Appendix F
Water Supply and Production Options

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											2019 dollars							
#	No.	Name	Supply Source	Use Cate	Description	Recharge	Supply credits	Average Yield	Drought Yield	Emergency	Capital or Program Cost ($)	Annual capital cost ($/year)	O&M Cost ($/yr)	Water Purchas	Groundwat	Unit Cost	Assumptions and Notes	Sources
1	IW-0	Treated imported water from MWD	MWD imported water	Direct	Treated imported water purchased from MWD.	n/a	n/a	Varies - determined by MWD's IRP reliability tables	Varies - determined by MWD's IRP reliability tables	Specific to the type of emergency	n/a	n/a	n/a	$ 1,444	n/a	$1,500	Costs are projected to increase at approximately 2.5% per year for CIP implementation (excluding inflation), and therefore are based on the average estimated cost from 2018 to 2045, and include the WaterFix. The costs of $1,444/AF is an average for the planning period. Our model will use the time series of costs.	2018-19 and 2019/20 Proposed Biennial Budget, Ten-Year Financial Forecast
2	IW-1	Agricultural Spot Market or Long-Term Transfer	Ag water rights holder	Direct	Spot market rights transfer or long-term transfer	n/a	100%	n/a	Specific to expected shortage level. Determined by the Analysis.	Specific to the type of emergency	$ -	$ -	$ -	$ 1,600	$0	$1,600	Costs assumed to increase at approximately 3% per year, and therefore are based on the average estimated cost from 2018 to 2045, and include the WaterFix. The costs of $1,536/AF is an average for the planning period. Our model will use the time series of costs. If a "No Ca Water Fix" scenario is analyzed, costs will be increased at a 5% rate.	2018-19 and 2019/20 Proposed Biennial Budget, Ten-Year Financial Forecast
3	IW-2	Pasadena Groundwater Storage Program	MWD imported water	Recharge	Enter into agreement with MWD to store imported water in Raymond Basin	8,350 for 3 years (~25,000 AF total Put)	95% - 100% (~1% loss for 5 yrs)	n/a	23,750 to 25,000	23,750 to 25,000	$16,000,000	$1,040,000	$ 320,000	$ 1,071	$200	$1,900	-Eastside Well Collector component has already been constructed, and therefore is removed from capital - Jourdan well is expected to be abandoned; assuming an additional new well will will be needed in its place. - Put and take through new wells. - Assumes that a blend of SWP and Colorado River water will be recharged, and will meet the SNMP quality requirements - Nitrate treatment unnecessary as wells will be placed away from high nitrate areas.	2011 WIRP Appendix E Table E-1. Groundwater options meeting information about specific wells.
4	IW-3	External groundwater banking	Imported water from groundwater bank	Direct	Partner in a groundwater banking program to store SWP bank water through the MWD delivery and treatment system (e.g. Semitropic, Kern, IRWD).	n/a	n/a	n/a - expected to be a drought supply	1,100 per year over 3 years	0	$ 2,000,000	$ 130,000	$ 520,000	Included in O&M	n/a	$2,000	This would only work if the out-of-basin bank could access the SWP (i.e. not a paper exchange). Drought supply, not emergency.	2011 WIRP Appendix E Table E-1 2014 Semitropic Rate Structure for Customers
5	IW-4	Raw Imported Water Pipeline Connecting to SGVMWD's Devil Canyon-Azusa Feeder & Carson Recycled Water Pipelines	Imported water	Recharge	Partner with foothill water agencies to construct new raw imported water to recharge areas in Raymond Basin. Project known as the San Gabriel/Raymond Basin Feeder, and would extend the existing Devil Canyon-Azusa Feeder Pipeline, owned by the San Gabrial Valley Municipal Water District (a State Water Project contractor), to the San Gabriel Basin and Raymond Basin for groundwater replenishment. Phase 1 would extend the pipeline from Azusa to the Santa Anita and Sierra Madre Spreading Grounds.	1,000	100% (pumping is the same year as recharge)	1,000	0	1,000	$26,000,000	$1,690,000	$60,000	$ 964	$200	$2,900	- Assumes 12 cfs to Eaton Spreading Grounds, 6 months of the year - Imported water cost equal to 90% of MWD untreated water cost. - Costs include Phases 1 and 2 - Costs include construction of 1 new wells, assuming capacity isn't available in the existing system. - Note that partnerships will be necessary for realize the unit cost.	Foothill Water Coalition http://www.foothillwc.org/proj.html#Raymond Foothill MWD Water Resources Plan Alterantives Screening Report, January 2009
6	LSW-0	Arroyo Seco Canyon Project	Arroyo Seco Surface Water diversion rights	Recharge	The Arroyo Seco Canyon Project will remove the Arroyo Seco Headworks structure and restore the area, replace the PWP diversion structure, and construct a new sedimentation basin, 3 acres of additional spreading basins, a new recreational parking lot, and an access road. Portions of the project expected to contribute to water supply are the new diversion structure and spreading basins. This project will be completed in 4 years.	1000	80%	800	100	450	$7,400,000	$480,000	$60,000	$ -	$200	$900	Supply volumes are based on additional recharge expected with new spreading grounds. Supply recharged based on existing recharge at Arroyo Seco of 1,940 AFY (5-year rolling average) to the 13.1 acre basin, and scaled to the size of the 3 acre basin. (Tables 5-1 and 5-2 of the Groundwater Replenishment Technical Assessment) Costs reflect new spreading grounds plus new diversion facility. Assumes PWP will be able to negotiate a higher credit percentage than used for the existing spreading grounds.	- Arroyo Seco Canyon Project email - SW Options Workshop (2/7)

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7	LSW-1a	Arroyo Seco to Eaton Canyon Raw Water Pipeline	Arroyo Seco Wash	Recharge	Project to use existing old and new pipelines and a new pump to move Arroyo Seco stream water following storm events from the reservoir pool behind Devil's Gate Dam to the Eaton Spreading Grounds. This project was originally proposed by LA County and put on hold because it would have delayed the road improvements to New York Drive.	1,070	80%	860	200	860	$6,600,000	$430,000	$100,000	$ -	$200	$800	Credits: 627 AFY Would count against Pasadena's 25 cfs right to divert Arroyo Seco Canyon water Either/or with the Arroyo Seco Pump Back project County pulled the original project.	- FINAL Devil's Gate to Eaton Water Conservation Pipeline Feasibility Copy - Devil's Gate Dam and Reservoir WC Project - website - Devil's Gate to Eaton Wash Diversion - PCR - PASADENA NOW devils-gate-Eaton-canyon-pipeline - GW and RW Options Workshop (1/31)
8	LSW-1	Arroyo Seco Pump Back Project	Arroyo Seco Wash	Recharge	Project consists of developing a new pipeline from the Devil's Gate Dam to the Arroyo Seco spreading basins and installing new pumping system and controls at the dam. County estimates an average of 1,000 AFY could be used for recharge.	1,000	60%	600	0	0	$4,000,000	$260,000	$200,000	$ -	$200	$1,000	-Assumes that the project increases pumping credits and LA County will pay for the pump and the pumping power - Costs provided in "FW: Arroyo Seco Pump Back System" include cost for both the piping and spreading ground enlargement. - One additional new well added to cost for pumping additional water	- Arroyo Seco Pump Back - FW Arroyo Seco Pump Back System - SW Options Workshop (2/7)
9	LSW-4	Re-Open and Upgrade Behner WTP to use Arroyo Seco water for drinking	Arroyo Seco Surface Water diversion rights	Direct potable use	Bring Behner WTP capacity back online to treat water for potable use, with excess Arroyo Seco water to be sent to spreading basins.	n/a	n/a	860	500	Specific to the type of emergency	$7,100,000	$460,000	$360,000	$ -		$1,000	Yield assumes surface diversions will first be sent to the new treatment plant before being sent to existing spreading areas.	2011 WIRP Appendix E Table E-1
10	LSW-5	Natural infrastructure	Arroyo Seco watershed - in addition to diversion rights	Recharge	Manage land (invasive species and sediment control) in the Arroyo Seco watershed to increase overall recharge within the natural watershed by up to 5%.	200	60%	120	40	n/a	$0	$0	$50,000		$200	$600	Land management would result in an increase of 5% in natural recharge.	Need reference.
11	LAG-1	Phase 1 Nonpotable Reuse using LAG-WRP Recycled Water	LAG-WRP tertiary treated recycled water	Direct non-potable use	Construct facilities to deliver recycled water from the LAG-WRP to Pasadena to serve non-potable demands. This is the Phase 1 Project in the PWP Recycled Water Planning Study.	n/a	n/a	700	700	700	$14,400,000	$940,000	$30,000	$ 829	n/a	$2,200	Phase 1 core project from the PWP Recycled Water Feasibility Study, but does not include tunnel water as this is a separate option in the WSRP (NP-1).	PWP Recycled Water Feasibility Study. 75% Design Cost.
12	LAG-2 (screened out)	Phase 1 recycled water program plus recharge recycled water from LAG-WRP at Eaton Wash	LAG-WRP tertiary treated recycled water	Recharge	Construct facilities for Phase 1 of the NPR program, and facilities to deliver recycled water from the LAG-WRP to Eaton Wash Spreading Grounds (405 AFY) and for non-potable use (700 AFY)	405	80%	1,000	1,000	1,000	$14,400,000	$940,000	$30,000	$829	$200	$1,880	Raymond Basin SNMP sets assimilative capacity limits that will limit the amount of tertiary treated recycled water from LAG to 405 AFY. Recommend screening out. Infeasible due to SNMP assimilative capacity limits.	PWP Groundwater Replenishment Technical Assessment

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13	LAG-3a	Advanced Treatment of Recycled Water from LAG-WRP for Recharge	LAG-WRP advanced treated recycled water	Recharge	Use advanced treated water from LAG for recharge. Option would construct a distribution system to convey tertiary treated water from the LAG-WRP to Pasadena, a brine disposal system that connects to either the LA BOS or LACSD systems, an advanced water treatment plant in the Pasadena area, and a distribution system to convey the advanced treated water to Eaton Wash Spreading Grounds, and monitoring wells. Project would use an abandoned pipe as part of the conveyance to Eaton Spreading	3,200	80%	2,600	2,600	2,600	$21,800,000	$1,420,000	$3,620,000	$ 829	$200	$3,000	Assumes advanced treatment system constructed to treat tertiary water in the PWP service area. This would be an either/or with NP-1 Would include the existing pipeline too. Based on Option EW4 in the PWP Groundwater Replenishment Technical Assessment (2010). Capital cost reduced to account for reuse of abandoned pipe.	GW and RW Options Workshop (1/31) PWP Groundwater Replenishment Technical Assessment
14	LAG-3b	Advanced Treatment of Recycled Water from LAG-WRP for Direct Use	LAG-WRP advanced treated recycled water	Direct potable use	Use advanced treated water from LAG for direct use. Option would construct a distribution system to convey tertiary treated water from the LAG-WRP to Pasadena, a brine disposal system that connects to either the LA BOS or LACSD systems, an advanced water treatment plant in the Pasadena area, and a connection to the potable water distribution system.	n/a	n/a	3,200	3,200	3,200	$15,800,000	$1,030,000	$3,620,000	$ 829	$0	$2,300	Assumes advanced treatment system constructed to treat tertiary water This would be an either/or with NP-1 Would include the existing pipeline too. Cost to upgrade LAG-WRP to advanced treatment plus conveyance facilities to PWP service area.	GW and RW Options Workshop (1/31) Central Los Angeles County Regional Water Recycling Project Technical Memorandum
15	NP-1	Tunnel Water to Brookside Golf Course	Devil's Gate Tunnel and Richardson Tunnel	Direct non-potable use	Use tunnel wells for irrigation at Brookside Golf Course. Option includes the use of Devil's Gate Tunnel (238 AFY of supply) and Richardson Tunnel (195 AFY). Included in NP-3.	n/a	n/a	433	0	0	$1,100,000	$71,557	$30,000	$ -	n/a	$200	PWP has water rights to 238 AFY of tunnel water. Assumes 433 AFY available on average (from the PWP Recycled Water Plannign Study, Table 4-20). This is included as a part of NP-3, and therefore is mutually exclusive.	2011 WIRP Appendix E 2012 PWP Recycled Water Planning Study
16	NP-2	Arroyo Seco Diversions from Channel to Brookside Golf Course	Arroyo Seco stream water diversion	Direct non-potable use	Divert Arroyo Seco to Brookside golf course for irrigation to capture additional water that cannot be recharged.	n/a	n/a	550	0	550	$6,500,000	$420,000	$210,000	$ -	n/a	$1,100	771 AFY of surface water expected to be available for the project in an average year, but Golf Course demand is approximately 550 AFY. This is included as a part of NP-3, and therefore is mutually exclusive.	2011 WIRP Appendix E Table E-1
17	NP-3	Local Non-Potable Project	Tunnel water rights & well water with nitrate levels above the drinking water MCLs	Direct non-potable use for irrigation	Construct a non-potable system that uses tunnel water and high nitrate well water as an irrigation supply. The system will serve non-potable demands for irrigation (Muir High School, Robinson Park, Victory Park, Pasadena High School, Brookside Park and Golf Course, Brenner Park, Villa Park, McDonald Park, Eaton Golf Course, Marshall Fundamental and other schools and landscaped areas in Pasadena.	500	80%	1400	500	1400	$10,000,000	$650,000	$73,000	$ -	$200	$700	Note that volumes and cost estimates are very high level, and will need to be confirmed. NP-3 overlaps with NP-1 and NP-2. Would only do one.	2011 WIRP Appendix E 2012 PWP Recycled Water Planning Study
18	NP-4 (screened out)	Satellite plant to treat wastewater near the Arroyo Seco Spreading Grounds	Local wastewater	Recharge	Construct a 0.25 mgd satellite plant (including MBR) to extract and treat wastewater from the LACSD Joint Outfall, and construct shallow infiltration galleries beneath the athletic fields at John Muir High School. Will recharge approximately 280 AFY. (Alternative A-6 in the Foothill study)	280	60%	200	200	200	$7,500,000	$490,000	$130,000	$ -	$200	$3,100	Recommend screening out due to potential impacts to the plume. Otherwise, would need to consider groundwater treatment.	FMWD Water Recycling - Project Alternative Analysis

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19	NP-5	Satellite Plant to Treat Wastewater near the Eaton Wash Spreading Grounds	Local wastewater	Recharge	Construct a 0.5 mgd satellite plant (including MBR) to extract and treat wastewater from the LACSD Joint Outfall, and recharge at Eaton Wash Spreading Grounds. Will recharge approximately 560 AFY. (Alternative E-1 in the Foothill study)	560	80%	450	450	450	$9,000,000	$590,000	$220,000	$ -	$200	$2,000	Assumes efluent TDS will be sufficiently low to comply with SNMP. Assumes 1 new well.	- FMWD Water Recycling - Project Alternative Analysis - SW Options Workshop (2/7)
20	NP-6	Wastewater and Stormwater Supply Capture at Glenarm Power Plant	Local wastewater and stormwater	Direct non-potable use	Potential sources include wastewater collected in the PWP's sewer system and the City's stormwater system. The relatively large-sized sewer and storm drain conduits in the vicinity of the Glenarm Power Plant present the potential for new sources of water at a location that seems favorable for adjacent or nearby facilities.	n/a	n/a	200	200	200	$4,400,000	$290,000	$130,000	$ -	$0	$2,100	Costs are assumed to be equal to those estimated for NP-4 to construct and operate a satellite treatment plant, minus infiltration gallery cost.	- Identification of potential supply at Glenarm - GW and RW Options Workshop (1/31)
21	Grey-1	Greywater Program	Greywater	Direct potable use	Implement policies and rebates to encourage greywater use for use in drip irrigation	n/a	n/a	150	150	150	$26,000,000	$1,690,000	$820,000	$ -	n/a	$16,700	Assumes approximately 4,000 homes (~10% of single family homes). 40% of indoor water use can become greywater.	2011 WIRP Appendix E Table E-1
22	Desal-1	Ocean desalination	Ocean desal - imported water exchange	Direct potable use	Partner on ocean desalination projects with coastal agencies. PWP would enter into an exchange agreement to receive water allocation via MWD's facilities. PWP would be interested in a partnership, such as with Huntington Beach.	n/a	n/a	5000	5,000	Specific to the type of emergency	$0		$0	$ 3,200	n/a	$3,200	Partner agencies pay Capital and O&M costs. PWP to pay commodity rate from partner agencies	2011 WIRP Appendix E Table E-1
23	SW-1	Infiltration galleries	Urban runoff (dry weather and stormwater)	Recharge	This is a concept that would install infiltration galleries under the parking lots on Lake. This would need to coincide with redevelopment of the area, but funding wouldn't be available from Stormwater Assessment Fees as redevelopments aren't assessed.	9	10.50%	1	0	1	$3,900,000	$250,000	$20,000	$ -	$200	$294,100	Stormwater captured is assumed to only be rainfall falling on the parking lot area (5 acres), 21 inches per year (on average).	SW Options Workshop (2/7)
24	SW-2	Altadena Drain diversion to the Arroyo Seco Spreading Grounds	Urban runoff (dry weather and stormwater)	Recharge	This project would direct Altadena Drain storm water into the Arroyo Spreading Grounds to recharge stormwater from the storm drain system.	285	60%	171	0	171	$3,000,000	$200,000	$5,000	$ -	$200	$1,400	Altadena Drain drainage area = 1,034.6 acres Average rainfall = 22 inches/year Runoff is generated from 15% of rainfall. Assumes no new recharge or diversion facilities are needed, and therefore, no additional cost is incurred for recharge activities. One new well is assumed.	SW Options Workshop (2/7)
25	SW-3	Centralized stormwater capture & conveyance to Eaton Wash for recharge	Urban runoff (dry weather and stormwater)	Recharge	Capture stormwater around Rubio Wash and divert to Eaton Spreading Grounds.	420	80%	340	0	340	$6,100,000	$400,000	$310,000	$ -	$200	$2,300	10.5% of total recharged	2011 WIRP Appendix E Table E-1
26	SW-4	Decentralized Stormwater Recharge, Tier 1	Urban runoff (dry weather and stormwater)	Recharge	On-site stormwater capture projects for groundwater recharge to capture 50% of EWMP capture goal through a combination of LID (Ordinance, Commercial LID, Public LID, Residential LID) and green streets.	2200	10.50%	231	0	24	$39,600,000	$2,580,000	$710,000	$ -	$200	$14,400	- Capital costs are assumed to be 50% of the cost estimated for LID and green streets for Pasadena's capital cost for meeting goals of the ULAR EMWP (ULAR EWMP, Table 9-2). O&M costs are assumed to be 50% of the estimated annual O&M costs for Pasadena to meet the goals of the ULAR EMWP, and scaled according to the cost of each component. - Assumes 10 rain events per year - Assumes 1 new well	2016 ULAR EWMP

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27	SW-5	Decentralized Stormwater Recharge, Tier 2	Urban runoff (dry weather and stormwater)	Recharge	On-site stormwater capture projects for groundwater recharge to capture 100% of EWMP capture goal through a combination of LID (Ordinance, Planned LID, Public LID, Residential LID) and green streets.	4300	10.50%	452	0	61	$76,300,000	$4,960,000	$1,410,000	$ -	$200	$14,300	Capital costs are assumed to be 100% of the cost estimated for LID and green streets for Pasadena's capital cost for meeting goals of the ULAR EMWP (ULAR EWMP, Table 9-2). O&M costs are assumed to be 100% of the estimated annual O&M costs for Pasadena to meet the goals of the ULAR EMWP, and scaled according to the cost of each component. - Assumes 10 rain events per year - Assumes 1 new well	2016 ULAR EWMP
28	SW-6 (screened out)	Divert storm drain south of Eaton Wash SG to the soft bottomed channel	Stormwater	Recharge	Divert the stormdrain located at on Paloma Street between Sunny Slope Avenue and Canyon Wash Drive that is currently draining to the hard bottomed channel to the soft bottomed channel, and allow to percolate.	5	10.50%	0.5	0	0	$30,000	$2,000			$200	$4,000	Recommend screening out due to the small volume of water that would be captured. Drainage area estimated at 10 acres.	PWP Estimate
29	WUE-0	Conservation programming to meet future regulations	WUE	Direct potable use	The supply volume calculated assumes PWP will meet the 50 gpcd indoor SFR requirements using a combination of passive and active indoor conservation measures (7,800 AFY by 2045, based on assumed 92 gpcd indoor residential use).	n/a	n/a	4,500	4,500	4,500	$7,700,000	n/a	n/a	n/a	n/a	$1,700	Assumes winter indoor water use is equivalent to meeting regulations (SFR approximately 50 gpcd)	
30	WUE-1	Conservation programming to meet future regulations plus 10% additional outdoor conservation	WUE	Direct potable use	Meet the WUE-0 conservation target plus save an additional 10% outdoor conservation	n/a	n/a	6,000	6,000	6,000	$12,000,000	n/a	n/a	n/a	n/a	$2,000	Assumes WUE-0 plus additional 10% of outdoor water savings	
31	WUE-2	Conservation programming to meet future regulations plus 25% additional outdoor conservation	WUE	Direct potable use	Meet the WUE-1 conservation target plus save an additional 25% outdoor conservation	n/a	n/a	8,500	8,500	8,500	$20,400,000	n/a	n/a	n/a	n/a	$2,400	Assumes WUE-0 plus additional 25% of outdoor water savings	
32	GW-0	Well rehab and new well replacement projects, importance level 1	Groundwater	Direct potable use	Implement improvements to maintain pumping capacity by replacing well pumps and motors, and/or replacing MCC. These improvements have been assigned an importance level of 1. This project is to sretore pumping capacity to be able to pump annual groundwater rights	n/a	n/a	2,000	2,000	2,000	$6,500,000	$420,000	n/a. Assuming current O&M is sufficient.	n/a	$200	$400	Assumes groundwater will be available.	Facilities upgrades workbook

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33	GW-00	Well rehab and equipment replacement projects, importance level 2	Groundwater	Direct potable use or non potable depending on well and option triggering the rehab below	Implement improvements to maintain pumping capacity by implementing projects to upgrade piping, replace electrical service, install/replace flowmeters, install new pressure monitoring, install new site control panels at wells. These improvements will only be required if the options below (GW2, GW3) are used. These improvements have been assigned an importance level of 2. Option will also implement projects listed as "importance level 2" and categorized as improvements to energy efficiency,	n/a	n/a	1,600	1,600	1,600	$400,000	$30,000	n/a. Assuming current O&M is sufficient.	n/a	$200	$200	Assumes groundwater will be available.	Facilities upgrades workbook
34	GW-2a	Add nitrate treatment to the Monk Hill wells	Groundwater	Direct potable use (after GAC treatment at Monk Hill WTP)	Add wellhead treatment for Nitrate to Wells 52 and Ventura to be able to send to Monk Hill WTP for additional treatment. This option is mutually exclusive with GW-3 for Ventura and well 52	n/a	n/a	2,400	2,400	2,400	$7,500,000	$490,000	$490,000	n/a	$200	$600		PWP staff at GW and RW Options Workshop (1/31)
35	GW-2b	Add Nitrate, Perchlorate & Volatile Organic Compounds Treatment to the Sunset Wells	Groundwater	Direct potable use	Add wellhead treatment to wells pumping in areas of plumes currently using blending to meet water quality requirements.	n/a	n/a	3,500	3,500	3,500	$2,900,000	$190,000	$150,000	n/a	$200	$300	Volumes are based on operating capacity by pumping zone (sunset area of the Pasadena Subbasin = 3,500 AFY out of the adjudication of 5,000 AFY)	PWP staff at GW and RW Options Workshop (1/31)
36	GW-3	Connect high nitrate wells to a local non-potable system	Groundwater	Direct non-potable use	Using high nitrate wells for non-potable uses would allow for the beneficial use of groundwater without over-treatment. This option is mutually exclusive with GW-2a for Ventura and well 52 (Sheldon and Copelin will not be treated for potable)	n/a	n/a	3,200	3,200	3,200	$3,000,000	$200,000	$200,000		$200	$300	Wells identified by PWP for NPR system: Ventura, Sheldon, Copelin Assumes groundwater will be available. Project assumed to be a part of NP-3.	PWP staff at GW and RW Options Workshop (1/31)