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HR

From: Nicki Pozos, P.E., HDR Ronan Igloria, O.E., HDR Joe Healy, HDR

Date: October 23, 2012

RE: Technical Memorandum 9E – Cost Share and NPV Analysis – FINAL

1.0 INTRODUCTION

The City of Hillsboro (City) is evaluating long-term water supply options that will deliver 80 million gallons per day (mgd) of additional treated water for the City and Joint Water Commission (JWC) partners. As part of that effort, HDR developed a long-term economic model of the options to evaluate the net present value (NPV) of each option.

This technical memorandum (TM) builds on work completed to date on the following TMs:

- TM 8 summarizes the water supply development options (including figures of the option components);
- TM 9A defined the individual options and developed capital, and operations and maintenance (O&M) cost estimates;
- TM 9B evaluated the cost risk associated with each option to be incorporated into the Monte Carlo simulations described in this TM;
- TM 9C described the timing of capital projects;
- TM 9D documented the economic evaluation for the supply options.

TM 9E documents the analysis and results of the City of Hillsboro's share of the costs associated with each water supply option. The information from TMs 9A through 9D was used to calculate the cost shares. Through the analysis, refinements to the water supply options were identified in the effort to more accurately reflect likely supply configurations and to make the evaluation fair and equitable among the options. These refinements are documented in this memo. Results were presented at the Utilities Commission meeting on September 18, 2012, and comments from the meeting were incorporated into this final TM.

2.0 APPROACH

In general, City of Hillsboro cost shares were calculated for each major component of each of the six supply options under consideration. Descriptions of the components of each supply option are described in TM 8 and TM 9A. Capital cost information and timing/phasing for each supply option were taken from TM 9C.

As with all planning level cost estimates, the cost estimates presented in this memo are subject to risks and uncertainties. Those risks and uncertainties are described in TM 9A Section 6.0.

The major components for each supply option are categorized as follows:

- Seismic improvements and dam raise (40' for Tualatin Basin Water Supply Project [TBWSP] option; 9' for all other options)
- Raw water river intake, pump station, and pipeline
- Water treatment plant
- Wells (Northern Groundwater option only)
- Booster pump station (finished water)
- 20 MG terminal reservoir
- Transmission lines

The City of Hillsboro cost shares were generally derived based on projected water supply deficits through 2050. For each JWC partner, the deficit in 2050 was calculated based on projected demands, net of existing treated supply capacity. Cost shares were then calculated based on the City of Hillsboro's proportion of the total projected deficit. The general approach to calculating the cost shares for each major component is described below.

Seismic Improvements and Dam Raise. All options include either a 40-foot (TBWSP option only) or 9-foot (all other options) raise of Scoggins Dam. Either dam raise includes seismic improvements. The City's cost share for the Scoggins Dam seismic improvements is based on the existing contract ownership percentage of the stored water volume, which is 9.32% for the City of Hillsboro. For the dam raise component of the 40-foot raise, the City's cost share is based on the ownership percentage stated in the Intergovernmental Agreement (IGA) associated with the TBWSP, which is 21.70% for the City of Hillsboro. All other supply options call for a 9-foot dam raise, which is to be paid for solely by Clean Water Services to meet their water quality augmentation needs. Therefore, the City's cost share for all other supply options is only for the seismic improvements.

Raw Water Intake, Pump Station, and Pipeline. The cost share calculation for the "raw water intake, pump station, and pipeline" varies depending on the supply option. In general, the cost share for this component is based on the City's proportion of the projected water supply deficit as of 2021 to meet year 2050 projected demands. For the City of Hillsboro, the current treatment capacity is 33.75 mgd with 2050 demand of 65.10 mgd, leaving a deficit of 31.35 mgd. Similarly, TVWD's current treatment capacity is 12.50 mgd with a 2050 demand of 61.40 mgd, leaving a deficit of 48.90 mgd. The combined deficit of the two partners is 80.25 mgd in 2050. The City's share is calculated by dividing 31.35 mgd by 80.25 mgd, which results in a 39.07% share based on total water supply deficit of the JWC partners that have a deficit in 2050. This cost share percentage applies for the Southern Willamette-West (formerly referred to as Newberg-West), Southern Willamette-East (formerly referred to as Newberg-East), and Northern Groundwater options.

The 39.07% cost City share applies to the City for the Mid-Willamette (formerly referred to as Willamette-Wilsonville) option, as well. However, in addition to that cost, the City is paying an additional \$2.5 million as buy-in to the existing Wilsonville Water Treatment Plant intake. This buy-in would be paid by City of Hillsboro to Tualatin Valley Water District (TVWD), and would become a "credit" to TVWD in calculating TVWD's cost of this option. This preliminary

placeholder value was provided by TVWD. It is based on the capacity proportion of TVWD's available capacity assuming Hillsboro's capacity share is 36.6 mgd and TVWD's capacity share is 43.4 mgd. Existing water treatment plant (WTP) facilities include intake, intake pipeline, raw water wet well and raw water pump station building (excluding existing pumps).

The TBWSP option assumes that 50% of total cost for the raw water intake, pump station and pipeline component applies to the raw water storage expansion and 50% applied to the water treatment plant improvements. That is, the City's cost share is based on City's ownership in the raw water storage expansion (21.70%) times 50% of the component cost, plus City's projected proportional ownership in the JWC WTP in 2050 (42.47%; including existing capacity) times 50% of the component cost. The value of 42.47% is based on the City's 2050 demand of 65.10 mgd out of a projected total JWC demand of 153.3 mgd.

Because there is no need for additional raw water improvements, the Portland Supply option and Northern Groundwater options include no costs for the "raw water intake, pump station, and pipeline" component.

Water Treatment Plant. All of the supply options identify phased expansion of water treatment capacity, as described in TM 9C. In general, the cost share for each expansion phase is based on the percentage of the total supply deficit met by the expansion before the next phase of expansion is needed. For example, the first phase of water treatment plant expansion for all options is adequate until 2026. Thus the cost share for the first phase of treatment expansion is based on the 2026 supply deficits. The City of Hillsboro's 2026 demand is 48.80 mgd, with a supply deficit of 15.05 mgd net of the City's existing 33.75 mgd capacity. The total JWC supply deficit in 2026 is 50.55 mgd net of the JWC WTP's existing 75 mgd capacity. The City's cost share (29.77%) for the first phase of the treatment expansion is calculated by the ratio of the City's deficit (15.05 mgd) to the total deficit (50.55 mgd) addressed by the expansion.

These calculations are completed for each phase for expansion using the deficit values for the period by when the next phase of expansion is needed. The specific phases are detailed in TM 9C. For the Portland Supply option, Hillsboro is responsible for 100% of costs for all treatment expansions; hence detailed cost share calculations were not required.

Wells (Northern Groundwater option only). This component only applies to the Northern Groundwater option. Since the timing of the well expansion phasing coincides with the water treatment plant expansion (one year offset), and it addresses the supply deficit similarly, the basis for calculating cost share for the wells is the same as the corresponding water treatment plant expansion.

20-MG Terminal Reservoir. The City's cost share for the new 20-MG Terminal Storage is based on the City's share of the water supply deficit in 2050, same as for the raw water intake, pump station, and pipelines. The same cost share of 39.07% is applied to all options.

Booster Pump Station (finished water). The methods to calculate cost share for the finished water booster pumping vary depending on the supply option, in part because finished water

pumping at the treatment plant is included within the treatment plant costs for some options, and in the booster pumping costs for others. Approaches to cost shares on each option are as follows:

- TBWSP and Southern Willamette-West options need a booster pump station to increase capacity of the existing South Transmission Line (STL), thereby delaying implementation of the STL2 until 2028. As with the water treatment plant expansion method, the cost share is calculated using the percent of the total deficit met by the booster pump based on 2028 demands. In this case, the City of Hillsboro has no deficit in 2028 so the cost share for this booster pump station is 0% for City of Hillsboro. The cost for booster pumping for the Southern Willamette-West option also includes finished water pumping at the WTP, which is allocated according to the same methodology as the intake. For the Mid-Willamette option pumping at the treatment plant is included in the treatment cost.
- Mid-Willamette, Southern Willamette-West, and Southern Willamette-East options need a booster pump station at the new water treatment plant. Same as the calculation for cost share of the intakes, the cost share for this booster pump is based on the proportion of 2050 supply deficit met by the new supply (39.07%).
- Mid-Willamette, Portland supply, and Southern Willamette-East options need a booster pump station for the Hillsboro extension line. The cost share for this booster pump is based on the total capacity desired by each partner. In this case, the analysis assumed that the City would need 22 mgd out of a total capacity of 36 mgd. This results in a 61.11% share for City of Hillsboro for this booster station.
- The Northern Groundwater option includes two pump stations, one at the water treatment facility and the second along the transmission line, with 50% of the total capacity in each station. The first station is included in the water treatment cost; whereas the second pump station is included in the booster pump station cost. The City's cost share for the booster pump station is the same as for the intakes (39.07%) based on proportion of 2050 supply deficit.

Transmission Lines. The methods to calculate cost share for the transmission lines vary depending on the supply option:

• TBWSP and Southern Willamette-West options require the STL2 to increase transmission capacity from Fern Hill Reservoir to Hazeldale. The cost share for the STL2 is based on the transmission deficit met by the new pipeline in 2050. The City's deficit is 6.1 mgd (65.1 mgd demand – 59.0 mgd current transmission capacity), out of a total pipeline capacity of 80 mgd. The portion of the STL2 capacity that is needed for new capacity is 25 mgd. The major portion of the 80 mgd capacity of the STL2 (55 mgd) is not needed to meet projected transmission needs and is instead allocated to redundancy (potential replacement of existing STL capacity). Based on its transmission capacity deficit of 6.1 mgd, the City's share of the *new capacity* is 24.4%, based on its deficit of 6.1 mgd; but in terms of the cost share of the total capacity cost, the City's share is 7.62%, or 6.1 mgd divided by the full 80 mgd.

- Mid-Willamette, Southern Willamette-West, Southern Willamette-East, and Northern Groundwater require a new transmission line from their respective WTPs (or wells for the Northern Groundwater option) to the terminal storage reservoir (or Hillsboro connection for the Northern Groundwater option). The City's cost share for these lines is based on the 2050 supply deficit (39.07%), same as for the intakes for these options.
- Mid-Willamette and Southern Willamette-East options require a transmission line from terminal storage location to Hazeldale. The cost share for these lines is based on the supply deficit taking into account that 30 mgd of TVWD's demands will be met through the Willamette Eastern Extension pipeline. In this case, the City's deficit is 31.35 mgd, out of a total deficit of 50.25 mgd, resulting in a cost share of 62.39% for the City of Hillsboro.
- The Portland option requires a 54-inch transmission line from Powell Butte to Hazeldale • based on a deficit of 45.55 mgd in 2050 accounting for the existing capacity of the Washington County Supply Line (WCSL). A portion of the length of this transmission line needs to be up-sized to 54-inch (Powell Butte to TVWD's Portland meter). The costs derived in TM-9A for this portion of the transmission line were scaled according to the adjusted pipeline diameter. For the City of Hillsboro, the current transmission capacity from the JWC and WCSL is 33.75 mgd with 2050 demand of 65.10 mgd, leaving a deficit of 31.35 mgd. TVWD's current transmission capacity is 12.50 mgd from JWC and 34.70 mgd from WCSL, with a 2050 demand of 61.40 mgd, leaving a deficit of 14.20 mgd. The combined deficit of the two partners is 45.55 mgd in 2050. The City's share is calculated by dividing 31.35 mgd by 45.55 mgd, which results in a 68.83% from Powell Butte to Hazeldale. From the Hazeldale to North Transmission Line (NTL; Hillsboro connection), it assumed that the City desired 22 mgd out of the total 36 mgd, which include 12 mgd for TVWD and 2 mgd for Beaverton. The City's share of the cost for this segment of transmission is then 22 mgd divided by 36 mgd, which is 61.11% for transmission from Hazeldale to NTL.
- All of the supply options have a new transmission line from Hazeldale to the North Transmission Line (note, except for the Northern Groundwater Option where the line only goes from the Beaverton meter to Hillsboro connection). The cost share for this line is based on the total capacity desired by each partner to deliver water to their meter. In this case, City of Hillsboro is assumed to require 22 mgd out of a total capacity of 36 mgd. This results in a 61.11% cost share for the City of Hillsboro for these transmission lines.

Operations and Maintenance Costs. O&M costs were divided into fixed and variable cost components. As most of the O&M costs are associated with treatment, the cost shares for the fixed costs were based on projected water treatment plant ownership in each option. For example, Hillsboro is projected to require 29.8% of the Phase 1 WTP expansion in the TBWSP supply option; a cost share of 29.8% was applied to fixed O&M costs for the years 2021 (year of implementation of Phase 1) through 2025 (year before implementation of Phase 2 expansion).

Variable O&M costs were calculated as a cost per CCF based on projected total annual usage in each year.

3.0 SUMMARY OF COST MODIFICATIONS AND ASSUMPTIONS

As noted above, a number of refinements were made to the supply options to more accurately represent likely supply configurations and to make the evaluation fair and equitable among the options. These changes are shown in updated figures for each of the supply options, included as Figures 8-2A through 8-2D (adapted from TM 8 by Black & Veatch; note the names for Willamette River options are from the original references). A brief discussion of each of the refinements is presented herein.

Dam Costs. A correction was made to the total portion of the 40-foot dam raise allocated to M&I users. The cost allocations shown in TM 9C had Tualatin Valley Irrigation District (TVID) paying for 54.5% of both the seismic portion and the dam raise portion of the overall costs. This was corrected to have TVID pay for a share of the seismic portion only, increasing the municipal & industrial (M&I) portion of the dam raise cost to \$267,400,000 from \$221,947,000.

Transmission Piping. Two refinements were made to the transmission piping for the Portland Supply option. The first refinement was that the capacity of the main transmission line from the Powell Butte Reservoirs to Hazeldale was increased from 38 mgd to 46 mgd, to take into account required capacity to serve the Metzger area of TVWD. The diameter of this pipeline was increased from 48 to 54 inches, based on maintaining the same flow velocity in the pipeline. The costs for this segment were then scaled linearly according to the old and new diameters. The second refinement eliminated the transmission piping between Hazeldale and the terminal storage reservoir, assuming that terminal storage could be located closer to the planned transmission lines. The cost for this segment was subtracted from the overall transmission line cost. The overall impact of these two refinements is a decrease from \$602,846,000 to \$472,411,000 for the cost of transmission piping for this option.

Though no changes were made to the transmission piping costs for the TBWSP and Southern Willamette-West options, it was recognized that only 25 mgd of the 80 mgd capacity of the STL2 is required to meet the projected transmission deficit, with the remainder used to replace existing capacity. Cash flows were refined for the TBWSP to have all transmission piping implemented in 2028, rather than a portion of piping implemented in 2021. Cash flows were refined for the Southern Willamette-West option, delaying a portion of the transmission piping costs (representing the STL2 and Hillsboro extensions) to implementation in 2028.

Any future piping for individual partners was not included in this study. For the Mid-Willamette and Southern Willamette – East options, transmission piping from the terminal storage reservoir to the West Hills area of the TVWD system would be needed by TVWD. As Hillsboro has a zero percent cost share for this piping, it is not included in this study, but would need to be included in any future evaluation of TVWD costs.

Booster Pump Stations. Through the evaluation of cost shares, it was identified that the cost estimates presented in TM 9A were missing the final booster pump station (boosting from the terminal reservoir head to overcome head in the JWC transmission system) in the Mid-

Willamette and Southern Willamette-East options. The estimate for the booster pump station for the Portland Supply option was used for this missing pump station; these costs were added onto the costs shown for booster pumping in TM 9C.

Operations and Maintenance Costs. Fixed O&M costs and chemical costs were updated based on the planned FY 2012/13 operating budget for the JWC WTP. At the current JWC WTP capacity of 75 mgd, the fixed O&M budget is \$3,537,000 (net of chemical and utilities costs). The following formula was used to calculate the fixed O&M cost for the water treatment facilities in each of the supply options:

 $Cost_{new} = Cost_{old} \times (1 + 0.25 \times (Capacity_{new} - Capacity_{old})/(Capacity_{old}))$ *Where:* $Cost_{new/old} = Fixed \ O\&M \ cost \ for \ the \ year \ of \ evaluation$ $Cost_{old} = Fixed \ O\&M \ cost \ at \ 75 \ mgd$ $Capacity_{new} = Capacity \ of \ WTP \ for \ year \ of \ evaluation$ $Capacity_{old} = Capacity \ of \ the \ existing \ JWC \ WTP \ (75 \ mgd)$

Chemical cost for FY 2012/13 is projected at \$642,000 at a total projected flow of 13,950,000 CCF, which is \$0.046/CCF. This unit chemical cost was applied as variable costs to projected annual water usage in each year for each supply option.

4.0 SUMMARY OF COST SHARE RESULTS

The cost share results are summarized in Table 1 on the following page. The City of Hillsboro's cost share is presented by water supply option and for each major component of the option. The cost share is presented in terms of percent and by non-construction and construction costs (2012 dollars).

The City's non-construction cost share for each option is based on the percentage of the City's cost share of the total construction cost. For example, the City's total cost share for the TBWSP is approximately \$260M, and the *total* TBWSP construction cost is approximately \$847M, which yields 30.7% non-construction cost share for the City. This is calculated similarly for the other options and listed in Table 1.

The remaining sections of the TM present the net present value for the Hillsboro cost share first (Sections 5 and 6), followed by the net present value for the *total* project cost (Sections 7 and 8) for comparison. Section 9 presents the results of the Monte Carlo analysis of the total project costs to quantify the uncertainty in the cost estimates. In both cases (Hillsboro cost share and total project cost), the results are presented for net present value with and without cost-risk accounted for in the capital costs.

In general, the cost estimates and cost share calculations involve assumptions that yield uncertainty or "cost risk." The analysis accounts for this with risk-adjusted cost evaluations. Two particular cost share issues are worth noting. First, the TBWSP cost share estimates do not include costs associated with water purchases or leasing that would result from a significant delay in schedule or mitigation for two newly identified endangered species. This could have significant impacts on the cost share option, which presents uncertainty in the cost share estimates. Second, the cost shares for all the options assume that partners exist for each option. However, no partners have been confirmed for the Southern Willamette-West option at this time. In particular, TVWD has not included the Southern Willamette options in their long-term water supply evaluation. As a result, the City of Hillsboro cost share for those options could be higher.

		TRWSP	м	id-Willsmette	Po	rtland Supply		Southern		Southern		Northern
		10 10 10	IVI	iu- winamette	10		W	illamette-West	W	illamette-East	•	roundwater
Non-Construction			1		1						1	
Total Cost (\$)	\$	142,000,000	\$	226,000,000	\$	316,000,000	\$	298,000,000	\$	278,000,000	\$	285,000,000
Hillsboro Cost Share (%)		30.70%		39.5%		70.0%		36.0%		39.1%		39.60%
Hillsboro Cost Share (\$)	\$	44,000,000	\$	89,000,000	\$	221,000,000	\$	107,000,000	\$	109,000,000	\$	113,000,000
Seismic/Dam Raise	_		-				-				-	
Total Cost (\$)	\$	267,000,000	\$	16,000,000	\$	16,000,000	\$	16,000,000	\$	16,000,000	\$	16,000,000
Hillsboro Cost Share (%)		17.84%		47.4%		47.4%		47.4%		47.4%		47.40%
Hillsboro Cost Share (\$)	\$	48,000,000	\$	8,000,000	\$	8,000,000	\$	8,000,000	\$	8,000,000	\$	8,000,000
River Intake/PS, Pipeline					-		_					
Total Cost (\$)	\$	251,000,000	\$	9,000,000		N/A	\$	17,000,000	\$	17,000,000		N/A
Hillsboro Cost Share (%)		32.08%		66.40%		N/A		39.07%		39.07%		N/A
Hillsboro Cost Share (\$)	\$	80,000,000	\$	6,000,000		N/A	\$	6,000,000	\$	6,000,000		N/A
Water Treatment Plant (+ Wells a	and	well piping for	Nor	thern Groundw	ater	option)						
Total Cost (\$)	\$	233,000,000	\$	137,000,000	\$	65,000,000	\$	137,000,000	\$	137,000,000	\$	310,000,000
Phase 1 (%)		29.77%		29.77%		100%		29.77%		29.77%		29.77%
Phase 2 (%)		47.78%		45.02%		100%		45.02%		45.02%		45.02%
Phase 3 (%)		48.00%		49.47%		100%		49.47%		49.47%		49.47%
Phase 4 (%)		N/A		49.78%		100%		49.78%		49.78%		49.78%
Phase 5 (%)		N/A		47.51%		100%		47.51%		47.51%		47.51%
Net Cost Share (%)		38.83%		38.69%		100%		38.69%		38.86%		37.80%
Hillsboro Cost Share (\$)	\$	90,000,000	\$	53,000,000	\$	65,000,000	\$	53,000,000	\$	53,000,000	\$	97,000,000
Booster Pump Station												
Total Cost (\$)	\$	4,000,000	\$	35,000,000	\$	10,000,000	\$	30,000,000	\$	35,000,000	\$	16,000,000
Hillsboro Cost Share (%)		0%		45.10%		61.11%		33.33%		45.10%		39.07%
Hillsboro Cost Share (\$)	\$	-	\$	16,000,000	\$	6,000,000	\$	10,000,000	\$	16,000,000	\$	6,000,000
20 MG Reservoir												
Total Cost (\$)	\$	15,000,000	\$	16,000,000	\$	16,000,000	\$	16,000,000	\$	16,000,000	\$	16,000,000
Hillsboro Cost Share (%)		39.07%		39.07%		39.07%		39.07%		39.07%		39.07%
Hillsboro Cost Share (\$)	\$	6,000,000	\$	6,000,000	\$	6,000,000	\$	6,000,000	\$	6,000,000	\$	6,000,000
Transmission Lines												
Total Cost (\$)	\$	141,000,000	\$	320,000,000	\$	472,000,000	\$	444,000,000	\$	455,000,000	\$	364,000,000
Phase 1 (%)		25.28%		48.48%		67.87%		34.65%		45.66%		41.0%
Phase 2 (%)		N/A		N/A		N/A		26.40%		N/A		45.0%
Phase 3 (%)		N/A		N/A		N/A		N/A		N/A		49.5%
Phase 4 (%)		N/A		N/A		N/A		N/A		N/A		49.8%
Phase 5 (%)		N/A		N/A		N/A		N/A		N/A		47.5%
Net Cost Share (%)		25.28%		48.48%		67.87%		31.76%		45.66%		41.21%
Hillsboro Cost Share (\$)	\$	36,000,000	\$	155,000,000	\$	321,000,000	\$	141,000,000	\$	208,000,000	\$	150,000,000
Total Hillsboro Construction	¢	260,000,000	¢	244 000 000	¢	406 000 000	¢	224 000 000	¢	207 000 000	¢	267 000 000
Cost Share (\$)	φ	200,000,000	¢	244,000,000	¢	400,000,000	¢	224,000,000	¢	297,000,000	φ	207,000,000
Total Hillsboro Construction + Non-Construction Cost Share (Rounded \$)	\$	304,000,000	\$	333,000,000	\$	627,000,000	\$	331,000,000	\$	406,000,000	\$	380,000,000

Table 1: City of Hillboro Cost Share Summary (2012 Dollars)

5.0 NET PRESENT VALUE RESULTS – HILLSBORO COST SHARE

The results of the economic evaluation are presented in two parts. First, there is a presentation of the Net Present Value (NPV) results *without* taking into account capital cost risk in this section. Second, there is a presentation of the NPV results *with* consideration of capital cost risk in the next Section 6.0.

The results presented in this section summarize the results of the analysis, *without taking into account cost risk*. Data are presented as overall costs in Table 2, with capital and O&M costs presented separately in Table 3 and Table 4, respectively. Included in each table are rankings for each option in order of least cost to highest cost. There are two sets of rankings, one based on the net present value of each source option, the other based on the undiscounted cost projections. NPV brings all future costs into a present-day cost basis using a discount rate, which is an estimate of a utility's weighted average cost of capital over time. The undiscounted costs include the effects of assumed inflation, construction cost escalation, and power price increases over time.

	Ne	et Present V	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$325,000,000	1	0%	\$0	\$690,000,000	1
Mid-Willamette	365,000,000	2	12%	40,000,000	740,000,000	2
Portland Supply	705,000,000	6	117%	380,000,000	1,580,000,000	6
Southern Willamette-W.	365,000,000	2	12%	40,000,000	765,000,000	3
Southern Willamette-E.	435,000,000	5	34%	110,000,000	830,000,000	4
Northern Groundwater	430,000,000	4	32%	105,000,000	930,000,000	5

Table 2: Comparison of Projected Total Cash Flows

Table 3: Comparison of Projected Cash Flows for Capital Costs

	Ne	t Present \	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$280,000,000	1	0%	\$0	\$510,000,000	1
Mid-Willamette	315,000,000	3	13%	35,000,000	525,000,000	2
Portland Supply	580,000,000	6	107%	300,000,000	1,075,000,000	6
Southern Willamette-W.	310,000,000	2	11%	30,000,000	540,000,000	3
Southern Willamette-E.	385,000,000	5	38%	105,000,000	625,000,000	4
Northern Groundwater	370,000,000	4	32%	90,000,000	685,000,000	5

	Ne	t Present \	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$45,000,000	1	0%	\$0	\$180,000,000	1
Mid-Willamette	50,000,000	2	11%	5,000,000	215,000,000	3
Portland Supply	125,000,000	6	178%	80,000,000	505,000,000	6
Southern Willamette-W.	55,000,000	4	22%	10,000,000	220,000,000	4
Southern Willamette-E.	50,000,000	2	11%	5,000,000	205,000,000	2
Northern Groundwater	60,000,000	5	33%	15,000,000	250,000,000	5

Table 4: Comparison of Projected Cash Flows for O&M Costs

As shown in Table 2, TBWSP is projected to be the least-cost option for Hillsboro cost share, and is approximately \$40 million less expensive than the next least expensive options (Mid-Willamette and Southern Willamette-West). The Northern Groundwater and Southern Willamette-East options are the next least expensive for Hillsboro cost share. The highest cost option is the Portland Supply option. The rank for Hillsboro cost share remained relatively consistent with respect to capital costs and O&M costs.

6.0 RISK-ADJUSTED RESULTS – HILLSBORO COST SHARE

The results presented in this section *include the effects of risk* probability on the capital costs. Similar to the previous section, results are presented by overall costs in Table 5, with capital costs presented separately in Table 6. O&M cost comparisons are the same as those presented above in Table 4. O&M costs are not affected by capital cost risk.

The introduction of cost risk did not change the ranking of the options, as projects with higher capital costs also tended to have higher risk. The cost risk increased the projected NPV for all options, and did not alter the "spread" among the options very much.

		J			J /	
	Ne	t Present \	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$335,000,000	1	0%	\$0	\$710,000,000	1
Mid-Willamette	370,000,000	2	10%	35,000,000	755,000,000	2
Portland Supply	725,000,000	6	116%	390,000,000	1,625,000,000	6
Southern Willamette-W.	370,000,000	2	10%	35,000,000	775,000,000	3
Southern Willamette-E.	440,000,000	4	31%	105,000,000	850,000,000	4
Northern Groundwater	450,000,000	5	34%	115,000,000	965,000,000	5

Table 5: Comparison of Projected Total Cash Flows (Risk-Adjusted)

	J				\ U	/
	Ne	t Present \	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$295,000,000	1	0%	\$0	\$530,000,000	1
Mid-Willamette	320,000,000	3	8%	25,000,000	535,000,000	2
Portland Supply	600,000,000	6	103%	305,000,000	1,120,000,000	6
Southern Willamette-W.	315,000,000	2	7%	20,000,000	555,000,000	3
Southern Willamette-E.	390,000,000	4	32%	95,000,000	640,000,000	4
Northern Groundwater	390,000,000	4	32%	95,000,000	715,000,000	5

 Table 6: Comparison of Projected Cash Flows for Capital Costs (Risk-Adjusted)

7.0 NET PRESENT VALUE RESULTS – TOTAL PROJECT COSTS

As with the Hillsboro cost share results in the previous sections, the results presented in this section summarize the results of the analysis for *total* project costs, *without taking into account cost risk*. In this case, "total project cost" refers to the cost of constructing the full 80-mgd supply infrastructure, where other partners would share in the costs. Data are presented as overall costs in Table 7, with capital and O&M costs presented separately in Table 8 and Table 9, respectively. Included in each table are rankings for each option in order of least cost to highest cost. There are two sets of rankings, one based on the net present value of each source option, the other based on the undiscounted cost projections.

Table 7:	Comparison	of Projected	Total Cash	Flows

	Ne	t Present V	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$1,040,000,000	4	22%	\$185,000,000	\$2,010,000,000	4
Mid-Willamette	855,000,000	1	0%	0	1,745,000,000	1
Portland Supply	1,080,000,000	5	26%	225,000,000	2,520,000,000	6
Southern Willamette-W.	975,000,000	2	14%	120,000,000	1,980,000,000	2
Southern Willamette-E.	1,035,000,000	3	21%	180,000,000	1,995,000,000	3
Northern Groundwater	1,100,000,000	6	29%	245,000,000	2,315,000,000	5

Table 8: Comparison of Projected Cash Flows for Capital Costs

	Ne	et Present \	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$925,000,000	5	29%	\$210,000,000	\$1,565,000,000	5
Mid-Willamette	715,000,000	1	0%	0	1,185,000,000	1
Portland Supply	825,000,000	2	15%	110,000,000	1,530,000,000	4
Southern Willamette-W.	835,000,000	3	17%	120,000,000	1,405,000,000	2
Southern Willamette-E.	900,000,000	4	26%	185,000,000	1,455,000,000	3
Northern Groundwater	940,000,000	6	31%	225,000,000	1,675,000,000	6

	Ne	t Present V	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$115,000,000	1	0%	\$0	\$440,000,000	1
Mid-Willamette	140,000,000	3	22%	25,000,000	565,000,000	3
Portland Supply	255,000,000	6	122%	140,000,000	990,000,000	6
Southern Willamette-W.	145,000,000	4	26%	30,000,000	575,000,000	4
Southern Willamette-E.	135,000,000	2	17%	20,000,000	535,000,000	2
Northern Groundwater	160,000,000	5	39%	45,000,000	640,000,000	5

Table 9: Comparison of Projected Cash Flows for O&M Costs

As shown in Table 7, the Mid-Willamette option is projected to be the least-cost option for *total* project cost, and is approximately \$120 million less expensive than the next least expensive option (Southern Willamette-West). The Southern Willamette-East and TBWSP options are the next least expensive at \$180 and \$185 million greater than Mid-Willamette, respectively. These options are followed by the Portland Supply option at \$225 million greater than Mid-Willamette. The highest cost option is the Northern Groundwater option. The rank for total cost share remained varied with respect to capital costs and O&M costs. For example, the Mid-Willamette option had the lowest capital cost, but had the third least expensive O&M costs. Furthermore, while the Portland Supply option had the second lowest capital costs, its O&M cost was highest which caused it to rank low overall for total costs.

8.0 RISK-ADJUSTED RESULTS – TOTAL PROJECT COSTS

The results presented in this section *include the effects of risk* probability on the *total* project capital costs. Similar to the previous section, results are presented by overall costs in Table 10, and with capital costs presented separately in Table 11. In general, the ordering is same as before (Section 7) for *total* project costs. O&M cost comparisons are the same as those presented above in Table 9. O&M costs are not affected by capital cost risk.

	Ne	Undiscounted Analysis								
	Net Present		% from	Diff. from	Undiscounted					
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank				
TBWSP	\$1,080,000,000	4	24%	\$210,000,000	\$2,070,000,000	4				
Mid-Willamette	870,000,000	1	0%	0	1,770,000,000	1				
Portland Supply	1,115,000,000	5	28%	245,000,000	2,580,000,000	6				
Southern Willamette-W.	995,000,000	2	14%	125,000,000	2,015,000,000	2				
Southern Willamette-E.	1,055,000,000	3	21%	185,000,000	2,030,000,000	3				
Northern Groundwater	1,140,000,000	6	31%	270,000,000	2,395,000,000	5				

 Table 10: Comparison of Projected Total Cash Flows (Risk-Adjusted)

					\ U	
	Ne	et Present V	Undiscounted Analysis			
	Net Present		% from	Diff. from	Undiscounted	
Scenario	Value	Rank	Lowest	Lowest	Cash Flow	Rank
TBWSP	\$965,000,000	5	32%	\$235,000,000	\$1,630,000,000	5
Mid-Willamette	730,000,000	1	0%	0	1,210,000,000	1
Portland Supply	860,000,000	3	18%	130,000,000	1,595,000,000	4
Southern Willamette-W.	850,000,000	2	16%	120,000,000	1,440,000,000	2
Southern Willamette-E.	920,000,000	4	26%	190,000,000	1,490,000,000	3
Northern Groundwater	985,000,000	6	35%	255,000,000	1,755,000,000	6

 Table 11: Comparison of Projected Cash Flows for Capital Costs (Risk-Adjusted)

9.0 MONTE CARLO RESULTS – TOTAL PROJECT COSTS

A Monte Carlo simulation was used to estimate the mean dispersion of the NPV for the supply options for the *total project costs*. Figure 1 (next page) shows the NPV rank frequency developed in the Monte Carlo analyses. The x-axis represents the percentage of total iterations that the options were ranked in the order of least-cost to highest-cost options. For example, Figure 3 shows that the Mid-Willamette option ranked as the least-cost option in 100% of the 20,000 iterations for this Monte Carlo simulation; and the Southern Willamette-West option was ranked very closely behind as next least costly option (99% of the simulations ranked as second). The Northern Groundwater option ranked as the highest-cost option in approximately 70% of the iterations.

The two tables that follow Figure 1 provide additional information from the Monte Carlo simulation. Table 12 provides a summary of the number of times each scenario occurred at each ranking in the simulations. Table 13 provides the same information represented as a percent of the 20,000 iterations.



Figure 1: Rank Frequency by Source Option – Total Project Costs

Table 12: Monte Carlo Analyses Rank Occurrence Results – Total Project Costs

Dauli	TBWSP	Mid-Willamette	Portland	S. Willamette-	S. Willamette-	Northern
капк				West	East	Groundwater
1	0	19,999	1	0	0	0
2	20	1	200	19,766	13	0
3	2,532	0	2,752	222	14,493	1
4	13,317	0	2,416	11	4,115	141
5	4,025	0	8,736	1	1,377	5,861
6	106	0	5,895	0	2	13,997

Table 13: Monte C	arlo Analyses F	Rank Frequency	Results – Tota	l Project Costs
		1 2		

Donk	TBWSP	Mid-Willamette	Portland	S. Willamette-	S. Willamette-	Northern
Rdlik				West	East	Groundwater
1	0%	100%	0%	0%	0%	0%
2	0%	0%	1%	99%	0%	0%
3	13%	0%	14%	1%	72%	0%
4	67%	0%	12%	0%	21%	1%
5	20%	0%	44%	0%	7%	29%
6	1%	0%	29%	0%	0%	70%

Figure 2 provides probability distributions of total NPV project costs, with the NPV shown along the x-axis and the relative probability of that NPV shown along the y-axis.¹ As shown in the figure, the Mid-Willamette option stands out as the least cost alternative, again followed by the Southern Willamette-West option, and with less differentiation among the remaining supply options.

¹ The area under the curve for each supply is equal to one.



Figure 2: Comparison of NPV Ranges by Source Option – Total Project Costs

10.0 SUMMARY

This technical memo presents the City of Hillsboro cost share for six water supply options. Cost information was based on those developed by the JWC in previous technical memoranda, with the refinements discussed above. The City's cost share of each major component of the supply options were derived based on the appropriate application of existing contract share, treatment or transmission capacity and water demand information. For comparison purposes, the net present values for the *total* project costs (all participants) were also calculated. In both analyses, an economic evaluation of cost risks or uncertainty in capital cost estimates was considered. The results of the analysis were presented to the Utilities Commission on September 18, 2012, and comments were incorporated into this final TM.







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JWC Transmission Main

JWC-Member Transmission Main

Willamette - Wilsonville Supply Option

JWC ASR Development focus Areas







Proposed Water Treatment Plant



ASR Study Area Waterbody

River



Project No.: 161669 Sources: Joint Water Commission (JWC) City of Hillsboro Tualitin Valley Water District (TVWD) Washington County Metro Data Resource Center



FIGURE 8-2B

OPTION

WILLAMETTE - WILSONVILLE









LEGEND



JWC Transmission Main

- JWC-Member Transmission Main
- Portland Supply Option
- JWC ASR Development focus Areas
- ASR Study Area
- Waterbody
- River



FIGURE 8-2C



Project No.: 161669 Sources: Joint Water Commission (JWC) City of Hillsboro Tualitin Valley Water District (TVWD) Washington County Metro Data Resource Center



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WTP



FACILITIE	s	WTP	LEGEND Proposed WTP	PIPES			FIGU	RE 8-2D
	JWC Intake	R	Proposed Terminal Reservoir		JWC-Member Transmission Main	Willam	iette	- Newberg
PS	JWC Pump Station	PS	Proposed Pumping Station	SUPPLY O	PTIONS Proposed West Sub-Ontion	Sup	ргу	Options
PS	JWC-Member Pump Station		Proposed Intake		Proposed Fast Sub-Option		HILL	SBORO
	JWC Reservoir		Beaverton Turnout	BASEMAP				
8	JWC-Member Reservoir	0	Forest Grove Turnout		Freeway		W	TER
WTP	JWC Treatment Plant	0	Hillsboro Turnout		Major Arterial	Ņ	Project No.:	161669
WTP	JWC-Member Treatment Plant	Ū Ū	North Plains Turnout TVWD - Portland Water Bureau Turnout	~~~	River		Sources:	Joint Water Commission (JWC) City of Hillsboro Tualitin Valley Water District (TVWD) Washington County Metro Data Resource Center
		•	TVWD Turnout			0.5	0 0.5	1 1.5
BLACK	& VEATCH	•	Divide Between Tualatin River Basin and Willamette River Basin				1 inch -	= 1.5 miles

er/GIS/Departments/DEPT-32691161661_Hillsboro_OR_Water_Master/Plan111GIS/01ProjectFiles/AmendmentTM_Revision3HA_Fig8-2D_Willamette-NewburgSupplyOptions(11X17)_2012.mxd | 9/14/2012 | K McRae

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