test of 2-inch meter....................... **$399**
- 3-inch and larger meter **$544**

Field testing of 1-inch or smaller meters **$99**

Field testing retail-service meters
outside Seattle direct-service area.............................. **$608**

3.5 METER REMOVAL

- ¾- inch or 1-inch meter **$122**
- 1 ½ -inch and larger meter **$158**
- 3-inch and larger meter,
  time and materials, deposit **$800**
- Removal of illegal jumper.................................. **$88**

3.6 SERVICE RETIREMENT

Abandonment with or without meter removal. This charge also applies to a customer-requested service transfer from one abutting water main to another, not related to new water main construction:

- 1 inch and smaller: **$1,153**
- 1 ½ inch and 2 inches: **$1,229**
- 3 inches and larger....................................... **$5,007**

Additional service retirement charge for second trip due to contractor delay. When contractor needs continuous water service or some other condition requires SPU to return to job site to perform the retirement:

- 1 inch and smaller **$692**
- 1 ½ and 2 inches **$737**
- 3 inches and larger **$3,004**

Service retirements are subject to the Street Restoration charges under section 3.1.

Repaving happens after SPU visits the site. If a contractor repaves before this time additional costs incurred by SPU will be billed at Time and Materials.

3.7 METER RESET

For meter resets following customer-requested removals:

- ¾-inch meter **$220**
- 1-inch meter **$222**
- 1 ½ -inch meter **$462**
- 2-inch meter **$565**

For meter resets following credit-related removals:

- ¾-inch meter **$220**
- 1-inch meter **$222**
- 1 ½ -inch meter **$462**
- 2-inch meter **$565**

Install temporary service jumper:

- 2 inches and smaller: **$91**

Note: If reduction in size occurs at time of reset, then charge reduction fee only.

3.8 SPECIAL FIELD TRIPS

Investigating on-property loss of water:

- When loss of water is caused by actions taken on-property, the same charges apply as for meter turn-ons and shut-offs above.
- When investigating leaks on-property and it is found that the City water-service line is intact, the same charges apply as for meter turn-ons and shut-offs above.

Inspection services for re-inspection required because the requesting customer is not ready for inspection by deadline or stated date: **$262**.

Special meter read:

- For actual readings meters of all sizes ordered in connection with property ownership or occupancy changes **$98**
- For obstructed meter readings **$117**

- Adjust buried, obstructed or low meter boxes or valve boxes caused by customer installed landscaping or resurfacing (¾-inch to 2-inch meters) **$462**

Trim customer-installed vegetation obstructing meter boxes or fire hydrants: **$149**

Replace customer damaged lock: **$50**

3.9 STATEMENT OF COMBINED UTILITY ACCOUNT

Customer request for billing system screen-print statement of account activity for each 12-month period: **$7**

Customer request for formal statement of account activity, for each account number per 12-month period: **$54**

External utility request for water consumption information to be used for billing the retail services of that utility: **$2** per account for information covering any period of 12 months or less.

3.10 PROCESS RETURNED CHECK OR DRAFT

Includes checks returned for nonsufficient funds or other reasons which prevent processing: **$25**

3.11 CREDIT AND COLLECTION CHARGES

Meter shut-off or turn-on charge, including Fire Services. Charges are for each trip.

Meter size (inches)	Charges		
	Normal Hours	*Extended Hours*	*After Hours*
¾ to 2	**$144**	**$252**	**$530**
3 or larger	**$565**	**$670**	**$775**

- This charge may be suspended in special circumstances as determined by the Director of SPU or designee.
- No charge for the first trip for a credit-related turn-on during SPU normal business hours. Second and subsequent trips are subject to applicable standard charge above.

Late Payment Charge. Past due balances may be subject to a late payment charge that will include one or both of the following charges:

- Collection Notice Charge: **$10** for active account Urgent or Shutoff Notice, or closed account Final Notice.
- Delinquent Interest Charge: Monthly interest at the legal rate on past due balances.

Credit field visit: **$44**

3.12 DUPLICATE BILL PREPARATION

For all duplicate bills produced at customer request after original bill was produced: **$7**

3.13 DELAYED FINAL CUSTOMER BILLING

Customer request for final bill when notification is received more than 45 days after final bill date: **$39**.

3.14 ACQUISITION OF HYDRAULIC FLOW DATA

Where records are available for fire protection grading purposes: No charge.
SPU measures hydrant flow, flushes main, and prepares flow test report: **$1,599**

Contractor measures hydrant flow with SPU assistance, SPU flushes main and reviews flow test results prepared by contractor: **$841**

Performance of hydraulic analysis and report to determine best alternative to meet or exceed fire flow requirements: Time and materials with **$2,000** deposit.

Preparation of Hydraulic Modeling Simulation Report, when a flow test is not feasible, during a declared water emergency, or when a calibrated hydraulic model is available: **$326**

3.15 NONFIREFIGHTING HYDRANT USE PERMIT

Permit fee: **$176**

Charge for water use, if SPU determines water use will be less than 8,000 gallons per day:

- September 16 - May 15.................................... **$43** per day
- May 16 - September 15.................................... **$55** per day

Otherwise, a hydrant meter is required and commercial rates are charged.

During a declared water emergency, any hydrant permit users allowed to continue their permits will be charged at established surcharge commercial rate, if any.

Billing fee: **$51** for billing made by SPU for payment subsequent to hydrant permit use.

Hydrant valve and meter assembly: **$400** deposit for use of any SPU supplied hydrant equipment and material. Deposit refunded upon return of all equipment and material in same-as-issued condition. In the event of damaged equipment, SPU will keep a portion of the deposit equal to the cost of the damaged equipment, including overhead cost.

Installation and removal: **$103** each

Water use charged at the commercial rate or surcharge commercial rate if during a declared water emergency.

3.16 HYDRANT RESET

Set hydrant back or move closer to water main, where no re-tapping of main is required: **$7,367**, plus City or County permitting, plan review or inspection fees.

Plus, as required:
- Street Restoration charges under section 3.1.
- Pre and post-inspection: **$327** per job site
- Quick connect adapter: **$254**

3.17 HYDRANT RELOCATION

Remove existing hydrant and move to new location, new tap on main required: **$14,186**, plus City or County permitting, plan review or inspection fees.

Plus, as required:
- Street Restoration charges under section 3.1.
- Pre and post-inspection: $**327** per job site
- Quick connect adapter: **$254**

3.18 INSTALL NEW HYDRANT ON EXISTING WATER MAIN

Install new hydrant on existing water main: **$5,982**, plus City or County permitting, plan review or inspection fees.

Plus, as required:
- Street Restoration charges under section 3.1.
- Quick connect adapter: **$254**

3.19 INSTALL VERTICAL EXTENSION ON EXISTING HYDRANT

Install vertical extension on existing hydrant: **$2,098**, plus City or County permitting, plan review or inspection fees.

Plus, as required: Street Restoration charges under section 3.1.

3.20 CROSS-CONNECTION CONTROL PROGRAM

Charge for mailing reminder letters to customers who do not provide acceptable proof of satisfactory performance test of their backflow preventers within 30 days of receiving original notification, or to customers who have not installed backflow preventers as required: **$98** for each backflow preventer.

Hanging shut-off notices: **$141**

Shut-off and turn-on: Applicable standard charge for Special Field Trip as specified in section 3.8.

3.21 ACCESS ALONG OR CROSSING TRANSMISSION RIGHT-OF-WAY

Gate opening:

- Minimum: **$167**
- Charge may be in excess of the minimum depending upon the circumstances of opening.

Third-party work on SPU property: Time and materials costs for City employees and equipment stationed to protect City property the pipeline during third-party work on SPU Property shall be charged as per section 5.10.

3.22 ADDITIONAL SERVICES

Relocation of meter and box
Limited to a lateral move of 30 inches, deposit amount to be determined upon order: Billed at site-specific cost.

Service damage
For repair of damaged curb stop or meter setter, tailrun, etc.: Billed at site-specific cost.

Water main cut and cap
For cut, cap and block of existing water main: Billed at site-specific cost.

Design and/or Install Pressure Reducer

- SPU design, time-and-materials, deposit: **$8,200**
- Installation by SPU, time-and-materials - deposit:
  - 4 inches PR (2 inches Bypass) **$31,000**
  - 6 inches PR (2 inches Bypass) **$33,000**
  - 8 inches PR (4 inches Bypass) **$41,000**
- The deposit amounts listed above are the expected project costs, and do not include the cost of street repair. Street repair costs will be borne by the developer.

Work Outside Normal Business Hours
All work performed outside of SPU normal business hours due to customer request, or due to customer water supply concerns, will be charged at an overtime rate.

SDOT Right-Of-Way
When any work is to be performed in a SDOT right-of-way which necessitates a Letter of Justification: **$600** deposit required for application to SDOT by SPU.

Installation Plans
Water meter and fire hydrant installation plans may be prepared by SPU at the developer's expense. The cost to prepare the plans depends primarily on the availability of as-built information and the number and complexity of the existing utilities. An advance deposit of **$360** is required from the customer before design work begins.

4. DEVELOPER PROJECTS

Note: Charges paid more than 12 months in advance of work performed will be recharged at current year's rate.

4.1 WATER MAIN CONNECTION

For cut-in tee connection to charged water mains, SPU furnishes sleeve(s) to connect new tee into existing main. For wet tap connection, SPU furnishes tapping sleeve and tapping valve. Contractor furnishes all other materials, tees, valves, valve boxes and lids, fittings, sleeves, excavation, backfill, compaction and restoration. SPU performs shutdown and draining of existing mains, connection of new main, and restoration of service: **$3,829** per connection.

4.2 WATER QUALITY INSPECTION, SAMPLE COLLECTION AND BACTERIOLOGICAL TESTING

- **$838** for first 500 feet of water main
- **$591** for each additional 500 feet thereafter

4.3 DESIGN REVIEW, PLAN APPROVAL, ADMINISTRATION AND ACCEPTANCE OF MAIN

- **$1,577** per water main project

4.4 CONSTRUCTION INSPECTION

Rate includes travel to and from job site:

- 0 to 350 lineal feet..................................... **$6,308**
- 351 to 700 lineal feet.................................... **$7,780**
- 701 to 1,050 lineal feet............................. **$11,354**
- Over 1,050 lineal feet requires Special Estimate: time and materials

Time and materials will be charged for re-inspection caused by contractor.

4.5 COMPACTION TESTS

Required when contractor uses native or imported backfill instead of control density fill

- Field in-place density test per ASTM D 2922.............. **$139**
- Maximum dry density per ASTM D 698....................... **$182**

4.6 NEW SERVICE INSTALLATION (DEVELOPER)

Standard charges will be reduced for new service installation in conjunction with developer installed water mains. None of the discounts for nondeveloper service installations listed in section 3 apply to the developer fees listed below.

The following conditions must be met:

- Property is within the direct service area of Seattle's water utility
  AND EITHER:
- Developer is installing a water main to serve the property
  OR

- During peak work load conditions, the Department authorizes the developer to open trench, shore, backfill, and complete all street/sidewalk paving restoration.

Note: If above conditions are not satisfactorily met, developer will pay SPU on a time and materials basis for completion of work.

Charges for new service installations meeting the conditions above are:

Domestic Services

Size (in.)	Installation Fee	
	Residential	*Arterial*
¾	**$1,932**	**$2,276**
1	**$2,018**	**$2,362**
1 ½	**$4,389**	**$4,926**
2	**$4,745**	**$5,498**
3	Cost*	Cost*
4	Cost*	Cost*
6	Cost*	Cost*

* All services 3 inches and larger will be based on a site-specific cost.

Fire Services

Size (in.)	Installation Fee	
	Residential	*Arterial*
2	**$6,667**	**$9,549**
4	Cost*	Cost*
6	Cost*	Cost*
8	Cost*	Cost*

* All services 3 inches and larger will be based on a site-specific cost.

Arterial streets include every street, or portion thereof, designated as such in Exhibit 11.18.010 of the Seattle Municipal Code.

If new service is being installed with developer water main, see section 5.

Any service request deemed by SPU to be nonstandard will be based on a site-specific cost.

Combination Fire/Domestic Services

- Combination fire/domestic services are available in 4-inch, 6-inch and 8-inch sizes. These services require approval from the SPU Director or designee.
- All combination fire/domestic services will be based on a site-specific cost.

Legislation for an easement granted to the City of Seattle for infrastructure to be owned by SPU but installed by a developer, see section 5.6.

5. PROPERTY SERVICES

SPU must charge for any administrative costs it incurs as a result of processing applications or requests for the use of SPU's property, or the purchase of SPU's property or property rights (such as an easement). These costs can be charged in the form of a "Standard Charge" or "Time and Material" as established by section 5 herein.

In addition to administrative costs SPU must receive "Fair Market Value" for any property sold, easements granted, other permanent or temporary property rights granted, or the use of SPU Property. Fair Market Value can include the value of any real and substantive benefit to SPU (Mutual and Offsetting Benefits).

Unless otherwise provided by Ordinance, no permit shall be issued that would extend for more than a year. Otherwise, all permits must be revocable.

Due to the variables inherent to real property transactions, administrative costs, legislative costs, and Use Fees established by section 5 may not always accurately apply. In such cases, charges may be adjusted to reflect the actual situation.

Leasehold Excise Tax is required on all permits and leases as required by RCW 82.29A, and RCW 82.29A.130.

All charges established by City of Seattle ordinance or regulations take precedence over all charges established by section 5 herein.

5.1 TIME AND MATERIAL CHARGES

If SPU determines that a Standard Charge established by section 5 is expected to be inadequate to cover SPU's administration costs arising from any application or request, an estimate of the expected Time and Material cost will be determined by SPU. The applicant or requester shall pay the estimated amount, which shall be deposited in a SPU Guaranteed Deposit Account, and billed periodically. If actual Time and Material costs are less than the deposit, the balance shall be refunded; if the actual costs exceed the deposit, the balance owing will be charged to the applicant.

If mutually agreed between SPU and the applicant or requester, the estimated amount may be paid up-front as payment in full, and no accounting of Time and Materials will be kept.

At SPU's discretion, a deposit will not be required for governmental or public entities such as state, county or municipal governments, or public utilities, provided that such entity has entered into an agreement with SPU to pay accrued charges on a periodic basis.

5.2 STANDARD CHARGES FOR USE PERMIT APPLICATION

The following fees are nonrefundable:

- **$1,745** is the Standard Charge for a permit application, when administration costs are expected to require up to 16 hours of SPU time. Generally, this charge applies for simple Utility Crossings, Linear Use, and Surface Use of SPU

Property. If more than 16 hours are expected to be required, Time and Material costs may be charged.

- **$340** is the Standard Charge for the first-time preparation of a Special Short-Term Surface Use Permit. **$110** will be the Standard Charge for each renewal of the permit. In addition, the Permittee is required to pay the appropriate gate opening fees, the Special Short-term Surface Use Fee of **$50** a day for the use of SPU's property, and provide proof of insurance as required by SPU. A single permit may be issued for recurring use up to 30 days per year.
- **$570** is the Standard Charge for Permittee name change with no change in use. Permit Terms and Conditions, and Use Fee, may be updated.

5.3 USE FEES

In addition to the Standard Charge for Use Permit Application Fee under section 5.4, herein, Use Fees for the use of SPU property for permits and leases to be granted shall be established at "Fair Market Value" unless a specific rate is provided below:

Utility Crossings
There is no use fee for utility crossings of SPU fee-owned right of way.

General Surface Use

- There are Use Fees for Surface Use of SPU fee-owned property. Typically this use is for parking in SPU right of way used by adjacent property owners, but, can include other uses such as construction staging, job shacks, etc.
- The Annual Use Fee for all for-profit Permittees shall be no less than **$1,000**, even if the estimated "Fair Market Value" for the use of the SPU fee-owned property is less.

Special Short-term Surface Use
$50 per day. Typically this use is for short term parking for community sponsored and non-profit events that are compatible with utility use, but is not limited to parking.

Linear Use of Property
There are Use Fee's for Linear Use of SPU fee-owned property, typically utility use of the surface, underground, or overhead. Linear Use Fees are currently under review. Until such time as the fees are officially changed, unless established otherwise by an existing permit, the following fees apply:

- **$500** Annual Use Fee for each communication related conduit, cable, or wire, plus 25 cents for each conduit, cable, or wire for each linear foot over 1,000 feet. This fee applies to cable, conduit, or wire of no more than 4 inches in diameter. This fee will be increased proportionately for larger sizes or more impactful installations.
- **$500** Annual Use Fee for each distribution or service related utility facilities, such as water, sewer, drainage, and gas, plus 25 cents for each conduit or cable, for each linear foot over 1,000 feet. This fee applies to facilities of no more than 4 inches in diameter. The fee for transmission facilities and facilities of more than 4 inches in diameter shall be determined on a case by case basis.
- When issuing new permits, there is a **$250** Annual Use Fee for each hand hole, vault or other above or below ground structure measuring less than 2 feet in width, height and depth. The Annual Use Fee for each hand hole, vault or other

below- or above-ground structure measuring over 2 feet in height, width or depth shall be determined on a case-by-case basis. An Annual Use Fee may be instituted for each hand hole, vault or other below- or above-ground structure that is discovered to exist within SPU property and was not included in approved plans submitted at the time of application of the permit.

Utility Use in SPU Tunnels

Use fees are currently under review, and could be changed at any time. Until such time as the fees are officially changed, unless established otherwise by an existing permit, the following annual fees apply.

- **$767** for each communications related conduit or inner duct under 2 inches diameter.
- **$1,534** for each communications related conduit between 2 to 3 inches diameter.
- **$2,300** for each communications related conduit (which can contain inner duct) 3-plus inches diameter up to 48 square inches in cross sectional area of the cable or conduit.
- The Annual Use Fee for non-communications related facilities, such shall usually be at the same rates as the communication facilities. However, the fee may be determined on a case by case basis.
- Any facilities of more than 48-square inches in cross sectional area may be determined on a case by case basis.

5.4 PREPARATION OF LEGISLATION

The following fee is nonrefundable.

$3,807 is the Standard Charge for the administrative cost for any legislation required due to the requests or actions of any person or entity, other than SPU. This charge is based on the requirement that the applicant and or requester provide all necessary information, such as acceptable proof of ownership, signatory authority, and an adequate survey and legal description. If, due to the applicant or requester's actions, SPU staff time significantly exceeds the cost of the Standard Charge, the applicant and or requester may be charged for additional SPU Time and Material costs.

Legislation is required when SPU buys or sells property, grants or acquires easements or any other property rights, grants permits, rental agreements or leases for more than one (1) year in duration.

Legislation is required for Partial or Full Transfers of Jurisdiction between City Departments.

5.5 REAL PROPERTY REVIEW OF STREET VACATION APPLICATIONS

No charge if SPU infrastructure is not located within the proposed vacation area.

Time and Materials shall be charged to the applicant or requester for SPU costs when either there is SPU infrastructure in the street vacation area, or the street vacation will impact other SPU infrastructure.

All reservations of rights for SPU infrastructure shall be subject to all other applicable costs and fees including, but not limited to legislation costs.

5.6 SURPLUS, SALE OR EXCHANGE OF SPU FEE-OWNED PROPERTY

Time and Materials and legislative costs shall be charged, as per section 5.1, for SPU costs in conjunction with the sale or exchange of SPU property, when initiated by an outside entity. These costs may include, but are not limited to: SPU staff time, title, appraisal, survey, document preparation, closing and recording. If actual costs are less than the deposit, the balance shall be refunded; if the actual costs exceed the deposit, the balance will be charged to the applicant.

Time and Materials and legislative costs generally are not charged when SPU initiates a sale of surplus property.

In addition to these charges, SPU must receive Fair Market Value for its property.

5.7 ENCROACHMENTS

Encroachments are unauthorized use of SPU fee-owned property or easement rights. Types of encroachments and the impact to SPU property rights vary greatly. Therefore, the Time and Material and Use Fees to resolve encroachments shall be determined on a case-by-case basis.

5.8 MINOR PROJECTS AND ACCESS TO SPU PROPERTIES

Gate opening fees according to section 3.21.

$125 per hour with a one hour minimum charge for entry to SPU facilities when a security specialist is required for access and/or to stay with non-SPU personnel while on SPU property.

$80 to **$125** per hour will be charged (hourly rates will vary) for entry to SPU facilities when SPU personnel are required for access and/or to stay with non SPU personnel while on SPU property. The rate will include overtime when applicable. When overtime is applicable, a minimum of 4 hours overtime will be charged. Travel time will also be charged.

$125 may be charged if a Site Security Plan provided by SPU Security is required.

6. LABORATORY ANALYSIS

All laboratory analyses will be conducted at the discretion of the Water Quality Laboratory Manager and on the basis of time availability. Prices reflect the cost for routine analyses with standard reporting and turnaround times. The price for analyses not included in this list will be based on the cost for labor, equipment, material and overhead, as determined by the Water Quality Laboratory Manager. If available and mutually agreeable, analyses may be available on a call-out basis at double the charges listed.

6.1 BACTERIOLOGICAL ANALYSIS — PER ANALYSIS

Bacteriological Analysis	Per Analysis
Total Coliform (MF)	**$25**
Total Coliform (MPN)	**$21**
Total Coliform/E. Coli (MMO/MUG; P/A)	**$17**
Coliform verification; including Fecal Coliform/E. Coli (EC/MUG)*	**$26**
Fecal Coliform (MF)	**$25**
Fecal Strep (MF)	**$21**
Enteric culture identification (API)	**$99**
Heterotropic plate count	**$26**
Pseudomnonas (MF)	**$25**
Biolog	**$145**
Sample prep for non-drinking water (filter/dilutions)	**$13**

* This test is performed on drinking water samples that test positive for Total Coliform by the membrane filtration method. It is used to verify the presence of Total Coliform and simultaneously test for Fecal Coliform and E. Coli.

6.2 CHEMICAL ANALYSIS — PER ANALYSIS

Metals/Inorganics

Chemical Analysis	Per Analysis
Metals by Flame AA and Flame Emission Screen	**$19** per element
Batch of 8 to 19	**$39** per element
Batch of 20 or more	**$22** per element
Metals by Graphite Furnace AA	
Batch of 1 to 19~	**$43** per element
Batch of 20 or more	**$29** per element
Digestion for non-drinking water samples	**$25** per sample
ICPMS 21 element screen⌖	**$237** per sample
ICPMS (less than 20 samples, 3 to 7 elements/sample	**$23** per element
ICPMS (20 or more samples for 3 to 7 elements or 10 or more samples for 8 or more elements)	**$16** per element
Metals Filtration	**$23** per sample

~ If two or more metals can be analyzed simultaneously, then 10 samples of two metals qualify for volume discount.

⌖ ICPMS screen includes: Al, Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, K, Mn, Na, Ni, Pb, Sb, Se, Sn, Tl, Zn

Titrations

Total Alkalinity ....**$21** per sample

Batch of 10 or more ....**$16** per sample

Calcium or Hardness, edta ....**$24** per sample

Batch of 10 or more ....**$18** per sample

Organics

Total Trihalomethanes (TTHMs) **$96**

Total Organic Carbon (TOC)..**$29**

Haloacetic Acids (HAAs)..**$140**

Dissolved Organic Carbon (DOC)..**$39**

DBP Formation/Simulate, Distribution System (prep only) **$83**

Nutrients

Total Nitrogen..**$25**

Total Phosphorus **$25**

Nitrate-Nitrite **$25**

Soluble Reactive Phosphorus...**$24**

Other Procedures

Color.. **$9**

Copper (comparitor, colorimetric)...**$11**

Fluoride (potentiemetric)...**$15**

Iron (colorimetric comparitor) **$11**

pH, potentimetric **$15**

Specific conductance..**$11**

Turbidity.. **$9**

Chlorine Residual, colorimetric **$11**

Chlorine Demand

Single contact time at the requested
temperature, pH, and Cl2 dosage **$103**

For each additional contact time, temperature,
pH or Cl2 dosage on the same water source. **$35**

Seepage (minimum or sum of parameters tested) **$58**

UVA (254-545)...**$14**

SOC-VOC Screen **$166**

VOC Screen **$134**

Nitrate-Nitrite Screen and UVA **$28**

Solids, Total Suspended...**$30**

Solids, Total Dissolved **$30**

SEATTLE PUBLIC UTILITIES
2012-2014 WATER RATES

Effective January 1, 2012

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)
	Direct Service												Wholesale
RATE SCHEDULES	Inside City				Outside City				City of Shoreline / City of Lake Forest Park				Full and Partial
	Residential	MMRD*	Gen Svc	Fire Service	Residential	MMRD*	Gen Svc	Fire Service	Residential	MMRD*	Gen Svc	Fire Service	
Commodity Charge ($/100 Cubic Feet)													
Offpeak Usage (Sept 16-May 15)	$4.04	$4.04	$4.04		$4.61	$4.61	$4.61		$4.90	$4.90	$4.90		$1.52
Peak Usage (May 16-Sept 15)													
Up to 5 ccf**	$4.34	$4.34	$5.15		$4.95	$4.95	$5.87		$5.26	$5.26	$6.25		$2.26
Next 13 ccf**	$5.15	$5.15	$5.15		$5.87	$5.87	$5.87		$6.25	$6.25	$6.25		$2.26
Over 18 ccf**	$11.80	$11.80	$5.15		$13.45	$13.45	$5.87		$14.31	$14.31	$6.25		$2.26
Usage over base allowance				$20.00				$22.80				$24.30	
Utility Credit ($/month)	$16.97		$10.14		$16.97		$10.14		$16.97		$10.14		
Demand Charge ($/1000 gallons of deficient storage)													$22.00
Base Service Charge ($/month/meter)													New Srvc Fee (One Time)
3/4 inch and less	$13.25		$13.25		$15.10		$15.10		$16.05		$16.05		$783
1 inch	$13.65		$13.65		$15.55		$15.55		$16.55		$16.55		$1,566
1-1/2 inch	$21.05	$21.05	$21.05		$24.00	$24.00	$24.00		$25.55	$25.55	$25.55		$3,915
2 inch	$23.35	$23.35	$23.35	$15.40	$26.60	$26.60	$26.60	$18.00	$28.30	$28.30	$28.30	$19.00	$6,264
3 inch	$86.35	$86.35	$86.35	$20.00	$98.45	$98.45	$98.45	$23.00	$104.70	$104.70	$104.70	$24.00	$17,226
4 inch	$123.75	$123.75	$123.75	$37.00	$141.10	$141.10	$141.10	$42.00	$150.10	$150.10	$150.10	$45.00	$24,273
6 inch		$152.30	$152.30	$63.00		$173.60	$173.60	$72.00		$184.70	$184.70	$76.00	$51,678
8 inch		$199.00	$199.00	$100.00		$227.00	$227.00	$114.00		$241.00	$241.00	$121.00	$87,696
10 inch		$297.00	$297.00	$144.00		$339.00	$339.00	$164.00		$360.00	$360.00	$175.00	$132,327
12 inch		$402.00	$402.00	$210.00		$458.00	$458.00	$239.00		$488.00	$488.00	$255.00	$186,354
16 inch		$477.00	$477.00			$544.00	$544.00			$579.00	$579.00		$186,354
20 inch		$614.00	$614.00			$700.00	$700.00			$745.00	$745.00		$186,354
24 inch		$771.00	$771.00			$879.00	$879.00			$935.00	$935.00		$186,354

Effective January 1, 2013

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)
	Direct Service												Wholesale
RATE SCHEDULES	Inside City				Outside City				City of Shoreline / City of Lake Forest Park				Full and Partial
	Residential	MMRD*	Gen Svc	Fire Service	Residential	MMRD*	Gen Svc	Fire Service	Residential	MMRD*	Gen Svc	Fire Service	
Commodity Charge ($/100 Cubic Feet)													
Offpeak Usage (Sept 16-May 15)	$4.50	$4.50	$4.50		$5.13	$5.13	$5.13		$5.46	$5.46	$5.46		$1.53
Peak Usage (May 16-Sept 15)													
Up to 5 ccf**	$4.73	$4.73	$5.72		$5.39	$5.39	$6.52		$5.74	$5.74	$6.94		$2.26
Next 13 ccf**	$5.72	$5.72	$5.72		$6.52	$6.52	$6.52		$6.94	$6.94	$6.94		$2.26
Over 18 ccf**	$11.80	$11.80	$5.72		$13.45	$13.45	$6.52		$14.31	$14.31	$6.94		$2.26
Usage over base allowance				$20.00				$22.80				$24.30	
Utility Credit ($/month)	$18.19		$11.22		$18.19		$11.22		$18.19		$11.22		
Demand Charge													$22.00
($/1000 gallons of deficient storage)													
Base Service Charge ($/month/meter)													New Srvc Fee
													(One Time)
3/4 inch and less	$13.50		$13.50		$15.40		$15.40		$16.35		$16.35		$783
1 inch	$13.90		$13.90		$15.85		$15.85		$16.85		$16.85		$1,566
1-1/2 inch	$21.45	$21.45	$21.45		$24.45	$24.45	$24.45		$26.00	$26.00	$26.00		$3,915
2 inch	$23.75	$23.75	$23.75	$15.40	$27.10	$27.10	$27.10	$18.00	$28.80	$28.80	$28.80	$19.00	$6,264
3 inch	$88.00	$88.00	$88.00	$20.00	$100.30	$100.30	$100.30	$23.00	$106.70	$106.70	$106.70	$24.00	$17,226
4 inch	$126.10	$126.10	$126.10	$37.00	$143.75	$143.75	$143.75	$42.00	$152.95	$152.95	$152.95	$45.00	$24,273
6 inch		$155.15	$155.15	$63.00		$176.85	$176.85	$72.00		$188.15	$188.15	$76.00	$51,678
8 inch		$199.00	$199.00	$100.00		$227.00	$227.00	$114.00		$241.00	$241.00	$121.00	$87,696
10 inch		$297.00	$297.00	$144.00		$339.00	$339.00	$164.00		$360.00	$360.00	$175.00	$132,327
12 inch		$402.00	$402.00	$210.00		$458.00	$458.00	$239.00		$488.00	$488.00	$255.00	$186,354
16 inch		$477.00	$477.00			$544.00	$544.00			$579.00	$579.00		$186,354
20 inch		$614.00	$614.00			$700.00	$700.00			$745.00	$745.00		$186,354
24 inch		$771.00	$771.00			$879.00	$879.00			$935.00	$935.00		$186,354

Effective January 1, 2014

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)
	Direct Service												Wholesale
RATE SCHEDULES	Inside City				Outside City				City of Shoreline / City of Lake Forest Park				Full and Partial
	Residential	MMRD*	Gen Svc	Fire Service	Residential	MMRD*	Gen Svc	Fire Service	Residential	MMRD*	Gen Svc	Fire Service	
Commodity Charge ($/100 Cubic Feet)													
Offpeak Usage (Sept 16-May 15)	$4.99	$4.99	$4.99		$5.69	$5.69	$5.69		$6.05	$6.05	$6.05		$1.53
Peak Usage (May 16-Sept 15)													
Up to 5 ccf**	$5.13	$5.13	$6.34		$5.85	$5.85	$7.23		$6.22	$6.22	$7.69		$2.27
Next 13 ccf**	$6.34	$6.34	$6.34		$7.23	$7.23	$7.23		$7.69	$7.69	$7.69		$2.27
Over 18 ccf**	$11.80	$11.80	$6.34		$13.45	$13.45	$7.23		$14.31	$14.31	$7.69		$2.27
Usage over base allowance				$20.00				$22.80				$24.30	
Utility Credit ($/month)	$19.46		$12.38		$19.46		$12.38		$19.46		$12.38		
Demand Charge ($/1000 gallons of deficient storage)													$22.00
Base Service Charge ($/month/meter)													New Srvc Fee (One Time)
3/4 inch and less	$13.75		$13.75		$15.70		$15.70		$16.70		$16.70		$783
1 inch	$14.20		$14.20		$16.20		$16.20		$17.20		$17.20		$1,566
1-1/2 inch	$21.85	$21.85	$21.85		$24.90	$24.90	$24.90		$26.50	$26.50	$26.50		$3,915
2 inch	$24.20	$24.20	$24.20	$15.40	$27.60	$27.60	$27.60	$18.00	$29.35	$29.35	$29.35	$19.00	$6,264
3 inch	$89.65	$89.65	$89.65	$20.00	$102.20	$102.20	$102.20	$23.00	$108.70	$108.70	$108.70	$24.00	$17,226
4 inch	$128.45	$128.45	$128.45	$37.00	$146.45	$146.45	$146.45	$42.00	$155.80	$155.80	$155.80	$45.00	$24,273
6 inch		$158.05	$158.05	$63.00		$180.20	$180.20	$72.00		$191.70	$191.70	$76.00	$51,678
8 inch		$199.00	$199.00	$100.00		$227.00	$227.00	$114.00		$241.00	$241.00	$121.00	$87,696
10 inch		$297.00	$297.00	$144.00		$339.00	$339.00	$164.00		$360.00	$360.00	$175.00	$132,327
12 inch		$402.00	$402.00	$210.00		$458.00	$458.00	$239.00		$488.00	$488.00	$255.00	$186,354
16 inch		$477.00	$477.00			$544.00	$544.00			$579.00	$579.00		$186,354
20 inch		$614.00	$614.00			$700.00	$700.00			$745.00	$745.00		$186,354
24 inch		$771.00	$771.00			$879.00	$879.00			$935.00	$935.00		$186,354

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

C. POLICIES, PROCEDURES AND STANDARDS

APPENDIX C-5

WATER AVAILABILITY CERTIFICATES

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Policy and Procedure

Title	Number
Water Availability Certificates (WACs)	CS-101
Responsibility	**Supersedes**
Drinking Water Division	2003 version
SPU Director's Approval	**Effective Date**
Ray Hoffman	May 9, 2011

1. PURPOSE

To establish policies for Seattle Public Utilities for issuance of Water Availability Certificates (WACs) in response to either certain applications within SPU Water's direct service area for the issuance of building permits, land use permits, or to customer requests for information about SPU's infrastructure and capacity requirements.

2. ORGANIZATIONS AFFECTED

- City of Seattle, Seattle Public Utilities
- City of Seattle, Department of Planning and Development
- City of Seattle, Fire Department
- King County Department of Building and Land Use
- King County Fire Districts
- City of Shoreline, Planning and Development Services
- Shoreline Fire District
- City of Burien
- City of Renton
- City of Lake Forest Park
- Developers/potential developers within SPU Drinking Water's direct service area

3. DEFINITIONS

Condominium is a type of housing consisting of one or more multiple-unit buildings. Each unit is owned separately but the surrounding land is owned in common. For purposes of this policy, the entire condominium is considered a single legal parcel.

Cottage-style development is a type of multi-family housing consisting of detached, separately-owned units with the surrounding land owned in common. For purposes of this policy, the entire cottage-style development is considered a single legal parcel.

Developer is a property owner, or a property owner's designee, who is building a structure to be supplied with water service on at least one legal parcel.

Engineering standards are Seattle Standard Specifications and Standard Plans, professional and technical society standards (such as AWWA, APWA), and City memoranda specifying design standards.

Frontage, for the purposes of this policy, is a boundary of any legal parcel or unit lot abutting a street right of way which is at least ten feet wide.

If the parent lot of a subdivision has frontage on more than one street right of way, the resulting lots are considered to have frontage on the street right of way nearest to the boundary.

If the parent lot of a subdivision has frontage on only one street right of way, all of the resulting lots are considered to have frontage on the same street right of way as the parent lot.

Landlocked Lot is a parcel or unit lot which has no street right of way within ten feet of any part of the boundary.

Master meter is a metered water service from a SPU-owned water main, serving more than one legal parcel or unit lot.

No-tap main is a water main for which SPU has determined that no new services shall be installed. Examples of no-tap mains are transmission or large diameter feeder mains, substandard mains with capacity inadequate for service, and mains from a different pressure zone. In some circumstances a main may be a no-tap main for services on only one side of the street.

Private water line is the customer-owned water pipe that extends from the end of the SPU water service at the city union point.

Standard water main is an SPU main which meets current size and material engineering standards and which can deliver required flows to service the project and surrounding area.

Townhouse, or *unit lot subdivision*, is a type of high-density residential development consisting of single or multiple-unit buildings. Each unit and its surrounding land are separately owned. For purposes of this policy, each unit lot is considered a separate legal parcel.

*Unio*n is a coupling at the end of SPU's water service connecting the public water service to the privately owned water service.

Water service is the portion of the SPU water distribution system dedicated to providing metered water service to a specific account. The water service begins at the water main, continues through the meter, and ends at the city union point.

4. GENERAL POLICIES

A. SPU will offer all customers in like circumstances the same requirements, services, agreements, or privileges.

B. WACs provide information on the SPU water system only. Information about on-site or privately owned water mains and/or hydrants is not included. The WAC document includes the following information:

1) Location of the property, including street address or Assessor's Parcel Number, and SPU map number.
2) Type of certificate (Inquiry, Meter Only, Building Permit or Land Use).
3) Certificate number, date of issue, and certifier's name.
4) Description of existing service(s) if any, including size, type and material.
5) Pressure zone and elevation.
6) Description of existing water main (if any), including size, material, installation date and distance from margin.
7) Description of hydrant, including distance from site and flow test or flow model, if available

C. Requirements for water service will be determined prior to issuing the WAC. An approved WAC is required for approval of building and land use permits.
   1) If an existing water service will be retained with no change, OR if the proposed project does not require water service, OR if water service is available at the project site with no changes to the existing distribution system, the WAC will be approved.
   2) If changes to the distribution system are required to provide water to the project, the WAC will not be approved, and the required changes to the distribution system will be described on the WAC.
   3) An Approved with Contract WAC will be issued when the property-owner/developer signs SPU's Property Owner Contract to Change SPU's Distribution System and pays the required fees.
   4) If the proposed project changes, the WAC will be re-evaluated. Changes to the project may result in increased requirements for water service.

D. SPU may reduce or waive the water main requirements under this policy, or may require an alternate improvement of equal or lesser cost, if such changes best serve the distribution system.

E. In some conditions (e.g., 20 percent or greater slopes, riparian corridors or other geological barriers, poor soil) the public right of way may be inappropriate for water main operation. The requirement to install a water main may be waived in such circumstances. SPU will determine on a case-by-case basis whether engineering remedies exist which would suffice for the construction of a main extension.

F. In special circumstances, the system may be best served by installation of a water main larger than required by this policy. In such cases, SPU will pay the difference in materials cost between the required standard main and the desired size.

G. In some circumstances, including but not limited to state highways, divided roads, presence of active railroad tracks, or other obstructions in the right of way, installation of a standard water main to serve each side of the road may be required.

H. Conditions not specifically described in this policy, including but not limited to multiple households on a single service, relocation of an existing service, increasing the size of an existing service, multiple services to the same legal parcel, and "no-man's land" areas not included in any existing water district, shall be evaluated on a case-by-case basis.

I. The property owner or developer may appeal the requirements made on the WAC by calling or writing to SPU. The WAC Review Committee will review the project and respond within two (2) weeks after receipt of the appeal to all interested parties, including the person appealing and other affected agencies. A revised WAC will be issued if required.

5. REQUIREMENTS FOR NEW WATER SERVICE

A. If no frontage of a parcel or unit lot abuts an existing standard water main, a standard water main will be extended to cross the full frontage of the property, and a portion of the adjoining street and/or alley, if any.

B. Unless landlocked, a parcel or unit lot must have at least ten feet of frontage abutting an existing standard water main to obtain water service from that main. The ten-foot width must be maintained from the frontage to the parcel or unit lot.

C. For parcels or unit lots with frontage on only one street or right of way:
   1) If there is an existing standard water main in that right of way, service shall be provided from that main.
   2) If there is not an existing standard water main in that right of way, a standard main will be extended across the full frontage of the legal parcel, and a portion of the adjoining alley, if any.
   3) SPU shall waive the requirement to install a standard water main if
      a. The parcel is located in a single family zone, AND
      b. The parcel is the last developable, single-family lot on the block, as determined by the permit-issuing agency with jurisdiction over it, AND
      c. There is no existing water main on the block.

D. For parcels or unit lots with frontage on more than one street right of way:
   1) If there are existing standard water mains on more than one frontage, SPU shall determine which main shall provide water service to the parcel.
   2) If a parcel or unit lot has frontage abutting only one existing standard water main, service shall be provided from that main.
   3) If there are no existing standard water mains on any frontage, SPU may require installation of a standard water main across the full frontage of the legal parcel, and a portion of the adjoining alley, if any.

E. If a parcel or unit lot is landlocked (has no frontage within ten feet of any right of way), SPU may require the Developer to install a water main on private property, to be owned by SPU. Landlocked parcel(s) or unit lot(s) for which SPU determines not to require a water main shall be served via private water lines through private easements, or through a master meter.

F. If the parent lot of a subdivision, including unit lot subdivisions, is more than 200 feet deep as measured from the property line at the public right of way to the point farthest away from it, SPU may require the Developer to install a water main on private property, to be owned by SPU.

G. New water mains installed under this policy shall follow current City of Seattle Plans and Specifications and SPU water main design standards.

H. Private water lines shall be on private property unless specifically approved by SPU and SDOT.

I. At SPU's discretion, new services may be installed each in a separate standard meter box (individual), or consolidated together into larger vaults and connected to the main with manifold piping, whereby each group of services is supplied from a single tap on the existing or newly installed water main in the public right of way.

J. The easement for an SPU-owned main on private property must be at least twenty feet wide.

K. Private water lines in easements may be bundled if desired.
   1) Bundled private water lines shall be installed in a casing pipe.
   2) Each private water line in the bundle shall be separately identified.

L. The easement for one private water line or for a casing pipe containing bundled private water lines must be at least 5 feet wide. If more private water lines will be installed in any portion of an easement, a minimum of one additional foot of easement width must be allowed for each additional private water line. The easement must be continuous from the water meter to the parcel or unit lot served by that meter.
   1) The easement must be obtained by the developer, recorded, and a copy provided to SPU at the time of ordering water service.
   2) Individual and bundled private water lines in easements shall be impermeable to petroleum products.

M. Cottage developments shall be served by an SPU master meter. Private submeters may be used if desired.

N. A common fire and/or irrigation service may be installed to serve properties which have individual domestic services (e.g., live/work townhouses with a common garage).

O. A covenant and a homeowners' association are required for legal parcels which are served by a master meter (with or without private submeters) OR by a privately owned water distribution system, OR which share a common fire and/or irrigation service. To order water service for the project, the Developer must provide:
   1) A signed, recorded covenant for each legal parcel/living unit within the boundary of the project stating that SPU will not separate shared water service(s).
   2) Documentation of the creation of a homeowners' association or other entity which will be responsible for the operation, maintenance, repair, replacement of the privately owned piping and/or shared water service as well as the payment of all SPU utility charges.
   3) SPU will not read or bill any privately owned water meters from privately owned water systems.

P. Lot boundary adjustments which have the effect of avoiding water main installation requirements under this policy shall not be considered by SPU when such determination is made.

6. AUTHORITY/REFERENCES

- RCW 80.28.080, Gas, electrical, and water companies
- SMC 21.040.060, Water rates and regulations

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

C. POLICIES, PROCEDURES AND STANDARDS

APPENDIX C-6

WATER SERVICE WITHIN THE DIRECT SERVICE AREA

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Seattle Public Utilities - Policy & Procedure

Subject:		Number: SPU-CS-102
Water Service within the Direct Service Area		Effective: October 17, 2003
		Supersedes: SPU-CS-010 (12/30/83) 400P-23-05 (9/01/82)
Approved: [signature]	Department: Seattle Public Utilities	Page(s):

1.0 PURPOSE

To establish policies and procedures for Seattle Public Utilities for granting water service connections to its water distribution system within its direct service area.

2.0 ORGANIZATIONS AFFECTED

2.1 City of Seattle, Seattle Public Utilities (SPU)
2.2 City of Shoreline
2.3 King County
2.4 Customers residing near and within SPU's direct water service area

3.0 AUTHORITY FOR RULE

3.1 Revised Code of Washington 35.91; 35.92; 80.28.080
3.2 Seattle Municipal Code 21.04
3.3 Most current SPU Water System Plan

4.0 GENERAL POLICIES

4.1 Standards and Requirements for New Services

4.1.1. All new SPU water service connections will be connected to a standard water main designed to serve that property. (see also Policy SPU-CS-101, Water Availability Certificates)

4.1.2 All water service connections to SPU's water distribution system will be metered and either monthly or bi-monthly bills will be sent to the property owner or owner's designee,

4.1.2.1 The only exception to the above metering and billing policy will be for the fire services on Interstate Highways 5 and 90.

4.1.3 Application for water service by the property owner will be approved when SPU has issued a current, approved Water Availability Certificate, and when SPU has been provided with the following:

4.1.3.1 SPU's application for water service form completed and signed by the property owner, and

4.1.3.2 the common street address and legal description of the parcel to be served, and

4.1.3.3 utility plans showing all existing and proposed utilities

4.1.3.4 all recorded easements needed for private service lines, when applicable.

4.1.3.5 payment of the current standard or estimated deposit fees for installation, and

4.1.3.6 payment of the street use permit if applicable, and

4.1.3.7 payment of the Connection Charge in full (see Policy _______, Connection Charge), or entering into SPU's finance contract for its payment over a 10-year period

4.1.4 Each legal parcel will be served by one domestic water service, except

4.1.4.1 When SPU has allowed or required parcels not abutting a water main to be served by either a privately owned water main or long service lines, a covenant or homeowner bylaws will be filed with those parcels to run with the land and prohibit the property owners of those parcels from requesting individual service directly from SPU's distribution system.

4.1.4.2 Certain parcels may be served by more than one domestic service due to the use of the property, i.e., hospitals, nursing homes and similar facilities, to assure continuous uninterrupted water service. Each service will be from separate water mains abutting the parcel when possible.

4.1.4.3 A community containing more than one legal parcel and either more than 350 feet of private road, or a gated private road of any length, will be served with one domestic meter at the perimeter of that community of legal parcels.

It may be possible that a second SPU domestic service be available to this community's private system from a second SPU-owned water main if needed to provide reliability via a "looped" private water system, i.e., a system having two separate sources of water from the SPU distribution system. Both domestic services would be located at the perimeter of the community of legal parcels. (see also Sec. 4.4.5 of Policy SPU-CS-101, WACs)

4.1.4.4 One very large parcel of land which contains a privately owned water distribution system may be served by more than one domestic service to provide reliability via a "looped" private water system (e.g., the University of Washington campus).

4.1.4.5 One property may not serve another with water service, unless explicitly approved by both SPU and the affected property owners for a temporary, specified time period.

4.1.4.6 Each legal parcel will be eligible for separate water service for irrigation in addition to other domestic service.

4.1.4.7 Each legal parcel will be eligible for separate fire-only service.

4.1.5 Fire-only water services will consist of a detector check valve and a bypass meter assembly.

4.1.5.1. Water may be used at no charge for testing of the on-property fire suppression system monthly as follows:

- 100 cubic feet for fire services 1-to-2inches
- 500 cubic feet for fire services 3-to-5 inches
- 1,000 cubic feet for fire services larger than 5 inches

4.1.5.2. The detector check valve will be changed by SPU, at the property owner's expense, to a fully metered fire service if water used at the property regularly exceeds the above limits set for system testing

4.1.6. If a property's water service will be used solely or in part for an internal fire suppression system (e.g. sprinkler heads), the property shall not be served by a water service less than one inch (1") in size.

4.1.7 Water service to direct service area customers will be from SPU's distribution water main system and not from its supply or transmission pipelines.

4.1.8 Water services up to two inches (2") in size will be charged a reduced installation rate when

4.1.8.1 a new water main to serve the property and to be owned by SPU is installed by a property owner, and

4.1.8.2 the property owner's contractor will trench for SPU's service line and backfill the trench.

4.1.9 Water service to customers within SPU's direct service area may be obtained from a water purveyor whose distribution system abuts the property within SPU's direct service area and SPU requests this purveyor in writing to provide temporary service to a particular property until SPU is ready to serve from its own distribution system.

4.1.10 SPU will consider an application for water service to a property not located within its direct service area only when

4.1.10.1 SPU's water service pipe and meter will be within SPU's direct service area, and

4.1.10.2 the water utility whose direct service area includes this property has requested SPU in writing to serve this property until such time as that utility is prepared to serve it directly, and all other applicable requirements in SPU's policies have been fulfilled.

4.1.11 Temporary water service from the distribution system for less than six months may be authorized via a hydrant use permit or hydrant use meter issued by SPU Customer Services if no other source of water is available. No administrative or water usage charges for hydrant permit holders will be made for water main installation projects sponsored by SPU and for which SPU will pay all project costs.

4.1.11.1 Hydrant use without a hydrant permit or hydrant meter, or use of a restricted hydrant, will result in monetary penalties in addition to all other hydrant use charges:
$ 300 penalty for the first occurrence
$ 500 penalty for the second occurrence
$1,000 penalty for the third and subsequent occurrence

4.1.11.2 Permits may be issued if water use will be for less than 8,000 gallons per day

4.1.11.3 Permit holder will pay a permit fee as well as a daily charge for the water used. Payment may be made either in advance of service, or subsequent to service following a billing by SPU. A billing fee will be charged for payments made subsequent to service.

4.1.11.4 Permit holder will use an SPU supplied (or approved) hydrant valve.

4.1.11.5 Permit holder will pay SPU for any hydrant repairs necessitated by the improper operation of the hydrant at a time and material basis.

4.1.11.6 Hydrant meters will be required either

4.1.11.6.1 at the discretion of SPU Customer Services, or

4.1.11.6.2 under the following circumstances:

- water use will exceed 8,000 gallons per day, and
- use will be longer than 30 days, and
- no other acceptable or practical method of measuring or estimating actual water used is practical, and
- one hydrant only will be used, and
- projected weather conditions will permit the meter to be used without danger of freezing its parts.

4.1.12 Metered service will be required when temporary water is needed from one location for longer than six months.

4.2 Standards and Requirements for Changes to Existing Services

4.2.1. Existing substandard water service will be brought to standard water service whenever possible.

4.2.1.1 When a distribution main is installed which extends the distribution system to abut properties not formerly served by an abutting main, or to serve properties not formerly served by a main designed to serve that property, each property will abandon the service line to the nonabutting main and receive service from the main designed to serve or abutting the property.

4.2.1.1.1 Property owner will not be responsible for the cost either for SPU to retire the existing water service if it is two inches (2") in size or smaller, or for SPU to relocate an existing two-inch (2") or smaller water service. (see also Policy________ Connection Charge)

4.2.1.1.2 Property owner will be responsible for the SPU costs for retirement and relocation of the existing water service if it is larger than two inches (2"). (see alsoPolicy _________ Connection Charge)

4.2.2. When a water main is replaced, existing water services from that segment of water main will be transferred to the new main, the property owner will not be responsible for either retirement or new installation charges.

4.2.3. When the City or SPU changes the street or other infrastructure abutting a property with substandard water service, that water service will be changed to conform to standard practices in preparation for other changes to or in the street.

4.2.4. Property owners may request changes in the size of their water service, the location of their meter along the frontage of their property, and the type of use of their existing water service.

4.2.4.1. When increasing a service size, SPU will both retire an existing service and tap for a new service and property owner will pay SPU standard or time-and-material charges.
(see also Policy __________ for Connection Charge.)

4.2.4.2. When decreasing a two-inch (2") or smaller service, SPU will reduce the size of the existing meter and property owner will pay on a time-and-material basis. Any subsequent changes to water service size at this property will require a service retirement and new tap.

4.2.4.3. When decreasing a service larger than two inches (2"), SPU will both retire the existing service and tap for a new service and property owner will pay SPU standard or time-and-material charges.

4.2.4.4. Property owner may request a relocation of an existing service to a site along the property's frontage, the new location may not be in a driveway or within five feet (5') of a tree. SPU will both retire the existing service and tap for a new service if the lateral distance between the old and new locations is 31 inches or greater. Property owner will pay SPU standard or time-and-material charges in keeping with the current SPU Standard, Connection and Administrative Charges.

4.2.5. An existing domestic, irrigation or fire service may be changed to another use at the request of the property owner if no change in size or location is needed. (see Connection Charge Policy _______)

4.2.5.1. The property owner will pay for any SPU services required to change a fire-only service to a combination fire and domestic service

4.2.5.2. Any other changes to meter type will be at SPU's discretion at no additional cost to the property owner when no change in water service location or size is requested by the property owner.

4.2.6. Property owner will be charged for SPU repair of damage to the curb stop, meter, meter setter, meter box or lid, or tailrun.

4.2.7. Termination of existing water service

4.2.7.1. Domestic (including irrigation) water service may be shut off by SPU due to either nonpayment of utility charges (see Policy 400P-23-02 Credit and Collection), at the request of the property owner, or to effect maintenance, repair or changes to the water system.

4.2.7.1.1. SPU may remove the meter at owner's expense following shut off of service

4.2.7.1.2. Property owner may request SPU, at owner's expense

- to remove the water meter to stop water and sewer services and charges during an extended vacancy at the property. The eventual reset of the water meter also will be charged to the property owner. Removal of the meter does not stop solid waste services or charges.

- to shut off the water meter to prevent damage to the property from leakage or unauthorized water use

- to retire the domestic or irrigation service to the property.

4.2.7.2. Fire service (either fire-only or combination domestic and fire) will not be terminated by SPU without written request by the property owner and written acknowledgement and concurrence by the local fire department or district.

4.2.8. SPU may retire a domestic water service after 15 years of nonuse and charge the property owner for the cost of the retirement.

4.2.9. If a jumper, not authorized by SPU, is installed to pilfer water, SPU may retire the service and charge the property for the retirement, as well as charge for estimated water and other utility services provided during the time period the jumper was in use, as determined by SPU.

5.0 PROGRAM REVIEW

Periodic review of this policy shall be performed by the SPU Customer Services Branch as changes or conditions warrant in order to ensure that it remains current and effective in guiding SPU employees. Any recommended changes will be submitted to the SPU Director for consideration.

6.0 RESPONSIBILITIES

6.1 Property owner is responsible for

- the installation, replacement or repair of the privately owned service line from the City's union to the building(s) served, including changing a private service line when the service location to the property changes in accord with this Policy

- calling SPU Customer Services for inspection of all private underground water service line installations, repairs or replacements prior to covering

- marking the desired location of a new water service before SPU installs the service

- identifying and correcting water leakage or unauthorized water usage and notifying SPU of corrections allowing SPU to inspect any repairs or corrected water use problems

- notifying SPU of changes in property ownership or owner's designee for receiving the utility billings

6.2 SPU is responsible for

- the installation, replacement or repair of the publicly owned service from the City's water main, including the tap into the main, to the City's union

- timely inspection and other customer services

- responsiveness to customer needs

- offering all customers in like circumstances the same requirements, services, contracts or agreements, or privileges

- notifying property owner of any water usage excesses through fire services to allow owner to correct any problems prior to SPU's changing the fire service from a detector check to a meter.

7.0 DEFINITIONS

7.1 Abutting water main is a main which crosses some amount of the property; it may not be a standard main designed to serve if either the abutting main does not cross the full frontage of the property and there is a developable parcel beyond the property, or if the abutting main is not standard in size or material.

7.2 Direct water service area is the retail service area served by SPU's water distribution system as defined by the most current SPU Water System Plan.

7.3 Domestic service is a type of water service serving all potable water used at a property except fire-only water service.

7.4 Fire-only water service is available to provide stand-by water service for the sole purpose of supporting fire suppression devices on property (sprinklers, private hydrants, etc.) via a detector check meter assembly. A combination fire and domestic service is a domestic water service and is not a fire-only water service.

7.5 Irrigation service is a type of domestic water service designed to provide irrigation-only water at a property; sewer charges are not made on the water used through irrigation-only water services.

7.6 Jumper is a pipe installed to allow domestic or irrigation water to freely flow from the publicly owned service line to the user without being measured or billed by a meter, usually located in the meter box when a meter has been removed or not yet installed.

7.7 Master meter is a metered water service from a SPU-owned water main serving more than one legal parcel due to and in accordance with established SPU policy and procedure.

7.8 Private water service consists of the underground pipe leading from SPU's union to the building(s) being served, including any valves, stopcock, private submeters, backflow devices, etc.

7.9 Retirement of water service occurs when SPU has removed the connection to its distribution system by removing the tap to the water main and all other related water service equipment

7.10 Standard water service exists when a property receives metered water service from a standard water main designed to serve that property

7.11 Substandard water service exists either when a property's water service comes from a water main not designed to serve that property (i.e., it could be an abutting or non-abutting substandard water main or a non-abutting standard main), or when a property's water service comes from a neighboring property's water service.

7.12 Tail run is a short length of pipe installed by SPU from the meter box to SPU's union.

7.13 Termination of water service may include shut off of water at the meter, removal of the water meter, or retirement of SPU's tap and service line to the property

7.14 Transmission or supply pipelines are used to move water from the source to the treatment plant and from the plant to the distribution system.

7.15 Union is a coupling at the end of SPU's water service connecting the public water service to the privately owned water service.

7.16 Water main designed to serve a property is a main either abutting the property or located as close to the property as possible considering barriers such as slope, soil or other conditions which make it unsafe or impractical to bring the water distribution system closer to the property. (see also Standard and Substandard Water Service)

7.17 Water service provides water from the distribution system to residential, industrial and commercial users within the direct service area. It includes a tap into a SPU water main and a SPU service line. (An active water service also includes a meter, tail run and union which connects to the property's private service line; an inactive water service has had the meter removed or not yet installed.)

7.17.1 Domestic water service is available to provide any potable water to a property, excluding fire-only water service.

7.17.2 Fire-only water service is available to provide stand-by water service for the sole purpose of supporting fire suppression devices on property (sprinklers, private hydrants, etc.) via a detector check meter assembly. A combination fire and domestic service is a domestic water service and is not a fire-only water service.

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

C. POLICIES, PROCEDURES AND STANDARDS

APPENDIX C-7

SYSTEM STORAGE LEVEL OF RELIABILITY

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Seattle Public Utilities
System Storage Level of Reliability
June 2012

A. INTRODUCTION AND BACKGROUND

As the water system evolved over the past century, reservoirs, tanks and standpipes were constructed to meet then anticipated needs for the system as configured at that time. Since the original formation of the City of Seattle, there have been 41 annexations to the City, which have created differences in the water infrastructure, primarily in pipe sizing, and resulted in variations in how that infrastructure met changing design standards. Over time, there has been a benefit of an increasing number of interconnections and amount of redundancy in the overall system. The system is now large and complex, with multiple ways of delivering water within the system. Major improvements include the addition of the Tolt supply, which resulted in a second, multi-pipeline supply source coming into the north end of the system, and substantial improvements to the transmission pipelines.

Another significant change that has occurred over the years is the anticipated water consumption used in planning for the water system. For most of Seattle's history, water consumption increased along with its population. However, that connection was broken around 1990 when consumption reached its highest level. Since then, total annual water consumption has declined by about 30 percent (50 MGD) despite population growth of 15 percent. Peak water demand has fallen even more than annual average demand. In the 1980's hot summer weather could produce peak day consumption of over 330 MGD, but in the last ten years peak day consumption has stayed below 250 MGD, even on the hottest days. As an example of how planning criteria have changed, the System Storage and Reliability Analyses (SSRA) conducted in the mid-1990s used a demand forecast for 2020 of 103.5 MGD average annual and 207.3 MGD peak day demand for the retail system, and 199.0 MGD average annual and 416.2 MGD peak day demand for the total system. The demand forecast in the *2013 Water System Plan* for 2020 indicates 53.5 MGD average annual and 107 MGD peak day demand for the retail system (without non-revenue water), and 133.1 MGD average annual and 266.2 MGD peak day demand for the total system (with non-revenue water), with the demand levels used in the SSRA not forecasted to be reached within the planning horizon (before 2060).

These changing conditions and anticipated needs have allowed SPU to downsize or decommission certain treated water storage facilities. Reservoirs that have been downsized consist of Lincoln, Myrtle, Beacon, and West Seattle Reservoirs. Roosevelt and Volunteer Reservoirs are being considered for decommissioning after testing. Maple Leaf Tank and Woodland Park Standpipe have been decommissioned and Barton Standpipe, Foy Standpipe, and Richmond Highlands #1 Tank will soon be decommissioned. Myrtle #1 Tank is proposed to be decommissioned. Decommissioning these facilities saves capital, operating and maintenance costs over the long-term. Also, the reduction in treated water storage allows for increased system turnover than would otherwise occur, thereby improving water quality. The approach, analysis and results used to determine reservoir sizing and identify facilities for decommissioning are described below.

B. SYSTEM RELIABILITY ANALYSIS

Hydraulic modeling of various scenarios is an effective way to evaluate current and future storage requirements for a complex system such as SPU's. Scenarios representing peak and off-peak demand seasons, as well as a range of emergency conditions, provide the basis for the analysis. SPU has analyzed its entire system to ensure that there is adequate storage to maintain continuity of retail and wholesale service in the future for certain emergencies with current and planned facilities in service or decommissioned. Under certain emergency scenarios and during periods of higher than average demands, SPU would aggressively message to retail and wholesale customers to reduce water use to indoor-use levels within 12 to 24 hours.

While the storage facilities are periodically removed from service for maintenance such as cleaning, the analyses assume all available storage facilities for that scenario are in service. Such maintenance outages slightly increase the water supply risk, but SPU mitigates this risk by scheduling the larger reservoirs for cleaning during the off-peak and shoulder seasons, and by taking only one large reservoir out of service at a time, if possible. Additionally, the frequency of reservoir cleaning is now lower than in the past because of filtration on the Tolt supply and covering of the reservoirs. Planned outages of other major facilities are also scheduled to reduce risks to the water supply whenever possible.

SPU has identified specific emergency scenarios that are appropriate for its system. These scenarios represent abnormal operating conditions associated with unscheduled power outages and facility failures, but without specific identification of the root cause of the outage or failure, although examples are provided for some scenarios. The scenarios analyzed could be caused by natural events such as severe weather storms or earthquakes, intentional or unintentional actions by humans (e.g., vandalism), or failure of a facility component due to age or other cause. Extreme events that may cause more than one scenario to occur concurrently are not considered because these have a very low probability of occurrence and system performance is very difficult to predict. There are three types of emergency scenarios that are used:

1. Transmission pipeline outages
2. Source water treatment facility outages
3. Regional power failure affecting all six individual pumped zones

1. Transmission Pipeline Outages

Transmission pipeline outages were analyzed in detail in the mid-1990s System Storage and Reliability Analyses (SSRA) where specific emergency scenarios were defined, each involving at least two system components serving a certain part of the system being unavailable. (For more details on the SSRA please refer to SPU's 2007 WSP.) Through detailed modeling it was demonstrated that retail and wholesale service can be maintained at average day demand levels which were much higher in the mid-1990s than they are now for at least seven days, which is a little more than twice the expected 3-day maximum repair time for any large pipeline break. (The 3-day maximum repair time is part of SPU's wholesale continuity of service level of service and is based in part on actual experience with the 1987 Tolt Pipeline break repair.) This analysis also demonstrated that Roosevelt and Volunteer Reservoirs could be decommissioned, and affirmed that Lincoln, Myrtle, Beacon, and West Seattle Reservoirs could be downsized to what is now in place.

2. Treatment Facility Outages

The first set of scenarios examines the reliability of the system in the event of loss of treated water delivery from one of the two primary treatment facilities. These scenarios could be due to the loss of treatment capability at the treatment plant itself, or loss of transmission to or from the treatment plant. It should be noted that both the Tolt and Cedar Water Treatment Facilities have backup electrical power supplies, as well as dual treatment trains, which reduce the likelihood of full loss of treated water supply. The Tolt Water Treatment Facility has a maximum treatment capacity of 120 MGD, and the Cedar Water Treatment Facility has a maximum treatment capacity of 180 MGD.

These scenarios were analyzed as part of the Tolt/Cedar Transfer Improvements Study conducted in 2006 and 2007. The study analyzed five emergency scenarios that represent complete outage of the Tolt or Cedar supply, both during peak week and the off-peak season, and complete Tolt outage during a shoulder (spring or fall) season. The different system-wide demand levels were as follows:

- Off-peak demand (November through March) of 110 MGD
- “Shoulder season” demand level (June and September) of 170 MGD
- Peak day demand of 250 MGD, with reduction to indoor water use only demand of 120 MGD under emergency mandatory water use restrictions within 12-24 hours.

Tolt Outage. This scenario examines complete failure of the Tolt Water Treatment Facility during the summer or shoulder season, requiring s days to repair. The scenario assumes that the clearwell and Tolt transmission pipelines are in service. The results indicate that off-peak water demands can be met indefinitely without any supply from Tolt, and without storage drawdown. If the emergency were to occur during higher demands, public messaging would be implemented to bring demand down to indoor levels within 12-24 hours, during which time service would be maintained by drawing down transmission and distribution reservoirs while maintaining at least 20 psi in the distribution system.

Cedar Outage. This scenario examines complete failure of Cedar Water Treatment Facility during summer, requiring 7 days to repair. It is assumed that the Clearwells would be available and Control Works would be functional. The operating strategy would be to reconfigure several transmission pipeline junctions (some remotely, while others manually in the field) so that available supply from the Tolt could be delivered far south into the area typically served by the Cedar. Additionally, the Seattle Wells would be activated without on-site treatment, if necessary, within 8 hours of the onset of the emergency. The analysis demonstrated that normal service can be maintained for up to 7 days at indoor water use levels through a combination of supply from the Tolt and the Seattle Wells and from drawing down reservoirs while maintaining at least 20 psi in the distribution system. If the emergency were to occur during higher demands, public messaging would be implemented to bring demand down to indoor levels within 12-24 hours. It was also noted in the course of the analysis that the Cedar Water Treatment Facility is much more distributed in nature than the Tolt, such that a problem with one component it less likely to affect the entire facility.

The results from the Tolt/Cedar Transfer Improvements Study affirmed that the reduced reservoir volumes identified in the SSRA provided the necessary level of reliability for these scenarios. In addition, this study indicated the need to install the modulating valve at Maple Leaf Gatehouse and improvements to the TESS Junction Pump Station.

3. Extended Regional Power Outage

This emergency scenario would involve disruption to the regional power grid that lasts for several days, similar to those experienced recently in the Northeast United States and the San Diego Metropolitan Area. Approximately 80 percent of SPU's system is supplied (directly or via reservoirs) by gravity from the clearwells of the two treatment facilities, which in turn are equipped with full capacity backup power generators. An extended power outage would therefore not be expected to affect the operation of the treatment facilities, nor the gravity flow to a large part of the system.

Six pressure zones (Richmond Highlands 590, Magnolia 480, Queen Anne 530, Volunteer 530, West Seattle 585 and West Seattle 498) that are normally supplied by pumping have been analyzed in greater detail to determine storage needs to maintain service through a combination of storage drawdown and pumping with non-electric pumps. This analysis resulted in the decision to provide a remote manual start for the permanent diesel pump at Bitter Lake pump station.

The operating strategy would be to meet demands at the onset of the outage through gravity flow out of elevated storage until pumped supply from larger ground-level storage or from transmission pipelines was actuated using power sources that are not dependent on the commercial power grid. SPU requires and plans for enough gravity storage to the pumped zones to allow for at least 15 minutes for activation of remote controlled facilities or at least three hours for activation of locally controlled facilities that pump water to the zone. SPU assumes average day demands in the zone at the onset of the power outage when determining the necessary gravity storage volume (deliverable at no less than 20 psi) to keep up with demand until the alternative pumping facilities can be activated. These alternative pumping facilities include hydraulic turbines and diesel powered pumps that receive regular maintenance and are periodically operated to ensure readiness.

The above approach is not applied to pressure sub-zones with booster pump stations, such as the Augusta 550, the Scenic Heights 550, the Queen Anne 580, and the Dayton Avenue 650 zones. For these zones, if the booster station fails or loses power, check valves at the pump station and the pressure zone boundary automatically open and the zone reverts to the surrounding zone's pressure, maintaining at least 20 psi pressure.

SPU has three hydraulic turbine-driven pumps that do not rely on electric power to run, but instead use the force of water flowing by gravity from higher pressure zones or pipelines to lower pressure zones to drive turbines that turn pumps to lift water from the same source to other higher pressure zones. These turbines can provide water to five of the six pressure zones that rely on pumps. The turbines are used regularly and controlled remotely from SPU's system control center. These non-electric pumping facilities provide water from gravity-fed ground level storage or from transmission pipelines operating at pressures lower than the zone's.

Table 1 below summarizes how supply to each of the six pumped-only zones would be maintained in the event of an extended regional power outage through a combination of gravity supply at first, and alternative pumping later. The amount of gravity standby storage provides adequate time to remotely or locally activate the non-electric pumping facilities, even under peak day demands. However, delivery to Magnolia 480, Queen Anne 530 and Volunteer 530 would be limited to the capacity of Lincoln Turbine, and emergency curtailments to reduce demands to indoor use only would be needed in these areas if a widespread power outage were to occur during peak season.

C. CONCLUSION

In conclusion, SPU has analyzed the performance of the water system under the above emergencies. Results show that at least five days of indoor water use can be met through year 2040 and possibly beyond. If the emergency were to occur during peak consumption periods, such as the summer irrigation season, SPU will request its customers to curtail discretionary water use until the emergency has been resolved.

SPU will make storage sizing and decommissioning decisions consistent with this emergency scenario based model for system storage reliability. Storage that is deemed necessary will be maintained (e.g., regular recoating, cleaning, sanitary surveys, structural inspections, etc) and storage that is deemed unnecessary will be physically disconnected from the system. Some decommissioned steel storage may be kept in a 'mothballed' state (e.g., aesthetic painting on the outside and left standing).

Table 1. Pumped Zones Summary

Pressure Zone	Average Day Demand, MGD[1]	Source of Gravity Standby Storage	Total Volume, MG (Depth, feet)	Operating Storage, MG (Operating Band, feet)	Dead Storage, MG[2]	Available Gravity Standby Storage, MG[3]	Amount of Time Provided, hours[4]	Actions Taken	Source of Non-Electric Powered Pumped Standby Storage
Richmond Highlands 590	3.95	Richmond Highlands Tank No. 2	2.0 (35')	0.5 (10')	1.4	0.1	0.6	Diesel engine driven pump at Bitter Lake Pump Station activated within 15 minutes.	Bitter Lake Reservoir via Bitter Lake Pump Station diesel engine pump (4000 gpm), remote manual startup (15-minute minimum start-up). Bitter Lake Reservoir is supplied by gravity from Lake Forest Park Reservoir, which is gravity-fed from the Tolt Water Treatment Facility and Clearwell.
Magnolia 480	0.82	Magnolia Tank	1.0 (25')	0.4 (10')	0.0	0.6	17.5	Lincoln Turbine activated within 15 minutes. Manually operated butterfly valve at 12 Av W & W Howe opened within 3 hours to re-activate 530 Armory Way feeder.	Cedar Water Treatment Facility and Clearwells via Lincoln Turbine (4000 gpm), remote manually controlled (15-minute minimum start-up).
Queen Anne 530	1.21	Queen Anne Standpipe	1.9 (58.5')	0.3 (10')	1.4	0.2	4.0	Lincoln Turbine is activated within 15 minutes.	Cedar Water Treatment Facility and Clearwells via Lincoln Turbine (4000 gpm), remote manually controlled (15-minute minimum start-up).
Volunteer 530	1.50	Volunteer Standpipe	0.9 (60')	0.1 (10')	0.4	0.3	4.8	Lincoln Turbine activated within 15 minutes.	Cedar Water Treatment Facility and Clearwells via Lincoln Turbine (4000 gpm), remote manually controlled (15-minute minimum start-up).

Table 1. Pumped Zones Summary (continued)

Pressure Zone	Average Day Demand, MGD[1]	Source of Gravity Standby Storage	Total Volume, MG (Depth, feet)	Operating Storage, MG (Operating Band, feet)	Dead Storage, MG[2]	Available Gravity Standby Storage, MG[3]	Amount of Time Provided, hours[4]	Actions Taken	Source of Non-Electric Powered Pumped Standby Storage
West Seattle 498	2.70	Charlestown Standpipe	1.3 (64')	0.2 (10')	0.9	0.2	21.3	35th & Morgan PRV activated within 15 minutes. Trenton Turbines activated within 15 minutes. Burien Pump Station diesel driven pump activated no earlier than 3 hours from the outage.[5]	Combination of West Seattle Reservoir via Trenton Turbines (4000 gpm), which is remote manually controlled (15-minute minimum start-up), and Riverton Heights Reservoir via Burien PS diesel-powered pump (6000 gpm), which has local manual start-up (3-hour minimum start-up). Both reservoirs are gravity-fed from the Cedar Water Treatment Facility and Clearwells.
		Myrtle Reservoir	5.0 (27')	1.2 (7')	1.5	2.2			
West Seattle 585	1.99	Myrtle Tank No. 2	1.0 (26')	0.4 (10')	0.2	0.5	14.4	Trenton Turbines activated within 15 min. Burien Pump Station diesel driven pump is activated no earlier than 3 hours from the outage.[5]	Combination of West Seattle Reservoir via Trenton Turbines (4000 gpm), which is remote manually controlled (15-minute minimum start-up), and Riverton Heights Reservoir via Burien PS diesel-powered pump (6000 gpm), which has local manual start-up (3-hour minimum start-up). Both reservoirs are gravity-fed from the Cedar Water Treatment Facility and Clearwells.
		Beverly Park Tank	2.0 (35')	0.4 (10')	0.9	0.7			

1. Average Day Demand based on metered water consumption in 2009 for each pressure zone.
2. Dead storage is storage below 20 psi, as measured as static pressure to nearest service connection.
3. Available gravity standby storage is available exclusively to pressure zone shown, and excludes operating storage and dead storage volumes.
4. Amount of time provided is the available gravity standby storage divided by average day demand, and converted to hours.
5. If electrical generation at West Seattle Reservoir is available from the portable generator permanently kept at the site, then West Seattle Low Service and Highland Park Pump Stations would be started instead.

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN
APPENDIX D

MISCELLANEOUS

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SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

D. MISCELLANEOUS

APPENDIX D-1

CAPITAL FACILITIES PLAN

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Seattle Public Utilities - 2013 Water System Plan

Capital Facilities Plan

2011 Dollars (in $1000s)

Business Area	Project / Program	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Water Resources	Morse Lake Pump Plant	$1,922	$1,790	$4,998	$8,357	$6,145	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Overflow Dike Improvements	$619	$2,981	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Landsburg Flood Passage Improvements	$192	$942	$554	$91	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Dam Safety	$100	$25	$23	$23	$22	$500	$275	$250	$300	$0	$0	$0	$0	$0	$500
	Regional Conservation Program	$1,850	$1,850	$1,850	$1,850	$1,850	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700	$1,700
	Low Income Conservation Assistance	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650
	Water System Plan	$25	$0	$0	$100	$480	$395	$50	$0	$44	$90	$450	$395	$50	$0	$44
Water Resources Total		**$5,359**	**$8,239**	**$8,076**	**$11,070**	**$9,147**	**$3,245**	**$2,675**	**$2,600**	**$2,694**	**$2,440**	**$2,800**	**$2,745**	**$2,400**	**$2,350**	**$2,894**
Water Quality and Treatment	Landsburg Chlorination	$700	$1,135	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Reservoir Covering-Volunteer	$0	$0	$92	$100	$100	$1,500	$10,000	$10,000	$1,000	$0	$0	$0	$0	$0	$0
	Reservoir Covering-West Seattle	$24	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Reservoir Covering-Maple Leaf	$4,133	$94	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Roosevelt Reservoir Retirement	$0	$0	$0	$0	$500	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Lake Forest Park Burying/Floating Cover Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$500	$1,000	$8,000	$500	$0	$0
	Bitter Lake Reservoir Burying/Floating Cover Replacement	$0	$0	$0	$0	$0	$0	$500	$1,500	$5,000	$11,000	$11,000	$0	$0	$0	$0
	Water Quality Equipment	$135	$135	$1	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	Treatment Facility/WQ Improvements	$96	$94	$92	$91	$100	$100	$100	$400	$500	$100	$100	$100	$600	$600	$250
Water Quality and Treatment Total		**$5,088**	**$1,458**	**$187**	**$190**	**$700**	**$1,600**	**$10,600**	**$11,900**	**$6,500**	**$11,600**	**$12,100**	**$8,100**	**$1,100**	**$600**	**$250**
Transmission	Cathodic Protection Program	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$1,600	$600	$600	$600	$600	$600
	Transmission Pipeline Rehabilitation	$1,010	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
	Purveyor Meter Replacements	$96	$94	$92	$91	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200
	Air Valve Chamber Replacements	$108	$110	$113	$113	$113	$113	$113	$113	$113	$113	$113	$113	$113	$113	$113
	Water System Dewatering Program	$96	$94	$92	$91	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
Transmission Total		**$2,910**	**$2,898**	**$2,898**	**$2,894**	**$3,013**	**$3,013**	**$3,013**	**$3,013**	**$3,013**	**$3,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**
Distribution	Distribution System Improvements	$3,967	$4,619	$5,545	$6,342	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104
	Transportation & Multiple Utility Relocations	$8,097	$4,539	$4,402	$3,574	$3,155	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500
	Watermain Rehabilitation	$1,538	$1,508	$3,000	$3,000	$3,000	$3,970	$4,082	$4,197	$4,313	$4,433	$4,555	$4,679	$4,804	$4,933	$5,064
	Watermain Extensions	$650	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750
	New Taps	$4,000	$4,000	$4,000	$4,000	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922
	Service Renewals	$5,500	$5,500	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900
	Meter Replacement	$683	$600	$599	$598	$603	$603	$603	$603	$603	$603	$603	$603	$603	$603	$603
	Hydrants	$502	$502	$447	$446	$395	$395	$395	$395	$395	$395	$395	$395	$395	$395	$395
	Valves	$300	$300	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
	Chamber Upgrades	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25
	Pump Station Improvements	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500
	Tank Improvements	$336	$1,413	$1	$1	$1	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250
Distribution Total		**$26,098**	**$24,257**	**$25,270**	**$25,237**	**$25,455**	**$25,019**	**$25,131**	**$25,246**	**$25,362**	**$25,482**	**$25,604**	**$25,728**	**$25,853**	**$25,982**	**$26,113**
Major Watersheds	Cedar River Watershed Habitat Conservation Plan	$3,241	$3,439	$2,721	$2,254	$1,606	$1,756	$1,756	$1,756	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354
	Watershed Stewardship	$995	$687	$554	$543	$533	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100
Major Watersheds Total		**$4,236**	**$4,125**	**$3,275**	**$2,797**	**$2,139**	**$1,856**	**$1,856**	**$1,856**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**
Other	Technology	$7,410	$8,184	$5,964	$5,358	$5,327	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
	SCADA	$466	$457	$443	$408	$355	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400
	Security	$1,922	$1,884	$1,847	$1,811	$1,793	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
	Heavy Equipment Purchases	$2,951	$1,934	$2,979	$2,156	$1,931	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500
	In-Town Facilities	$1,514	$3,775	$2,225	$2,547	$2,387	$2,550	$1,100	$1,350	$1,200	$1,200	$900	$1,150	$1,150	$1,400	$1,400
	Regional Facilities	$3,296	$3,315	$4,227	$4,494	$8,480	$2,450	$2,250	$2,250	$1,700	$700	$500	$500	$500	$850	$850
	Emergency Storm Response	$48	$47	$46	$45	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
	1% for Art	$174	$224	$231	$191	$224	$134	$160	$164	$147	$162	$162	$150	$128	$127	$128
Other Total		**$17,781**	**$19,820**	**$17,963**	**$17,010**	**$20,497**	**$15,034**	**$13,410**	**$13,664**	**$12,947**	**$11,962**	**$11,462**	**$11,700**	**$11,678**	**$12,277**	**$12,278**
Grand Total		**$61,471**	**$60,797**	**$57,668**	**$59,199**	**$60,951**	**$49,767**	**$56,684**	**$58,278**	**$51,970**	**$55,951**	**$55,433**	**$51,740**	**$44,498**	**$44,676**	**$45,002**

Seattle Public Utilities - 2013 Water System Plan

Capital Facilities Plan

2011 Dollars (in $1000s)

Business Area	Project / Program	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2013-2040 Total
Water Resources	Morse Lake Pump Plant	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$23,213
	Overflow Dike Improvements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$3,600
	Landsburg Flood Passage Improvements	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,779
	Dam Safety	$0	$0	$0	$250	$250	$250	$0	$0	$100	$100	$400	$25	$0	$3,393
	Regional Conservation Program	$1,700	$1,700	$1,700	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$31,350
	Low Income Conservation Assistance	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$650	$18,199
	Water System Plan	$90	$450	$395	$50	$0	$44	$90	$450	$395	$50	$0	$44	$90	$4,271
Water Resources Total		**$2,440**	**$2,800**	**$2,745**	**$950**	**$900**	**$944**	**$740**	**$1,100**	**$1,145**	**$800**	**$1,050**	**$719**	**$740**	**$85,806**
Water Quality and Treatment	Landsburg Chlorination	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$1,836
	Reservoir Covering-Volunteer	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$22,792
	Reservoir Covering-West Seattle	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$24
	Reservoir Covering-Maple Leaf	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$4,227
	Roosevelt Reservoir Retirement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$500
	Lake Forest Park Burying/Floating Cover Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$10,000
	Bitter Lake Reservoir Burying/Floating Cover Replacement	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$29,000
	Water Quality Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$270
	Treatment Facility/WQ Improvements	$850	$2,200	$1,900	$500	$500	$1,000	$850	$600	$600	$600	$850	$100	$100	$13,973
Water Quality and Treatment Total		**$850**	**$2,200**	**$1,900**	**$500**	**$500**	**$1,000**	**$850**	**$600**	**$600**	**$600**	**$850**	**$100**	**$100**	**$82,623**
Transmission	Cathodic Protection Program	$600	$600	$600	$600	$600	$600	$600	$600	$600	$600	$600	$600	$600	$26,800
	Transmission Pipeline Rehabilitation	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$28,010
	Purveyor Meter Replacements	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$5,173
	Air Valve Chamber Replacements	$113	$113	$113	$113	$113	$113	$113	$113	$113	$113	$113	$113	$113	$3,156
	Water System Dewatering Program	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$2,773
Transmission Total		**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$2,013**	**$65,912**
Distribution	Distribution System Improvements	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$7,104	$190,963
	Transportation & Multiple Utility Relocations	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$58,267
	Watermain Rehabilitation	$5,198	$5,334	$5,473	$5,614	$5,758	$5,904	$6,053	$6,204	$6,358	$6,515	$6,675	$6,836	$7,001	$135,999
	Watermain Extensions	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$750	$20,908
	New Taps	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$3,922	$110,118
	Service Renewals	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$5,900	$164,400
	Meter Replacement	$603	$603	$603	$603	$603	$603	$603	$603	$603	$603	$603	$603	$603	$16,958
	Hydrants	$395	$395	$395	$395	$395	$395	$395	$395	$395	$395	$395	$395	$395	$11,379
	Valves	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$3,200
	Chamber Upgrades	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$25	$700
	Pump Station Improvements	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$14,000
	Tank Improvements	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	$7,503
Distribution Total		**$26,247**	**$26,383**	**$26,522**	**$26,663**	**$26,807**	**$26,953**	**$27,102**	**$27,253**	**$27,407**	**$27,564**	**$27,724**	**$27,885**	**$28,050**	**$734,395**
Major Watersheds	Cedar River Watershed Habitat Conservation Plan	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$1,354	$45,608
	Watershed Stewardship	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$100	$5,612
Major Watersheds Total		**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$1,454**	**$51,221**
Other	Technology	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$170,242
	SCADA	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400	$400	$11,329
	Security	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$32,258
	Heavy Equipment Purchases	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$69,451
	In-Town Facilities	$2,400	$2,900	$1,900	$900	$1,200	$1,200	$1,200	$900	$900	$900	$900	$900	$900	$42,948
	Regional Facilities	$850	$600	$500	$1,100	$1,600	$1,100	$600	$500	$500	$500	$500	$500	$500	$45,712
	Emergency Storm Response	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$187
	1% for Art	$129	$134	$134	$124	$125	$127	$126	$127	$128	$127	$129	$126	$127	$4,166
Other Total		**$13,279**	**$13,534**	**$12,434**	**$12,024**	**$12,825**	**$12,327**	**$11,826**	**$11,427**	**$11,428**	**$11,427**	**$11,429**	**$11,426**	**$11,427**	**$376,292**
Grand Total		**$46,283**	**$48,384**	**$47,068**	**$43,604**	**$44,499**	**$44,691**	**$43,985**	**$43,847**	**$44,046**	**$43,858**	**$44,520**	**$43,597**	**$43,784**	**$1,396,249**

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

D. MISCELLANEOUS

APPENDIX D-2
LAND USE AND ZONING MAPS

LAND USE AND ZONING MAPS

Land Use Zoning Maps provided here were downloaded on February 22, 2012, from the following websites, except as noted. For maps not provided, please refer to the website listed below.

City of Seattle

Generalized Zoning (attached):
HTTP://WWW.SEATTLE.GOV/DCLU/RESEARCH/GIS/WEBPLOTS/SMALLZONEMAP.PDF

Zoning Maps Online: http://www.seattle.gov/dpd/Research/Zoning_Maps/default.asp

City of Shoreline

http://www.cityofshoreline.com/index.aspx?page=125

http://cosweb.ci.shoreline.wa.us/uploads/attachments/gis/maps/complu.pdf
(downloaded and added 6/1/2012)

http://cosweb.ci.shoreline.wa.us/uploads/attachments/gis/maps/Zoning.pdf

City of Lake Forest Park

http://www.lakeforestca.gov/civica/filebank/blobdload.asp?BlobID=3663

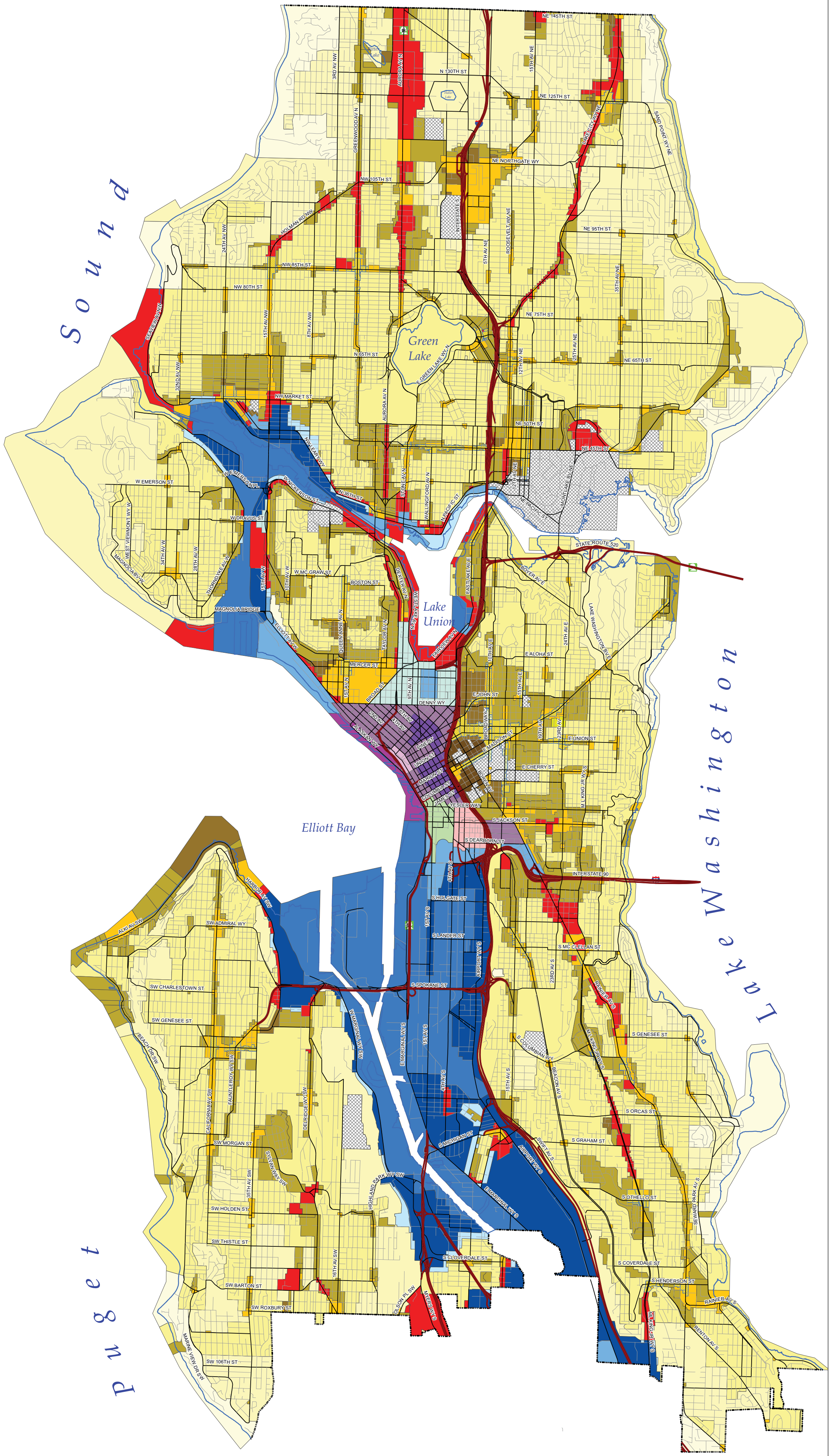
City of Burien

http://www.burienwa.gov/index.aspx?nid=717 http://www.burienwa.gov/DocumentView.aspx?DID=665

King County

http://www.kingcounty.gov/operations/GIS/Maps/VMC/Planning.aspx#DCC1A71A09194E73A35D915B4A3FE271

http://www.kingcounty.gov/operations/GIS/Maps/VMC/~/media/operations/GIS/maps/vmc/images/zoning_2004.ashx



City of Seattle

Generalized Zoning

as of January 27, 2012

Legend

- Single Family 5000
- Single Family 7200
- Single Family 9600
- Residential Small Lot
- Lowrise
- Midrise
- Highrise
- Seattle Mixed
- Neighborhood Commercial
- Neigh/Comm Incentive
- Commercial
- Downtown Office Core
- Downtown Harborfront
- Downtown Mixed
- International District
- Pike Market Mixed
- Pioneer Square Mixed
- Industrial Buffer
- Industrial Commercial
- Industrial General 1
- Industrial General 2
- Major Institution
- Pedestrian Areas

Note: This map is a view of generalized zoning only. For precise zoning information, please call or visit the Seattle Municipal Tower, Department of Planning and Development at 700 5th Ave Suite 2000, 206-684-8850.

0 1 2 Miles

Prepared by:

Department of Planning and Development

No warranties of any sort, including accuracy, fitness, or merchantabilty accompany this product.

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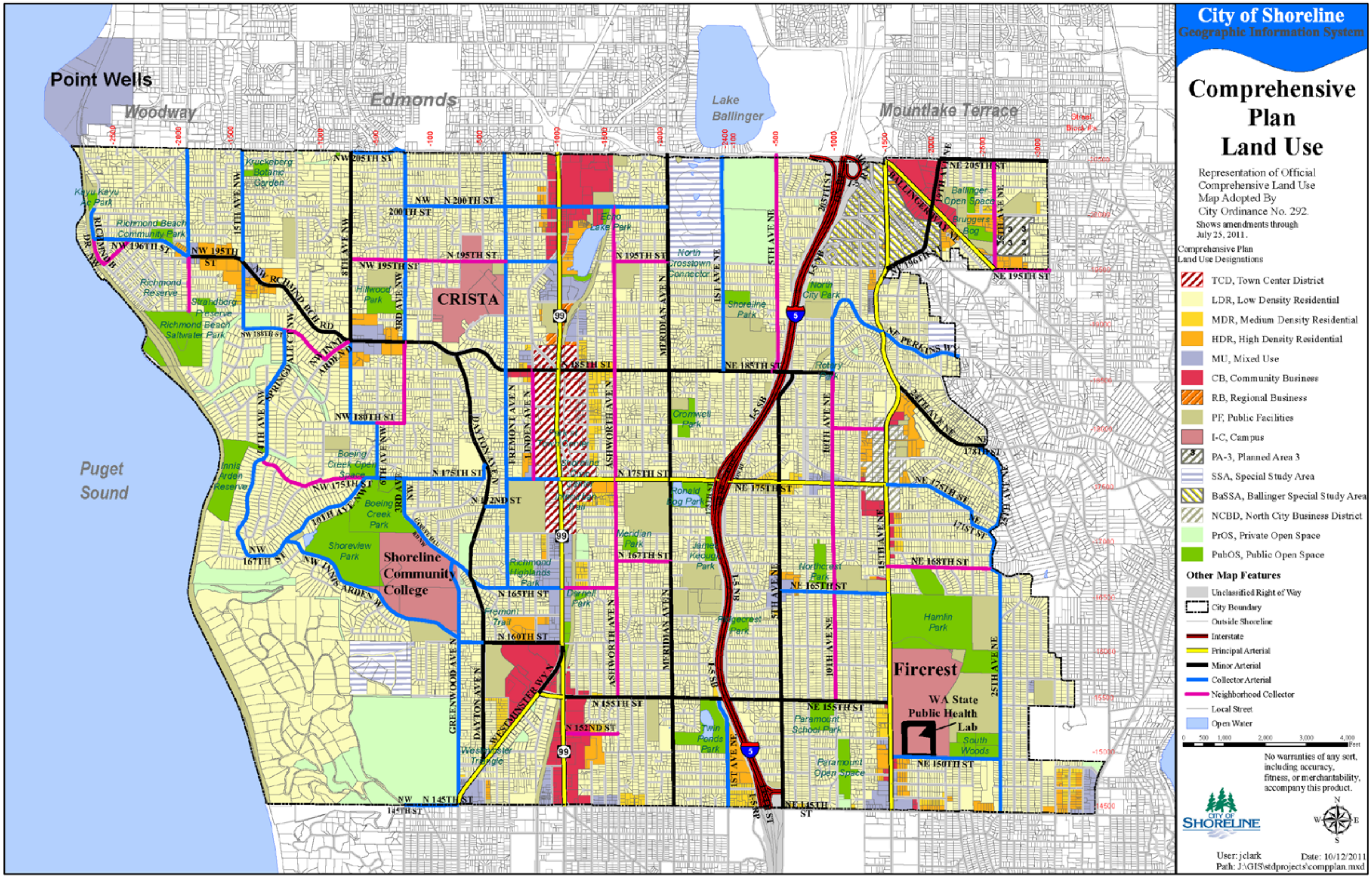
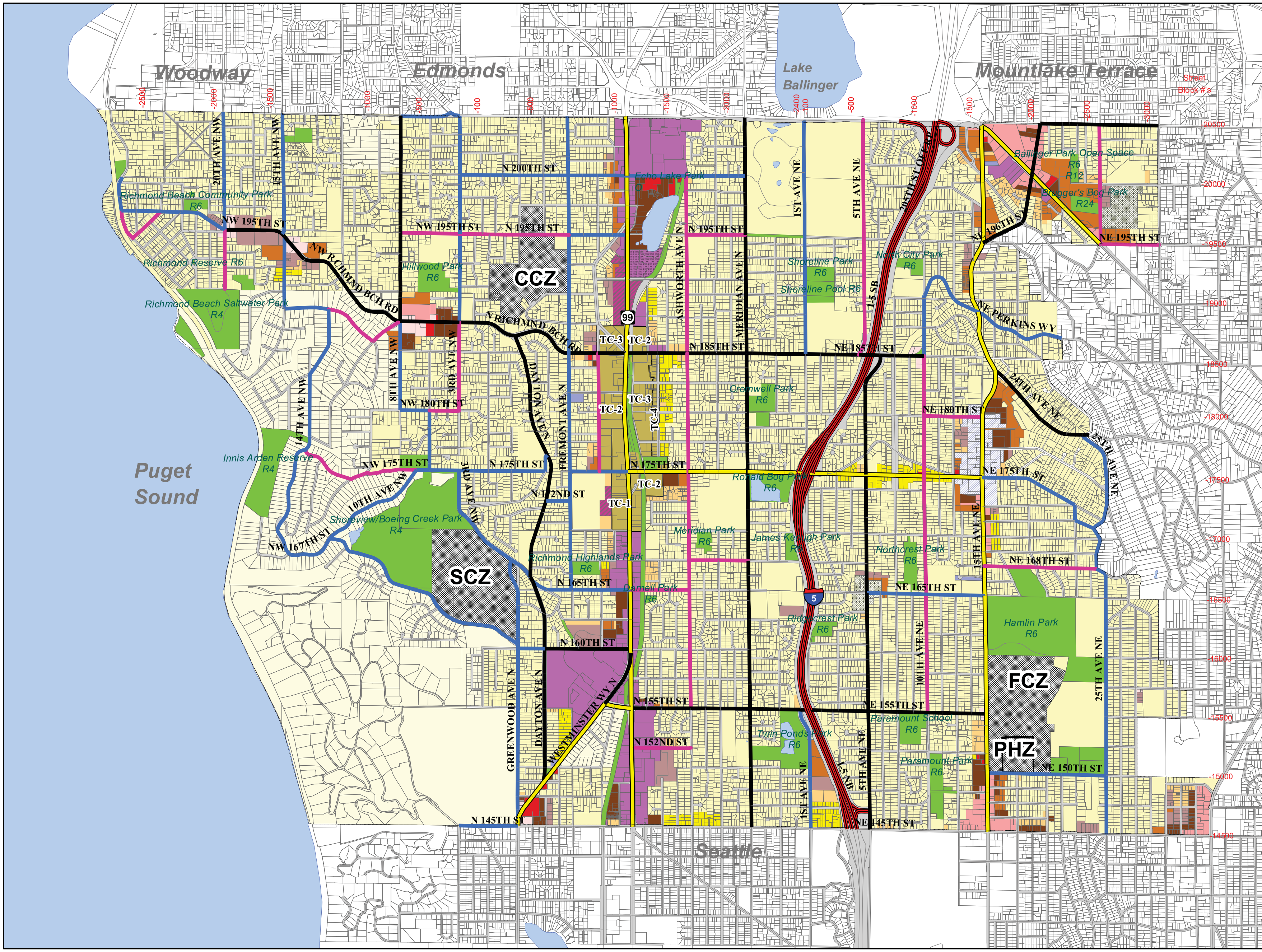

City of Shoreline
Geographic Information System
Comprehensive Plan Land Use
Representation of Official Comprehensive Land Use Map Adopted By City Ordinance No. 292.
Shows amendments through July 25, 2011.
Comprehensive Plan Land Use Designations
TCD, Town Center District
LDR, Low Density Residential
MDR, Medium Density Residential
HDR, High Density Residential
MU, Mixed Use
CB, Community Business
RB, Regional Business
PF, Public Facilities
I-C, Campus
PA-3, Planned Area 3
SSA, Special Study Area
BaSSA, Ballinger Special Study Area
NCBD, North City Business District
PrOS, Private Open Space
PubOS, Public Open Space
Other Map Features
Unclassified Right of Way
City Boundary
Outside Shoreline
Interstate
Principal Arterial
Minor Arterial
Collector Arterial
Neighborhood Collector
Local Street
Open Water
0 500 1,000 2,000 3,000 4,000 Feet
No warranties of any sort, including accuracy, fitness, or merchantability, accompany this product.
CITY OF SHORELINE
User: jclark
Date: 10/12/2011
Path: J:\GIS\stdprojects\compplan.mxd
Point Wells
Woodway
Edmonds
Lake Ballinger
Mountlake Terrace
Puget Sound
CRISTA
Shoreline Community College
Fircrest
WA State Public Health Lab
Hamlin Park
Shoreline Park
Shoreview Park
Boeing Creek Park
Richmond Beach Saltwater Park
Richmond Beach Community Park
Kruckeberg Botanic Garden
Innis Arden Reserve
Echo Lake Park
Cromwell Park
Twin Ponds Park
Paramount School Park
Paramount Open Space
South Woods
Ballinger Open Space
Bruggers Bog
North City Park
Northcrest Park
Ridgecrest Park
Meridian Park
Hillwood Park
Westminster Triangle
NE 205TH ST
N 200TH ST
N 195TH ST
NE 195TH ST
N 185TH ST
NE 185TH ST
N 175TH ST
NE 175TH ST
N 165TH ST
NE 165TH ST
N 160TH ST
N 155TH ST
NE 155TH ST
N 152ND ST
NE 150TH ST
N 145TH ST
NE 145TH ST
AURORA AVE N (99)
MERIDIAN AVE N
ASHWORTH AVE N
DAYTON AVE N
GREENWOOD AVE N
15TH AVE NE
25TH AVE NE
5TH AVE NE
1ST AVE NE
10TH AVE NE
8TH AVE NW
3RD AVE NW
15TH AVE NW
BALLINGER WAY NE
NE PERKINS WY
NW RICHMOND BCH RD
WESTMINSTER WY N
NW INNIS ARDEN W
I-5



City of Shoreline
Geographic Information System

Zoning

Representation of Official
Zoning Map Adopted By
City Ordinance No. 292.
Shows amendments through
November 28, 2011.

Zoning Designations

- TC 1-4; Town Center 1 to 4
- R-48; Residential, 48 units/acre
- R-24; Residential, 24 units/acre
- R-18; Residential, 18 units/acre
- R-12; Residential, 12 units/acre
- R-8; Residential, 8 units/acre
- R-6; Residential, 6 units/acre
- R-4; Residential, 4 units/acre
- I; Industrial
- MUZ; Mixed Use Zone
- MUCZ; Mixed Use Contract Zone
- PA 2; Planned Area 2
- PA 3; Planned Area 3
- C; Campus
- NCBD: North City Business District
- O; Office
- CB; Community Business
- NB; Neighborhood Business
- CZ; Contract Zone

Other Map Features

- City Boundary
- Open Water
- Outside Shoreline
- Interstate
- Principal Arterial
- Minor Arterial
- Collector Arterial
- Neighborhood Collector
- Local Street
- Tax Parcel Boundary
- Park
- Unclassified Right of Way

Note:
See SMC Figure 20.92.020 for Town Center Overlays

1 inch = 2,000 feet

0 500 1,000 2,000 3,000 4,000 Feet

No warranties of any sort, including accuracy, fitness, or merchantability, accompany this product.

User: jclark
Date: 12/7/2011
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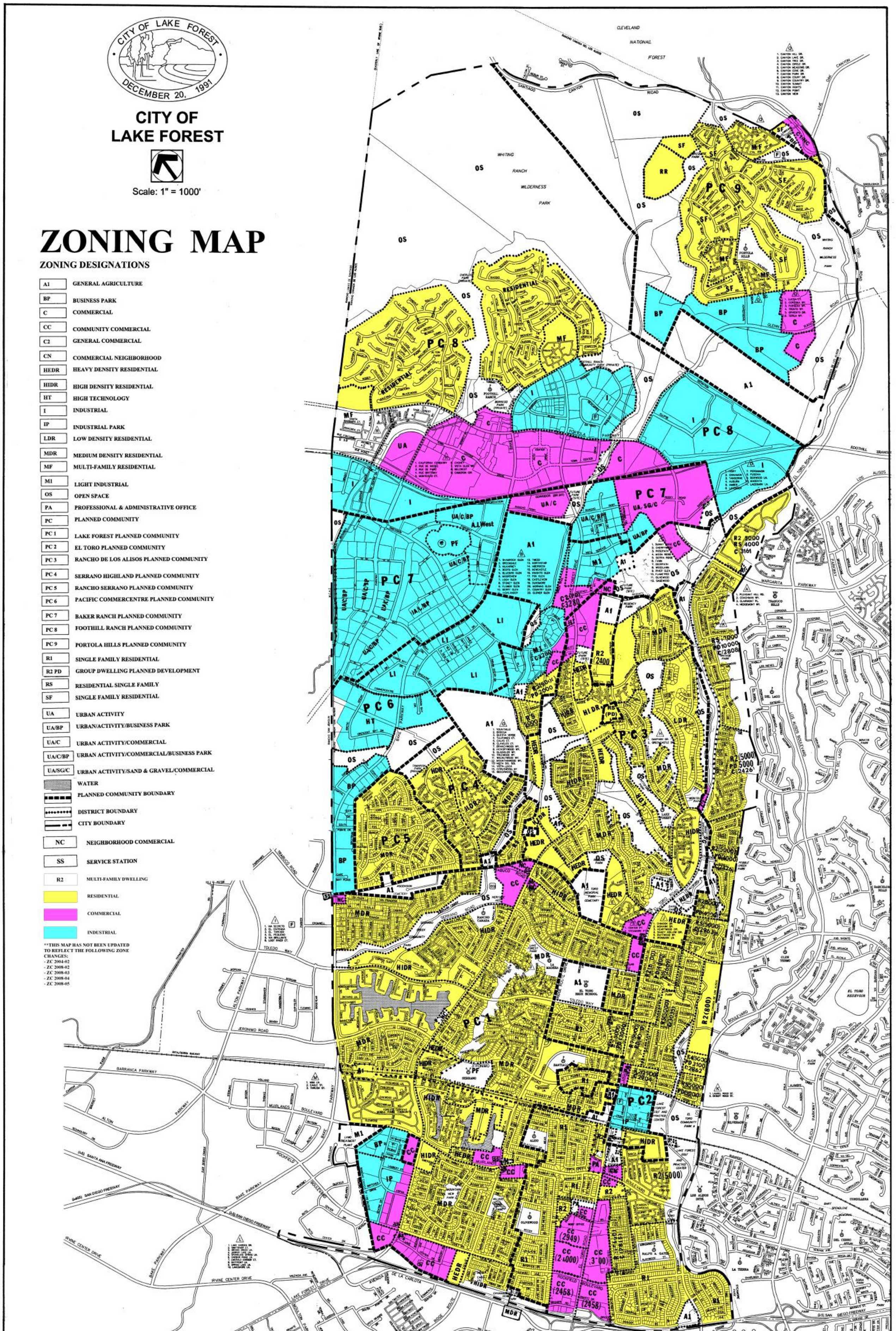
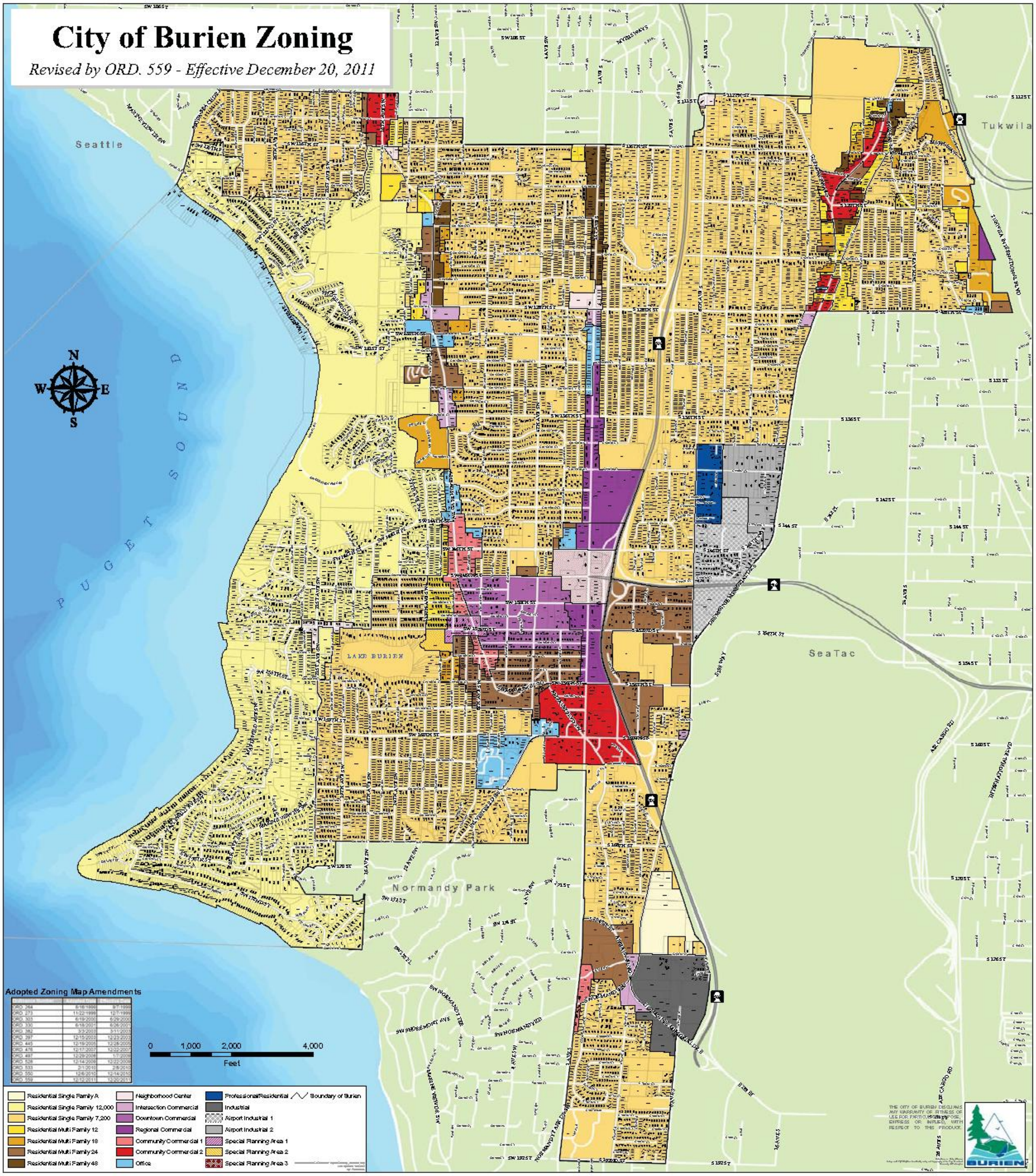
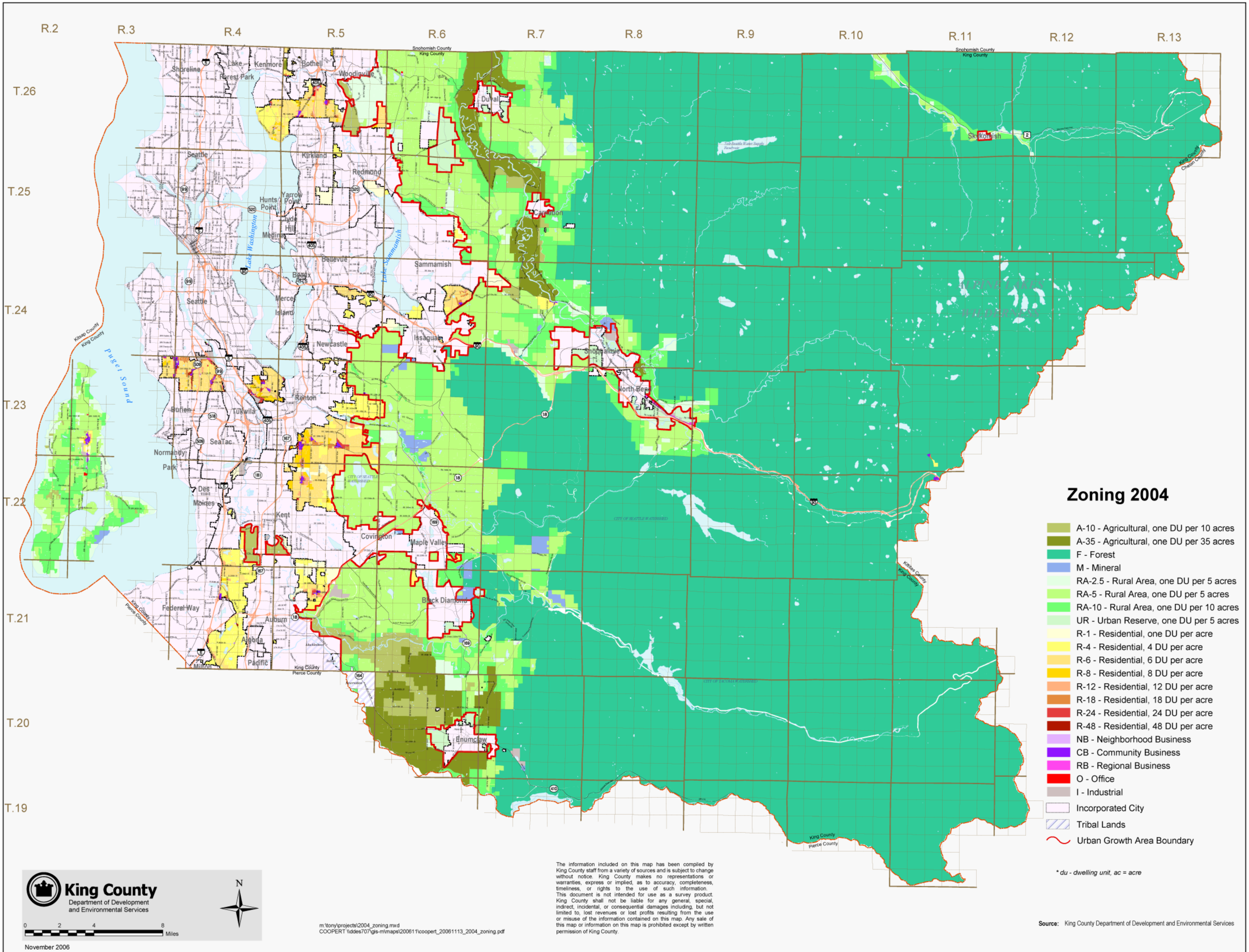

CITY OF LAKE FOREST
DECEMBER 20, 1991
CITY OF
LAKE FOREST
Scale: 1" = 1000'
ZONING MAP
ZONING DESIGNATIONS
A1 GENERAL AGRICULTURE
BP BUSINESS PARK
C COMMERCIAL
CC COMMUNITY COMMERCIAL
C2 GENERAL COMMERCIAL
CN COMMERCIAL NEIGHBORHOOD
HEDR HEAVY DENSITY RESIDENTIAL
HIDR HIGH DENSITY RESIDENTIAL
HT HIGH TECHNOLOGY
I INDUSTRIAL
IP INDUSTRIAL PARK
LDR LOW DENSITY RESIDENTIAL
MDR MEDIUM DENSITY RESIDENTIAL
MF MULTI-FAMILY RESIDENTIAL
M1 LIGHT INDUSTRIAL
OS OPEN SPACE
PA PROFESSIONAL & ADMINISTRATIVE OFFICE
PC PLANNED COMMUNITY
PC1 LAKE FOREST PLANNED COMMUNITY
PC2 EL TORO PLANNED COMMUNITY
PC3 RANCHO DE LOS ALISOS PLANNED COMMUNITY
PC4 SERRANO HIGHLAND PLANNED COMMUNITY
PC5 RANCHO SERRANO PLANNED COMMUNITY
PC6 PACIFIC COMMERCENTRE PLANNED COMMUNITY
PC7 BAKER RANCH PLANNED COMMUNITY
PC8 FOOTHILL RANCH PLANNED COMMUNITY
PC9 PORTOLA HILLS PLANNED COMMUNITY
R1 SINGLE FAMILY RESIDENTIAL
R2 PD GROUP DWELLING PLANNED DEVELOPMENT
RS RESIDENTIAL SINGLE FAMILY
SF SINGLE FAMILY RESIDENTIAL
UA URBAN ACTIVITY
UA/BP URBAN/ACTIVITY/BUSINESS PARK
UA/C URBAN ACTIVITY/COMMERCIAL
UA/C/BP URBAN ACTIVITY/COMMERCIAL/BUSINESS PARK
UA/SG/C URBAN ACTIVITY/SAND & GRAVEL/COMMERCIAL
WATER
PLANNED COMMUNITY BOUNDARY
DISTRICT BOUNDARY
CITY BOUNDARY
NC NEIGHBORHOOD COMMERCIAL
SS SERVICE STATION
R2 MULTI-FAMILY DWELLING
RESIDENTIAL
COMMERCIAL
INDUSTRIAL
**THIS MAP HAS NOT BEEN UPDATED TO REFLECT THE FOLLOWING ZONE CHANGES:
- ZC 2004-02
- ZC 2008-02
- ZC 2008-03
- ZC 2008-04
- ZC 2008-05
CLEVELAND NATIONAL FOREST
WHITING RANCH WILDERNESS PARK
SANTIAGO CANYON ROAD
BARRANCA PARKWAY
ALTON PARKWAY
JERONIMO ROAD
MUIRLANDS BOULEVARD
AVENIDA DE LA CARLOTA
MARGARITA PARKWAY
IRVINE CENTER DRIVE
PC 1
PC 2
PC 3
PC 4
PC 5
PC 6
PC 7
PC 8
PC 9



City of Burien Zoning
Revised by ORD. 559 - Effective December 20, 2011
Seattle
Tukwila
SeaTac
Normandy Park
PUGET SOUND
LAKE BURIEN
N
W
E
S
Adopted Zoning Map Amendments
0
1,000
2,000
4,000
Feet
Residential Single Family A
Residential Single Family 12,000
Residential Single Family 7,200
Residential Multi Family 12
Residential Multi Family 18
Residential Multi Family 24
Residential Multi Family 48
Neighborhood Center
Intersection Commercial
Downtown Commercial
Regional Commercial
Community Commercial 1
Community Commercial 2
Office
Professional/Residential
Industrial
Airport Industrial 1
Airport Industrial 2
Special Planning Area 1
Special Planning Area 2
Special Planning Area 3
Boundary of Burien
BURIEN



November 2006

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COOPERT \\ddes707\gis-m\maps\200611\coopert_20061113_2004_zoning.pdf

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Source: King County Department of Development and Environmental Services

SEATTLE PUBLIC UTILITIES
2013 WATER SYSTEM PLAN

D. MISCELLANEOUS

APPENDIX D-3

PLAN CONTENT AND CONSISTENCY REVIEW CHECKLISTS

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Seattle Public Utilities
2013 Water System Plan
Plan Content Checklist

Water System Planning Handbook Chapter	Water System Plan		
	Part	Section	Comments
Chapter 1 - Description of Water System			
Ownership and Management			
System Name	I	1.1	
Type of Ownership	I	1.1	
Management Structure	Appendix	B-2	
Water Facilities Inventory Report Form	Appendix	B-1	
System Background			
History of Water System Development and Growth	I	1.1	
Geography	I	1.1	
Neighboring/Adjacent Purveyors	I	1.4.2.5	
Ordinances/By Laws	I II	1.3.1 2.1 3.1 4.1 5.1 2.1	
Inventory of Existing Facilities			
Description of Facilities and Major Components	I Appendix	2.3 3.3 4.3 5.3 B-4	
Number of Service Connections (Existing and Approved)	I	2.3	Approved number of connections is not applicable.
Existing Interties	I Appendix	2.3 B-4	SPU does not use interties as a normal source of supply.
Related Plans			
List of Related Plans	I	1.4.2	
Comments From Agencies and Adjacent Purveyors			Comments from agencies and public sent under separate cover
Responses to Comments			Sent separately
Existing Service Area and Characteristics			
Existing Service Area Map	I	1.1 2.3	See Figures 1-1 and 2-1.
Zoning and Land Use	Appendix	D-2	
Future Service Area			
Future Service Area Map	I	2.3	
Zoning and Land Use	Appendix	D-2	

Water System Planning Handbook Chapter	Water System Plan		
	Part	Section	Comments
Service Area Agreements	I	2.3.1.3	Wholesale water contracts provided to WDOH under separate cover, as they become available.
Service Area Policies	I	1.2	Service Area Policy from 2007 WSP carried forward.
Satellite Management	I	1.1.2	Not applicable.
Condition of Service Policies	I Appendix	1.2 C-4 C-5 C-6	Service Area Policy from 2007 WSP carried forward.
Complaints			
Policy	I	3.3.7.3	
Recordkeeping	I	5.3.3.5	
Chapter 2 - Basic Planning, Data and Water Demand Forecasting			
Current Population, Service Connections, Water Use, and Equivalent Residential Units			
Current Population	I	2.3	
Total Service Connections	I	2.3	
Water Use Data Collection	I Appendix	2.3.2 A-1	
Equivalent Residential Units			Not applicable
Projected Land Use, Future Population, and Water Demand			
Projected Land Use	I Appendix	2.4.1.2 A-1	
Projected Population	Appendix	A-1	
Projected Non-Residential Water Needs	I Appendix	2.4.1.2 A-1	
Projected Non-Revenue Water	Appendix	A-1	
Water Rates and Rate Impacts on Water Demand	II Appendix	2.3.1 A-1	
Water Demand Forecasting	I Appendix	2.4.1 A-1	
Chapter 3 – System Analysis			
System Design Standards	Appendix	C-2 C-7	
Water Quality Analysis			
Historical Review of Trends	I	3.3	
Future Requirements	I	3.4	
System Description and Analysis			
Source	I Appendix	2.3 – 2. 4 A-3	
Water Treatment	I Appendix	3.3 – 3.4 B-4	
Storage	I Appendix	3.3.6 B-4 C-7	

Water System Planning Handbook Chapter	Water System Plan		
	Part	Section	Comments
Distribution System/Hydraulic Analysis	I Appendix	5.3 – 5.4 B-4	
Identification of System Improvements Assessment of Alternatives Prioritizing Improvements Selection of Alternatives	I II	2.4 – 2.5 3.3 – 3.5 4.4 – 4.5 5.4 – 5.5 1.2 – 1.3	
Chapter 4 - Conservation Program, Water Right Analysis, System Reliability and Interties			
Conservation Program Development and Implementation			
Required Measures For All Systems Other Measures and Level of Implementation Conservation Program Outline Regional Conservation Programs	I	2.4.1.1	
Source of Supply Analysis			No new water rights to be pursued in next 20 years
Enhanced Conservation Measures	I	2.4.1.1	
Water Right Changes	I Appendix	2.3.4.2 A-2	
Interties			SPU has no plans to use interties for normal supply purposes.
Artificial Recharge	I	2.3.4.1	
Use of Reclaimed Water, Reuse, and other Non-potable Sources	I Appendix	2.4.1.4 A-4	
Treatment	I Appendix	3.3.5 3.4 B-3 B-4	
Water Right Evaluation			
Permits, Certificates, Claims and Applications – Narrative Existing Water Right(s) Status Forecasted Water Right(s) Status Water Rights, Current Water Usage and Projected Needs Assessment of Need for Additional Water Rights	I Appendix	2.3.4.2 2.4.1 A-2	
Water Reservations			Not applicable
Water Supply Reliability Analysis			
Summary of System Reliability Efforts	I Appendix	2.3.4.3 2.4.1.2 2.4.1.3 C-7	
Water Shortage Response Planning			No change from 2007 WSP.
Monitoring Well Levels	Appendix	A-3	
Interties			
Existing Interties	I Appendix	2.3.1.3 B-4	
New Intertie Proposals	.	.	See 2007 WSP; no change in policy.

Water System Planning Handbook Chapter	Water System Plan		
	Part	Section	Comments
Intertie Agreements	I	2.3.1.3	Wholesale water contracts provided to WDOH under separate cover, as they become available.
Identification of System Improvements Assessment of Alternatives Prioritizing Improvements Selection of Alternatives	I Appendix	2.4 A-2	
Chapter 5 - Source Water Protection			
Wellhead Protection Program	I	3.3.3.2	See also Seattle Public Utilities, *Highline Wellfield Wellhead Protection Program*, 2000. Unchanged since approval with 2001 WSP, except for potential contaminant inventory updated every other year.
Watershed Control Program	I	3.3.3.1	See also Seattle Public Utilities, *Watershed Protection Plan*, October 2011, covering Cedar River Municipal Watershed, South Fork Tolt Municipal Watershed, Lake Youngs Reservation.
Identification of System Improvements Assessment of Alternatives Prioritizing Improvements Selection of Alternatives	I	3.4	Refer also to Wellhead Protection and Watershed Protection Plans, above.
Chapter 6 - Operation and Maintenance Program			
Water System Management and Personnel	Appendix	B-2	
Operator Certification	Appendix	B-2	
System Operations and Control			See Seattle Public Utilities, *System Operations and Control*, February 2012.
Identification of Major System Components	I Appendix	2.3 3.3 4.3 5.3 B-4	
Routine System Operation	I	2.3.5 3.3.7 4.3.2 5.3.2	See Seattle Public Utilities, *System Operations and Control*, February 2012.

Water System Planning Handbook Chapter	Water System Plan		
	Part	Section	Comments
Preventative Maintenance Program	I	2.3 3.3.8 4.3.3 5.3.3	
Equipment, Supplies and Chemical Listing	Appendix	B-3 B-4	
Comprehensive Monitoring (Regulatory Compliance) Plan	I Appendix	3.3.7.1 C-1	
Emergency Response Program Water System Personnel Emergency Call-Up List Notification Procedures Vulnerability Analysis Contingency Operational Plan	Appendix	C-7	See also Seattle Public Utilities, *System Operations and Control*, February 2012, and 2007 WSP.
Safety Procedures			See 2007 WSP; no significant changes.
Cross-Connection Control Program	I	3.3.7.2	
Customer Complaint Response Program	I	3.3.7.3	
Recordkeeping and Reporting	I	5.3.3.5	
O & M Improvements Identification of System Improvements Assessment of Alternatives Prioritizing Improvements Selection of Alternatives	I	2.3 - 2.5 3.3 – 3.5 4.4 – 4.5 5.3 – 5.5	
Chapter 7 - Distribution Facilities Design and Construction Standards			
Project Review Procedures	Appendix	C-3	
Policies and Requirements for Outside Parties	I Appendix	5.4.2 - 5.4.3 C-2	
Design Standards (Performance Standards and Sizing Criteria)	Appendix	C-2	
Construction Standards (Materials and Methods)	Appendix	C-2	See also the *2011 City of Seattle Standard Specifications* and *2011 Seattle Standard Plans*.
Construction Certification and Follow-up Procedures	Appendix	C-3	
Identification of System Improvements Assessment of Alternatives Prioritizing Improvements Selection of Alternatives	I	5.4 – 5.5	
Chapter 8 - Improvement Program			
Improvement Schedule	II Appendix	1.2 1.3 D-1	
Chapter 9 - Financial Program			
Water Systems with 1,000 or More Connections (Not Regulated by UTC)			
Past and Present Financial Status	II	2.2	
Available Revenue Sources	II	2.2 2.3	
Allocation of Revenue Sources	II	2.4	

Water System Planning Handbook Chapter	Water System Plan		
	Part	Section	Comments
Program Justification	II	2.4 2.5	
Assessment of Rates	II	2.3	
Chapter 10 - Miscellaneous Documents			
Supportive Documents			
State Environmental Policy Act			Separately bound
Other Documents	Appendix	D-3	Local government consistency certifications
Agreements			Sent separately
Comments on WSP from County			To be sent separately as appropriate
Comments on WSP from Adjacent Utilities			To be sent separately as appropriate

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Local Government Consistency Review Checklist

Water System Name: Seattle Public Utilities PWS ID: 77050 Y

Planning/Engineering Document Title: 2013 Water System Plan Plan Date: April 2012

Local Government with Jurisdiction: City of Seattle

WAC 246-290-108 Consistency with local plans and regulations:
Consistency with local plans and regulations applies to planning and engineering documents under WAC 246-290-106, 246-290-107, and 246-290-110(4)(b (ii).

1) Municipal water suppliers must include a consistency review and supporting documentation in its planning or engineering document describing how it has addressed consistency with **local plans and regulations**. This review must include specific elements of local plans and regulations, as they reasonably relate to water service as determined by Department of Health (DOH). Complete the table below and see instructions on back.

Local Government Consistency Statement	Page(s) in Planning Document	Yes – No – Not Applicable
a) The water system service area is consistent with the adopted land use and zoning within the applicable service area.	Part I, Section 1.4.2 Appendix D-2	yes
b) The six-year growth projection used to forecast water demand is consistent with the adopted city/county's population growth projections. If a different growth projection is used, provide an explanation of the alternative growth projection and methodology.	Part I, Sect. 2.4.1.2 Appendix A-1	yes
c) Applies to cities and towns that provide water service: All water service area policies of the city or town are consistent with the utility service extension ordinances of the city or town.	Appendix C-5 and C-6	yes
d) Service area policies for new service connections are consistent with the adopted local plans and adopted development regulations of all jurisdictions with authority over the service area [City(ies), County(ies)].	Appendix C-5 and C-6	yes
e) Other relevant elements related to water supply are addressed in the water system plan, if applicable; Coordinated Water System plans, Regional Wastewater plans, Reclaimed Water plans, Groundwater Area Management plans, and Capital Facilities Element of Comprehensive plans.	Part I, Section 1.4.2 Part II, Chapter 1 Appendix A-4 Appendix D-1	yes

I certify that the above statements are true to the best of my knowledge and that these specific elements are consistent with adopted local plans and development regulations.

Signature: [signature] Date: 4/6/12

Printed Name, Title, & Jurisdiction: TOM HAUGER, Comprehensive Plan Manager, City of Seattle

Consistency Review Guidance

For Use by Local Governments and Municipal Water Suppliers

This checklist may be used to meet the requirements of WAC 246-290-108. When using an alternative format, it must describe all of the elements; 1a), b), c), d), and e), when they apply.

For **water system plans (WSP)**, a consistency review is required for the retail service area and any additional areas where a municipal water supplier wants to expand its water right's place of use.

For **small water system management programs**, a consistency review is only required for areas where a municipal water supplier wants to expand its water right's place of use. If no water right place of use expansion is requested, a consistency review is not required.

For **engineering documents**, a consistency review is required for areas where a municipal water supplier wants to expand its water right's place of use (water system plan amendment is required). For non-community water systems, a consistency review is required when requesting a place of use expansion. All engineering documents must be submitted with a service area map per WAC 246-290-110(4)(b)(ii).

A) Documenting Consistency: Municipal water suppliers must document all of the elements in a consistency review per WAC 246-290-108.

1 a) Provide a copy of the adopted **land use/zoning** map corresponding to the service area. The uses provided in the WSP should be consistent with the adopted land use/zoning map. Include any other portions of comprehensive plans or development regulations that are related to water supply planning.

1 b) Include a copy of the **six-year growth projections** that corresponds to the service area. If the local population growth rate projections are not used, provide a detailed explanation on why the chosen projections more accurately describe the expected growth rate. Explain how it is consistent with the adopted land use.

1c) Include water service area policies and show that they are consistent with the **utility service extension ordinances** within the city or town boundaries. This applies to cities and towns only.

1 d) Include all **service area policies** for how new water service will be provided to new customers.

1 e) **Other relevant elements** related to water supply planning as determined by the department (DOH). See Local Government Consistency – Other Relevant Elements, Policy B.07, September 2009.

B) Documenting an Inconsistency: Please document the inconsistency, include the citation from the comprehensive plan or development regulation, and provide direction on how this inconsistency can be resolved.

C) Documenting Lack of Consistency Review by Local Government: Where the local government with jurisdiction did not provide a consistency review, document efforts made and the amount of time provided to the local government for their review. Please include: name of contact, date, and efforts made (letters, phone calls, and e-mails). In order to self-certify, please contact the DOH Planner.

CITY OF SHORELINE

Planning and Community Development

17500 Midvale Avenue North
Shoreline, WA 98133-4905
(206) 801-2500 ♦ Fax (206) 801-2788

June 1, 2012

Joan M. Kersnar
Drinking Water Planning
Seattle Public Utility
P.O. Box 34018
Seattle, WA 98124-4018

RE: Consistency Review of Seattle Public Utility's 2013 Water System Plan

Dear Ms. Kersnar:

This letter is in response to your requested review of SPU's water system plan (Plan). As you are aware WAC 246-290-108 directs municipal water suppliers to submit their plans to local government for a determination of the plan's consistency with all adopted local plans and development regulations applicable to the supplier's service area. For cities like Shoreline with special districts, municipal water system plans are incorporated by reference into the Comprehensive Plan and accordingly must demonstrate internal consistency.

For the purpose of our review we evaluated the water system against the City's 2005 Comprehensive Plan, Title 20 of the Shoreline Municipal Code, and Vision 2029. Vision 2929 is a set of framework goals developed by our shared citizens in collaboration with the Shoreline City Council. The framework goals provide the overall policy foundation for the Comprehensive Plan and support the City Council's vision. When implemented the goals are intended to protect the City's future. It is a vision where newer development has accommodated for changing times and both blends well with established neighborhood character and sets new standards for sustainable building, energy efficiency and environmental sensitivity. The vision of the citizens of Shoreline sees growth and development as necessary to fulfill the vision and implement the principles of the Growth Management Act (GMA).

The format of our review follows the criteria outlined in the checklist published by the Washington State Department of Health (DOH) to aid local government and suppliers in determining consistency. Our observations are listed below and a completed DOH checklist is enclosed for reference.

a. *The water system service area is consistent with the adopted land use and zoning within the applicable service area.*
   The general land use designations from the Comprehensive Plan are not included or referenced in the Plan. The planning model appears to use the current zoning designations. By not using general land use designations from the City's Comprehensive Plan planning for future densities

may be limited and inaccurate relative to development potential but, this would not cause the Plan to be inconsistent.

b. *The six-year growth projection used to forecast water demand is consistent with the adopted city/county's population growth projections. If a different growth projection is used, provide an explanation of the alternative growth projection and methodology.*
The Plan appropriately describes the methodology used for calculating the growth projections. In gross measures the forecast appears to be reasonable.

c. *Applies to cities and towns that provide water service: All water service area policies of the city or town are consistent with the utility service extension ordinances of the city or town.*
Not applicable.

d. *Service area policies for new service connections are consistent with the adopted local plans and adopted development regulations of all jurisdictions with authority over the service area [City(ies), County(ies)].*
City of Shoreline's development regulations require that an adequate supply of potable water and water for fire protection exist at the time development is ready to be occupied. The Plan is consistent with the City's plans and development regulations.

e. *Other relevant elements related to water supply are addressed in the water system plan, if applicable; Coordinated Water System plans, Regional Wastewater plans, Reclaimed Water plans, Groundwater Area Management plans, and Capital Facilities Element of Comprehensive plans.*
Not applicable.

Based on our review and we have found that the update is generally consistent with the Capital Facilities and Land Use Elements of the Comprehensive Plan.

Sincerely,

Rachael Markle, AICP
Director of Planning and Community Development

Cc: Julie T. Underwood, City Manager
Jeff Forry, Permit Services Manager
Mark Relph, Public Works Director

Enclosure: Department of Health Checklist

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Local Government Consistency Review Checklist

Water System Name: Seattle Public Utilities PWS ID: 77050 Y

Planning/Engineering Document Title: 2013 Water System Plan Plan Date: April 2012

Local Government with Jurisdiction: City of Shoreline

WAC 246-290-108 Consistency with local plans and regulations:
Consistency with local plans and regulations applies to planning and engineering documents under WAC 246-290-106, 246-290-107, and 246-290-110(4)(b (ii).

1) Municipal water suppliers must include a consistency review and supporting documentation in its planning or engineering document describing how it has addressed consistency with **local plans and regulations**. This review must include specific elements of local plans and regulations, as they reasonably relate to water service as determined by Department of Health (DOH). Complete the table below and see instructions on back.

Local Government Consistency Statement	Page(s) in Planning Document	Yes – No – Not Applicable
a) The water system service area is consistent with the adopted land use and zoning within the applicable service area.	Part I, Section 1.4.2 Appendix D-2	YES
b) The six-year growth projection used to forecast water demand is consistent with the adopted city/county's population growth projections. If a different growth projection is used, provide an explanation of the alternative growth projection and methodology.	Part I, Sect. 2.4.1.2 Appendix A-1	YES
c) Applies to cities and towns that provide water service: All water service area policies of the city or town are consistent with the utility service extension ordinances of the city or town.	Appendix C-5 and C-6	NA
d) Service area policies for new service connections are consistent with the adopted local plans and adopted development regulations of all jurisdictions with authority over the service area [City(ies), County(ies)].	Appendix C-5 and C-6	YES
e) Other relevant elements related to water supply are addressed in the water system plan, if applicable; Coordinated Water System plans, Regional Wastewater plans, Reclaimed Water plans, Groundwater Area Management plans, and Capital Facilities Element of Comprehensive plans.	Part I, Section 1.4.2 Part II, Chapter 1 Appendix A-4 Appendix D-1	NA

I certify that the above statements are true to the best of my knowledge and that these specific elements are consistent with adopted local plans and development regulations.

[signature] 5/30/12
Signature Date

JEFFREY E FORRY PERMIT SERVICES MANAGER CITY OF SHORELINE
Printed Name, Title, & Jurisdiction

Consistency Review Guidance

For Use by Local Governments and Municipal Water Suppliers

This checklist may be used to meet the requirements of WAC 246-290-108. When using an alternative format, it must describe all of the elements; 1a), b), c), d), and e), when they apply.

For **water system plans (WSP)**, a consistency review is required for the retail service area and any additional areas where a municipal water supplier wants to expand its water right's place of use.

For **small water system management programs**, a consistency review is only required for areas where a municipal water supplier wants to expand its water right's place of use. If no water right place of use expansion is requested, a consistency review is not required.

For **engineering documents**, a consistency review is required for areas where a municipal water supplier wants to expand its water right's place of use (water system plan amendment is required). For non-community water systems, a consistency review is required when requesting a place of use expansion. All engineering documents must be submitted with a service area map per WAC 246-290-110(4)(b)(ii).

A) Documenting Consistency: Municipal water suppliers must document all of the elements in a consistency review per WAC 246-290-108.

1 a) Provide a copy of the adopted **land use/zoning** map corresponding to the service area. The uses provided in the WSP should be consistent with the adopted land use/zoning map. Include any other portions of comprehensive plans or development regulations that are related to water supply planning.

1 b) Include a copy of the **six-year growth projections** that corresponds to the service area. If the local population growth rate projections are not used, provide a detailed explanation on why the chosen projections more accurately describe the expected growth rate. Explain how it is consistent with the adopted land use.

1c) Include water service area policies and show that they are consistent with the **utility service extension ordinances** within the city or town boundaries. This applies to cities and towns only.

1 d) Include all **service area policies** for how new water service will be provided to new customers.

1 e) **Other relevant elements** related to water supply planning as determined by the department (DOH). See Local Government Consistency – Other Relevant Elements, Policy B.07, September 2009.

B) Documenting an Inconsistency: Please document the inconsistency, include the citation from the comprehensive plan or development regulation, and provide direction on how this inconsistency can be resolved.

C) Documenting Lack of Consistency Review by Local Government: Where the local government with jurisdiction did not provide a consistency review, document efforts made and the amount of time provided to the local government for their review. Please include: name of contact, date, and efforts made (letters, phone calls, and e-mails). In order to self-certify, please contact the DOH Planner.

Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Local Government Consistency Review Checklist

Water System Name: Seattle Public Utilities PWS ID: 77050 Y

Planning/Engineering Document Title: 2013 Water System Plan Plan Date: April 2012

Local Government with Jurisdiction: City of Lake Forest Park

WAC 246-290-108 Consistency with local plans and regulations:
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I certify that the above statements are true to the best of my knowledge and that these specific elements are consistent with adopted local plans and development regulations.

[signature] 6/11/12

Signature Date

STEPHEN BENNETT, PLANNING DIRECTOR, LFP

Printed Name, Title, & Jurisdiction

Consistency Review Guidance

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Washington State Department of Health
Division of Environmental Health
Office of Drinking Water

Local Government Consistency Review Checklist

Water System Name: Seattle Public Utilities PWS ID: 77050 Y

Planning/Engineering Document Title: 2013 Water System Plan Plan Date: April 2012

Local Government with Jurisdiction: City of Burien

WAC 246-290-108 Consistency with local plans and regulations:
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I certify that the above statements are true to the best of my knowledge and that these specific elements are consistent with adopted local plans and development regulations.

[signature] 5/22/12

Signature Date

SCOTT GREENBERG, COMMUNITY DEVELOPMENT DIRECTOR, CITY OF BURIEN.

Printed Name, Title, & Jurisdiction

Consistency Review Guidance

For Use by Local Governments and Municipal Water Suppliers

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