December 30, 2014

Project 0087700012

Mr. Ed. Jones
Washington State Department of Ecology
Northwest Regional Office
3190-160th Avenue SE
Bellevue, WA 98008-5452

Subject: **Potability Determination Five-Year Review**
Stericycle Georgetown Facility
Seattle, Washington

Dear Mr. Jones:

AMEC Environment & Infrastructure, Inc. (AMEC), prepared this letter on behalf of Burlington Environmental LLC, a wholly owned subsidiary of PSC Environmental Services LLC, which is a wholly owned subsidiary of Stericycle Environmental Solutions, Inc. (Stericycle), for Stericycle's Georgetown facility located in Seattle, Washington (site). In November 2003, Stericycle submitted the Final Comprehensive Remedial Investigation (RI) Report to the Washington State Department of Ecology (Ecology) for the former Georgetown operations, which determined that drinking water is not the highest beneficial use of groundwater at or near the site based on background analytical results and current drinking water quality regulations (PSC, 2003). Agreed Order No. DE 7347 and the Georgetown Facility's Part B permit require that the nonpotability determination designated in the RI report be revisited 6 months prior to Ecology's five-year review. This letter serves as an update to the 2003 RI report's potability analysis.

As part of the review of the 2003 nonpotability determination, AMEC updated the following information:

- The 2003 water well survey and groundwater beneficial use for the area using existing databases and recent references;
- The water chemistry data since 2003 based on the database from the long-term groundwater monitoring network;
- The water treatment costs that would be necessary to use groundwater in the area for beneficial use; and
- Our current understanding of the local regulations for installation and use of drinking water wells in the area.

The designation of the highest beneficial use of groundwater in a particular area is established by several different agencies, including Ecology, the Washington State Department of Health (DOH), and county and city governments. The requirements, rules, and guidance of each of these agencies were considered in the determination of the highest beneficial use of the groundwater in this potability determination five-year review.

AMEC Environment & Infrastructure, Inc.
600 University Street, Suite 600
Seattle, Washington
USA 98101-4107
Tel (206) 342-1760
Fax (206) 342-1761
www.amec.com

GROUNDWATER BENEFICIAL USE UNDER MODEL TOXICS CONTROL ACT

According to Washington Administrative Code (WAC) 173-340-720, groundwater cleanup levels shall be based on estimates of the highest beneficial use, which Ecology determined to be drinking water, unless the groundwater at the facility meets the criteria listed in WAC 173-340-720(2)(a) through (c). Groundwater in the shallow/intermediate zones and the deep aquifer in the vicinity of the facility was evaluated using each criterion presented in WAC 173-340-720(2). Those criteria are listed below, followed by a discussion of groundwater or aquifers affected by releases from the facility. Groundwater in the shallow/intermediate zones and the deep aquifer migrates to the southwest, eventually discharging to the Duwamish Waterway, as discussed in the 2003 RI. Therefore, the "area of interest" is defined to include groundwater located in the shallow/intermediate zones or the deep aquifer in the area between the facility and the Duwamish Waterway (see Figure 6-4 from the 2003 RI Report in Attachment 2).

WAC 173-340-720(2) defines all groundwater as potable unless all of the following criteria can be demonstrated:

(a) The groundwater does not serve as a current source of drinking water.

Information from a number of sources indicates that groundwater does not currently serve as a source of drinking water in the area of interest:

- There are no water supply wells within one mile downgradient or cross-gradient of the facility, based on a review of Ecology's files for well logs (Ecology, 2014), the U.S. Environmental Protection Agency (EPA) Office of Water Public Water System database (EDR, 2014), and the United States Geological Survey Water Well database (USGS, 2014).
- The area around the facility is served by the Seattle Public Utilities water system, which is supplied by the Cedar and Tolt River Watersheds located in the Cascade Mountains (SPU, 2012). The Highline Well Field, located over 5 miles south of the facility in SeaTac, also provides water service. The Highline Well Field is not hydraulically connected to the area of interest.
- The 2003 RI indicated that several surveys of businesses and residences located in the area of interest were conducted in 2000 and 2001. The results of the surveys indicated that no water supply wells exist at any of the responding properties.
- The 2003 RI also indicated that a review of the Seattle-King County Health Department Water System database in 1997 (Herman and Snider 1998) identified no public water supply wells in the Duwamish Valley north of the south end of King County International Airport.

(b) The groundwater is not a potential future source of drinking water for any of the following reasons:

(i) The groundwater is present in insufficient quantity to yield greater than 0.5 gallon per minute on a sustainable basis to a well constructed in compliance with chapter 173-160 WAC and in accordance with normal domestic water well construction practices for the area in which the site is located.

The shallow/intermediate zones and the deep aquifer in the area of interest can yield more than 0.5 gallon per minute (gpm), based on previous pumping tests (BEI, 1993; PSC, 2000a,b).

(ii) The groundwater contains natural background concentrations of organic or inorganic constituents that make use of the water as a drinking water source not practicable. Groundwater containing total dissolved solids at concentrations greater than 1,000 milligrams per liter (mg/l) shall normally be considered to have fulfilled this requirement. (Note: The total dissolved solids concentration provided here is an example. There may be other situations where high natural background levels also meet this requirement.)

The Model Toxics Control Act (MTCA) defines "practicable" as "capable of being designed, constructed and implemented in a reliable and effective manner, including consideration of cost. When considering cost under this analysis, an alternative shall not be considered practicable if the incremental cost of the alternative is disproportionate to the incremental degree of benefits provided by the alternative over other lower-cost alternatives" (WAC 173-340-200).

As indicated in the 2003 RI report, groundwater in the Duwamish Valley is generally considered to be of poor quality, as it is naturally saline with high concentrations of total dissolved solids rendering the groundwater unacceptable for use as a source of drinking water (PSC, 2003). These saline conditions can be attributed to the influence of tidal mixing in the shallow and intermediate zones, and to residual salinity from deposition of the aquifer materials in the deep aquifer. Furthermore, high levels of iron and manganese have been noted historically in groundwater in the shallow groundwater zone (Herman and Snider, 1998). Analysis of water quality in groundwater in the shallow/intermediate zones and the deep aquifer just upgradient of the Georgetown facility shows results that are consistent with these general observations (PSC, 2003). Although the concentrations of these parameters may be reduced by treatment, the cost of the treatment would make the use of the groundwater impracticable.

A detailed evaluation of groundwater quality in the shallow/intermediate zones and the deep aquifer near the Georgetown facility is presented below together with an assessment of the practicability of treating groundwater beneath the site for potential beneficial use based on background concentrations of organic and inorganic constituents.

Required Treatment

The need for treatment was determined by a comparison of site-specific natural background concentrations to the DOH and EPA maximum contaminant levels (MCLs). (See WAC 246-290, WAC 246-291, and 40 Code of Federal Regulations Parts 141 and 143.) WAC 246-290 and WAC 246-291 contain the state's primary and secondary MCLs for groundwater as the maximum permissible concentrations of selected organic and inorganic constituents in groundwater used as a public drinking water supply. Public water supplies encompass all water systems with the exception of a private well serving a single-family residence. While the private water supply well serving a single-family residence is not required by law to meet these standards, these standards are recommended for use with single family wells in order to protect the health of the users (DOH, 2001). Primary MCLs are chemical, physical, and bacteriological standards selected to prevent adverse health effects while secondary MCLs are standards developed to control factors such as taste and odor. Although secondary MCLs are not enforceable limits, these values are recommended guidelines (EPA, 2009). Groundwater exceeding a secondary MCL would require treatment before it could be used as a source of domestic water. Site-specific background concentrations in the shallow/intermediate zones and the deep aquifer were compared to primary and secondary MCLs since these represent the best available indicators of whether groundwater is suitable for use as a source of drinking water without treatment.

Potability Determination Five-Year Review

Site-specific natural background concentrations were not updated for this five-year review. AMEC assumes that the site-specific natural background concentrations calculated for the 2003 RI report using data from upgradient and cross-gradient monitoring wells (CG-101-S-1, CG-101-S2, CG-3, CG-106-WT, CG-106-I, CG-107-WT, CG-111-I, and CG-106-D) are representative of current background conditions in the shallow/intermediate zones and the deep aquifer. The monitoring wells used to determine natural background concentrations are not part of the Long-Term Groundwater Monitoring Plan for the site and have not been sampled recently. In addition, in 2012 monitoring wells in the CG-101 cluster at well depth intervals in the Shallow 1, Shallow 2, and Intermediate zones, and in well cluster CG-106 at depth intervals in the shallow/intermediate zones and the deep aquifer, were abandoned at the request of the Seattle Department of Transportation.

As discussed in the 2003 RI report, the shallow and intermediate zones are hydraulically interconnected, with no confining unit between these water-bearing zones (PSC, 2003). This hydraulic interconnection indicates that groundwater may move between these zones depending on the difference in hydraulic head. Consequently, if the groundwater from either the shallow or intermediate zone is considered to be nonpotable, the groundwater from both zones should be considered nonpotable. Therefore, the shallow and intermediate zones were considered together for the evaluation of natural background conditions. The groundwater samples collected from these wells likely represent area background for organic constituents and natural background for inorganic constituents and other water quality parameters, as discussed in Appendix 6A of the 2003 RI report (PSC, 2003).

The 2003 RI report used data from groundwater monitoring events conducted from the first quarter 2000 through the second quarter 2003 to calculate site-specific background concentrations. The background turbidity was calculated using stabilized water quality readings collected during the quarterly groundwater monitoring events. These values should accurately reflect a hypothetical best case for domestic wells because the monitoring wells at the facility and in the surrounding area were constructed using domestic well construction guidelines (WAC 173-160) and were sampled using low-flow methodology designed to minimize turbidity. Upper end percentiles were selected as site-specific background concentrations, as specified in WAC-173-340-709. The distribution of the available background data for each parameter was tested for normality and lognormality. The 90th percentile value was selected as the background concentration for lognormally distributed parameters and the 80th percentile was selected as the background concentration for normally distributed parameters. Calculated background concentrations for the shallow/intermediate zones and deep aquifer for the area of interest are summarized in Tables 6-1 and 6-2 of Attachment A.

For the shallow and intermediate zones, background concentrations of turbidity and coliform bacteria exceed their primary MCLs, while concentrations of iron, manganese, total dissolved solids, and color exceed their secondary MCLs, as presented in Table 6-1 of Attachment A. Turbidity, a measure of the cloudiness of the water, is often associated with the presence of disease-causing microorganisms and may interfere with the ability to effectively disinfect drinking water. Coliforms, which are often used as an indicator of the presence of other potentially harmful bacteria (EPA, 2009), were detected in groundwater samples collected from wells screened in the shallow and intermediate zones. Excess iron and manganese in water result in rusty or blackish-brown coloration, a bitter, metallic taste, staining of household fixtures and laundry, and particulates. Elevated concentrations of total dissolved solids, or salts, can cause deposits, colored water, and staining and can impart a salty taste to water. Color may also indicate dissolved organic material or bacteria.

For the deep aquifer, all reported concentrations of arsenic and turbidity exceeded primary MCLs and all reported concentrations of ferric iron, dissolved manganese, and total dissolved solids exceeded secondary MCLs, as presented in Table 6-2 of Attachment A.

Site-specific natural background concentrations were compared to MCLs to determine the suitability of untreated groundwater for use as a source of drinking water. Owing to the natural values for several water quality parameters, including iron, manganese, turbidity, color, and total dissolved solids, groundwater from the shallow/intermediate zones and the deep aquifer would likely require treatment before use as a source of drinking water. The potential costs of this treatment are discussed in the following section.

Potential Treatment Costs

Groundwater from the shallow/intermediate zone and the deep aquifer would need to be treated to reduce turbidity; concentrations of coliform bacteria, iron, manganese, and total dissolved solids; and color prior to its use as drinking water. Groundwater from the deep aquifer also would need to be treated to reduce arsenic concentrations. A number of different treatment technologies are available to address these parameters, as described in Attachment 3. Treatment technologies were reviewed in light of new technology and methods that may not have been readily available or have changed in cost since the 2003 RI. Reverse osmosis (RO) was selected as the primary treatment for this evaluation because:

- RO provides hyperfiltration – even viruses and metal ions, such as iron and manganese, are removed from the treated groundwater.
- RO does not require use of hazardous chemicals – Other technologies, such as ion exchange resins, require the handling and use of caustic solutions to regenerate the spent ion exchange resins.
- RO is more energy efficient than distillation treatment methods, and produces a higher quality treated groundwater stream in a one-step process.

Other technologies available to treat groundwater with high concentrations of dissolved solids, iron, and manganese, such as ion exchange resins or distillation, are inappropriate for residential use due to the costs for ion exchange resins or energy required for distillation of water. RO offers the simplest option for treating the extracted water, and is cost competitive even for a public water supply system.

RO uses a semipermeable membrane that allows the water being purified to pass through it, while rejecting the contaminants. RO technology uses a process known as cross-flow to allow the membrane to continually clean itself. Some of the fluid passes through the membrane and the rest continues downstream, sweeping the rejected species away from the membrane. An additional 25 percent of the desired total water flow would be used as crossflow and disposed of in a sanitary sewer. While significant amounts of water would be disposed of, this cost is relatively minor compared to the chemical usage required by other equivalent treatment alternatives. The costs associated with treatment of groundwater from both the shallow/intermediate zones and the deep aquifer were evaluated for two potable groundwater use scenarios: a typical single-family residential water supply and a typical small public water supply system. These estimated costs are summarized in Table 1. Supporting details are presented in Attachment 5.

The costs of other capital equipment, such as wells or piping, is not considered in this cost analysis since these costs would be incurred regardless of the need for treatment of the extracted groundwater.

For a typical single-family residence, costs associated with treating groundwater with an RO system were calculated based on providing 2 gpm flow as a peak demand for household use[1] with a typical daily usage rate of 123 gallons of water per day for a typical Seattle household (SPU, 2011). A typical home RO system would likely be followed by ultraviolet (UV) photo-oxidation or residual chlorination, a polishing step that should kill any pathogens not removed during RO, or if there were an undetected failure of the RO membrane. The treatment equipment required for a single-family well system includes a sediment filter, RO and UV units, and a secondary distribution pump, configured as shown in Figure 4-1 of Attachment 4. The costs associated with purchasing, maintaining, and operating this system at a 123-gallon-per-day rate are approximately $1,750 per year (Table 1; Attachment 5).[2] In comparison, the cost of this same amount of water would be approximately $467 annually based on the current Seattle Public Utilities 2014 residential rate schedule (SPU, 2014a). The costs for water treatment alone for a single-family residence would be over three times higher than the cost for the same amount of water provided by Seattle Public Utilities.[3]

For a public water supply system, costs associated with treating groundwater with RO were estimated based on a desired production rate of 1,000 gpm, as this is the smallest supply system typically in use in the region due to the considerable costs of constructing a public water supply system (CPSWSF, 2001). As in the case of the single-family residence, when using RO, the pumping rate must be increased by 25 percent to provide adequate water for cleaning the filtration membranes. Figure 2 of Attachment 4 shows a schematic of the equipment for the public water supply system. The additional

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[1] RO treatment costs were calculated using the GE cost estimating RO Tools™ website (GE Water, 2014) based on peak usage of 2 gpm. Operational costs were scaled to reflect the fact that while the peak rate was 2 gpm, the overall rate is approximately 0.10 gpm.
[2] Capital cost for equipment amortized over 10-year service life.
[3] The costs associated with the installation of a well and the purchase of a pump and control system were not included in the cost estimates for treatment but are estimated to be similar to the cost of installing a new connection of a single-family residence to the City water lines at the street. These costs are not considered an added cost for this scenario. The cost of installing a well and pump and control system, or connecting to a public water supply are estimated to be on the order of $10,000–$15,000.

treatment equipment includes the filter, the RO equipment, and a chlorination step. While RO treatment removes coliform bacteria from the water, subsequent chlorination is required to ensure that the water remains pathogen-free until it reaches the consumer.

The incremental cost to treat water to supply 1,000 gpm is equivalent to $1,348,000 per year as capital and operation and maintenance costs, or $836 per acre-foot (Table 1). This cost estimate for treating groundwater does not account for the expense of installing wells, acquiring easements, and purchasing the land required to construct a public water supply system, as these costs would be incurred in any public water system development scenario. Furthermore, multiple wells would need to be installed over a large area with wells separated by at least approximately 1,500 feet, as the uppermost aquifer cannot provide more than 250 gpm from a single well without dewatering the aquifer.[4]

The City of Seattle can currently supply such large bulk quantities of water to a public water supply system at an approximate cost of $1,160,050 or $719 per acre-foot of water (see Attachment 6). The incremental cost of treating the extracted groundwater is more than $180,000 more than purchasing the same amount of water at wholesale cost from the City of Seattle per year.

The estimated treatment costs for groundwater from the Georgetown area are based on reducing groundwater concentrations to levels just below primary and secondary MCLs. Seattle Public Utilities currently obtains water from the Cedar River and the South Fork of the Tolt River, which both have extremely low mineral contents, as documented in Attachment 7, and also maintains a small well field in the Highline area of South King County for additional capacity during periods of peak demand (SPU, 2014b). These existing supplies are projected to meet demands through at least 2060 (SPU, 2012). Several alternative potential sources of water also being considered by SPU to meet any increases in demand in the future include the Snoqualmie Aquifer, utilization of Tacoma's Second Supply Project, dead storage on Chester Morse Lake, additional drawdown from Lake Youngs, and the North Fork of the Tolt River, as well as conservation and water re-use for industrial purposes and irrigation.

In summary, the costs required to install and maintain a well and the required water treatment equipment are several times greater than those associated with obtaining water from Seattle Public Utilities. In addition, the quality of the treated groundwater is still likely to be inferior to that available to Seattle Public Utilities' customers from the region's multiple surface water and groundwater sources. The cost of treating groundwater from the shallow/intermediate zones and deep aquifer compared to the costs associated with obtaining water from other identified sources via the public utilities renders the use of area groundwater as a source of drinking water impracticable under WAC 173-340-720(2)(ii).

(iii) The groundwater is situated at a great depth or location that makes recovery of water for drinking water purposes technically impossible.

Groundwater can be recovered from both the shallow/intermediate zones and the deep aquifer.

[4] Based on simple MODFLOW simulation presented in the RI report.

(c) The department determines it is unlikely that hazardous substances will be transported from the contaminated groundwater to ground water that is a current or potential future source of drinking water, as defined in (a) and (b) of this subsection, at concentrations which exceed groundwater quality criteria published in chapter WAC 173-200.

As discussed earlier in this letter, the contaminated groundwater at the facility is not a current or future potential source of drinking water. Groundwater at the facility generally flows to the southwest and eventually discharges to the Duwamish Waterway. The groundwater between the facility and the Duwamish Waterway is not a current source of drinking water. Furthermore, this groundwater is never likely to be considered as a potential source of drinking water due to poor water quality and regulatory concerns discussed in the Groundwater Beneficial Use Under Current Local Regulations section below.

(d) Even if groundwater is classified as a potential future source of drinking water under (b) of this subsection, the department recognizes that there may be sites where there is an extremely low probability that the groundwater will be used for that purpose because of the site's proximity to surface water that is not suitable as a domestic water supply. An example of this situation would be shallow groundwater in close proximity to marine waters such as on Harbor Island in Seattle. At such sites, the department may allow groundwater to be classified as nonpotable for the purposes of this section if each of the following conditions can be demonstrated. These determinations must be for reasons other than that the groundwater or surface water has been contaminated by a release of a hazardous substance at the site.

(i) The conditions specified in (a) and (c) of this subsection are met;

Conditions specified in subsections (a) and (c) have been met.

(ii) There are known or projected points of entry of the groundwater into the surface water;

Groundwater flows in a west-southwest direction from the facility toward the Duwamish Waterway (PSC, 2003)

(iii) The surface water is not classified as a suitable domestic water supply source under chapter 173-201A WAC

The groundwater at and downgradient of the facility does not discharge to a suitable domestic water supply source under WAC-173-201A-602. The Duwamish Waterway designation uses are salmonid rearing/migration, secondary contact recreation, industrial water, agricultural water, stock water, wildlife habitat, fish harvesting, commerce and navigation, boating, and aesthetic qualities under Table 602. However, the Duwamish Waterway is not classified as a suitable domestic water supply source under WAC 173-201A.

(iv) The groundwater is sufficiently hydraulically connected to the surface water that the groundwater is not practicable to use as a drinking water source.

Groundwater located near the Duwamish Waterway is slightly brackish due to the influence of the saline waters in the waterway. Results of the July 2003 tidal monitoring study indicate that the zone of brackish water intrusion extends approximately 1,000 feet inland from the waterway to well CG-140 in the shallow and intermediate zones (PSC, 2003). As a result, groundwater located up to 1,000 feet from the waterway is sufficiently hydraulically connected to the surface water that the groundwater is not practicable to use as a drinking water source. This distance also could be increased by pumping groundwater from a well located outside the area if the tidal mixing zone is within the radius of influence of the well. A 600-foot radius around a well is considered to be the "preliminary short-term groundwater contribution area" under WAC-246-291-125.

GROUNDWATER BENEFICIAL USE UNDER CURRENT LOCAL REGULATIONS

Local regulations and well construction practices continue to prevent the use of groundwater at or near the facility as a potential drinking water source by prohibiting the installation of new wells in the area. These include the following regulations:

- King County rules require connection to existing water supplies where available (King County, 2013). The area around the facility is served by the Seattle Public Utilities water system.
- Private wells are only permitted on lots of 5 acres or larger (King County, 2013). There are currently no residential lots of this size in the Georgetown area.
- A water right permit is required when developing a new source of groundwater that will withdraw more than 5,000 gallons per day (King County, 2013). Water rights in the Duwamish basin would be difficult to obtain because the Green-Duwamish Basin instream flow requirements are not currently being met (WAC 173-509). The instream flows constitute a prior water right and as such have a priority on water use.
- Well setback requirements for water wells must be approved by the DOH or local health jurisdiction and be at least:
    - 100 feet from known or potential sources of contamination, which may include hazardous waste sites, sea/salt water intrusion areas, chemical and petroleum storage areas, pipelines used to convey materials with contamination potential (WAC 173-160-171);
    - 100 feet from animal enclosures, houses and/or garages, garbage and manure piles (King County, 2013);
    - 100 feet from public roads (King County, 2013);
    - 100 feet from sewers, septic systems (King County, 2013);
    - 100 feet from surface water (King County, 2013);

- 100 feet from railroad tracks, power utility or gas lines, and underground storage tanks (King County, 2013); and
- 1,000 feet from soil waste landfills.

The well setbacks requirements severely limit, if they do not eliminate, the areas where a well could be placed around the area of interest.

ADDITIONAL BENEFICIAL USE CONSIDERATIONS

As discussed in the previous sections, the evaluation of the groundwater quality in the vicinity of the facility with respect to potability determination criteria specified in MTCA supports the designation of the groundwater as nonpotable. In addition, the likelihood that groundwater from the shallow or intermediate zones will be used as a source of drinking water is further diminished by the following:

- The Duwamish Valley aquifers are not listed as one of the city's long-range water supply options (City of Seattle, 1997), indicating that the use of the more than 20 listed alternate water supply sources would have to be impracticable before the use of the Duwamish aquifers would be considered.
- The City of Seattle has stated that they are not "interested in using the shallow aquifer for drinking water because of the treatment requirements and public health and safety concerns" (City of Seattle, 1997).[5]
- The Seattle-King County Department of Public Health has stated that future requests for the development of drinking water wells in the Duwamish Valley would *"most likely be refused since there is a higher and better source of water in the area"* (Seattle-King County Department of Public Health, 1997).
- The presence of organic chemicals in upgradient and cross-gradient wells indicates that there are other uncontrolled sources of groundwater contamination in the area proximate to the facility.

GROUNDWATER BENEFICIAL USE DESIGNATIONS IN THE DUWAMISH VALLEY

There are several other sites in the Duwamish Valley where groundwater has been either designated as nonpotable or protection of surface water has been deemed the highest beneficial use of groundwater. These sites include, but are not limited to: Harbor Island, Southwest Harbor Project, Great Western Chemical, Fostoria Business Park, Spencer Industries, Holnam Markey Site, the former All City Wrecking Site, and the Myrtle Street Property. Cleanup standards developed for these sites are based on the protection of surface water as a nonpotable water body (see Figure 6-5 in Attachment 2).

SUMMARY AND CONCLUSIONS OF GROUNDWATER BENEFICIAL USE EVALUATION

The groundwater in the area of interest is not currently used as a source of drinking water and is not classified as a potential future source of drinking water under WAC 173-340-720(2). Furthermore, it is

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[5] The City's definition of the shallow aquifer encompasses both the shallow and intermediate zones as defined in this report.

highly unlikely that the groundwater contamination in the shallow/intermediate zones and deep aquifer in the area of interest is hydraulically connected to any groundwater or surface water that is a potential future source of drinking water. Groundwater in parts of the area of interest is also rendered not potable by the intrusion of brackish water from the Duwamish Waterway. Various state and local regulations prohibit the installation and use of drinking water wells in the area of interest by requiring connection to the available public supply and through numerous setback requirements that severely limit the area in which a well could be installed.

In summary, drinking water continues to not be the highest beneficial use of groundwater at or near the Georgetown facility, based on background groundwater analytical results and current drinking water quality regulations. This determination is consistent with studies at other sites located in the Duwamish Valley where the highest beneficial use of groundwater has been evaluated. The highest beneficial use of groundwater in the area is the protection of surface water as a nonpotable water body. Groundwater in the shallow/intermediate zones and the deep aquifer that discharges to the Duwamish Waterway is classified for use for salmonid rearing/migration, secondary contact recreation, industrial water, agricultural water, stock water, wildlife habitat, fish harvesting, commerce/navigation, boating, and aesthetic qualities. Groundwater cleanup standards considered for chemicals of potential concern are protective of these uses.

Stericycle will revisit the groundwater potability analyses prior to the next Ecology five-year review in 2020 or if new information becomes available suggesting that the groundwater might be considered as a drinking water source.

Sincerely yours,
AMEC Environment & Infrastructure, Inc.

Natasya Gray, LG
Associate Geologist
Direct Tel.: (206) 342-1786
E-mail: natasya.gray@amec.com

John Long, LHG
Associate Hydrogeologist
Direct Tel.: (206) 342-1779
E-mail: john.long@amec.com

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Enclosure(s): Table 1
Attachment 1 – Tables 6-1 and 6-2 from the 2003 RI Report
Attachment 2 – Figures 6-3 through 6-5 from the 2003 RI Report
Attachment 3 – Comparison of Potential Groundwater Treatment Technologies
Attachment 4 – RO Treatment Diagrams
Attachment 5 – Supporting Details for RO Cost Estimates
Attachment 6 – Potable Water Costs
Attachment 7 – Seattle Public Utilities 2014 Annual Analysis of Cedar & Tolt Water Supplies

cc: William Beck, Stericycle

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TABLE 1

SUMMARY OF WATER TREATMENT COSTS

PSC Georgetown Facility
Seattle, Washington

	Single Family	Decentralized System
	RO System	
Capital Cost		
Flow (GPM)	2	1,000
Base Unit[1]	$7,565.00	$524,000.00
Cleaning Tank[2]	$500.00	$10,000.00
UV System[2]	$500.00	--
Chlorinator[2]	--	$50,000
Installation[2]	$1,000	$50,000
Total Capital:	$9,565	$634,000
Amortization[3]		
Monthly Payment	$106	$7,039
Annual Payment	$1,274	$84,464
O&M From RO Tools[4]		
Annual O&M	$473	$1,263,691
Total Annual Cost:	$1,750	$1,348,000
Per Acre-Foot:	$542	$836
	Potable Water Treatment Cost[5]	
Annual Potable Cost	$467	$1,160,050
Per Acre-Foot:	$145	$719
	RO System/Potable Water Cost Comparison	
Difference in Annual Costs	$1,283	$187,950
Per Acre-Foot	$398	$117

Notes
1. Cost estimates for RO systems provided by local sales rep for GE.
2. Based on engineering judgment.
3. Loan amoritization based on a ten year loan period at an annual interest rate of 6% with monthly payments.
4. O&M costs estimated from RO tools (see Attachment 5).
5. Potable water treatment cost details provided in Attachment 6.

ATTACHMENT 1

Tables 6-1 and 6-2 from the 2003 RI Report

Table 6-1

Site-Specific Background Concentrations in Groundwater from the Shallow and Intermediate Aquifers

PSC Georgetown Facility

Compound	Number of Samples	Number of Detects	Frequency of Detection	Units	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Distribution of Data	Background Concentration	Primary MCL	Secondary MCL	Exceeds MCL?
Antimony	21	0	0%	ug/L	---	---	---	---	---	6	---	---
Arsenic	57	30	53%	ug/L	0.0724	12.5	1.21	lognormal	1.51 *	10	---	no
Barium	48	20	42%	ug/L	5.43	46.9	17	lognormal	21.53	2,000	---	no
Beryllium	21	0	0%	ug/L	---	---	---	---	---	4	---	---
Cadmium	31	0	0%	ug/L	---	---	---	---	---	5	---	---
Chloride	52	52	100%	ug/L	3790	343000	81677.5	**	22,320 *	---	250,000	no
Chromium	29	17	59%	ug/L	1.07	20.6	4.30	lognormal	4.56 *	100	---	no
Chromium (Hexavalent)	17	3	18%	ug/L	16.6	24.2	---	---	---	100	---	---
Copper	47	23	49%	ug/L	1	34.8	4.391	**	2 *	1,300	---	no
Cyanide	54	5	9%	ug/L	10	41.9	20.46	normal	---	200	---	no
Ferric Iron	**46**	**26**	**57%**	**ug/L**	**290**	**39200**	**4396.61**	**lognormal**	**2,726 ***	**---**	**300**	**Yes**
Ferrous Iron	**41**	**10**	**24%**	**ug/L**	**514**	**17000**	**4217.9**	**lognormal**	**312 ***	**—**	**300**	**Yes**
Ferrous Iron (Field Test)	**21**	**18**	**86%**	**ug/L**	**40**	**3010**	**1283.33**	**normal**	**1,904**	**—**	**300**	**Yes**
Iron	**15**	**9**	**60%**	**ug/L**	**313**	**8600**	**3234.778**	**normal**	**2,408 ***	**---**	**300**	**Yes**
Lead	55	6	11%	ug/L	1.08	5.75	3.02	normal	---	15	---	---
Magnesium	41	41	100%	ug/L	1120	17400	6792.68	lognormal	17,136	---	---	---
Manganese	**52**	**45**	**87%**	**ug/L**	**12.2**	**988**	**222.99**	**	**569**	**---**	**50**	**Yes**
Mercury	25	0	0%	ug/L	---	---	---	---	---	2	---	---
Nickel	45	22	49%	ug/L	1	9.25	2.194	lognormal	2.93	100	---	no
Nitrate(as N)	51	13	25%	ug/L	183	638	339.15	lognormal	330	10,000	---	no
Nitrite (as N)	52	2	4%	ug/L	82	280	181	**		1,000	---	no
Potassium	41	32	78%	ug/L	561	31700	12641.91	lognormal	22140.89 *	---	---	---
Selenium	47	8	17%	ug/L	1.44	6.12	2.206	lognormal	1.55	50	---	no
Silver	42	0	0%	ug/L	---	---	---	---	---	---	100	---
Sodium	41	41	100%	ug/L	2250	359000	81000.73	**	64000 *	---	---	---
Sulfate	52	37	71%	ug/L	449	49400	9551.68	lognormal	12766.66	---	250,000	no
Sulfide	53	0	0%	ug/L	---	---	---	---	---	---	---	---
Thallium	21	0	0%	ug/L	---	---	---	---	---	2	---	---
Total Dissolved Solids	**41**	**41**	**100%**	**ug/L**	**13000**	**1100000**	**313682.93**	**lognormal**	**684378.9**	**—**	**500,000**	**Yes**
Vanadium	15	11	73%	ug/L	1.08	16.7	3.77	lognormal	5.83 *	---	---	---
Zinc	10	2	20%	ug/L	18.4	61.9	40.15	**	---	---	5,000	no
Turbidity	**68**	**68**	**100%**	**NTU**	**0**	**290**	**12.145**	**lognormal**	**11.5**	**1**	**---**	**Yes**
Coliforms	**4**	**3**	**75%**	**CFU/100ml**	**17**	**5100**	**1284**	**	**76 ***	**>0**	**---**	**Yes**
Color	**7**	**6**	**86%**	**color units**	**5**	**120**	**55**	**normal**	**94.71**	**—**	**15**	**Yes**

Notes:

ug/L = micrograms per liter = parts per billion (ppb)

mg/L = milligrams per liter = parts per million (ppm)

NTU = Nephelometric units

CFU = Colony forming units

MCL = Maximum contaminant level (WDOH, 1995 and Updates; EPA, 2002)

Bold text indicates that background concentration exceeds MCL

Background concentrations were calculated in accordance with WAC-173-340-709 using data from CG-3, CG-101-S1, CG-101-S2, CG-106-WT, CG-106-I, CG-107-WT and CG-111-I for the shallow and intermediate aquifers.

Data from January 2000 through May 2003 were used for all parameters except coliforms. Coliform data were collected in August and November 1999.

Background concentrations were not calculated for parameters with six or fewer data points as statistics can not be reliably calculated from small data sets.

* In cases where the upper 90th percentile was greater than 4 times the 50th percentile, 4 times the 50th percentile was used as the background concentration.

** Distribution could not be determined; non-parametric statistical methods were used.

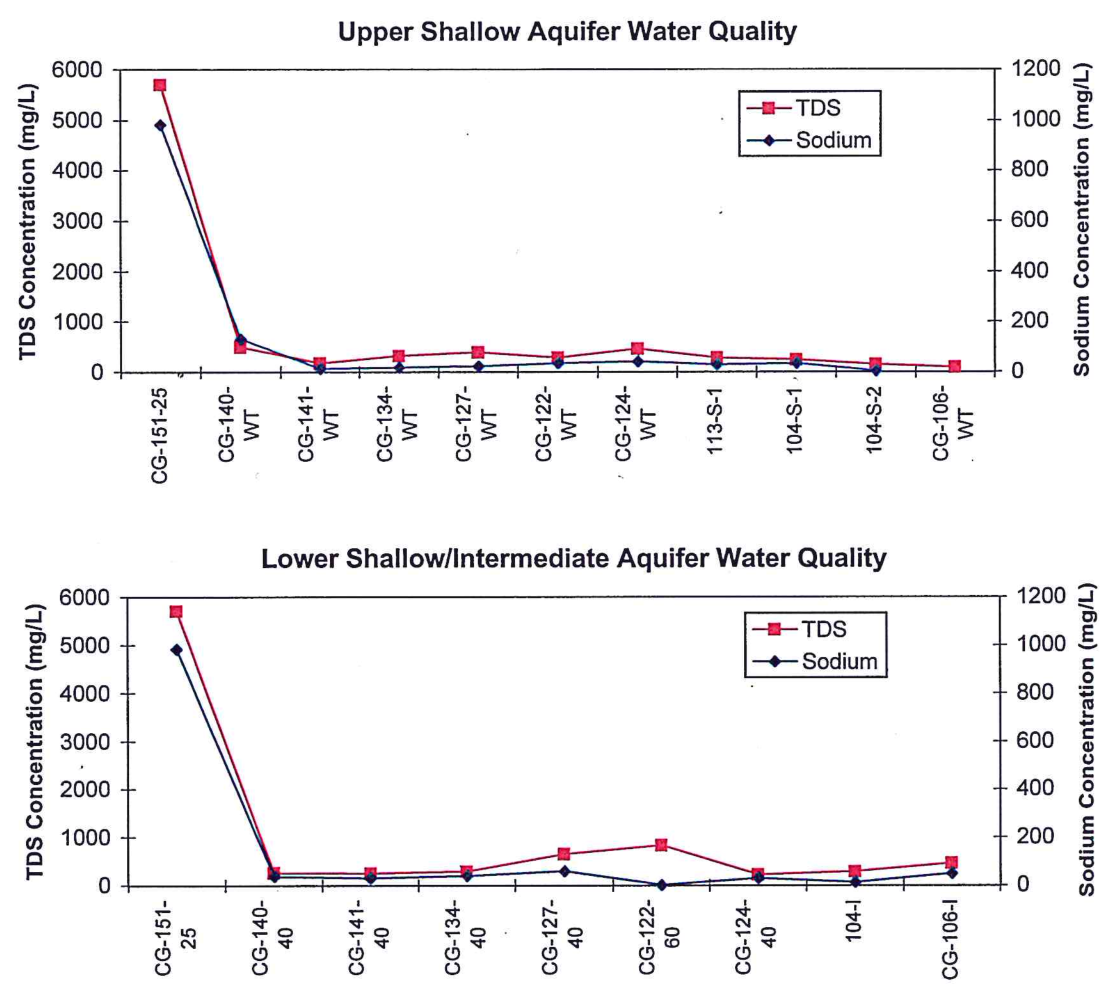
Table 6-2
Site-Specific Background Concentrations in Groundwater from the Deep Aquifer
PSC Georgetown Facility

Compound	Number of Samples	Number of Detects	Frequency of Detection	Minimum Detected Concentration	Maximum Detected Concentration	Average Detected Concentration	Distribution of Data	Background Concentration	Primary MCL	Secondary MCL	Exceeds MCL?
Antimony	3	0	0%	---	---	---	---	---	6	---	---
Arsenic	**6**	**6**	**100%**	**11.5**	**15.9**	**13.43**	**lognormal**	**15.88**	**10**	**—**	**Yes**
Barium	6	3	50%	4.74	41.9	19.18	**	---	2,000	---	no
Beryllium	3	0	0%	---	---	---	---	---	4	---	---
Cadmium	3	0	0%	---	---	---	---	---	5	---	---
Chloride	**5**	**5**	**100%**	**156,000**	**234,000**	**200,600**	**lognormal**	**254,873**	**—**	**250,000**	**Yes**
Chromium	3	3	100%	2.85	13.6	7.04	**	---	100	---	no
Chromium (Hexavalent)	3	1	33%	38	38	---	---	---	100	---	---
Copper	6	6	100%	23.5	75.6	38.53	**	133.8	1,300	---	no
Cyanide	4	0	0%	---	---	---	---	---	200	---	no
Ferric Iron	**4**	**4**	**100%**	**123**	**13,000**	**3,788**	**lognormal**	**4,485 ***	**—**	**300**	**Yes**
Ferrous Iron	3	0	0%	---	---	---	---	---	---	300	no
Ferrous Iron (Field Test)	3	3	100%	110	360	236.67	**	---	---	300	no
Iron	**2**	**2**	**100%**	**483**	**510**	**496.5**	**	**—**	**—**	**300**	**Yes**
Lead	6	4	67%	1.06	14	4.785	**	4.03 *	15	---	---
Magnesium	5	5	100%	5,980	9,440	7,078	**	26,720 *	---	---	---
Manganese	**7**	**7**	**100%**	**126**	**257**	**162**	**	**596 ***	**—**	**50**	**Yes**
Mercury	3	0	0%	---	---	---	---	---	2	---	---
Nickel	6	6	100%	5.5	16.6	9.36	**	32.9 *	100	---	no
Nitrate(as N)	5	0	0%	---	---	---	---	---	10,000	---	no
Nitrite (as N)	5	0	0%	---	---	---	---	---	1,000	---	no
Potassium	5	5	100%	17,100	21,600	16,336	**	76,200 *	---	---	---
Selenium	6	6	100%	1.58	2.68	1.97	lognormal	2.61	50	---	no
Silver	6	0	0%	---	---	---	---	---	---	100	---
Sodium	5	5	100%	532,000	593,000	560,800	lognormal	593,567	---	---	---
Sulfate	5	5	100%	5,630	7,560	6,880	**	28,520 *	---	250,000	no
Sulfide	5	0	0%	---	---	---	---	---	---	---	---
Thallium	3	0	0%	---	---	---	---	---	2	---	---
Total Dissolved Solids	**5**	**5**	**100%**	**1,400,000**	**1,600,000**	**1,480,000**	**	**6,000,000 ***	**—**	**500,000**	**Yes**
Vanadium	1	1	100%	44.9	44.9	44.9	---	---	---	---	---
Zinc	0	0	0%	---	---	---	---	---	---	5,000	no
Turbidity	**6**	**6**	**100%**	**4.86**	**446**	**100.29**	**lognormal**	**141.74**	**1**	**—**	**Yes**
Color	**1**	**1**	**100%**	**400**	**400**	**400**	**—**	**—**	**—**	**15**	**Yes**

Notes:
ug/L = micrograms per liter = parts per billion (ppb)
mg/L = milligrams per liter = parts per million (ppm)
NTU = Nephelometric units
MCL = Maximum contaminant level (WDOH, 1995 and Updates; EPA, 2002)
Bold text indicates that background concentration exceeds MCL
Background concentrations were developed in accordance with WAC-173-340-709 using data from CG-106-D
Background concentrations were not calculated for parameters with six or fewer data points as statistics can not be reliably calculated from small data sets.
* In cases where the upper 90th percentile was greater than 4 times the 50th percentile, 4 times the 50th percentile was used as the background concentration.
** Distribution could not be determined; non-parametric statistical methods were used.

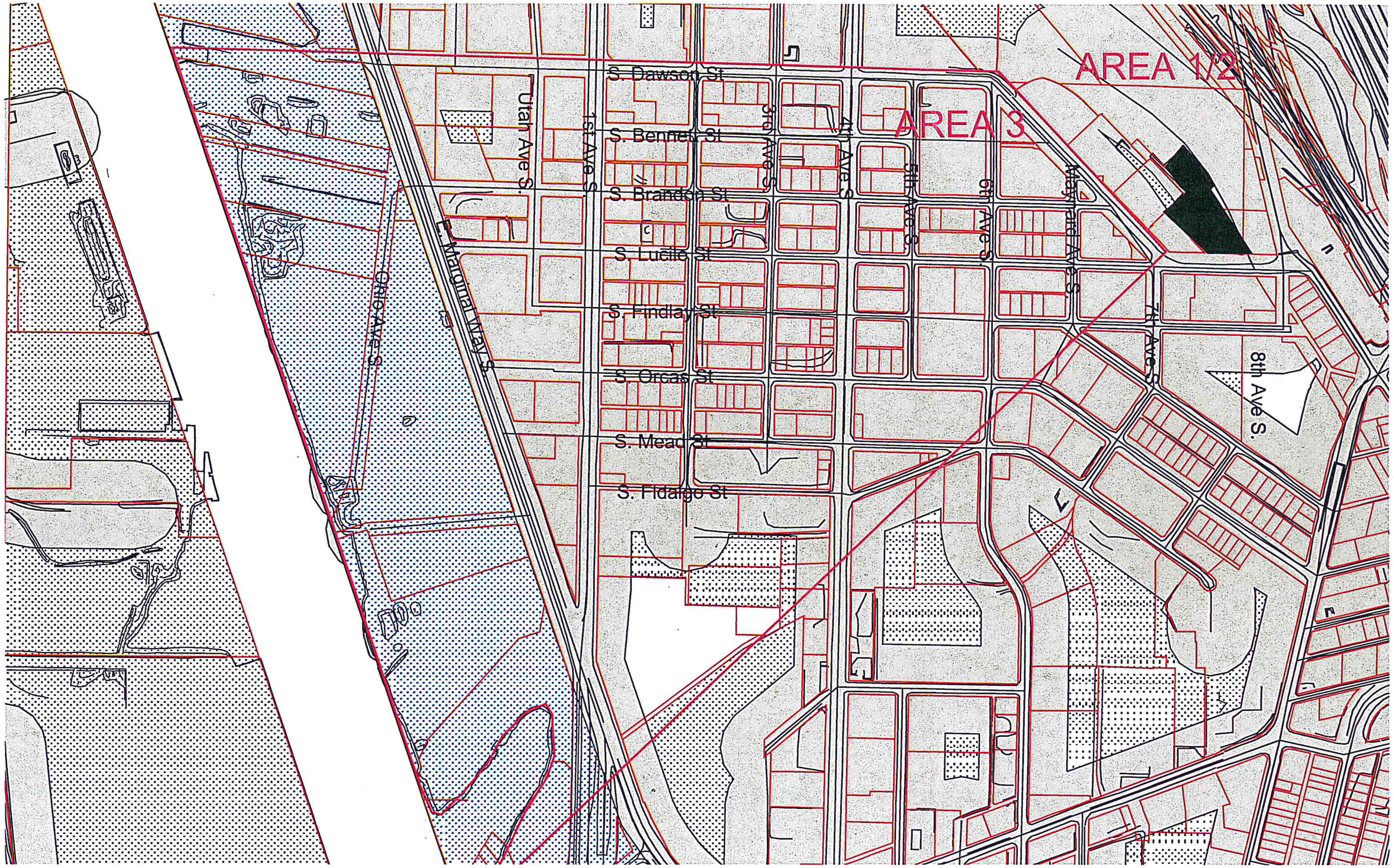
ATTACHMENT 2

Figures 6-3 through 6-5 from the 2003 RI Report



PSC

Figure 6-3
Water Quality with Distance from the Duwamish Waterway
PSC Georgetown Facility



Legend

- Public Roads
- King Co. Tax Parcel
- Drinking water wells must be set back:
  - 100 ft from railines
  - 100ft from gas & power lines
  - 100 ft from public roads

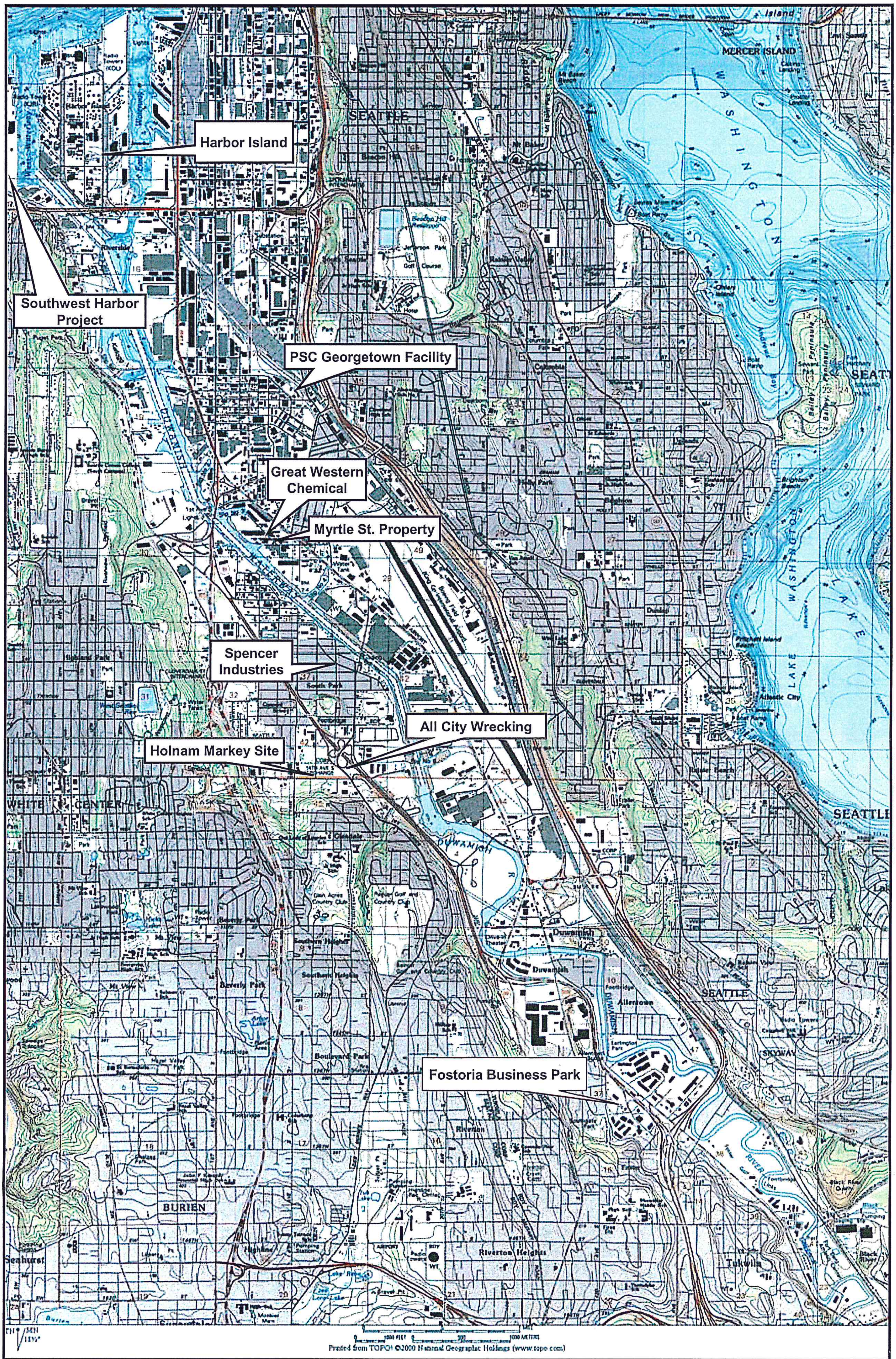
  (King Co., Title 12)
- Drinking water wells not permitted on parcels < 5 Acres (King Co., Title 12)
- Groundwater not potable due to hydraulic connection to Class B surface water body (WAC 173-340-720(d))

N

Note: This figure does not consider the requirement of 100 ft setbacks from landfills, and hazardous waste sites (King Co., Title 12). Numerous unidentified historic landfills likely exist in the study area, and numerous hazardous waste sites have been identified in the area, as shown in Appendix 1A.

900 0 900 1800 Feet

PSC	Well Placement Restrictions Based on Current Regulations PSC Georgetown Facility	Drawn by: DTB	Project: RI2003
		Date: 8/29/2003	Figure Number: 6-4



PSC

Locations of Sites in Duwamish River Valley where Highest Beneficial Use is not as a Source of Drinking Water

Project	RI 2003
Figure	6-5

ATTACHMENT 3

Comparison of Potential Groundwater Treatment Technologies

ATTACHMENT 3

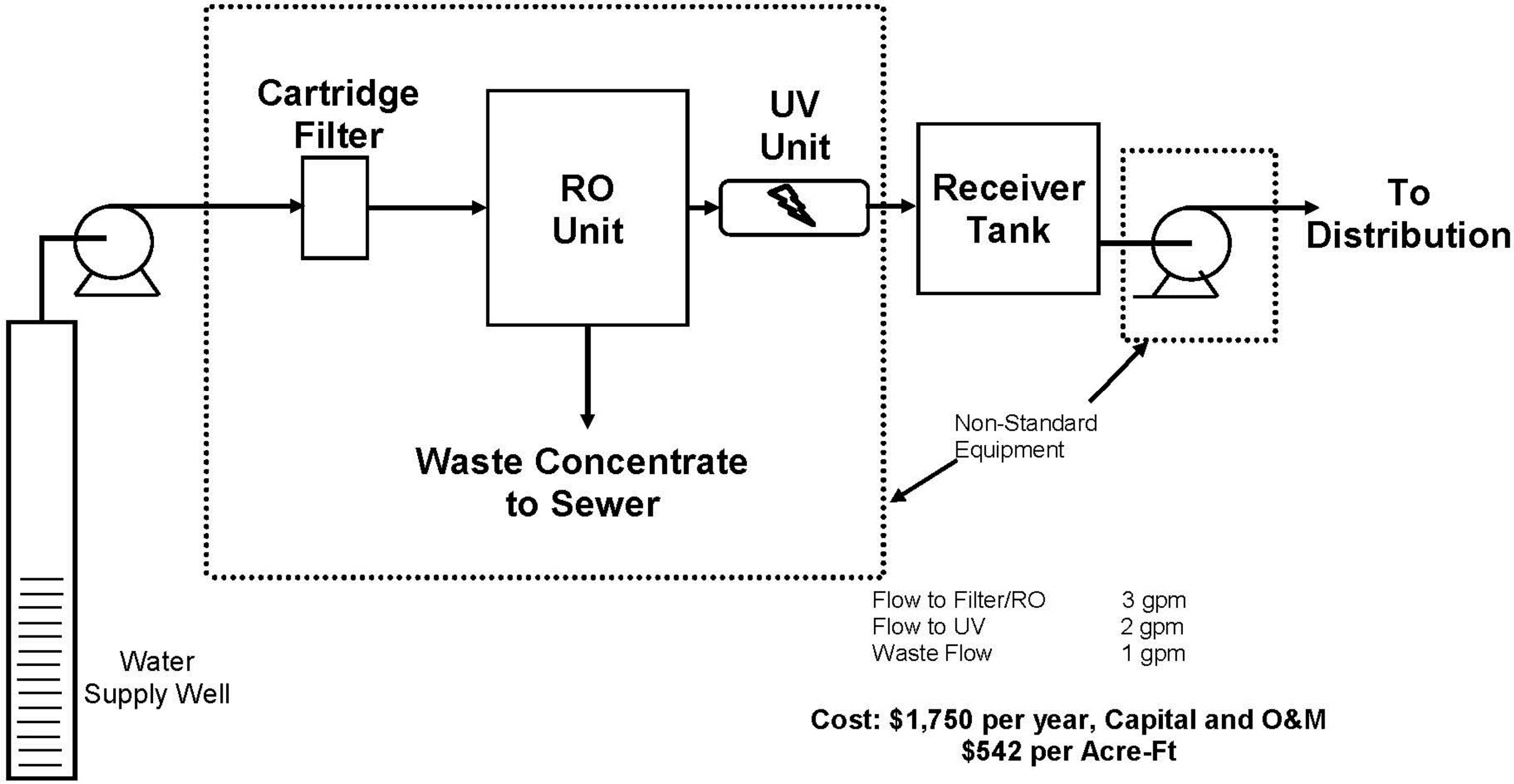
COMPARISON OF POTENTIAL GROUNDWATER TREATMENT TECHNOLOGIES
PSC Georgetown Facility
Seattle, Washington

Treatment Option	Parameter Addressed						Advantages	Disadvantages
	Arsenic	Iron	Manganese	Total Dissolved Solids	Turbidity	Pathogens		
Ion Exchange (cation and anion exchange)	√	√	√	√	√		Effective at treating dissolved constituents. Proven technology used widely for commercial, industrial, and public water supply. Softeners used widley for home water treatment systems.	Costly; ion exchange resins can become fouled, requiring periodic maintenance. Requires prefiltering. Requires use of hazardous chemical regenerants (brine, caustic soda, acid). Waste regenerant must be disposed of appropriately. May produce hazardous waste. hazardous waste disposal required.
Distillation	√	√	√	√	√		Effective at treating most of the constituents	Expensive, high energy use. Requires proper operation and maintenance. Produces concentrated waste for disposal. Waste could be hazardous due to arsenic.
Aeration and Filtration		√	√		√		Can remove dissolved and particulate iron and manganese and turbidity. Proven technology, widely used for public water treatment system.	Requires specialized equipment and proper operation/maintenance. Not suited for single family resdience.
Chlorination						√	Widely used and proven for disinfection of water supplies.	Hazardous chemical storage and handling; not appropriate for residential use
Ultraviolet (UV) Oxidation						√	Proven disinfection method. Simple technology, requires minimal operation.	Fouling potential requires maintenance to be effective.
Reverse Osmosis	√	√	√	√	√		Proven technology. Treats multiple parameters in a single step. Fairly simple operation, doesn't require hazardous chemical use.	Expensive. Periodic maintenanceis required to maintain operation. May reaurie chemical feed to control fouling. Requires disposal of concentrate (20-25% of total flow). Requires prefiltering.

ATTACHMENT 4

RO Treatment Diagrams

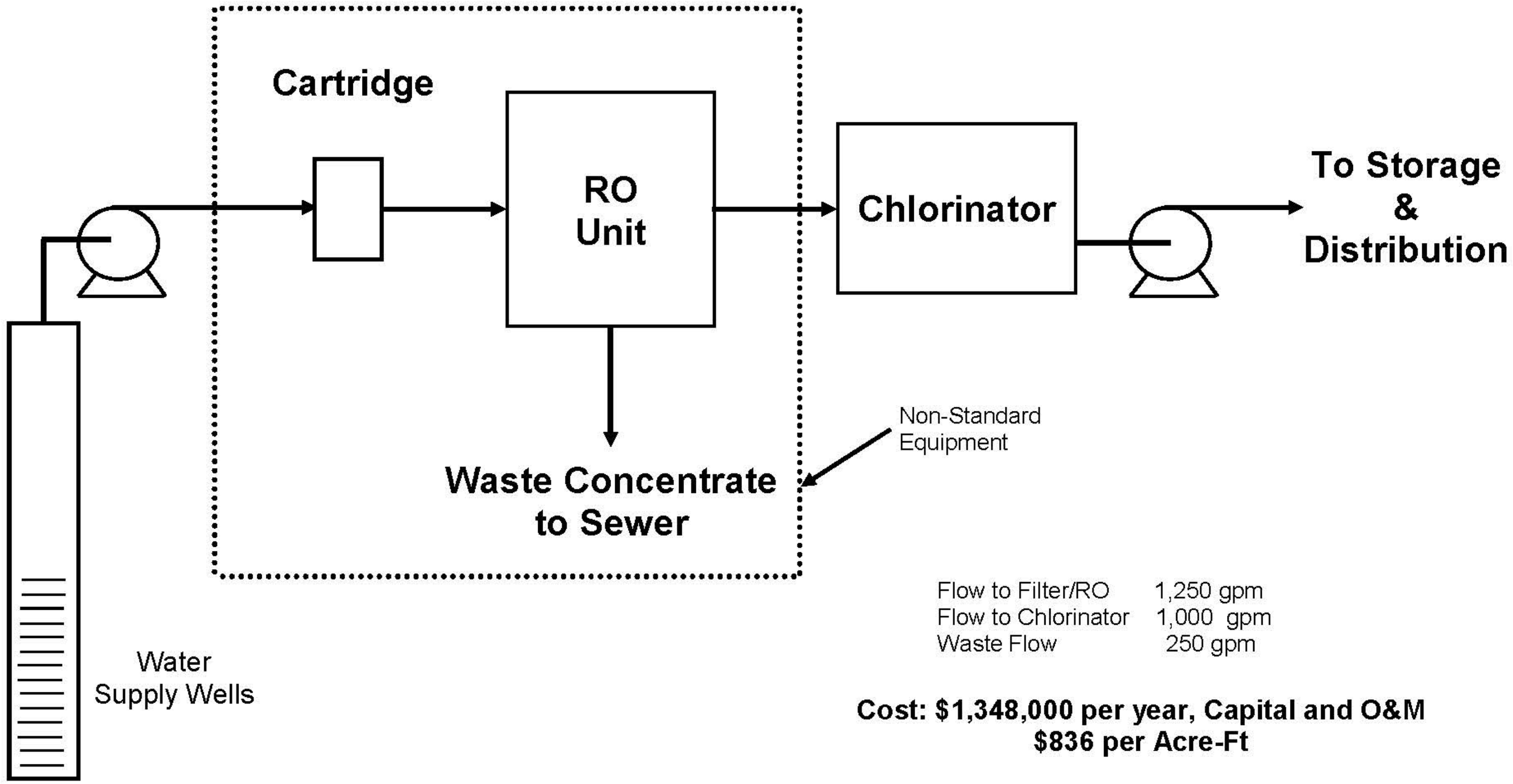
Non GDS



SINGLE FAMILY GROUNDWATER TREATMENT SYSTEM
PSC Georgetown Facility
Seattle, Washington

By: TRI	Date: 12/19/14	Project No. 8770
amec		Figure **4-1**

Non GDS



Flow to Filter/RO	1,250 gpm
Flow to Chlorinator	1,000 gpm
Waste Flow	250 gpm

Cost: $1,348,000 per year, Capital and O&M
$836 per Acre-Ft

PUBLIC WATER SUPPLY
TREATMENT SYSTEM
PSC Georgetown Facility
Seattle, Washington

By: TRI	Date: 12/19/14	Project No. 8770
amec		Figure **4-2**

ATTACHMENT 5

Supporting Details for RO Cost Estimates

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Cost of Operations

The Cost of Operations calculator is a tool to help project the costs associated with running an RO system. We have defaulted in some common values, but please change any of the values shown to give a more accurate calculation of operating costs for your proposed RO system in your area of the world.

Measurements		
Unit of Measure:	English	
Currency:	USD	
RO Specifications		
* Product Water Flow:	2	gpm
* RO Recovery:	75	%
	Recommend an RO Model	
RO Feed Flow:	3	gpm
RO Concentrate:	1	gpm
RO Model:	E4-4400-DLX-60	
Operation		
* Hours/Day of Operation:	24	hours
* Days/Year of Operation:	365	days
Utilities		
* Cost of Electricity: **$**	0.07	/kWh
* Power:	240	VAC
* Power Frequency:	60	Hz
* RO Pump Efficiency:	70	%
* RO Pump Pressure:	600	psig
* Motor Efficiency:	Standard	
Chemicals		
Chlorine: **$**	0.61	per pound
Ferric Sulfate: **$**	0	per pound
Sulfuric Acid: **$**	0.048	per pound of 100%
Citric Acid: **$**	0	per pound of 100%
Hydrochloric Acid: **$**	0	per poundpound of 100%
Sodium Bisulfite: **$**	0.61	per pound
Antiscalant: **$**	4.88	per pound
Sodium Hydroxide: **$**	0.065	per pound
Pretreatment	**Dosage Rate**	
Chlorine:	0	ppm
Ferric Sulfate:	0	ppm
RO Inlet		
Sulfuric Acid:	0	ppm
Citric Acid:	0	ppm
Hydrochloric Acid:	0	ppm
Sodium Bisulfite:	0	ppm
Antiscalant:	0	ppm

Product Water

Sodium Hydroxide:	0	ppm
Chlorine:	1	ppm

RO Membrane

*RO Membrane Replacement:	1	years
*# of RO Membranes:	2	
*Price Per RO Membrane: **$**	175	per membrane element (Typical prices are $450 for 8" and $175 for 4" membrane elements)

Cartridge Replacement

*Cartridge Filters Replaced:	14	days
*Filter Cost: **$**	90	per ten inches equivalent (TIE)

Cleaning

*Cleaning Frequency:	90	days
*Cleaner Cost: **$**	7.00	per pound of cleaner chemical
*Chemical Types Used:	Acid and Caustic	
*Size of Cleaning Tank:	250	gallons

Maintenance Costs

*Cost of Water: **$**	1	per 1000 gallons of feed water
*Cost of Sewer: **$**	2	per 1000 gallons of discharged water
*Labor	10	minutes per day
*Cost of Labor: **$**	85	per hour

Calculate

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Cost of Operations

System Design

Operating Hours:	24	hours per day
Operating Days:	365	days per year
Finished Water:	1,051,200	gallons per year
Plant Recovery:	75	%
RO Feed Flow:	3	gpm
Total Concentrate Flow:	1	gpm
Total Permeate Flow:	2	gpm

Cost of Operations Totals

Electricity:	10.36	kWh / 1000 gallons	$0.73	/ 1000 gallons
Chemicals:	0.008	lbs / 1000 gallons	$0.01	/ 1000 gallons
Inlet Cartridge Filters:	$0.00	per change	$0.00	/ 1000 gallons
RO Membrane Replace:	$350.00	per change	$0.33	/ 1000 gallons
Membrane Cleaning:	$242.67	per cleaning	$0.94	/ 1000 gallons
Labor:			$0.00	/ 1000 gallons
Feed Water:			$1.50	/ 1000 gallons
Sewer Treatment:			$1.00	/ 1000 gallons
TOTAL:	$4.50	/ 1000 gallons of finished water produced		
TOTAL without Water/Sewer:	$2.00	/ 1000 gallons of finished water produced		
Annual Costs:	$4,730.03			

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Cost of Operations

The Cost of Operations calculator is a tool to help project the costs associated with running an RO system. We have defaulted in some common values, but please change any of the values shown to give a more accurate calculation of operating costs for your proposed RO system in your area of the world.

Measurements		
Unit of Measure:	English	
Currency:	USD	
RO Specifications		
* Product Water Flow:	200	gpm
* RO Recovery:	80	%
	Recommend an RO Model	
RO Feed Flow:	250	gpm
RO Concentrate:	50	gpm
RO Model:	E8-288K-DLX-60-LE	
Operation		
* Hours/Day of Operation:	24	hours
* Days/Year of Operation:	365	days
Utilities		
* Cost of Electricity: **$**	0.07	/kWh
* Power:	240	VAC
* Power Frequency:	60	Hz
* RO Pump Efficiency:	70	%
* RO Pump Pressure:	600	psig
* Motor Efficiency:	Standard	
Chemicals		
Chlorine: **$**	0.61	per pound
Ferric Sulfate: **$**	0	per pound
Sulfuric Acid: **$**	0.048	per pound of 100%
Citric Acid: **$**	0	per pound of 100%
Hydrochloric Acid: **$**	0	per poundpound of 100%
Sodium Bisulfite: **$**	0.61	per pound
Antiscalant: **$**	4.88	per pound
Sodium Hydroxide: **$**	0.065	per pound
Pretreatment	**Dosage Rate**	
Chlorine:	0	ppm
Ferric Sulfate:	0	ppm
RO Inlet		
Sulfuric Acid:	0	ppm
Citric Acid:	0	ppm
Hydrochloric Acid:	1	ppm
Sodium Bisulfite:	0	ppm
Antiscalant:	0	ppm

Product Water

Sodium Hydroxide:	0	ppm
Chlorine:	1	ppm

RO Membrane

*RO Membrane Replacement:	1	years	
*# of RO Membranes:	4		
*Price Per RO Membrane: **$**	450	per membrane element	(Typical prices are $450 for 8" and $175 for 4" membrane elements)

Cartridge Replacement

*Cartridge Filters Replaced:	14	days
*Filter Cost: **$**	90	per ten inches equivalent (TIE)

Cleaning

*Cleaning Frequency:	90	days
*Cleaner Cost: **$**	7.00	per pound of cleaner chemical
*Chemical Types Used:	Acid and Caustic	
*Size of Cleaning Tank:	250	gallons

Maintenance Costs

*Cost of Water: **$**	0.5	per 1000 gallons of feed water
*Cost of Sewer: **$**	1	per 1000 gallons of discharged water
*Labor	10	minutes per day
*Cost of Labor: **$**	85	per hour

Calculate

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Cost of Operations

System Design

Operating Hours:	24	hours per day
Operating Days:	365	days per year
Finished Water:	105,120,000	gallons per year
Plant Recovery:	80	%
RO Feed Flow:	250	gpm
Total Concentrate Flow:	50	gpm
Total Permeate Flow:	200	gpm

Cost of Operations Totals

Electricity:	8.64	kWh / 1000 gallons	$0.60	/ 1000 gallons
Chemicals:	0.019	lbs / 1000 gallons	$0.01	/ 1000 gallons
Inlet Cartridge Filters:	$4,500.00	per change	$0.89	/ 1000 gallons
RO Membrane Replace:	$1,800.00	per change	$0.02	/ 1000 gallons
Membrane Cleaning:	$252.00	per cleaning	$0.01	/ 1000 gallons
Labor:			$0.00	/ 1000 gallons
Feed Water:			$0.62	/ 1000 gallons
Sewer Treatment:			$0.25	/ 1000 gallons
TOTAL:	$2.40	/ 1000 gallons of finished water produced		
TOTAL without Water/Sewer:	$1.53	/ 1000 gallons of finished water produced		
Annual Costs:	$252,738.21			

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ATTACHMENT 6

Potable Water Costs

DESIGN MEMORANDUM

amec

Client:	PSC	Sheet 1 Of 1	
Project:	Georgetown	Date:	11/11/2014
Data For:	5-year review - potable water cost	Work Order:	
Prepared By:	CDH	Checked By:	
		File No:	

Note: This form must be used for project calculations and original filed in project files

Single Family Home

Refer to Seattle Public Utilities - Residential Drinking Water Rates (effective 1/1/2014) for unit costs (Source 1 Attached)

Assumptions:

Base service charge = $13.75 per month per meter (assume 1 meter).

Off peak usage (9/16-5/15) = $4.99 per CCF

Peak Usage (5/16-9/15) = $5.13 per CCF (up to 5 CCF).

& $6.34 per CCF (up to 13 CCF).

Average residential usage = 5.0 CCF (Median User; Source 2 Attached)

Total Annual Cost:

Base Service Charge = $13.75 per month per meter × 1 meter × 12 months = $165.00

Off peak usage = $4.99 per CCF × 5.0 CCF × 8 months = $199.60

Peak usage = $5.13 per CCF × 5.0 CCF × 4 months = $102.60

Total Annual Cost = $467.20

* Total annual cost for a residential home is ~$467 per year

Bulk Commodity

Refer to email correspondence with Sherri Crawford (Interim Deputy Director, Finance & Administration SPU) for unit costs for bulk/wholesale costs (Source 3 Attached).

Wholesale Off peak usage (9/16-5/15) = $1.42 per CCF

Wholesale peak usage (5/16-9/15) = $2.10 per CCF

Smallest practical water treatment system = 1000 GPM

or 1000 GPM × $\frac{1\ \text{cu ft}}{7.48\ \text{Gal}}$ × $\frac{43,920\ \text{min}}{\text{month}}$ = 58,717 CCF per Month

Total

Total Annual Cost:

Off peak usage = $1.42 per CCF × 58,717 CCF per month × 8 Months = $667,030

Peak usage = $2.10 per CCF × 58,717 CCF per month × 4 months = $493,220

Total Annual Cost = $1,160,050

* Total annual cost for bulk potable water is ~$1,160,050 per year

Residential Drinking Water Rates

Base Service Charge per month, per meter

Effective January 1, 2014

	Inside Seattle	Outside Seattle	Shoreline & Lake Forest Park*
3/4" and less	$13.75	$15.70	$16.70
1"	$14.20	$16.20	$17.20
1-1/2"	$21.85	$24.90	$26.50
2"	$24.20	$27.60	$29.35
3"	$89.65	$102.20	$108.70

* These rates apply to the Cities of Shoreline and Lake Forest Park, not the water districts.

Residential Commodity Charge per CCF (100 cubic feet)

Effective January 1, 2014

	Inside Seattle	Outside Seattle	Shoreline & Lake Forest Park*
Off-Peak Usage (Sept. 16 - May 15)	$4.99	$5.69	$6.05
Peak Usage (May 16 - Sept. 15)			
Up to 5 CCF per month	$5.13	$5.85	$6.22
Next 13 CCF per month	$6.34	$7.23	$7.69
Over 18 CCF per month	$11.80	$13.45	$14.31

* These rates apply to the Cities of Shoreline and Lake Forest Park, not the water districts.

Low Income Assistance

Eligible low income customers can receive a 50% credit on their bill. For more information, please see the link to the Payment Assistance Program listed below.

Related Links

Water Rates Question and Answers
Payment Assistance Program
Rate Changes Summary

Seattle Public Utilities
2012-2014 Water Rate Study

Dec 2011

(Includes City Council Revisions)

City Council changes are included in tables
Changes to text are noted in blue

Residential accounts represent about 82 percent of total SPU retail water accounts. Residential customers are further broken into four subclasses: in-city customers, City of Shoreline/City of Lake Forest Park customers, other out-of-city customers, and master-metered customers. Low-income customers in any of these residential subclasses may qualify for a discount off their water utility bill. This section provides additional detail on the components of the residential rate design, the residential rate changes, residential rate subclasses and the low-income credit program.

Under the adopted rates, residential rates increase a typical single family residential bill by **$2.25** per month in 2012, **$2.43** per month in 2013 and **$2.55** in 2014 (given constant consumption). These impacts can vary based on the amount of water used, as presented in **Table 5-2**.

Table 5-2
Monthly Residential Bills at Adopted Rates

CUSTOMER TYPE	MONTHLY CONSUMPTION		MONTHLY RESIDENTIAL BILLS						
			2011 Adopted	2012 Adopted	Change from 2011	2013 Adopted	Change from 2012	2014 Adopted	Change from 2013
Low Volume User (15th %tile)	Winter	2.9	$23.50	$24.97	$1.47	$26.55	$1.58	$28.22	$1.67
	Summer	3.8	$28.12	$29.74	$1.62	$31.47	$1.73	$33.24	$1.77
	Average	3.2	**$25.04**	**$26.56**	**$1.52**	**$28.19**	**$1.63**	**$29.90**	**$1.70**
Median User (50th %tile)	Winter	4.7	$30.01	$32.24	$2.22	$34.65	$2.41	$37.20	$2.55
	Summer	5.5	$35.08	$37.37	$2.29	$39.84	$2.47	$42.38	$2.54
	Average	5.0	**$31.70**	**$33.95**	**$2.25**	**$36.38**	**$2.43**	**$38.93**	**$2.55**
High Volume User (85th %tile)	Winter	9.8	$48.48	$52.84	$4.37	$57.60	$4.76	$62.65	$5.05
	Summer	13.4	$71.79	$78.21	$6.42	$85.20	$6.99	$92.66	$7.46
	Average	11.0	**$56.25**	**$61.30**	**$5.05**	**$66.80**	**$5.50**	**$72.65**	**$5.85**
Very High User	Winter	32.0	$128.84	$142.53	$13.69	$157.50	$14.97	$173.43	$15.93
	Summer	50.0	$470.69	$479.50	$8.81	$489.11	$9.61	$499.42	$10.31
	Average	38.0	**$242.79**	**$254.85**	**$12.06**	**$268.04**	**$13.18**	**$282.09**	**$14.06**

Note: All bill impacts are for in-city customers and assume a ¾" meter.

Hand, Charles

From: Crawford, Sherri [Sherri.Crawford@seattle.gov]
Sent: Thursday, November 13, 2014 11:15 AM
To: Hand, Charles
Subject: RE: Water Cost for City of Seattle

Dear Charles:

It is still accurate that the median single family home in Seattle consumes 5 ccf per month. The average consumption of a single family home, however, is slightly higher than 5 ccf. We have not recently studied the peak demands of a household.

For 2015, wholesale rates are $1.42/ccf off-peak and $2.10/ccf peak (May 16-Sep 15). However, it is worth noting that wholesale customers are not defined simply as large customers. Seattle's wholesale customers are separate water systems governed by the Washington Department of Health, with their own distribution and regulatory costs.

I hope this answers your questions. If you need anything else, please let me know.

Sherri Crawford
Interim Deputy Director, Finance & Administration Seattle Public Utilities
206-615-1372

From: Hand, Charles [mailto:charles.hand@amec.com]
Sent: Wednesday, November 12, 2014 10:25 AM
To: Crawford, Sherri
Subject: Water Cost for City of Seattle

Good morning Sherri.
My name is Charles Hand and I'm an engineer here in Seattle working with Ecology on a supervised cleanup action. I am looking for some ballpark cost estimates for water costs from the city of Seattle to compare to prospective cleanup costs associated with a similar type of water supply.

I have seen your rates page for a typical residential consumer in Seattle and from your 2012-2014 Water Rates Study it looks like the average water consumption per household per month was 5 CCF. Is this number still accurate today (I believe you guys track this pretty closely)? Also, have you looked into peak demand per household (I believe it was around 2 GPM 5+ years ago but not sure what it is now). I need these numbers to conceptually design a system and see how that cost compares to purchase from SPU.

My last question is in regards to bulk purchasing of water from your wholesale division (roughly 1000 GPM). When we had inquired a while back the amount was $1,1865 per CCF for the commodity charge (fixed charge was negligible so we were able to ignore it). Can you please let me know what the approximate number is today?

I appreciate your help. If you have any questions feel free to give me a call or shoot me back an email.

Thank you,

Charles Hand, EIT | Technical Professional II - Engineering

AMEC | 600 University St, Suite 600 | Seattle, WA 98101
206.342.1769 (direct) | 509.499.8363 (cell) | **charles.hand@amec.com**

ATTACHMENT 7

Seattle Public Utilities 2014 Annual Analysis of Cedar & Tolt Water Supplies

2014 ANNUAL ANALYSIS OF CEDAR & TOLT WATER SUPPLIES

Distribution Water Quality *(unless otherwise noted)*

Samples Collected: May 13, 2014 *(unless otherwise noted)*

Cedar Distribution = South of the ship canal & lower elevations North of ship canal. Tolt Distribution = Higher elevations North of the ship canal.

Water Quality Parameter	State Dept. of Health Maximum Contaminant Level	CEDAR	TOLT	Minimum Reporting Level
Primary Standards *	**MCL**			
Antimony	6 µg/L	ND	ND	0.8
Arsenic	10 µg/L	ND	ND	0.5
Asbestos $	7 million fibers/L (>10um long)	ND (2009)	ND (2009)	0.2
Barium	2000 µg/L	1.4	1.2	0.2
Beryllium	4 µg/L	ND	ND	0.2
Bromate #	10 µg/L	ND (5/07/14)	ND(5/13/14)	5.0
Cadmium	5 µg/L	ND	ND	0.2
Chromium	100 µg/L	ND	ND	0.5
Cyanide	200 µg/L	ND	ND	10
Fluoride	4 mg/L	0.79	0.77	0.10
Haloacetic Acids(5), Total~	60 µg/L	28	33	1.0
Mercury	2 µg/L	ND	ND	0.2
Nickel	100 µg/L	ND	ND	0.5
Nitrate-Nitrogen	10 mg/L	0.02	0.11	0.01
Nitrite-Nitrogen	1 mg/L	ND	ND	0.002
Selenium	50 µg/L	ND	ND	0.8
Thallium	2 µg/L	ND	ND	0.2
Trihalomethanes, Total~	80 µg/L	28	29	0.5
Turbidity #	5 NTU for Cedar/ 0.30 NTU for Tolt	0.66	0.12	0.1
Uranium	30 µg/L	ND	ND	0.2
Secondary Standards **	**SMCL**			
Aluminum	50 - 200 µg/L	16.9	31.1	1.0
Chloride	250 mg/L	3.5	2.8	0.5
Color	15 std. units	ND	ND	5
Fluoride	2 mg/L	0.79	0.77	0.10
Iron	300 µg/L	42	38	6
Manganese	50 µg/L	2.0	2.6	0.5
pH, 2013 range ++	6.5 - 8.5 pH units, Target 8.2	7.82 - 8.35	8.16 - 8.61	NA
Silver	100 µg/L	ND	ND	0.8
Solids,Total Dissolved	500 mg/L	38.3	37.8	5.0
Specific Conductance	700 µmhos/cm	55.8	57.7	5.0
Sulfate	250 mg/L	1.2	1.6	1.0
Zinc	5000 µg/L	ND	1.0	0.8
Other Parameters	**Units**			
Alkalinity, Total	mg/L (as $CaCO_3$)	18.1	20.3	2.0
Bromide	µg/L	ND	ND	5
Calcium	mg/L (as $CaCO_3$)	19.4	24.9	2.0
Copper, Source water	µg/L	0.9	ND	0.5
Hardness, Total	mg/L (as $CaCO_3$)	21.8	25.6	2.0
Hardness, Total	grains/gal. (as $CaCO_3$)	1.3	1.5	0.1
Lead, Source water	µg/L	ND	ND	0.5
Magnesium	mg/L	0.90	0.36	0.01
Combined Nitrate + Nitrite	mg/L	ND	0.10	0.01
Oxygen, Dissolved	mg/L	12.9	19.4	0.5
Phosphate, soluable-reactive	µg/L	1	ND	1
Potassium	mg/L	0.23	0.10	0.02
Silica, Reactive	mg/L	6.2	5.3	1.0
Sodium	mg/L	1.77	0.85	0.08
Temperature, 2013 annual range	deg. C.	6 - 24	4 - 21	NA
Thorium	µg/L	ND	ND	0.5
Total Organic Carbon #	mg/L	0.91	0.98	0.2
Vanadium	ug/L	0.6	0.5	0.5
Reduced Monitoring Residential Survey @	**Action Level**	**Combined System**		
2013 Lead	15 µg/L	3.0		1.0
2013 Copper	1300 µg/L	104		1.0

Primary and Secondary Standards were measured at the Intake to the distribution system after treatment.

* Health stds.: Supplier subject to public notification.

** Aesthetic stds.: Supplier not subject to public notification.

~ Average of the last 4 quarters testing, through 6/14.

ND = Not Detected at or above the Minimum Reporting Level

++ January-Dec 2013, 10-90th percentile

$ Test results 9/2/2009.

As measured at treatment plant.

1 ppm = 1 mg/L = 1000 µg/L

@ Measured at 90th percentile of overnight standing residential samples from homes with copper pipes and lead solder. Next round 9/2016.