Appendix 5-1 –
Avoided Cost of Supply Technical Memorandum

Everett Comprehensive Water Plan
Technical Memorandum

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Subject: Avoided Cost Associated with Conserved Water

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Introduction

When water is saved through conservation actions, certain costs associated with the water and wastewater systems are avoided. This can include operational costs such as pumping drinking water and wastewater and capital costs associated with capacity of facilities. Collectively these are termed "avoided costs." Avoided costs are financial savings that help to offset the cost of conservation actions.

In developing the conservation program for Everett's 2006 Comprehensive Water Plan (CWP), information was gathered on avoided costs. This technical memorandum summarizes the information gathered and the results of the avoided cost analysis. The results will be used in defining the cost-effectiveness of water conservation measures. Conservation measures whose cost per unit is below the avoided cost will be deemed cost effective.

Results

Table 1 displays the results of the avoided cost analysis. Explanation of the various components shown in Table 1 is provided in the following section of this Technical Memorandum.

The total avoided cost is $0.35/ccf. This value is appropriate for comparison with conservation actions that yield both water supply and wastewater reductions. This applies to most indoor water conservation actions.

For outdoor water conservation actions, the wastewater avoided costs are not considered. Subtracting all of the wastewater components (operations and capital) and allocating the environmental component only to water supply elements yields an avoided cost of $0.21/ccf. This value should be used for comparison with outdoor water conservation actions that do not affect wastewater flows.

Table 1. Summary of Avoided Costs from Water Conservation				
Item		Description	Relation to Conservation	Avoided Cost ($/CCF)
Water System Operations				
	Regional WFP Chemicals	Treatment process chemicals	Direct	$0.02
	Regional WFP Energy	Energy use at WFP. Less estimate of costs for heating/lighting.	Direct	$0.01
	Local Distr. Pumping	Energy for pumping water in local distribution systems	Direct	$0.08
	Local re-chlorination	Chemical additions to maintain Cl residual in wholesale cust. systems	Unknown	$0.00
	Subtotal			$0.11
Wastewater System Operations				
	Regional WPCF Chemicals	Wastewater treatment process chemicals. Cost based on loading, not volume.	None	$0.00
	Regional WPCF Energy	Energy use at WPCF Less estimate of costs for heating/lighting.	Direct	$0.05
	Local lift station pumping	Energy for pumping wastewater at local lift stations	Direct	$0.02
	Subtotal			$0.07
Water System Capital Facilities				
	WFP Improvements - Everett	Phase II Improvements from 2002 WFP Facilities Plan	Direct	$0.02
	Transmission Pipelines - Everett	Improvements not tied to capacity needs.	None	$0.00
	Local pump stations - Everett	No capacity improvements until after 2025	None	$0.00
	Local storage tanks - Everett	No capacity improvements until after 2025	None	$0.00
	Local water mains - Everett	Main sizing is dictated by fire flow requirements, which conservation does not impact.	None	$0.00
	Local improvements - wholesale	Extrapolation from wholesale customer Water System Plans	Direct	$0.06
	Lake Chaplain Reservoir	None identified. Capacity not constrained.	None	$0.00
	Jackson Project Reservoir	None identified. Capacity not constrained.	None	$0.00
	Subtotal			$0.08
Wastewater System Capital Facilities				
	WPCF Improvements	Capacity driven by stormwater and I/I, not base sewage flows	None	$0.00
	Conveyance line to outfall	Capacity driven by stormwater and I/I, not base sewage flows	None	$0.00
	Local collection pipes - Everett	N. End capacity driven by stormwater. S. end projects not needed until 2020s.	Minimal	$0.01
	Local lift stations - Everett	N. End capacity driven by stormwater. S. end projects not needed until 2020s.	Minimal	$0.005
	Collection pipes - other systems	Extrapolation from figure for Everett wastewater service area	Partial	$0.03
	Lift stations - other systems	Extrapolation from figure for Everett wastewater service area	Partial	$0.02
	Subtotal			$0.07
Environmental Benefits				
	Estimated Avoided Cost Factor	Assumption: 10% of all other avoided costs	Direct	$0.03
	Subtotal			$0.03
Total Avoided Cost				**$0.35**

Avoided Cost Components

The major categories of avoided cost are operations costs and capital costs. These two categories can occur on both the water supply side and the wastewater side, wherever a reduction in water use yields cost savings for the utility system.

Avoided Costs of Operations

For the water supply system, the following operational costs were considered:

- Chemical use at the Water Filtration Plant (WFP)
- Energy use at the WFP (not including heating/lighting, assumed to be 10 percent of costs)
- Energy use for local pump stations throughout Everett Water Service Area (EWSA).

For the wastewater system, operational costs that were considered included:

- Chemical use at the Water Pollution Control Facility (WPCF). Based on City staff input, this was deemed to be negligible because chemical use is based on pollutant loading, rather than water volume. Since drinking water has minimal loading, reduced flows of drinking water down customer drains does not reduce chemical needs at the WPCF.

- Energy use at the WPCF (not including heating/lighting, assumed to be 10 percent of costs), extrapolated to regional cost based on proportion of EWSA population served by Everett's WPCF.

- Energy for pumping wastewater at local lift stations.

Data on each of these operational costs was provided by Everett staff.

Avoided Costs of Capital Projects

Capital costs considered in relation to the water supply system were:

- **Capacity-related improvements at the WFP at Lake Chaplain.** These costs are identified as "Phase 2" costs in the 2002 Water Filtration Plant Facilities Plan.

- **Improvements to the transmission lines from Lake Chaplain to the drinking water service area.** Improvements identified at this stage of the water system plan process are not tied to capacity needs. Therefore, these costs are not considered further.

- **Pump stations and storage facilities in Everett.** Analysis for the CWP Capital Improvement Program (CIP) indicates that Everett's storage capacity and pump station capacity for its retail service area are adequate to meet needs through the end of the 20-year planning period. Since there is no opportunity in this time frame to postpone or avoid costs of these facilities, these costs are not considered further.

- **Local water mains in Everett.** Sizing and scheduling of water distribution mains are based on requirements for both fire flow and peak hour demands. When fire flow is the

main factor, conservation does not offer opportunities to defer or reduce costs. Some savings may be achievable when peak hour demand is the main factor. At the time this memorandum was prepared, data from the hydraulic modeling task was not available to permit identification of these cases. Therefore, the avoided cost does not include these projects.

- **Local pump stations, storage, facilities and transmission mains outside Everett's retail service area.** CIPs from water system plans prepared by seven of Everett's largest wholesale customers were reviewed. Costs for transmission lines, pump stations and reservoirs were extracted. Where CIP tables clearly indicated costs were due to factors other than capacity limitations, these costs were excluded. Based on these seven systems, costs were extrapolated to represent all wholesale systems served by Everett.

- **Source reservoirs.** No capacity-related improvements were identified with respect to Lake Chaplain or Spada Lake. Therefore, no avoided cost is included for these facilities.

Capital costs considered in relation to wastewater are listed below. Everett's wastewater system serves approximately 30 percent of the regional population that is served by the water system. Therefore, avoided costs estimated for Everett's water system were extrapolated to yield avoided cost on the wastewater side for the entire water service area.

- **Everett WPCF**. No capacity related improvements were identified. Everett staff involved in wastewater system planning reported that capacity needs are driven by large flows associated with stormwater and infiltration/inflow. Actual wastewater generated by the community is a small percentage of total flow, so a reduction of wastewater by 5 to 15 percent would have minimal impact on capacity improvements.

- **Conveyance Line from Everett WPCF to outfall**. Same conditions as for WPCF.

- **Everett wastewater collection pipes**. Everett staff reported that the North End system receives stormwater, leading to similar conditions as for the WPCF. The South End has separated piping, so that wastewater flows have a greater impact on capacity needs. However, most piping projects for the South End are not needed until after 2020. These projects were not analyzed in detail. To reflect a small component for these projects, a value of $0.01/ccf was used in the avoided cost analysis.

- **Everett lift stations**. Same conditions as Everett collection pipes. To reflect a small component for these projects, a value of $0.005/ccf was assumed.

- **Other communities' wastewater collection pipes.** This value was extrapolated from the Everett value based on the percentage of the regional water service population that is also served by Everett's wastewater system.

- **Other communities' lift stations.** This was also extrapolated from the Everett value based on the percentage of the regional water service area population served by Everett's wastewater system.

Avoided Costs Associated with Environmental Benefits

The avoided cost of capital projects and operations and maintenance discussed above relate solely to costs saved by the water and wastewater utilities and their ratepayers in the region. There are additional environmental benefits associated with reduced need for raw water from the Sultan River system. This analysis did not attempt to develop a detailed breakdown of environmental benefits and their economic value. However, an assumption was made that these benefits have a value of at least ten percent of the avoided costs related to capital projects and operations. Therefore, the avoided cost includes a line item incorporating this assumption.

Calculations

In order to achieve a single measure of avoided cost, operational and capital costs must be expressed in common units and summed. This section describes how operational and capital costs are both calculated in terms of dollars per unit of water saved. Units are dollars per hundred cubic feet ($/ccf). Data used for these calculations are shown in Attachment A.

Calculation of Avoided Costs from Operations

The expression of operational costs in terms of dollars per unit of water saved is relatively simple. The operational costs listed earlier are generally linear, in that a reduction in the volume of water produced yields a corresponding reduction in cost. Total costs were estimated on an annual basis based on data available from 2005. The total quantity of water produced in the same year was obtained from Everett's water system records. Annual cost was divided by annual production, yielding a cost in dollars per ccf. Since the cost function for these operational components is approximately linear, each unit of water saved through conservation will yield the same value in cost savings.

For local operational costs, such as energy costs associated with local pump stations, it was assumed that the avoided cost for the Everett system was the same as the avoided cost for wholesale customer systems. This assumption is realistic, given that energy costs, terrain, and other factors that could affect the operational costs considered are similar throughout the regional water service area.

Calculation of Avoided Cost from Capital Projects

The following procedure was followed to convert capital costs into avoided costs in order to compare them with the costs of conservation actions. Data on upcoming capital projects, including the cost and the construction year, were gathered from CIPs. The cost estimates were prepared in various years from 2002 to 2006. All project costs were updated to reflect 2006 dollars using the construction cost index from the publication *Engineering News Record*.

Specific analysis of the capacity needs at Everett's WFP showed that reducing demand by 5 percent would allow projects to be deferred by approximately one year. Reducing demand by 10 percent would allow deferral by three years. Reducing demand by 15 percent would allow deferral by five years. These findings were assumed to be similar for all other capital projects, both in Everett and the wholesale customer service areas.

The present value was calculated for each project cost based on the construction year scheduled. A discount rate of 4 percent was used. Effects of inflation are not included in this discount rate, since project costs were expressed in 2006 dollars. Present values were then recalculated under scenarios where all projects were deferred by either one year, three years, or five years. The difference between the present value as originally scheduled and the present value of deferred projects was considered to be the cost savings attributable to the conservation program.

The quantity of water saved is needed to calculate unit costs in dollars per ccf. The quantity of water saved was calculated to be either five, ten, or fifteen percent of total peak season potable water demand in all years from 2006 to 2025. In each year, peak season demand was assumed to be 50 percent of annual demand. Peak season demands were used because the unit cost of conservation actions is also expressed as a peak season unit cost.

Additional capital cost savings could be achieved if capital facilities are either downsized or completely eliminated due to reduced demand for water. Based on review of available CIPs and discussion with Everett staff, no opportunities for downsizing or avoidance were identified. These opportunities could exist for specific capital projects but are not included in the avoided costs shown here.

Attachment A

Table A-1. Calculation of Operational Avoided Costs

Water Supply System	Regional Service Area		Direct Service Area	
	2005	2005 $/CCF	2005	2005 $/CCF
Annual Production (in MGD)	50.9	N/A	9.02	N/A
Annual Production (CCF)	24,834,247	N/A	4,401,345	N/A
Annual Chemical Costs ($27/MG)	$501,620	$0.02	$88,901	$0.02
Annual Energy Costs--Plant ($)	$252,180	$0.01	$44,694	$0.01
Annual Pumping Costs	$1,892,186	$0.08	$335,350	$0.08
Waste Water System				
Annual Production (in MGD)	57.4	N/A	16.8	N/A
Annual Production (CCF)	27,990,227	N/A	8,196,765	N/A
Annual Chemical Costs ($)	$117,161	$0.00	$34,310	$0.00
Annual Energy Costs--Plant ($)	$1,359,172	$0.05	$398,025	$0.05
Annual Energy Costs--Pumping (Lift Stations)	$524,921	$0.02	$153,720	$0.02

Table A-2. Present Value Calculations - Capital Projects, Wholesale Customer Water Supply Projects ($000s)

Project	Year	Deferred 1 year	Deferred 3 years	Deferred 5 years	Orig. Cost Estimate	Cost 2006 $s	Present Value (PV)	PV if deferred 1 yr.	PV if deferred 3 yrs.	PV if deferred 5 yrs	Savings for 1 yr. deferral	Savings 3 yr. deferral	Savings 5 yr. deferral
Pump Station	2009	2010	2012	2014	2,100	2,100	1,867	1,795	1,660	1,534	72	207	332
Transmission Main	2011	2012	2014	2016	900	900	740	711	658	608	28	82	132
Transmission Main	2015	2016	2018	2020	400	461	324	312	288	266	12	36	58
Transmission Main	2015	2016	2018	2020	400	461	324	312	288	266	12	36	58
Transmission Main	2015	2016	2018	2020	100	115	81	78	72	67	3	9	14
Reservoir	2010	2011	2013	2015	3,400	3,804	3,251	3,126	2,891	2,672	125	361	579
Transmission Main	2008	2009	2011	2013	800	824	762	733	677	626	29	85	136
Reservoir	2009	2010	2012	2014	1,600	1,648	1,465	1,409	1,303	1,204	56	163	261
Reservoir	2018	2019	2021	2023	2,300	2,369	1,480	1,423	1,316	1,216	57	164	264
Pump Station	2010	2011	2013	2015	100	112	96	92	85	79	4	11	17
Reservoir	2013	2014	2016	2018	3,800	4,251	3,231	3,106	2,872	2,655	124	359	575
Reservoir	2009	2010	2012	2014	2,300	2,573	2,288	2,200	2,034	1,880	88	254	407
Total PV of local plans							15,908	15,296	14,142	13,075	**612**	**1,766**	**2,833**
								Savings Extrapolated to All Wholesale Customers					
											Savings for 1 yr. deferral	**Savings 3 yr. deferral**	**Savings 5 yr. deferral**
											857	**2,472**	**3,966**

Systems Reviewed: CIPs from seven utilities representing 72% of Everett's wholesale water demand in 2011.
(Alderwood 2002, Mukilteo 2006, Monroe 2005, Lynnwood 2005, Marysville 2002, Edmonds 2002, Snohomish PUD 2002)
(Dates represent year of original project estimates, based on the respective CIP Tables)
Projects counted: Reservoirs, transmission mains and pump stations (excluding projects that were clearly rehabilitation and not capacity-related)

Interest Rate:	4.0%	ENR CCI (Seattle) for 2006:	8,455
Current Year	2006	Wholesale Demand/Seven Systems Demand:	1.4

Table A-3. Present Value Calculations - Capital Projects at Everett Water Filter Plant ($000s)

Project	Year	Deferred 1 year	Deferred 3 years	Deferred 5 years	Orig. Cost Estimate	Cost 2006 $s	Present Value (PV)	PV if deferred 1 yr.	PV if deferred 3 yrs.	PV if deferred 5 yrs	Savings for 1 yr. deferral	Savings 3 yr. deferral	Savings 5 yr. deferral
WFP Phase II [(1)]	2016	2017	2019	2021	7,000	7,831	5,291	5,087	4,703	4,348	**203**	**587**	**942**

[(1)] Phase 2 represents capacity-driven improvements from 2002 WFP Facilities Plan.

Table A-4. Cost Adjustment Factors for Capital Projects

ENR CCI (Seattle)		Inflation Multiplier
Jun-00	7,150.92	1.18
Jun-01	7,329.03	1.15
Jun-02	7,557.73	1.12
Jun-03	7,645.56	1.11
Jun-04	7,993.50	1.06
Jun-05	8,208.45	1.03
Jun-06	8,455.31	1.00

Table A-5. Conversion to Peak Season Avoided Cost in $/ccf

A. Wholesale Customer Local Costs		B. Water Filtration Plant	
1 year deferral with 5% water savings.		**1 year deferral with 5% water savings.**	
water savings (ccf)	17,635,309	water savings (ccf)	17,635,309
Cost Savings ($)	$856,599	Cost Savings ($)	$203,484
Avoided cost ($/ccf)	$0.05	Avoided cost ($/ccf)	$0.01
3 year deferral with 10% water savings		**3 year deferral with 10% water savings**	
water savings (ccf)	35,270,618	water savings (ccf)	35,270,618
Cost Savings ($)	$2,472,225	Cost Savings ($)	$587,273
Avoided cost ($/ccf)	$0.07	Avoided cost ($/ccf)	$0.02
5 year deferral with 15% water savings		**5 year deferral with 15% water savings**	
water savings (ccf)	52,905,927	water savings (ccf)	52,905,927
Cost Savings ($)	$3,965,962	Cost Savings ($)	$942,108
Avoided cost ($/ccf)	$0.07	Avoided cost ($/ccf)	$0.02
1/4 is attributable to WFP projects: round to $0.02			
3/4 is attributable to local projects: round to $0.03			

Table A-6. Water Quantity for Avoided Cost Calculations

Year	Retail & Wholesale ADD w/Tulalip Stream Augm. (ADD in mgd)	Tulalip Stream Aug.	Retail & Wholesale Demand w/o Tulalip Stream Augm.	Conversion to Annual gallons	Conversion to annual CCF
2006	58.2	0.0	58.2	21,233,435,135	**28,383,151**
2007	59.5	0.0	59.5	21,717,345,818	**29,030,004**
2008	60.8	0.0	60.8	22,203,175,977	**29,679,423**
2009	62.2	0.0	62.2	22,690,367,985	**30,330,662**
2010	63.4	0.0	63.4	23,154,327,774	**30,950,846**
2011	64.8	2.0	62.8	22,936,720,293	**30,659,966**
2012	68.4	2.0	66.4	24,222,810,945	**32,379,108**
2013	69.8	2.0	67.8	24,733,253,000	**33,061,426**
2014	71.2	2.0	69.2	25,243,445,747	**33,743,411**
2015	72.6	2.0	70.6	25,754,120,580	**34,426,040**
2016	76.6	3.6	73.0	26,654,618,969	**35,629,754**
2017	79.7	5.2	74.5	27,179,193,977	**36,330,964**
2018	82.7	6.8	75.9	27,704,591,944	**37,033,274**
2019	86.3	8.4	77.9	28,443,890,658	**38,021,509**
2020	89.4	10.0	79.4	28,976,014,757	**38,732,809**
2021	91.0	10.0	81.0	29,561,763,394	**39,515,791**
2022	93.4	10.0	83.4	30,435,789,081	**40,684,119**
2023	95.0	10.0	85.0	31,029,310,685	**41,477,491**
2024	96.6	10.0	86.6	31,624,493,416	**42,273,083**
2025	98.3	10.0	88.3	32,220,313,725	**43,069,528**
Total 20-year demand					**705,412,356**
Peak season 20-yr. demand (ccf) (assumes 1/2 of all demand occurs in peak season)					**352,706,178**