To: Peter Martins, P.E., Project Manager

From: Dave Carlson, Black & Veatch
Carmen Nale, P.E., Black & Veatch
Joe Broburg, P.E., CH2M Hill

Date: June 4, 2012

RE: **Technical Memorandum 9C –Phasing of Water Supply Options – *FINAL***

1.0 INTRODUCTION

This technical memorandum (TM) 9C-*Phasing of Water Supply Options* summarizes the phasing for each water supply option to meet the projected JWC peak day water demand through year 2050. TM 9C is the third of four smaller technical memoranda which make up the overall TM 9 series required to complete the financial analysis. TM 9A-*Water Supply Option Cost Estimating Detail* was the first technical memorandum of the series which evaluated the cost estimate of each water supply option. TM 9B-*Approach to Incorporating Cost Risk into the Economic Model* was the second and discussed the approach to evaluating and incorporating cost risk into the economic analysis model. TM 9D-*Present Worth Analysis* will be the fourth and will incorporate the information generated by the three previous TM's (TM 9A, 9B, and 9C) into the economic analysis model (Monte Carlo simulation model) to evaluate the overall cost and cost risk for each water supply option.

2.0 WATER SUPPLY OPTION PHASING

Each water supply option includes major capital facility projects. The facilities identified in each water supply option need to be constructed and operational by a specific date to meet the projected peak day water demand (PDD) of the JWC partners. Peak day water demand projections were developed in TM03-*Water Demand Needs* and Figure 1 illustrates those projections. The water projection shows a vertical jog in the projected demands based on TVWD reducing its Portland water supply in year 2015. The existing JWC Water Treatment Plant is assumed to be able to provide 75 million gallons per day (mgd). In order to meet the future PDD of 155 mgd, each water supply option will need to deliver 80 mgd of additional treated water. From now until year 2021, the JWC with find alternative water supply to delay the water supply project until year 2021.

While some facilities within each water supply option need to be built in their entirety initially, such as dam construction, the construction of other facilities can be phased to provide incremental capacity to meet projected demand increases over time. The projected phasing of facility construction allows construction costs to be distributed in a logical manner over time in the economic analysis model. The phasing of each water supply option is evaluated at a planning level by breaking facilities into the major groupings of water treatment plants, pump stations, storage reservoirs, and transmission pipelines. The raw water infrastructure (intakes, pump stations, and transmission lines) are included within the water treatment plant major grouping.

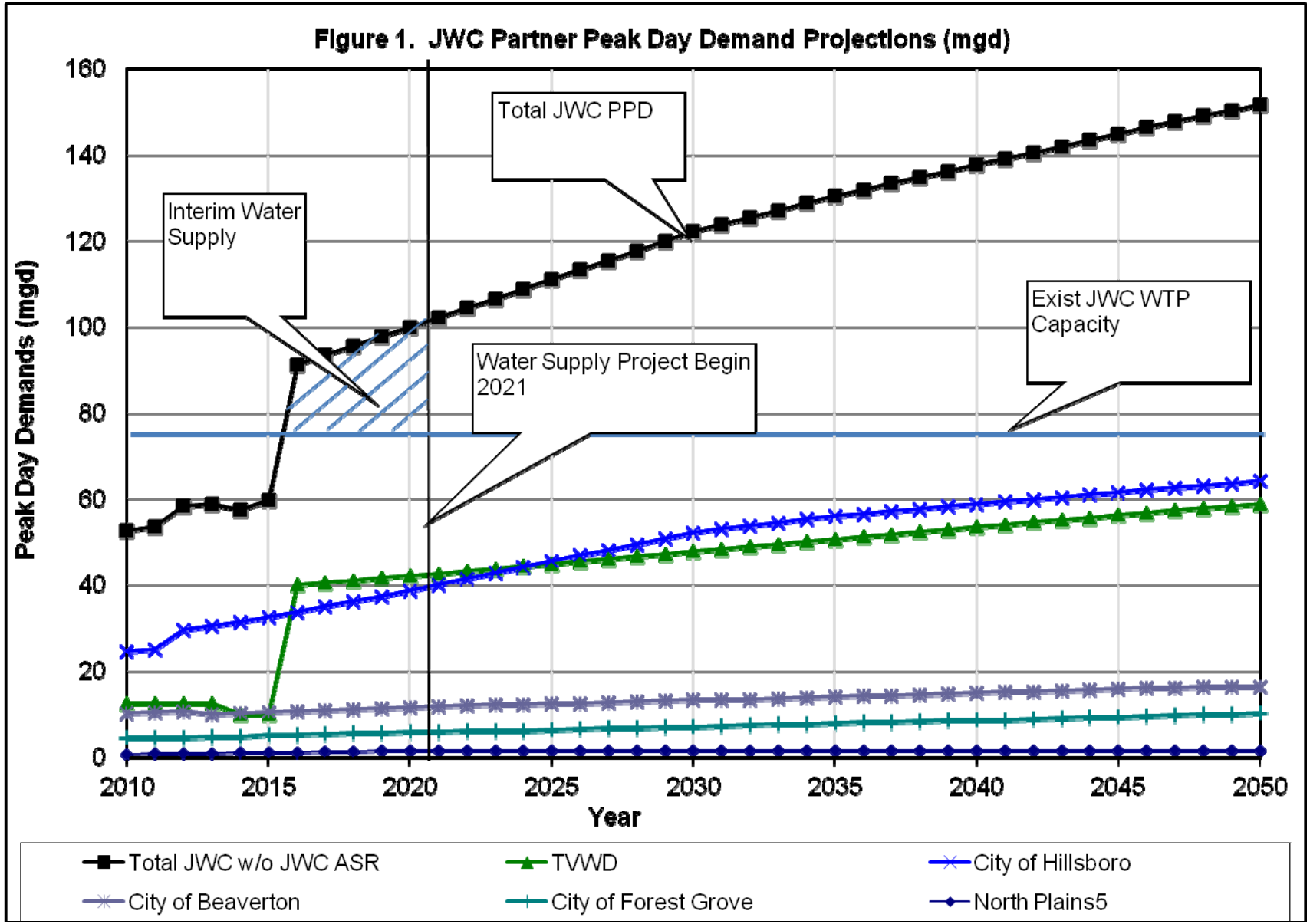


Figure 1. JWC Partner Peak Day Demand Projections (mgd)
Peak Day Demands (mgd)
160
140
120
100
80
60
40
20
0
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year
Total JWC PPD
Interim Water Supply
Water Supply Project Begin 2021
Exist JWC WTP Capacity
Total JWC w/o JWC ASR
TVWD
City of Hillsboro
City of Beaverton
City of Forest Grove
North Plains5

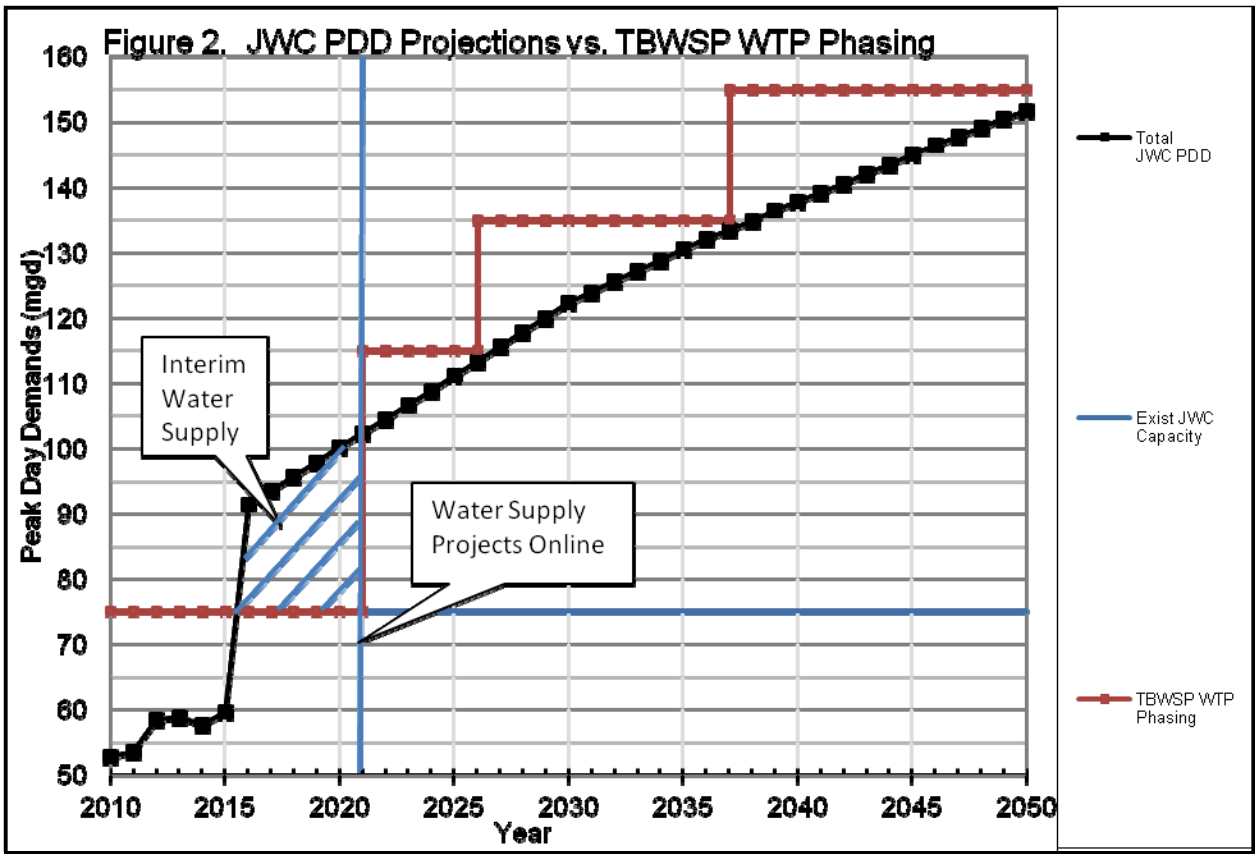
2.1 Water Treatment Plant Phasing

Water treatment plant expansion phasing depends on many factors including the type of treatment components, projected PDD, type of existing facilities, etc. The water treatment plant component for each supply option was reviewed to identify a logical expansion phasing and the selected increment of initial and subsequent capacity increases. The incremental capacities and the year each expansion needs to come online to meet projected PDD are as shown in Table 1 and in Figure 2 through Figure 6, respectively for each water supply option. An offset for each year shown will have to be made to allow for design, construction, and startup before each expansion is brought online by the phase year. Note that the phase year for each water supply option varies. For clarification, the figures also show the PDD projections throughout year 2050 and then existing JWC WTP assumed capacity of 75 mgd.

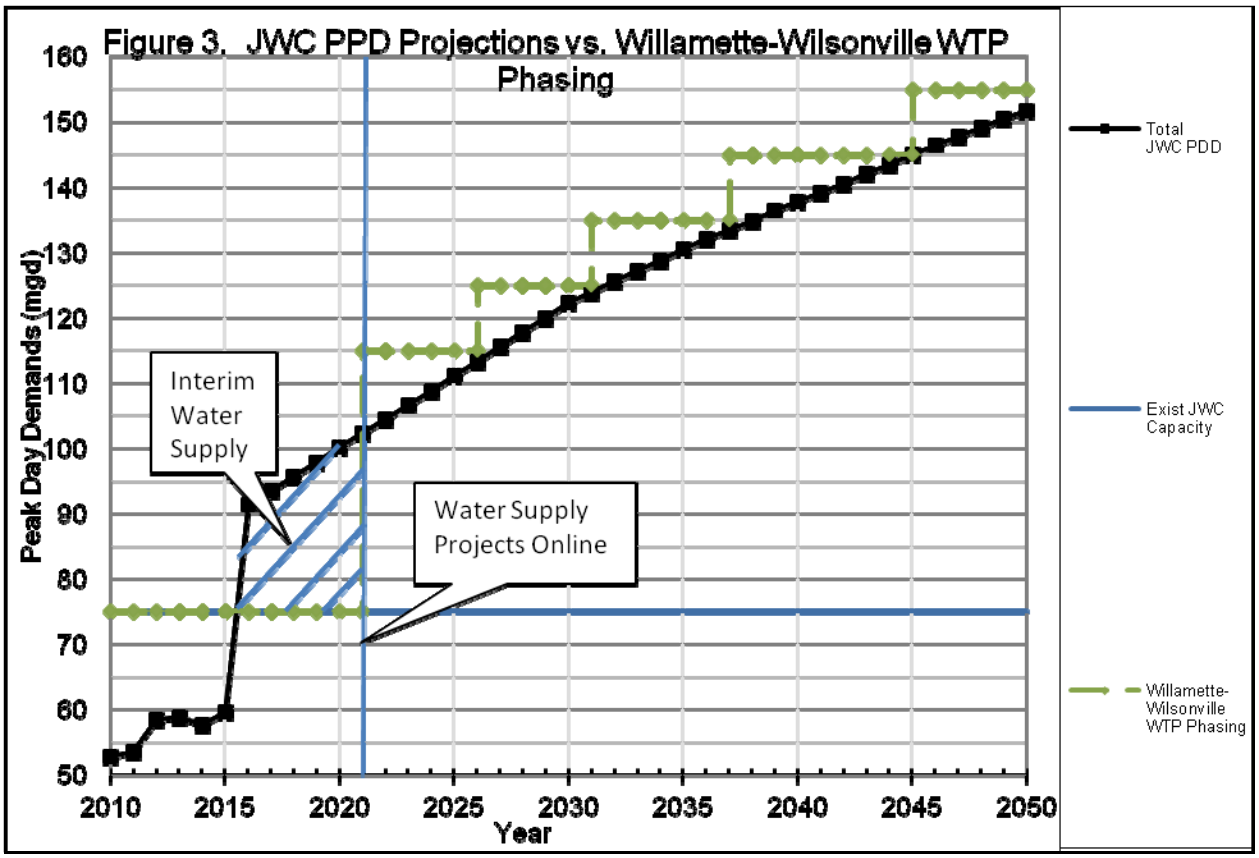
Table 1. Water Treatment Plant Incremental Capacity Phasing

Water Supply Option	Water Supply Expansion Phase (mgd, year)				
	1	**2**	**3**	**4**	**5**
TBWSP	40 mgd Yr 2021	20 mgd Yr 2026	20 mgd Yr 2037		
Willamette - Wilsonville	40 mgd Yr 2021	10 mgd Yr 2026	10 mgd Yr 2031	10 mgd Yr 2037	10 mgd Yr 2045
Portland Supply*	10 mgd Yr 2022	10 mgd Yr 2028	10 mgd Yr 2037		
Newberg West or East	40 mgd Yr 2021	10 mgd Yr 2026	10 mgd Yr 2031	10 mgd Yr 2037	10 mgd Yr 2045
Northern Groundwater	40 mgd Yr 2021	10 mgd Yr 2026	10 mgd Yr 2031	10 mgd Yr 2037	10 mgd Yr 2045

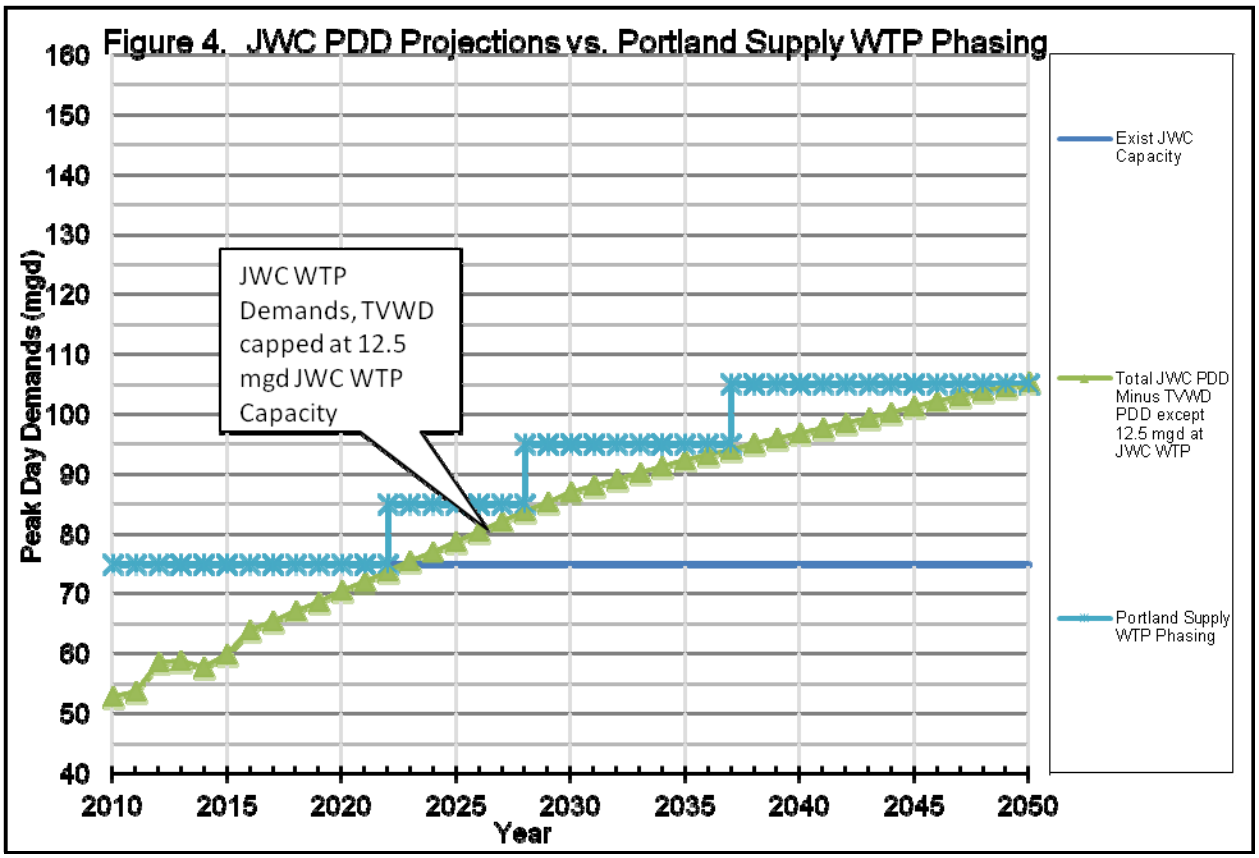
* Water treatment is only required for water supplied to the City of Hillsboro. Therefore, only 30 mgd is required to be treated. The existing Washington County Supply Line (WCSL) will provide the remaining water to TVWD, which is not required to be treated. This is discussed in detail later in this TM.



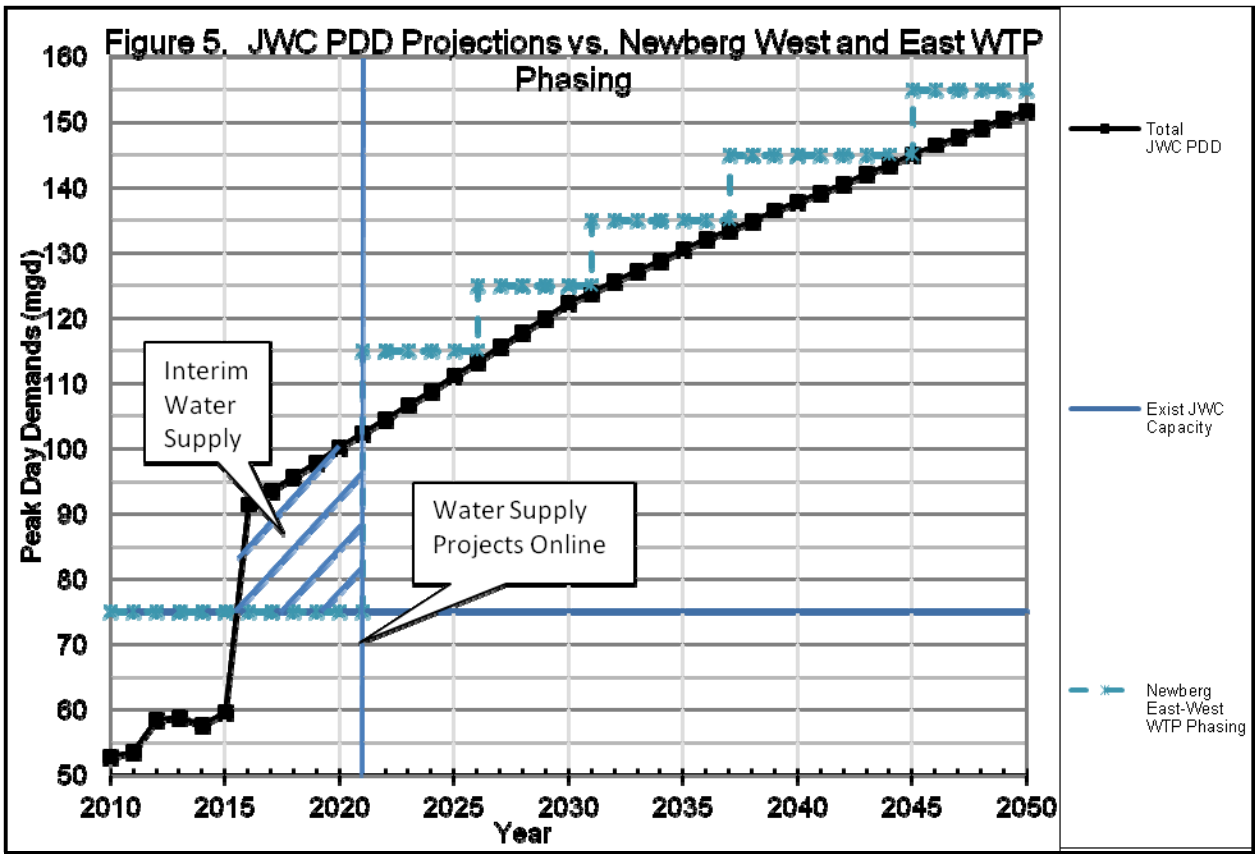
The Tualatin Basin Water Supply Project (TBWSP) option includes the full construction of the dam raise, raw water pipeline in the initial phase. This option also includes a 40 mgd WTP expansion at the existing JWC WTP in the initial phase followed by two 20 mgd incremental capacity expansion.



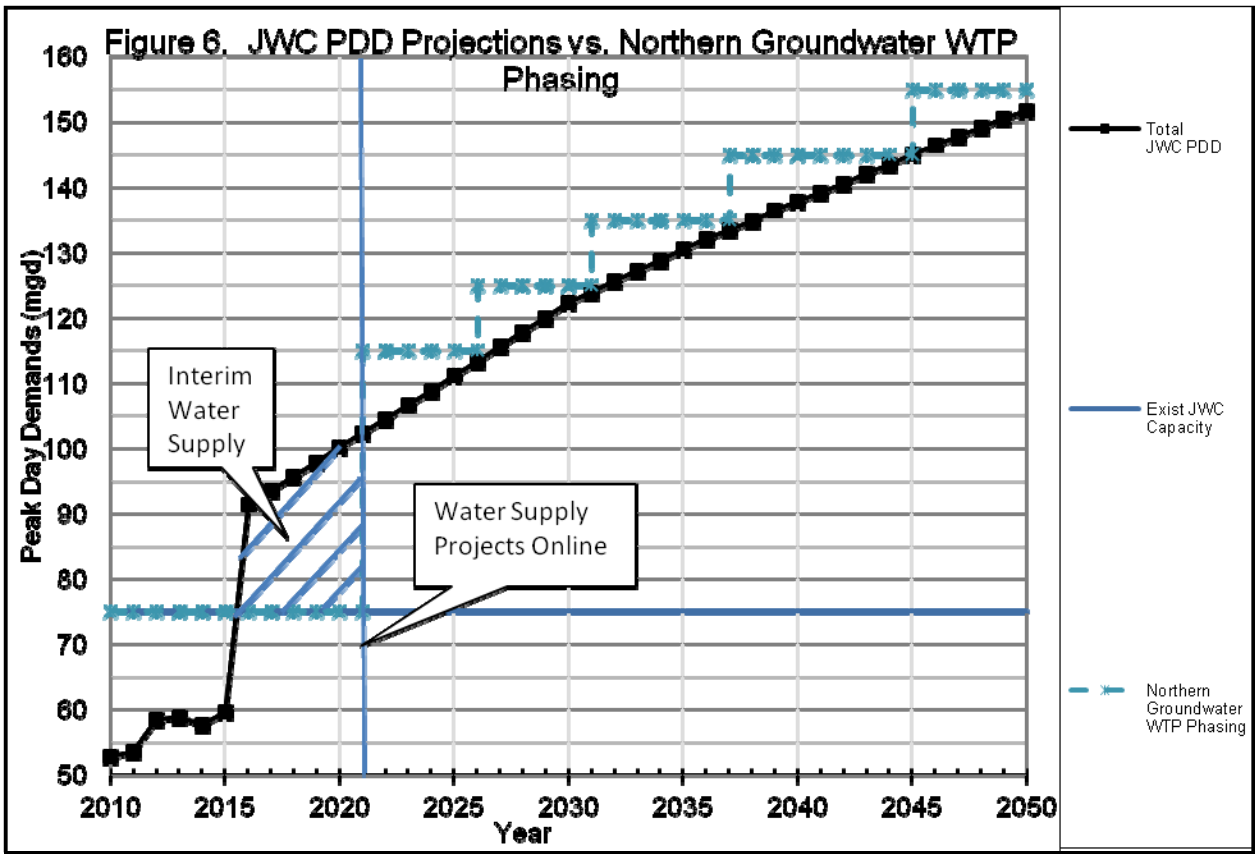
The Willamette-Wilsonville water supply option is developed entirely on the upper site. The upper site would be developed as a separate treatment facility for the total 80 mgd demand and built in the phases as shown.



Water treatment for the Portland Supply option is only required for water supplied to the City of Hillsboro. However, due to the existing JWC transmission system, the new WTP will serve everyone in the JWC except TVWD, which is already connected to the PWB. The water treatment plant will be constructed when Hillsboro needs to receive water from the Portland Water Bureau (PWB) and then expanded in increments to its full capacity for this option for planning-level costing. This assumes that TVWD remains on the existing Portland system and the remaining capacity in the existing JWC WTP could be supplied to the City of Hillsboro. This would delay the needed construction of the Hillsboro WTP to the point where demand requires Hillsboro to receive Portland water. The WTP would then be constructed when the existing WCSL capacity is reached and the new parallel pipeline from PWB is required, which is discussed in detail in the following section.



The Newberg West or East water supply options will have a larger portion of the water treatment plant cost allocated for the first phase which will include full site acquisition, with expansion in subsequent phases. Later phases will add capacity as smaller incremental expansions.



The Northern Groundwater supply option will have a larger portion of the water treatment plant cost allocated for the first phase which will include full site acquisition, with expansion in subsequent phases. The number of wells will be developed incrementally as required to meet the overall capacity of each phase.

Transmission Pipeline, Pump Station, and Reservoir Phasing

New transmission piping, pump stations, and reservoirs typically are constructed to full capacity in a single phase. One qualification is that pump stations are designed for full capacity of the transmission pipeline, but may have phased installation of pump units over time as capacity is needed. For this planning-level analysis phasing of pump units is not considered as the single pump costs are insignificant as compared to the overall building costs. Therefore, the pump station will be constructed to full capacity at the same time the transmission pipeline is constructed. In addition, the reservoir storage for each supply option will be constructed to full capacity at the same time as the transmission pipeline. The year the conveyance and storage facilities are online is shown in Table 2.

Table 2. Pipeline, Pumping, and Storage Facilities

Water Supply Option	Year Facilities Online
TBWSP	Year 2028
Willamette-Wilsonville	Year 2021
Portland Supply	Year 2025
Newberg West or East	Year 2021
Northern Groundwater	Year 2021

The TBWSP option may be able to use the existing JWC transmission pipelines under key operational conditions to around 119 mgd water demand based on the findings from the JWC 2009 Master Plan by Black & Veatch. This demand corresponds to the expected demand in year 2028. In this year, the finished water transmission pipeline, pump stations, and storage facilities would need to be online. The raw water pipelines will be built at an earlier date than the finished water transmission pipeline.

The Willamette-Wilsonville, Newberg West or East, and Northern Groundwater water supply options require construction of pipeline, pump stations, and storage facilities are online by year 2021.

For the Portland Supply option, the existing PWB WCSL could be used by only TVWD until TVWD's full capacity share is reached. TVWDs peak day capacity in the WCSL is 42.3 mgd, which includes TVWDs supply to Metzger and Wolf Creek. It is assumed Metzger will stay on WCSL; thus, additional supply is required when Wolf Creek demand exceeds 42.3 mgd with Metzger. After the existing WCSL capacity share is reached, a parallel and connecting transmission pipelines, new pump stations, and new storage reservoir would then need to be online. These facilities would be built by 2025, when the water demand exceeds the total capacity

existing JWC WTP capacity (75 mgd) plus the existing WCSL capacity share (42 mgd) to equal a total of 117 mgd conveyance capacity.

2.2 Dam Construction

Both the 9 ft and 40 ft dam raise is assumed to be online by year 2021. The actual construction of each dam option needs to be completed a year prior to allow time to fill the reservoir.

2.3 Water Facility Cost Phasing

Detailed phasing and anticipated costs of the five supply options have been created and are provided herein. Table 3 shown below compares the costs for the M&I apportioned costs of the alternatives. The costs shown in Table 3 include the allowance for either a large dam raise or short dam raise at Hagg Lake depending on the option chosen. Although, the costs and funding associated with the existing dam safety upgrades and the resultant funding anticipated by Reclamation and Tualatin Valley Irrigation District has been accounted, thereby reducing the total project values of the dam construction work to only the M&I funded portion of the project. Table 3 is only the M&I portion of the total project costs. In TM-9A, Table 1 provides the full project costs, which include all costs associated with dam improvements and water supply options costs.

Table 3. Water Supply Option Costs – Municipal and Industrial Users Only

Water Supply Option	Municipal and Industrial Capital Costs ($)	
	Year 2012 Estimate	Year 2020 Estimate
TBWSP	$ 1,007,130,000	$1,378,300,000
Willamette-Wilsonville	$ 738,503,600	$1,010,690,000
Portland Supply	$1,015,073,400	$1,389,200,000
Newberg West	$ 942,254,300	$1,289,540,000
Newberg East	$ 933,943,800	$1,278,170,000
Northern Groundwater	$ 995,911,390	$1,362,970,000

Table 4 shows the accounting of costs attributed to M&I users for the two dam raise options. The values shown at the bottom of Table 4 are used in Tables 5 through 10 for the scheduling and costing presentation of the supply options as attributed to M&I users. The basis of Table 4 is the anticipation that Reclamation will provide 85% of the value of the existing dam safety improvements, TVID would provide an additional 8.1%, leaving the M&I users to fund 6.9% of the dam safety improvement costs. Additional dam improvement or replacement costs above the value of the existing dam safety improvements would be funded by the M&I users.

Operational costs for 2012 can be found in TM-9A and should be accounted for in the Monte Carlo analysis.

Table 4. Summary of M&I Cost of Full and Short Dam Raise		
Description	**40' Dam Raise [1]**	**9' (+/-) Dam Raise[2]**
Cost for Seismic Upgrades to existing dam (from CWS in 2009 dollars)	$493,986,000	
Cost for Seismic Upgrades escalated (4% annually) to 2012 Dollars	$556,000,000	
Dam Project Cost from CWS in 2009 Dollars	$658,000,000	$434,918,290
Dam Project Cost escalated (4% annually) to 2012 Dollars	$740,000,000	$489,000,000
Reduction in Project Cost related to Federal Contribution of funds for Seismic Upgrades (-85% of $556M)	($472,600,000)	($472,600,000)
Local Project Contribution (15% of $556M)	($83,400,000)	($16,400,000)
Reduction in Project Cost related to TVID Contribution of funds for Seismic Upgrades (-54.5% of Local Contribution Cost)	($45,453,000)	($8,938,000)
Net M&I Cost Share of Dam Improvements	$221,947,000	$7,462,000
Notes: 1. The Expanded Dam (40'), with seismic improvements applies only to the TBWSP water supply option. 2. The Expanded Dam (9'+/-), with seismic improvements applies to the Willamette-Wilsonville, Portland Supply, Newberg West, Newberg East, and Northern Groundwater Supply Options.		

Tables 5 through Table 10 show the estimated cost over time for each water supply option using the phasing for each of the five water facilities described above. These tables are broken out by phase of construction or expansion. The phases of construction or expansion correspond to the increment increases as shown in Table 1.

Within each of the Tables 5 through 10, the costs for each facility are scheduled to account for the early activities of design required before construction commences, meeting the required time for service commissioning as defined in the graphics presented earlier in the TM-9C.

Table 5, the TBWSP water supply option, shows the majority of expenditures are incurred in the first phase of the three phase planned construction activities. The first phase includes construction of the 40-foot dam raise, the raw water pipeline, property acquisition, and the JWC WTP initial expansion. The WTP is further expanded in each of the following two phases and the costs are apportioned throughout those years. Transmission pipeline construction costs are included in the second phase to provide for additional supply from the expanded WTP. Alternatively, the pipelines could be constructed entirely in Phase 3.

Table 6, the Willamette-Wilsonville water supply option, shows that the majority of the cost occurs in the first phase with the water treatment plant initial construction, finish water pipeline, and terminal storage. WTP and Intake expansions then occur over the ensuing development phases.

Table 7, the Portland Supply option, shows the WTP, booster pump station, reservoir, and 1-mile of the transmission pipeline would be constructed in the first phase. Further expansions of the WTP occur in phases 2 and 3, while the remaining pipelines to provide the additional water to the WTP would be constructed in phase 2.

Tables 8 and 9, the Newberg West and East supply options, show the majority of the cost for water facilities in the initial phase, with WTP and intake capacity expansions being phased over several later phases.

Table 10, the Northern Groundwater Supply Option, shows each facility included in the initial phase, with 4 wells, raw water pipelines to the WTP, the WTP, and finish water transmission pipeline and booster pump station constructed entirely in the first phase. The WTP expansions, 4 additional wells, and additional raw water pipelines for the wellfield to the WTP are constructed incrementally in later phases.

3.0 SUMMARY

The purpose of this TM 9C is to provide a rational basis for the phasing of each water supply option to meet the projected JWC peak day water demand through year 2050. The goal is to come to agreement with the TAC team on planning-level phasing.

Table 5: TBWSP Supply Option

Project Elements	Year	Municipal and Industrial Expenditures in 2012 Dollars (Includes 30% Contingencies)														
		Non-Construction Costs					Construction Costs									
		Non-Construction Services at 20%	Easement Acquisition and Occupation Fees	Property Acquisition	Subtotal Non-Construction Costs	Non-Construction Total by Phase	40' Dam Construction[1]	Short Dam Construction	Wells	River Intake and Pumping	Water Treatment Plant	Booster Pumping Stations	20 MG Reservoir	Pipelines	Subtotal Construction Costs	Construction Total by Phase	Total Expeditures by Year
Totals to allocate without contingencies		$128,696,250		$13,000,000	$141,696,250		Too complicated to calculate			$209,062,500	$193,750,000	$3,645,833	$12,692,708	$117,083,333			
Totals to allocate with contingencies							$221,947,000			$250,875,000	$232,500,000	$4,375,000	$15,231,250	$140,500,000		$865,428,250	
Property and Easement Acquisition; Construction of the 40' Dam Raise; Design and Construction of a River Intake, 40 MGD Water Treatment Plant Expansion, and Raw Water Pipeline	2015			$6,500,000	$6,500,000	$117,514,071										$702,813,250	$6,500,000
	2016	$23,703,043		$6,500,000	$30,203,043												$30,203,043
	2017	$10,906,047			$10,906,047		$55,486,750								$55,486,750		$66,392,797
	2018	$17,658,746			$17,658,746		$55,486,750			$62,718,750	$21,796,875			$23,533,750	$163,536,125		$181,194,871
	2019	$17,658,746			$17,658,746		$55,486,750			$62,718,750	$21,796,875			$23,533,750	$163,536,125		$181,194,871
	2020	$20,264,225			$20,264,225		$55,486,750			$62,718,750	$36,328,125	$2,187,500	$7,615,625	$23,533,750	$187,870,500		$208,134,725
	2021	$14,323,265			$14,323,265					$62,718,750	$36,328,125	$2,187,500	$7,615,625	$23,533,750	$132,383,750		$146,707,015
Project Totals		$104,514,071		$13,000,000	$117,514,071		$221,947,000			$250,875,000	$116,250,000	$4,375,000	$15,231,250	$94,135,000	$702,813,250		**$820,327,321**
Design and Construction of a 20 MGD Water Treatment Plant Expansion and Finished Water Pipelines	2022					$15,538,517									$0	$104,490,000	$0
	2023	$1,553,852			$1,553,852												$1,553,852
	2024	$2,330,777			$2,330,777												$2,330,777
	2025	$4,534,159			$4,534,159						$29,062,500			$11,591,250	$40,653,750		$45,187,909
	2026	$4,534,159			$4,534,159						$29,062,500			$11,591,250	$40,653,750		$45,187,909
	2027	$1,292,785			$1,292,785									$11,591,250	$11,591,250		$12,884,035
	2028	$1,292,785			$1,292,785									$11,591,250	$11,591,250		$12,884,035
Project Totals		$15,538,517			$15,538,517						$58,125,000			$46,365,000	$104,490,000		**$120,028,517**
Design and Construction of a 20 MGD Water Treatment Plant Expansion	2035	$2,160,916			$2,160,916	$8,643,662										$58,125,000	$2,160,916
	2036	$3,241,373			$3,241,373						$29,062,500				$29,062,500		$32,303,873
	2037	$3,241,373			$3,241,373						$29,062,500				$29,062,500		$32,303,873
Project Totals		$8,643,662			$8,643,662						$58,125,000				$58,125,000		**$66,768,662**
TBWSP Supply Option Totals		$128,696,250		$13,000,000		$141,696,250	$221,947,000			$250,875,000	$232,500,000	$4,375,000	$15,231,250	$140,500,000		$865,428,250	**$1,007,124,500**

Notes: 1. The full cost of the 40' dam design/construction cost is $740,000,000 (2012 dollars), derived from the value provided by CWS of $658,000,000 (2009 dollars). Project cost shown in the construction cost column is inclusive of both non-construction services (project management, permitting, engineering, services during construction, and contingencies) and a 25% contingency as outlined by CWS. The values shown in this table indicate only the portion of costs attributed to M&I users, after 85% federal share funding and 54.5% TVID share of remainder of seismic imporvements for existing dam safety improvements.

Table 6: Willamette-Wilsonville Supply Option

Project Elements	Year	Municipal and Industrial Expenditures in 2012 Dollars (Includes 30% Contingencies)														
		Non-Construction Costs					Construction Costs									
		Non-Construction Services at 30%	Easement Acquisition and Occupation Fees	Property Acquisition	Subtotal Non-Construction Costs	Non-Construction Total by Phase	Dam Construction	Short Dam Construction[1]	Wells	River Intake and Pumping	Water Treatment Plant	Booster Pumping Stations	20 MG Reservoir	Pipelines	Subtotal Construction Costs	Construction Total by Phase	Total Expeditures by Year
Property and Easement Acquisition; Design and Construction of a River Intake Capacity Increase, 40 MGD Water Treatment Plant, Booster Pump Station, 20 MG Reservoir, and Raw and Finished Water Pipelines	2015	$7,172,923			$7,172,923	$207,187,688										$441,440,350	$7,172,923
	2016	$18,841,594	$15,468,750		$34,310,344												$34,310,344
	2017	$19,469,513	$15,468,750	$10,000,000	$44,938,263												$44,938,263
	2018	$29,305,670	$15,468,750		$44,774,420			$466,375			$17,125,063			$79,922,375	$97,513,813		$142,288,233
	2019	$29,769,422	$15,468,750		$45,238,172			$914,095			$17,125,063			$79,922,375	$97,961,533		$143,199,704
	2020	$17,447,833			$17,447,833			$3,876,509		$4,573,400	$17,125,063	$12,687,350	$7,920,250	$79,922,375	$126,104,947		$143,552,779
	2021	$13,305,733			$13,305,733			$2,205,021			$17,125,063	$12,687,350	$7,920,250	$79,922,375	$119,860,059		$133,165,791
Project Totals		$135,312,688	$61,875,000	$10,000,000	$207,187,688			$7,462,000		$4,573,400	$68,500,250	$25,374,700	$15,840,500	$319,689,500	$441,440,350		**$648,628,038**
Design and Construction of a River Intake Capacity Increase and 10 MGD Water Treatment Plant Expansion	-6	$0				$5,524,616									$0	$21,698,463	$0
	2021	$0													$0		$0
	2022	$795,610			$795,610												$795,610
	2023	$1,141,841			$1,141,841						$4,281,266				$4,281,266		$5,423,107
	2024	$1,742,795			$1,742,795						$4,281,266				$4,281,266		$6,024,061
	2025	$922,185			$922,185					$4,573,400	$4,281,266				$8,854,666		$9,776,850
	2026	$922,185			$922,185						$4,281,266				$4,281,266		$5,203,450
Project Totals		$5,524,616			$5,524,616					$4,573,400	$17,125,063				$21,698,463		**$27,223,078**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2027	$627,919			$627,919	$4,381,266									$0	$17,125,063	$627,919
	2028	$916,982			$916,982						$4,281,266				$4,281,266		$5,198,248
	2029	$1,380,734			$1,380,734						$4,281,266				$4,281,266		$5,662,000
	2030	$727,815			$727,815						$4,281,266				$4,281,266		$5,009,081
	2031	$727,815			$727,815						$4,281,266				$4,281,266		$5,009,081
Project Totals		$4,381,266			$4,381,266						$17,125,063				$17,125,063		**$21,506,328**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2033	$627,919			$627,919	$4,381,266										$17,125,063	$627,919
	2034	$916,982			$916,982						$4,281,266				$4,281,266		$5,198,248
	2035	$1,380,734			$1,380,734						$4,281,266				$4,281,266		$5,662,000
	2036	$727,815			$727,815						$4,281,266				$4,281,266		$5,009,081
	2037	$727,815			$727,815						$4,281,266				$4,281,266		$5,009,081
Project Totals		$4,381,266			$4,381,266						$17,125,063				$17,125,063		**$21,506,328**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2040					$4,381,266									$0	$17,125,063	$0
	2041	$627,919			$627,919										$0		$627,919
	2042	$916,982			$916,982						$4,281,266				$4,281,266		$5,198,248
	2043	$1,380,734			$1,380,734						$4,281,266				$4,281,266		$5,662,000
	2044	$727,815			$727,815						$4,281,266				$4,281,266		$5,009,081
	2045	$727,815			$727,815						$4,281,266				$4,281,266		$5,009,081
Project Totals		$4,381,266			$4,381,266						$17,125,063				$17,125,063		**$21,506,328**
Willamette-Wilsonville Supply Option Totals		$153,981,100	$61,875,000	$10,000,000		$225,856,100		$14,924,000		$9,146,800	$137,000,500	$25,374,700	$15,840,500	$319,689,500		$514,514,000	**$740,370,100**

Notes: 1. The full cost of the short dam design/construction cost is $489,000,000 (2012 dollars), derived from the value provided by CWS of $434,918,290 (2009 dollars). Project cost shown in the construction cost column is inclusive of both non-construction services (project management, permitting, engineering, services during construction, and contingencies) and a 25% contingency as outlined by CWS. The values shown in this table are only the portion of costs attributed to M&I users, after 85% federal share funding for existing dam safety improvements.

Table 7: Portland Supply Option

Project Elements	Year	Municipal and Industrial Expenditures in 2012 Dollars (Includes 30% Contingencies)														
		Non-Construction Costs					Construction Costs									
		Non-Construction Services at 30%	Easement Acquisition and Occupation Fees	Property Acquisition	Subtotal Non-Construction Costs	Non-Construction Total by Phase	Dam Construction	Short Dam Construction[1]	Wells	River Intake and Pumping	Water Treatment Plant	Booster Pumping Stations	20 MG Reservoir	Pipelines	Subtotal Construction Costs	Construction Total by Phase	Total Expeditures by Year
Property and Easement Acquisition; Design and Construction of a 10 MGD Water Treatment Plant, Booster Pump Station, 20 MG Reservoir, and 1 mile of Finished Water Pipeline	2015	$875,593			$875,593	$149,841,488										$87,558,409	$875,593
	2016	$875,593	$25,571,250		$26,446,843												$26,446,843
	2017	$7,135,230	$25,571,250		$32,706,480												$32,706,480
	2018	$7,135,230	$25,571,250	$4,000,000	$36,706,480										$0		$36,706,480
	2019	$7,135,230	$25,571,250		$32,706,480			$466,375			$10,168,031				$10,634,406		$43,340,887
	2020	$8,886,416			$8,886,416			$914,095			$10,168,031	$4,782,050			$15,864,176		$24,750,592
	2021	$8,886,416			$8,886,416			$3,876,509			$10,168,031	$4,782,050	$7,920,250	$7,009,842	$33,756,682		$42,643,098
	2022	$2,626,779			$2,626,779			$2,205,021			$10,168,031		$7,920,250	$7,009,842	$27,303,144		$29,929,923
Project Totals		$43,556,488	$102,285,000	$4,000,000	$149,841,488			$7,462,000			$40,672,125	$9,564,100	$15,840,500	$14,019,684	$87,558,409		**$237,399,896**
Design and Construction of a 10 MGD Water Treatment Plant Expansion and Finished Water Pipeline	2023	$6,010,344			$6,010,344	$156,758,591								$196,275,572	$196,275,572	$601,028,354	$202,285,916
	2024	$19,233,100			$19,233,100									$196,275,572	$196,275,572		$215,508,672
	2025	$32,756,373			$32,756,373						$3,050,409			$196,275,572	$199,325,981		$232,082,354
	2026	$34,923,040			$34,923,040						$3,050,409				$3,050,409		$37,973,449
	2027	$34,923,040			$34,923,040						$3,050,409				$3,050,409		$37,973,449
	2028	$28,912,696			$28,912,696						$3,050,409				$3,050,409		$31,963,105
Project Totals		$156,758,591			$156,758,591						$12,201,638			$588,826,716	$601,028,354		**$757,786,945**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2029	$390,456			$390,456	$9,550,440										$12,201,638	$390,456
	2030	$664,996			$664,996						$3,050,409				$3,050,409		$3,715,405
	2031	$2,831,663			$2,831,663						$3,050,409				$3,050,409		$5,882,072
	2032	$2,831,663			$2,831,663						$3,050,409				$3,050,409		$5,882,072
	2033	$2,831,663			$2,831,663						$3,050,409				$3,050,409		$5,882,072
Project Totals		$9,550,440			$9,550,440						$12,201,638				$12,201,638		**$21,752,077**
No construction	2040					$0									$0	$0	$0
	2041														$0		$0
	2042														$0		$0
	2043														$0		$0
Project Totals															$0		**$0**
Portland Supply Option Project Totals		$209,865,519	$102,285,000	$4,000,000		$316,150,519		$7,462,000			$65,075,400	$9,564,100	$15,840,500	$602,846,400		$700,788,400	**$1,016,938,919**

Notes: 1. The full cost of the short dam design/construction cost is $489,000,000 (2012 dollars), derived from the value provided by CWS of $434,918,290 (2009 dollars). Project cost shown in the construction cost column is inclusive of both non-construction services (project management, permitting, engineering, services during construction, and contingencies) and a 25% contingency as outlined by CWS. The values shown in this table are only the portion of costs attributed to M&I users, after 85% federal share funding for existing dam safety improvements.

Table 8: Newberg West Supply Option

Project Elements	Year	Municipal and Industrial Expenditures in 2012 Dollars (Includes 30% Contingencies)														
		Non-Construction Costs					Construction Costs									
		Non-Construction Services at 30%	Easement Acquisition and Occupation Fees	Property Acquisition	Subtotal Non-Construction Costs	Non-Construction Total by Phase	Dam Construction	Short Dam Construction[1]	Wells	River Intake and Pumping	Water Treatment Plant	Booster Pumping Stations	20 MG Reservoir	Pipelines	Subtotal Construction Costs	Construction Total by Phase	Total Expeditures by Year
Property and Easement Acquisition; Design and Construction of a River Intake, 40 MGD Water Treatment Plant, Booster Pump Station, 20 MG Reservoir, and Raw and Finished Water Pipelines	2015	$9,209,333			$9,209,333	$279,649,112										$573,248,650	$9,209,333
	2016	$24,502,709	$23,703,750		$48,206,459												$48,206,459
	2017	$25,130,627	$23,703,750	$10,000,000	$58,834,377												$58,834,377
	2018	$37,932,451	$23,703,750		$61,636,201			$466,375			$17,125,063			$110,899,750	$128,491,188		$190,127,389
	2019	$38,396,202	$23,703,750		$62,099,952			$914,095			$17,125,063			$110,899,750	$128,938,908		$191,038,860
	2020	$22,449,909			$22,449,909			$3,876,509		$12,472,200	$17,125,063	$12,687,350	$7,920,250	$110,899,750	$164,981,122		$187,431,030
	2021	$17,212,881			$17,212,881			$2,205,021			$17,125,063	$12,687,350	$7,920,250	$110,899,750	$150,837,434		$168,050,315
Project Totals		$174,834,112	$94,815,000	$10,000,000	$279,649,112			$7,462,000		$12,472,200	$68,500,250	$25,374,700	$15,840,500	$443,599,000	$573,248,650		**$852,897,762**
Design and Construction of a River Intake Capacity Increase and 10 MGD Water Treatment Plant Expansion	-6					$5,420,608									$0	$21,282,463	$0
	2021														$0		$0
	2022	$780,356			$780,356												$780,356
	2023	$1,121,386			$1,121,386						$4,281,266				$4,281,266		$5,402,652
	2024	$1,709,859			$1,709,859						$4,281,266				$4,281,266		$5,991,125
	2025	$904,503			$904,503					$4,157,400	$4,281,266				$8,438,666		$9,343,169
	2026	$904,503			$904,503						$4,281,266				$4,281,266		$5,185,769
Project Totals		$5,420,608			$5,420,608					$4,157,400	$17,125,063				$21,282,463		**$26,703,070**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2027	$627,918			$627,918	$4,381,259										$17,125,063	$627,918
	2028	$916,981			$916,981						$4,281,266				$4,281,266		$5,198,247
	2029	$1,380,732			$1,380,732						$4,281,266				$4,281,266		$5,661,998
	2030	$727,814			$727,814						$4,281,266				$4,281,266		$5,009,080
	2031	$727,814			$727,814						$4,281,266				$4,281,266		$5,009,080
Project Totals		$4,381,259			$4,381,259						$17,125,063				$17,125,063		**$21,506,322**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2033	$627,918			$627,918	$4,381,259										$17,125,063	$627,918
	2034	$916,981			$916,981						$4,281,266				$4,281,266		$5,198,247
	2035	$1,380,732			$1,380,732						$4,281,266				$4,281,266		$5,661,998
	2036	$727,814			$727,814						$4,281,266				$4,281,266		$5,009,080
	2037	$727,814			$727,814						$4,281,266				$4,281,266		$5,009,080
Project Totals		$4,381,259			$4,381,259						$17,125,063				$17,125,063		**$21,506,322**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2040					$4,381,259									$0	$17,125,063	$0
	2041	$627,918			$627,918										$0		$627,918
	2042	$916,981			$916,981						$4,281,266				$4,281,266		$5,198,247
	2043	$1,380,732			$1,380,732						$4,281,266				$4,281,266		$5,661,998
	2044	$727,814			$727,814						$4,281,266				$4,281,266		$5,009,080
	2045	$727,814			$727,814						$4,281,266				$4,281,266		$5,009,080
Project Totals		$4,381,259			$4,381,259						$17,125,063				$17,125,063		**$21,506,322**
Newberg West Supply Option Project Totals		$193,398,497	$94,815,000	$10,000,000		$298,213,497		$14,924,000		$16,629,600	$137,000,500	$25,374,700	$15,840,500	$443,599,000		$645,906,300	**$944,119,797**

Notes: 1. The full cost of the short dam design/construction cost is $489,000,000 (2012 dollars), derived from the value provided by CWS of $434,918,290 (2009 dollars). Project cost shown in the construction cost column is inclusive of both non-construction services (project management, permitting, engineering, services during construction, and contingencies) and a 25% contingency as outlined by CWS. The values shown in this table are only the portion of costs attributed to M&I users, after 85% federal share funding for existing dam safety improvements.

Table 9: Newberg East Supply Option

Project Elements	Year	Municipal and Industrial Expenditures in 2012 Dollars (Includes 30% Contingencies)															
		Non-Construction Costs					Construction Costs										
		Non-Construction Services at 30%	Easement Acquisition and Occupation Fees	Property Acquisition	Subtotal Non-Construction Costs	Non-Construction Total by Phase	Dam Construction	Short Dam Construction[1]	Wells	River Intake and Pumping	Water Treatment Plant	Booster Pumping Stations	20 MG Reservoir	Pipelines	Subtotal Construction Costs	Construction Total by Phase	Total Expeditures by Year
Property and Easement Acquisition; Design and Construction of a River Intake, 40 MGD Water Treatment Plant, Booster Pump Station, 20 MG Reservoir, and Raw and Finished Water Pipelines	2015	$9,389,526			$9,389,526	$259,697,066										$584,890,150	$9,389,526
	2016	$25,003,087	$17,842,500		$42,845,587												$42,845,587
	2017	$25,631,006	$17,842,500	$10,000,000	$53,473,506												$53,473,506
	2018	$38,694,801	$17,842,500		$56,537,301			$466,375			$17,125,063			$113,810,125	$131,401,563		$187,938,864
	2019	$39,158,554	$17,842,500		$57,001,054			$914,095			$17,125,063			$113,810,125	$131,849,283		$188,850,337
	2020	$22,892,073			$22,892,073			$3,876,509		$12,472,200	$17,125,063	$12,687,350	$7,920,250	$113,810,125	$167,891,497		$190,783,570
	2021	$17,558,018			$17,558,018			$2,205,021			$17,125,063	$12,687,350	$7,920,250	$113,810,125	$153,747,809		$171,305,826
Project Totals		$178,327,066	$71,370,000	$10,000,000	$259,697,066			$7,462,000		$12,472,200	$68,500,250	$25,374,700	$15,840,500	$455,240,500	$584,890,150		**$844,587,216**
Design and Construction of a River Intake Capacity Increase and 10 MGD Water Treatment Plant Expansion	2020					$5,420,623										$21,282,463	
	2021																
	2022	$780,358			$780,358												$780,358
	2023	$1,121,389			$1,121,389						$4,281,266				$4,281,266		$5,402,655
	2024	$1,709,864			$1,709,864						$4,281,266				$4,281,266		$5,991,129
	2025	$904,506			$904,506					$4,157,400	$4,281,266				$8,438,666		$9,343,171
	2026	$904,506			$904,506						$4,281,266				$4,281,266		$5,185,771
Project Totals		$5,420,623			$5,420,623					$4,157,400	$17,125,063				$21,282,463		**$26,703,085**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2027	$627,920			$627,920	$4,381,271										$17,125,063	$627,920
	2028	$916,983			$916,983						$4,281,266				$4,281,266		$5,198,249
	2029	$1,380,736			$1,380,736						$4,281,266				$4,281,266		$5,662,002
	2030	$727,816			$727,816						$4,281,266				$4,281,266		$5,009,082
	2031	$727,816			$727,816						$4,281,266				$4,281,266		$5,009,082
Project Totals		$4,381,271			$4,381,271						$17,125,063				$17,125,063		**$21,506,334**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2033	$627,920			$627,920	$4,381,271										$17,125,063	$627,920
	2034	$916,983			$916,983						$4,281,266				$4,281,266		$5,198,249
	2035	$1,380,736			$1,380,736						$4,281,266				$4,281,266		$5,662,002
	2036	$727,816			$727,816						$4,281,266				$4,281,266		$5,009,082
	2037	$727,816			$727,816						$4,281,266				$4,281,266		$5,009,082
Project Totals		$4,381,271			$4,381,271						$17,125,063				$17,125,063		**$21,506,334**
Design and Construction of a 10 MGD Water Treatment Plant Expansion	2040					$4,381,271									$0	$17,125,063	$0
	2041	$627,920			$627,920										$0		$627,920
	2042	$916,983			$916,983						$4,281,266				$4,281,266		$5,198,249
	2043	$1,380,736			$1,380,736						$4,281,266				$4,281,266		$5,662,002
	2044	$727,816			$727,816						$4,281,266				$4,281,266		$5,009,082
	2045	$727,816			$727,816						$4,281,266				$4,281,266		$5,009,082
Project Totals		$4,381,271			$4,381,271						$17,125,063				$17,125,063		**$21,506,334**
Newberg East Supply Option Project Totals		$196,891,502	$71,370,000	$10,000,000		$278,261,502		$14,924,000		$16,629,600	$137,000,500	$25,374,700	$15,840,500	$455,240,500		$657,547,800	**$935,809,302**

Notes: 1. The full cost of the short dam design/construction cost is $489,000,000 (2012 dollars), derived from the value provided by CWS of $434,918,290 (2009 dollars). Project cost shown in the construction cost column is inclusive of both non-construction services (project management, permitting, engineering, services during construction, and contingencies) and a 25% contingency as outlined by CWS. The values shown in this table are only the portion of costs attributed to M&I users, after 85% federal share funding for existing dam safety improvements.

Table 10: Northern Groundwater Supply Option

Project Elements	Year	Municipal and Industrial Expenditures in 2012 Dollars (Includes 30% Contingencies)															
		Non-Construction Costs					Construction Costs										
		Non-Construction Services at 30%	Easement Acquisition and Occupation Fees	Property Acquisition	Subtotal Non-Construction Costs	Non-Construction Total by Phase	Dam Construction	Short Dam Construction[1]	Wells	River Intake and Pumping	Water Treatment Plant	Booster Pumping Stations	20 MG Reservoir	Pipelines	Subtotal Construction Costs	Construction Total by Phase	Total Expeditures by Year
Property and Easement Acquisition; Design and Construction 4 Wells with pumps, 40 MGD Water Treatment Plant, Booster Pump Station, 20 MG Reservoir, and Raw and Finished Water Pipelines	2015	$9,554,290			$9,554,290	$248,394,916										$569,783,604	$9,554,290
	2016	$24,018,565	$15,266,250		$39,284,815												$39,284,815
	2017	$25,624,931	$15,266,250	$10,000,000	$50,891,181												$50,891,181
	2018	$38,081,962	$15,266,250		$53,348,212			$466,375			$32,734,975			$86,430,858	$119,632,208		$172,980,420
	2019	$39,346,261	$15,266,250		$54,612,511			$914,095	$12,025,000		$32,734,975			$86,430,858	$132,104,928		$186,717,439
	2020	$23,250,621			$23,250,621			$3,876,509	$12,025,000		$45,828,965	$15,940,600	$7,920,250	$90,070,052	$175,661,376		$198,911,996
	2021	$17,453,285			$17,453,285			$2,205,021			$45,828,965		$7,920,250	$86,430,858	$142,385,094		$159,838,379
Project Totals		$177,329,916	$61,065,000	$10,000,000	$248,394,916			$7,462,000	$24,050,000		$157,127,880	$15,940,600	$15,840,500	$349,362,624	$569,783,604		**$818,178,520**
Design and Construction 1 Additional Well, 10 MGD Water Treatment Plant Expansion, and Raw Water Pipeline	-6					$9,059,919										$35,839,674	
	2022	$1,314,121			$1,314,121												$1,314,121
	2023	$1,837,117			$1,837,117												$1,837,117
	2024	$2,862,308			$2,862,308				$3,006,250						$3,006,250		$5,868,558
	2025	$1,523,186			$1,523,186				$3,006,250		$13,093,990			$3,639,194	$19,739,434		$21,262,620
	2026	$1,523,186			$1,523,186						$13,093,990				$13,093,990		$14,617,176
Project Totals		$9,059,919			$9,059,919				$6,012,500		$26,187,980			$3,639,194	$35,839,674		**$44,899,593**
Design and Construction 1 Additional Well, 10 MGD Water Treatment Plant Expansion, and Raw Water Pipeline	2027	$1,314,121			$1,314,121	$9,059,919										$35,839,674	$1,314,121
	2028	$1,837,117			$1,837,117												$1,837,117
	2029	$2,862,308			$2,862,308				$3,006,250						$3,006,250		$5,868,558
	2030	$1,523,186			$1,523,186				$3,006,250		$13,093,990			$3,639,194	$19,739,434		$21,262,620
	2031	$1,523,186			$1,523,186						$13,093,990				$13,093,990		$14,617,176
Project Totals		$9,059,919			$9,059,919				$6,012,500		$26,187,980			$3,639,194	$35,839,674		**$44,899,593**
Design and Construction 1 Additional Well, 10 MGD Water Treatment Plant Expansion, and Raw Water Pipeline	2033	$1,314,121			$1,314,121	$9,059,919										$35,839,674	$1,314,121
	2034	$1,837,117			$1,837,117												$1,837,117
	2035	$2,862,308			$2,862,308				$3,006,250						$3,006,250		$5,868,558
	2036	$1,523,186			$1,523,186				$3,006,250		$13,093,990			$3,639,194	$19,739,434		$21,262,620
	2037	$1,523,186			$1,523,186						$13,093,990				$13,093,990		$14,617,176
Project Totals		$9,059,919			$9,059,919				$6,012,500		$26,187,980			$3,639,194	$35,839,674		**$44,899,593**
Design and Construction 1 Additional Well, 10 MGD Water Treatment Plant Expansion, and Raw Water Pipeline	2040					$9,059,919									$0	$35,839,674	$0
	2041	$1,314,121			$1,314,121										$0		$1,314,121
	2042	$1,837,117			$1,837,117										$0		$1,837,117
	2043	$2,862,308			$2,862,308				$3,006,250						$3,006,250		$5,868,558
	2044	$1,523,186			$1,523,186				$3,006,250		$13,093,990			$3,639,194	$19,739,434		$21,262,620
	2045	$1,523,186			$1,523,186						$13,093,990				$13,093,990		$14,617,176
Project Totals		$9,059,919			$9,059,919				$6,012,500		$26,187,980			$3,639,194	$35,839,674		**$44,899,593**
Northern Groundwater Supply Option Project Totals		$213,569,590	$61,065,000	$10,000,000		$284,634,590		$14,924,000	$48,100,000		$261,879,800	$15,940,600	$15,840,500	$363,919,400		$713,142,300	**$997,776,890**

Notes: 1. The full cost of the short dam design/construction cost is $489,000,000 (2012 dollars), derived from the value provided by CWS of $434,918,290 (2009 dollars). Project cost shown in the construction cost column is inclusive of both non-construction services (project management, permitting, engineering, services during construction, and contingencies) and a 25% contingency as outlined by CWS. The values shown in this table are only the portion of costs attributed to M&I users, after 85% federal share funding for existing dam safety improvements.