APPENDIX L: PORTFOLIO SCORING DETAILS

As described in the main report, options were combined into groupings known as portfolios, which were scored according to the objectives and sub-objectives identified through the Water Forward process (see **Section 3.5** of the main plan report). The composition of options for each portfolio is included in **Section L.7** of this appendix. The full Water Forward plan objectives and subobjectives weighting can be found in **Table L-24** at the end of the report. The ability of each portfolio to meet each sub-objective was determined by a set of metrics, which were used to measure portfolio performance. These performance metrics fall into three broad measurement categories as follows:

1. **Quantitative Metrics** – These are measured on a continuous scale, and are based on modeling results (e.g., water availability model simulations or demand forecasting model output) or engineering cost estimates using standard practice.

2. **Purely Qualitative Metrics** – These are scored from one to five (with five being the best score), based on professional judgement and insights. The scores are first assessed at an individual demand-management or supply option level, then rolled up to create a full portfolio estimate using the average of option scores weighted by option yields. To increase differentiation between portfolios to better evaluate performance, the spread of portfolio scores was designed to span from one to five, with the other scores scaled to fall in between.

3. **Qualitative Informed by Quantitative Metrics** – These metrics were determined in one of two ways: 1) qualitative professional judgement informed by quantitative model output or engineering cost estimates, or 2) the metric was created from a mathematical index based on quantitative option-level water yield estimates multiplied by a qualitative score. These metrics were then converted to a one to five scale in the same manner as the purely qualitative metrics.

Once the metrics were developed, they were inputted to a tool known as Criterium Decision Plus (CDP). CDP is a software tool that converts metrics like those described, which each have different measurement units, into standardized scores so that the performance measures can be summarized into an overall value based on the sub-objective and objective weights. Those overall values can then be compared to evaluate overall relative performance; in the case of Water Forward, the overall portfolio scores were used to compare the relative performance of portfolios in meeting the plan objectives. This appendix provides details on how the scoring metrics were derived, summarize the assumptions used for the calculations, shows the various performance metrics that were input to CDP, and shows the CDP output for each sub-objective.

L.2 Water Supply Benefits

Water supply benefits were evaluated using two metrics: reliability and vulnerability. The reliability metric was intended to show how often modeling indicated the City would not have enough water to meet all its identified needs, while the vulnerability metric was intended to show the magnitude of shortages, if they were projected to occur. The vulnerability and reliability metrics were inputted into CDP, which generated the standardized water supply benefits scores illustrated in **Figure L-1**. More detail on how each element of the total Water Supply Benefits score was calculated is presented in the rest of this section.

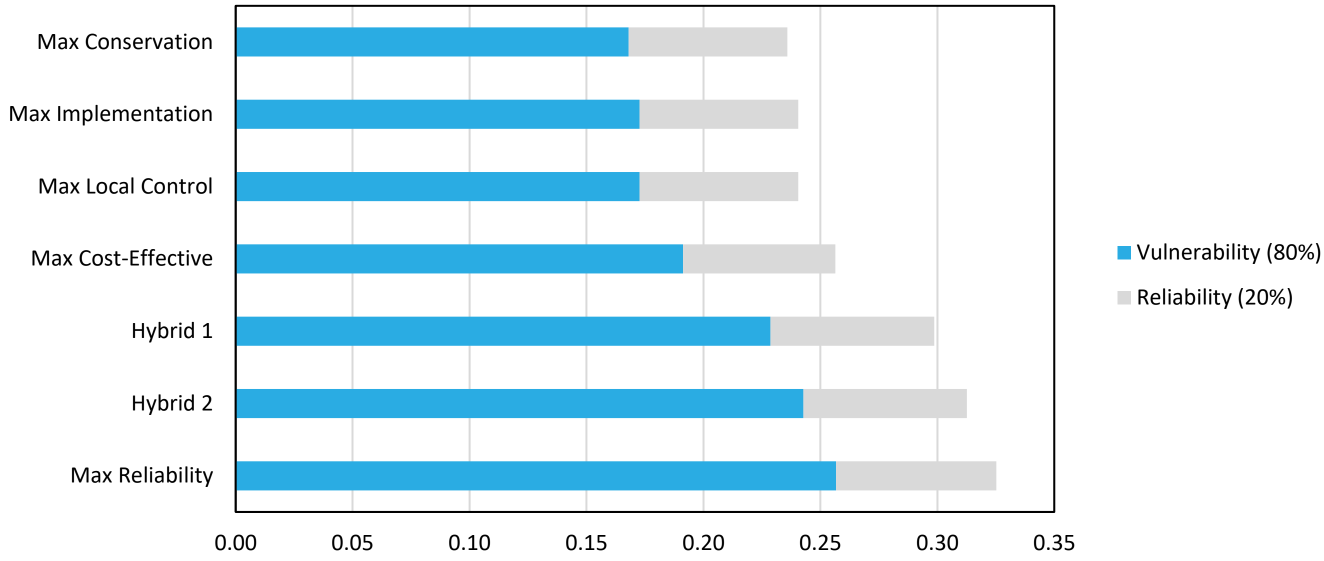


Figure L-1. Water supply benefits standardized score output from CDP

Performance metrics under the water supply benefits objective were tied to three types of City of Austin needs for water that were specific to the Water Forward planning context (the City's identified needs are described in more detail in **Appendix F**). Identified needs were calculated using output from Austin Water's Water Forward Water Availability Model (WAM). The Water Forward Water Availability Model is a computer modeling system for simulating surface water availability (see **Appendix E** for more detail). Modeling showed that regional shortages over and above City of Austin's identified needs may also be present in certain projected time horizons and hydrology scenarios. The City's identified needs do not include those potential regional shortages. For example, Hybrid 1 met all the City's identified needs and showed no additional regional shortages when modeled in the Scenario A historical period of record hydrology. Using the Scenario B period of record climate change-adjusted hydrology, however, the portfolio met all the City's identified needs while the region experienced some shortages. Austin Water plans to continue to work with our partners in the Colorado River Basin to help address these regional needs in a collaborative way to improve basin-wide reliability in the future.

For each portfolio, the model was run under hydrologic scenarios B and D (the period of record and extended period, both with climate change) for the four planning horizons: 2040, 2070, and 2115. The vulnerability metric was calculated based on the geometric mean of how much of the City's identified water needs are met during the worst 12 months of drought during Scenario B and the worst 12 months of drought in candidate droughts in Scenario D. The reliability metric was calculated as the geometric mean of the percent of months without shortage relative to identified needs during the period of simulation[1]. The results of these calculations are shown in **Table L-1**.

[1] Reliability for the extended simulation excludes months falling within periods of drought that exceed the risk of occurrence of the candidate droughts.

Table L-1 Water Supply Benefits Scoring

Portfolio	Percent of an Identified Need Met During Worst 12-Months of Candidate Drought		Percent of all Months without an Identified Need Shortage		Geometric Mean: Vulnerability	Geometric Mean: Reliability
	Scenario B	Scenario D	Scenario B	Scenario D		
Max Conservation						
2040	96%	87%	99%	99%	76%	97%
2070	96%	62%	99%	99%		
2115	67%	57%	92%	94%		
Max Cost-Effective						
2040	100%	92%	100%	100%	81%	93%
2070	95%	70%	98%	99%		
2115	72%	64%	83%	83%		
Max Reliability						
2040	96%	90%	99%	100%	95%	98%
2070	96%	94%	98%	98%		
2115	98%	98%	96%	97%		
Max Implementation						
2040	95%	82%	99%	99%	77%	97%
2070	93%	63%	98%	99%		
2115	70%	62%	91%	93%		
Max Local Control						
2040	95%	85%	99%	99%	77%	97%
2070	95%	64%	98%	99%		
2115	69%	61%	92%	94%		
Hybrid 1						
2040	100%	91%	100%	100%	89%	100%
2070	100%	73%	100%	99%		
2115	100%	74%	100%	99%		
Hybrid 2						
2040	100%	97%	100%	100%	92%	100%
2070	100%	73%	100%	99%		
2115	100%	86%	100%	99%		

Scoring Method: Quantitative

Note: These vulnerability and reliability results are focused solely on the City's identified water needs (called Type 1, 2, and 3 water needs and described in more detail in **Appendix F** being met. They do not reflect a basin-wide water supply vulnerability or reliability metric, only as defined by identified needs.

L.3 Economic Benefit Scores

The economic benefit objective was measured based on how well each portfolio met the two economic benefits sub-objectives: maximize cost-effectiveness and maximize advantageous external funding. The maximize cost-effectiveness sub-objective score was determined based on the life cycle unit cost of each portfolio, while the maximize advantageous external funding sub-objective was determined based on the potential for projects owned and operated by AW to receive outside funding and the potential for developer contribution to the cost of implementing a portfolio strategy. Detail on how each of the sub-objective scores were calculated is presented in the following sub-sections. After developing the final cost-effectiveness and advantageous external funding sub-objective score, those values were inputted to CDP, which standardized and weighted the metrics according to the sub-objective weightings developed through the Water Forward process, and produced the final economic benefits score shown in **Figure L-2**.

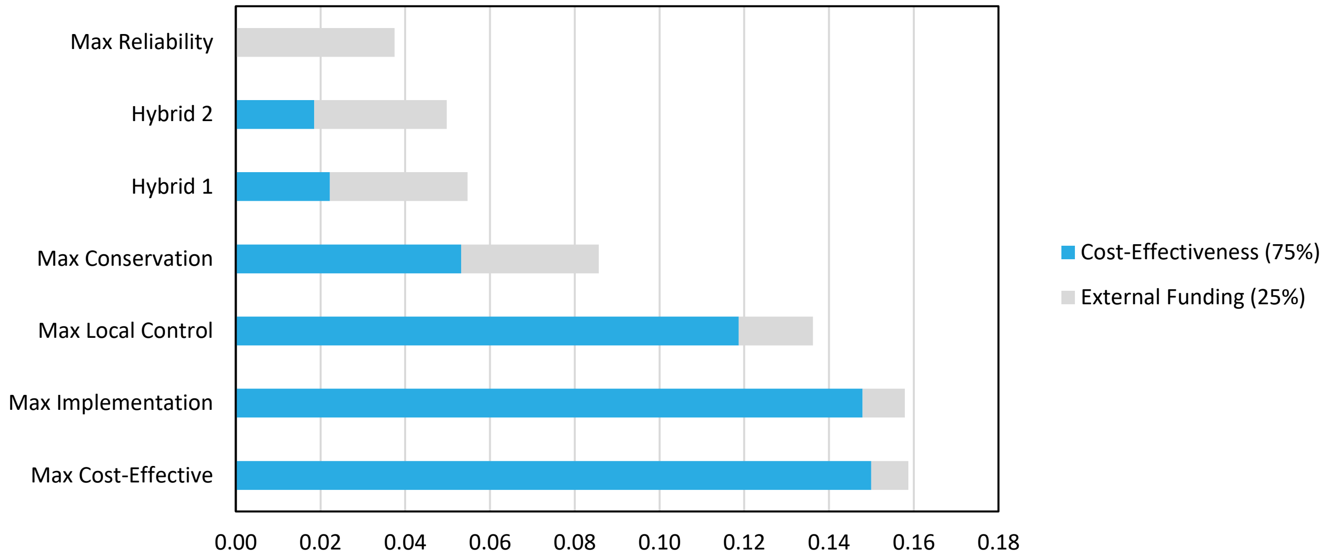


Figure L-2. Economic benefits standardized score output from CDP

L.3.1 Maximize Cost-Effectiveness

A standard method used by many water and power agencies across the country for assessing cost-effectiveness of projects is levelized unit cost (LUC). Central to the LUC method for water projects is an accounting of both fixed costs (such as construction) and variable costs (such as operations and maintenance) through the planning period, and a reflection of the actual supply need for new water rather than supply capacity. As opposed to the more commonly used capacity unit cost (CUC) method where annualized costs (both fixed and variable) are divided by supply capacity, the LUC method divides annualized costs by water supply need. Thus, the LUC method is more representative because it treats larger projects with greater economies of scale (which typically have a lower CUC) and smaller decentralized projects (which often have a larger CUC but can be developed incrementally over time) more accurately. For example, for a larger project that has a lower CUC but provides unused excess supply capacity, the LUC will be greater than the CUC and better reflect actual project use, because the denominator for estimating unit cost is based on supply need not supply capacity.

For the Water Forward evaluation process, a *simplified* LUC method was used based on the following steps:

1) For options that are assumed to be available and used on a near-constant basis, regardless of hydrological condition (i.e., all demand management options, centralized non-potable reuse, decentralized wastewater reuse, decentralized sewer mining, and community-scale stormwater and rainwater harvesting), the total unit cost was used as a basis to quantify cost-effectiveness. The option's total unit cost represents the annualized capital cost plus the annual operations and maintenance (O&M) cost, estimated using standard engineering methods and including financing costs. For each option, the unit cost was multiplied by the annual yield for each option, then those total costs were totaled for each planning horizon (2040, 2070, and 2115). Because escalating and discounting costs over 100 years is highly speculative, unit costs were not escalated or discounted,

and thus can be interpreted as current year dollars. The total unit cost for each constant-operation option is shown in **Table L-2** in the non-shaded rows.

2) For options that were assumed to be providing supply on an as-needed basis, particularly during drought periods (i.e., all storage options, indirect and direct potable reuse, brackish groundwater, imported seawater desalination, and imported groundwater), the modeled average annual water yield of the options from the WAM using Scenario B hydrology were multiplied by the annual O&M cost, while the maximum potential annual water supply yield for each option was multiplied by the annualized capital cost (with financing). These costs were then totaled for each planning horizon (2020, 2040, 2070, and 2115). The capital unit costs and O&M unit costs for these options are shown in grey in **Table L-2**.

3) Finally, the costs for each planning horizon (2020, 2040, 2070, and 2115) from steps (1) and (2) were totaled to get a total representative cost. This total representative cost should not be interpreted as a total aggregate cost for the portfolios for the 100-year planning period, as it only represents four planning horizons for the purpose of estimating the simplified LUC. The total representative water supply needs for the same four periods (2020, 2040, 2070, and 2115) were estimated based on the Water Forward Water Availability Model using hydrologic scenario B (period of record hydrology with climate change). As with costs, this total representative supply need should not be interpreted as the total aggregate supply need for the entire 100-year planning period, as it was only used for estimating the simplified LUC for portfolio evaluation. The total representative cost was then divided by the total representative supply need to estimate the simplified LUC for each portfolio. The components of this calculation are shown in **Table L-3**.

Table L-2. Total, Capital, and O&M Unit Cost for Options (Hybrid 1 Decentralized Representative Costs)

Options	Total Unit Cost ($/AF)	Capital Unit Cost ($/AF)	O&M Unit Cost ($/AF)
Advanced Metering Infrastructure	$2,800		
Water Loss Control Utility Side	$3,690		
CII Ordinances for Cooling Towers and Steam Boilers	$71		
Water Use Benchmarking and Budgeting	$21		
Landscape Transformation Ordinance	$23		
Landscape Transformation Incentives	$96		
Irrigation Efficiency Incentives	$202		
Stormwater Harvesting (Lot-Scale)	$6,470		
Rainwater Harvesting (Lot-Scale)	$2,864		
Graywater Harvesting (Lot-Scale)	$9,797		
Building Scale Wastewater Reuse (Lot-Scale)	$11,726		
AC Condensate Reuse (Lot-Scale)	$2,702		
Aquifer Storage and Recovery		$1,174	$318
Brackish Groundwater Desalination		$1,883	$807
Direct Non-Potable Reuse (Centralized Reuse – Purple Pipe)	$1,229		

Options	Total Unit Cost ($/AF)	Capital Unit Cost ($/AF)	O&M Unit Cost ($/AF)
Direct Potable Reuse		$1,455	$749
Indirect Potable Reuse with Capture Lady Bird Lake Inflows		$284	$321
Additional Supply from LCRA		$73[2]	$353
Off-Channel Reservoir w/ Lake Evaporation Suppression		$499	$347
Imported Option Category - Seawater Desalination		$1,555	$1,477
Imported Option Category - Conventional Groundwater		$845	$274
Community-Scale Distributed Wastewater Reuse	$1,295		
Community-Scale Wastewater Scalping (Sewer Mining)	$2,906		
Community-Scale Stormwater Harvesting	$4,261		
Community-Scale Rainwater Harvesting	$11,666		

Scoring Method: Quantitative

Note: Options with no table background shading are assumed to be available on a near-constant basis and use the total unit cost. Options in gray shading are used when needed or available and use capital unit cost for potential yield but only O&M cost for average modeled need. Some option costs may vary from costs presented in Appendix J due to further refinement during portfolio evaluation.

Table L-3. Simplified Life-Cycle Unit Cost Calculation by Portfolio

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Representative Cost Using Years 2020, 2040, 2070, and 2115 ($M)	$587	$738	$596	$1,346	$1,040	$1,190	$1,207
Representative Supply Need Using Years 2020, 2040, 2070, and 2115 (AF)	388,143	385,756	387,003	392,097	377,625	377,625	377,625
Simplified Levelized Unit Cost ($/AFY)	$1,513	$1,914	$1,540	$3,434	$2,753	$3,150	$3,197

Scoring Method: Quantitative

L.3.2 Maximize Advantageous External Funding

The score for maximizing advantageous funding considers two metrics: (1) the potential that a project owned and operated by Austin Water could receive outside funding (e.g. loans, grants, or other), and (2) the potential for project costs to be borne by customers/developers rather than the utility. For the outside funding component (1), each option was scored on a scale of one to five with a score of one indicating a low potential for a project to be owned and operated by Austin Water or low potential for project that would be owned and operated by Austin Water to receive outside funding, and a score of five indicating a high potential for the same situations. The score for each option is provided in **Table L-4**. Each portfolio's score for (1) was then the average of the costs weighted by the 2115 yield of each option, with results shown in **Table L-5.**

[2] For this option, this fixed cost corresponds to a reservation fee for the water

Table L-4. Qualitative Scores for Potential that a Project Owned and Operated by Austin Water Could Receive Outside Funding (e.g. Loans, Grants, or Other)

Project Options	Score	Note
Demand Side Options		
Advanced Metering Infrastructure	5	Owned by AW. Approved for SWIFT funding (low interest loans) by TWDB
Water Loss Control Utility Side	4	Owned by AW. Potential for SWIFT funding (low interest loans) from TWDB
CII Ordinances for Cooling Towers and Steam Boilers	2	Likely not owned by AW. Cost borne by customer/developer
Water Use Benchmarking and Budgeting	2	Likely not owned by AW. Cost largely borne by customer/developer (would require city staff program implementation costs)
Landscape Transformation Ordinance	2	Likely not owned by AW. Cost largely borne by customer/developer (would require city staff program implementation costs)
Landscape Transformation Incentives	1	Cost for incentive borne by AW, less likely to receive outside funding.
Irrigation Efficiency Incentives	1	Cost for incentive borne by AW, less likely to receive outside funding.
Stormwater Harvesting (Lot-Scale)	2	Likely not owned by AW. Cost potentially borne largely by customer/developer (may require city staff program implementation costs)
Rainwater Harvesting (Lot-Scale)	2	
Graywater Harvesting (Lot-Scale)	2	
Building Scale Wastewater Reuse	2	
AC Condensate Reuse (Lot-Scale)	2	
Supply Side Options		
Aquifer Storage and Recovery	3	Owned by AW and most likely AW funded. Higher potential for outside funding, for example SWIFT funding (low interest loans) from TWDB
Brackish Groundwater Desalination	1	Owned by AW and most likely AW funded. Potential for SWIFT funding (low interest loans) from TWDB.
Direct Non-Potable Reuse	5	Owned by AW. Approved for SWIFT funding (low interest loans) by TWDB for some existing projects, potential for SWIFT funding for additional components
Direct Potable Reuse	1	Owned by AW and most likely AW funded. Potential for SWIFT funding (low interest loans) from TWDB.
Indirect Potable Reuse with Capture Lady Bird Lake Inflows	1	Owned by AW and most likely AW funded. Potential for SWIFT funding (low interest loans) from TWDB.
Additional Supply from LCRA	1	Contracted by AW and most likely AW funded.
Off-Channel Reservoir w/ Lake Evaporation Suppression	1	Owned by AW and most likely AW funded. Potential for SWIFT funding (low interest loans) from TWDB.
Seawater Desalination	1	Owned by AW and most likely AW funded. Potential for SWIFT funding (low interest loans) from TWDB.
Distributed Wastewater Reuse	4	Owned by AW and most likely AW funded. Potential for SWIFT funding (low interest loans) from TWDB
Wastewater Scalping (Sewer Mining)	2	Cost potentially borne largely by customer/developer (may require city staff program implementation costs)
Community Stormwater Harvesting	2	
Community Rainwater Harvesting	2	
Conventional Groundwater	1	Owned by AW and most likely AW funded. Some project components may have potential for SWIFT funding (low interest loans) from TWDB.

Note: Future supply option implementation may consider regional partnership approaches.

Table L-5. Score for Potential that a Project Owned and Operated by Austin Water Could Receive Outside Funding (e.g. Loans, Grants, or Other) Metric

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Qualitative Score for Potential that a Project Owned and Operated by Austin Water Could Receive Outside Funding Metric	2.63	3.10	2.84	2.50	2.97	2.89	2.79

Scoring Method: Purely Qualitative

The metric for (2) potential customer/developer contribution was found by summing the unit costs of options that may have a potential for customer/developer contribution. These options were lot-scale stormwater, lot-scale rainwater, lot-scale greywater harvesting, building-scale wastewater reuse, and wastewater scalping. This calculated cost for each portfolio was then converted to a score of one to five where the portfolio with the highest total potential for developer contribution received a five, the portfolio with the lowest potential for customer/developer contribution received a one, and the other scores fall in between, as shown in **Table L-6.**

Table L-6. Score for Cost Borne by Developer Metric

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Total Cost from Options with the Potential for Developer Contribution ($M)	$0 (lowest)	$79	$13	$358 (highest)	$272	$272	$272
Qualitative Score Based on Potential for Developer Contribution (above)	1.00	1.88	1.15	5.00	4.04	4.04	4.04

Scoring Method: Qualitative Informed by Quantitative

The final score for advantageous external funding was then determined as 40% of the score for the potential that a project owned and operated by Austin Water could receive outside funding (e.g. loans) and 60% of the score for the potential for developer contribution. The sub-component and final scoring for this sub-objective is provided in **Table L-7**.

Table L-7. Score for Maximize Advantageous External Funding Sub-Objective

Scoring Element	% of Sub-Objective Score	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Qualitative Score Based on Potential that Project Owned and Operated by AW Could Receive Outside Funding	40%	2.63	3.10	2.84	2.50	2.97	2.89	2.79
Qualitative Score Based on Potential for Developer Contribution	60%	1.00	1.88	1.15	5.00	4.04	4.04	4.04
Final Maximize Advantageous External Funding Score		**1.65**	**2.37**	**1.82**	**4.00**	**3.61**	**3.58**	**3.54**

L.4 Environmental Benefit Scores

The environmental benefit score was based on portfolio performance for three sub-objectives: minimizing ecosystem impacts, minimizing net energy use and maximizing water use efficiency. The minimize ecosystem impact sub-objective was based on the volume of net diversions in each portfolio and the volume of rainwater/stormwater harvesting in each portfolio. The net energy use sub-objective looked at the annual energy use of each of each portfolio, while the water use efficiency sub-objective looked at the per-capita water use of each portfolio. The scores for each sub-objective were inputted to CDP, which produced the overall standardized environmental benefit scores shown in **Figure L-3**. More detail on how each sub-objective score was calculated is presented in the following sub-sections.

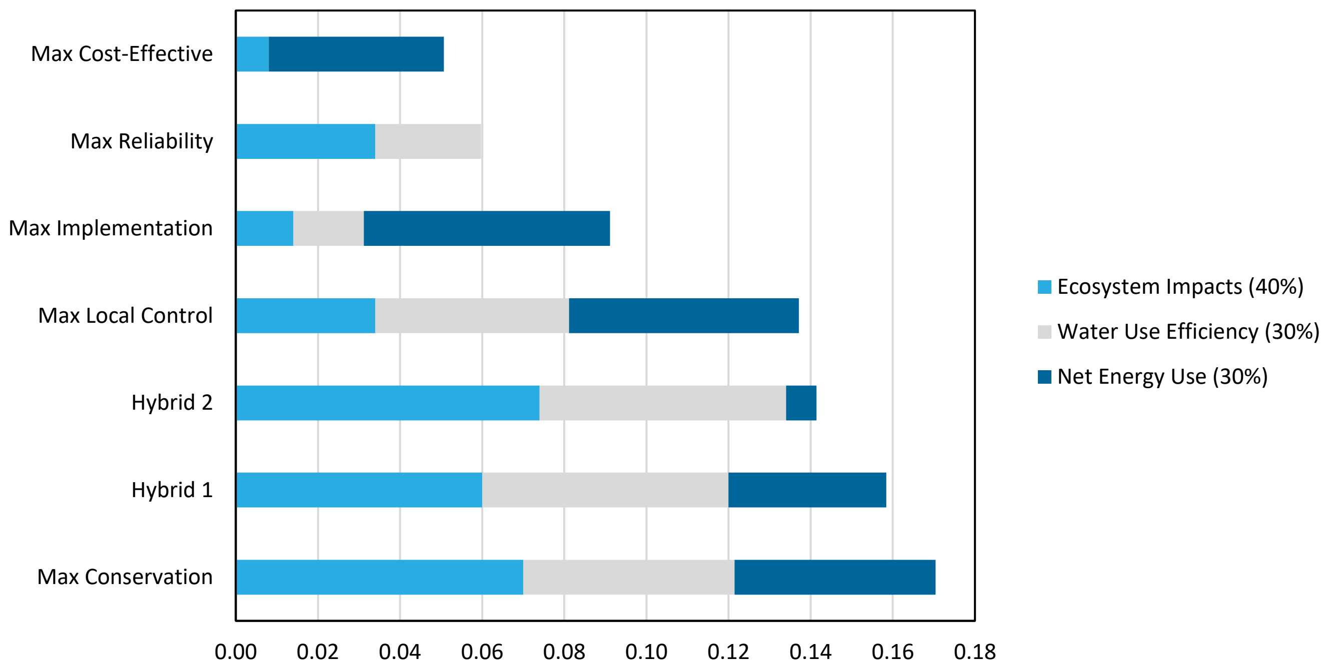


Figure L-3. Environmental benefits standardized score output from CDP

L.4.1 Minimize Ecosystem Impacts

The ecosystem impact score was based on two metrics: net diversions from the Colorado River and the volume of stormwater/rainwater harvesting in each portfolio. The net diversions volume is based on Water Forward WAM output and is equal to the total volume of modeled City of Austin diversion from the river minus the return flow from the City of Austin to the river. Therefore, a higher net diversions score means the portfolio performs more poorly for that subobjective. To score portfolios based on net diversions, an estimated annual volume of net diversions was derived for each portfolio based on the average monthly net diversion amount from WAM modeling using Scenario B for the 2040, 2070, and 2115 planning horizons and Scenario A for the 2020 planning horizon and the geometric mean of all planning horizons was calculated. The portfolio with the greatest net diversions received a score a one, the lowest received a score of five, and the other portfolios were ranked in between. The results of this method are shown in **Table L-8.**

Table L-8. Net Diversions Volume and Score

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Net Diversions (AFY)	65,684	62,843	68,268	57,851	56,962	60,453	56,179
Net Diversion Scaled Score	1.85	2.80	1.00	4.45	4.74	3.59	5.00

Scoring Method: Qualitative Informed by Quantitative

For the stormwater/rainwater capture portion of the minimize ecosystem impacts sub-objective, the volume of stormwater/rainwater capture was calculated as amount of demand offset by the stormwater and rainwater harvesting options in each portfolio. Portfolios were scored along a linear scale with zero stormwater/rainwater capture receiving a score of one and a top bound amount of stormwater/rainwater capture receiving a five (the top bound was set at 14,357 AF, which represented the largest volume of stormwater/rainwater harvesting possible due to end-use demand constraints), as shown in **Table L-9**.

Table L-9. Stormwater and Rainwater Harvesting Volume and Score

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Stormwater/Rainwater Harvesting Volume (AFY)	0	5,717	4,887	0	12,029	12,029	12,029
Stormwater/Rainwater Harvesting Volume Converted Score	1.00	2.59	2.36	1.00	4.35	4.35	4.35

Scoring Method: Qualitative Informed by Quantitative

The final minimize ecosystem impacts sub-objective score was then calculated as 50% of the net diversion score and 50% of the stormwater/rainwater harvesting score. The results of the sub-objective scoring are shown in **Table L-10**.

Table L-10. Score for Minimize Ecosystem Impacts

Scoring Element	% Sub-Obj. Score	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Net Diversion Converted Score	50%	1.85	2.80	1.00	4.45	4.74	3.59	5.00
Stormwater/Rainwater Converted Score	50%	1.00	2.59	2.36	1.00	4.35	4.35	4.35
Final Minimize Ecosystem Impacts Score		**1.43**	**2.70**	**1.68**	**2.72**	**4.55**	**3.97**	**4.68**

L.4.2 Minimize Net Energy Use

For the minimize net energy use sub-objective, the incremental change in energy use from baseline use attributed to each portfolio was used as the scoring metric. The incremental change in energy use considers the additional energy required to operate each option as well as energy savings from not having to treat water that would have been used if not for the demand offset provided by the demand management options. **Table L-11** shows the additional energy use or energy savings for each option in kWh/AF. These values were determined using the energy costs developed as part of option characterization. Some of the decentralized options show a range of energy usages, as the energy use is different depending on the scope of the option included in the portfolio. For example, lot-scale rainwater harvesting targeting just outdoor use takes less energy than rainwater harvesting targeting both indoor and outdoor uses.

Table L-11. Additional Energy Use or Savings Per Options

Project Options	Energy Use (kWh/AF)
Demand Side Options	
Advanced Metering Infrastructure	-649
Water Loss Control Utility Side	-582
CII Ordinance for Cooling Towers and Steam Boilers	-817
Water Use Benchmarking and Budgeting	-747
Landscape Transformation Ordinance	-582
Landscape Transformation Incentives	-580
Irrigation Efficiency Incentives	-574
Stormwater Harvesting (Lot-Scale)	925
Rainwater Harvesting (Lot-Scale)	463 – 1,850
Graywater Harvesting (Lot-Scale)	1,080 – 1,850
Building Scale Wastewater Reuse	1,850
AC Condensate Reuse	-581
Supply Side Options	
Aquifer Storage and Recovery	1,222
Brackish Groundwater Desalination	1,222
Direct Non-Potable Reuse	207
Direct Potable Reuse	250
Indirect Potable Reuse with Capture Lady Bird Lake Inflows	45
Additional Supply from LCRA	0
Off-Channel Reservoir w/ Lake Evaporation Suppression	145
Seawater Desalination	2,976
Distributed Wastewater Reuse	109
Wastewater Scalping (Sewer Mining)	68-77
Community Stormwater Harvesting	121-139
Community Rainwater Harvesting	0
Conventional Groundwater	1,833

A portfolio's net energy use score was then calculated as the summation of additional energy use or savings from each option in millions of kWh per year, which was determined using the unit energy cost in kWh/AF, the yield of the portfolio options, and the unit cost of energy. Since the sub-objective was to *minimize* net energy use, a lower score is relatively better for this performance measure. The final score for the minimize net energy use sub-objective are shown in **Table L-12.**

Table L-12. Final Minimize Net Energy Use Score

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Final Minimize Net Energy Use Score (millions of kWh/yr)	**124**	**66**	**48**	**315**	**97**	**144**	**282**

Scoring Method: Quantitative

L.3.3 Maximize Water Use Efficiency

The sub-objective to maximize water use efficiency was scored as the potable water use of the portfolio measured in gallons per capita per day (GPCD). To calculate GPCD, projected 2115 climate-adjusted potable water demands (based on average demands taken from the Disaggregated Demand Model –

described further in Appendix A) for each portfolio were converted to treated potable water pumpage to align with standard methods for GPCD calculation. Pumpage is an estimate of how much treated potable water is pumped from the water treatment plants, so it does not include losses incurred between the diversion point and leaving the plant. Both demand and pumpage values are shown in the following table. Once pumpage values were obtained, that volume was divided by the projected 2115 population and the number of days in a year to find the projected average city-wide total GPCD for each portfolio in 2115. For this performance measure, a lower score is better since it indicates more efficient use of potable water. The scoring for this performance metric is shown in **Table L-13**.

Table L-13. Score for Maximize Water Use Efficiency (based on 2115 projections)

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Projected 2115 Potable Water Demands (AFY)	363,983	313,595	345,181	336,090	306,797	296,197	296,197
Estimated 2115 Pumpage (AFY)	354,005	304,999	335,718	326,877	298,387	288,078	288,078
Final Maximize Water Use Efficiency Score (Projected GPCD)	**79**	**68**	**75**	**73**	**67**	**65**	**65**

Scoring Method: Quantitative

Note: Projected AW served population in 2115 is 3,977,380.

L.5 Social Benefit Scores

The social benefit objective score was based on scores for three sub-objectives: maximizing multi-benefit infrastructure, maximizing net benefits to the local economy, and maximizing social equity and environmental justice. The scores for each of these sub-objectives are based on metrics that measure relative portfolio performance and which are described in more detail in the following sub-sections. The raw scores for each social benefit sub-objective were inputted to CDP, and the standardized total social benefits score output from CDP is shown in **Figure L-4**.

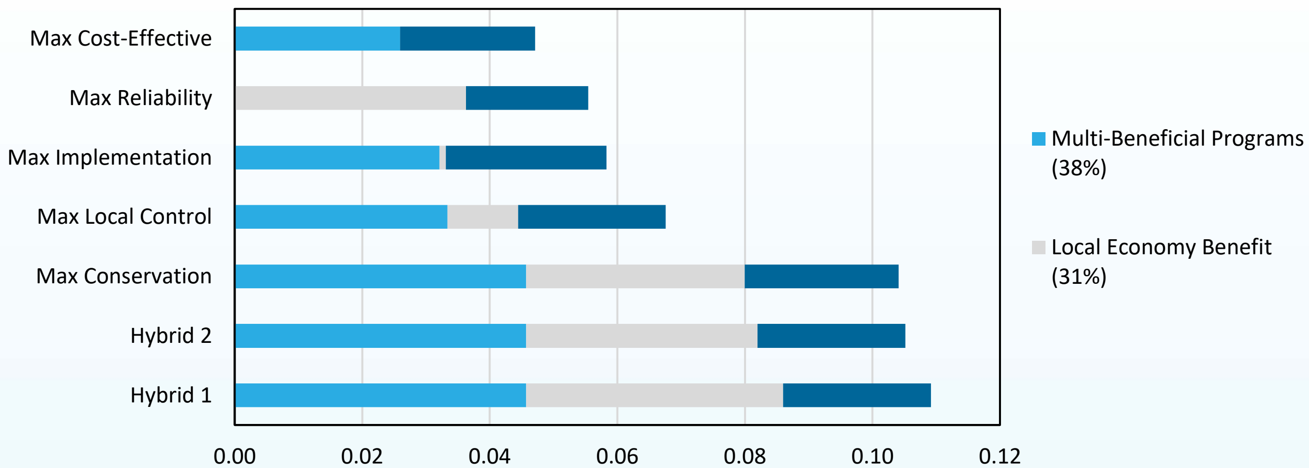


Figure L-4. Social benefits standardized score output from CDP

L.4.1 Maximize Multi-Benefit Infrastructure / Programs

Stormwater harvesting, rainwater harvesting, and options that provide landscape transformation benefits were used as a proxy for representing multi-benefit infrastructure. The total demand reduction or supply yield of these options was summed for each portfolio, and then assigned a score of one through five. A score of one indicated that a portfolio had no demand reduction or supply coming from multi-benefit infrastructure proxies, while a score of five indicated a portfolio which fully utilized all the multi-benefit infrastructure proxies (resulting in a demand-constrained yield of 30,336 AFY in 2115). The scoring for this performance metric is shown in **Table L-14**.

Table L-14. Score for Multi-Benefit Infrastructure

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Total Yield from Options that Focus on Stormwater, Rainwater, Landscaping (Proxies for Multi-Benefit Infras.) (AFY)	15,979	20,767	19,937	0	28,009	28,009	28,008
Final Score for Multi-Benefit Infrastructure	**3.11**	**3.74**	**3.63**	**1.00**	**4.69**	**4.69**	**4.69**

Scoring Method: Qualitative Informed by Quantitative

L.4.2 Maximize Net Benefits to Local Economy

While all options characterized for Water Forward would likely contribute some benefit to the local economy, this sub-objective focused on those options with the highest potential to generate local economic activity. This could be through options having significant locally-based construction and ongoing operations, or through the development of new and innovative water-focused industries. Options considered to bring significant benefit to the local economy are listed in **Table L-15**.

Table L-15. Relative Levels of Potential Benefit to the Local Economy

Project Options	Potential Level of Impact to Local Economy
Demand Side Options	
Advanced Metering Infrastructure	Some Benefit
Water Loss Control Utility Side	Some Benefit
CII Ordinance for Cooling Towers and Steam Boilers	Some Benefit
Water Use Benchmarking and Budgeting	Some Benefit
Landscape Transformation Ordinance	Some Benefit
Landscape Transformation Incentives	Some Benefit
Irrigation Efficiency Incentives	Some Benefit
Stormwater Harvesting (Lot)	**Significant Benefit**
Rainwater Harvesting (Lot)	**Significant Benefit**
Graywater Harvesting (Lot)	**Significant Benefit**
Building Scale Wastewater Reuse	**Significant Benefit**
AC Condensate Reuse	**Significant Benefit**
Supply Side Options	
Aquifer Storage and Recovery	**Significant Benefit**
Brackish Groundwater Desalination	**Significant Benefit**
Direct Non-Potable Reuse	Some Benefit
Direct Potable Reuse	**Significant Benefit**
Indirect Potable Reuse with Capture Lady Bird Lake Inflows	Some Benefit
Additional Supply from LCRA	Some Benefit
Off-Channel Reservoir w/ Lake Evaporation Suppression	**Significant Benefit**
Seawater Desalination	Some Benefit
Distributed Wastewater Reuse	**Significant Benefit**

Project Options	Potential Level of Impact to Local Economy
Wastewater Scalping (Sewer Mining)	**Significant Benefit**
Community Stormwater Harvesting	Some Benefit
Community Rainwater Harvesting	Some Benefit
Conventional Groundwater	Some Benefit

The demand reduction or supply yield from each of the options that have the highest potential for providing significant benefit to the local economy was multiplied by its unit cost and then the totals were summed for each portfolio. These total dollar figures were then converted to a one to five scale, with a score of one going to the lowest total, a score of five going to the highest total, and the other portfolios falling in between as shown in **Table L-16**.

Table L-16. Score for Net Benefits to the Local Economy

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Potential Contributions to Economic Benefit ($M)	$143	$245	$157	$480	$462	$523	$485
Final Score for Net Benefits to the Local Economy	**1.00**	**2.07**	**1.14**	**4.55**	**4.36**	**5.00**	**4.60**

Scoring Method: Qualitative Informed by Quantitative

L.4.3 Maximize Social Equity and Environmental Justice

The social equity score is based on an Equity Analysis Worksheet provided by the City of Austin Equity Office. This worksheet is an adaptation of the Equity Assessment Tool, which lays out a process and a set of questions to guide city departments in evaluating policies, practices, budget allocations, and programs and begin addressing their role and impacts on equity. This worksheet was created to assist the City in thinking through the potential impact on equity of a specific project. As with the Equity Assessment Tool, this worksheet leads with race, as it is the primary predictor of access, outcomes, and opportunities for all quality of life indicators. The adapted Equity Analysis Worksheet is shown in **Table L-18**.

In the future, Austin Water will continue to work with other City departments to strengthen the tools and datasets needed to perform this type of evaluation. Austin Water has also engaged in broad public outreach (attending and presenting at over 80 outreach events) and will continue to work with the community during subsequent phases of the Water Forward initiative to incorporate a social equity lens into project implementation.

Each option is scored within each category and then summed into a total composite score. The lowest composite score is converted to a score of one and the highest converted to a five, with the portfolios falling in between assigned relative scores rounded to the nearest integer. This scoring is shown in **Table L-19**. The portfolios are then assigned a final score based on a water yield-weighted average of their options, as shown below in **Table L-17.**

Table L-17. Score for Maximize Social Equity and Environmental Justice

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Final Scaled Score for Social Equity and Environmental Justice	**3.07**	**3.31**	**3.49**	**2.85**	**3.36**	**3.30**	**3.30**

Scoring Method: Qualitative Informed by Quantitative

Table L-18. Detailed Score for Net Benefits to the Local Economy

<table>
<tr><th>Score</th><th>Alignment</th><th>History</th><th>Data</th><th>Community Engagement</th><th>Advancing Equity</th><th>Unintended Outcomes</th><th>Impact</th><th>Access to Benefits</th></tr>
<tr><td>1</td><td>No connection between the option and desired outcomes</td><td>There are needed strategies and resources to ensure equity to marginalized populations</td><td>Option is not supported by disaggregated data on racial inequities</td><td>Communities of color have not been engaged or have not been engaged appropriately or effectively</td><td colspan="2" rowspan="3">These categories were scored up to six points based on the number of Council strategic outcomes that were either positively or negatively impacted by each option.
Economic Opportunity
Mobility
Safety
Health
Cultural and Learning Opportunities
Government that Works</td><td>Potential negative impacts for people of color</td><td>Low potential for people of color to access benefits from the option</td></tr>
<tr><td>2</td><td>Unclear if there is a connection between the option and desired outcomes</td><td>No historical events have caused racial disparities or social exclusion to marginalized communities</td><td>Data reflect no impact on equity; not a racial issue</td><td>Communities of color are not affected by the option</td><td>Neutral impacts for people of color</td><td>Medium potential for people of color to access benefits from the option</td></tr>
<tr><td>3</td><td>Clear connection between the option and desired outcomes</td><td>Option identifies and will address unintended consequences to communities of color</td><td>Option addresses inequities validated by disaggregated racial disparity data</td><td>Communities of color have been actively and effectively engaged</td><td>Potential positive impacts for people of color</td><td>High potential for people of color to access benefits from the option</td></tr>
<tr><td>Notes</td><td>All options received a score of three based on an assumption that option implementation would seek to align clearly with desired outcomes.</td><td>All options received a score of two based on an assumption that option implementation would at least seek to have no historical racial impact.</td><td>No scores were added for this category due to lack of data.</td><td>All options scored as a three based on assumption was that this score applies to the plan development process. There will be additional community engagement to follow during the plan implementation phase.</td><td></td><td></td><td></td><td>This was a new category added to the Water Forward social equity scoring framework to address those options that had a limited spatial reach.</td></tr>
</table>

Table L-19. Social Equity and Environmental Justice Option Scoring

Project Option	Alignment	History	Data	Community Engagement	Advancing Equity*	Unintended Outcomes*	Impact	Access to Benefits	Total Composite Score	Converted Score
Demand Side Options										
Advanced Metering Infrastructure	3	2	-	3	3 (Health, GTW, C&LO)	6	3	3	23	**5**
Water Loss Control Utility Side	3	2	-	3	3 (Health, GTW, Safety)	6	3	3	23	**5**
CII Ordinances for Cooling Towers and Steam Boilers	3	2	-	3	2 (Health, EO)	5 (EO)	3	2	20	**3**
Water Use Benchmarking and Budgeting	3	2	-	3	3 (Health GTW, EO)	5 (EO)	3	3	22	**4**
Landscape Transformation Ordinance	3	2	-	3	2 (Health, EO)	5 (EO)	3	3	21	**4**
Landscape Transformation Incentives	3	2	-	3	2 (Health, EO)	6	3	3	22	**4**
Irrigation Efficiency Incentives	3	2	-	3	2 (Health, EO)	6	3	3	22	**4**
Stormwater Harvesting (Lot)	3	2	-	3	3 (Health, EO, C&LO)	5 (Safety)	2	2	20	**3**
Rainwater Harvesting (Lot)	3	2	-	3	3 (Health, EO, C&LO)	5 (Safety)	2	2	20	**3**
Graywater Harvesting (Lot)	3	2	-	3	3 (Health, EO, C&LO)	5 (Safety)	2	2	20	**3**
Building Scale Wastewater Reuse	3	2	-	3	3 (Health, EO, C&LO)	5 (Safety)	2	2	20	**3**
AC Condensate Reuse	3	2	-	3	3 (Health, EO, C&LO)	5 (Safety)	2	2	20	**3**
Supply Side Options										
Aquifer Storage and Recovery	3	2	-	3	2 (Health, Safety)	6	3	3	22	**4**
Brackish Groundwater Desalination	3	2	-	3	1 (Health)	5 (Safety)	2	3	19	**2**
Direct Non-Potable Reuse	3	2	-	3	2 (Health, C&LO)	5 (Safety)	3	2	20	**3**
Direct Potable Reuse	3	2	-	3	1 (Health)	5 (Safety)	2	2	18	**2**
Indirect Potable Reuse with Capture Lady Bird Lake Inflows	3	2	-	3	1 (Health)	5 (Safety)	2	3	19	**2**
Additional Supply from LCRA	3	2	-	3	1 (Health)	6	3	3	21	**4**
Off-Channel Reservoir w/ Lake Evaporation Suppression	3	2	-	3	2 (Health, Safety)	6	1	3	20	**3**
Seawater Desalination	3	2	-	3	2 (Health, Safety)	5 (Safety)	2	3	20	**3**
Distributed Wastewater Reuse	3	2	-	3	2 (Health, C&LO)	5 (Safety)	1	2	18	**2**
Wastewater Scalping (Sewer Mining)	3	2	-	3	2 (Health, EO)	5 (Safety)	1	2	18	**2**
Community Stormwater Harvesting	3	2	-	3	2 (Health, EO)	5 (Safety)	2	2	19	**2**
Community Rainwater Harvesting	3	2	-	3	2 (Health, EO)	5 (Safety)	2	2	19	**2**
Conventional Groundwater	3	2	-	3	2 (Health, EO)	5 (Safety)	1	2	17	**1**

* EO = Economic Opportunity; C&LO = Cultural and Learning Opportunities; GTW = Government That Works

L.6 Implementation Benefit Scores

The implementation benefit objective scores were based on input from two sub-objectives: the potential risk associated with a portfolio of options option and what volume of demand reduction or water supply is considered to be under local control or a local resource. Metrics for these sub-objectives were inputted to CDP, which produced the final standardized implementation benefit scores shown in **Figure L-5**. More detail is presented in the sub-sections below.

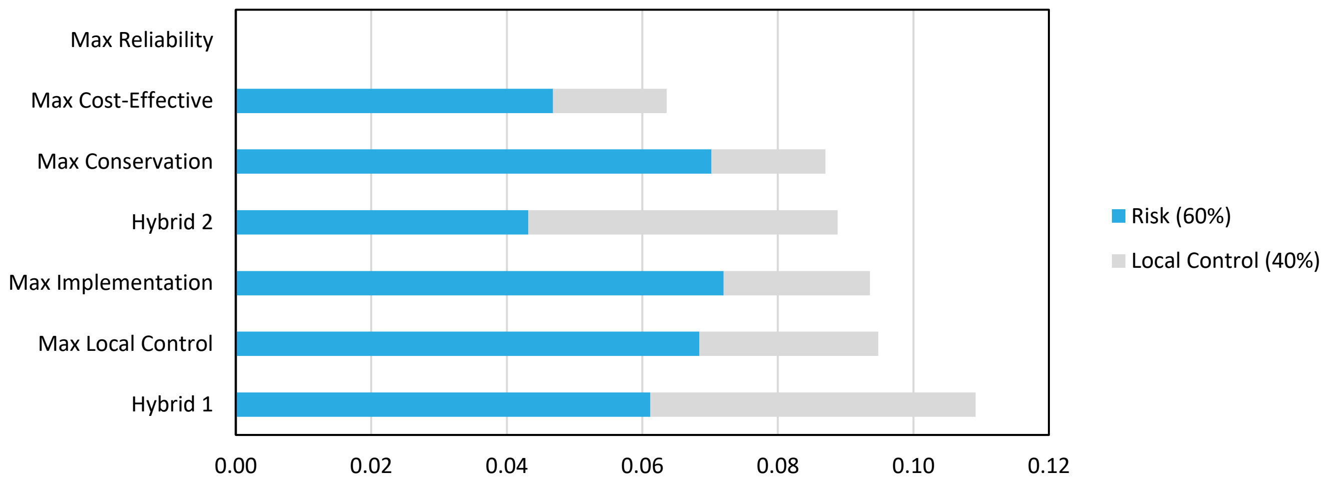


Figure L-5. Implementation benefits standardized score output from CDP

L.5.1 Risk Potential

The risk potential sub-objective score is based on the percentage of a portfolio's demand reduction or supply yield coming from higher-risk options. For each option, ten different risk types were considered, and a point was awarded for each type of risk the option may experience. The risks included: institutional challenges, public/developer opposition, scalability issues after initial construction, geographic/distribution limitations, permitting/regulatory difficulties, potential for infrastructure failure, supply/saving uncertainties, operations and maintenance (O&M) challenges, siting/land acquisition challenges, and emerging technology challenges. **Table L-21** shows the risk scoring for each option. Nine options received a risk score of four through seven and were considered the higher-risk options.

The percentage of yield coming from the higher-risk options was calculated for each portfolio and was then converted into a score of one to five, with a score of five going to the portfolio with the lowest percentage of higher-risk options, and a score of one being assigned to the portfolio with the highest percentage. The scoring for the risk potential performance metric is shown in **Table L-20**.

Table L-20. Score for Risk Potential

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Yield from Higher-Risk Options (AFY)	65,000	27,255	20,000	157,189	23,662	49,662	93,662
Higher-Risk Option Yield as % of Portfolio Total Yield	23%	10%	7%	54%	9%	14%	26%
Final Scaled Score for Risk Potential	**3.64**	**4.74**	**5.00**	**1.00**	**4.83**	**4.40**	**3.38**

Scoring Method: Qualitative Informed by Quantitative

Table L-21. Risk Scores Used to Determine Higher-Risk Options

Project Option		Institutional Challenge	Public / Developer Opposition	Scalability Issue After Initial Const.	Geographic / Distribution Limitations	Permitting / Regulatory Difficulty	Infrastructure Failure	Supply / Saving Uncertainty	O&M Challenges	Siting / Land Acquisition	Emerging Technology	Total Risk Score
S8a	Imported Option Category – Seawater Desalination	1	0	1	0	1	1	0	1	1	1	**7**
S8b	Imported Option Category – Conventional Groundwater	1	1	0	0	1	1	1	1	1	0	**7**
S4	Direct Potable Reuse	1	1	0	0	1	0	0	1	1	1	**6**
D11	Building Scale Wastewater Reuse	0	1	0	1	1	0	0	1	0	1	**5**
S12	Community Rainwater Harvesting	1	1	0	1	0	0	1	1	0	0	**5**
S2	Brackish Groundwater Desalination	1	0	0	0	1	0	0	1	1	0	**4**
S5	Indirect Potable Reuse with Capture Lady Bird Lake Inflows	0	1	0	0	1	0	0	0	1	1	**4**
S11	Community Stormwater Harvesting	1	0	0	1	0	0	1	1	0	0	**4**
S10	Wastewater Scalping (Sewer Mining)	0	0	0	1	1	0	0	1	0	1	**4**
D4	Water Use Benchmarking/Budgeting	1	0	0	0	0	0	1	0	0	1	**3**
D8	Stormwater Harvesting (Lot)	0	1	0	0	0	0	1	1	0	0	**3**
D9	Rainwater Harvesting (Lot)	0	1	0	0	0	0	1	1	0	0	**3**
D10	Graywater Harvesting (Lot)	0	1	0	1	0	0	0	1	0	0	**3**
S1	Aquifer Storage and Recovery	0	0	0	0	0	0	0	1	1	1	**3**
S6	Additional Supply from LCRA	1	0	1	0	0	0	1	0	0	0	**3**
S7	Off-Channel Reservoir w/ Lake Evap. Suppression	0	0	1	0	1	0	0	0	1	0	**3**
S9	Distributed Wastewater Reuse	0	0	0	1	1	0	0	1	0	0	**3**
D1	Advanced Metering Infrastructure	0	0	0	0	0	0	0	1	0	1	**2**
D2	Water Loss Control Utility Side	0	0	0	0	0	0	0	1	0	1	**2**
D5	Landscape Transformation Ordinance	0	1	0	0	0	0	1	0	0	0	**2**
S3	Direct Non-Potable Reuse	0	1	0	1	0	0	0	0	0	0	**2**
D6	Landscape Transformation Incentives	0	0	0	0	0	0	1	0	0	0	**1**
D7	Irrigation Efficient Incentives	0	0	0	0	0	0	1	0	0	0	**1**
D12	AC Condensate Reuse	0	0	0	0	0	0	0	1	0	0	**1**
D3	CII Ordinance for Cooling Towers and Steam Boilers	0	0	0	0	0	0	0	0	0	0	**0**

Note: Options in light gray were considered the higher-risk options.

L.5.2 Local Control / Local Resource

The local control/local resource score was based on two components: (1) yield from options where AW will control the implementation and operation (local control), and (2) yield from options sited locally (local resource). The options which were considered a part of these two groups are shown in **Table L-22**.

Table L-22. Options Considered Under AW Control and as a Local Resource

Project Options	Option Projected to be Implemented and Operated by Austin Water?	Option Considered a Local Water Resource?
Demand Side Options		
Advanced Metering Infrastructure	Yes	Yes
Water Loss Control Utility Side	Yes	Yes
CII Ordinances for Cooling Towers and Steam Boilers	Yes	Yes
Water Use Benchmarking and Budgeting	Yes	Yes
Landscape Transformation Ordinance	Yes	Yes
Landscape Transformation Incentives	Yes	Yes
Irrigation Efficiency Incentives	Yes	Yes
Stormwater Harvesting (Lot)		Yes
Rainwater Harvesting (Lot)		Yes
Graywater Harvesting (Lot)		Yes
Building Scale Wastewater Reuse		Yes
AC Condensate Reuse		Yes
Supply Side Options		
Aquifer Storage and Recovery	Yes	Yes
Brackish Groundwater Desalination	Yes	
Direct Non-Potable Reuse	Yes	Yes
Direct Potable Reuse	Yes	Yes
Indirect Potable Reuse with Capture Lady Bird Lake Inflows	Yes	Yes
Additional Supply from LCRA		Yes
Off-Channel Reservoir w/ Lake Evaporation Suppression	Yes	Yes
Seawater Desalination	Yes	
Distributed Wastewater Reuse	Yes	Yes
Wastewater Scalping (Sewer Mining)		Yes
Community Stormwater Harvesting		Yes
Community Rainwater Harvesting		Yes
Conventional Groundwater	Yes	

The total yield or demand management savings for options anticipated to be under AW control and for local resources was determined for each portfolio and the two values were summed. This total demand management and supply yield volume for each portfolio was then converted to a score of one to five, with five being assigned to the portfolios with the highest totals. The final scoring for the local control / local resource sub-objective is shown in **Table L-23**.

Table L-23. Detailed Score for Local Control / Local Resource

Scoring Element	Max Cost-Effectiveness	Max Control	Max Implem.	Max Reliability	Max Conserv.	Hybrid 1	Hybrid 2
Yield from Options that AW will Control (AFY)	233,065	282,537	281,629	195,118	267,979	328,579	302,752
Yield from Options that are Local Water Resources (AFY)	247,088	234,978	215,765	242,147	209,148	275,748	319,748
Sum of Yields from Local Control/Local Resource (AFY)	480,153	517,515	497,395	437,264	477,127	604,327	622,500
Final Scaled Local Control / Local Resource Score	**1.93**	**2.73**	**2.30**	**1.00**	**1.86**	**4.61**	**5.00**

Scoring Method: Qualitative Informed by Quantitative

Table L-24. Water Forward Integrated Water Resources Plan Objectives

Primary Objective	Objective Weight	Sub-Objective	Defining Question	Performance Measure	Sub-Objective Weight
Water Supply Benefits	35%	Minimize Water Supply Vulnerability	How does the portfolio perform in terms of how large are shortages under various hydrologic conditions, including climate change scenarios?	Percent of shortage compared to demand during drought based on WAM modeling results	28%
		Maximize Water Supply Reliability	How does the portfolio perform in terms of how often is there a shortage under various hydrologic conditions, including climate change scenarios?	Percent of time a shortage occurs based on WAM modeling results	7%
Economic Impacts	20%	Maximize Cost-Effectiveness	What is the total capital (construction) and operations/maintenance costs of all projects/programs in the portfolio over the lifecycle, divided by the sum of all water yield produced by the portfolio?	Unit cost ($/AF) expressed as a present value sum of all costs over the lifecycle, including utility and customer costs.	15%
		Maximize Advantageous External Funding	Does the portfolio have an opportunity for advantageous external funding from Federal, State, local, and private sources?	External Funding Score (1-5), where 1 = low potential and 5 = high potential	5%
Environmental Impacts	20%	Minimize Ecosystem Impacts	To what extent does the portfolio positively or negatively impact receiving water quality (e.g., streams, river, lakes), terrestrial and aquatic habitats throughout Austin, and net streamflow effects both upstream and downstream from Austin?	Ecosystem Impact Score (1-5), where 1 = high combined negative impacts and 5 = high combined positive impacts	8%
		Minimize Net Energy Use	What is the net energy requirement of the portfolio, considering energy generation?	Incremental net change in kWh	6%
		Maximize Water Use Efficiency	What is the reduction in potable water use from water conservation, reuse and rainwater capture for the portfolio?	Potable per capita water use (gallon/person/day)	6%
Social Impacts	13%	Maximize Multi-Benefit Infrastructure/Programs	To what extent does the portfolio provide secondary benefits such as enhanced community livability/beautification, increased water ethic, ecosystem services, or others?	Multiple Benefits Score (1-5), where 1 = low benefits and 5 = high benefits	5%
		Maximize Net Benefits to Local Economy	To what extent does the supply reliability and water investments of the portfolio protect and improve local economic vitality, including permanent job creation?	Local Economy Score (1-5), where 1 = high negative impact and 5 = high positive impact	4%
		Maximize Social Equity and Environmental Justice	To what extent does the portfolio support social equity and environmental justice, with emphasis on underserved communities? (see accompanying reference slide)	Social Equity and Environmental Justice Score (1-5), where 1 = significant support and 5 = minimal support	4%
Implementation Impacts	12%	Minimize Risk	What major implementation and operational risks and uncertainties will the portfolio face?	Risk Score (1-5), where 1 = high combined risks and uncertainties and 5 = low combined risks and uncertainties	7%
		Maximize Local Control	To what extent does AW have control over the quantity and storage of water and operation of options (especially during drought periods) included in the portfolio?	Measured by assessing both AW's control over operations of resource and whether resource resides within the local area	5%

This page intentionally left blank.

L.7 Portfolio Composition Summary

	#	Options	Decentralized Option Parameters							Maximize Conservation and Environmental Stewardship							
			Sub-Option / Scenario	SFR	MFR	COM	COA	End Uses	Type of New Development Option Applies To	On?	Implement. Year	Decent. Saturation Rate	2020 Yield (AF/Yr)	2040 Yield (AF/Yr)	2070 Yield (AF/Yr)	2115 Yield (AF/Yr)	2115 Unit Cost ($/AF/Yr)
Demand Management Options	D1	AMI								✔	2020		596	3,882	5,766	9,371	$ 2,799
	D2	Water Loss Control								✔	2020		3,108	9,326	10,918	13,064	$ 5,187
	D3	CII Ordinances								✔	2020		1,063	1,063	1,063	1,063	$ 73
	D4	Benchmarking								✔	2020		-	5,953	11,670	25,228	$ 19
	D5	Landscape Ordinance								✔	2020		-	3,038	7,428	15,050	$ 19
	D6	Landscape Incentive								✔	2020		-	321	633	929	$ 825
	D7	Irrigation Incentive								✔	2020		42	205	427	394	$ 833
	D8	Lot Scale Stormwater Harvesting	Outdoor		Y			IRR	All	✔	2020	20%	-	180	496	1,391	$ 6,858
			Outdoor			Y		IRR	All	✔	2020	20%	-	149	373	885	$ 5,861
			Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-	
	D9	Lot Scale Rainwater Harvesting	Outdoor	Y				IRR	All	✔	2020	40%	-	937	2,410	5,088	$ 3,293
			Outdoor		Y			IRR	All	✔	2020	10%	-	54	151	425	$ 2,200
			Outdoor			Y		IRR	All	✔	2020	10%	-	82	209	498	$ 1,945
			Dual pipe	Y				IRR TL CW	All				-	-	-	-	
			Dual pipe		Y			IRR TL	All	✔	2020	20%	-	195	556	1,562	$ 2,451
			Dual pipe			Y		IRR TL HVC	All	✔	2020	20%	-	281	706	1,678	$ 2,386
			Potable	Y				ALL	All				-	-	-	-	
	D10	Gray Water Harvesting	Outdoor	Y				IRR	All	✔	2020	10%	-	244	631	1,336	$ 4,546
			Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe	Y				IRR TL CW	All	✔	2020	10%	-	571	1,461	2,860	$ 12,258
			Dual pipe		Y			IRR TL CW	All	✔	2020	20%	-	991	2,702	6,832	$ 9,887
			Dual pipe			Y		IRR TL	All	✔	2020	15%	-	321	823	1,638	$ 9,402
	D11	Building Scale Wastewater Reuse	Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All	✔	2020	20%	-	1,323	3,672	7,875	$ 11,726
	D12	AC Condensate Reuse								✔	2020		100	1,084	2,711	5,150	$ 2,702
Supply Options	S1	Aquifer Storage and Recovery								✔	2040		-	30,000	30,000	60,000	$ 1,053
	S2	Brackish Groundwater Desal								✔	2070		-	-	5,000	10,000	$ 2,690
	S3	Direct Non-Potable Reuse								✔	2020		4,000	12,000	24,000	44,000	$ 1,229
	S4	Direct Potable Reuse											-	-	-	-	
	S5	Indirect Potable Reuse											-	-	-	-	
	S6	LCRA Additional Supply											-	-	-	-	
	S7	Off Channel Reservoir								✔	2070		-	-	25,827	25,827	$ 846
	S8a	Seawater Desal (Import Option)											-	-	-	-	
	S8b	Conventional Groundwater (Import Option)															
	S9	Distributed WW Reuse	Dual pipe	Y	Y	Y	Y	IRR TL CW	Greenfield	✔	2040	70%	-	3,154	14,467	30,049	$ 1,251
	S10	Sewer Mining	Outdoor				Y	IRR	NA	✔	2040	40%	-	-	-	-	$ -
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Mainly Brownfield	✔	2040	30%	-	1,000	2,211	5,284	$ 2,725
	S11	Community Stormwater	Outdoor				Y	IRR	NA	✔	2040	30%	-	48	48	48	$ 1,754
			Outdoor	Y	Y	Y	Y	IRR	Green & Brownfield	✔	2040	30%	-	109	188	455	$ 1,476
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Green & Brownfield				-	-	-	-	
	S12	Community Rainwater	Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Greenfield				-	-	-	-	

	#	Options	Decentralized Option Parameters							Maximize Local Control							
			Sub-Option / Scenario	SFR	MFR	COM	COA	End Uses	Type of New Development Option Applies To	On?	Implement. Year	Decent. Saturation Rate	2020 Yield (AF/Yr)	2040 Yield (AF/Yr)	2070 Yield (AF/Yr)	2115 Yield (AF/Yr)	2115 Unit Cost ($/AF/Yr)
Demand Management Options	D1	AMI								✔	2020		596	3,882	5,766	9,371	$ 2,799
	D2	Water Loss Control								✔	2020		3,108	9,326	10,918	13,064	$ 5,187
	D3	CII Ordinances								✔	2020		1,063	1,063	1,063	1,063	$ 73
	D4	Benchmarking								✔	2020		-	5,953	11,670	25,228	$ 19
	D5	Landscape Ordinance								✔	2020		-	3,038	7,428	15,050	$ 19
	D6	Landscape Incentive											-	-	-	-	
	D7	Irrigation Incentive											-	-	-	-	
	D8	Lot Scale Stormwater Harvesting	Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-	
	D9	Lot Scale Rainwater Harvesting	Outdoor	Y				IRR	All				-	-	-	-	
			Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe	Y				IRR TL CW	All	✔	2040	20%	-	917	2,350	4,819	$ 3,398
			Dual pipe		Y			IRR TL	All				-	-	-	-	
			Dual pipe			Y		IRR TL HVC	All				-	-	-	-	
			Potable	Y				ALL	All				-	-	-	-	
	D10	Gray Water Harvesting	Outdoor	Y				IRR	All				-	-	-	-	
			Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe	Y				IRR TL CW	All				-	-	-	-	
			Dual pipe		Y			IRR TL CW	All	✔	2040	10%	-	495	1,351	3,416	$ 9,887
			Dual pipe			Y		IRR TL	All	✔	2040	10%	-	214	549	1,092	$ 9,402
	D11	Building Scale Wastewater Reuse	Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-	
	D12	AC Condensate Reuse								✔	2020		100	1,084	2,711	5,150	$ 2,702
Supply Options	S1	Aquifer Storage and Recovery								✔	2040		-	30,000	30,000	60,000	$ 1,053
	S2	Brackish Groundwater Desal											-	-	-	-	
	S3	Direct Non-Potable Reuse								✔	2020		4,000	12,000	25,000	59,600	$ 1,229
	S4	Direct Potable Reuse											-	-	-	-	
	S5	Indirect Potable Reuse								✔	2070		-	-	10,000	20,000	$ 605
	S6	LCRA Additional Supply											-	-	-	-	
	S7	Off Channel Reservoir								✔	2070		-	-	25,827	25,827	$ 846
	S8a	Seawater Desal (Import Option)											-	-	-	-	
	S8b	Conventional Groundwater (Import Option)															
	S9	Distributed WW Reuse	Dual pipe	Y	Y	Y	Y	IRR TL CW I	Greenfield	✔	2040	90%	-	3,391	15,144	31,602	$ 1,295
	S10	Sewer Mining	Outdoor				Y	IRR	NA				-	-	-	-	
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Mainly Brownfield	✔	2040	50%	-	1,255	2,673	6,357	$ 2,906
	S11	Community Stormwater	Outdoor				Y	IRR	NA	✔	2040	70%	-	73	73	73	$ 2,980
			Outdoor	Y	Y	Y	Y	IRR	Green & Brownfield	✔	2040	80%	-	21	43	101	$ 1,757
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Green & Brownfield	✔	2040	80%	-	174	324	700	$ 4,757
	S12	Community Rainwater	Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Greenfield	✔	2040	100%	-	16	17	24	$ 11,666

	#	Options	Decentralized Option Parameters							Maximize Water Supply Reliability and Climate Resiliency							
			Sub-Option / Scenario	SFR	MFR	COM	COA	End Uses	Type of New Development Option Applies To	On?	Implement. Year	Decent. Saturation Rate	2020 Yield (AF/Yr)	2040 Yield (AF/Yr)	2070 Yield (AF/Yr)	2115 Yield (AF/Yr)	2115 Unit Cost ($/AF/Yr)
Demand Management Options	D1	AMI								✔	2020		596	3,882	5,766	9,371	$ 2,799
	D2	Water Loss Control								✔	2020		3,108	9,326	10,918	13,064	$ 5,187
	D3	CII Ordinances								✔	2020		1,063	1,063	1,063	1,063	$ 73
	D4	Benchmarking											-	-	-	-	
	D5	Landscape Ordinance											-	-	-	-	
	D6	Landscape Incentive											-	-	-	-	
	D7	Irrigation Incentive											-	-	-	-	
	D8	Lot Scale Stormwater Harvesting	Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-	
	D9	Lot Scale Rainwater Harvesting	Outdoor	Y				IRR	All				-	-	-	-	
			Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe	Y				IRR TL CW	All				-	-	-	-	
			Dual pipe		Y			IRR TL	All				-	-	-	-	
			Dual pipe			Y		IRR TL HVC	All				-	-	-	-	
			Potable	Y				ALL	All				-	-	-	-	
	D10	Gray Water Harvesting	Outdoor	Y				IRR	All	✔	2040	20%	-	488	1,262	2,672	$ 4,546
			Outdoor		Y			IRR	All	✔	2040	20%	-	334	925	2,524	$ 1,134
			Outdoor			Y		IRR	All	✔	2040	20%	-	229	665	1,558	$ 1,120
			Dual pipe	Y				IRR TL CW	All	✔	2040	10%	-	571	1,461	2,860	$ 12,258
			Dual pipe		Y			IRR TL CW	All	✔	2040	20%	-	991	2,702	6,832	$ 9,887
			Dual pipe			Y		IRR TL	All	✔	2040	20%	-	428	1,098	2,185	$ 9,402
	D11	Building Scale Wastewater Reuse	Dual pipe		Y			IRR TL CW	All	✔	2040	10%	-	585	1,637	4,209	$ 13,827
			Dual pipe			Y		IRR TL CW HVC	All	✔	2040	30%	-	1,985	5,509	11,812	$ 11,726
	D12	AC Condensate Reuse								✔	2020		100	1,084	2,711	5,150	$ 2,702
Supply Options	S1	Aquifer Storage and Recovery											-	-	-	-	
	S2	Brackish Groundwater Desal								✔	2040		-	5,000	5,000	10,000	$ 2,690
	S3	Direct Non-Potable Reuse								✔	2020		4,000	12,000	25,000	54,600	$ 1,229
	S4	Direct Potable Reuse								✔	2040		-	20,000	20,000	20,000	$ 2,204
	S5	Indirect Potable Reuse								✔	2040		-	10,000	10,000	20,000	$ 605
	S6	LCRA Additional Supply											-	-	-	-	
	S7	Off Channel Reservoir											-	-	-	-	
	S8a	Seawater Desal (Import Option)								✔	2070		-	-	40,000	84,000	$ 3,032
	S8b	Conventional Groundwater (Import Option)															
	S9	Distributed WW Reuse	Dual pipe	Y	Y	Y	Y	IRR TL CW	Greenfield	✔	2070	70%	-	3,154	14,467	30,049	$ 1,251
	S10	Sewer Mining	Outdoor				Y	IRR	NA				-	-	-	-	
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Mainly Brownfield	✔	2040	50%	-	1,417	3,012	7,168	$ 2,934
	S11	Community Stormwater	Outdoor				Y	IRR	NA				-	-	-	-	
			Outdoor	Y	Y	Y	Y	IRR	Green & Brownfield				-	-	-	-	
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Green & Brownfield				-	-	-	-	
	S12	Community Rainwater	Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Greenfield				-	-	-	-	

	#	Options	Decentralized Option Parameters							Minimize Cost							
			Sub-Option / Scenario	SFR	MFR	COM	COA	End Uses	Type of New Development Option Applies To	On?	Implement. Year	Decent. Saturation Rate	2020 Yield (AF/Yr)	2040 Yield (AF/Yr)	2070 Yield (AF/Yr)	2115 Yield (AF/Yr)	2115 Unit Cost ($/AF/Yr)
Demand Management Options	D1	AMI								✔	2020		596	3,882	5,766	9,371	$ 2,799
	D2	Water Loss Control								✔	2020		3,108	9,326	10,918	13,064	$ 5,187
	D3	CII Ordinances								✔	2020		1,063	1,063	1,063	1,063	$ 73
	D4	Benchmarking								✔	2020		-	5,953	11,670	25,228	$ 19
	D5	Landscape Ordinance								✔	2020		-	3,038	7,428	15,050	$ 19
	D6	Landscape Incentive								✔	2020		-	321	633	929	$ 825
	D7	Irrigation Incentive								✔	2040		-	205	427	394	$ 833
	D8	Lot Scale Stormwater Harvesting	Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-	
	D9	Lot Scale Rainwater Harvesting	Outdoor	Y				IRR	All				-	-	-	-	
			Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe	Y				IRR TL CW	All				-	-	-	-	
			Dual pipe		Y			IRR TL	All				-	-	-	-	
			Dual pipe			Y		IRR TL HVC	All				-	-	-	-	
			Potable	Y				ALL	All				-	-	-	-	
	D10	Gray Water Harvesting	Outdoor	Y				IRR	All				-	-	-	-	
			Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe	Y				IRR TL CW	All				-	-	-	-	
			Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL	All				-	-	-	-	
	D11	Building Scale Wastewater Reuse	Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-	
	D12	AC Condensate Reuse								✔	2020		100	1,084	2,711	5,150	$ 2,702
Supply Options	S1	Aquifer Storage and Recovery								✔	2070		-	-	30,000	60,000	$ 1,053
	S2	Brackish Groundwater Desal											-	-	-	-	
	S3	Direct Non-Potable Reuse								✔	2020		4,000	8,000	16,000	40,000	$ 1,229
	S4	Direct Potable Reuse											-	-	-	-	
	S5	Indirect Potable Reuse								✔	2040		-	10,000	10,000	20,000	$ 605
	S6	LCRA Additional Supply								✔	2020		-	-	-	-	$ 352
	S7	Off Channel Reservoir								✔	2040		-	25,827	25,827	25,827	$ 846
	S8a	Seawater Desal (Import Option)								✔	2040		0	0	0	0	$ 3,032
	S8b	Conventional Groundwater (Import Option)											-	10,000	20,000	45,000	
	S9	Distributed WW Reuse	Dual pipe	Y	Y	Y	Y	IRR TL CW	Greenfield	✔	2040	20%	-	1,055	8,025	16,989	$ 1,069
	S10	Sewer Mining	Outdoor				Y	IRR	NA				-	-	-	-	
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Mainly Brownfield				-	-	-	-	
	S11	Community Stormwater	Outdoor				Y	IRR	NA				-	-	-	-	
			Outdoor	Y	Y	Y	Y	IRR	Green & Brownfield				-	-	-	-	
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Green & Brownfield				-	-	-	-	
	S12	Community Rainwater	Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Greenfield				-	-	-	-	

	#	Options	Decentralized Option Parameters							Minimize Implementation Challenges							
			Sub-Option / Scenario	SFR	MFR	COM	COA	End Uses	Type of New Development Option Applies To	On?	Implement. Year	Decent. Saturation Rate	2020 Yield (AF/Yr)	2040 Yield (AF/Yr)	2070 Yield (AF/Yr)	2115 Yield (AF/Yr)	2115 Unit Cost ($/AF/Yr)
Demand Management Options	D1	AMI								✔	2020		596	3,882	5,766	9,371	$ 2,799
	D2	Water Loss Control								✔	2020		3,108	9,326	10,918	13,064	$ 5,187
	D3	CII Ordinances								✔	2020		1,063	1,063	1,063	1,063	$ 73
	D4	Benchmarking								✔	2020		-	5,953	11,670	25,228	$ 19
	D5	Landscape Ordinance								✔	2020		-	3,038	7,428	15,050	$ 19
	D6	Landscape Incentive											-	-	-	-	
	D7	Irrigation Incentive								✔	2040		-	207	434	401	$ 833
	D8	Lot Scale Stormwater Harvesting	Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-	
	D9	Lot Scale Rainwater Harvesting	Outdoor	Y				IRR	All	✔	2040	20%	-	468	1,205	2,544	$ 3,293
			Outdoor		Y			IRR	All	✔	2040	20%	-	107	302	850	$ 2,200
			Outdoor			Y		IRR	All	✔	2040	30%	-	247	626	1,493	$ 1,945
			Dual pipe	Y				IRR TL CW	All				-	-	-	-	
			Dual pipe		Y			IRR TL	All				-	-	-	-	
			Dual pipe			Y		IRR TL HVC	All				-	-	-	-	
			Potable	Y				ALL	All				-	-	-	-	
	D10	Gray Water Harvesting	Outdoor	Y				IRR	All				-	-	-	-	
			Outdoor		Y			IRR	All				-	-	-	-	
			Outdoor			Y		IRR	All				-	-	-	-	
			Dual pipe	Y				IRR TL CW	All				-	-	-	-	
			Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL	All				-	-	-	-	
	D11	Building Scale Wastewater Reuse	Dual pipe		Y			IRR TL CW	All				-	-	-	-	
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-	
	D12	AC Condensate Reuse								✔	2020		100	1,084	2,711	5,150	$ 2,702
Supply Options	S1	Aquifer Storage and Recovery								✔	2040		-	30,000	30,000	60,000	$ 1,053
	S2	Brackish Groundwater Desal											-	-	-	-	
	S3	Direct Non-Potable Reuse								✔	2020		4,000	12,000	25,000	54,600	$ 1,229
	S4	Direct Potable Reuse											-	-	-	-	
	S5	Indirect Potable Reuse								✔	2070		-	-	10,000	20,000	$ 605
	S6	LCRA Additional Supply								✔	(95,720)		-	-	-	30,000	$ 352
	S7	Off Channel Reservoir								✔	2070		-	-	25,827	25,827	$ 846
	S8a	Seawater Desal (Import Option)											-	-	-	-	
	S8b	Conventional Groundwater (Import Option)															
	S9	Distributed WW Reuse	Dual pipe	Y	Y	Y	Y	IRR TL CW	Greenfield	✔	2070	20%	-	1,055	8,025	16,989	$ 1,069
	S10	Sewer Mining	Outdoor				Y	IRR	NA				-	-	-	-	
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Mainly Brownfield				-	-	-	-	
	S11	Community Stormwater	Outdoor				Y	IRR	NA				-	-	-	-	
			Outdoor	Y	Y	Y	Y	IRR	Green & Brownfield				-	-	-	-	
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Green & Brownfield				-	-	-	-	
	S12	Community Rainwater	Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Greenfield				-	-	-	-	

	#	Options	Decentralized Option Parameters							Hybrid 1						
			Sub-Option / Scenario	SFR	MFR	COM	COA	End Uses	Type of New Development Option Applies To	On?	Implement. Year	Decent. Saturation Rate	2020 Yield (AF/Yr)	2040 Yield (AF/Yr)	2070 Yield (AF/Yr)	2115 Yield (AF/Yr)
Demand Management Options	D1	AMI								✔	2020		596	3,882	5,766	9,371
	D2	Water Loss Control								✔	2020		3,108	9,326	10,918	13,064
	D3	CII Ordinances								✔	2020		1,063	1,063	1,063	1,063
	D4	Benchmarking								✔	2020		-	5,953	11,670	25,228
	D5	Landscape Ordinance								✔	2020		-	3,038	7,428	15,050
	D6	Landscape Incentive								✔	2020		-	321	633	929
	D7	Irrigation Incentive								✔	2020		42	205	427	394
	D8	Lot Scale Stormwater Harvesting	Outdoor		Y			IRR	All	✔	2020	20%	-	180	496	1,391
			Outdoor			Y		IRR	All	✔	2020	20%	-	149	373	885
			Dual pipe		Y			IRR TL CW	All				-	-	-	-
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-
	D9	Lot Scale Rainwater Harvesting	Outdoor	Y				IRR	All	✔	2020	40%	-	937	2,410	5,088
			Outdoor		Y			IRR	All	✔	2020	10%	-	54	151	425
			Outdoor			Y		IRR	All	✔	2020	10%	-	82	209	498
			Dual pipe	Y				IRR TL CW	All				-	-	-	-
			Dual pipe		Y			IRR TL	All	✔	2020	20%	-	195	556	1,562
			Dual pipe			Y		IRR TL HVC	All	✔	2020	20%	-	281	706	1,678
			Potable	Y				ALL	All				-	-	-	-
	D10	Gray Water Harvesting	Outdoor	Y				IRR	All	✔	2020	10%	-	244	631	1,336
			Outdoor		Y			IRR	All				-	-	-	-
			Outdoor			Y		IRR	All				-	-	-	-
			Dual pipe	Y				IRR TL CW	All	✔	2020	10%	-	571	1,461	2,860
			Dual pipe		Y			IRR TL CW	All	✔	2020	20%	-	991	2,702	6,832
			Dual pipe			Y		IRR TL	All	✔	2020	15%	-	321	823	1,638
	D11	Building Scale Wastewater Reuse	Dual pipe		Y			IRR TL CW	All				-	-	-	-
			Dual pipe			Y		IRR TL CW HVC	All	✔	2020	20%	-	1,323	3,672	7,875
	D12	AC Condensate Reuse								✔	2020		100	1,084	2,711	5,150
Supply Options	S1	Aquifer Storage and Recovery								✔	2040		-	60,000	60,000	90,000
	S2	Brackish Groundwater Desal								✔	2070		-	-	5,000	16,000
	S3	Direct Non-Potable Reuse								✔	2020		*4,000*	12,000	25,000	54,600
	S4	Direct Potable Reuse											-	-	-	-
	S5	Indirect Potable Reuse								✔	2040		-	11,000	20,000	20,000
	S6	LCRA Additional Supply											-	-	-	-
	S7	Off Channel Reservoir								✔	2070		-	-	25,000	25,000
	S8a	Seawater Desal (Import Option)											-	-	-	-
	S8b	Conventional Groundwater (Import Option)											-	-	-	-
	S9	Distributed WW Reuse	Dual pipe	Y	Y	Y	Y	IRR TL CW	Greenfield	✔	2040	70%	-	3,154	14,467	30,049
	S10	Sewer Mining	Outdoor				Y	IRR	NA	✔	2040	40%	-	-	-	-
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Mainly Brownfield	✔	2040	30%	-	1,000	2,211	5,284
	S11	Community Stormwater	Outdoor				Y	IRR	NA	✔	2040	30%	-	48	48	48
			Outdoor	Y	Y	Y	Y	IRR	Green & Brownfield	✔	2040	30%	-	109	188	455
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Green & Brownfield				-	-	-	-
	S12	Community Rainwater	Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Greenfield				-	-	-	-

	#	Options	Decentralized Option Parameters							Hybrid 2						
			Sub-Option / Scenario	SFR	MFR	COM	COA	End Uses	Type of New Development Option Applies To	On?	Implement. Year	Decent. Saturation Rate	2020 Yield (AF/Yr)	2040 Yield (AF/Yr)	2070 Yield (AF/Yr)	2115 Yield (AF/Yr)
Demand Management Options	D1	AMI								✓	2020		596	3,882	5,766	9,371
	D2	Water Loss Control								✓	2020		3,108	9,326	10,918	13,064
	D3	CII Ordinances								✓	2020		1,063	1,063	1,063	1,063
	D4	Benchmarking								✓	2020		-	5,953	11,670	25,228
	D5	Landscape Ordinance								✓	2020		-	3,038	7,428	15,050
	D6	Landscape Incentive								✓	2020		-	321	633	929
	D7	Irrigation Incentive								✓	2020		42	205	427	394
	D8	Lot Scale Stormwater Harvesting	Outdoor		Y			IRR	All	✓	2020	20%	-	180	496	1,391
			Outdoor			Y		IRR	All	✓	2020	20%	-	149	373	885
			Dual pipe		Y			IRR TL CW	All				-	-	-	-
			Dual pipe			Y		IRR TL CW HVC	All				-	-	-	-
	D9	Lot Scale Rainwater Harvesting	Outdoor	Y				IRR	All	✓	2020	40%	-	937	2,410	5,088
			Outdoor		Y			IRR	All	✓	2020	10%	-	54	151	425
			Outdoor			Y		IRR	All	✓	2020	10%	-	82	209	498
			Dual pipe	Y				IRR TL CW	All				-	-	-	-
			Dual pipe		Y			IRR TL	All	✓	2020	20%	-	195	556	1,562
			Dual pipe			Y		IRR TL HVC	All	✓	2020	20%	-	281	706	1,678
			Potable	Y				ALL	All				-	-	-	-
	D10	Gray Water Harvesting	Outdoor	Y				IRR	All	✓	2020	10%	-	244	631	1,336
			Outdoor		Y			IRR	All				-	-	-	-
			Outdoor			Y		IRR	All				-	-	-	-
			Dual pipe	Y				IRR TL CW	All	✓	2020	10%	-	571	1,461	2,860
			Dual pipe		Y			IRR TL CW	All	✓	2020	20%	-	991	2,702	6,832
			Dual pipe			Y		IRR TL	All	✓	2020	15%	-	321	823	1,638
	D11	Building Scale Wastewater Reuse	Dual pipe		Y			IRR TL CW	All				-	-	-	-
			Dual pipe			Y		IRR TL CW HVC	All	✓	2020	20%	-	1,323	3,672	7,875
	D12	AC Condensate Reuse								✓	2020		100	1,084	2,711	5,150
Supply Options	S1	Aquifer Storage and Recovery								✓	2040		-	45,000	90,000	90,000
	S2	Brackish Groundwater Desal								✓	2040		-	5,000	5,000	10,000
	S3	Direct Non-Potable Reuse								✓	2020		*4,000*	12,000	25,000	54,600
	S4	Direct Potable Reuse											-	-	-	-
	S5	Indirect Potable Reuse								✓	2040		-	20,000	20,000	20,000
	S6	LCRA Additional Supply											-	-	-	-
	S7	Off Channel Reservoir											-	-	-	-
	S8a	Seawater Desal (Import Option)								✓	2115		-	-	-	50,000
	S8b	Conventional Groundwater (Import Option)											-	-	-	-
	S9	Distributed WW Reuse	Dual pipe	Y	Y	Y	Y	IRR TL CW	Greenfield	✓	2040	70%	-	3,154	14,467	30,049
	S10	Sewer Mining	Outdoor				Y	IRR	NA	✓	2040	40%	-	-	-	-
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Mainly Brownfield	✓	2040	30%	-	1,000	2,211	5,284
	S11	Community Stormwater	Outdoor				Y	IRR	NA	✓	2040	30%	-	48	48	48
			Outdoor	Y	Y	Y	Y	IRR	Green & Brownfield	✓	2040	30%	-	109	188	455
			Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Green & Brownfield				-	-	-	-
	S12	Community Rainwater	Dual pipe	Y	Y	Y	Y	IRR TL CW HVC	Greenfield				-	-	-	-

APPENDIX M: WATER FORWARD ADAPTIVE MANAGEMENT PLAN AND IMPLEMENTATION OUTLOOK

10/05/2018

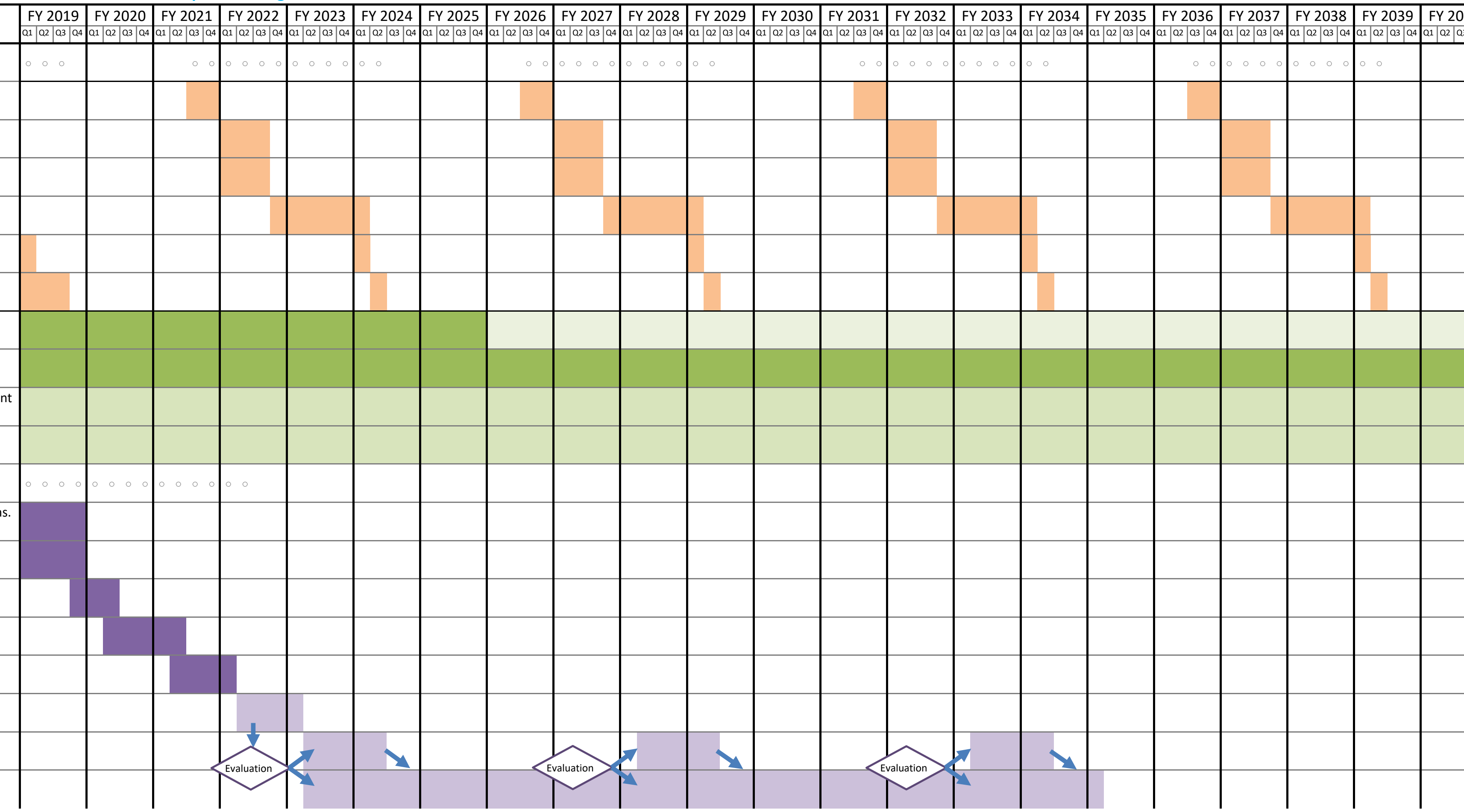
REVISED DRAFT

Water Forward

Implementation Outlook and Adaptive Management Plan

AW will continue implementation of Advanced Metering Infrastructure and Water Loss Control utility initiatives.
AW will continue to monitor AC Condensate Reuse and CII Ordinances that have recently been adopted into code.
NOTE: All process steps are not included on this informational visual.

	Row No.	Option No.	Task Name	Description
Planning Cycles	1		**Integrated Water Resource Plan Development and Update Process**	
	2		Scope of Work and Project Schedule Development	
	3		Consultant Procurement	
	4		Data Gathering and Preliminary Analyses	
	5		Plan Development Process	
	6		Target Final Plan Presentation To and Adoption By Council	
	7		Implementation Plan Development	
Ongoing Utility Initiatives	8	D1	**Advanced Metering Infrastructure**	Implement customer facing programs that provide real-time water use information. Savings achieved through identification of customer-side leaks, behavior modification, etc.
	9	D2	**Water Loss Control - Utility Side**	Leak detection, correction, and prevention program to reduce the Infrastructure Leakage Index (ILI) to 2.7 by 2020 and further reduce and sustain a 2.0 ILI from 2040 to 2115.
	10	D3	**Commercial, Institutional, and Industrial (CII) Ordinances**	Already in Code - Require older cooling towers to meet water efficiency benchmarks and use efficient equipment and require efficiency standards for steam boilers in new development.
	11	D12	**AC Condensate Reuse**	Already in Code - Require collection and reuse of condensate water from Air Handling Units (AHUs) for cooling systems from new development with cooling capacity over 200 tons.
	12		**Expansion of Current Centralized Reclaimed Water Connection Requirements**	Stakeholder process will explore expanding existing centralized reclaimed water connection requirements.
	13		Evaluation of potential implementation approaches	Evaluation to include refinement of ordinance scope, applicability, location in code, enforcement considerations.
	14		Preliminary stakeholder outreach	
	15		Develop draft ordinance language	
	16		Stakeholder outreach and draft code language changes as needed	
	17		Boards and Commissions and Council action	
	18		Implementation and monitoring	
	19		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	20		Maintain approach and continue monitoring	



10/05/2018

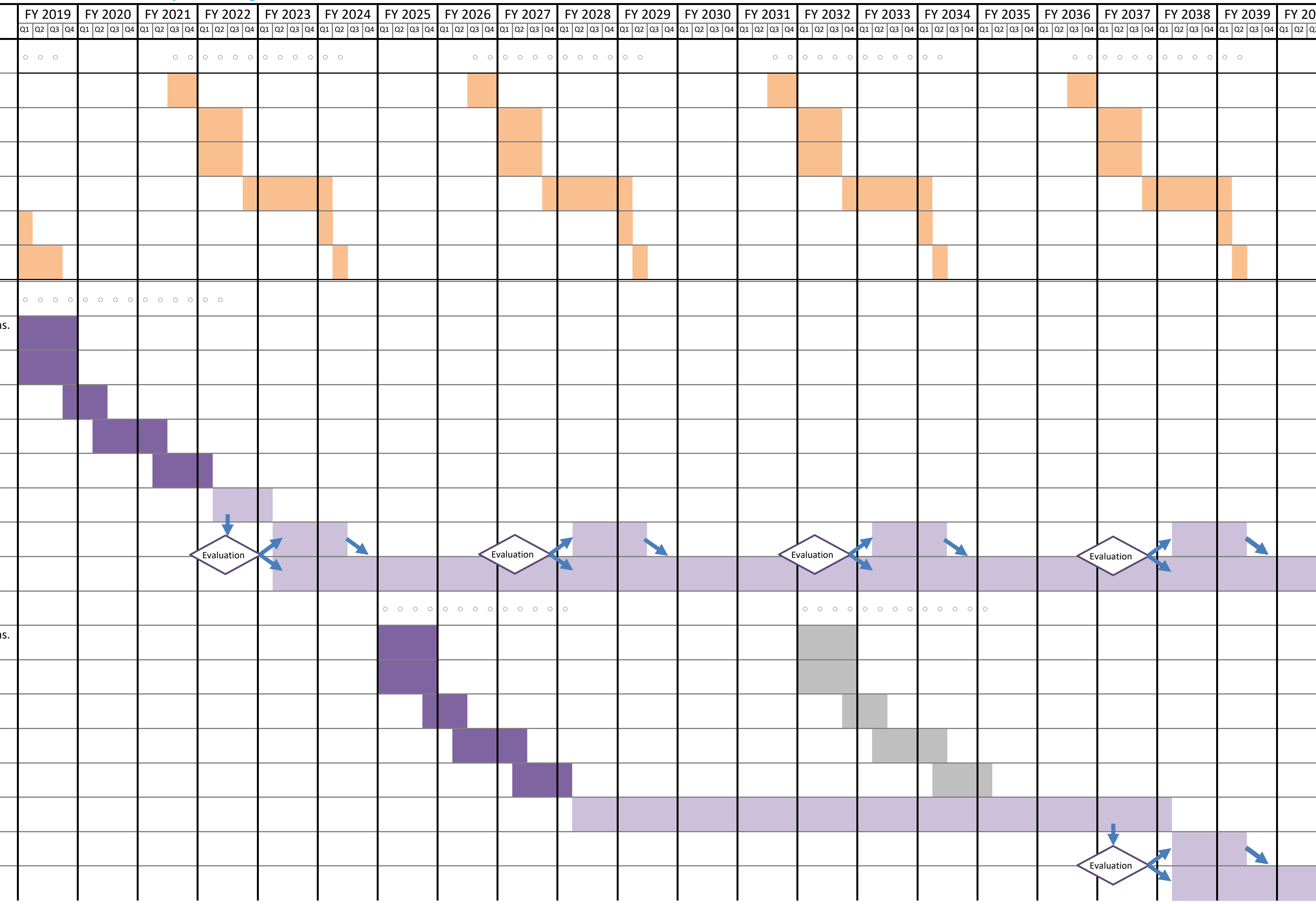
REVISED DRAFT

Water Forward

Implementation Outlook and Adaptive Management Plan

AW will continue implementation of Advanced Metering Infrastructure and Water Loss Control utility initiatives.
AW will continue to monitor AC Condensate Reuse and CII Ordinances that have recently been adopted into code.
NOTE: All process steps are not included on this informational visual.

	Row No.	Option No.	Task Name	Description
Planning Cycles	1		**Integrated Water Resource Plan Development and Update Process**	
	2		Scope of Work and Project Schedule Development	
	3		Consultant Procurement	
	4		Data Gathering and Preliminary Analyses	
	5		Plan Development Process	
	6		Target Final Plan Presentation To and Adoption By Council	
	7		Implementation Plan Development	
	21	D8, D9, D10, D11, S11	**Phase 1 Dual Plumbing Ordinance Development**	Stakeholder process will explore requiring dual plumbing for new large Commercial and Multifamily development (with a potable backup).
	22		Evaluation of potential implementation approaches	Evaluation to include refinement of ordinance scope, applicability, location in code, enforcement considerations.
	23		Preliminary stakeholder outreach	
	24		Develop draft ordinance language	
	25		Stakeholder outreach and draft code language changes as needed	
	26		Boards and Commissions and Council action	
	27		Implementation and monitoring	
	28		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	29		Maintain approach and continue monitoring	
	30		**Phase 2 Dual Plumbing Ordinance Development**	Stakeholder process will explore expanding ordinance's applicability to potentially include mid-size new commercial and multifamily (with a potable back-up required).
	31		Evaluation of potential implementation approaches	Evaluation to include refinement of ordinance scope, applicability, location in code, enforcement considerations.
	32		Preliminary stakeholder outreach	
	33		Develop draft ordinance language	
	34		Stakeholder outreach and draft code language changes as needed	
	35		Boards and Commissions and Council action	
	36		Implementation and monitoring	
	37		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	38		Maintain approach and continue monitoring	



10/05/2018

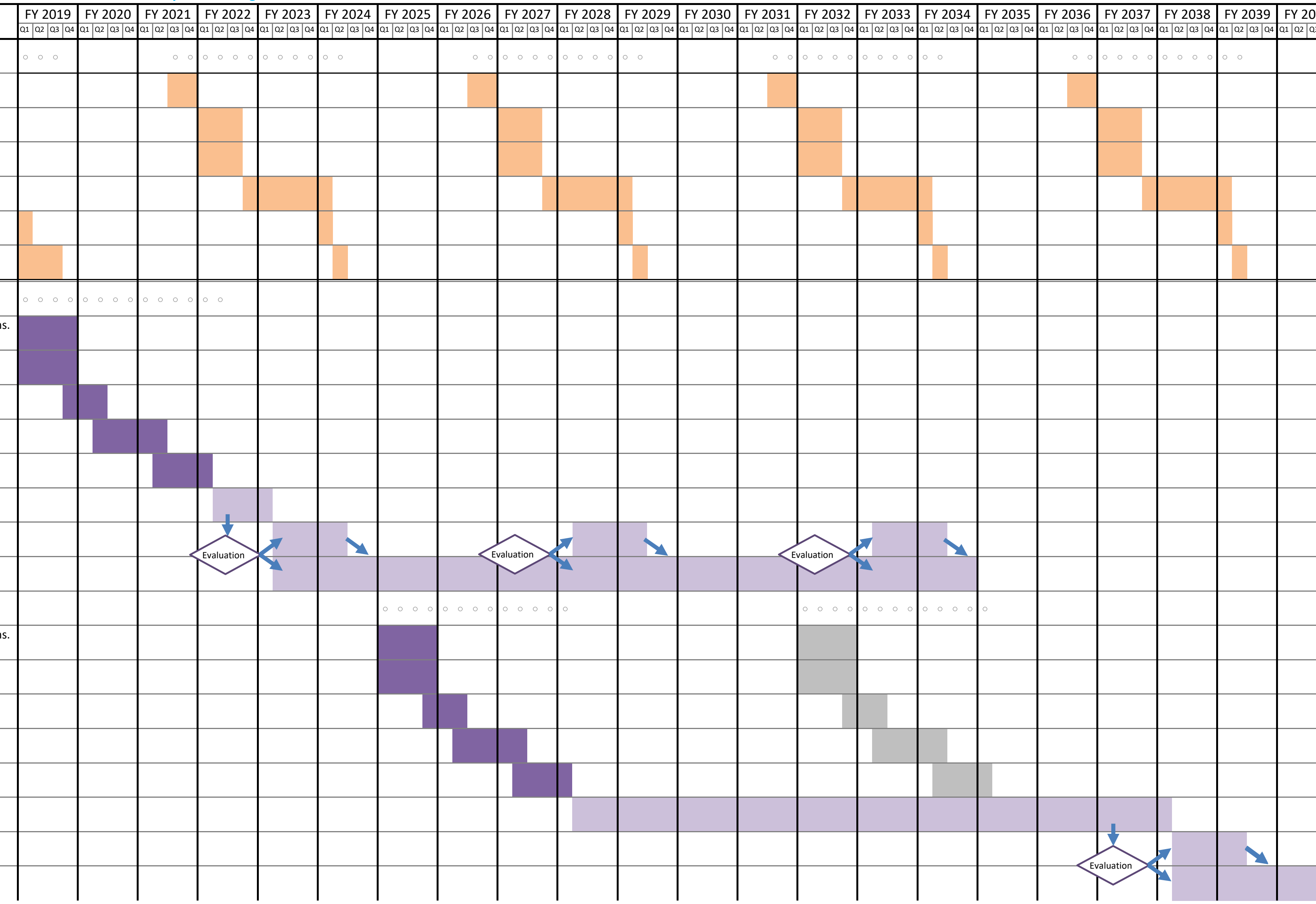
REVISED DRAFT

Water Forward

Implementation Outlook and Adaptive Management Plan

AW will continue implementation of Advanced Metering Infrastructure and Water Loss Control utility initiatives.
AW will continue to monitor AC Condensate Reuse and CII Ordinances that have recently been adopted into code.
NOTE: All process steps are not included on this informational visual.

	Row No.	Option No.	Task Name	Description
Planning Cycles	1		**Integrated Water Resource Plan Development and Update Process**	
	2		Scope of Work and Project Schedule Development	
	3		Consultant Procurement	
	4		Data Gathering and Preliminary Analyses	
	5		Plan Development Process	
	6		Target Final Plan Presentation To and Adoption By Council	
	7		Implementation Plan Development	
	39	D8, D9, D10, D11, S11	**Phase 1 Alternative Water Ordinance Development**	Stakeholder process will explore requiring use of alternative waters for new large Commercial and Multifamily development (with a potable backup).
	40		Evaluation of potential implementation approaches	Evaluation to include refinement of ordinance scope, applicability, location in code, enforcement considerations.
	41		Preliminary stakeholder outreach	
	42		Develop draft ordinance language	
	43		Stakeholder outreach and draft code language changes as needed	
	44		Boards and Commissions and Council action	
	45		Implementation and monitoring	
	46		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	47		Maintain approach and continue monitoring	
	48		**Phase 2 Alternative Water Ordinance Development**	Stakeholder process will explore expanding ordinance's applicability to potentially include mid-size new commercial and multifamily (with a potable back-up required).
	49		Evaluation of potential implementation approaches	Evaluation to include refinement of ordinance scope, applicability, location in code, enforcement considerations.
	50		Preliminary stakeholder outreach	
	51		Develop draft ordinance language	
	52		Stakeholder outreach and draft code language changes as needed	
	53		Boards and Commissions and Council action	
	54		Implementation and monitoring	
	55		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	56		Maintain approach and continue monitoring	



10/05/2018

Water Forward

Implementation Outlook and Adaptive Management Plan

REVISED DRAFT

AW will continue implementation of Advanced Metering Infrastructure and Water Loss Control utility initiatives.
AW will continue to monitor AC Condensate Reuse and CII Ordinances that have recently been adopted into code.
NOTE: All process steps are not included on this informational visual.

Category	Row No.	Option No.	Task Name	Description
Planning Cycles	1		**Integrated Water Resource Plan Development and Update Process**	
	2		Scope of Work and Project Schedule Development	
	3		Consultant Procurement	
	4		Data Gathering and Preliminary Analyses	
	5		Plan Development Process	
	6		Target Final Plan Presentation To and Adoption By Council	
	7		Implementation Plan Development	
Developer or customer installed, owned, and operated	57	D4	**Phase 1 Development-focused Water Use Benchmarking and Budgeting - Submittal Process Development**	Stakeholder process to explore requiring submittal of water use estimates for new development.
	58	D4	Development of water usage calculator	
	59	D4	Evaluation of potential implementation approaches	Determination if an ordinance is needed - If so, process will include refinement of ordinance scope, applicability, location in code, enforcement considerations
	60	D4	Preliminary stakeholder outreach	
	61	D4	Develop draft ordinance language if needed	
	62	D4	Stakeholder outreach and draft code language changes as needed	
	63	D4	Boards and Commissions and Council action	
	64	D4	Implementation	City staff will provide potential water use efficiency and alternative water recommendations and information on available incentive and rebate programs.
	65	D4	Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	66	D4	Maintain approach and continue monitoring	
	67	D4	**Phase 2 Development-focused Water Use Benchmarking and Budgeting Ordinance Development**	Stakeholder process will explore requiring new development to submit a water usage estimate and comply with a water budget - compliance mechanism to be determined.
	68	D4	Public stakeholder process in advance of benchmark development	Stakeholder process will explore development of benchmarks to be applied to buildings developed post-2025.
	69	D4	Data gathering and development of water usage database	
	70	D4	Evaluation of potential implementation approaches (refinement of ordinance scope, applicability, location in	
	71	D4	Preliminary stakeholder outreach	
	72	D4	Develop draft ordinance language	
	73	D4	Stakeholder outreach and draft code language changes as needed	
	74	D4	Boards and Commissions and Council action	
	75	D4	Implementation and monitoring	Starting in FY 2032, water budgets will be applied to development built post-2025.
	76	D4	Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	77	D4	Maintain approach and continue monitoring	
	78	D5	**Landscape Transformation Ordinance**	Stakeholder process will explore requiring single-family residential to limit turf-grass area and include additional requirements for existing COM and MFR ordinance
	79	D5	Evaluation of potential implementation approaches (refinement of ordinance scope, applicability, location in	
	80	D5	Preliminary stakeholder outreach	
	81	D5	Develop draft ordinance language	
	82	D5	Stakeholder outreach and draft code language changes as needed	
	83	D5	Boards and Commissions and Council action	
	84	D5	Implementation and monitoring	
	85	D5	Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	86	D5	Maintain approach and continue monitoring	

REVISED DRAFT

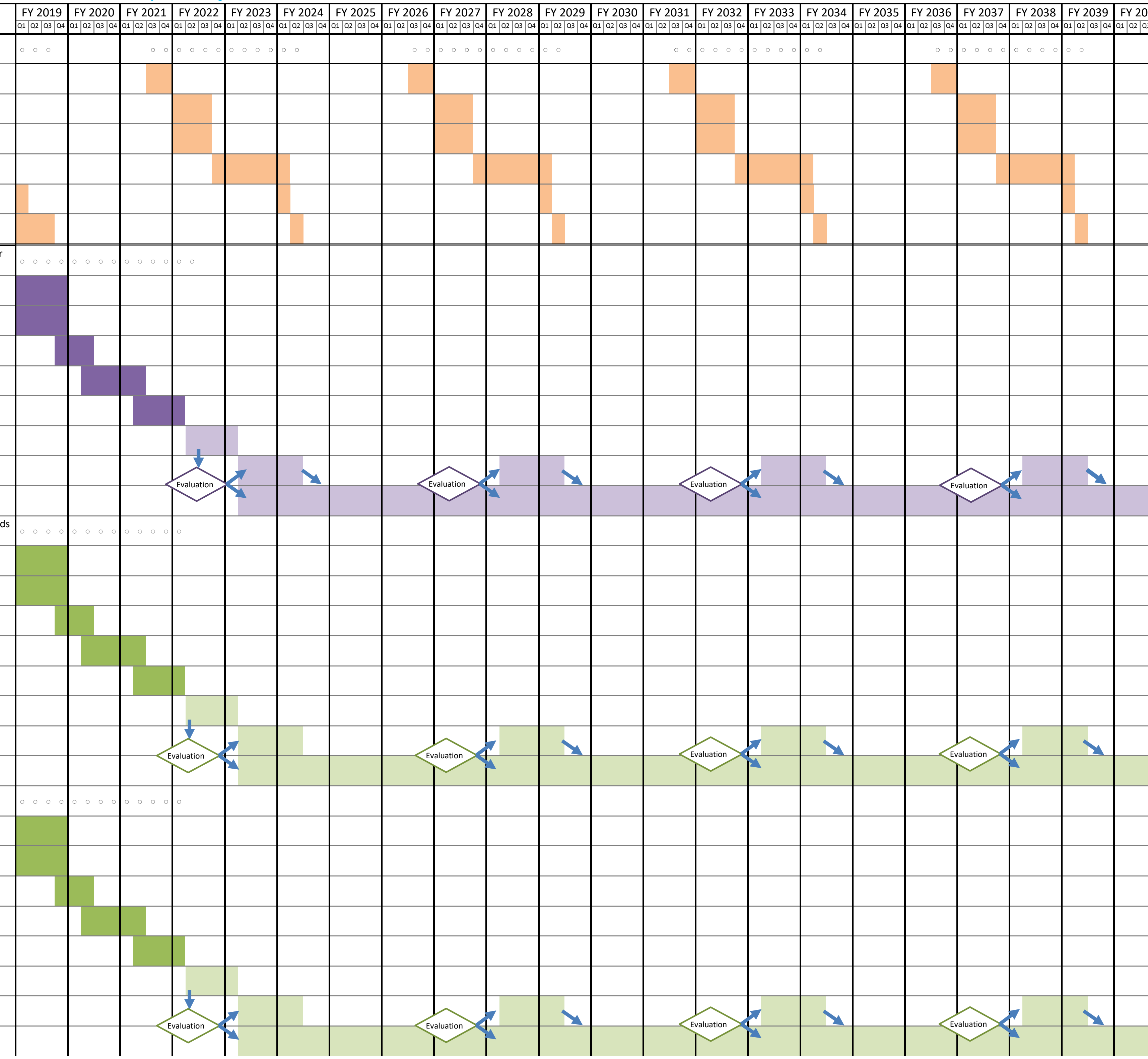
10/05/2018

Water Forward

Implementation Outlook and Adaptive Management Plan

AW will continue implementation of Advanced Metering Infrastructure and Water Loss Control utility initiatives.
AW will continue to monitor AC Condensate Reuse and CII Ordinances that have recently been adopted into code.
NOTE: All process steps are not included on this informational visual.

	Row No.	Option No.	Task Name	Description
Planning Cycles	1		**Integrated Water Resource Plan Development and Update Process**	
	2		Scope of Work and Project Schedule Development	
	3		Consultant Procurement	
	4		Data Gathering and Preliminary Analyses	
	5		Plan Development Process	
	6		Target Final Plan Presentation To and Adoption By Council	
	7		Implementation Plan Development	
	87	D8, D9, D10, D11, S11	**Alternative Water Incentive**	Expansion of existing rebate program - incentive would encourage the use of rainwater harvesting, stormwater harvesting, graywater reuse, and blackwater reuse.
	88		Evaluation of potential implementation approaches	Evaluation to potentially include amount and/or type of incentive to offer.
	89		Preliminary stakeholder outreach	
	90		Program development and cost-benefit analysis	
	91		Stakeholder outreach and incentive program refinement as needed	
	92		Boards and Commissions Input	
	93		Program implementation and monitoring	
	94		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	95		Maintain approach and continue monitoring	
	96	D6	**Landscape Transformation Incentive**	Expansion of existing rebate program - incentive would encourage water use efficiencies and reduce water needs for outdoor irrigation through regionally appropriate landscapes
	97		Evaluation of potential implementation approaches	Evaluation to potentially include amount and/or type of incentive to offer.
	98		Preliminary stakeholder outreach	
	99		Program development and cost-benefit analysis	
	100		Stakeholder outreach and incentive program refinement as needed	
	101		Boards and Commissions Input	
	102		Program implementation and monitoring	
	103		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	104		Maintain approach and continue monitoring	
	105	D7	**Irrigation Efficiency Incentive (Expand existing rebate program)**	Expansion of existing rebate program - incentive would encourage use of include irrigation system controllers.
	106		Evaluation of potential implementation approaches	Evaluation to potentially include amount and/or type of incentive to offer.
	107		Preliminary stakeholder outreach	
	108		Program development and cost-benefit analysis	
	109		Stakeholder outreach and incentive program refinement as needed	
	110		Boards and Commissions Input	
	111		Program implementation and monitoring	
	112		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	113		Maintain approach and continue monitoring	



REVISED DRAFT

10/05/2018

Water Forward

Implementation Outlook and Adaptive Management Plan

AW will continue implementation of Advanced Metering Infrastructure and Water Loss Control utility initiatives.
AW will continue to monitor AC Condensate Reuse and CII Ordinances that have recently been adopted into code.
NOTE: All process steps are not included on this informational visual.

	Row No.	Option No.	Task Name	Description
Planning Cycles	1		**Integrated Water Resource Plan Development and Update Process**	
	2		Scope of Work and Project Schedule Development	
	3		Consultant Procurement	
	4		Data Gathering and Preliminary Analyses	
	5		Plan Development Process	
	6		Target Final Plan Presentation To and Adoption By Council	
	7		Implementation Plan Development	
Potentially a combination	114	S3	**Centralized Reclaimed System (Direct Non-Potable Reuse)**	Implementation to focus on Reclaimed Master Plan through 2040.
	115		Approach refinement and/or implementation of other option(s) identified in plan update cycle	
	116		Maintain approach and continue implementation	
	117	S9, S10	**Decentralized Reclaimed (Community Scale Distributed Wastewater Reuse and Sewer Mining)**	
	118		Refinement of decentralized option analysis	
	119		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	120		Future additional decentralized reclaimed project identification	
	121		Decentralized reclaimed project design and construction	Implementation will consider timing and location of new development opportunities.
Utility constructed, owned and operated	122	S1	**Aquifer Storage and Recovery**	
	123		Further Study and Modeling, Permitting, Land Acquisition	Initial steps will include further study for pilot and full project, further modelling for operational considerations, land acquisition, legal and permitting considerations, and piloting
	124		Pilot Design, Construction, and Testing	
	125		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	126		Design of full-scale ASR facility	
	127		Construction of full-scale ASR facility	
	128		ASR fill/refill cycles	
	129	S5	**Indirect Potable Reuse (IPR) through Lady Bird Lake Capture Local Inflows to Lady Bird Lake**	Note: IPR option could be accelerated if required in a drought situation.
	130		Approach refinement and/or implementation of other option(s) in subsequent plan update cycle	
	131		Alternatives Analysis, Permitting, and Public Outreach	
	132		Design	
	133		Construction	
	134	S7, S2	**New Off Channel Reservoir and Brackish Groundwater Desalination**	
	135		Continued study and refinement of option	This phase to include public outreach and possible exploratory land acquisition efforts.