# 2018 Orange County Water Reliability Study

Report Prepared for:

Municipal Water District of Orange County

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# Report Preface

This report summarizes the technical work of the 2018 Orange County Water Reliability Study (2018 OC Study). The goal of this study is to provide independent, consistent, and accurate information on current and future water supply conditions in Orange County and provide objective comparisons of local projects that can effectively meet projected water demands. The intent is that this information will be used by a broad audience, including elected and appointed officials, water agency staff and the general public, to form fact-based policies and make informed decisions on project investments. The goal is not to dictate decisions, as every city, water agency, and regulatory agency has the authority and responsibility to make their own decisions.

This is a technical report of a fairly complicated and detailed analytical process. The Municipal Water District of Orange County (MWDOC) has attempted to present this information in a format that will be valuable across multiple audiences. No doubt that this study will invoke different opinions and lead to further questions across many different spectrums (i.e., policy, planning, and engineering). MWDOC is committed to working with the entire audience to clarify information, answer questions, receive input, and maximize the utility of this study.

The 2018 OC Study accomplishes the following from a process standpoint:

- Projects regional and Orange County water demands and supplies through the year 2050
- Utilizes four scenarios, representing differing levels of climate change impacts and non-Orange County water supply investments, to bookend reasonable future conditions of water reliability
- Evaluates water shortages that could be caused by seismic events or other major unplanned system outages (referred to as system reliability in this study)
- Evaluates water shortages caused by hydrologic droughts and extended dry periods, using the four scenarios of climate change/non-Orange County investments (referred to as supply reliability in this study)
- Provides comparative information on a number of proposed local Orange County water supply projects that provide both system and supply reliability benefits, and ranks these projects based on cost-effectiveness

While a number of comments on this process have been included in Section 8 of this report, two fundamental comments stand out:

1. **Local water projects are in different stages of development, and therefore it is not valid to compare and rank their cost-effectiveness.** This is the common situation in comparative planning studies and there are well established procedures to account for these differences. MWDOC feels that it has addressed this concern by applying standard and appropriate cost contingencies, and made certain that project information was being presented consistently.

2. **It is not possible to predict 30 years into the future with specificity and certainty**. No forecast or plan will be 100 percent certain. But not to plan in the face of uncertainty is not an option. Decisions for future water supply investments are always made with best available information at the time. To address uncertainty, this study used plausible planning scenarios to test project performance and illustrate a range of cost-effectiveness.

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CDM Smith

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# Abbreviations and Acronyms

| | |
|---|---|
| 20x2020 | 20% water use reduction in Gallons Per Capita per Day by year 2020 |
| AES | Company that owns the Huntington Beach Power Plant |
| AF | Acre-Feet |
| AFM | Acre-Feet per month |
| AFY | Acre-Feet per Year |
| AMP | Allen McColloch Pipeline; one of two major pipelines (the other is the EOCF#2) delivering water from MET's Diemer Filtration Plant in Yorba Linda to SOC. |
| AOP | Advanced Oxidation Processes |
| ATM | Aufdenkamp Transmission Main |
| AWTP | Advanced Water Treatment Plant |
| AVEK | Antelope Valley East Kern (Water Bank) |
| B/C Ratio | Benefit/Cost Ratio (see also Evaluation Metric or EM) |
| BDCP | Bay-Delta Conservation Plan |
| BEA | Basin Equity Assessment |
| Biops | Biological Opinions |
| BMP | Best Management Practice |
| BOR | US Bureau of Reclamation |
| BPP | Basin Production Percentage |
| CBMWD | Central Basin Municipal Water District |
| CBWB | Chino Basin Water Bank |
| CCC | California Coastal Commission |
| CCKA | California Coastkeeper Alliance |
| CDR | Center for Demographic Research |
| CFS | cubic feet per second |
| CII | Commercial/Industrial/Institutional |
| CMIP5 | Coupled Model Intercomparison Project Phase 5 - a collaborative framework designed to improve our knowledge of climate change; the most recently completed phase of the project (2010-2014) |
| CRA | Colorado River Aqueduct |
| CSIRO | Commonwealth Scientific and Industrial Research Organization (an Australian Organization to advance inventions and innovations); they have developed a climate model that was used in this analysis. |
| CSJC | City of San Juan Capistrano (see Ground Water Recovery Plant (GWRP)) |
| CUP | Conjunctive Use Program |
| CVP | Central Valley Project |
| CVWD | Cucamonga Valley Water District |
| CWRP | Chiquita Water Reclamation Plant |

| | |
|---|---|
| DATS | Deep Aquifer Treatment System |
| DCP | Drought Contingency Plan |
| DDW | Division of Drinking Water (part of the SWRCB) |
| Delta | Sacramento-San Joaquin River Delta |
| Diemer WFP | MET's Diemer Water Filtration Plant in Orange County which produces most of the treated imported water in Orange County |
| DMM | Demand Management Measure |
| Doheny Desal | *Doheny Local* was used to describe the Doheny Ocean Desalination Project currently being pursued by South Coast Water District, while *Doheny Regional* is a project concept for a larger ocean desalination project that builds off of the Doheny Local project for use by other water agencies in South Orange County |
| DPR | Direct Potable Reuse |
| DVL | Diamond Valley Lake |
| DWR | California Department of Water Resources |
| EOCF#2 | East Orange County Feeder No. 2 |
| EIR | Environmental Impact Report |
| EMWD | Eastern Municipal Water District |
| EPA | US Environmental Protection Agency |
| EOC | Emergency Operation Center |
| EOCWD | East Orange County Water District |
| ESA | Environmental Species Act |
| ET | Evapotranspiration (also $E_t$) |
| FY | Fiscal Year |
| GCM | General Circulation Model (or Global Climate Model) |
| GPCD | Gallons per Capita per Day |
| GPD | Gallons per Day |
| GRF | Groundwater Recovery Facility (South Coast Water District) |
| GWRP | Groundwater Recovery Plant (City of San Juan Capistrano) |
| GWRS | Groundwater Replenishment System |
| HB | Huntington Beach |
| ICS | Intentionally Created Surplus water in Lake Mead is defined as water that has been conserved through an extraordinary conservation measures, such as land fallowing |
| IEUA | Inland Empire Utilities Agency |
| IPR | Indirect Potable Reuse |
| IRP | Integrated Water Resources Plan |
| IRWD | Irvine Ranch Water District |
| ISTAP | Independent Technical Advisory Panel |

| | |
|---|---|
| JPA | Joint Powers Authority or Joint Powers Agreement |
| JRWSS | Joint Regional Water Supply System (also JTM and Tri-Cities Transmission Main and includes the Local Transmission Main) |
| JRTM | Joint Regional Transmission Main (see JTM or JRWSS) |
| JTM | Joint Transmission Main (serves many SOC agencies) |
| JWPCP | Joint Water Pollution Control Plant |
| LRP | Local Resources Program |
| LTM | Local Transmission Main (serves South Coast and San Clemente) |
| MAWA | Maximum Allowed Water Allowance |
| M&I | Municipal and Industrial |
| MAF | Million Acre-Feet |
| MCL | Maximum Contaminant Level |
| MET | Metropolitan Water District of Southern California |
| MGD | Million Gallons per Day |
| MPI | Material Physical Injury |
| MTBE | Methyl Tert-Butyl Ether |
| MWDOC | Municipal Water District of Orange County |
| MWRF | Mesa Water Reliability Facility |
| MWRP | Michelson Water Recycling Plant |
| NDM | N-nitrosodimethylamine |
| NPV | Net Present Value |
| OC | Orange County |
| OC–44 | Service connection off of the EOCF#2 with a long pipeline serving Mesa WD and Huntington Beach. |
| OC Basin | Orange County area served by OCWD groundwater |
| OCSD | Orange County Sanitation District |
| OCWD | Orange County Water District |
| Poseidon | Poseidon Resources LLC, the proponent of the Huntington Beach Desalination Plant |
| O&M | Operation and Maintenance |
| PPB | Parts per Billion |
| PV | Present Value – bringing future flow of money to a value today. |
| RA | Replenishment Assessment (charged by OCWD on every AF pumped from the Basin) |
| RO | Reverse Osmosis |
| R&R | Repair and Replacement |
| RRWP | Regional Recycled Water Program (Also Carson IRP) |
| RWQCB | Regional Water Quality Control Board |
| SAR | Santa Ana River |

| | |
|---|---|
| SARCCUP | Santa Ana River Conservation and Conjunctive Use Program |
| SBVMWD | San Bernardino Valley Municipal Water District |
| SCP | South County Pipeline |
| SCWD | South Coast Water District |
| SDP | Seawater Desalination Program |
| SJBA | San Juan Basin Authority |
| SMWD | Santa Margarita Water District |
| SOC | South Orange County or SOC agencies as a group |
| SOCWA | South Orange County Wastewater Authority |
| SWP | State Water Project |
| SWRCB | California State Water Resources Control Board |
| TDS | Total Dissolved Solids |
| USBR | United States Bureau of Reclamation |
| UV | Ultraviolet |
| WEAP | Water Evaluation And Planning model; a software tool that utilizes an integrated approach to water resources planning developed by the Stockholm Environment Institute's U.S. Center. |
| WEROC | Water Emergency Response Organization of Orange County |
| WIP | Water Importation Pipeline |
| WMWD | Western Municipal Water District |
| WOCWB | West Orange County Water Board |
| WSAP | Water Supply Allocation Plan |
| WSDM | Water Surplus and Drought Management Plan |
| WUE | Water Use Efficiency |

# Orange County Water Reliability Study Contributors

This study was the culmination of work by many at both MWDOC and our Consultant CDM Smith.

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# Section 1

# Introduction

*If you have not read the report preface, please do so now*

In 2014, the Municipal Water District of Orange County (MWDOC) initiated the first of its kind, comprehensive assessment of water reliability[1] for Orange County, which culminated in a 2016 report called the Orange County Water Reliability Study (2016 OC Study). The 2016 OC Study examined a range of potential water supply shortfalls between future water demands and existing water supplies under a range of planning scenarios, and assessed potential new water supplies that could be developed by the Metropolitan Water District of Southern California (MET), the MET member agencies, and Orange County water agencies. The potential MET and MET member agency projects were organized under six portfolios of projects, three of which were fully reliable. These MET portfolios were analyzed in terms of reliability impacts to Orange County water agencies. In addition, an illustrative analysis of four portfolios of local water projects was conducted for the South Orange County area, as this area had significant water system and supply reliability needs.

Because of several important changed conditions that occurred after the 2016 OC Study was completed, a 2018 Orange County Water Reliability Study (2018 OC Study) was undertaken and recently completed. This report documents this updated effort.

## 1.1 Purpose and Findings for 2016 OC Study

The 2016 OC Study examined water supply and system (emergency) reliability for three areas of the county, as shown in **Figure 1**: (1) Brea/La Habra; (2) Orange County Basin (OC Basin); and (3) South Orange County (SOC). These areas were formulated based on the amount of local sources of water supply available (mainly a function of geology) and vulnerability to MET system outages. SOC has a relatively low percentage of local water supplies and has a higher dependence on imported water facilities (i.e., the majority of water imported into SOC comes from MET's Diemer Water Filtration Plant and two pipelines). Thus, SOC is more vulnerable to both system outages of these facilities and droughts (due to few local supplies). In contrast, those areas with a larger percentage of local supplies (e.g., Brea/La Habra and the OC Basin) have more local water supply and system flexibility during system outages and droughts.

The purpose of the 2016 OC Study was to evaluate water supply and system reliability for Orange County with no new MET or local investments under a range of growth and climate change scenarios, and then examine the relative benefits of portfolios of MET and local Orange County projects. However, the 2016 OC Study did not compare individual Orange County projects in terms of reliability benefits and costs.

[1] See Section 1.4 for definitions of water reliability.

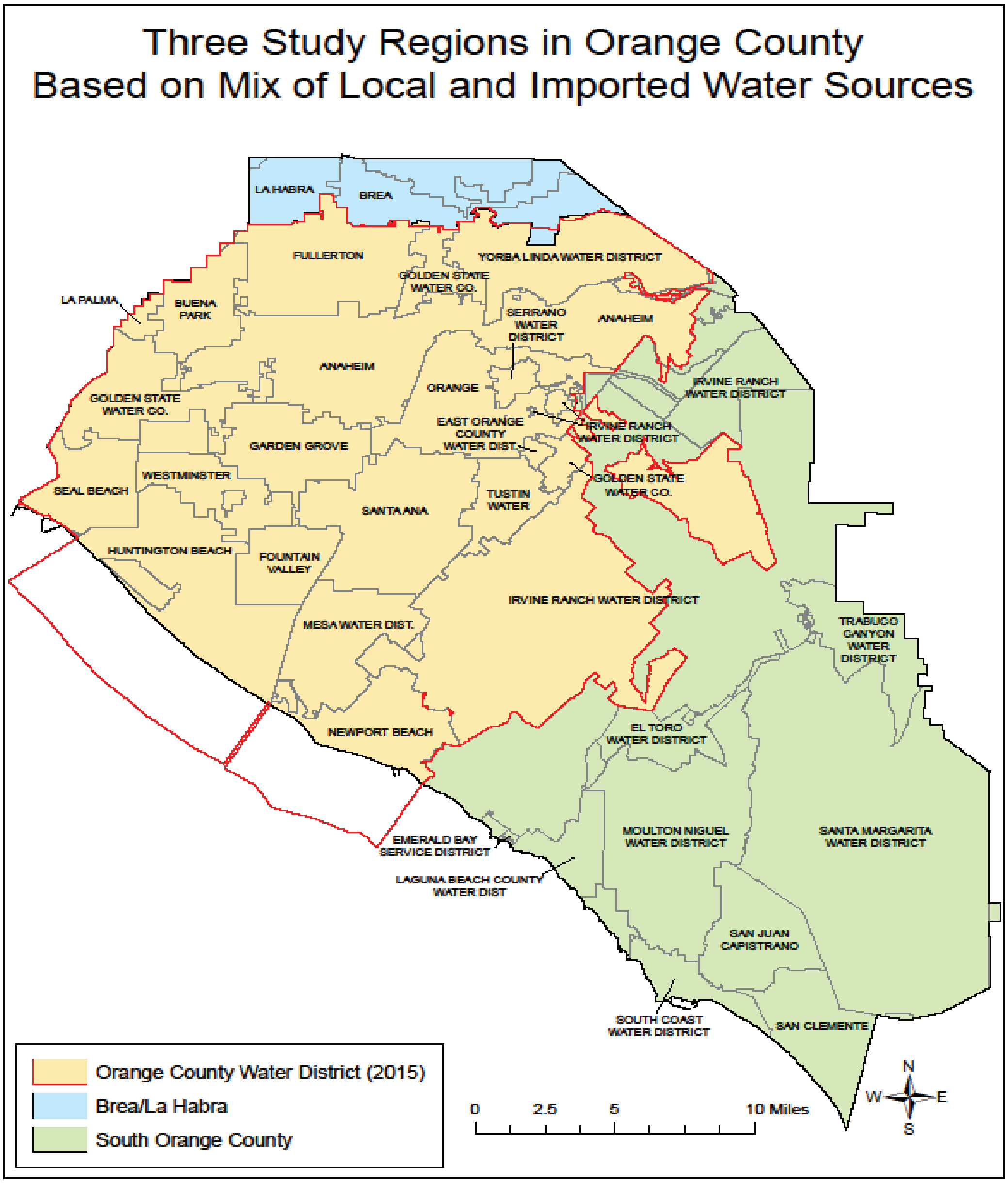


**Figure 1-1. Study Areas for OC Water Reliability Study**

The conclusions from the 2016 OC Study were as follows:

1) Without new supply and system investments made by MET, its member agencies and Orange County, projected water shortages would be too great and overall reliability would not be sustainable by as early as 2030, with shortages projected to occur in 8 of 10 years in 2040.

2) The California WaterFix (WaterFix) offers the most cost-effective solution for achieving supply reliability. However, it is prudent to examine contingencies should this project not be implemented. The implementation of the WaterFix would reduce shortages to 3 in 10 years by 2040 under moderate climate change conditions.

3) At the MET regional level, there are multiple paths of achieving supply reliability, including strategies other than the WaterFix. The study identified two portfolios that were fully reliable that did not include the WaterFix and one portfolio that was fully reliable that included the WaterFix.

4) Assuming MET Supply Portfolio B (one of six regional portfolios evaluated in the study)—which did not include the WaterFix but did include other MET investments—supply reliability for Orange County is greatly improved. MET Supply Portfolio B included the Carson Indirect Potable Reuse project, new water transfers, and new MET member agency local projects that were assumed to receive incentive funding from MET's Local Resources Program (LRP).

5) For the Brea/La Habra and the OC Basin areas, the potential supply shortages that were identified utilizing MET Portfolio B were deemed small enough to be managed by enhanced groundwater management or additional conservation.

6) For SOC, the remaining water shortages identified utilizing MET Portfolio B during droughts (supply reliability needs) and during an emergency outage event (system reliability needs) necessitated additional local water improvements.

7) Illustrative SOC portfolios of different combinations of new local base-loaded water supplies, emergency supply investments, and water transfers demonstrated that both supply and system reliability could be achieved in a cost-effective manner. Base-loaded projects are operated at a relatively constant supply rate throughout the year compared to projects that provide supplies only during specific peak summer periods or during droughts or dry-years.

## 1.2 Changed Conditions and Need for 2018 OC Study

One of the main recommendations from the 2016 OC Study was the need for "adaptive management" and periodic updates should future conditions change. Adaptive management is utilized to re-assess planned local projects to meet reliability based on success of regional MET projects, outcomes of regulatory actions, actual levels of demographic growth and water efficiency, and evolving understanding of the impacts of climate change. Normally updates to a planning study such as this would occur in 3 to 5-year cycles. However, shortly after the 2016 OC Study was finalized, several very important and impactful changed conditions occurred. The following changed conditions necessitated an early update to the 2016 OC Study:

- MET's Board approval of financial commitment for more than 60 percent of the total funding for the California WaterFix, including providing financial support to ensure construction of two tunnels for the WaterFix instead of just one. As such, the 2018 OC Study Update now assumes that the WaterFix will be operational by 2035 as a base condition. Our modeling/financial assumptions are that MET receives its share of the SWP portion of yield from only one of the tunnels and does not include any yield from the second tunnel. Also, for the financial projections, we have assumed there is no income from others contracting with MET for yield out of the second tunnel (a very conservative assumption).

- New climate change modeling from the Coupled Model Intercomparison Project Phase 5 (CMIP5) which indicates significantly greater future temperatures for the Colorado River Basin and California over and above what was utilized in the 2016 OC Study, but coupled with greater variability in future precipitation.
- The U.S. Bureau of Reclamation (BOR) has indicated that a declared water shortage for the Colorado River is likely within the next three to five years, given that Lake Mead water surface elevation has been hovering near the shortage declaration trigger since 2014. As a result, BOR is working to finalize a Drought Contingency Plan (DCP) that would implement cutbacks in Colorado River supplies to the Lower Colorado River Basin States before Lake Mead falls below 1,075 feet (the current trigger for a shortage declaration)—with California and MET agreeing to take earlier cutbacks in exchange for storage and operational flexibility when shortage conditions worsen.
- MET completed a very detailed engineering feasibility study for its Regional Recycled Water Program, located in the City of Carson, for indirect potable reuse (IPR) in several local groundwater basins within MET's service area (referred to in the OC Study as the Carson IPR). The feasibility study includes; refined project concepts for treatment and distribution of highly treated recycled water for groundwater recharge, detailed engineering cost estimates, enumeration of project benefits, and estimation of potential impacts on MET water rates.
- Newer information regarding local Orange County water supply projects (as a result of ongoing feasibility studies, grant funding and updated project terms) became available, and MWDOC Board direction to compare local projects in terms of cost-effectiveness in meeting reliability needs.

## 1.3 Purpose of 2018 OC Study

The 2018 OC Study has three main goals:

1) Determine the water supply and demand reliability impacts in Orange County due to changed conditions, specifically regarding implementation of the WaterFix, improved climate change modeling, and newer information becoming available from BOR for the implementation of the DCP for California and MET.
2) Evaluate/rank local Orange County water supply projects in a manner to allow discussion and debate; and to provide comparative information to help local agencies make decisions on moving projects forward.
3) Provide information for MWDOC to advocate on policy issues regarding MET's regional projects and water rates, 2020 Integrated Resources Plan (IRP) update, Local Resources Program (LRP) funding, Water Supply Allocation Plan (WSAP) issues, and groundwater replenishment needs as it relates to Orange County and Southern California. The findings from this study will also guide MWDOC in facilitating potential partnerships/agreements between or with multiple MWDOC agencies wishing to jointly implement projects.

**The 2018 OC Study differs from the 2016 OC Study by explicitly evaluating/ranking and comparing local water projects in terms of providing reliability benefits and cost-effectiveness. The intent of these project comparisons is to provide independent, objective and consistent information that can be used by local decision-makers. It is not the purpose of this study to dictate which projects local water agencies should implement.**

## 1.4 Water Reliability Defined

For the 2018 OC Study, the following water reliability terms were defined as:

- **System Reliability.** The continuing ability of a local water agency to meet customer water demands when there are unplanned emergency outages of key water facilities (e.g., treatment plants, conveyance, and distribution pipelines), caused by seismic events, facility failures, or other catastrophic events (typically for the duration of weeks or months). Water demand during these emergency events would be at reduced levels, most likely through mandated water use restrictions and requests for conservation of supplies. System reliability is needed to ensure public health and safety of residents and businesses in the area affected by the outage.

- **Supply Reliability.** Having enough water supplies to meet water demands under different hydrologic conditions, measured in terms of frequency (probability of occurrence), duration (length of occurrence), and magnitude (size) of water shortages. These water shortages can be caused by hydrologic droughts and/or limitations in supply availability due to regulatory constraints (e.g., Endangered Species Act). Water supply availability is driven by water contracts and appropriations, temperature, precipitation, and storage conditions; whereas water demand is driven by demographic/economic growth, levels of water use efficiency, and customer behavior. During severe and longer-lasting droughts, water agencies can help to manage available supplies by requesting water customers to reduce water usage (i.e., demand curtailment). However, studies in California have shown that frequent use of mandatory water use restrictions can lead to significant economic and quality of life impacts.[2] Supply reliability is needed to ensure long-term economic vitality and quality of life.

- **Water Rationing/Demand Curtailment.** Water Reliability does not mean the absolute elimination of water rationing. In fact, during major system outages it is expected that non-essential water uses (e.g., landscape irrigation) would be minimized for the duration of the outage to ensure enough water for public health and safety. As for the use of demand curtailment during droughts, there are generally two schools of thought: (1) it is acceptable that water agencies ask water customers to cutback significantly on water use during severe droughts; or (2) because of significant investments in permanent/structural water efficiency (e.g., plumbing codes, landscape ordinances, and utility conservation rebates for ultra-efficient devices and landscape transformation), water agencies should strive to

[2] Value of Water Supply Reliability for Orange County (Orange County Business Council, 2004); Socioeconomic Impacts of Water Shortages within the Hetch Hetchy Regional Water System Service Area (The Brattle Group, 2013); Economic Analysis of California WaterFix (David Sunding, PhD/The Brattle Group, 2018).

develop adequate supplies so that demand curtailments are minimized. In discussions with Orange County water agencies during both the 2016 OC Study and 2018 OC Study, most agencies believed it was appropriate to count on demand curtailments roughly 1 in 20 years (5 percent of the time), with expected curtailments to result in a 10 percent reduction in water use into the future. While it is true that during the most recent drought water demands were reduced by roughly 20 percent statewide, it is assumed that it will be more difficult for water customers to achieve such high reductions in the future due to "demand hardening". Demand hardening occurs because as water efficiency (from plumbing codes, landscape ordinance and utility rebates) increases there will be less ability to conserve additional water. In the end, however, it is up to local and regional water agencies to determine how frequent demand curtailment will be used and at what target reduction in customer water usage will be requested.

## 1.5 Study Process Overview

The 2016 and 2018 OC Studies are fundamentally different. The 2016 OC Study focused on developing methodologies and modeling tools to assess water reliability, and then applying them to one selected planning scenario (i.e., moderate future climate change with no WaterFix assumed, but with other potential MET investments to mitigate impacts). Numerous workshops were held with the Orange County water agencies during the 2016 study to jointly discuss and evaluate the planning and technical modeling assumptions used to assess water reliability. Coming out of the 2016 OC Study was the general consensus that the planning methodology and modeling assumptions were sound and appropriate. However, there were two major comments received after the 2016 OC Study was finalized, these being: (1) the study was too restrictive in terms of planning scenarios, in that only one scenario was carried forward for final analysis; and (2) the study's usefulness for decision-making was limited, in that specific projects were not objectively compared to each other. The 2018 study was designed to address these issues. The tools developed in 2016 were applied to four scenarios in the 2018 study that were designed to bookend likely conditions of climate change and regional project investments. All four scenarios included the WaterFix becoming operational in 2035, another key difference from the 2016 study.

Most of the MET and local water supply project information (e.g., supply yield, cost, project terms, potential operational dates) advanced from the conceptual levels used in the 2016 OC Study to feasibility levels for the 2018 study. While this has resulted in improved understanding of these projects and their potential costs and benefits; preliminary and full design of these projects may be several years out and could change the economics presented in this study. It is also noted that the project assumptions are based on published reports, evaluation summaries and contract terms provided by project sponsors; along with supplemental, conceptual analyses conducted by MWDOC that includes adding integration and chloramination facilities for regional projects. Additional, specific projects were then objectively evaluated to meet Orange County's water supply and system (emergency) reliability needs.

MWDOC worked closely with its member agencies and project proponents to verify project water yields, costs, and operational assumptions. MWDOC reviewed but did not independently corroborate numbers for each project analyzed. The emphasis of this consultative effort was to make sure the information and analysis were robust and consistent. MWDOC will continue to solicit input, suggestions and collaborative discussion with its agencies regarding the study results and any updates that may be required from time to time.

Contingency allowances were used in the cost estimates to account for unknown and unanticipated issues that might result in increased project costs as the projects proceed towards implementation. Because the estimates in our study came from a variety of sources, the cost assumptions and contingency assumptions varied somewhat as noted below:

**OC Water Reliability Study Cost Estimating Assumptions**

| Cost Factor | Doheny Local | Doheny Regional | San Juan Watershed | Integration Work on Poseidon | Emergency GW Pump-in |
|---|---|---|---|---|---|
| Land purchase cost | (1) | (2) | (3) | (3) | (2) |
| Cost contingency above estimated construction costs (4) | 42% | 42% | 49% | 42% | 38% |

(1) No cost was included because the project will use land that is already owned by SCWD.

(2) Included specific land purchase cost.

(3) No cost was included as it is anticipated that existing land or public right of way will be used.

(4) Each estimate was done slightly different in applying contingency amounts when subtotaling is utilized prior to the next contingency being added; the amount shown is the simple addition of the various contingency or mark-up factors; the actual contingency could be higher (i.e., compounded)

Additionally, the following should also be noted with respect to the analysis of local projects:

- If new information becomes available, updates can be made.
- It is expected that local agencies would use the information provided in this study as input into their decision-making process regarding potential future projects. It is not expected that local agencies would move forward with project implementation without further evaluation or technical work. This provides an opportunity for refined information, if necessary.
- The development of projects is a process and this 2018 study represents a snapshot in time. This is the way potential projects are always evaluated, with the best information at a given time. Cost estimates can/will change over time, and other factors might impact project implementation.

A number of comments for the 2018 study were related to the ability of planning studies to precisely, accurately, or reasonably produce reliable estimates of future conditions—which are then utilized to evaluate future supply needs and potential projects. Specific concerns ranged from what will climate change look like to how realistic are project cost estimates. No planning process will ever be perfect in accurately predicting the future. It is not a valid argument that projects cannot be evaluated and compared because future conditions cannot be precisely predicted. Decisions to implement projects are always made based on information that is known today. The use of reasonable assumptions, improved planning techniques and plausible scenarios to bound the future can be used along with adaptive management to re-assess conditions to minimize under-performing or over-investing in terms of reliability.

The 2018 OC Study represents a comprehensive assessment of current and future water reliability at the regional and local levels by MWDOC and CDM Smith that was made using the best available information to date. It also represents an objective evaluation of potential Orange County local water projects that is based on the most recent studies and terms by project proponents. The intent was to provide accurate, reasonable information to assist MWDOC, its member agencies and other agencies as they plan for the future. MWDOC believes that the project information used for the 2018 OC Study meets or exceeds the planning standards for assessing the relative benefits, costs, and trade-offs of implementing local projects in Orange County given our current understanding of hydrologic and regulatory risks, as well as knowledge of other projects under consideration by MET and its other member agencies.

## 1.6 Complexity in Evaluating Water Reliability

The work required to evaluate Orange County's water reliability is extensive. It not only requires estimating water demands and supplies in the County, but it also requires understanding and evaluation of MET's regional water demands, supplies and delivery system. And this understanding of MET's opportunities and constraints includes MET's goals for future water investments, including LRP funding for local water projects; and MET's policies and operations regarding regional storage, banking and water transfer programs, and local groundwater replenishment. And finally, evaluating water reliability for Orange County requires an understanding of what other MET member agencies are planning in terms of future water projects. Consequently, the complexity is increased because all of Southern California's water reliability is linked and falls under MET's Integrated Resources Plan (IRP) and MET's Water Supply Allocation Plan (WSAP). The MET IRP forecasts future regional water demands and local water supplies to determine future needs for regional water through the year 2050. Additionally, MET's WSAP is used during droughts to help balance water demands with limited water supplies by allocating imported water to its member agencies. This MET allocation is based on formulas that seek to balance reliability among agencies with varying amounts of local water supply. This has the effect of spreading some of the reliability gains from a local water project implemented by one agency to the rest of the MET region.

This reliability analysis is not static and requires sound assumptions to be made about when MET will augment their water supplies and the cost of these supplies so that Orange County water agencies can make the best decisions to move forward with local water investments. However, one thing we do know is that the future is uncertain. But this uncertainty should not prevent planning and implementation of needed projects. Adaptive management is key to balancing insufficient supplies vs. stranding significant investments if there is too much water. Adaptive management also requires periodic re-assessment over time.

Specifically, re-assessment should take into account the following:

- How are regional and local water demands tracking, as compared to forecasts? Are demographics changing differently than expected? Is water efficiency increasing faster or slower than anticipated?

- How are water deliveries from the State Water Project (SWP) and Colorado River Aqueduct tracking? Are new regulations resulting in greater constraints on imported deliveries? How will the implementation of the proposed BOR DCP impact CRA deliveries?
- What is the progress of the California WaterFix?
- What other new water supply investments will MET make? What will they cost? How will they perform?
- Will there be changes to MET's LRP, in terms of caps on investments or types of investments to qualify for the program?
- What water supply decisions will other MET member agencies make?
- How often and to what degree will MET implement its WSAP? Will changes be made in how MET water is allocated to reflect local agency implementation of higher-cost water supplies?
- What is the cost and availability of "Extraordinary Supplies" which ride on top of MET water supply allocations?
- What will be the impacts of future climate on water demands and water supplies? Will climate modeling under or over-estimate the need for additional water investments?
- What will MET's future water rates be?
- Which local water projects in Orange County will be implemented? What will they cost? How will they perform?

To provide context for the complexities involved in assessing water reliability and comparison of projects, relevant background information is provided in **Appendix A**.

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# Section 2

# MET Supply Reliability

Assessment of MET supply reliability for the 2018 OC Study was based on the same modeling methods used for the 2016 OC Study, but with updated assumptions and changed conditions, specifically on the Colorado River supplies. The analysis includes climate change modeling (two scenarios that encompass the range of plausible outcomes), two levels of future supply investments by MET, and an analysis of future MET rate impacts under the four planning scenarios outlined.

## 2.1 Climate Change Modeling

The 2016 OC Study utilized the Coupled Model Intercomparison Project Phase 3 (CMIP3) global climate models (GCMs), along with the 2000 Intergovernmental Panel on Climate Change's Special Report on Emissions Scenarios (SRES) A2 scenario, to estimate supply reliability impacts related to long-term changes in temperature and precipitation. In late 2014, CMIP Phase 5 (CMIP5) climate projections were released and are now starting to be used to re-evaluate water supply impacts by water agencies around the globe. The CMIP5 projections are considered superior in several key ways: (1) they are based on more intensive and higher resolution computer simulations; and (2) they are based on more physical variables such as atmospheric concentrations rather than the development scenarios used for CMIP3.

The CMIP5 models utilize Representative Concentration Pathways (RCP's) to show a range in climate projections based on radiative forcing (the difference between the incoming energy from sunlight and the energy radiated back into space). For the 2018 OC Study we utilized RCP8.5 for assessing potential impacts from climate change, which can be considered as a "business-as-usual" condition regarding future emissions of greenhouse gases (which assumes as a society we do not mitigate such impacts). While the RCP scenarios for CMIP5 and the SRES scenarios used for CMIP3 climate modeling are not exactly measuring the same conditions, they can be generally compared to each other as they both represent high levels of projected emissions of greenhouse gases. **Table 2-1** summarizes the comparisons of climate between CMIP3 SRES A2 GCMs used for the 2016 OC Study and CMIP5 RCP8.5 GCMs used for 2018 OC Study for the Sierra-Nevada Mountain Watershed (the area that impacts State Water Project supplies) and Upper Colorado River Basin (the region that impacts Colorado River supplies). The selection of CMIP5 RCP8.5 models for the 2018 OC Study were specifically made to ensure a minimal climate impact across the watersheds and another model to show large concurrent impacts on the Colorado River and State Water Project supplies. This allows us to bracket the impacts of climate modeling to better understand the potential future impacts.

**Table 2-1. Comparisons of Climate Models Used for 2016 and 2018 OC Studies**

| Region/Climate Parameter | Historical Period 1970-2000 | 2016 STUDY CMIP3 SRES A2 2045-2070 | 2018 STUDY CMIP5RCP8.5 2045-2070 |
|---|---|---|---|
| **Sierra-Nevada Mountain Watershed** | | | |
| Mean Annual Temperature (°F) | 48.6 | 53.1 | 54.1 |
| Annual Temperature Range (°F) | 48.0 – 49.5 | 50.0 – 54.1 | 51.4 – 55.8 |
| Mean Annual Precipitation (inches) | 36.2 | 36.0 | 39.1 |
| Annual Precipitation Range (inches) | 35.9 – 38.8 | 31.6 – 43.1 | 33.1 – 47.4 |
| **Upper Colorado River Basin** | | | |
| Mean Annual Temperature (°F) | 34.9 | 40.3 | 41.1 |
| Annual Temperature Range (°F) | 34.0 – 35.2 | 37.8 – 42.4 | 39.4 – 43.2 |
| Mean Annual Precipitation (inches) | 23.1 | 22.8 | 24.1 |
| Annual Precipitation Range (inches) | 22.8 – 24.1 | 19.4 – 25.7 | 20.1 – 28.0 |

What this comparison indicates for both the Sierra-Nevada Mountain Watershed and Upper Colorado River Basin is that future temperature predictions are greater than historical record temperatures and slightly greater than temperatures predicted from the 2016 OC Study climate modeling. This would result in lower snowpack volumes, leading to earlier spring runoff flows and less summer runoff flows (when water demands are greatest). On the other hand, the climate modeling used for the 2018 OC Study shows greater mean precipitation predictions than both historical records and climate modeling predictions used in the 2016 OC Study, but with substantial variability—meaning that some of the GCMs show less precipitation than historical while others show significantly more precipitation. For more details on the climate modeling used for the 2018 Study see **Appendix B**.

## 2.2 Drought Contingency Plan for Lower Colorado River Basin

The BOR has indicated that the likelihood of a declared water shortage for the Lower Colorado River Basin states (Arizona, Nevada and California)[3] is 57 percent by 2020, 68 percent by 2021, and 70 percent by 2022. A shortage declaration, under the 2007 Interim Guidelines (which currently govern shortages), is made when Lake Mead surface elevation is below 1,075 feet at the end of the water year. Since Lake Mead has never been below 1,075 feet at the end of the water year, and since the 2007 Interim Guidelines do not cover shortage provisions below 1,000 feet, it remains uncertain how BOR will allocate water supplies to Arizona, Nevada and California during a declared water shortage. To reduce the chances of Lake Mead hitting any shortage declaration threshold or the more drastic levels of shortages, the BOR has been developing a Drought Contingency Plan (DCP) for the Lower Colorado River Basin (with some changes also being made among the Upper Colorado River Basin States). The DCP is nearing final negotiations between Arizona, Nevada and California. **Table 2-2** shows the proposed reduction in Colorado River deliveries that each state would take during different Lake Mead levels beginning at surface elevation 1,090 (sooner than the prior trigger elevation) to below 1,025 feet.

[3] Per the 1922 Colorado River Compact and federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as 'The Law of the River'.

Of the California reductions in Colorado River deliveries, it is proposed that MET would incur 25 percent of the reduced deliveries.[4] The intent of the DCP is to start the allocations of water sooner than the prior trigger and to determine which states will accommodate certain levels of cutbacks as the Lake Mead level declines. In exchange for beginning the allocations sooner, California will receive benefits in the form of access to Intentionally Created Surplus (ICS) storage during shortage situations that are not currently allowed. ICS water in Lake Mead is defined as water that has been conserved through an extraordinary conservation measure, such as land fallowing. The DCP shortage provisions do not cover circumstances below a Lake Mead elevation of 1,000 feet. **Figures 2-1** and **2-2** graphically show the proposed DCP contributions by State and the elevations triggers as proposed.

**Table 2-2. Proposed BOR Draft Drought Contingency Plan for Lower Colorado River States**

| Jan 1 Lake Mead Elevation (feet) | Reductions in Colorado River Deliveries (thousand acre-feet) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2007 Interim Guidelines Shortages | | Draft Drought Contingency Plan Contributions | | | Combined Volumes (2007 Interim Guidelines + DCP Contributions) | | | |
| | AZ | NV | AZ | NV | CA | AZ | NV | CA | Total |
| >1075 to 1090 | 0 | 0 | 192 | 8 | 0 | 192 | 8 | 0 | 200 |
| >1050 to 1075 | 320 | 13 | 192 | 8 | 0 | 512 | 21 | 0 | 533 |
| >1045 to 1050 | 400 | 17 | 192 | 8 | 0 | 592 | 25 | 0 | 617 |
| >1040 to 1045 | 400 | 17 | 240 | 10 | 200 | 640 | 27 | 200 | 867 |
| >1035 to 1040 | 400 | 17 | 240 | 10 | 250 | 640 | 27 | 250 | 917 |
| >1030 to 1035 | 400 | 17 | 240 | 10 | 300 | 640 | 27 | 300 | 967 |
| >1025 to 1030 | 400 | 17 | 240 | 10 | 350 | 640 | 27 | 350 | 1,017 |
| >1000 to 1025 | 480 | 20 | 240 | 10 | 350 | 720 | 30 | 350 | 1,100 |

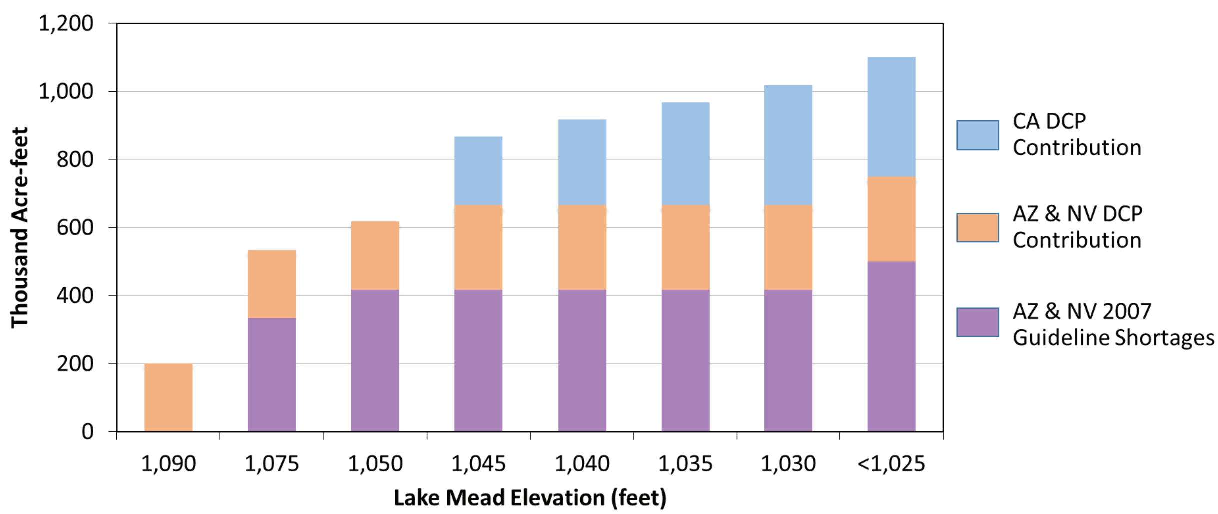
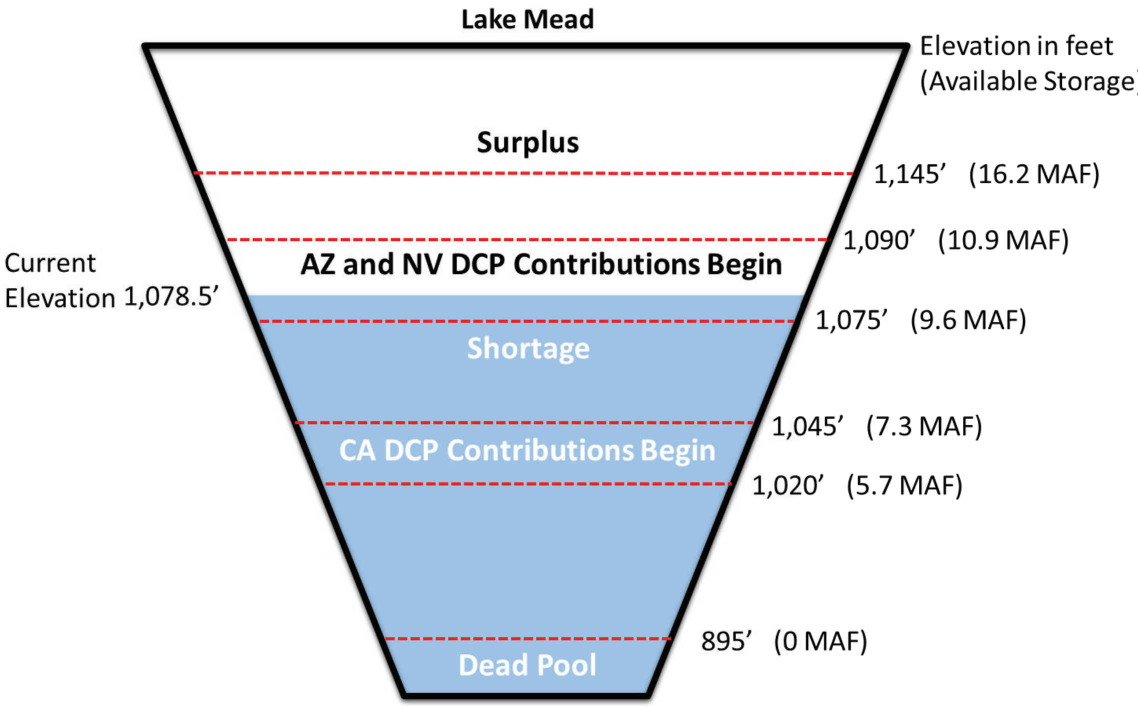



**Figure 2-1. DCP Contributions by State**

[4] Informational Board Letter to MET's Water Planning and Stewardship Committee (11/08/2016).




MAF = million acre-feet

**Figure 2-2. Lake Mead Trigger Elevations and Storage**

## 2.3 Combined Impacts of Climate Change and DCP

The 31 GCMs from various modeling institutes for CMIP5 RCP8.5 were analyzed in terms of their potential impacts to MET's State Water Project (SWP) and Colorado River Aqueduct (CRA) water supplies. Some of the climate models indicated very little change in historical hydrology for both the SWP and CRA, mainly due to offsetting higher precipitation and moderately warming temperatures. On the other end of the spectrum, there were a few climate models that showed reduced deliveries compared to historical records for both SWP and CRA supplies. And finally, there were some climate models that showed reduced deliveries to either the SWP or the CRA, but no or slightly improved deliveries for the other supply source. To cover the range of potential impacts, three representative GCMs were selected for review purposes:

1) CNRM, which has moderately reduced supply from the CRA, but minimal change in SWP supply;
2) MIROC, which has moderately reduced supply from SWP supply, but slightly improved supply from CRA; and
3) CSIRO, which has significantly reduced supply from CRA and moderately reduced SWP supplies.

**Figure 2-3** shows the expected SWP deliveries to MET (without any new investments and without the WaterFix) for the three climate models for the year 2050, along with an updated 2018 baseline which is based on historical hydrology through the year 2016. The CNRM GCM shows lightly reduced SWP deliveries during wet years, but slightly increased deliveries during dry years with average deliveries being close to the baseline. The MIROC GCM shows moderately reduced SWP deliveries during wetter years only; while the CSIRO GCM shows significant SWP deliveries for almost all hydrologic conditions.

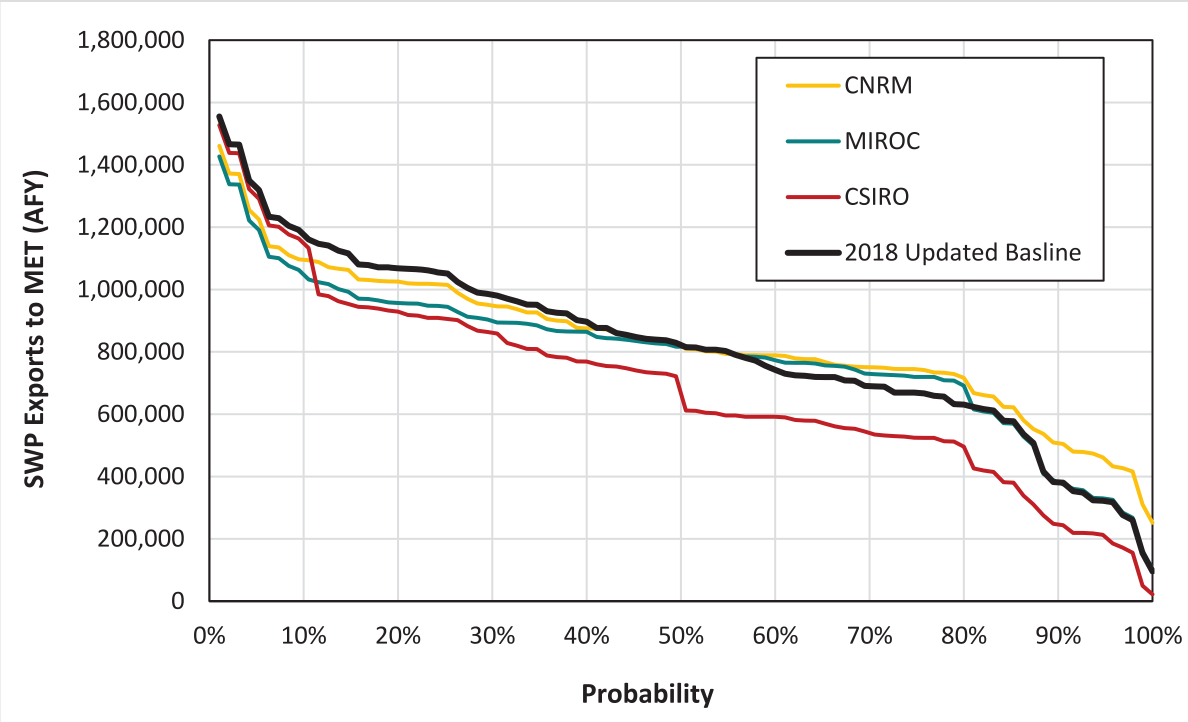



**Figure 2-3. SWP Deliveries to MET Under Different Climate Change Models in Year 2050 Without Any New Investments**

**Figure 2-4** shows the potential shortages in MET's CRA supplies (without any new investments) as a result of both the climate modeling and BOR DCP for the year 2050. It should be noted that under the CNRM and MIROC climate models, Lake Mead continues to fall well below 1,000 feet. As such, we assumed that shortages under these conditions (elevations below 1,000 feet) would be allocated to MET proportionately to each state's basic Colorado River apportionment; and within California, according to the current California 4.4 Plan.[5] Under the CNRM and the CSIRO modeling, the CRA shortages to MET can grow quite large because it is modeled that Lake Mead will fall below 1,000 feet and significant cutbacks will be needed. Under the historical baseline and the MIROC modeling, Lake Mead is not anticipated to fall below 1,000 feet, and thus shortages are limited to 88,000 AFY per the BOR DCP.

The overall impact of climate change and DCP on MET's supply reliability in the year 2050 is shown in **Figure 2-5**, without any new MET investments. For reference the climate change scenarios from the 2016 OC Study are also shown, these being Scenario 2 (moderate climate change) and Scenario 3 (significant climate change).

[5] In 1999, the California Colorado River Water Use Plan was drafted to outline the State's proposed plan to maintain its use of Colorado River water use at 4.4 million acre-feet a year, down from prior higher levels of use, when there were unused water supplies for the Lower Basin States.

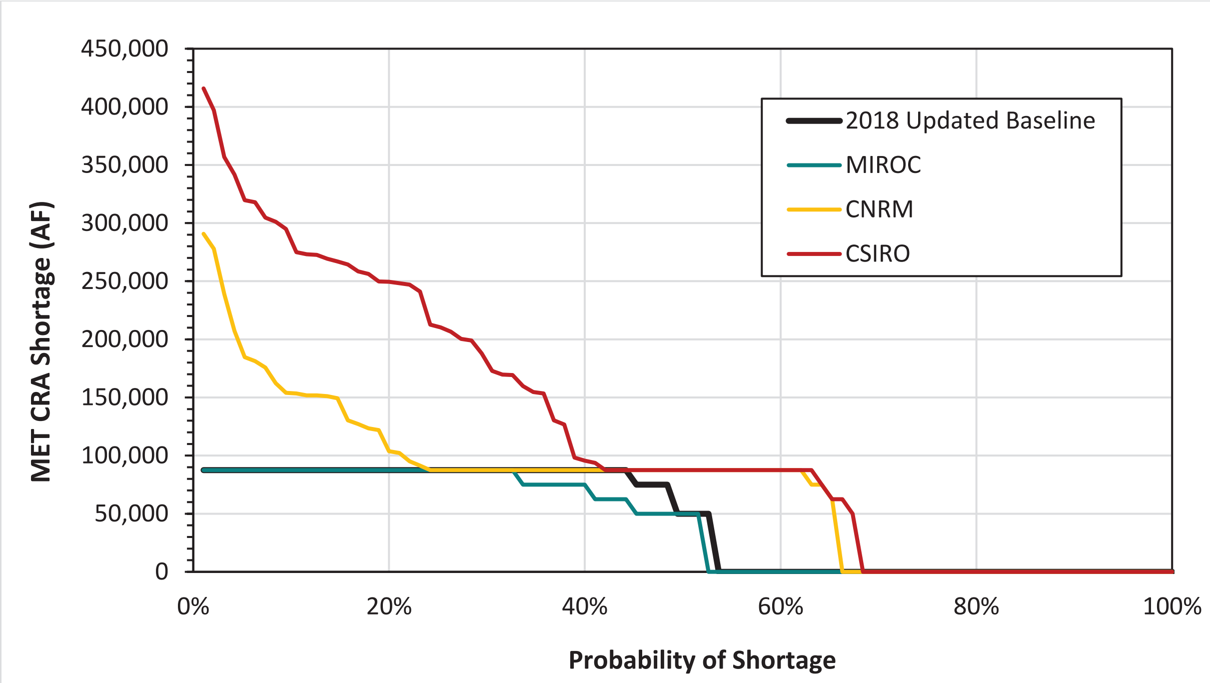



**Figure 2-4. Shortages in MET CRA Deliveries Under Different Climate Change Models with DCP in 2050 Without Any New Investments**

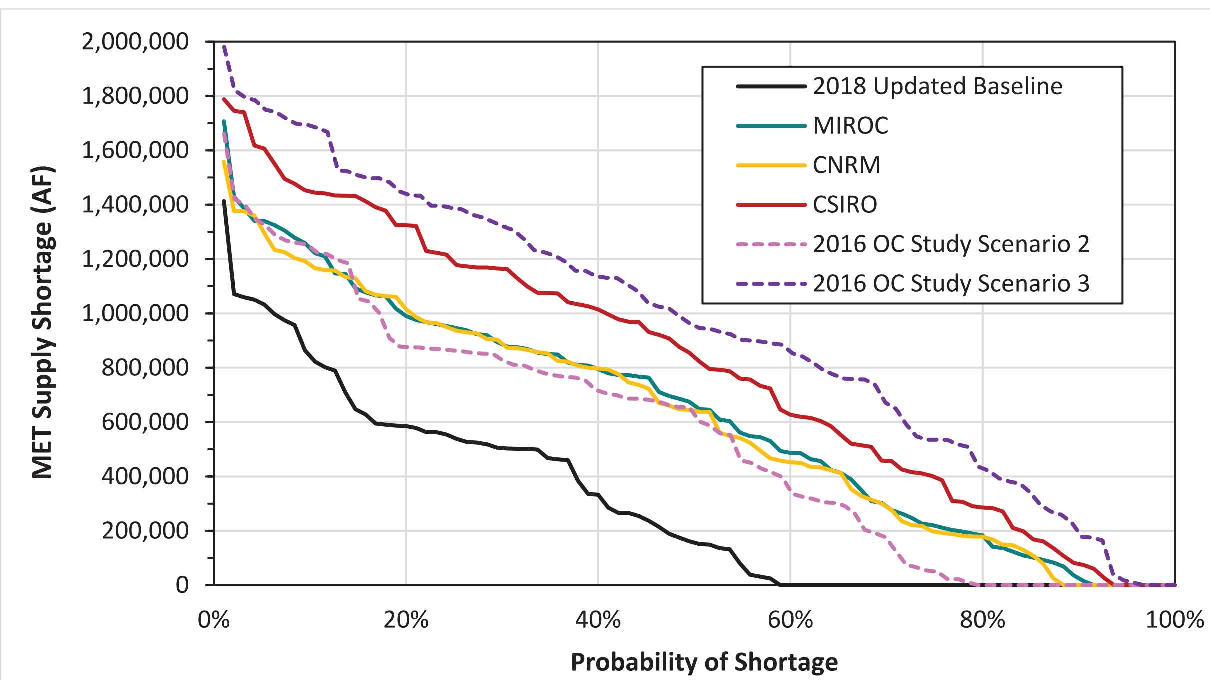



**Figure 2-5. Overall Impacts of Climate Change and DCP on MET Supply Reliability in Year 2050 Without Any New Investments**

What **Figure 2-5** indicates is, that for compensating reasons, the CNRM and MIROC climate models used for 2018 OC Study have similar overall impacts on MET reliability, and both model impacts are close to the impacts of Scenario 2 (moderate climate change) used for the 2016 OC Study. The CSIRO climate model used for the 2018 OC Study is significantly worse for MET reliability, especially compared to the historical Baseline. However, the CSIRO climate model impact is less than Scenario 3 (significant climate change) used for the 2016 OC Study. All models show a worse situation than the historical period.

## 2.4 Planning Scenarios for 2018 OC Study

Four planning scenarios were developed for the 2018 OC Study. The scenarios included two dimensions: (1) two climate change scenarios, both coupled with the DCP for CRA; and (2) two different levels of new MET investments, one called low-cost and one called high-cost. The high-cost MET investments are intended to improve supply reliability in both of the climate change scenarios. To illustrate the full range of possible climate change impacts for planning analysis, it was decided that one of the climate change scenarios should only include minimal impacts to the SWP supplies (which are imbedded in California Department of Water Resources modeling); while the other climate scenario should be based on the CSIRO GCM, which results in significant impacts to both MET's SWP and CRA supplies.

Assumptions regarding water demands and OC Basin assumptions regarding Santa Ana River baseflows from upstream wastewater discharges remained unchanged from Scenario 2 of the 2016 OC Study.

For both of the climate scenarios it was assumed that there would be additional MET and MET member agency investments to improve supply reliability, as this has been the demonstrated case now for several decades. Even right now, MET Board is considering an additional storage investment in the Antelope Valley East Kern Water Bank to increase the amount of put and take water into groundwater storage by about 70,000 acre-feet per year (AFY). This investment is being considered because MET realized its SWP allocation can drop below 5 percent (which was the case in 2016) and it was difficult for MET, under those circumstances, to meet demands in its SWP-only service territory (western portion of MET). This example of adaptive management and these types of investments are expected to continue.

The four planning scenarios are defined as:

1A – Minimal Climate Change with Low-Cost MET investments (including the WaterFix)

1B – Minimal Climate Change with High-Cost MET Investments (additional to 1A)

2A – Significant Climate Change with Low-Cost MET investments (including the WaterFix)

2B – Significant Climate Change with High-Cost MET investments (additional to 2A)

All four scenarios are considered to be "plausible" and therefore, no formal probabilities are assigned a likelihood of one scenario occurring over another. In addition, the scenarios are internally consistent—meaning that both the low-cost and high-cost MET investments are greater for Scenario 2 than compared to Scenario 1, as water needs are increased in Scenario 2 due to greater climate change impacts.

Furthermore, the distinction between low-cost and high-cost MET supplies is not based on a specific unit cost threshold but rather reflects the reality that as more water supplies are needed they become more expensive than prior supplies developed. **Table 2-3** presents the new MET supplies assumed for the four planning scenarios that were used for the 2018 OC Study. It should be noted that these new MET supplies are only used for planning purposes and do not necessarily reflect implementation commitments by MET.

**Table 2-3. Assumed New MET Supply Investments for 2018 OC Study Planning Scenarios**

| New MET Supply Investments (thousand acre-feet) | Planning Scenarios | | | |
|---|---|---|---|---|
| | Scenario 1. Minimal Climate Change Impacts | | Scenario 2. Significant Climate Change Impacts | |
| | A. Low-Cost | B. High-Cost | A. Low-Cost | B. High-Cost |
| WaterFix (average) | 440 | 440 | 440 | 440 |
| CRA Transfers (base loaded) | 100 | 100 | 100 | 100 |
| LRP (base loaded) | 88 | 88 | 88 | 88 |
| SWP Transfers (dry year) | 0 | 150 | 150 | 150 |
| Carson IPR (base loaded) | 0 | 168 | 0 | 168 |
| More LRP (base loaded) | 0 | 0 | 74 | 74 |
| More CRA Transfers (dry year) | 0 | 0 | 80 | 80 |
| More SWP Transfers (dry year) | 0 | 0 | 0 | 150 |
| Regional Surface Reservoir | 0 | 0 | 0 | 400 |
| **Total Base Loaded Supplies** | **628** | **796** | **702** | **870** |
| **Total Dry Year Supplies** | **0** | **150** | **230** | **380** |
| **New Storage** | **0** | **0** | **0** | **400** |
| **Total Supplies and Storage** | **628** | **946** | **932** | **1,250** |

Notes: Base loaded supplies are those delivered every year, while dry year supplies and storage are utilized only when needed. The yield for the WaterFix represents the average difference between MET SWP deliveries under degraded existing conditions and deliveries with the WaterFix project, but actual SWP deliveries under the WaterFix will vary by hydrology.

As shown in Table 2-3, the WaterFix is included in all of the scenarios, as are additional base loaded CRA transfers and LRP investments. High-cost MET investments include the addition of MET's proposed Carson IPR project and new SWP transfers for Climate Scenario 1; with even greater CRA transfers, SWP transfers and LRP investments, along with a new regional surface reservoir, for Climate Scenario 2.

The assumed timing for these new MET investments shown in Table 2-3 are presented in Figure 2-6. While this assumed timing was based on reasonable assumptions, as well as cited MET studies, it should not be interpreted as official projections from MET.

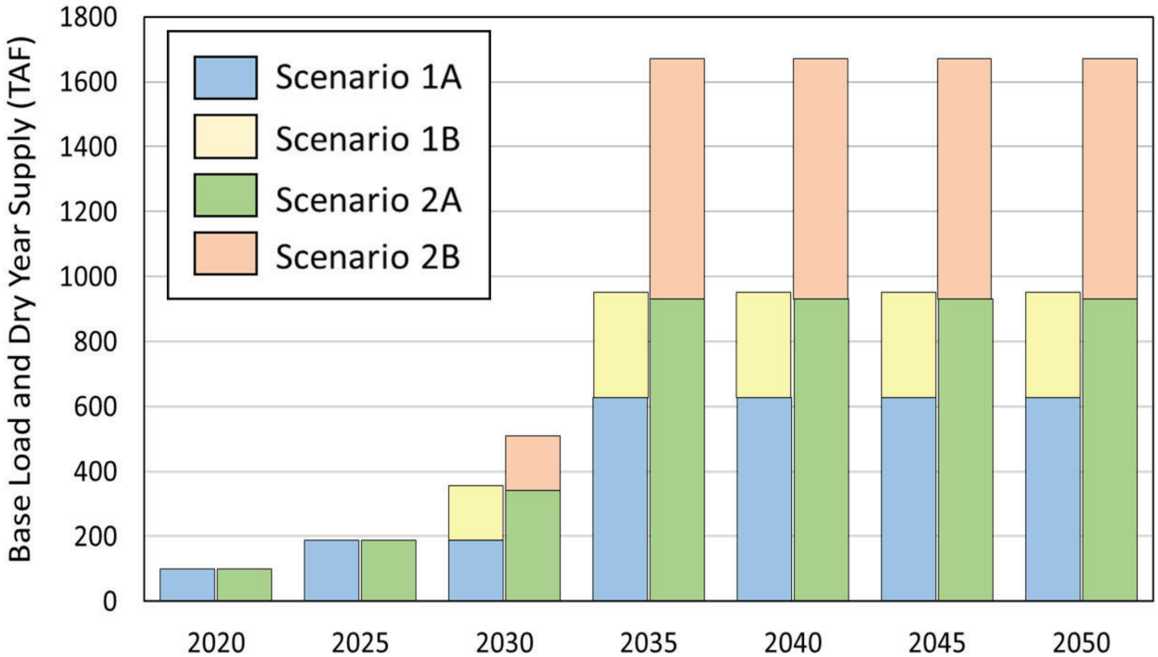



**Figure 2-6. Projected Water Supply for New MET Investments Assumed for 2018 OC Study**

## 2.5 Projected MET Water Rates

Using MET's published rate projections through 2028 as the baseline starting point, the future costs associated with the new MET supplies beyond 2028, as shown in Table 2-3, were estimated and used to extend MET rate projections to 2050 for each of the four scenarios. As more water supply investments are needed to maintain reliability, the projected MET rates are the highest under Scenarios 1B and 2B as the high-cost MET investments are assumed to be made (e.g., MET's Carson IPR project is estimated to cost $2.7 billion). Assumptions for the MET investments and how costs were allocated among MET's water rate components are summarized in **Appendix C**.

For the 2018 OC Study, MET's tier 1 treated volumetric water rate plus MWDOC's portion of MET's RTS and Capacity Charge (converted to $/AF) was used to represent the MET cost that could be avoided with development of new local water supplies in Orange County. It should be noted that the current rate structure and allocation of MET costs from 2018-2028 is assumed to continue to 2050. It is, however, certainly possible that MET's current rate structure and allocation of costs will change over time.

**Figure 2-7** presents the projected cost of MET water (this is also the avoided MET cost ($/AF) used in the economic evaluations) to Orange County water agencies for the four scenarios. These costs are presented in future year dollars, with escalation. Scenarios 1A and 2A are projected to increase at slightly lower rates of growth than historical increases in MET's water rates, while Scenarios 1B and 2B are projected to increase at slightly higher rates of growth than historical MET water rates.

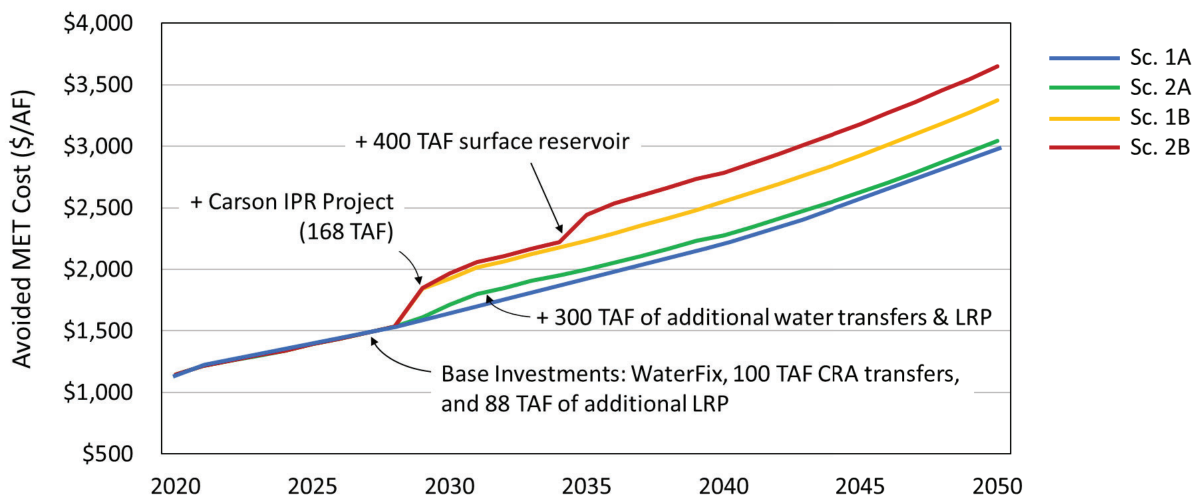



**Figure 2-7. Projected Cost of MET Water (Avoided MET Cost) to Orange County**

## 2.6 MET Supply Reliability for Planning Scenarios

For the 2018 OC Study, supply reliability curves were estimated using a regional Water Evaluation And Planning (WEAP) model to provide an indication of the likelihood (probability) that regional water shortages would occur, and the magnitude of those water shortages for each year they occur. In this modeling, shortages are estimated when MET cannot supply enough water from its SWP, CRA, storage and water transfer sources to meet its water demands. The model uses historical hydrology from 1922 to 2016 superimposed on future water demands. The historical hydrology dictates the availability of water from the SWP and CRA, as well as modifies demands on MET. MET is a swing supply, meaning when local supplies from its member agencies are very low, MET demands increase significantly (upwards of 10-15 percent increase over average), and vice versa when local supplies are high. The model also simulates storage operations, with "puts" to storage occurring when MET has excess SWP and CRA supplies, and "takes" occurring when SWP and CRA supplies are not sufficient to meet demands. Storage levels are kept track of in the model, and when levels become low the model augments storage with MET's water transfers. When all sources of MET water cannot meet demands, shortages are estimated. The historical hydrology is modified by future climate change.

Using the results from the modeling of regional water supplies and demands, supply reliability curves for MET were generated for each forecast year and for each planning scenario. To interpret these reliability curves, the following guidance should be noted:

- The probability of the supply shortage is read along the X axis
- The magnitude of the supply shortage is read along the Y axis
- The supply reliability curve (different colored lines) indicates the junction between the probability and magnitude of shortages for a given scenario

**Figure 2-8** presents a summary of modeled MET supply reliability for Scenario 1 (Minimal Climate Change); under no new investments (without WaterFix), under low-cost MET investments (Scenario 1A) and under high-cost MET investments (Scenario 1B).

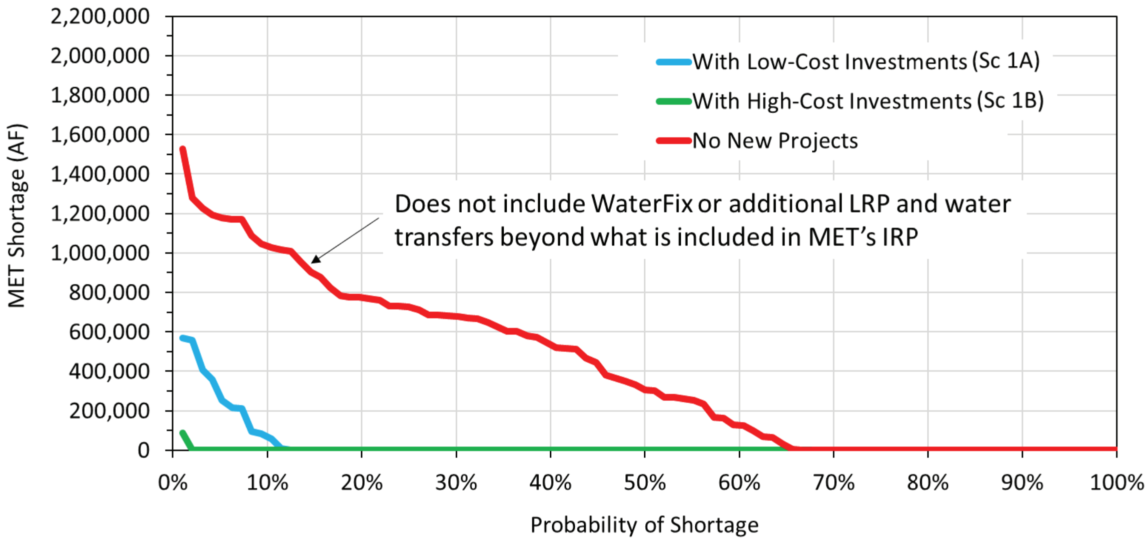



**Figure 2-8. MET Water Supply Reliability in 2050 for Scenario 1 – Minimal Climate Change Impacts (with Assumed Dry-Year MET Water Demands of 2.4 Million Acre-Feet)**

The red line in Figure 2-8 shows that without the WaterFix and other investments identified in MET's IRP, shortages will occur about 65 percent of the time and be as great as 1.5 MAF in year 2050, without implementation of MET's WSAP or demand curtailment at the local agency level. The 'no-investment' red line reliability curve does not represent a valid scenario for planning as it assumes no actions by MET or its member agencies would occur to improve conditions over time. The blue line (Scenario 1A) in Figure 2-8 shows great improvement in supply reliability (mainly as a result of the WaterFix and additional LRP investments in local water supplies), with shortages expected to occur 11 percent of the time and be as great as 0.6 MAF. When Carson IPR project and additional water transfers are added (the green line in Figure 2-8), MET is essentially fully reliable, and by extension, the MET region would be fully reliable for Scenario 1B.

**Figure 2-9** presents a summary of modeled MET supply reliability for Scenario 2 (Minimal Climate Change); under no new investments (without WaterFix), under low-cost MET investments (Scenario 2A) and under high-cost MET investments (Scenario 2B).

The red line in Figure 2-9 shows that without the WaterFix and other investments identified in MET's IRP, shortages will occur about 93 percent of the time and be as great as 2.2 MAF in year 2050, without implementation of MET's WSAP or demand curtailment at the local agency level. The 'no-investment' red line reliability curve does not represent a valid scenario for planning as it assumes no actions by MET or its member agencies would occur to improve conditions over time. The blue line (Scenario 2A) in Figure 2-9 shows great improvement in supply reliability (mainly as a result of the WaterFix and additional LRP investments in local water supplies), but under this significant climate change scenario shortages are expected to occur 35 percent of the time and be as great as 1.5 MAF. When Carson IPR project plus additional water plus additional LRP plus a new surface reservoir are added (the green line in Figure 2-9), MET reliability improves more, but is not fully reliable for Scenario 2B. Shortages under this scenario are modeled to occur about 15 percent of the time and be as great as 0.9 MAF.

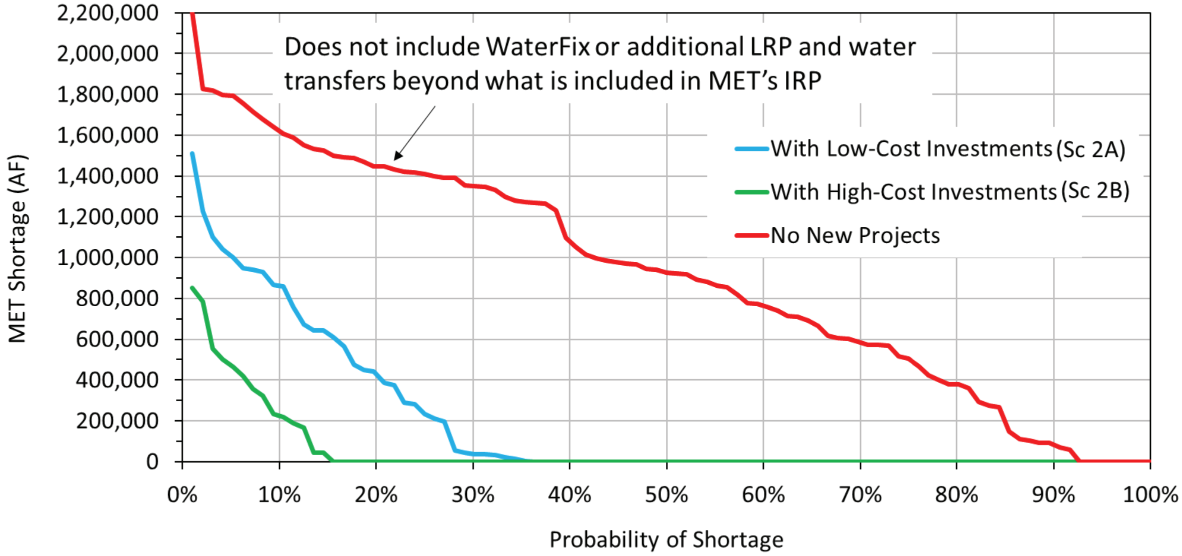



**Figure 2-9. MET Water Supply Reliability in 2050 for Scenario 2 – Significant Climate Change Impacts (with Assumed Dry-Year MET Water Demands of 2.6 Million Acre-Feet)**

**Table 2-4** summarizes the MET supply reliability for years 2020, 2030, 2040 and 2050 for the four scenarios and is another way of capturing and presenting statistics from the reliability curves.

**Table 2-4. MET Supply Reliability for OC Study Planning Scenarios**

| MET Shortages | 2020 | 2030 | 2040 | 2050 |
|---|---|---|---|---|
| Scenario 1A | | | | |
| Probability of Any Shortage (%) | 1% | 6% | 8% | 11% |
| Maximum Shortage (AFY) | 18,400 | 541,300 | 497,600 | 570,130 |
| Average Shortage (AFY) | 190 | 11,803 | 19,800 | 29,400 |
| Scenario 1B | | | | |
| Probability of Any Shortage (%) | 1% | 2% | 0% | 1% |
| Maximum Shortage (AFY) | 18,400 | 373,500 | 0 | 88,130 |
| Average Shortage (AFY) | 190 | 4,000 | 0 | 920 |
| Scenario 2A | | | | |
| Probability of Any Shortage (%) | 2% | 27% | 24% | 35% |
| Maximum Shortage (AFY) | 211,700 | 1,269,600 | 1,284,070 | 1,511,700 |
| Average Shortage (AFY) | 2,371 | 93,580 | 128,120 | 186,470 |
| Scenario 2B | | | | |
| Probability of Any Shortage (%) | 2% | 18% | 8% | 15% |
| Maximum Shortage (AFY) | 211,700 | 1,101,900 | 527,700 | 853,130 |
| Average Shortage (AFY) | 2,371 | 56,620 | 16,300 | 53,600 |

Note: Average MET water demands start from 1.85 to 1.95 million acre-feet/year (MAF) in 2020 and increase to 2.13 to 2.23 MAF by 2050, depending on climate scenarios.

The following should be noted in interpreting results shown in Table 2-4.

- The severity of climate change increases both the probability and size of MET water shortages, as seen by moving from Scenario 1 to 2, with Scenario 2A having the worst reliability levels.
- Additional supply investments help improve reliability, decreasing both the probability and size of MET shortages, as seen by moving from Scenarios 1A to 1B, and from Scenarios 2A to 2B.
- The WaterFix is assumed operational in 2035, which is why 2030 generally has the greatest shortages among the scenarios; with shortages in 2040 and 2050 being reduced.
- The average shortages can be viewed as the magnitude of new base loaded supplies needed by MET (or its member agencies) to close the reliability gap, assuming MET can store sufficient water in the wetter years and draw from this storage in drier years.
- The Carson IRP project is the greatest single reliability improvement in moving from Scenarios 1A to 1B, and from Scenarios 2A to 2B. This is the case because of it is a base loaded supply which increases overall regional storage (surface and groundwater) in wetter years. Then in drier years, the stored water plus the base loaded project water are both used, providing double benefits.
- Investments will be needed between now and when the WaterFix becomes operational to help maintain reliability. These could involve Water Banking or Transfers, as well as base loaded supplies.

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# Section 3

# Orange County Water System (Emergency) Needs

## 3.1 Background

Water systems in Southern California are vulnerable to seismic events (as well as other unplanned catastrophes) that can result in varying degrees of water disruptions for periods of days, weeks and months. Seismic events could sever pipelines and groundwater wells, and cause major damages to water treatment plants. While seismic events are difficult to predict, we know they will happen, and we know we must be prepared. During these emergency conditions, water will be needed for public health and safety, with the desire that water outages will not delay any community from recovery after a major earthquake. Specifically, in this context, recovery means there should be sufficient water to meet the basic indoor needs of the residential population, plus sufficient water to allow industry, commercial, institutional and municipal customers to continue near normal operations. It is assumed that non-essential uses of water, such as landscape irrigation, will be mostly curtailed for the duration of the water outage.

It is recognized that within the first hours to days after a major earthquake, there may be variations in water demand due to the following issues:

- Damage to distribution system pipelines can cause severe leakage of water in the system, resulting in drop in pressure until such time that the leaking pipelines can be valved off and eventually repaired. High flows due to leaks will also significantly reduce the water pressures in the undamaged pipes.
- Fires may ignite after a major earthquake. If these fires are large or spread substantially, there may be a material increase in water demands.
- Concurrent earthquake damage to the Orange County end-user water customers (residences, commercial, industrial, etc.) will alter normal water demands by those users.
- Water systems near the epicenter or with adverse geology or that rely on supplies that cross the epicenter may be totally without water whereas other systems may only suffer minor damage.

The Water Emergency Response Organization of Orange County (WEROC) recommendations for emergency water supplies for homeowners for drinking, cooking and sanitation purposes is three gallons per person per day to supply needs for an initial outage duration of up to 7 days. Simple repairs to water systems may be completed in 7 days whereas more complex repairs may take longer. Significant damages to a distribution system will take numerous rotations of repair leaks, refill pipelines, re-pressurize pipelines, locate additional leaks, shutdown pipelines, drain pipelines, repair pipelines and start over again.

A study completed by MWDOC's consultant John Eidinger from G&E Engineering Systems, Inc. examined wells in the OCWD groundwater basin and the susceptibility of the wells to the four primary hazards induced by earthquakes (seismic or co-seismic forces):

- Ground Shaking
- Liquefaction
- Landslide
- Surface faulting

Out of the 199 wells 77 are in liquefaction zones. Wells in liquefaction zones are those that are most at risk to major damage due to permanent ground deformations. However, as outlined in the report, it is expected that only a few of these 77 wells will be subject to major ground deformations in any single earthquake. The worst case earthquakes for wells include the Compton and Newport Inglewood that would cause functional outages of approximately 8 wells, primarily in the Fountain Valley, Huntington Beach, IRWD, Mesa, Newport Beach, Golden State Water Company and Westminster areas. This does not account for damage at wellhead facilities that would typically result in outages of several days to repair damaged piping or electrical connections caused by ground shaking.

This section of the study updates the system (emergency) reliability needs for SOC. The OC Basin and Brea/La Habra areas did not have system reliability needs due to access to local groundwater through many wells that could be used during an extended outage of MET treated water deliveries. It should be pointed out that it is recommended that the OC Basin and Brea/La Habra review their back-up generator capacities to ensure sufficient supplies can be delivered in the event of an extended duration power grid outage.

## 3.2 SOC System Needs During MET System Outages

MWDOC has been working with the SOC agencies for a number of years on improvements for system (emergency) reliability primarily due to the risk of earthquakes causing outages of the MET imported water system as well as extended power grid outages. Substantial progress has been made because of projects like:

- Upper Chiquita Reservoir (750 AF)
- Expansion of storage in ETWD's R-6 Reservoir (750 AF)
- Construction of the IRWD SOC Emergency Interconnection – max delivery 20 – 30 cfs under the Agreement Between MWDOC, IRWD and OCWD
- Construction of the Baker Treatment Plant which serves up to 43.5 cfs of water into SOC

**Figure 3-1** provides a map of Orange County showing the major water lines and the well locations (black dots) within the OC Basin; while **Figure 3-2** shows the idealized faulting in Orange County with the same pipeline and well infrastructure, which are the locations where fault displacement or high intensity shaking can result in damages to these facilities.

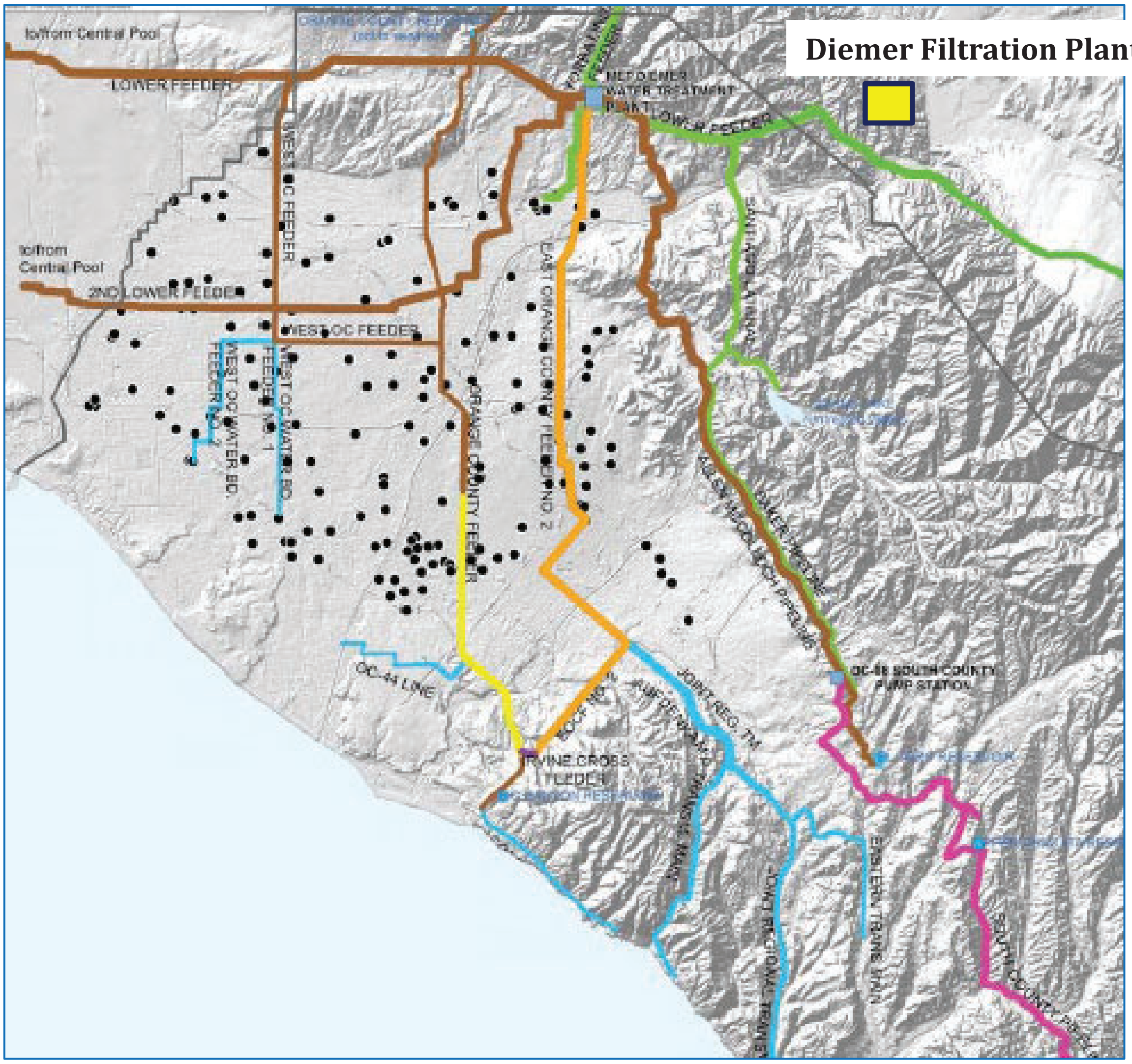


**Figure 3-1. Major Pipelines, Wells and MET's Diemer Filtration Plant in Orange County**
(The well locations are shown as black dots).

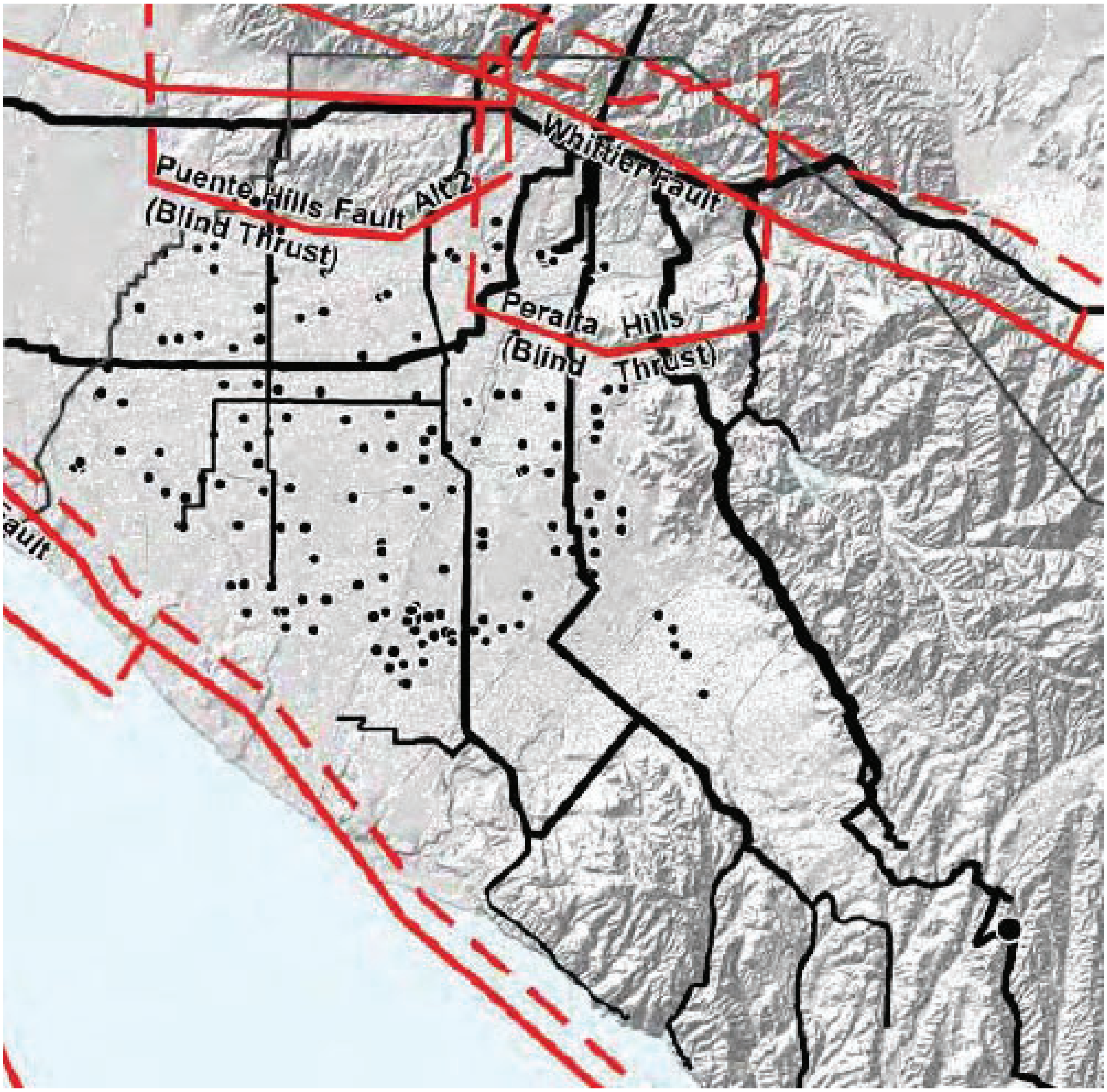


**Figure 3-2. Idealized Faults for Ground Motion Evaluations**

MET does not have specific recommendations for their member agencies regarding planning for the durations of facility outages due to earthquakes or other events, other than MET requires its agencies to be able to accommodate a planned 7-day outage during periods of annual average demands. MET can request longer duration planned shutdowns but must provide a 1-year notice to its agencies of such an outage. For emergency planning, MET's current policy is to retain 630,000 AF of water in storage to help meet the emergency needs of its member agencies. MET assumes a 25% demand curtailment during the shortage event and previously expected all local regional import facilities to be up and operating within 6 months. These criteria are being reviewed and evaluated at this time.

Furthermore, MET and MWDOC worked together several years ago to determine the likely "time to restore" regional import or treatment facilities to partial operations based on the location of earthquake faults in OC and the potential maximum considered earthquakes. This information is summarized in **Table 3-1**. Based on these conditions, MWDOC developed the criteria that its agencies should plan for a 100% interruption of MET supplies for up to 60 days with a concurrent power grid outage for a minimum of 7 days. MET concurred that these criteria were appropriate for OC. These criteria essential mean that the retail agencies are on their own for up to 2 months following a major earthquake in OC. During that time work will be prioritized in the MET system to enable the largest number of people to be served. **Table 3-1** provides a summary of the outage durations currently posited by MET.

Of particular concern is a concurrent outage of the CRA, the SWP and Los Angeles Aqueduct (LAA) [brings water from the east side of the Sierra Mountains to Los Angeles] caused by a San Andreas Fault rupture of the entire Southern Section from the Salton Sea to north of the Tehachapis. An outage of all three key facilities would place a huge strain on local supplies and supplies in storage and would require substantial water conservation (demand curtailment) to meet demands during the restoration period. MET, DWR and LADWP have formed a Task Force to examine what further precautions can be taken to help mitigate for emergency water needs in Southern California given that about 50% of our water supplies are imported from outside the region. It is likely that a recommendation will be made to work with Southern California Groundwater Basin Managers to increase storage and increase put and take capacity from the groundwater basins to help meet emergency needs. This will likely take a number of years to bring to fruition.

**Table 3-1. MET Seismic Performance Expectations Estimated Outage Durations**

| MET Seismic Performance Expectations Estimated Outage Durations | |
|---|---|
| **Facility** | **Maximum Considered Earthquake** |
| Metropolitan – CRA (Colorado River Aqueduct) | 2-6 months |
| Dept. of Water Resources – SWP (State Water Project East & West Branches) | 6-24+ months<br>(under study at this time) |
| Metropolitan Conveyance & Distribution Pipelines | 1 week<br>to 3 months |
| Metropolitan Treatment Plants | 1-2 months (Partial flow)<br>Up to 6 months (Full capacity) |

MWDOC then worked primarily with its SOC agencies (due to the limited local supplies available in the event of an outage of the import system) and analyzed a number of water demand scenarios with the SOC agencies to estimate the additional system reliability needs during outages of MET treated water deliveries. The scenarios included the following assumptions:

- Demand curtailment at some level is a reasonable expectation during an extended emergency event. If an outage lasted 60 days or greater, it was generally concurred by SOC retail water agencies that water customers would be supportive of curtailing upwards of 100 percent of outdoor irrigation water use (about 50% of overall water use). Some also thought that business demands should be provided for rather than assuming businesses would shut down for the entire 60-day recovery period. While there were many ways to determine what level of water demand this would constitute, two methods of estimating water demand needed for public health and safety and to protect businesses were developed using two methods:
  - 75 percent of annual average demand for fiscal year 2017-18 (similar to a winter low demand with little irrigation use)
  - 2040 indoor residential usage at 55 gallons per capita per day (gpcd) + 2040 Commercial, Industrial, Institutional (CII) (business) demands estimated for the OC Study
- The additional system reliability needs were calculated as the "recovery period needs" by assuming:
  - Water in emergency storage reservoirs is utilized for at least 60 days
  - Locally produced groundwater and use of emergency storage water can be moved throughout SOC agencies' distribution system
  - Untreated MET water, and potentially water from Irvine Lake, will be treated to the maximum capacity of the Baker Water Treatment Plant (Baker WTP) currently 43.5 cfs to continue delivering water into SOC. IRWD's ownership is 10.5 cfs, leaving 33.0 cfs for the remaining parts of SOC.
  - Water from the Irvine Ranch Water District (IRWD) SOC Regional Interconnection is <u>not</u> available. [This assumption was made because a study is currently underway to determine if additional capacity can be developed through IRWD or via the pump-in to the East Orange County Feeder #2 pipeline (EOCF#2). The study is targeted for completion in January 2019.]

The range of additional system recovery needs for SOC are shown for the two water demand methods in **Table 3-2**.

**Table 3-2. Range of System Reliability Needs for SOC Under Two Water Demand Methods**

| Summary of Emergency Reliability Needs in MGD for SOC Assumes NO Emergency Capacity from the SOC Interconnection | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 75% Normalized Potable | Recovery Needs from OC GAP Analysis at | Recovery Needs CFS | Recovery Needs MGD | Demands at 2040 Indoor at 55 gpcd + | Recovery Needs from OC GAP Analysis with 2040 | Recovery Needs CFS | Recovery Needs MGD |
| El Toro WD | 3,673 | 194 | 0.4 | 0.3 | 4,557 | 1,195 | 2.7 | 1.7 |
| Laguna Beach CWD | 1,580 | 0 | 0.0 | 0.0 | 1,700 | 0 | 0.0 | 0.0 |
| Moulton Niguel WD | 11,518 | 4,708 | 10.5 | 6.7 | 13,361 | 6,794 | 15.1 | 9.7 |
| San Clemente | 3,704 | 2,473 | 5.5 | 3.5 | 4,276 | 3,120 | 6.9 | 4.5 |
| San Juan Capistrano | 3,763 | 1,894 | 4.2 | 2.7 | 3,305 | 1,376 | 3.1 | 2.0 |
| Santa Margarita WD | 11,254 | 2,863 | 6.4 | 4.1 | 12,550 | 4,331 | 9.6 | 6.2 |
| South Coast WD | 2,580 | 1,847 | 4.1 | 2.6 | 3,009 | 2,332 | 5.2 | 3.3 |
| Trabuco Canyon WD | 1,166 | 0 | 0.0 | 0.0 | 835 | 0 | 0.0 | 0.0 |
| Total | 37,657 | 13,979 | 31.1 | 20.0 | 43,592 | 19,149 | 42.6 | 27.5 |

(1) "Recovery needs" assumes use of wells, Baker Treatment Capacity, other local production and use of tank and reservoir storage over 60 days
(2) "Recovery needs" assumes NO emergency capacity is available from IRWD; this option is still under investigation

Assuming no emergency capacity from the existing IRWD/SOC emergency interconnection, SOC needs between **20.0** and **27.5** million gallons per day (MGD) of additional system reliability capacity. Securing additional emergency capacity of 20 to 27.5 MGD would result in SOC being able to withstand a MET outage of treated water deliveries for up to 60 days, assuming elimination of most all outside irrigation with potable water. This is the assumed outage time required to get MET's Diemer Water Filtration Plant back to partial flow capacity if it were affected by a significant seismic event. These improvements would also enable SOC to withstand lessor outages of either of the two major pipelines serving SOC, the EOCF#2 or the Allen McColloch Pipeline (AMP).

New local projects can provide both supply and system reliability improvements. However, when determining the additional system reliability needs for SOC, it is also important to understand the monthly patterns of water demands and current local supply and treatment capacity. New local projects must be integrated into the water system by taking into account the other local supplies and the demands for water (varies day to day and month to month). Furthermore, it is also important to note that the imported water pipelines serving SOC require a minimum amount of MET water deliveries to maintain water quality (chloramine residual) – this further reduces the size of base-loaded local supply projects that can be accommodated under winter demands in SOC. The planning for such should consider a limitation on base-loaded supplies of no greater than the winter demand less the amount of imported water needed to maintain water quality, otherwise supply projects may have to be cut-back in winter periods. Constructing projects and then not utilizing them on a base-loaded operation is inefficient and strands a portion of the local investment. Emergency only projects can be used to augment the emergency supplies for SOC without conflicting with the winter demand issue.

**Figure 3-3** shows the monthly demands aggregated for SOC agencies based on (1) the maximum month delivery out of the last 5 years, which has some level of outdoor irrigation use in the winter months and significant outdoor irrigation in the summer months; and (2) the forecasted 2040 demand that assumes 55 gpcd usage for residential indoor plus projected CII use (assumes no outdoor use). During the three-month minimum winter period it was estimated that 1300 acre-feet per month (AFM) from MET is needed to maintain adequate water quality in the import pipelines. As demands increase from the winter demands, the MET water needed (1300 AFM) can go to supply the higher needs. The implication for local project development is that there is a 2200 AFM of headroom capacity for 9 months of the year and a headroom capacity of 900 AFM for three months of the year, resulting in an overall local project capacity of 22,500 AFY. Headroom capacity is defined as the level of demands that can be satisfied with a new local project without having to be cut back in the low winter demand months. Thus, the maximum base-loaded supply projects that can be accommodated in SOC without having to cut back supply production in winter periods was calculated as:

(900 AFM x 3 Months) + (2,200 AFM x 9 Months) = 22,500 AFY or 20 MGD

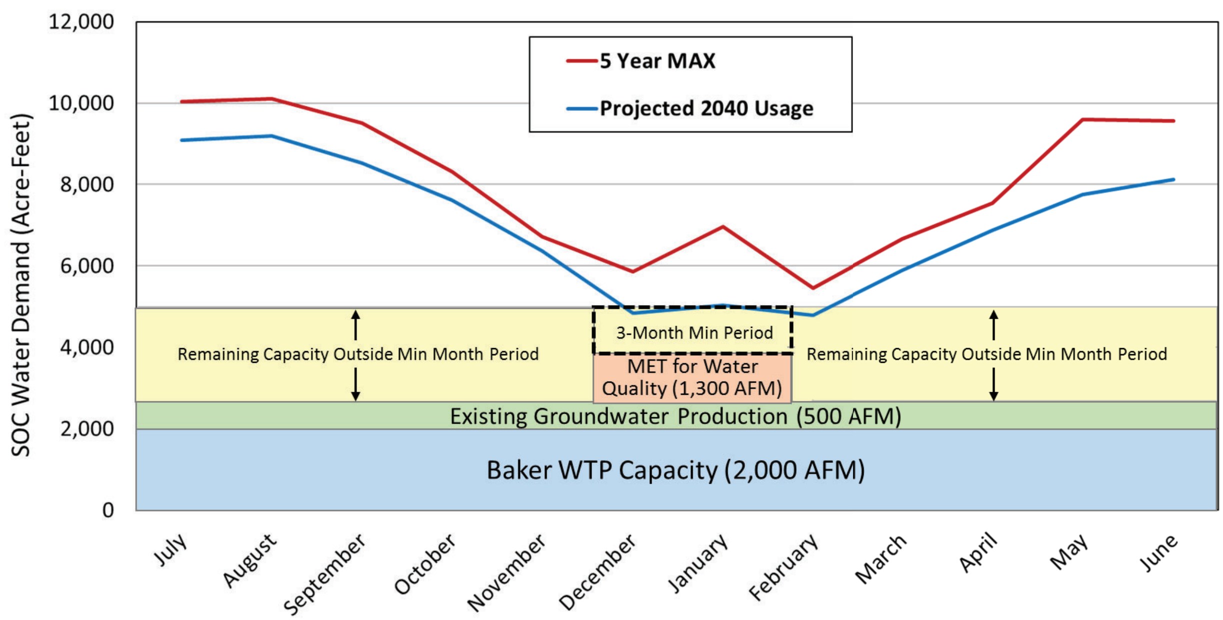


**Figure 3-3. SOC Monthly Water Demand and Existing Local Supply Capacity**

The conclusions of the system or emergency needs analysis for SOC are:

- Additional emergency system capacity is needed today to protect SOC in case of an outage of the import water system.
- Assuming the IRWD SOC Regional Interconnection cannot supply any water, emergency needs exist today that range from 20 MGD to 27.5 MGD. Any capacity that can be developed by way of the IRWD SOC Regional Interconnection would reduce these amounts.
- Local supply projects that can keep operating during emergency events can provide new emergency supplies to SOC, but base loading of these project should not exceed about 22,500 AFY (20 MGD) or the projects would have to be cut back in the winter periods.

- Other local projects can provide both system (emergency) and supply reliability benefits, whereas "emergency only" do just that, they provide emergency capacity during times of emergencies and typically, they are not operated. The "emergency only" projects, which should be evaluated to determine which ones should be implemented, include:
  - IRWD SOC Regional Emergency Interconnection
  - Pump-in to the EOCF#2

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# Section 4

# Orange County Water Supply Needs

The water supply modeling for the 2018 OC Study used to estimate the probability and size of potential MET shortages, and then allocate those shortages to Orange County, is different from the actual decision-making by the MET Board on when water supply conditions necessitate implementation of MET's Water Supply Allocation Plan (WSAP). Part of this difference is that the modeling operates with perfect foresight—meaning the pattern of hydrologic years is known (i.e., the length and severity of various droughts, followed by wet and normal years), because the modeling uses historical hydrology from 1922 to 2016 in sequence to simulate future conditions. In contrast, the actual decision regarding "declaring a shortage" by the MET Board begins to be considered as SWP and CRA supplies become more limited and accumulated storage in reservoirs and groundwater basins decline. The MET Board then evaluates its likely supplies and demands over the next year, along with a projected use of water being pulled from storage reserves. MET then makes one of the following decisions:

- If the MET Board sees the dry year storage reserves in their system dropping below about 1.5 Million Acre Feet (MAF), they typically would initiate the early stages of their WSAP; which involves either calling upon water agencies and general public to voluntarily reduce water demand, or calling requesting its member agencies for a more formal reduction in water usage (on the order of 10 to 15 percent), depending on the next year's supply forecasts.

- If the hydrology in the shortage year turns out to be average to wet, MET can terminate the WSAP call prior to the end of the fiscal year in which the call was made. Historically, when this has occurred, MET has canceled the reconciliation of use of water over the amounts allocated.

- If the drought event is more severe and/or it rolls over to a second year, it is likely that the formal reductions under the WSAP would increase to between 20 to 40 percent depending on the actual conditions. The MET service area has never experienced this second consecutive year of an allocation, although it has been on the verge several times, in 1990-91 and 2015-16, both times sufficient rains occurred to fill reservoirs and improve the water supply situation, allowing termination of the second year of the WSAP.

For the 2018 OC Study, only water supply reliability needs for SOC and OC Basin were modeled, as estimates of water shortages for Brea/La Habra area were deemed manageable through additional groundwater management and modest gains in water conservation strategies.

## 4.1 SOC Water Supply Needs

The water demand and existing local water supply assumptions for SOC remain unchanged from the 2016 OC Study.

SOC water demands are forecasted to increase from 117,000 AFY in 2020 to 125,000 AFY in 2050. Allocating the MET water shortages for the four planning scenarios, as summarized in Section 2.6, to SOC results in projected water supply needs for SOC. **Figure 4-1**, **Figure 4-2** and **Figure 4-3** show the projected water supply needs for SOC for years 2030, 2040 and 2050.

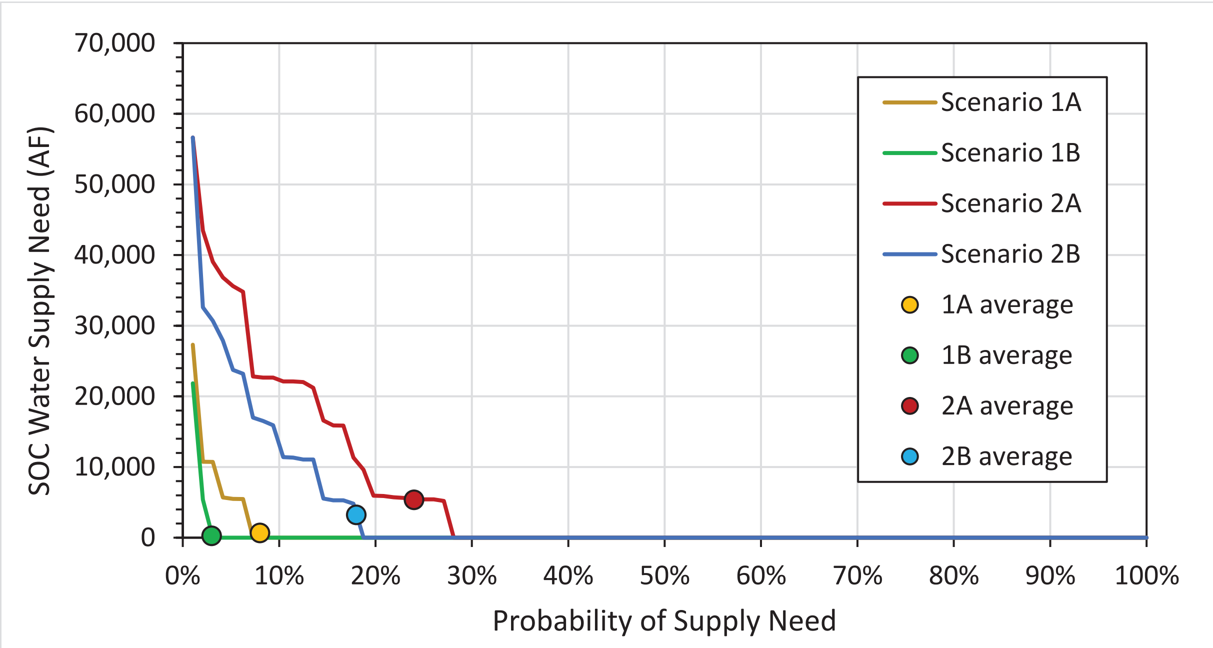


**Figure 4-1. Projected Water Supply Need for SOC in Year 2030**

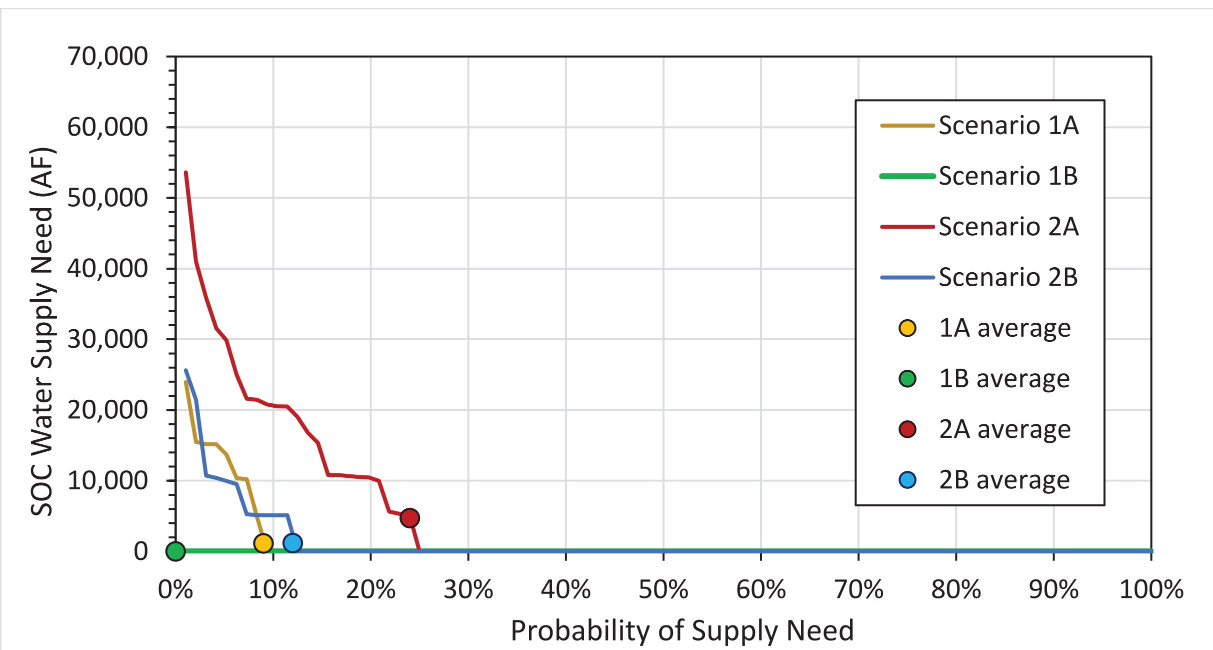


**Figure 4-2. Projected Water Supply Need for SOC in Year 2040**

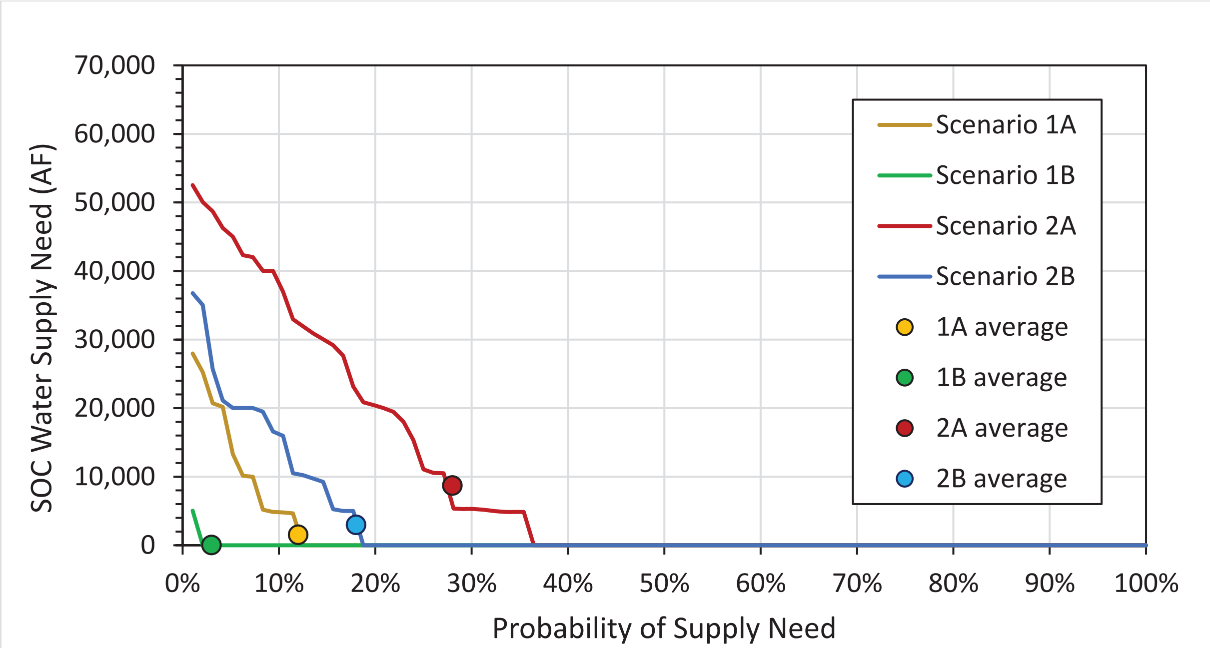


**Figure 4-3. Projected Water Supply Need for SOC in Year 2050**

The probability that any level of water shortage occurs in SOC by the year 2050, ranges from 3 percent for Scenario 1B to 35 percent of the time for Scenario 2A. The maximum supply needs for 2050, range from 5,000 AFY for Scenario 1B to 53,000 AFY for Scenario 2A. The average supply need (across all probabilistic hydrologic conditions) range from almost zero for Scenario 1B to 10,000 AFY for Scenario 2A.

The annual maximum water supply needs for SOC over time are summarized in **Table 4-1**. The year 2030 usually constitutes the year in which the maximum water supply needs occurs, as the WaterFix is projected to be operational by 2035. Table 3-2 also shows the remaining water supply needs with an assumed 10 percent demand curtailment (mandated conservation) implemented.

**Table 4-1. Summary of Maximum Water Supply Needs for SOC**

| Scenario | 2030 Max Supply Need (AFY) | 2040 Max Supply Need (AFY) | 2050 Max Supply Need (AFY) | Max Supply Need Over Entire Period (AFY) | Assumed 10% Demand Curtailment (AFY) | Remaining Supply Need (AFY) |
|---|---|---|---|---|---|---|
| 1 A) Minimal Climate Impacts with Low-Cost MET Investments | 27,000 | 24,000 | 28,000 | 28,000 | 12,000 | 16,000 |
| 1 B) Minimal Climate Impacts with High-Cost MET Investments | 22,000 | 0 | 5,000 | 22,000 | 12,000 | 10,000 |
| 2 A) Significant Climate Impacts with Low-Cost MET Investments | 57,000 | 53,000 | 53,000 | 57,000 | 12,000 | 45,000 |
| 2 B) Significant Climate Impacts with High-Cost MET Investments | 56,000 | 26,000 | 37,000 | 56,000 | 12,000 | 44,000 |
| | | | | | **Average of Four Scenarios** | **28,750** |
| **Range of Four Scenarios after Demand Curtailment: 10,000 to 45,000 AFY** | | | | | | |

The average water supply need for the four planning scenarios, assuming 10 percent demand curtailment in extreme drought conditions, is estimated to be approximately 29,000 AFY (about 24% of the annual demands) and ranges between 10,000 and 45,000 AF.

## 4.2 OC Basin Water Supply Needs

The modeling assumptions for the OC Basin used for the 2016 OC Study, which were reviewed by and accepted as being reasonable by Orange County Water District (OCWD) staff, remain unchanged for the 2018 OC Study. These assumptions are:

- Santa Ana River base flows (from upstream wastewater discharges) = 53,000 AFY
- Santa Ana River stormflows (under historical hydrology) = 6,000 to 150,000 AFY
- Groundwater Replenishment System (GWRS) ultimate expansion = 134,000 AFY in 2023
- Pumping Exempt from Basin Equity Assessment (BEA) outflows = 9,000 to 22,000 AFY
- Miscellaneous pumping by small producers = 8,500 AFY
- OC Basin water demand forecast increasing from about 400,000 AFY in 2020 to 435,000 AFY in 2050
- Basin Production Percentage (BPP) = 75% of OC Basin water demand (the BPP is the % of total demand that can be met by the OCWD groundwater basin without incurring the BEA. The BEA is an additional per AF charge by OCWD for pumping above the BPP to increase the local groundwater cost up to the cost of MET water (to eliminate any incentive for over-pumping, thus helping with management of the groundwater basin).

Using the same two climate change scenarios as MET and SOC, future Santa Ana River stormflows were modified to reflect forecasted changes in precipitation under climate change. In addition, under Scenarios 1B and 2B it was assumed that approximately 60,000 AFY from the MET Carson IPR project is recharged into the OC Basin, replacing existing MET replenishment water with a more drought-proof source of water.

Allocating the MET water shortages for the four planning scenarios, as summarized in Section 2.6, to OC Basin results in projected water supply needs for OC Basin**. Figure 4-4**, **Figure 4-5** and **Figure 4-6** show the projected water supply needs for OC Basin for years 2030, 2040 and 2050.

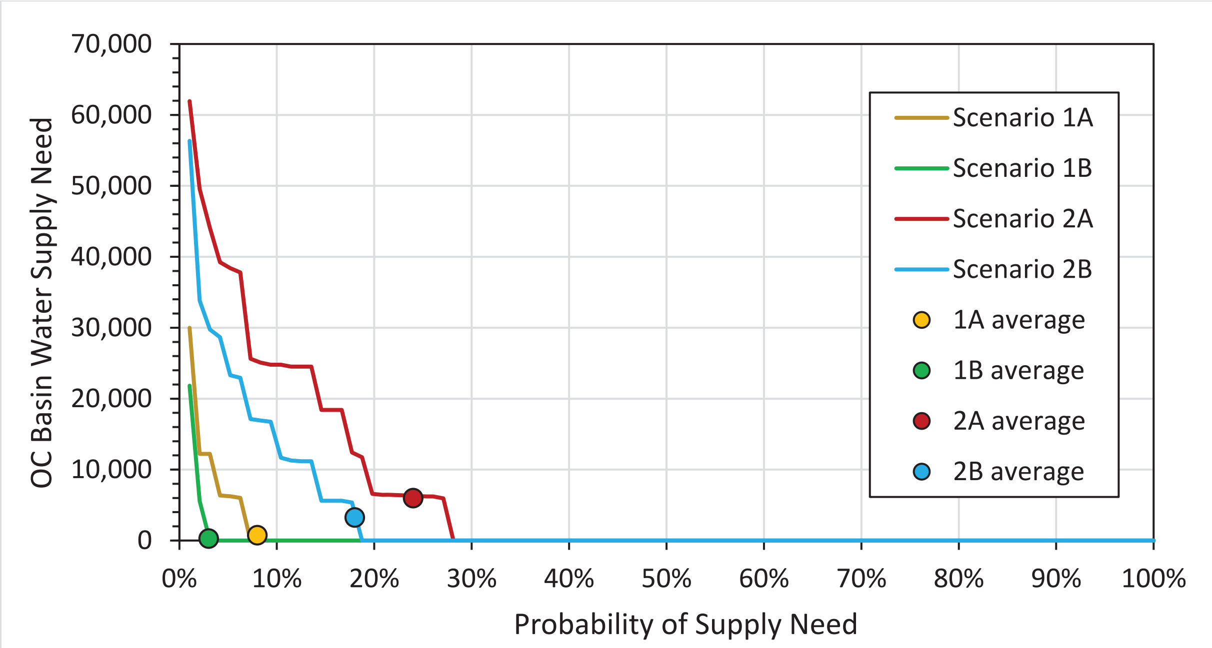


**Figure 4-4. Projected Water Supply Need for OC Basin in Year 2030**

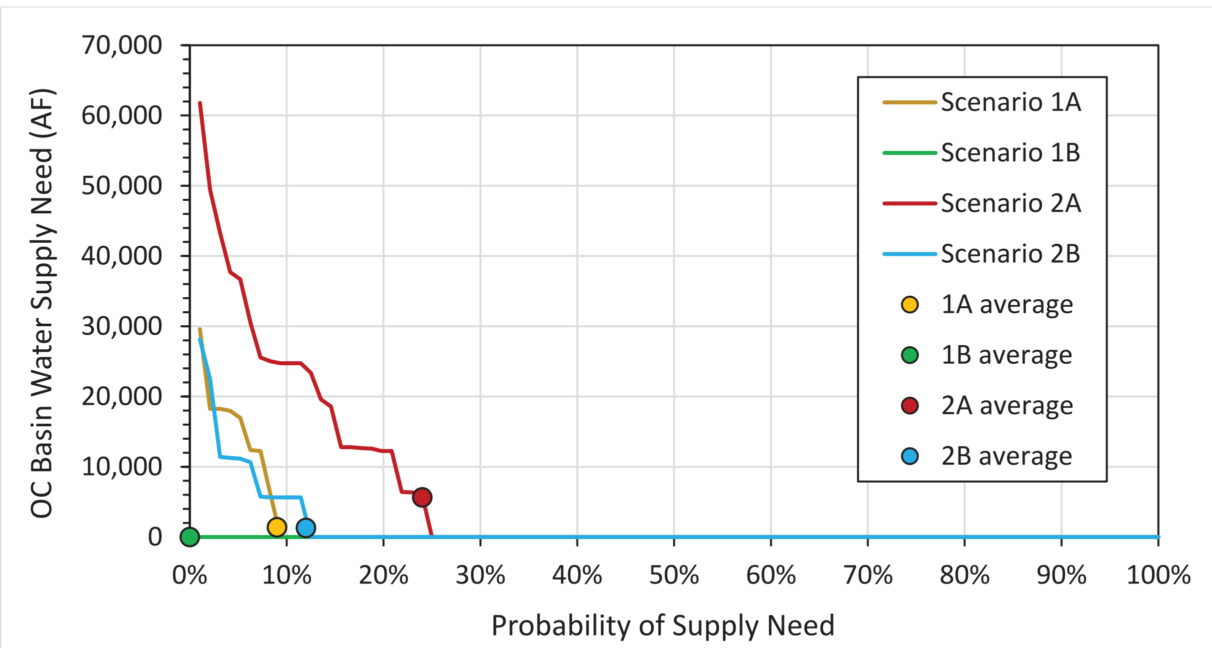


**Figure 4-5. Projected Water Supply Need for OC Basin in Year 2040**

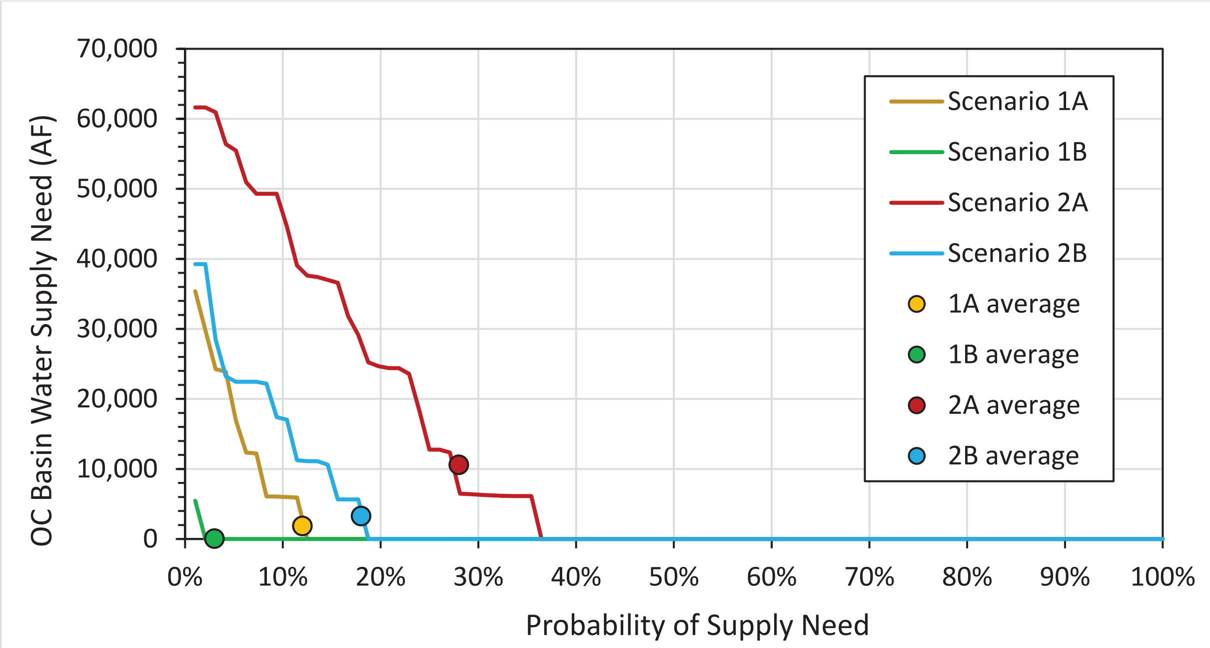


**Figure 4-6. Projected Water Supply Need for OC Basin in Year 2050**

The probability that a shortage of any level occurs in the OC Basin by the year 2050, ranges from almost 3 percent for Scenario 1B to 35 percent of the time for Scenario 2A. The maximum supply needs (one or two years out of 100, 1 to 2% of the time) for 2050, range from 5,000 AFY for Scenario 1B to 62,000 AFY for Scenario 2A. The average supply need (across all probabilistic hydrologic conditions) range from almost zero for Scenario 1B to 10,000 AFY for Scenario 2A.

While these water supply needs for the OC Basin are similar in size to the needs for SOC, they represent a far lower percentage of demand for the OC Basin. For example, the maximum annual water supply need in year 2050 for Scenario 2A of 62,000 AFY (which happens only 1 to 2 percent of the time) represents about 14 percent of the projected 2050 water demand in OC Basin; whereas a 53,000 AFY supply water supply need for SOC (**Figure 4-3; Table 4-1**) represents about 42 percent of the projected 2050 water demand in SOC.

The annual maximum water supply needs for OC Basin over time are summarized in **Table 4-2**. The year 2030 usually constitutes the year in which the maximum water supply needs occurs, as the WaterFix is projected to be operational by 2035. Table 4-2 also shows the remaining water supply needs with an assumed 10 percent demand curtailment implemented.

Note that the 10% demand curtailment for the OC Basin is 40,000 AFY while that for SOC is 12,000 AFY because of their difference in size and overall demands.

**Table 4-2. Summary of Maximum Water Supply Needs for OC Basin**

| Scenario | 2030 Max Supply Need (AFY) | 2040 Max Supply Need (AFY) | 2050 Max Supply Need (AFY) | Max Supply Need Over Entire Period (AFY) | Assumed 10% Demand Curtailment (AFY) | Remaining Supply Need (AFY) |
|---|---|---|---|---|---|---|
| 1 A) Minimal Climate Impacts with Low-Cost MET Investments | 56,000 | 35,000 | 41,000 | 56,000 | 40,000 | 16,000 |
| 1 B) Minimal Climate Impacts with High-Cost MET Investments | 22,000 | 0 | 5,000 | 22,000 | 40,000 | 0 |
| 2 A) Significant Climate Impacts with Low-Cost MET Investments | 62,000 | 62,000 | 62,000 | 62,000 | 40,000 | 22,000 |
| 2 B) Significant Climate Impacts with High-Cost MET Investments | 56,000 | 28,000 | 39,000 | 56,000 | 40,000 | 16,000 |
| **Average of Four Scenarios** | | | | | | **13,500** |
| **Range of Four Scenarios after Demand Curtailment: 0 to 22,000 AFY** | | | | | | |

The average water supply need for the four planning scenarios, assuming 10 percent demand curtailment in extreme drought conditions, is estimated to be approximately 13,500 AFY (about 3.4% of the OC Basin demands) and ranges from 0 to 22,000 AF.

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# Section 5

# Evaluation of Orange County Water Projects

To address the system and supply needs in SOC and the supply needs in OC Basin, a number of local Orange County water projects were identified and analyzed in terms of cost-effectiveness.

## 5.1 Orange County Local Water Projects

Most of the information presented in the 2018 OC Study regarding local water project yields, cost, and timing originated from project sponsors. However, MWDOC did conceptualize the system integration costs for the Poseidon ocean desalination project and the OC Basin/SOC emergency supply project costs, with input from OCWD.

The following should be noted when reviewing the local project descriptions and information on project yields and costs:

- MWDOC's staff and consultant spent considerable time working with the project sponsors in reviewing project details, assumptions and calculations to ensure the information used was up-to-date and appropriate.
- The intent of project comparisons is to provide accurate, reasonable, information to assist MWDOC, its member agencies and others as they plan for the future. MWDOC believes that the project information used for the 2018 OC Study meets the goal and standard for understanding the relative costs, benefits, trade-offs, and potential financial consequences of implementing local projects in Orange County given our current understanding of the projects.
- MWDOC has particularly focused on making the project cost estimates as comparable as possible. The estimates can never be 100 percent accurate. It is not a valid argument that projects cannot be compared unless all project information is absolutely certain, including how projects will perform in the future. Water managers and elected/appointed officials always made decisions about the future in the present, using the best information and analyses available.

The following represents a brief description of each local water project, followed by a cost summary table for all of the projects. For more project details, see **Appendix D**.

### 5.1.1 Poseidon Huntington Beach Ocean Desalination Project

Poseidon Resources L.L.C. (Poseidon) proposes to construct and operate the Huntington Beach Ocean Desalination Plant on a 12-acre parcel adjacent to the AES Huntington Beach Generating Station in Huntington Beach. Poseidon proposes to produce 50 million gallons per day (MGD) of potable water for distribution through the OC water system with part of the supply going directly to the city of Huntington Beach. The project would intake seawater through the AES generating station seawater cooling intake. The desalination process consists of source water screening, coagulation, filtration, pH adjustment, chlorination, de-chlorination, reverse osmosis (RO) membrane separation, and product water chlorination and chemical conditioning. The brine produced by removal of seawater constituents would be mixed with seawater and discharged back to the Pacific Ocean through a modified brine discharge diffuser which would meet the State Water Resource Control Board's recently adopted Ocean Plan Amendment requirements.

This project would provide both system and supply reliability benefits to SOC, the OC Basin and Huntington Beach, as shown by the delivery assumptions that were utilized for the study (see **Table 5-1**).

**Table 5-1. Poseidon Huntington Beach Water Delivery Assumptions**

| Delivery Location | Supply Yield (AFY) | System Yield (MGD) |
|---|---|---|
| Poseidon Water Production at Plant Site | 56,000 | 49.90 |
| Poseidon Water Delivery to SOC (1) | 15,964 | 14.22 |
| Poseidon Water Delivery to OC Basin (2) | 36,676 | 32.68 |
| Poseidon Water Delivery to Huntington Beach (3) | 3,360 | 3.00 |

(1) Selected to match the nominal production at Doheny for the 15 mgd facility for comparison purposes
(2) Full production less SOC less HB direct
(3) Supply to Huntington Beach at 95% of the MWDOC water rate

For the 2018 OC Study, MWDOC utilized several sources of information to summarize the cost of the Poseidon ocean desalination treatment, which were then 'trued-up' to information that was available in the public domain as presented by OCWD staff to OCWD Board in June 2018. MWDOC developed system integration costs to deliver the water to the OC Basin and SOC, based on information developed by MWDOC with input from OCWD.

### 5.1.2 Doheny Ocean Desalination Project

South Coast Water District (SCWD), proposes to develop an ocean water desalination facility in Dana Point, at Doheny State Beach. SCWD intends to construct a facility with an initial nominal capacity of 5 MGD (annual production of 5,321 AFY, 7.3 cfs, 4.74 MGD actual capacity), with potential for future expansions up to a nominal capacity of 15 MGD (annual production of 15,963 AFY, 22.05 cfs, 14.22 MGD actual capacity). The Doheny Ocean Desalination Project would consist of the following main components:

- A subsurface water intake system consisting of subsurface slant wells that draw ocean water from offshore subsurface alluvial material (located below the ocean floor), while providing natural sand bed filtration and eliminating the entrainment and impingement of marine biota, consistent with the State Water Resource Control Board's (SWRCB) recently adopted Ocean Plan Amendment.

- A raw (ocean) water conveyance pipeline that would deliver the subsurface intake system's ocean water to the desalination facility site.

- A desalination facility that would receive ocean feedwater at up to approximately 10 to 30 MGD, with a potable water recovery rate of ~50% resulting in up to 5 to 15 MGD of potable drinking water. The proposed desalination facility is located on SCWD's existing San Juan Creek Property, on an industrial site located away from the beach.



CDM Smith

- A concentrate (brine) disposal system that would utilize the existing San Juan Creek Ocean Outfall sewage pipeline, to return brine and treated process waste streams to the Pacific Ocean.
- A product water storage tank, pump station and distribution system that would feed into the local water distribution system.

For the 2018 OC Study two projects were characterized: (1) a local project for SCWD with a yield of 5,300 AFY (5 MGD) coming online in year 2021; and (2) a regional project to be used by other SOC agencies with yield of 10,600 AFY (10 MGD). Both projects would provide both system and supply reliability benefits for SOC.

The costs for the Doheny local project were provided by SCWD with no modifications. The costs for the Doheny regional project were based on SCWD studies by GHD consultants, but with some modifications by MWDOC (cost of funding was increased to 4.0 percent, no grants were assumed, allowances were added for land costs, regional integration of the capacity to the South County Pipeline and an allowance was added for dealing with the State Park) .

### 5.1.3 San Juan Watershed Project

Santa Margarita Water District (SMWD), along with other project partners, have proposed a multi-phased project within the San Juan Creek Watershed to capture local stormwater and develop, convey and recharge recycled water into the San Juan groundwater basin and treat the water upon pumping it out of the basin. Phase 1 of the project would include installation of three rubber dams within San Juan Creek that would act as in-stream detention facilities for both dry weather and wet weather flows within San Juan Creek and Arroyo Trabuco. The dams would promote in-stream recharge of the groundwater basin by allowing for the ponded water to naturally infiltrate into the stream bed. In the case of large storm events, the rubber dams would deflate to allow full passage of the stormwater flow downstream to the Doheny State Beach. Each dam would be operated by a control building that would house equipment for telemetry, dam controls, surveillance, and compressed air. Initially, the San Juan Watershed Participants would participate in the funding and operation of the San Juan Groundwater Recovery Plant (GWRP) to treat up to 5 MGD (plant capacity) of water combined between the City of San Juan and what is developed via the watershed project.

Subsequent phases of the proposed project would develop more aggressive surface water and groundwater management practices to maximize use of the available storage/recharge capacity for both stormwater and recycled water. Facilities associated with the proposed project's subsequent phases include construction of additional rubber dams within San Juan Creek and/or Arroyo Trabuco, recycled water conveyance pipelines and storage, groundwater extraction wells, additional upgrades/expansions at the existing City of San Juan Capistrano GWRF to increase the treatment capacity.

For the 2018 OC Study it was assumed that the full-sized project (Phases 1, 2 and 3) would be operational by year 2020 and produce approximately 9,500 AFY for both system and supply reliability benefits. All project information regarding yield, costs and timing for the San Juan Watershed Project were provided to MWDOC by SMWD.

### 5.1.4 Cadiz Water Bank

The Cadiz Water Bank is a project that creates a new water supply by conserving groundwater that is currently being lost to evaporation, then recovering the conserved water by pumping it out of the Fenner Valley Groundwater Basin and conveying it via 43 miles of pipelines and several pump stations to MET's CRA. The Project will also create/utilize new underground storage capacity (up to 1 MAF) that will provide the ability to improve water reliability during times of drought. This project has been the subject of debate, but commitments by the Project Proponents to continually monitor groundwater levels throughout the project's lifespan and promptly order adjustments to reverse any negative impacts along with the commitment to treat the water (primarily to remove Chromium VI – or Hexavalent Chromium) have reduced many of the concerns.

A key component for success of this project is an agreement by MET to allow use of its CRA to convey the water. By law, MET has to allow its unused capacity to wheel water. However, MET has indicated that it has plans to fully utilize its CRA capacity with its own water and water transfers and banking programs. This makes it difficult for MET to commit to a long term use of the CRA for conveyance of the Cadiz water. A number of meetings and discussions have taken place to explore conveyance of the water, but an acceptable solution has not been reached. If conditions in the Lower Colorado River Basin continue to decline, there may be more opportunities to work with MET to enable conveyance of the supply, and storage of water in Fenner Valley groundwater basin, for this project.

SMWD, as the project lead agency, has rights to storage capacity in Fenner Valley basin and receives their initial 5,000 AF per year yield at a reduced cost below the retail rate of other subscribers. The analysis herein examined both the cost of water to SMWD (Cadiz – SMWD) and the cost of water to others (Cadiz-Retail). The SMWD savings over retail costs were estimated at $253/AF in 2020 and grow over time to about $614/AF in 2050 as the cost of water from the project escalates. SMWD could proceed as a single agency beneficiary or they could increase the capacity of the project by including another 5,000 AF of supply for a total project of 10,000 AF, with supplies to be shared with other agencies in Orange County. The project was analyzed in two increments, the first 5,000 AF at the reduced SMWD costs and another 5,000 AF at the Retail cost. SMWD can treat up to about 8,700 AF of this water at the Baker WTP. For purposes of the project analysis the treatment cost of the first 5,000 AF was estimated at the incremental O&M costs of SMWD ownership of the Baker WTP of $200/AF in 2020 (including the pumping lift to pump the water into the South County Pipeline). This provides SMWD the ability to ability to benefit from the prior investment in the Baker Treatment Plant; the Retail water will be treated by MET at the Diemer plant at an estimated treatment rate in 2020 of $323/AF.

For SMWD and Retail customers, the Cadiz project was evaluated as a supply reliability project only. Some may argue the benefits of groundwater storage to include a system benefit, but the source of the water (Fenner Valley) is over 100 miles from SOC and hence any system benefits were considered minimal. In addition, MWDOC had already captured the full capacity of the Baker WTP as being available for system reliability needs and so counting the system reliability benefit again would be double counting.

### 5.1.5 Strand Ranch Water Banking – Pilot Program for MWDOC

Rosedale-Rio Bravo Water Storage District and Irvine Ranch Water District (IRWD) developed groundwater banking facilities on the Strand Ranch in Kern County for use by both districts. Strand Ranch was annexed into Rosedale's existing service area. All groundwater banking facilities on the Strand Ranch are owned by IRWD and operated and maintained by Rosedale for the duration of the proposed project. Facilities have been constructed to recharge and recover up to 17,500 AFY for IRWD. IRWD is provided a cumulative maximum banking allotment (maximum storage capacity) within Rosedale's Conjunctive Use Program of 50,000 AF.

A proposed pilot program between IRWD and MWDOC would allow for up to 5,000 AFY of water in Strand Ranch to be delivered to MWDOC as 'extraordinary' supply during a MET water allocation period. MET has strict rules as to what constitutes extraordinary supplies and these can only be accessed at such times as MET is in a water allocation; extraordinary supplies ride on top of MET's allocated imported water for almost a full one-to-one supply benefit. IRWD's current Strand Ranch program fits this definition.

It should be noted that as the 2018 OC Study was wrapping up in the summer of 2018, MWDOC and IRWD entered into discussions regarding MWDOC offering participation in the IRWD Strand Ranch Water Banking Program under initial terms which were reviewed with the MWDOC Board and the member agencies. These terms are discussed below. Based on the modeling completed in the Study, MWDOC plans to conduct further work on the proposed terms and conditions for MWDOC's agencies to participate in the Program. This work should be completed in January 2019 and will likely include revisions to the initial terms developed.

The initial proposed terms and conditions as a Pilot Program included MWDOC paying IRWD a $25/AF annual reservation charge over the life of the agreement for up to a maximum of 5,000 AF to be reserved. If MWDOC reserved the entire 5,000 AF, the fixed cost payment would be $125,000 per year; the Pilot Program was suggested to extend over the next seven years; the total fixed payments over this period would be $875,000. During a MET water allocation scenario, the water can be called at an additional cost of approximately $1,776/AF in 2025, consisting of an IRWD charge of $533/AF for facilities, the cost of water and extraction costs, plus a MET Wheeling payment of $1,243/AF (total cost is approximately $1,952/AF if the reservation fee is included). The cost of this water is about $771/AF less than the cost of purchasing MET water at the allocation surcharge water rate in 2025. MWDOC will be studying these terms and conditions to determine if this Pilot program meets the needs of its agencies. This program would only provide supply reliability benefits as the water would be treated at MET's Diemer Plant.

### 5.1.6 SOC Emergency Interconnection Expansion (SOC Emergency Water)

MWDOC has been working with the SOC agencies for a number of years on improvements for system (emergency) reliability primarily due to the risk of earthquakes causing outages of the MET imported water system as well as extended power grid outages. Two criteria developed by MWDOC for targeting emergency water needs are:

1. To plan for the MET system to be out of water for up to 60 days (based upon a forecasted likely outage duration by MET for the Diemer Treatment Plant); and

2. That agencies should be planning on being without the electrical grid for a minimum of one week (based upon forecasted likely outage durations by Southern California Edison and San Diego Gas & Electric).

Local agencies have the flexibility to adjust these criteria based on their own evaluation of their local system issues.

Existing regional interconnection agreements (2006 Phase 1 Emergency Service Program Participation and 2009 Operations Agreement South Orange County Irvine Ranch Water District Interconnection Projects) between Irvine Ranch Water District (IRWD) and the South Orange County (SOC) agencies provides for the delivery of water through the IRWD system to participating SOC agencies during times of emergencies. The exchange of water for emergency delivery was authorized under the earlier agreement between MWDOC, Orange County Water District (OCWD), IRWD and the SOC agencies. The 2009 agreement provides the details and cost-sharing among the parties for delivery of the target flows by IRWD under contractual terms and then additional flows to the best of IRWD's ability.

Recent conversations involving MWDOC and SOC agencies indicates an interest in exploring with IRWD the possibilities of providing more flow than the existing agreement provides for, and/or extending the agreement past the current expiration year of 2030.

MWDOC and IRWD are currently studying an expansion of the current program that should be completed by January 2019. Included in the study efforts with IRWD is the East Orange County Feeder #2 pipeline (EOCF#2), which will be examined as an alternative facility whereby groundwater wells near EOCF#2 could be pumped into EOCF#2 at such times when MET water is unavailable. The EOCF#2 is a major pipeline that runs from the Diemer Water Treatment Plant in Yorba Linda to central Orange County where it connects to other pipelines that convey water into SOC (i.e. the Joint Regional Water Supply System (JRWSS) and the Aufdenkamp Transmission Main (ATM)). MWDOC is working with MET staff and legal counsel to review and determine how to address the issues of conveying non-MET water in EOCF#2.

For the 2018 OC Study, MWDOC conceptualized an expanded and scalable emergency groundwater program that would include new groundwater production wells or simply connections from local water systems to the EOCF#2, with chloramination facilities and booster pumps to convey local groundwater in the EOCF#2 (see **Figure 5-1**). The concept would be that pumpers in the OC Basin would be able to use these production wells in non-emergency periods, while SOC agencies would be able to use the wells during an unplanned system outage. SOC agencies would be responsible for the cost of the chloramination facilities, pump stations and conveyance facilities to EOCF#2, and a portion of the cost for the groundwater wells (with OC Basin pumpers responsible for the other portion of well costs). In addition, SOC would be responsible for replenishing any groundwater that is utilized during the emergency as a water exchange. This project would not be used by SOC for water supply reliability needs during dry years or droughts.

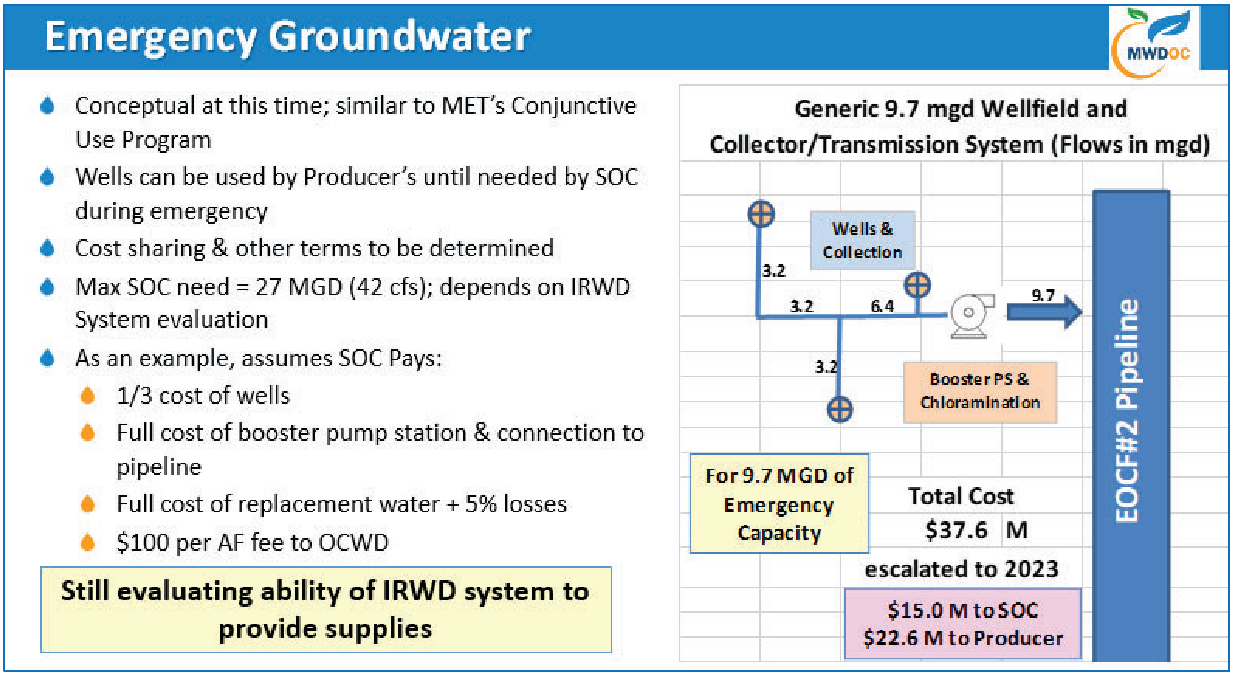



**Figure 5-1. Schematic for Emergency Groundwater Pump-in to the EOCF#2**

### 5.1.7 Other OCWD and EOCWD Projects Not Included in the 2018 OC Study

OCWD has been studying other potential projects to improve supply reliability of the OC Basin, which include:

- Santa Ana River Conservation and Conjunctive Use Project (SARCCUP)
- Purchase and Development of Additional Replenishment Basins
- West Orange County Well Field Project
- Prado Dam Operations and Silt Removal
- GWRS RO Brine Recovery
- Captured Urban Runoff and Shallow Groundwater for GWRS
- Chino Basin Water Bank
- Purchase of Upstream Santa Ana River Water for the OCWD Basin
- Cadiz Project

At the time of this 2018 OC Study, OCWD did not want these projects to be included in the study and MWDOC complied with that request. Because the Poseidon Project, also being pursued by OCWD, is a project that can jointly provide water to the OCWD basin and to SOC, MWDOC included the Poseidon Project in the study evaluation. Although the projects listed above were not included in this study, indications are that these projects could potentially provide significant supply benefits to OC Basin and possibly SOC (with OCWD concurrence).

In addition to the OCWD projects not included in the Study, East Orange County Water District (EOCWD) has been in the preliminary scoping stages for the Peters Canyon Water Treatment Plant project; this project was also not included in the study. EOCWD has been examining construction and operation of a treatment plant to treat various supplies of water. EOCWD has an existing site and reservoir where a previous water treatment plant was located prior to construction of the AMP. EOCWD is looking at providing a portion of the water from the new plant within their own service area and are looking at options to serve a portion of the water to other agencies including agencies in SOC. MWDOC has agreed to evaluate supplies EOCWD could produce at the treatment plant (approximately 6 mgd) and convey to the EOCF#2 where it can be moved to SOC. This will occur after the publication of this report, concurrent with completing the work with IRWD on the SOC Regional Interconnection and the pump-in to the EOCF#2 and is expected to be completed in the first quarter of calendar year 2019.

**Table 5-2** provides the estimated yields of these projects that were not included. As previously discussed, the potential yields shown clearly exceed the previous shortages shown for the OC Basin.

**Table 5-2. Potential Local Projects for the OC Basin NOT included in the Modeling**

| Project | Amount (AFY) |
|---|---|
| **OCWD Projects** | |
| CADIZ for OCWD supplies | 5,000 to 10,000 |
| West Orange County Well Field | 3,000 to 6,000 |
| Prado Dam Operations to 505' year-round | ~7,000 |
| Purchasing Upper SAR Watershed Supplies | ? |
| Silting up of Prado Dam (loss of storage) | ? |
| GWRS RO Brine Recovery | 5,000 to 10,000 |
| Purchase Land for Additional Replenishment Basins | ? |
| SARCCUP – dry year yield | 12,000 |
| **EOCWD Projects** | |
| Peters Canyon Water Treatment Plant | 6,720 |

## 5.1.8 Orange County Water Project Summary

**Table 5-3** summarizes main reliability benefit, yield and assumed online date for the projects evaluated in the 2018 OC Study, while **Table 5-4** summarizes the capital, O&M and unit costs.

**Table 5-3. Reliability Benefit, Online Date and Yield Summary for Orange County Water Projects**

| Water Project | Main Reliability Benefit | Area that Reliability Benefit Occurs | Assumed Online Date | Supply Yield (AFY) | System Capacity Yield (MGD) |
|---|---|---|---|---|---|
| Poseidon Desalination – OC Basin* | Supply (1) | OC Basin | 2023 | 36,676 | NA |
| Poseidon Desalination – SOC* | System/Supply | SOC | 2023 | 15,964 | 14.3 |
| Doheny Desalination – SCWD | System/Supply | SOC | 2021 | 5,321 | 4.8 |
| Doheny Desalination – Regional | System/Supply | SOC | 2026 | 10,642 | 9.5 |

| Water Project | Main Reliability Benefit | Area that Reliability Benefit Occurs | Assumed Online Date | Supply Yield (AFY) | System Capacity Yield (MGD) |
|---|---|---|---|---|---|
| San Juan Watershed Project | System/Supply | SOC | 2022 | 9,480 | 8.5 |
| Cadiz Water Bank – SMWD | Supply (2) | SOC | 2020 | 5,000 | NA |
| Cadiz Water Bank – Retail | Supply | SOC | 2020 | 5,000 | NA |
| Strand Ranch Water Banking – Pilot | Supply | SOC | 2019 | 5,000 | NA |
| Expanded SOC Emergency Water | System | SOC | 2021 | NA | 4.7 – 20.0 |

* Represents the portion of the total water produced from the Poseidon Desalination Treatment Plant allocated to the OC Basin and SOC areas. The difference in total treatment plant water (56,000 AFY) and the values shown in this table for OC Basin and SOC is delivered to City of Huntington Beach.

(1) While the Poseidon Desalination Project for OC Basin could provide system reliability benefits, it is not needed for this purpose as there is sufficient local groundwater that can be used if MET water was interrupted for 60 days or more.

(2) While Cadiz Water Bank for SMWD can be treated at Baker WTP, thereby providing a system reliability benefit, it is not needed for this purpose as MET untreated water can also be treated at Baker WTP and used during an outage of MET's Diemer treatment plant.

**Table 5-4. Cost Summary for Orange County Water Projects**

| Water Project | Capital Cost in Initial Year ($M) | Annual O&M Cost in Initial Year ($M) | Total Unit Cost in Initial Year ($/AF) | Total Unit Cost in Year 2050 ($/AF) |
|---|---|---|---|---|
| Poseidon Desalination – OC Basin (1)(5) | $1,041.1 | $34.9 | $2,197 | $3,519 |
| Poseidon Desalination – SOC (1)(5) | $433.4 | $15.7 | $2,132 | $3,485 |
| Doheny Desalination – SCWD (1) (2) | $107.2 | $6.2 | $1,622 | $3,225 |
| Doheny Desalination – Regional (1) | $133.1 | $13.9 | $1,712 | $3,296 |
| San Juan Watershed Project (1) | $148.5 | $10.3 | $1,521 | $3,257 |
| Cadiz Water Bank – SMWD (3) | NA | NA | $1,276 | $3,236 |
| Cadiz Water Bank – Retail (3) | NA | NA | $1,652 | $3,710 |
| Strand Ranch Water Banking – Pilot (3) | NA | NA | $1,971 | NA |
| Expanded SOC Emergency Water (4) | $15.0 | $3.0 | NA | NA |

(1) Capital costs assumed to be financed at financing terms provided by project sponsors. Annual debt payments included in total unit costs. Eligible projects are assumed to get maximum LRP funding from MET, which is reflected in the total unit costs.

(2) Capital cost for project reduced by $10 million of secured state grant monies.

(3) Costs for water banking projects are based on terms which have fixed costs that are paid to recover capital cost or reserve the water supply, and variable costs that are paid when water is taken (including MET wheeling costs and MET/local water treatment); these costs are shown as a total unit cost. Note that SMWD gets a discounted cost for Cadiz Water Bank; and that Strand Ranch Water Banking is only a pilot program from 2019 to 2025 (with water assumed to be taken in years 2024 and 2025, with a 14% probability of need in those years).

(4) Project only provides system reliability benefits during an unplanned outage, and thus making it impossible to calculate a unit cost in $/AF. Cost shown is for a capacity of 9.7 MGD and assumes first unplanned outage in year 2023 for O&M cost.

(5) Costs reflect a discount that Poseidon provides to City of Huntington Beach for locating treatment plant in its City. The stream of payments for the discounted water purchases are counted as revenue towards the Poseidon Project, with the remaining Poseidon costs spread over the remaining 52,640 AFY production from the plant.

## 5.2 Evaluation Methodology

To provide for standard comparison between the Orange County water projects, two evaluation metrics (EM) were used:

**System Reliability EM** = Avoided annual MET water purchases MINUS local project costs (capital/fixed and O&M costs) over life of project, DIVIDED by project capacity in MGD. The resulting number is a NET cost per MGD of emergency capacity. ***Positive numbers are better than negative numbers and smaller negative numbers are better than larger negative numbers.***

**Supply Reliability EM** = When there are no water shortages, the EM is the avoided annual MET water purchases DIVIDED by local project costs over life of project. But during periods of water shortages after implementation of the project (supply need), the EM is the avoided annual MET water purchases PLUS avoided MET drought allocation surcharge, DIVIDED by local project costs. The resulting number is similar to a benefit/cost ratio. ***A ratio near or greater than 1.0 is better than a ratio less than 1.0; the greater the ratio, the greater the relative benefit. Note, not all costs or benefits have not been captured in the analysis; only direct project costs and benefits tied to avoiding MET water purchases are captured.***

Both EMs are calculated using present value project costs and present value avoided MET water purchases (which differ by scenario), using a discount factor of 4 percent. Standard economic practices require that future costs and benefits to be expressed in present value terms, as a dollar today is worth more than a dollar 10 or 30 years from now because of the return on investment opportunity. Present value also corrects for projects that supply too much water in earlier years, even if water shortages in further out years warrant the project size.

For the supply reliability EM, the probability and magnitude of supply need for each forecast year was utilized. This information comes from modeling hydrologic years from 1922 to 2017 under historical and climate changed conditions for SOC and OC Basin (as summarized in Sections 3.2 and 3.3). Then each project that provides a supply reliability benefit is tested to see how much of the supply need is achieved. The supply that a project provides does not always equate to a 1 to 1 benefit as a reduction in supply need, as MET's Water Supply Allocation Plan utilizes a portion of the project's supply for regional benefit. However, because the local project in Orange County also reduces demands on MET, some of this regional benefit comes back to Orange County by way of improved MET reliability. The simulation model captures all of this nuance in reliability benefits. When there are no water supply needs, under hydrologic conditions that do not result in water shortages to MET, then the project supply simply offsets a MET water purchase. This method is far superior than simply estimating the project's total cost over its lifecycle and dividing it total water supply to obtain a unit-cost metric because it only attributes full economic benefits when a project reduces a bona fide water shortage.

**Figure 5-2** presents this methodology for one theoretical forecast year, as an example, for a given planning scenario for a local project that produces a base loaded water supply of 10,000 AFY.

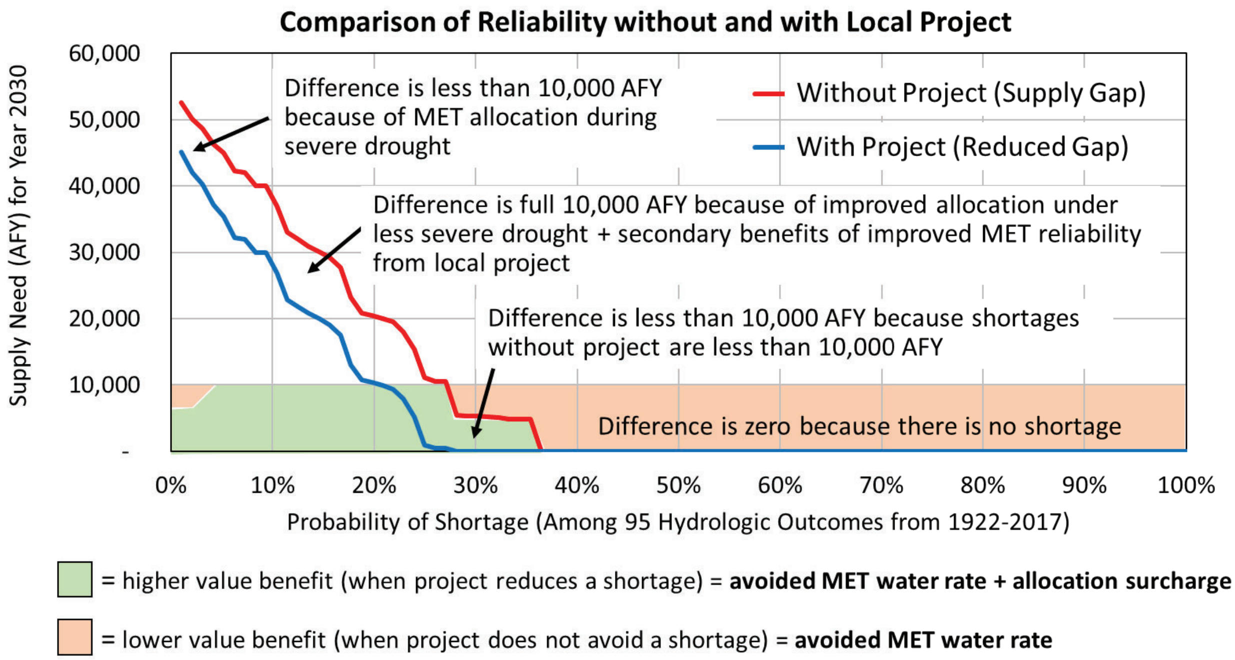



**Figure 5-2. Methodology for Estimating Avoided MET Water Purchases for Supply Reliability EM**

The red reliability line shown on Figure 5-2 represents a supply need for SOC in a given forecast year for a given planning scenario. The blue reliability line represents the reduction in supply need, as a result of a project producing 10,000 AFY. The difference between the two reliability lines indicates the amount of MET water purchase plus allocation surcharge that is applied as a benefit, as indicated by the green shaded area. When the project does not reduce the supply need, as indicated by the orange shaded area, the benefit is represented by avoided MET water purchases. This is calculated for every forecast year through 2050, and for each of the four planning scenarios.

**Figure 5-3** illustrates how the discounting of the streams of costs and avoided MET purchases is applied to estimate the Supply Reliability EM for the Doheny Desalination (SCWD) project, for Planning Scenario 2A over time. In this figure, the orange solid line represents the project cost (capital and O&M) in future-year dollars with assumed escalation; while the orange dotted line represents the project cost in present value dollars with an assumed discount rate. The blue solid and dotted lines show the escalated and discounted values for avoided MET water purchases. The “kink” upwards in the project cost after year 2035 represent the end of MET’s LRP funding for the project. The sum of the present value (PV) avoided MET cost less the sum of the PV project cost represents the net PV; while the sum of PV avoided MET cost divided by the sum of PV project cost represents the EM, similar to a benefit-cost ratio.

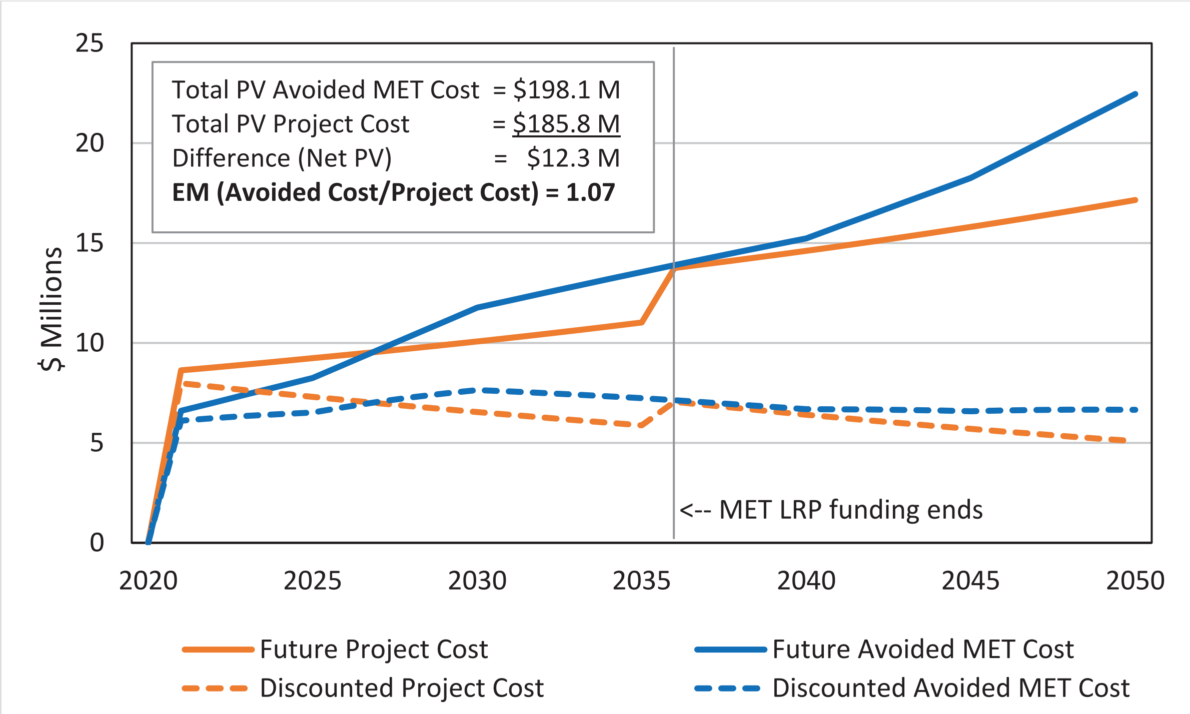



**Figure 5-3. Calculation of Supply Reliability EM for Doheny Desalination SCWD for Planning Scenario 2A**

## 5.3 Evaluation of Projects for System Reliability in SOC

Using the System Reliability EM as defined in Section 5-2, five projects that provide system reliability benefits for SOC were compared. **Table 5-5** presents the EM for each planning scenario, along with an average EM. Also shown on this table is a ranking score of 1 to 5, with a score of 1 being assigned to the project with the best EM, and a 5 being assigned to the project with the worst EM. Positive numbers are the best and smaller negative numbers are next best.

**Table 5-5. Comparison of Projects Providing System Reliability Benefits to SOC**

| Project | Max Capacity (MGD) | EM (1) 1A | EM (1) 1B | EM (1) 2A | EM (1) 2B | Average EM | Project Ranking Score (2) |
|---|---|---|---|---|---|---|---|
| Doheny Desal – SCWD | 4.75 | -$5.9 | -$2.8 | -$5.6 | -$1.0 | -$3.8 | 4 |
| Doheny Desal – Regional | 9.50 | -$3.0 | $0.3 | -$2.7 | $2.3 | -$0.8 | 1 |
| San Juan Watershed Project | 8.50 | -$5.1 | -$2.3 | -$4.9 | -$0.6 | -$3.2 | 3 |
| Poseidon Desal – SOC | 14.25 | -$10.3 | -$7.0 | -$10.0 | -$5.0 | -$8.1 | 5 |
| Expanded SOC Emergency (3) | 9.70 | -$2.3 | -$2.3 | -$2.3 | -$2.4 | -$2.3 | 2 |

1) Represents avoided discounted MET water purchases for different water rate scenarios LESS discounted project costs, DIVIDED by emergency capacity (MGD) = $/MGD. Positive numbers indicate that project is cheaper than purchasing MET water over the life of project. Negative numbers indicate that project is more expensive than purchasing MET water.
2) Ranking is based on average EM between four scenarios, converted to a rank score from 1 (best) to 5 (worst).
3) This project is scalable to fill remaining system reliability need.

As shown on Table 5-5, Doheny Desalination Regional has the best ranked score, followed by Expanded SOC Emergency Water, San Juan Watershed Project, Doheny Desalination SCWD, and finally Poseidon Desalination SOC. It should be noted that the Doheny Desalination SCWD project includes certain elements designed for regional expansion—meaning that it is foundational to the incremental cost that Doheny Desalination Regional project adds. Note that the regional Doheny project cannot be done as presented here in this study without the SCWD project being done first.

## 5.4 Evaluation of Projects for Supply Reliability in SOC and OC Basin

Using the Supply Reliability EM as defined in Section 5.2, eight projects that provide supply reliability benefits for SOC and OC Basin were compared. For Scenario 1A (minimal climate change and low-cost MET investments) **Table 5-6** presents: (1) the present value project costs; (2) present value avoided MET purchases; (3) the net present value; (4) the Supply Reliability EM; and (5) project ranking score, where the higher the EM score the better a project ranks.

As shown in Table 5-6, the best ranked water supply project is the Cadiz Water Bank – SMWD with an EM of 1.0, followed closely by the Doheny Desalination – Regional with an EM of 0.98. The worst ranked water supply project is Poseidon Desalination – OC Basin with an EM of 0.77.

**Table 5-7** presents the same information as Table 5-6 but for Scenario 2B (significant climate change and high-cost MET investments). Under this scenario, the best ranked projects are the Strand Ranch Water Bank – Pilot with an EM of 1.22 and Doheny Desalination – Regional with an EM of 1.21. The worst ranked project is Poseidon Desalination – OC Basin with an EM of 0.93.

**Table 5-6. Comparison of Projects Providing Water Supply Benefits for Scenario 1A**

| Project | Project Cost (1) ($M) | Avoided MET Purchase (2) ($M) | Net Present Value (3) ($M) | Evaluation Metric (4) | Project Ranking Score |
|---|---|---|---|---|---|
| Cadiz Water Bank – SMWD | $163.1 | $163.4 | $0.3 | 1.00 | 1 |
| Cadiz Water Bank – Retail | $197.5 | $163.4 | -$34.1 | 0.83 | 6 |
| San Juan Watershed Project | $300.0 | $274.2 | -$25.8 | 0.91 | 3 |
| Doheny Desal – SCWD | $185.8 | $169.5 | -$16.3 | 0.91 | 4 |
| Doheny Desal – Regional | $305.1 | $298.8 | -$6.4 | 0.98 | 2 |
| Poseidon Desal – SOC | $633.4 | $495.4 | -$138.0 | 0.78 | 7 |
| Poseidon Desal – OC Basin | $1,485.8 | $1,088.9 | -$396.9 | 0.73 | 8 |
| Strand Ranch Water Bank – Pilot | $1.5 | $1.3 | -$0.2 | 0.84 | 5 |

1) Capital and O&M costs over life of project, discounted to present value terms.
2) Average of avoided MET water purchases + allocation surcharge (when shortages exist) and avoided MET purchases when shortages do not exist, discounted to present value terms.
3) Avoided discounted MET water purchases LESS discounted project cost.
4) Avoided discounted MET water purchases DIVIDED by discounted project cost.

**Table 5-7. Comparison of Projects Providing Water Supply Benefits for Scenario 2B**

| Project | Project Cost (1) ($M) | Avoided MET Purchase (2) ($M) | Net Present Value (3) ($M) | Evaluation Metric (4) | Project Ranking Score |
|---|---|---|---|---|---|
| Cadiz Water Bank – SMWD | $165.1 | $195.3 | $30.2 | 1.18 | 3 |
| Cadiz Water Bank – Retail | $199.5 | $195.3 | -$4.2 | 0.98 | 6 |
| San Juan Watershed Project | $300.0 | $329.9 | $29.9 | 1.10 | 5 |
| Doheny Desal – SCWD | $185.8 | $205.6 | $19.8 | 1.11 | 4 |
| Doheny Desal – Regional | $305.1 | $312.8 | $7.7 | 1.21 | 2 |
| Poseidon Desal – SOC | $633.4 | $599.1 | -$34.2 | 0.95 | 7 |
| Poseidon Desal – OC Basin | $1,485.8 | $1,316.2 | -$169.6 | 0.89 | 8 |
| Strand Ranch Water Bank – Pilot | $2.9 | $3.5 | $0.6 | 1.22 | 1 |

1) Capital and O&M costs over life of project, discounted to present value terms.
2) Average of avoided MET water purchases + allocation surcharge (when shortages exist) and avoided MET purchases when shortages do not exist, discounted to present value terms.
3) Avoided discounted MET water purchases LESS discounted project cost.
4) Avoided discounted MET water purchases DIVIDED by discounted project cost.

**Figure 5-4** shows the range in Supply Reliability EM for the four planning scenarios, as well as an average EM. When all planning scenarios are considered, a final project ranking is established based first on the average EM (shown as yellow square), and secondly on the range of EM for the scenarios (as shown as the blue bar). The smaller the length of the blue bar on Figure 5-4 means the more consistent it performs from a cost-benefit perspective.

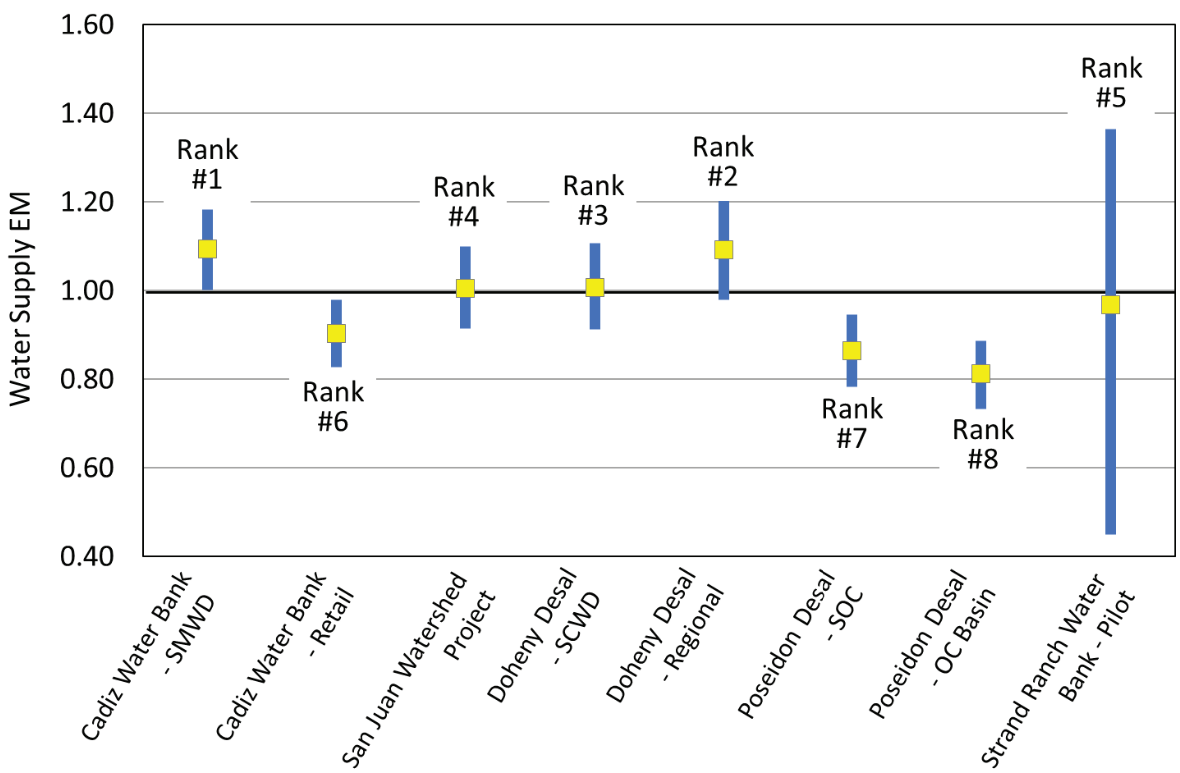



**Figure 5-4. Range and Average Supply Reliability EM and Project Ranking**

**Table 5-8** presents this information in a slightly different way, in which supply projects are ranked for each scenario using Net Present Value (NPV) and Supply Reliability EM. The NPV represents the difference between present value avoided MET water purchases and present value project costs. If the NPV is positive, it means the project is more cost-effective than MET water; whereas if the NPV is negative, it means that the project is not as cost-effective as purchasing MET water. Project rankings are shown for both the EM and NPV for all scenarios, as well as an overall average ranked score.

**Table 5-8. Ranking Supply Projects Based on EM and NPV**

| Project | SC 1A | | SC 1B | | SC 2A | | SC 2B | | Average |
|---|---|---|---|---|---|---|---|---|---|
| | EM | NPV | EM | NPV | EM | NPV | EM | NPV | Rank |
| Cadiz Water Bank - SMWD | 1 | 1 | 1 | 2 | 3 | 2 | 3 | 2 | 1.9 |
| Cadiz Water Bank - Retail | 6 | 6 | 5 | 6 | 6 | 6 | 6 | 6 | 5.9 |
| San Juan Watershed Project | 3 | 5 | 3 | 5 | 5 | 3 | 5 | 3 | 4.0 |
| Doheny - SCWD | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.0 |
| Doheny - Regional | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 1 | 1.8 |
| Poseidon - SOC | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 7 | 6.9 |
| Poseidon - OC Basin | 8 | 8 | 7 | 8 | 8 | 8 | 8 | 8 | 7.9 |
| Strand Ranch Water Bank - Pilot | 5 | 2 | 8 | 3 | 1 | 5 | 1 | 5 | 3.8 |

1 = Top Ranked Project; 8 = Bottom Ranked Project

When both the EM and NPV are used, the final project rankings for water supply reliability are:

| | |
|---|---|
| 1st | Doheny Desalination – Regional |
| 2nd | Cadiz Water Bank – SMWD |
| 3rd | Strand Ranch Water Bank - Pilot |
| 4th (tie) | San Juan Watershed Project |
| 4rd (tie) | Doheny Desalination – SCWD |
| 6th | Cadiz Water Bank – Retail |
| 7th | Poseidon Desalination – SOC |
| 8th | Poseidon Desalination – OC Basin |

While the EM can be interpreted as the relative benefit that projects have regardless of their supply yield, the difference between buying MET water (even with allocation surcharges included during shortage conditions) and the project cost under Scenario 1B (which has the highest reliability of the four scenarios) can indicate the downside financial risk. Put another way, if an agency believed that Scenario 2A (the scenario showing the most water shortages) was most likely to occur and made an investment to address these shortages, but Scenario 1B occurred instead, what would be the downside financial exposure. **Figure 5-5** presents this potential downside financial risk.

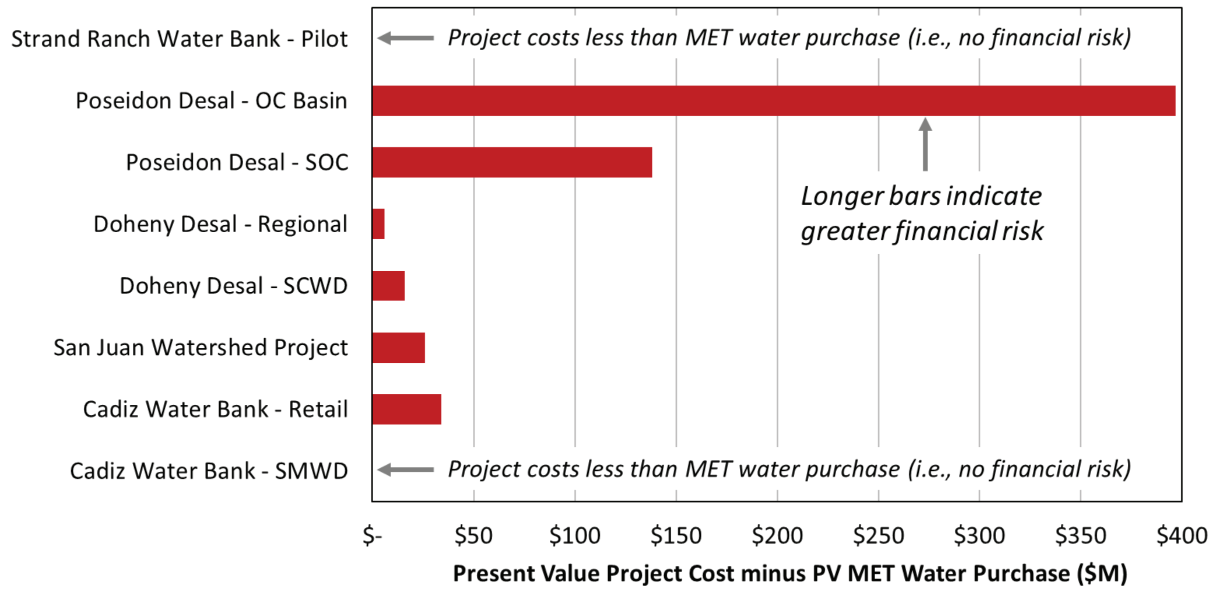



**Figure 5-5. Potential Downside Financial Risk, Based on Scenario 1B**

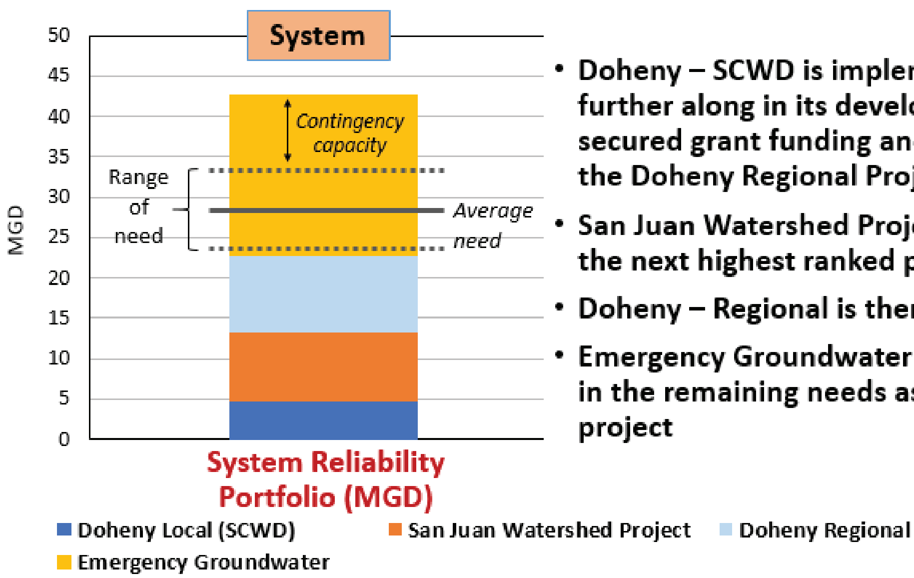
# Section 6

# A Portfolio for System and Supply Reliability in SOC

The results of the project ranking for system reliability in SOC, and supply reliability for SOC and OC Basin can be used to build portfolios of multiple projects to best meet overall needs. For SOC, projects that meet system reliability needs may also provide supply benefits. In addition, each local agency can decide how much reliance they place on mandated water use reductions during droughts to reduce peak shortages and meet supply reliability needs. In the OC Basin, however, this study can only draw a partial conclusion because only one project, Poseidon Desalination, was evaluated.

## 6.1 A Portfolio for System and Supply Reliability in SOC

Under a situation in which SOC water agencies partnered to develop a strategy that best met system and supply reliability needs, a portfolio of projects can be developed. This process starts with assessing a range of system reliability needs and adds the highest ranked projects to meet these needs, as illustrated in **Figure 6-1**.




- **Doheny – SCWD is implemented first, as it is further along in its development path and has secured grant funding and it sets the stage for the Doheny Regional Project**
- **San Juan Watershed Project follows, as it is the next highest ranked project**
- **Doheny – Regional is then implemented**
- **Emergency Groundwater via the EOCF#2 fills in the remaining needs as it is a scalable project**

**Figure 6-1. Example SOC Portfolio for System Reliability Needs**

Determining the portfolio for supply reliability needs is a bit more complicated because of the nature of hydrology and the nature of base loaded water projects that are included in the portfolio for meeting system reliability needs. If the system reliability portfolio in **Figure 6-1** was selected as the preferred strategy, then the base loaded supplies for Doheny Desalination (SCWD and Regional), plus San Juan Watershed Project would equal 22,500 AFY. Under Scenario 1A and 1B that would almost meet all of the water supply needs, except for peak needs that happen less than 5 percent of the time. These infrequent peak needs could be addressed with mandated water use restrictions (see **Figure 6-2**).

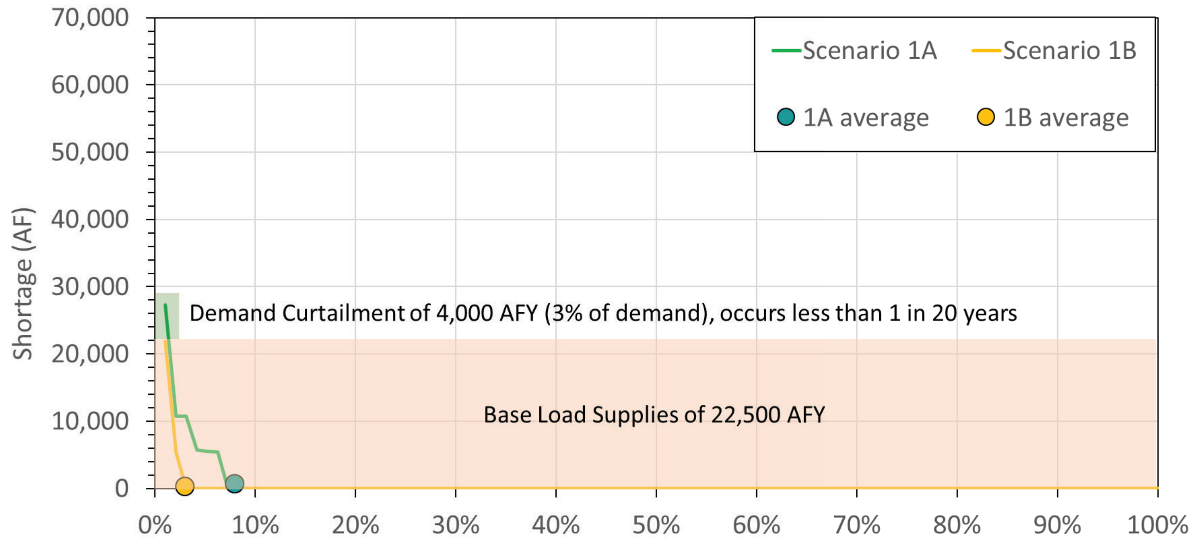



**Figure 6-2. Strategy for Meeting SOC Supply Reliability Needs Under Scenarios 1A and 1B**

However, if Scenario 2A or 2B occurred, a "bridge supply" between the base loaded supply and mandatory restrictions might be preferred. This bridge would be ideally suited for a dry-year water supply such as water banking or extraordinary water supplies (see **Figure 6-3**).

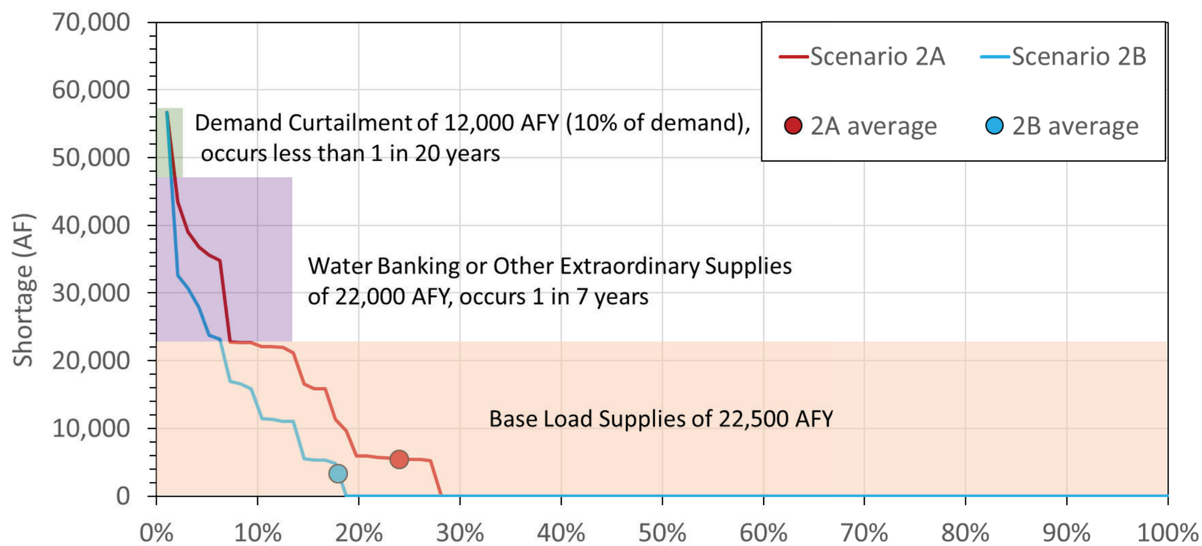



**Figure 6-3. Strategy for Meeting SOC Supply Reliability Needs Under Scenarios 2A and 2B**

Based on these different supply reliability strategies and the identified need for local projects to meet system reliability needs, the two aspects of water reliability become complementary (see **Figure 6-4**).

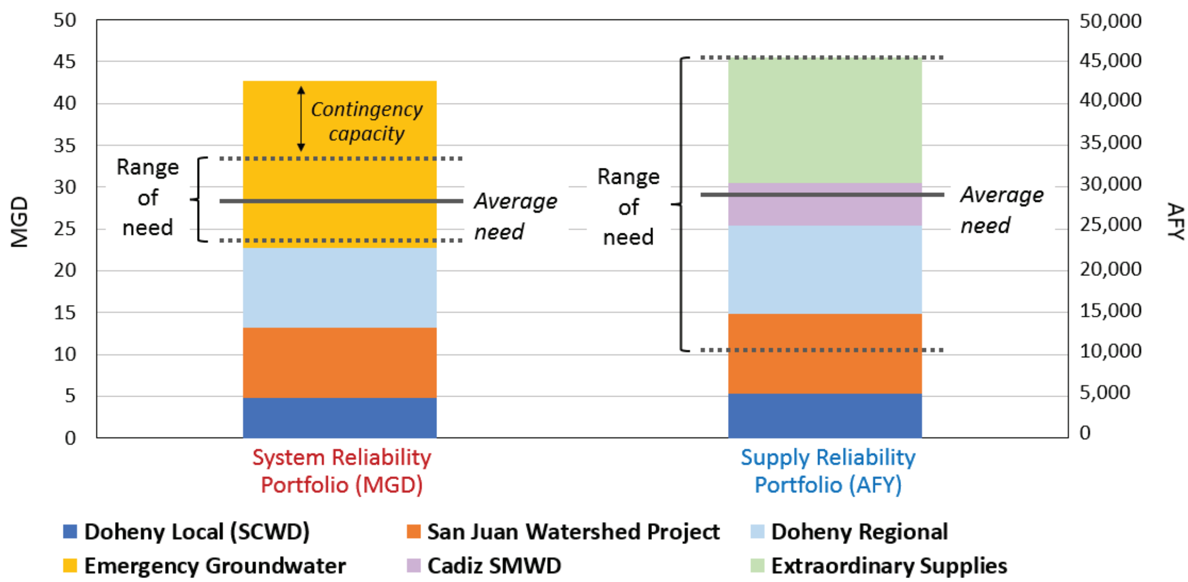



**Figure 6-4. Complementary System and Supply Portfolios for SOC**

## 6.2 Achieving Supply Reliability in the OC Basin

Ideally more than one project would have had sufficient data to compare with Poseidon Desalination for the OC Basin. However, the same logic used in SOC can be applied using the reliability curves estimated for the OC Basin. Under Scenarios 1A and 1B, shortages or supply need occurs less than 1 in 20 years (5 percent of time). And the peak supply need is 30,000 AFY, which is only 8 percent of the OC Basin water demand. This could be managed through water use restrictions or temporary increase of BPP. For Scenarios 2A and 2B, supply needs increase and a combination of water use restrictions for dealing with peak needs, bridge strategy for dealing with needs that happen roughly 10 percent of the time, and base loaded supply for the remaining needs looks promising (see **Figure 6-5**), as do the alternative OC Basin projects listed in Table 5-2.

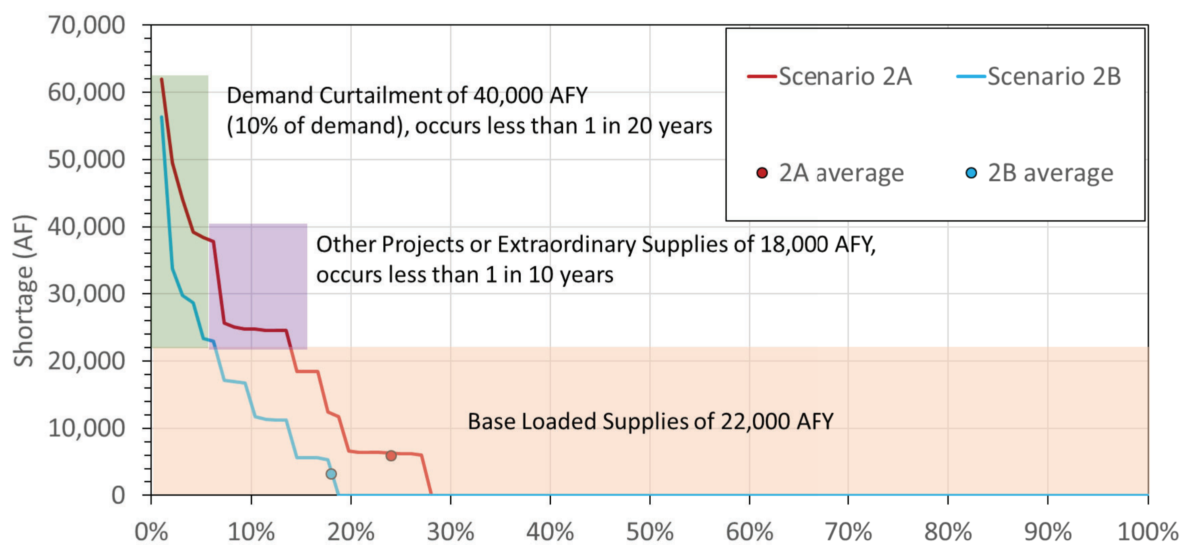



**Figure 6-5. Concept for Meeting Water Supply Needs in OC Basin Under Scenarios 2A and 2B**

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# Section 7

# Conclusions and Recommendations

The 2018 OC Study has been very beneficial in examining water demands and supplies among MET, MET's member agencies and Orange County out to the year 2050 under four planning scenarios (representing two levels of climate change impacts and two levels of MET supply investments). The study also provides insights with respect to upcoming issues at MET, including the update of its 2020 Integrated Resources Plan which will help MWDOC advocate for issues beneficial to Orange County and Southern California. The study has bounded what might occur in the future and examined how demands will be met over time under these disparate but reasonable scenarios. Finally, the study has evaluated and compared a number of new Orange County local water projects in terms of reliability benefits and cost-effectiveness.

Some reviewers of the study raised issues about difficulties in predicting the future and pitfalls with comparison of local projects that are in different stages of development. However, MWDOC believes that the planning assumptions made, and evaluation methods utilized appropriately deals with these issues. Others noted that the information provided by the study filled an information vacuum and corrected misinformation and misunderstandings of where we stand today with existing reliability provided by MET and the local agencies.

MWDOC believes that the project information and evaluation technique used for the 2018 OC Study meets or exceeds the goal and standard for understanding the relative costs, benefits, trade-offs, and potential financial impacts of implementing local projects in Orange County given our understanding of hydrologic and regulatory risks and the various projects under consideration. The project evaluations showed distinct differences between the costs of the projects evaluated. Some projects are more cost-effective and complementary to one another in filling the gaps. We would also note that "doing nothing" is a decision in and of itself, but not the appropriate one in this case. While MWDOC has provided factual and consistent information and analysis, every water agency has the right to make decisions as to which projects to implement.

With respect to the future, climate change and the WaterFix are both critical issues. Our expectation is that climate change will have gradual impacts that increase over time. The most significant impacts will occur because higher temperatures reduce snowpack in the mountains that feed our water supplies. Snowpack is essentially "free" storage, which ideally thaws in late spring providing much needed supplies for summer demands. When this snowpack melts earlier in the year, the runoff cannot easily be captured for summer use because precipitation in the winter has likely filled reservoirs. It will be critical to monitor and estimate the speed of these changes to understand the timing of future investments at the MET level to avoid degradation of water supply reliability. The California WaterFix is included as a new supply under all four scenarios. In the event it does not come to fruition, an update of this study will be triggered, and adaptive management actions will be sought to replace lost supplies.

The study findings and recommendations are very different for each of the three study areas:

- Brea/La Habra – For the Brea/La Habra areas, the potential supply shortages that were identified in the 2016 study were deemed small enough to be managed by enhanced groundwater management or additional conservation.
- OC Basin – This is discussed in Section 7.1.
- SOC – This is discussed in Section 7.2.

## 7.1 Findings and Recommendations for the OC Basin

The need for additional water supplies for the OC Basin is fairly small, meaning the OC Basin performs well under the scenarios evaluated. Without any new investments, the OC Basin may utilize demand curtailment at the level of 10 percent about once every 20 years to meet supply gaps. Alternatively, the study noted that there are a number of projects available to OCWD that can help meet supply gaps, including:

- Santa Ana River Conservation and Conjunctive Use Program (SARCCUP)
- Purchase and Development of Additional Replenishment Basins
- West Orange County Well Field Project
- Prado Dam Operations and Silt Removal
- GWRS RO Brine Recovery
- Captured Urban Runoff and Shallow Groundwater for GWRS
- Chino Basin Water Bank
- Purchase of Upstream Santa Ana River Water for the OCWD Basin
- Cadiz Project

While the Study did not evaluate the cost-effectiveness of these options to the OC Basin, we believe these projects would provide more than sufficient supplies to meet the remaining gaps within the OC Basin and that these projects should be fully analyzed and implemented, if proven to be cost-effective.

The Study also did not evaluate the Peters Canyon Water Treatment Plant being studied by EOCWD at this time. MWDOC has agreed to evaluate supplies EOCWD could produce at the treatment plant and convey to the EOCF#2, where these supplies can be provided to SOC. This will occur after the publication of this report concurrent with completing the work with IRWD on the SOC Regional Interconnection and the pump-in to the EOCF#2 and is expected to be completed in the first quarter of calendar year 2019.

### MWDOC's Recommendations for the OC Basin:

- Because the study indicated only a small supply reliability gap for the OC Basin, OCWD should evaluate all of the available supply options before they move forward with future investments.

- The Carson IPR project by MET may be the next least-cost supply available to the OC Basin, pending the final terms and conditions. MWDOC and OCWD should work together to fully evaluate the opportunities this project provides to the OC Basin.

- OCWD is pursuing the SARCCUP Project which could provide significant benefits in the form of extraordinary supplies (drought protection) for the OC Basin. If not fully needed by the OC Basin, the utilization of the supplies by others in OC should be evaluated. MWDOC and OCWD should work together on this effort.

- The study indicated minimal system (emergency) supply needs for the OC Basin, but recommends that all retail agencies review their needs for backup generators for emergency response throughout Orange County.

## 7.2 Findings and Recommendations for SOC

The study noted that SOC is short of emergency supplies <u>today</u> by 20 to 27.5 MGD (which can be met through a combination of local projects and emergency projects such as the IRWD SOC Emergency Interconnection and the pump-in to the EOCF#2). The emergency needs is the major driver of the need for new local projects in SOC. It is suggested that SOC may want to add a contingency amount on top of their emergency needs to build flexibility into the system.

Additional non-emergency water supply reliability needs to deal with droughts and water allocations by MET are also needed by SOC. This need can be met by:

- SOC investing in additional local projects

- Changes to MET's WSAP to provide a larger allocation credit for local supply development

- SOC investing in "extraordinary" supplies, either from the IRWD Strand Ranch, SARCCCUP or from another source

- MET having a higher reliability

### MWDOC's Recommendations for SOC:

- The study analysis indicates that the San Juan Watershed Project and the Doheny Project both provide cost-effective annual supplies and emergency supplies as shown in **Table 7-1**. These two projects should make up the core reliability improvement strategy for SOC, and should be augmented by other projects evaluated in this study, such as the emergency use of groundwater for system outages, Cadiz water banking and extraordinary supplies. **Figure 7-1** demonstrates how SOC can meet both its system and supply reliability needs.

- Additional study is recommended to determine the appropriate timing and sizing of phases of the Doheny and San Juan Watershed Projects, to better understand system integration issues with water quality and stranding of assets, operational issues during winter months and operational issues to enable water to be moved through various pipelines in SOC to deal with emergency situations.

**Table 7-1. Combined Benefits of the Doheny and San Juan Projects**

| SOC Analysis of Supply & System Needs | | |
|---|---|---|
| Project | SYSTEM Peak Supply in MGD | SUPPLY Maximum Supply in AFY |
| Doheny Full Size | 14.25 | 15,963 |
| San Juan Watershed | 8.50 | 9,480 |
| **Total** | **22.75** | **25,443** |

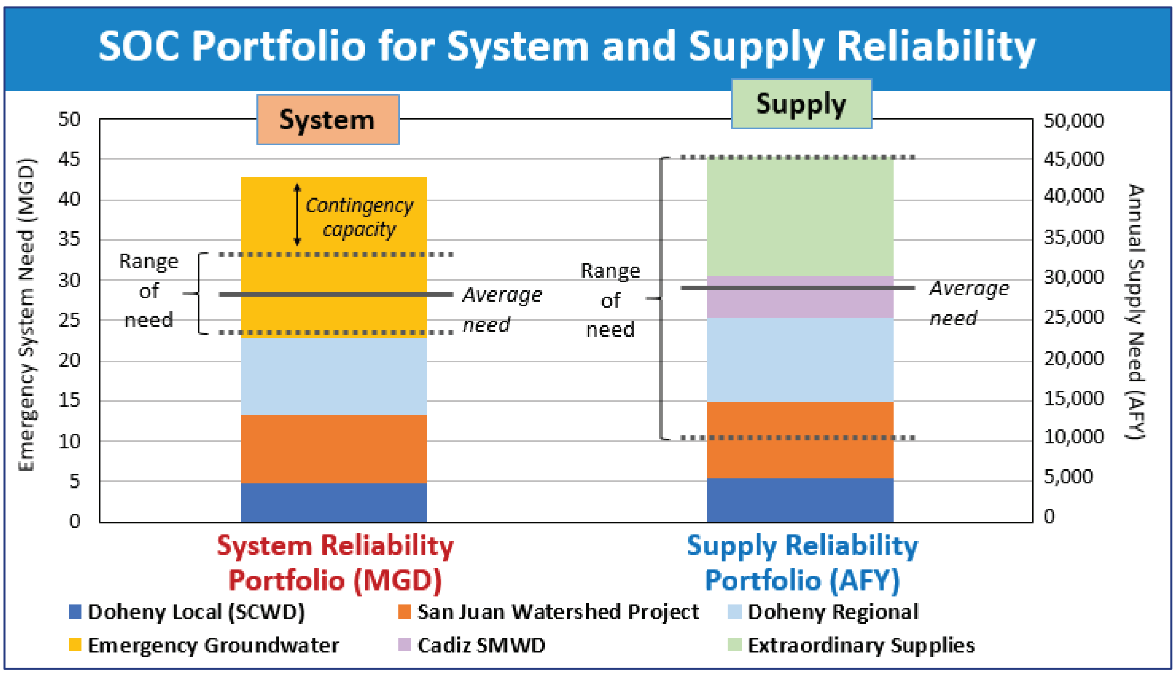


**Figure 7-1. Portfolio Recommendation for SOC**

## 7.3 Findings for MET

The Study, along with other recent discussions, has identified issues that should be discussed and addressed within MET's next IRP Update, which is scheduled to be completed in 2020. These include:

- Evaluation of the Carson IPR Project. Is it a beneficial project? Who pays and who receives the benefits? Is it good for Orange County? Is it good for MET at $1,700/AF? What does SOC pay and what benefits do they receive? Should there be any specific performance terms for agencies receiving the water during allocation situations?

- Use of MET Storage. What does it look like in our modeling? Does MET need more put and take capacity? What is the split between the SWP and CRA side of MET and how do these work independently when either the SWP or the CRA are constrained in any particular year and have low flows?

- Operational issues associated with new projects. These include a large gamut of concerns ranging from operational issues associated with adding new projects within MET and OC to issues associated with water moving in different directions in the same pipeline, getting approval from MET for introducing local sources in the MET system, long residence times in pipelines during low demands or during periods of certain operations, chloramine residual decay, and water quality issues from blending various sources of water. Also included is the stranding of assets (MET and local) and the base-loaded integration during low demand winter months. MWDOC is looking at hydraulic and water quality modeling to help on some of these issues.

- Stranding of MET assets. How much "roll-off" of MET supply is anticipated? How should we incorporate this into our planning? What are the operational and financial implications?

- Changes to MET's WSAP. The Reliability Study identified areas of conflict between local supply development and improvements or benefits under a MET allocation. Can the WSAP be improved to allow agencies to significantly improve their drought protection? Extraordinary supplies seem to be the holy grail of drought protection. How can these opportunities be opened up for agencies that want to make such investments? Should MET offer drought protection for a price? Should local projects get more of a credit under the WSAP? Do we want to remain under a "share the pain" allocation system, or is it time to go down another path?

- MET emergency storage. What level of storage should MET be providing for emergency situations including for concurrent outages of the CRA, SWP and LAA?

- Future MET rate structure and LRP. What changes are needed or what changes can be anticipated?

- MET Total Dissolved Solids (TDS). How will changing water quality in terms of TDS impact water supply planning at local levels?

    - How TDS control issues are working on the CRA? Can additional measures be implemented?

    - Feasibility of lowering the TDS via RO of a portion of the CRA flows? Is this the most cost-effective way of managing TDS for the groundwater basins and recycling? What are the hidden costs of TDS to plumbing and other?

    - TDS for groundwater basins with respect to replenishment water?

- Quagga mussel control. How will this issue impact use of MET supplies to replenishment local groundwater?

- Improved Groundwater Basin Management & MET Storage Programs. How can these provide better drought and emergency protection through conjunctive use, Cyclic Storage and other MET programs. Historically, there have been problems with developing effective MET groundwater programs. Having the groundwater basins at low storage levels prior to and during allocations are situations that should be discouraged. How can we help reverse these types of situations?

- MET's 2020 IRP Update. Initial thoughts for the process include:
  - Use of scenario planning to incorporate a more adverse climate change future for MET as a planning technique
  - Get MET to take a close look at recent and future demand projections as these are what drives the investments at MET.
  - Looking at the issue of MET agencies rolling off the system or decreasing their dependence on MET. How can we develop an overall "low cost" plan for Southern California by working together? This was part of the origin for MET's first IRP, but it has not been addressed with subsequent updates.
  - Need for changes in MET's LRP program and MET's WSAP to provide opportunities for improved drought protection by the member agencies.
  - More definitive forecast of LRP projects to be included.
  - More clarity between water use efficiency investments and what they will bring separate from recycling and local projects.
  - More definitive evaluation of benefits that could accrue from improved groundwater management issues within MET.
  - Resolution of the Los Angeles Aqueduct as a "local project"; it should stand on its own and not be included with other local projects.
  - Targeting projects to provide specific reliability benefits in certain areas of MET, i.e., spatial reliability analysis.
  - Consider the need for additional surface storage in Southern California to deal with both emergency supplies and the capture of additional wet year water

## 7.4 Findings with Respect to MWDOC

A number of findings were made in the study regarding MWDOC. These include:

- Advocate for policies at MET that are beneficial to Orange County and Southern California as we move forward at MET on reviewing the LRP, WSAP, Emergency Storage and the 2020 IRP.

- The Strand Ranch drought protection program was evaluated as a seven-year pilot program in the study. Further work should proceed to develop terms and conditions for a potentially expanded program with Strand Ranch or other extraordinary supply programs (e.g., SARCCUP) to develop additional drought protection until the completion of the California WaterFix.

- Additional study is recommended to determine the appropriate timing and sizing of phases of the Doheny and San Juan Watershed Projects. MWDOC should work on this with the SOC agencies along with system integration and operational issues from new projects. A hydraulic model with a water quality component could provide to be very useful and should be pursued by MWDOC for use by any agencies in OC.

- Given that the Poseidon SOC project was evaluated as being less cost-effective among other SOC options evaluated in this study, a full 56,000 AFY Poseidon project for the OC Basin would incur greater system integration costs than were included in the study. This would result in a lower cost effectiveness for implementation within the OC Basin than was presented in the Study. Given the scenarios examined, the Poseidon Project is a more costly option for augmenting supplies to the OC Basin than purchasing MET water or Carson water (including purchases with the allocation surcharge). The Poseidon project would however provide benefits under the following conditions:

  - MET implements Poseidon as a regional project.

  - Climate change is even more extreme than the most intense climate change scenario in the Study (low probability) resulting in low reliability from MET, and OC decides to implement the project.

  - OC decides that we want a higher degree of independence from MET and that the Poseidon Project should be implemented regardless of cost (if this is the position taken, consideration must be given to stranding of MET assets).

- While the 2016 and 2018 study results indicated minimal emergency supply needs for the OC Basin and Brea/La Habra areas, MWDOC recommends that all retail agencies review their needs for backup generators for emergency response throughout Orange County and include refueling plans coordinated through WEROC.

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# Section 8

# Comments on the Draft Report and Presentations

Appendix H includes the detailed comments received on the draft report including at the various presentations/briefings provided. Below, in summary format, is a listing of key issues/concerns derived from that list:

- We heard both "take the ranking out of the study" and "leave the ranking in the study" and we heard that the rankings result in "dictating what projects our agencies should pursue". The purpose of the study was to provide reasonable, reliable, comparable information to assist agencies in the decision-making process. Some agencies like more information and others like less. It was not MWDOC's intention to dictate projects but to provide sufficient information to allow decisions to be made.

- Hold more meetings with the agencies. Staff requested direct input from the member agencies to see if they wanted more meetings at the October 25 MWDOC Manager's Meeting. Support for additional meetings was not requested.

- There is more conservation potential (demands are too high). As included in the discussion in Section 1.4 and in Appendix A, we note that the demands projected in the 2016 Study and used again in the 2018 Study are quite low compared to any prior planning work for OC. As part of MET's IRP Update for 2020, we will request an analysis of demand trends and determine at that time if an update in the OC demand forecast is warranted.

- Include detailed financial information on all projects. The information is included in the **Appendix D**.

- There is more opportunity for developing DPR supplies in SOC than outlined in the report. Based on this comment, we took detailed input from two agencies and rewrote the section outlining the potential for DPR development in SOC (included in **Appendix A**).

- Concerns about water quality issues created by implementation of projects. We also heard about TDS issues of the incoming imported water which is the starting point for TDS for recycling. With the typical addition of salts in the first time use of the water, it is difficult for some agencies to provide recycled water at a low enough TDS so that problems with growth in plants is not stunted. The question was also raised about the hidden costs to consumers in the form of appliance and plumbing fixture life. To address such an issue would require a reexamination/reevaluation of MET's blending goals and potentially a decision to desalt a side-stream of the CRA or to implement desalting in front of water recycling. This issue has been flagged to address.

- Should have analyzed a more aggressive stance on demand management options to manage water shortages from MET.

- Concern about MET's future rate structure changes and its implication. This issue was noted by a number of agencies. MET sends pricing and economic signals with the way its rates and charges are applied. Concerns were raised about MET's future economic health with agencies potentially rolling of (reducing demands on) MET. Depending on what MET sees coming, they may need to make changes to preserve their financial health which in turn can influence what happens downstream from MET at the various wholesalers and retailers. This issue will be a key one for the long run.
- Questions raised about a "plan B" or options in case certain anticipated projects do not come to fruition
- Consider implications to MET as secondary to implications for OC regarding stranding of assets and water quality
- Evaluate OCWD basin operating criteria (this was deemed outside the scope of the study)
- Evaluate the impacts to MET assuming SDCWA and LADWP are successful in taking significant demands off of MET
- Consider opt out conditions for project participation
- Make a list of the implications of the study on future planning efforts locally and at MET. This was done and was made part of the findings/conclusions.

# Appendix A

# Background Information for 2018 Study

# Background Section for 2018 Study

This section was provided to supplement the background information in the report on the following topics:

- Water Demands
- MET Water Supply Allocation Plan (WSAP)
- Extraordinary Supplies Under MET's WSAP
- Local Projects in the MET Service Area
- The future of Direct Potable Reuse in OC
- Project Benefits NOT Quantified
- State Water Project Contract Extension

# Water Demands

The water demand forecast for Orange County utilized in the 2018 OC Study is based on the latest set of demographic projections from the Center for Demographic Research (an Orange County institution that specializes in projections of population, housing and employment), and is derived from a statistical analysis of weather and climate, conservation, and economy. This current demand forecast is substantially lower than prior forecasts, but much more in line with current actual water use trends. However, it is important to continue to update these demand forecasts every five or so years to reflect trends that are more difficult to predict. The tools and models used to estimate supply reliability can easily be updated with new water demand forecasts as they are prepared.

The water demand forecasts used for the 2018 OC Study remained unchanged from the 2016 OC Study. The assumptions and methodology for these demand forecasts are extensively documented in the 2016 OC Study report, found at: https://www.mwdoc.com/wp-content/uploads/2017/06/OC-Study-Executive-Report_with-Appendices_1-4-2017-FINAL-Low-Resolution.pdf A summary of the demand forecast is included here for easy reference.

Table A-1. Orange County Water Demand Forecast with Conservation Measures

**Table 1. Water Demand Forecast with Conservation Measures**

**Brea / La Habra**

| | With Conservation Demand | | | | |
|---|---|---|---|---|---|
| | SF AFY | MF AFY | CII AFY | Non Rev AFY | Total AFY |
| 2020 | 8,094 | 2,925 | 6,368 | 1,043 | 18,429 |
| 2025 | 8,546 | 3,154 | 6,789 | 1,109 | 19,598 |
| 2030 | 8,519 | 3,200 | 6,796 | 1,111 | 19,626 |
| 2035 | 8,475 | 3,313 | 6,762 | 1,113 | 19,663 |
| 2040 | 8,454 | 3,302 | 6,745 | 1,110 | 19,611 |

**OC Basin**

| | With Conservation Demand | | | | |
|---|---|---|---|---|---|
| | SF AFY | MF AFY | CII AFY | Non Rev AFY | Total AFY |
| 2020 | 148,902 | 89,733 | 136,077 | 26,230 | 400,941 |
| 2025 | 157,528 | 97,180 | 147,532 | 28,157 | 430,396 |
| 2030 | 157,284 | 98,240 | 149,476 | 28,350 | 433,350 |
| 2035 | 156,263 | 99,076 | 149,552 | 28,342 | 433,233 |
| 2040 | 155,399 | 100,275 | 149,797 | 28,383 | 433,854 |

**South County**

| | With Conservation Demand | | | | |
|---|---|---|---|---|---|
| | SF AFY | MF AFY | CII AFY | Non Rev AFY | Total AFY |
| 2020 | 49,212 | 23,793 | 37,326 | 6,620 | 116,951 |
| 2025 | 53,186 | 26,250 | 40,624 | 7,204 | 127,263 |
| 2030 | 53,735 | 26,135 | 40,575 | 7,227 | 127,672 |
| 2035 | 53,545 | 25,697 | 39,769 | 7,141 | 126,151 |
| 2040 | 53,496 | 25,509 | 39,602 | 7,116 | 125,725 |

**Total Orange County**

| | With Conservation Demand | | | | |
|---|---|---|---|---|---|
| | SF AFY | MF AFY | CII AFY | Non Rev AFY | Total AFY |
| 2020 | 206,207 | 116,451 | 179,770 | 33,893 | 536,321 |
| 2025 | 219,260 | 126,583 | 194,945 | 36,470 | 577,257 |
| 2030 | 219,537 | 127,575 | 196,848 | 36,688 | 580,647 |
| 2035 | 218,283 | 128,086 | 196,082 | 36,596 | 579,047 |
| 2040 | 217,349 | 129,087 | 196,144 | 36,610 | 579,189 |

Notes: SF = single-family, MF = multifamily, CII = commercial/institutional/industrial, Non Rev = non-revenue

Notes: SF = single-family, MF = multifamily, CII = commercial/institutional/industrial, Non Rev = non-revenue

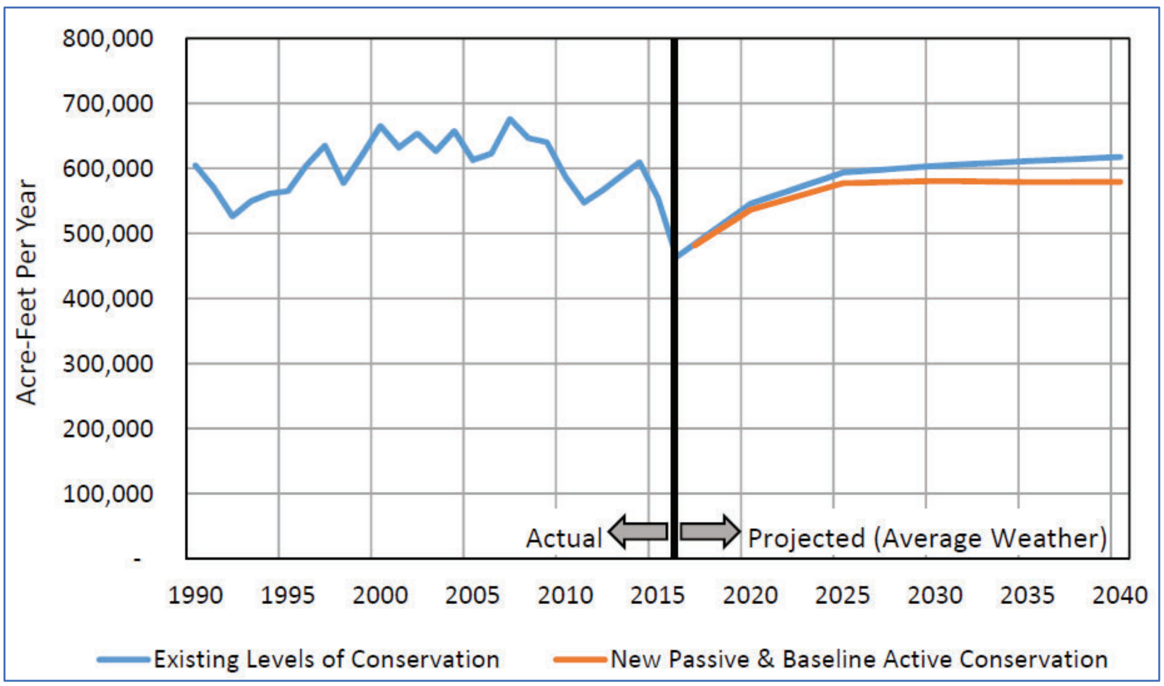


Figure A-1. Orange County Water Demand Forecast from 2016 OC Water Reliability Study

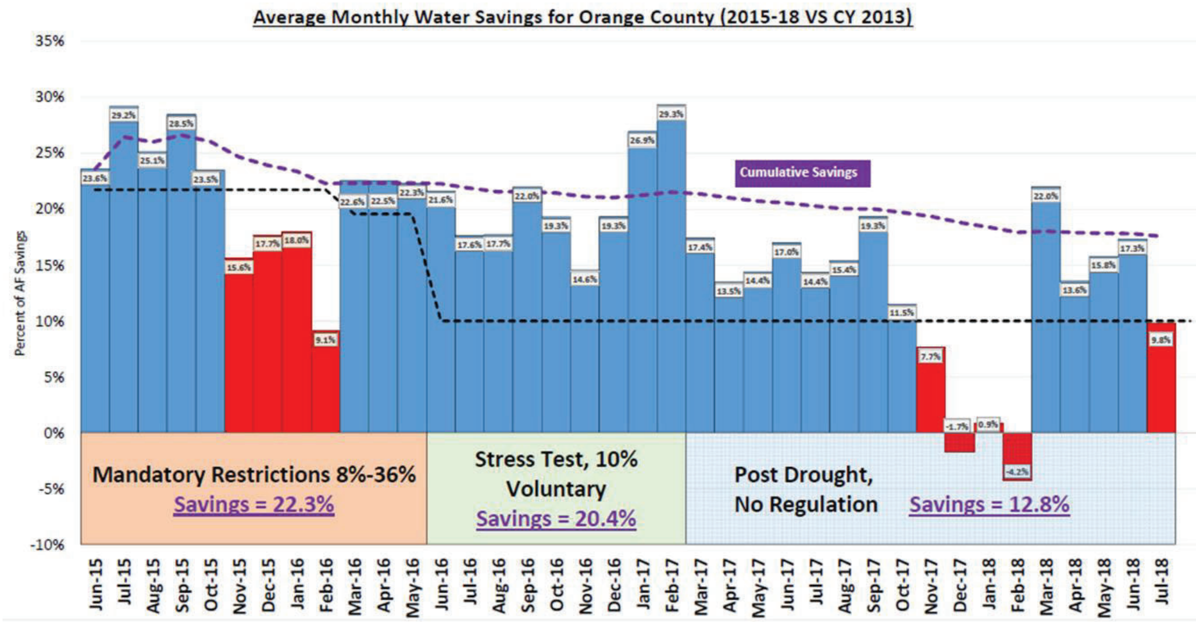


Figure A-2. Orange County Water Savings

MET's water demand forecast from their 2015 Integrated Water Resources Plan (IRP) is provided below. It shows very flat growth between 2020 and 2040, growing at less than 1/2 of 1% per year. The growth in the MET service area is expected to add about 3 million more residents and accompanying jobs over that same period. That amount of growth would add demands on the order of 300,000 to 400,000 AF per year, but the primary supplies to meet those demands will come from local projects, and with continuing investments in WUE by the 19 million people already in Southern California, regional growth demands are only expected to be at about half of that level.

**Forecast of Demands on Metropolitan by Type (Acre-Feet)**

| Demand On Metropolitan | 2016 | 2020 | 2025 | 2030 | 2035 | 2040 |
|---|---|---|---|---|---|---|
| Consumptive Use | 1,423,000 | 1,689,000 | 1,750,000 | 1,791,000 | 1,840,000 | 1,879,000 |
| Seawater Barrier | 16,000 | 5,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Replenishment | 214,000 | 166,000 | 166,000 | 166,000 | 166,000 | 166,000 |
| Total Demand on Metropolitan | 1,653,000 | 1,859,000 | 1,918,000 | 1,959,000 | 2,008,000 | 2,048,000 |

* 2015 MET IRP Demand Forecasts does not include Regional Recycled Water Program (Carson IPR Project) in the Replenishment figures shown.

# MET Water Supply Allocation Plan (WSAP)

Since the 1976-77 fiscal year, MET has utilized various methods of allocating imported water during water shortages among its member agencies. The current WSAP was last updated in 2014 and was utilized during the 2015-16 fiscal year. The WSAP includes specific formulas for calculating member agency supply allocations if and when a shortage is declared. The allocation formula seeks to balance the impacts of a shortage at the retail level while maintaining equity on the wholesale level, and considers growth, dependence on MET water, local investments, changes in supply conditions and the demand hardening aspects of non-potable recycled water use and the implementation of conservation savings programs. The formula is calculated in three steps:

- Base period calculations
- Allocation year calculations
- Supply allocation calculations

The first two steps involve standard computations, while the third step contains specific methodology for actual application of the WSAP for the supply reduction in the year being implemented. The frequency and severity of allocations from MET is one measurement of water supply reliability. During periods of extreme water supply shortage MET utilizes its WSAP to allocate a specific reduced level of MET supplies as determined by the MET Board. If MET member agencies need and purchase water above their allocation amount, substantial allocation surcharges are imposed. MET water allocations have been imposed three times since 2000 with allocation reductions of 10% to 15% of the baseline imported sales. It is expected that the likelihood of MET allocations being implemented again will be highest between now and when the California WaterFix project is completed (estimated 2035).

MET's allocation surcharge is charged for water use above the MET member agency's annual allocation amount and is charged in addition to MET's standard rates for water service. Allocation surcharges are only assessed to the extent that an agency's total annual usage exceeds its total annual allocation. Any revenues collected through the Allocation Surcharge will be applied towards MET's Water Management Fund, which is used to in part to fund expenditures in dry-year conservation. No billing or assessment of allocation surcharges rates will take place until the end of the twelve-month allocation period.

The Allocation Surcharge structure is a two-tier structure that provides a lower level of Allocation Surcharge for minor overuse of allocations and a higher level of Allocation Surcharge for major overuse of allocations. The structure and applicable Allocation Surcharges are listed below.

| Water Use | Base Water Rate | Allocation Surcharge | Total Rate |
|---|---|---|---|
| ≤100% of Allocation | Tier 1 | 0 | Tier 1 |
| Between 100% and 115% | Tier 1 | $1,480 | Tier 1 + ($1,480) |
| Greater than 115% | Tier 1 | $2,960 | Tier 1 + ($2,960) |

The Allocation Surcharge was developed in 2014 based on the costs that MET and its member agencies were incurring to implement outdoor water use reductions through landscape transformation (turf removal) programs[2]. The Allocation Surcharge provides a price signal based on the marginal conservation costs incurred to reduce water use in dry and shortage years. Any revenues collected from the Allocation Surcharge would be used to fund the implementation of WUE programs designed to conserve water and reduce future demands.

Water use between 100 percent and 115 percent of WSAP supply allocations is charged with the Allocation Surcharge of $1,480 per acre-foot. Water use greater than 115 percent of WSAP supply allocations is charged at two times the Allocation Surcharge or $2,960 per acre-foot. Two times the Allocation Surcharge would allow the funding of additional landscape transformation and conservation programs to conserve additional water and further reduce demand or, if appropriate, allow for a higher per square foot incentive payment.

In the 2018 Water Reliability Study, avoiding the cost of MET water under a WSAP is a benefit that can be achieved by developing projects to avoid going into a WSAP or having extraordinary supplies under a WSAP. For the project evaluation purposes, the "value" of a project is to avoid incurring the allocation surcharge by MET during a water shortage event. We used the 100% to 115% tier surcharge of $1,480 per AF and escalated it at 3% over time. For the analysis, we did not consider charges for water in an amount beyond 115% of the allocation amount.

In OC, MWDOC's pooling of allocations makes it possible for some member agencies to exceed their allocation if other agencies are under their allocation and net use for all of MWDOC is at or below its allocation.

[2]The Allocation Surcharge was based on MET's cost of the Landscape Transformation (formerly Turf Removal) Program, whereby MET was paying $2 per square foot of turf removed. The estimated water savings is 44 gallons per year for each square foot of landscape transformed for a period of ten years. Based on this savings rate, the estimated cost of the program is $1,480 per acre-foot.

# Extraordinary Supplies Under MET's WSAP

One way to decrease the impact of MET allocations is through the use of an 'extraordinary water supply'. The value of extraordinary supply is that it is directly added to the agencies' baseline supply (essentially on a 1:1 basis, but not exactly) and is not discounted or reduced in the supply allocation calculation. There are several conditions that must be met for a water supply to qualify as MET extraordinary supply and the most germane conditions are that it cannot be derived from a MET water supply and it must be used <u>only</u> during allocations or certain emergencies. For example, storing MET water in a surface reservoir or groundwater basin would not qualify nor would a baseload water supply that produced water that was used during non-allocation periods. While extraordinary supplies can provide significant relief from an allocation, they are typically expensive to acquire and maintain due to the required conditions. Essentially you are paying for a water supply and then putting it on the shelf for future use under very limited conditions.

There are currently few extraordinary water supplies and even fewer that have been actually used during a MET allocation. Examples include, Western Municipal Water District has banked 6,000 Acre Feet (AF) of groundwater that qualifies as extraordinary supply. During the 2010 allocation the San Diego County Water Authority received approval from the MET Board of Directors for 15,200 AF of extraordinary supply for a water transfer from the Placer County Water Agency, and Irvine Ranch Water District (IRWD) has developed the Strand Ranch Integrated Banking Program. MWDOC could independently develop an extraordinary supply through a commercial groundwater storage facility (e.g., Semi-Tropic), but again, at a very high cost to purchase, place, store, retrieve and deliver the water.

Additional extraordinary supplies are likely to be developed in the future. For example, OCWD through the SARCCUP program is likely to develop an extraordinary supply in the future. However, the SARCCUP program requires MET Board approval, agency implementation and the availability and purchase of excess water from San Bernardino Valley Municipal Water District (a non-MET source) for storage in the OCWD groundwater basin. If the OCWD Board of Directors decided to make a program available to MWDOC, it may take five or more years before an adequate volume of water is accumulated by OCWD.

IRWD and MWDOC have entered into discussions to allow OC agencies to participate in the Strand Ranch Project. This is discussed and evaluated further as part of this study effort.

# Local Projects in the MET Service Area

Part of the 2018 reliability analysis includes an examination of local projects that are being developed either by MET, MET's member agencies, or in OC to determine what impact they will have on future reliability. Assumptions regarding local projects can be divided into three groups:

- Group 1 – MET – MET is looking at the possibility of developing the Regional Recycled Water Program in the City of Carson (Carson Indirect Potable Reuse Project or Carson IPR). The MET Board has yet to make a decision to implement this project, but it could develop maximum supplies of 168,000 AFY.
- Group 2 - Member Agencies - The modeling work assumed two levels of development of local projects outside of OC. The two levels of assumptions were 88,000 AF per year in LRP projects and the second level was 162,000 AF per year. Specific projects from the total of all possible local projects within the MET service area (over 500,000 AF per year yield in many stages of development) were targeted to set the 88,000 AF per year yield, including the LA San Fernando Groundwater Basin Treatment, the City of San Diego Pure Water Program (Phase 1), the Los Angeles Department of Water and Power Groundwater Replenishment Project and the Eastern Municipal Water District Indirect Potable Reuse Project.

  Specific projects per se were not targeted for the additional local projects to increase the investment from the 88,000 to 162,000 (an additional 74,000 AF per year), however MWDOC's review of projects in the 2016 OC Reliability Study indicated there are a sufficient number of projects to allow production of the amounts indicated. A point to note here is if there are that many local projects, why not just develop them all to ensure full reliability. The answer is that the 2016 OC Reliability Study along with MET's IRP are looking for the most economical solution to reliability over the long run. It is not currently known if the current LRP incentive that offers up to $475 per AF for 15 years (or alternatively up to $340 per AF for 25 years, or a fixed payment up to $320 per AF for 25 years) are sufficient incentives to move these local projects into implementation. Furthermore, we cannot expect every local project completed in Southern California will automatically secure LRP funding from MET – MET will provide sufficient incentives to secure the number of local projects necessary to meet the reliability needs in combination with all other supplies and WUE investments. In addition, as these projects are developed, they take a demand off of MET and lower the amount of treated water to be provided by MET. A balance over the long run must be struck to ensure that we do not over invest (too many projects) or under-perform (have lower reliability than desired) or leave major investments stranded. In addition, MET has a number of investments it can make in securing additional supplies over time and this balancing process is one of the main objectives under the MET IRP.
- Group 3 – OC Projects - Involves those projects that can be developed in OC. These are discussed elsewhere in this document.
- As an indication of the current level of local projects that have already been submitted under MET's LRP program, but have not completed the permitting to enable MET Board consideration at this time, the following Table below lists the projects and yields (in AF per Year). This information was recently discussed at MET, as part of the Board's approval for a new interim LRP target of 170,000 AF of LRP funding incentives.

| Projects Currently Submitted for LRP | Yield (AFY) |
|---|---|
| La Puente Recycling | 60 |
| Central Basin MWD Recycled Water Expansion | 500 |
| Santa Margarita River Conjunctive Use | 3,100 |
| East County Advanced Water Purification | 11,600 |
| San Diego Pure Water Program | 33,600 |
| Carlsbad Seawater Desalination | 56,000 |
| Huntington Beach Ocean Desalination | 56,000 |
| **Total** | **160,860** |

## The future of Direct Potable Reuse in OC

Some believe the development of Direct Potable Reuse (DPR) will be the silver bullet to meeting future needs, especially in South Orange County (SOC). However, we do not believe that is the case in either North or SOC. The North OC system has already been developed to recycle 134,000 AF per year via an indirect potable reuse (IPR) system called the Groundwater Replenishment System. We do not believe that significant levels of direct potable supplies will be developed in addition to this in North OC. There are opportunities within IRWD and possibly within South OC agencies. However, without the required regulations having been fully developed (and likely not developed for some time), it is difficult to assess. IRWD may develop several thousand AF of direct potable supplies using reservoir augmentation in Irvine Lake. With respect to development of DPR supplies in SOC we sought additional information from SMWD and MNWD, as follows:

- ✓ *It was reported that SOCWA has a combined outfall flow of about 20,000 AFY (about 18 MGD) which could be used to support recycling over and above what is being recycled today. Next we asked each agency to outline their thinking about the potential for each of them to pursue Direct Potable Reuse (DPR) in the future.*

- ✓ *MNWD currently uses 100% of the wastewater (WW) they generate in the summer and overall about 60% to 70% of the annual WW they generate. They have about 4,000 AF of WW they generate and send to the ocean. Total recycling is about 7,000 AF per year. They believe they will bring on an additional estimated 500 to 1300 AF of recycled water use demands. To recycle even more, MNWD would need to secure seasonal storage capacity to store winter period generated WW for use in the hotter portion of the year. MNWD is examining the potential to expand Sulfur Creek Reservoir, adjacent to the Regional WW Treatment Plant site, for seasonal storage purposes. The existing lake occupies a surface area of about 40 acres.*

- ✓ *Key issues to proceeding with DPR for MNWD will be the final regulations and the costs involved in treating the water. If they did produce DPR at the Regional WW Treatment Plant site, the* *integration into their distribution system would be quite simple, involving a lift of 100 to 300 feet. They believe the cost of their recycling is about $1500 per AF today. They believe the tertiary treatment costs today are between $300 and $350 per AF including O&M (manpower, chemicals, power).*

- ✓ *They believe the potential water available within MNWD for DPR would be about 4,000 AF and whether they proceed or not will be driven by economics and potential changes in the MET rate structure. As part of the DPR treatment, it may be beneficial to add some RO to lower the TDS of the water; RO for other constituents may also be necessary. They believe 10 years is the appropriate horizon for DPR to come to fruition.*

- ✓ *SMWD believes that all recycling for domestic water purposes in SOC will have to meet the DPR regulations since there is not a large reservoir or groundwater basin in SOC to serve as the environmental buffer. They have been attempting to convince the Regional Board since the San Juan Groundwater Basin is degraded and all water being pumped out needs treatment, they should not have to have extreme levels of treatment going into the basin. They are pursuing two parallel paths:*

    - *The first is to use tertiary recycled water with nitrogen removal for percolating into the groundwater basin by way of the rubber dams and to provide environmental flows during non-rainfall portions of the year. The intend to blend groundwater and recycled water going into Trampas Reservoir and then coming out of Trampas, they can add tertiary treatment to the water to provide for irrigation demands and they can add RO and whatever other requirements are determined to be needed for the domestic stream.*

    - *The second path is to evaluate full treatment of recycled water and will use the Lake Mission Viejo treatment plant as a demonstration to test UF/RO/UV without AOP vs GAC/BAC/Ozone along with a potential sidestream of RO to knock down the TDS. They believe the cost difference if you can avoid full RO will be $130 per AF compared to about $600 per AF with the RO.*

- ✓ *SMWD currently recycled about 8,000 AFY and has an estimated additional 1,200 to 1,600 AF of recycling demands remaining they can add to their system, however, the cost of pipelines to reach these areas makes the water quite expensive. After this, SMWD may have 4,000 to 5,000 AF of WW generated in their service area that could be used for DPR (this depends on landscaping demands and where they go over time). DPR typically reduces the available water by 20% for the RO component. They believe the time horizon for DPR is 5 years (optimistically) to 10 years out (more practical).*

Conclusions Regarding DPR in SOC - By way of the discussions with SMWD and MNWD, it appears that within these two agencies, there may be excess wastewater in the amount of 8,000 to 10,000 AF above what their ultimate recycling will require for supplies. Assuming 80% recovery for DPR, and assuming a target amount of maybe 50% of the available wastewater (as a target of the percent of available WW that might ultimately be developed), the potential for SOC for these two agencies is about 4,000 AF. They also noted that wastewater not being used by others could also be used for DPR which could increase the overall potential depending on the regulations and availability of regional storage (which is key). The discussions identified an optimistic timeline of maybe 5 years and a more realistic timeline of 10 years for DPR to come to fruition. The discussions did not suggest that all other planning and supply decisions be put on hold until the regulations are fully developed, but that moving forward on reliability investments, as long as they are smart ones, should continue. Additional discussions noted the potential for adding tertiary treatment at the Latham Plant may be able to be permitted as blending water for the Doheny Desal Project to increase the capacity of the project. The regulations and the treatment costs will be the drivers in making these decisions.

## Project Benefits NOT Quantified

The 2018 OC- Study project evaluations uses certain metrics to calculate the benefits of bringing projects on line. While these evaluations were deemed appropriate for evaluating projects to understand the differences in the costs and benefits provided by each project, not all benefits were quantified. The list below summarizes the main benefits that were not quantified:

- Economic and social impacts of being unreliable (such as costs for landscape replacements, job losses from existing businesses leaving the area/new business not locating in the area, and deterioration of quality of life)
- Environmental impacts (negative and positive)
- Project cost impacts due to future energy/technology issues (negative and positive)
- Potential project challenges (permitting, legal, institutional, public)
- Increased local control
- Increased resiliency to unknowns (e.g., even more extreme climate change or increased water demands in the future)
- Scalability (e.g., can a project be more easily implemented in phases for adaptive management)
- Integration ease into existing water systems
- Changes in MET policies related to LRP/water allocations for local projects

# State Water Project Contract Extension

Another changed condition may provide increased flexibility for multi-year transfers within the provisions of the SWP contracts. This change could come about through the negotiations currently underway with respect to extension of the SWP Contract, which currently ends in 2035 and is in the process of being extended for 50 years to 2085. The contract extension provisions should be completed in early 2019 and are expected to provide for greater water management flexibility regarding transfers and exchanges of SWP water within the SWP service area. This will likely provide MET with increased opportunities to store water in wet years and could potentially reduce the gaps identified in the report.

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# Appendix B

# Technical Memorandum on Climate Change and Bureau of Reclamation Drought Contingency Plan

# 2018 Orange County Water Reliability Study Update

## Technical Memorandum #1:
## Updated Water Supply Modeling without Future Supply Investments

*To:* *Karl Seckel, Assistant Manager/District Engineer*
*Municipal Water District of Orange County*

*From:* *Andrea Zimmer, Engineer, CDM Smith*
*Reviewed:* *Dan Rodrigo, Senior Vice President, CDM Smith*

*Date:* *January 19, 2018*

# Executive Summary

This technical memorandum (TM) describes the updated water reliability modeling that will be used for the 2018 Orange County Water Reliability Study Update (2018 OC Study Update). The updated water reliability modeling incorporated new baseline data, revised assumptions regarding Colorado River supply availability to the Metropolitan Water District of Southern California (MET), and the latest climate modeling from the Coupled Model InterComparison Project Phase 5. The ensemble (grouping of all climate models) of the latest climate modeling shows greater temperature increases over the climate models used for the 2016 Orange County Water Reliability Study (2016 OC Study), but also shows greater precipitation for California and western United States. From the latest set of global climate models, three models (downscaled to the watersheds that feed into the region's imported and local water supplies) were used to represent a range of possible impacts: (1) CNRM, which has minimal impacts to the State Water Project (SWP) supply but moderate impacts to MET's Colorado River Aqueduct (CRA) supply; (2) MIROC, which has moderate impacts to the SWP but slightly improved impacts to the CRA; and (3) CSIRO, which has moderate impacts to the SWP and moderate impacts to the CRA.

**Figures ES-1, ES-2, and ES-3** show the revised water supply reliability results for the year 2040 with no new investments from this updated modeling for MET, the Orange County Basin (OC Basin), and South Orange County (SOC), respectively. The figures show the potential water shortages on the vertical axis and probability of shortage on the horizontal axis, with the average shortage across all hydrologic simulations shown as a dark circle. Three climate scenarios are specifically called out, those being: (1) the updated 2018 baseline with historical hydrology, labeled as **Historic**; (2) the MIROC climate modeling, labeled as **Planned**; and (3) the CSIRO climate modeling, labeled as **Potential**. For reference, the CNRM climate modeling and prior climate modeling from the 2016 OC Study (Scenarios 2 and 3) are also shown.

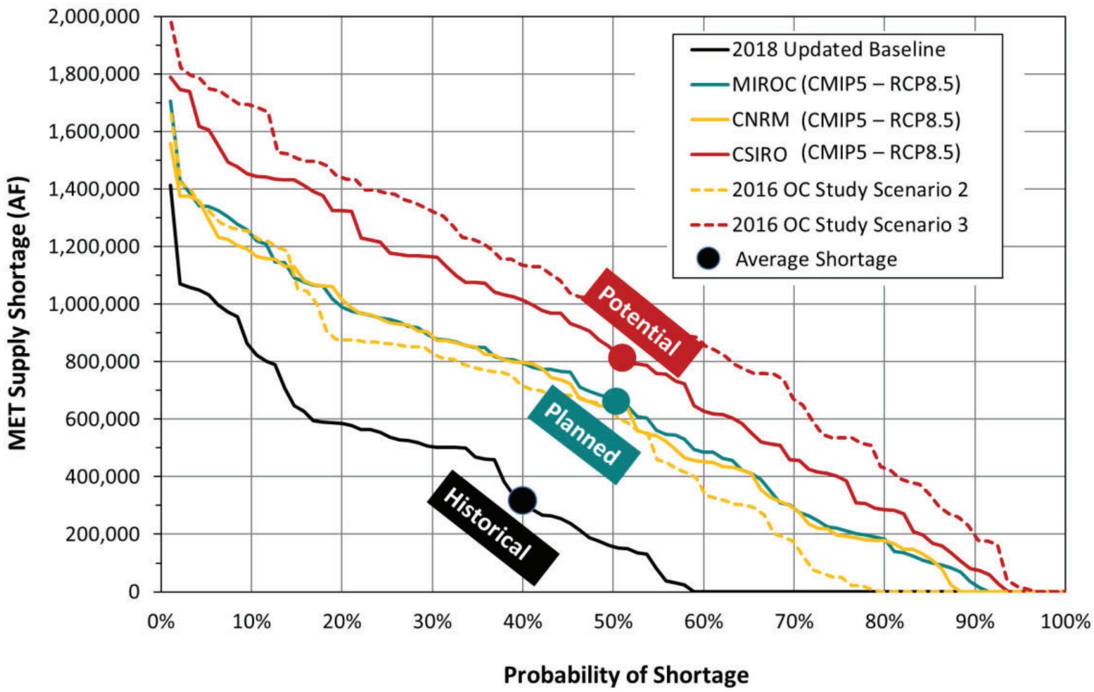


**Figure ES-1. Updated Reliability for Metropolitan Water District in 2040 with No New Investments**

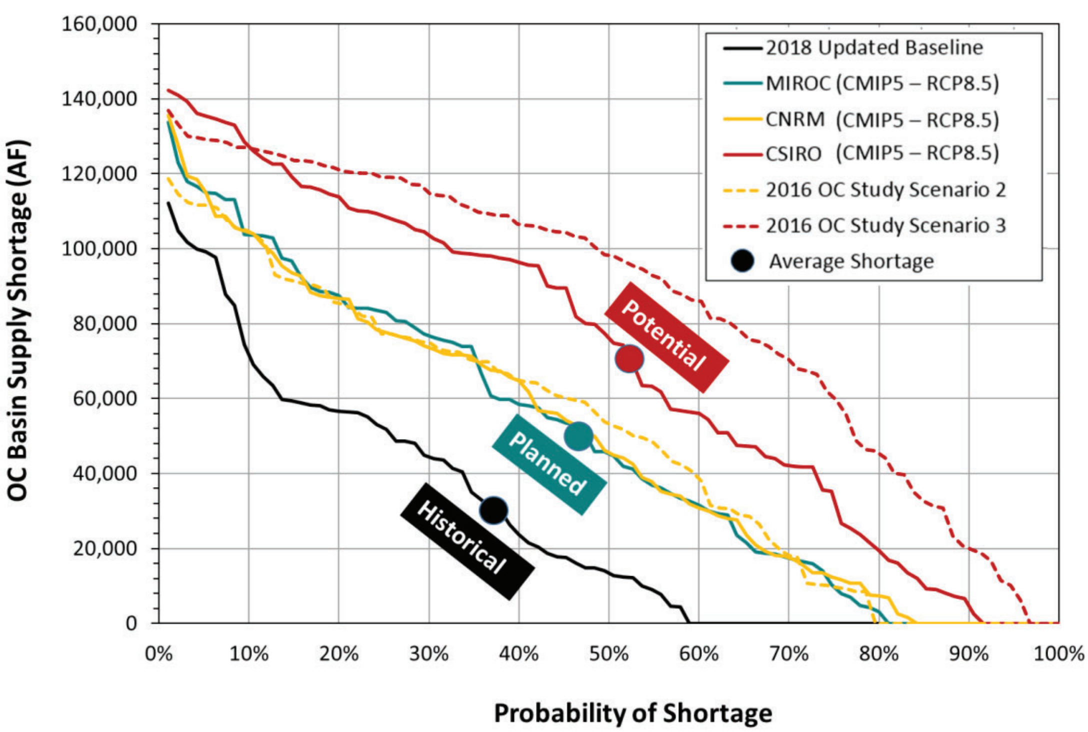


**Figure ES-2. Updated Reliability for Orange County Basin in 2040 with No New Investments**

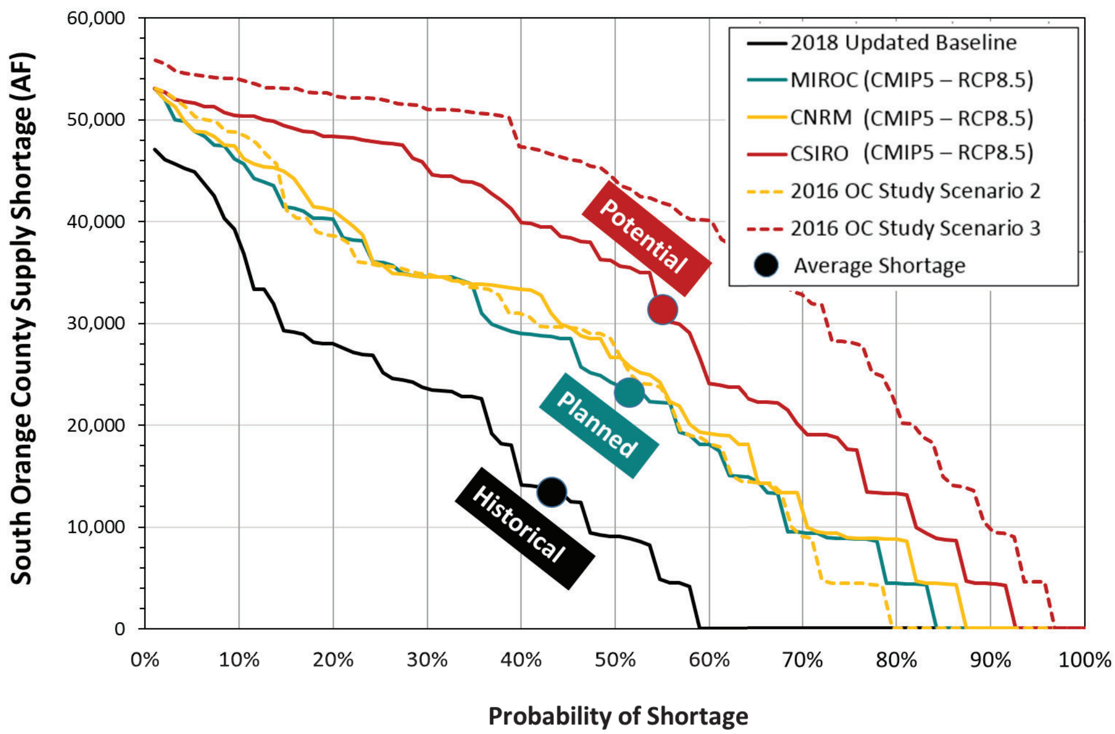


**Figure ES-3. Updated Reliability for South Orange County in 2040 with No New Investments**

The results of the updated reliability modeling can be summarized for the year 2040 with no new investments, as follows:

1) Average water shortages for **MET** under historical climate are **300,000** acre-feet (AF), with planned shortages under moderate climate change of **650,000** AF, and potential shortages under more severe climate change of **800,000** AF.

2) Average water shortages for **OC Basin** under historical climate are **30,000** AF, with planned shortages under moderate climate change of **50,000** AF, and potential shortages under more severe climate change of **75,000** AF.

3) Average water shortages for **SOC** under historical climate are **12,000** AF, with planned shortages under moderate climate change of **22,000** AF, and potential shortages under more severe climate change of **31,000** AF.

# 1.0 Introduction

The 2016 OC Study, published in January 2017, was a first-of-its kind effort to comprehensively assess county-wide water demands and supplies under a wide range of planning scenarios and potential supply portfolios implemented at the regional and local levels. A 2018 update to this study, referred to as 2018 OC Study Update, is being conducted by the Municipal Water District of

Orange County (MWDOC) for various reasons, including incorporation of new climate forecasts and other variables that can impact supply reliability, as well as reflect new information regarding key potential water supply projects in Orange County.

The 2016 OC Study utilized the Coupled Model Intercomparison Project Phase 3 (CMIP3) global climate models (GCMs) to estimate supply reliability impacts related to climate change. In the 2016 modeling, two climate scenarios were used for the 2016 OC Study: (1) moderate and (2) more severe. The moderate climate scenario resulted in <u>significant</u> reductions in MET's SWP supplies but did not result in declared water shortages for MET's CRA deliveries, as measured by simulated Lake Mead elevations. In the 2016 OC Study it was assumed that Colorado River shortage declarations occurred when Lake Mead elevations fell below 1,000 feet. However, under the more severe climate scenario, it was estimated that Lake Mead elevations would fall below 1,000 feet approximately 50 percent of the time, and thus would trigger California and MET shortage provisions. Because this extreme shortage condition has not yet occurred, it is uncertain how much Colorado River water supply California and MET would receive when Lake Mead falls below elevation 1,000 feet. For the 2016 OC Study, CDM Smith assumed that when Lake Mead elevation falls below 1,000 feet water shortages to MET would be proportional to MET's firm apportionment for Colorado River within California and within the Lower Basin states.

In late 2014, CMIP Phase 5 (CMIP5) climate projections were released and are now starting to be used to re-evaluate water supply impacts by water agencies around the globe. The CMIP5 projections are considered superior in several key ways: (1) they are based on the latest, more intensive and higher resolution computer simulations; and (2) they are based on more physical variables such as atmospheric concentrations rather than the development scenarios used for CMIP3. Climate models continue to improve, but still have not progressed to the point of being able to be used to "predict" specific climate impacts, such as frequency and length of droughts or super storms, in the future with great accuracy. However, climate models can be used to identify potential long-term climatic trends and potential impacts on water demand and supplies. It is also important to note that current climate models have more consistency in projecting temperatures than precipitation, although improvement in the later is being made. Thus, it is important to continuously re-assess potential climate impacts on water supply reliability as climate science and modeling evolves.

In 2016, a draft Drought Contingency Plan (DCP) was discussed among the U.S. Bureau of Reclamation (BOR), MET, and other Lower Basin entities. To avoid Lake Mead elevations from reaching critical levels (i.e., below 1,000 feet), there was consideration in this DCP that California and MET would begin taking shortages when Lake Mead elevations fall to 1,045 feet. To date, these discussions and the draft DCP have not materialized into any formal policy regarding Colorado River shortage declarations for the Lower Basin states.

This TM summarizes the range of impacts on water supply reliability for the 2018 OC Study Update based on using: (1) CMIP5 projections; (2) incorporation of the draft DCP for Colorado River shortage declarations to MET to reflect more realistic drought allocations that are likely to be implemented; and (3) incorporation of two additional calendar years into the model simulation, 2015 and 2016 (which includes an El Nino condition followed by another year of extremely wet weather). These updates were used to modify the 2016 OC Water Supply Simulation Model (2016 OC Model), which uses the commercially available Water Evaluation and Planning (WEAP) software. The updated simulation model is herein referred to as 2018 OC Model.

## 2.0 Overview of Climate Change Models

Many water agencies in California have utilized various GCMs to estimate potential impacts to water supply reliability. The California Department of Water Resources (DWR) and BOR have led much of this work, utilizing downscaled versions of GCMs to estimate changes in river inflows, snowpack and sea level rise.

The CMIP3 ensemble, used for the 2016 OC Study, consists of 112 bias-corrected, downscaled climate projections. These climate projections are derived from 16 GCMs, each developed by a different climate modeling organization. The GCMs are combined with three emissions projections from the 2000 IPCC Special Report on Emissions Scenarios (SRES) as summarized in **Table 1**. A single GCM-emissions combination can be run with different initial conditions to generate multiple projections. As a result, many of the 16 GCMs contribute more than 3 scenarios to the total 112 projections.

**Table 1. CMIP3 Emissions Scenarios from 2016 Modeling**

| Emissions Scenario | Description |
|---|---|
| SRES A2 | High Emissions: High population growth coupled with slow economic development and slow technological change leads to a continuously increasing rate of greenhouse gas emissions. |
| SRES A1B | Medium Emissions: Low population growth and rapid introduction of new and more efficient technology. However, emissions are not reduced beyond a medium level due to a lack in environmentally friendly investments. |
| SRES B1 | Low Emissions: Low population growth coupled with rapid changes in economic structures toward a service and information economy, with reductions in materials intensity, and the introduction of clean and resource-efficient technologies. |

In 2014, the SRES projections used in CMIP3 were superseded by Representative Concentration Pathways (RCP's) for use in the CMIP5 projections. The RCP's portray updated values of radiative forcing (the difference between the incoming energy from sunlight and radiation back to space). An increase in radiative forcing produces warming, and is reflected by numeric values affiliated with the RCP scenarios listed in **Table 2**.

**Table 2. CMIP5 Representative Concentration Pathways for 2018 Modeling**

| RCP | Description |
|---|---|
| RCP 2.6 | Radiative forcing equal to 2.6 Watts per square meter (W/m$^2$)<br>Annual GHG emissions peak between 2010-2020 and decline substantially afterward |
| RCP 4.5 | Radiative forcing equal to 4.5 W/m$^2$<br>Annual GHG emissions peak near 2040 then decline |
| RCP 6.0 | Radiative forcing equal to 6 W/m$^2$<br>Annual GHG emissions peak near 2080 then decline |
| RCP 8.5 | Radiative forcing equal to 8.5 W/m$^2$<br>Annual GHG emissions increase throughout 21$^{st}$ century |

The CMIP5 ensemble reduces the number of total climate projections to 97. A total of 31 GCMs from different modeling groups are combined with a total of 4 RCPs. Each GCM has a single projection for each (or fewer) of the 4 RCPs.

**Figure 1** shows global carbon dioxide emissions (in gigatons of carbon per year) and the atmospheric concentration of carbon dioxide (in parts per million) under the 4 RCP scenarios (Meinhausen et al., 2011). Historical data for $CO_2$ emissions are taken from the Global Carbon Budget 2017 (Le Quéré et al., 2017 and Boden et al., 2017), and historical global $CO_2$ concentrations are from NOAA (Tans and Keeling, 2018.)

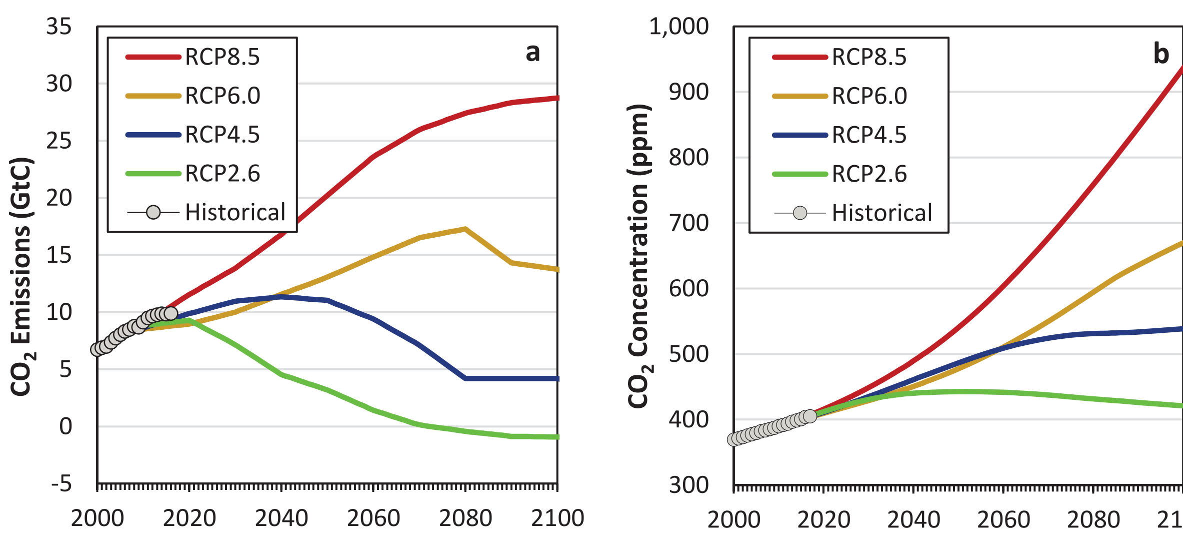


**Figure 1. Carbon Emissions and Concentration for Climate Modeling in CMIP5**

While RCP 8.5 corresponds to the pathway with the highest greenhouse gas emissions (and the most warming), it was developed to represent a "business-as-usual" scenario in which there would be limited technology or policies to significantly constrain and/or reduce $CO_2$ emissions (Riahi et al., 2011).

The last couple of years of historical world-wide $CO_2$ emissions are tracking slightly lower than emissions assumed for RCP 8.5 (see Figure 1a). Jackson et al. (2017) describe three years of stable emissions despite continued growth in the global economy; while PBL Netherlands Environmental Assessment Agency (2015) attribute much of this trend to decreased coal consumption in China. However, the stabilization in emissions may not be maintained through 2018 and beyond (Jackson et al., 2017). The historical world-wide $CO_2$ concentration (see Figure 1b) is tracking slightly greater than concentrations assumed for RCP 8.5. It should be noted that $CO_2$ concentrations is the actual variable used to determine radiative forcing and climate change in CMIP5 modeling.

Although some climate policy analysts predict between $CO_2$ emissions of 15 and 20 GtC be the end of the century, which would follow a trajectory closer to RCP 6.0 (van Vuuren et al., 2011); other climate specialists believe it is more likely that global carbon emissions, and more importantly, carbon concentrations will follow more closely to the trajectory closer to RCP 8.5 at least through 2060 (Lenton, 2015). Furthermore, according to climate specialist Glen Peters (Peters et al., 2017) "the latest carbon dioxide emissions continue to track the high end of emission scenarios, making it even less likely global warming will stay below 2 °C. A shift to a-lower-than 2 °C pathway requires immediate significant and sustained global mitigation, with a probable reliance on net negative emissions in the longer term". Lastly, many climate policy experts believe that the growing economies of China and India, coupled with the United States departure from the 2015 Paris Agreement and recent policies regarding expansion of coal and oil energy production, will result in significant increases of $CO_2$ concentrations for the coming decades.

## 2.1 Comparison of CMIP3 and CMIP5

The differences between how the SRES and RCP emissions models work prohibit direct comparison of forecasted variables (temperature and precipitation) produced by a single GCM across the CMIP3 and CMIP5 trajectories. The most comparable CMIP5 climate models to the CMIP3 models used for the 2016 OC Study (SRES A2) are those included in RCP8.5. As a result, an ensemble approach was used to compare model output from CMIP3 SRESA2 and CMIP5 RCP8.5. A climate model ensemble is used to estimate uncertainty in future projections and collects forecasts developed from a variety of different modeling centers, and relies on the group characteristics (median and various percentiles) for trend analysis.

The median, as well as the $10^{th}$, $25^{th}$, $75^{th}$, and $90^{th}$ percentiles, of forecasted temperature and precipitation values are compared for the CMIP5 and CMIP3 projections against the historic interval (1970-2000) used to initialize the CMIP5 ensemble. These percentile, or box and whisker charts, are included for the Upper Colorado River Basin, Northern California, and Southern California and follow the pattern indicated in **Figure 2**.

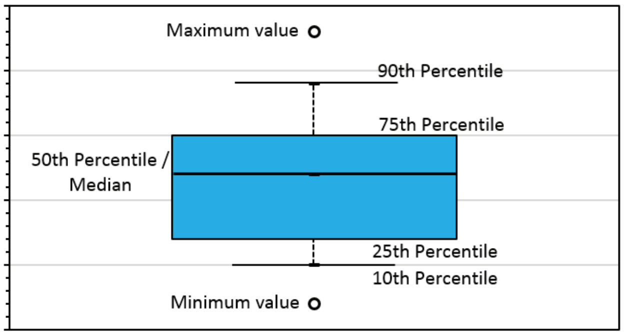


**Figure 2. Example Box and Whiskers Chart**

The lines in the bar chart extend from the 10th to the 90th annual export values, the minimum and maximum values are marked with o's, and the boxes show the 25th to 75th percentile bounds. The median value is shown as a heavy black line within the box.

**Figure 3** compares the range of average daily temperature (in degrees Celsius) and average daily precipitation (in mm) for the Upper Colorado Basin for the years 2045-2075. The median temperature for the ensemble for SRESA2 (CMIP3) climate models is significantly greater than historical, while the median temperature for the ensemble for RCP8.5 (CMIP5) is slightly greater than SRESA2. In the range of temperatures between the 10th and 90th percentile for RCP8.5 is greater than the same percentile range for SRESA2 and much tighter, indicating less variability with the newer climate models.  the average daily precipitation in the Upper Colorado River Basin. The median precipitation for the SRESA2 (CMIP3) ensemble is slightly lower than historical, but the range in precipitation is much greater, as shown by the 10th and 90th percentiles. The median precipitation for the RCP8.5 (CMIP5) is greater than both SRESA2 and historical, and the upper range of precipitation, as shown in the 90th percentile, is far greater than SRESA2 and historical.

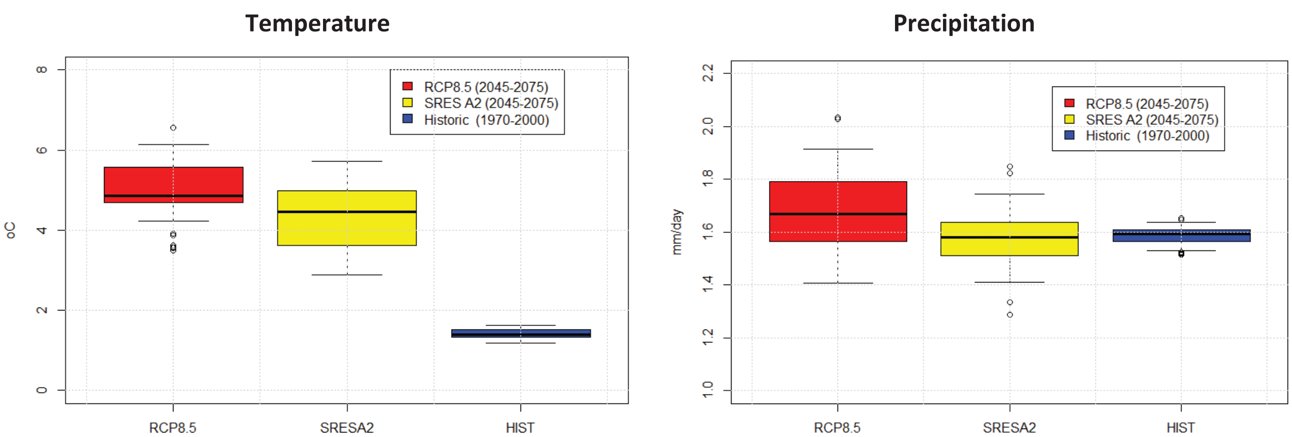


**Figure 3. Temperature and Precipitation Projections for Upper Colorado Basin**

**Figure 4** compares the range of average daily temperature (in degrees Celsius) and average daily precipitation (in mm) for Northern California for the years 2045-2075. The temperature comparisons are similar to the Upper Colorado River Basin, although the climate modeling for both SRESA2 (CMIP3) and RCP8.5 (CMIP5) shows greater variability for Northern California. The precipitation comparisons for Northern California are very similar to the Upper Colorado River Basin.

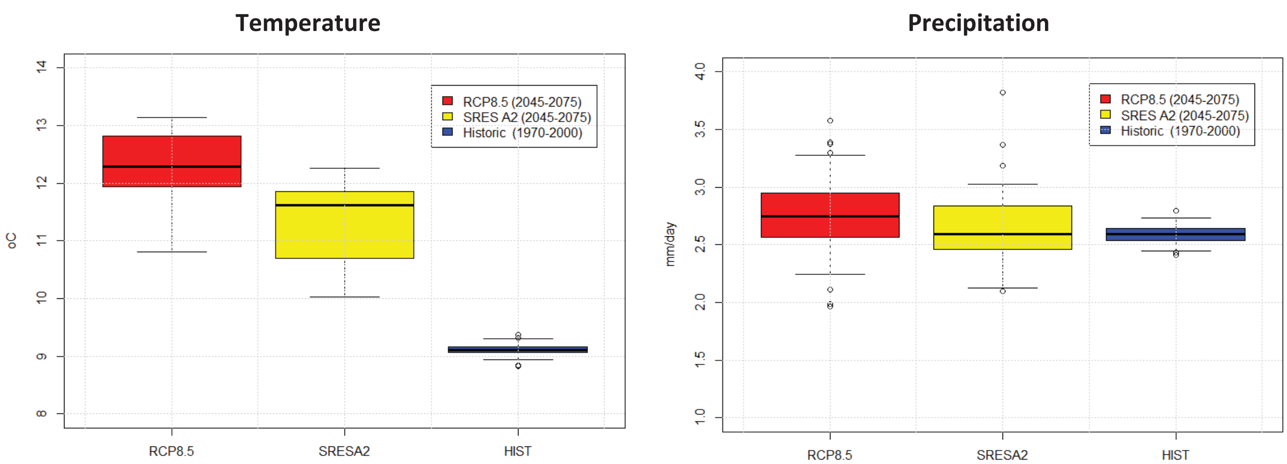


**Figure 4. Temperature and Precipitation Projections for Northern California**

**Figure 5** compares the range of average daily temperature (in degrees Celsius) and average daily precipitation (in mm) for Southern California for the years 2045-2075. The temperature comparisons are similar to the Upper Colorado River Basin. However, precipitation comparisons for Southern California show more uncertainty in precipitation for the RCP8.5 projections compared to SRESA2.

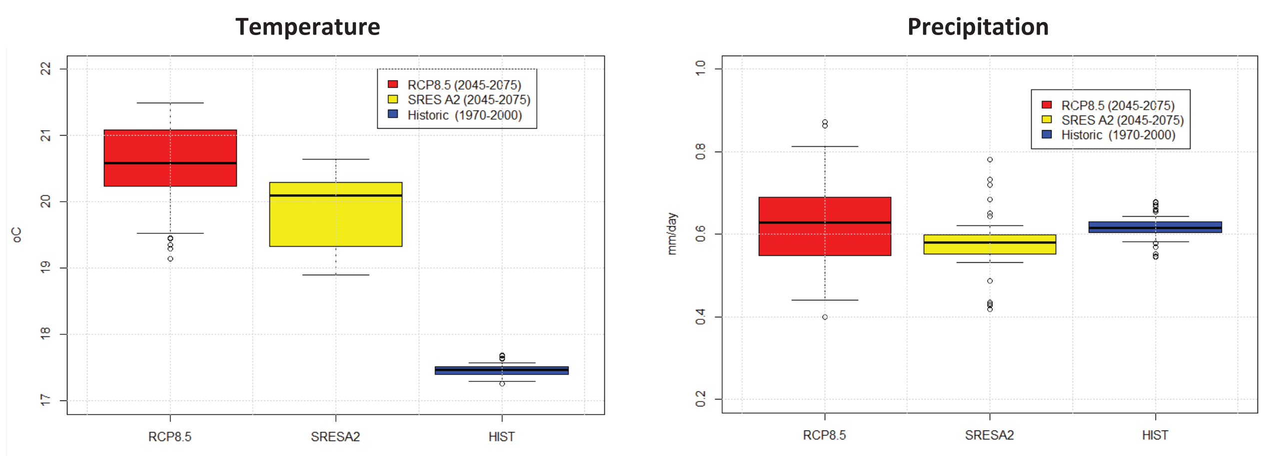


**Figure 5. Temperature and Precipitation Projections for Southern California**

In summary, for all three watershed areas that impact water supplies in Orange County, the RCP8.5 climate projections from the CMIP5 models show significantly greater temperature over historical climate and moderate increases in temperature over SRESA2 climate models used for the 2016 OC Study. However, most of the RCP8.5 climate models show increased precipitation over both historical and SRESA2 climate models.

# 3.0 Updates to MET Supply Reliability

The OC Model uses indexed-sequential simulation to compare water demands and supplies now and into the future. For all components of the simulation (e.g., water demands, regional and local supplies) the OC Model maintains a given index (e.g., the year 1990 is the same for regional water demands, as well as supply from Northern California and Colorado River) and the sequence of historical hydrology. The planning horizon of the model is from 2015 to 2040 (25 years). The 2016 OC Study used the historical hydrology from 1922 to 2014 to generate 93 separate 25-year sequences of water demand and supplies in order to assess overall supply reliability. For example, sequence one of the simulation maps historical hydrologic year 1922 to forecast year 2015, then 1923 maps to 2016 … and 1947 maps to 2040. Sequence two shifts this one year, so 1923 maps to 2015, then 1924 maps to 2016 … and 1948 maps to 2040.

The 2018 OC Model was updated to reflect:

1) Acquisition of the most recent data from the SWP and the CRA for the additional hydrologic years (2015 and 2016) added since the original 2016 OC Study;

2) Utilizes data published by MET after completion of the MET 2015 Integrated Resources Plan (MET IRP); and

3) Incorporates revised shortage declarations for Lake Mead based on the draft DCP that was presented to MET's Board, but has yet to be adopted by California, Arizona and Nevada.

## 3.1 Data Acquisition and Model Assumptions

Baseline (without future climate change) OC Model data was expanded for the Colorado River, the SWP, and MET storage based on final publication of the MET 2015 IRP and data published thereafter, particularly on changes in storage.

### Colorado River

Deliveries to MET from the Colorado River are obtained from the Colorado River Supply Simulation (CRSS) model results reflected in the 2007 Basin Study (BOR, 2012). CRSS results are updated several times each year; the August 2016 runs were utilized in the updates to the OC Model as they contain the release year 2016 in index sequential format.

Historical hydrology data for four additional years (2013, 2014, 2015, and 2016) was incorporated into the BOR simulations to extend the Colorado River data for the entire index sequential period.

Added records included Powell inflows, Powell elevation, Powell storage, Mead elevation, and Mead storage. Historical values for each of these were taken from BORs' 24-month study.

A summary of the parameters changed for CRA deliveries is summarized in **Table 3**.

**Table 3. Changes to CRA Simulation**

| Parameter | Change |
|---|---|
| Mead Elevation | New CRSS results |
| Mead Storage | New CRSS results |
| Powell Inflow | New CRSS results |
| Powell Storage | New CRSS results |
| ICS representation | Separate Storage Node |
| Shortage Representation | Per 2016 DCP Guidelines discussions (these were never finalized) |

Changes to the ICS and shortage volumes are discussed in the following sections.

### MET Intentionally Created Surplus

Intentionally Created Surplus (ICS) was created in 2007 as a mechanism to encourage the Basin States to conserve and augment Colorado River water supplies. Contractors may develop new water sources or enact conservation measures to reduce their dependence on the Colorado River. Water left on the River as a result of these measures may be accessed by the contractor at a later date, but in the interim, may help to increase lake levels and postpone shortage declaration.

ICS is represented as a separate storage node to better reflect additions due to surplus flows, extra CRA flows, and to act similarly to other representations of MET storage. Consistent with BOR regulations, the maximum volume of ICS was limited to 1,500,000 acre-feet (AF) and the maximum put in any year is 400,000 AF. A 5 percent system assessment loss (to increase storage in Lake Mead) is assessed to any surplus volume put into the account (surplus is 250,000 AF whenever Mead is above 1211 feet which resembles MET IRP deliveries), and each year a 3 percent annual evaporation loss is assessed by BOR when Mead levels are above 1075 feet.

Initial MET ICS storage is updated to the end of year 2016 balance of 71,000 AF.

### Colorado River Declared Shortage

According to the 2007 BOR Guidelines for the Colorado River, California was not subject to shortage declarations on the Colorado River (at least above Lake Mead elevations of 1,000 feet). However, the draft 2016 DCP would have redefined Lake Mead shortage triggers for above 1,000 feet. While discussions on the draft DCP have stalled, it is proposed by CDM Smith that they be used for the 2018 OC Study Update as it is very likely that shortage declarations for California and MET will occur before Lake Mead reaches elevation 1,000 feet.

**Table 4** presents the assumed Lake Mead elevation triggers (as considered in the DCP discussions) and corresponding reduced delivery volumes. Under these provisions, MET takes 25 percent of the shortage allocated to the State of California (MET, 2016).

**Table 4. Assumed Colorado Shortage Declarations Based on Draft 2016 Drought Contingency Plan**

| Mead Trigger Elevation (feet) | Shortage Requirements per 2007 Guidelines (TAFY) | | Assumed Shortage Declarations (TAFY) | | | | Lower Basin States Total (TAFY) |
|---|---|---|---|---|---|---|---|
| | Arizona | Nevada | Arizona | Nevada | California | MET (25% of California) | |
| 1,090 | 0 | 0 | 192 | 8 | 0 | 0 | 200 |
| 1,075 | 320 | 13 | 192 | 8 | 0 | 0 | 533 |
| 1,050 | 400 | 17 | 192 | 8 | 0 | 0 | 617 |
| 1,045 | 400 | 17 | 240 | 10 | 200 | 50.0 | 867 |
| 1,040 | 400 | 17 | 240 | 10 | 250 | 62.5 | 917 |
| 1,035 | 400 | 17 | 240 | 10 | 300 | 75.0 | 967 |
| 1,030 | 400 | 17 | 240 | 10 | 350 | 87.5 | 1,017 |
| 1,025 | 480 | 20 | 240 | 10 | 350 | 87.5 | 1,100 |

TAFY = Thousand Acre-Feet per Year.

## Colorado River Hydrologic Shortage

There are not any current policies to follow in the event Lake Mead elevation falls below 1,000 feet and approaches dead pool, at which point the DCP volume reductions may not be sufficient to meet the actual hydrologic shortage in Lake Mead. Assumptions to handle this situation need to be incorporated into the 2018 OC Model. The total volume of undefined hydrologic shortage is included as a function of Lake Powell inflows and Mead elevation, roughly calibrated to 2015 CRSS volumes.

MET's share of the undefined shortage at each time step is calculated by assuming California takes a portion of the shortage according to its respective river allocation (Equation 1); values in Equation 1 are the allocations to each state and Mexico in MAFY.

**Equation 1:** $\frac{4.4}{(4.4+2.8+0.3+1.5)} = 48\%$

MET shortage is assumed to be allocated proportionately to its 550 KAFY allocation within the state (Equation 2).

**Equation 2:** $48\% \times \left(\frac{0.55}{4.4}\right) = 6\%$

Even if Mead falls below 1,000 feet, inflows from Lake Powell may be sufficient to meet DCP adjusted demands in all Lower Basin States. As a result, this excess reduction is applied only when physically necessary (based on CRSS results) and MET reductions when Mead falls below 1,000 feet are assumed to be the maximum of 87.5 (from the DCP volumes in Table 4 when Lake Mead falls below 1,025 feet) or 6 percent of the undefined shortage volume.

## State Water Project

State Water Project deliveries for the 2018 Updated OC Model are based on the 2015 State Water Project Delivery Capability Report (DCR). **Table 5** describes the flow scenarios presented in the DCR which are applied in the OC Model.

**Table 5. DCR Scenarios**

| DCR Scenario | Description |
|---|---|
| Base Scenario | • 2030 level of land development<br>• Folsom Capacity lowered<br>• VAMP not included<br>• Re-implementation of Hodge flow limitations on City of Sacramento diversions<br>• Updated implementation of fishery management program<br>• Updated Tuolumne River and New Don Pedro operations<br>• Implementation of SWP settlement allocation adjustments<br>• Revised Water Supply Index/Delivery Index (WSI-DI) procedure |
| Early Long-Term (ELT) | Base Scenario with 2025 emission level and 15 cm sea level rise. |
| Existing Conveyance High Outflow (ECHO) | Base Scenario with 2025 emission level and 15 cm sea level rise. Fall X2 and enhanced spring outflow requirements (a sharp and permanent decline in pumping and exports could occur.) |
| Existing Conveyance Low Outflow (ECLO) | Base Scenario with 2025 emission level and 15 cm sea level rise; no fall X2 and no enhanced spring outflow requirements. |
| Alternative 4 | Base Scenario with 2025 emission level and 15 cm sea level rise; BDCP. |

MET IRP data referenced to the 2015 State Water Project Delivery Capability Report (DCR) indicated that that SWP deliveries begin in 2016 at allocations similar to the DCR Base Case Scenario, and decrease gradually over time towards the Early Long-Term (ELT) scenario. Prior to 2020, the SWP deliveries can be approximated by 75 percent of the Base Case allocation plus 25 percent of the ELT scenario. In 2020, the allocation drops to the Existing Conveyance High Outflow (ECHO) scenario and stays at this level until the end of the forecast period. These projections for the base modeling assume that the WaterFix is not put into operation and hence there are no improvements in out-year deliveries from such an intervention.

The DCR data is available until hydrologic year 2003. Allocations for hydrologic years 2004 to 2012 are taken from the MET IRP. For hydrologic years 2013 through 2016, the actual historic allocations are used.

It should be noted that neither the base case described in the DCR nor the 2004 to 2012 MET IRP allocation assumptions reproduce actual historical allocations. This required an adjustment to maintain allocations similar to those published in the 2015 MET IRP without running a separate model of the Bay Delta. The observed allocations from 2013 to 2016 were adjusted for the base case prior to being appended to the time series. The resulting average annual flows (over all hydrologic traces) are similar to that of the MET IRP; an average allocation of 62 percent dropping to 43 percent in 2020.

**Table 6** summarizes the sources, and if applicable the model forecast years within these sources, assumed for SWP deliveries.

**Table 6. SWP Deliveries for OC Model**

| Hydrologic Period | Forecast Period 2017 - 2019 | | | | | Forecast Period 2020 - 2040 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Forecast Period | DCR Base Case | DCR ELT | DCR ECHO | IRP Data | Historic Allocation | DCR Base Case | DCR ELT | DCR ECHO | IRP Data | Historic Allocation |
| 1922 - 2003 | 75 % | 25% | | | | | | 100% | | |
| 2004 - 2012 | | | | 100% *(2016-2019)* | | | | | 100% *(2020-2040)* | |
| 2013 - 2016 | | | | | Adjusted at 200% | | | | | 100% |

Changes to the SWP imports are summarized in **Table 7**.

**Table 7. Changes to SWP for OC Model**

| Parameter | Change |
|---|---|
| High Allocation (until 2020) | Actual Base Case and ELT values, supplemented with IRP values and modifications to recent allocations |
| Low Allocation (2020 to 2040) | Actual ECHO values, supplemented with IRP values and recent allocations |

## MET Storage

Storage capacities and initial storage volumes were updated in accordance with recent MET publications (MET, 2017). Additionally, allowable volumes pulled from storage were modified to better calibrate to IRP volumes and actual operations.

The 2016 OC model assumed surface water storage capacity equal to 1.9 MAF. **Table 8** documents the surface water storage capacities, excluding ICS, in the 2018 OC Model.

**Table 8. Surface Water Storage Capacities for OC Model**

| Area | Storage | Total Capacity (AF) | Non-Emergency Capacity (AF) | January 2017 Volume (AF) | Assumed in 2017 Updated Model (AF) |
|---|---|---|---|---|---|
| SWP | MET SWP Carryover | Allocation Dependent | 200,000 | 168,000 | 168,000 |
| | Desert Water & Coachella Water SWP Carryover | Allocation Dependent | 120,000 | 42,000 | 42,000 |
| | Castaic Lake (SWP – flexible storage) | 325,000 | 154,000 | 154,000 | 154,000 |
| | Lake Perris (SWP – flexible storage) | 70,000 | 65,000 | 0 | 0 |
| Colorado River (non-ICS) | Desert Water & Coachella Water Advance Delivery Account | 800,000 | 800,000 | 38,000 | 38,000 |
| In-Basin | Pyramid Lake (SWP) | 158,000 | 0 | 0 | 0 |
| | Diamond Valley | 810,000 | 610,000 | 566,000 | **366,000** |
| | Lake Matthews | 179,000 | 100,000 | 135,000 | **56,000** |
| | Lake Skinner | 44,000 | 10,000 | 37,000 | **18,000** |
| **Total** | | | **2,059,000** | **1,140,000** | **842,000** |

The adjustments to the storage volumes shown above were made to ensure that the January 2017 emergency storage volume was 626,000 AF (MET, 2017) was maintained throughout the modeling period. To ensure that 626,000 AF was always maintained, 298,000 AF of emergency storage is required to be set aside in the surface water storage volumes above. It was assumed that that the 328,000 AF was derived from 170,000 AF in Castaic Lake and 158,000 AF in Pyramid Lake, with the remaining emergency storage amount being set aside as: 200,000 AF in Diamond Valley Lake, 79,000 in Lake Mathews, and 19,000 in Lake Skinner. The bold red numbers in Table 7 show where the useable volume differs from the total reservoir volumes.

MET IRP results and MET Water Surplus and Drought Management (WSDM) Reports from 2009 indicate that the 800,000 AF in the DWCV flexible delivery account is rarely used. To maintain consistency with the 2015 MET IRP volumes and maximum volumes from WSDM records, the DWCV flexible delivery volume is programmed into the 2018 OC Model as 300,000 AF. The total surface water storage capacity is assumed to be 1.5 MAF, slightly below the surface storage volume assumed in the 2016 OC Model.

The maximum allowable withdrawal from surface storage in any single year is programmed to be 500,000 AF (close to the maximum take from the IRP.)

**Table 9** lists the updated groundwater storage capacities.

**Table 9. Groundwater Storage Capacities for OC Model**

| In-Basin | Capacity (AF) | January 2017 Volume (AF) |
|---|---|---|
| CUP - Chino Basin | 100,000 | 0 |
| CUP - Compton | 2,300 | 0 |
| CUP - Long Beach (Cent Basin) | 13,000 | 0 |
| CUP - Long Beach (Lakewood) | 3,600 | 0 |
| CUP - Foothill (Raymond and Monkhill) | 9,000 | 0 |
| CUP - METOC (Orange County Basin) | 66,000 | 0 |
| CUP - Three Valleys (Live Oak) | 3,000 | 1,000 |
| CUP - Three Valleys (Upper Claremont) | 3,000 | 0 |
| CUP - Western/Elsinore | 12,000 | 0 |
| Pasadena CSP | 17,617 | 0 |
| Cyclic – Upper San Gabriel | 100,000 | Not included in model |
| Cyclic –Three Valleys | 40,000 | Not included in model |
| **Total** | **230,000** | **1,000** |
| Arvin Edison | 350,000 | 108,000 |
| Semitropic | 350,000 | 125,000 |
| Kern Delta | 250,000 | 99,000 |
| Mojave | 390,000 | 27,000 |
| San Bernardino | 50,000 | Not included in model |
| Total | 1,340,000 | 359,000 |
| **Total** | **1,570,000** | **360,000** |

The 2016 OC Model groundwater capacity for MET was specified as 1.45 MAF, and the updated capacity is 1.57 MAF. The updated initial groundwater storage volume for MET is 0.36 MAF as shown above.

The maximum allowable withdrawal from groundwater storage is programmed to be 500,000 AF (close to the maximum take from the IRP.)

Overall, the 360,000 AF of groundwater storage, 842,000 AF of surface storage, and 71,000 AF of ICS total to the 1.273 MAF of available storage for MET at the beginning of January 2017. **Table 10** summarizes the changes to MET storage.

**Table 10. Changes to Storage for OC Model**

| Parameter | 2016 OC Model Capacity (MAF) | 2018 OC Model Capacity (MAF) | 2016 Initial Storage (MAF) | 2017 Initial Storage (MAF) |
|---|---|---|---|---|
| Surface Water | 1.90* | 1.50* | 0.80 | 0.84 |
| Groundwater | 1.45 | 1.57 | 0.63 | 0.36 |
| ICS | 1.50 | 1.50 | 0.15 | 0.07 |
| Total | 4.85 | 4.57 | 1.58 | 1.27 |

*Note that MET SWP Carryover and DWCV SWP Carryover volumes are allocation dependent

## 3.2 Updated Baseline MET GAP Supply Reliability

As was done in the 2016 OC model, the baseline MET supply reliability is updated without climate change, without a California WaterFix, and with no additional local or MET water supplies other than what is already planned. This repeats the initial supply gap analysis from the 2016 OC Study, where the **supply gap is defined as the difference between projected demand and supplies without any new water investments over what is existing today under historical climate and hydrology**.

**Figure 6** compares the original MET baseline supply reliability used for the 2016 OC Study and the updated MET baseline reliability that includes two additional years of data for Colorado River, SWP and MET Storage. The baseline MET reliability is similar between the 2016 OC model and 2018 OC Model for years 2030 and 2040, but the updated in 2018 OC Model is slightly better in supply reliability for 2020 as a result of 2015 and 2016 being wet years with improved starting storage volumes.

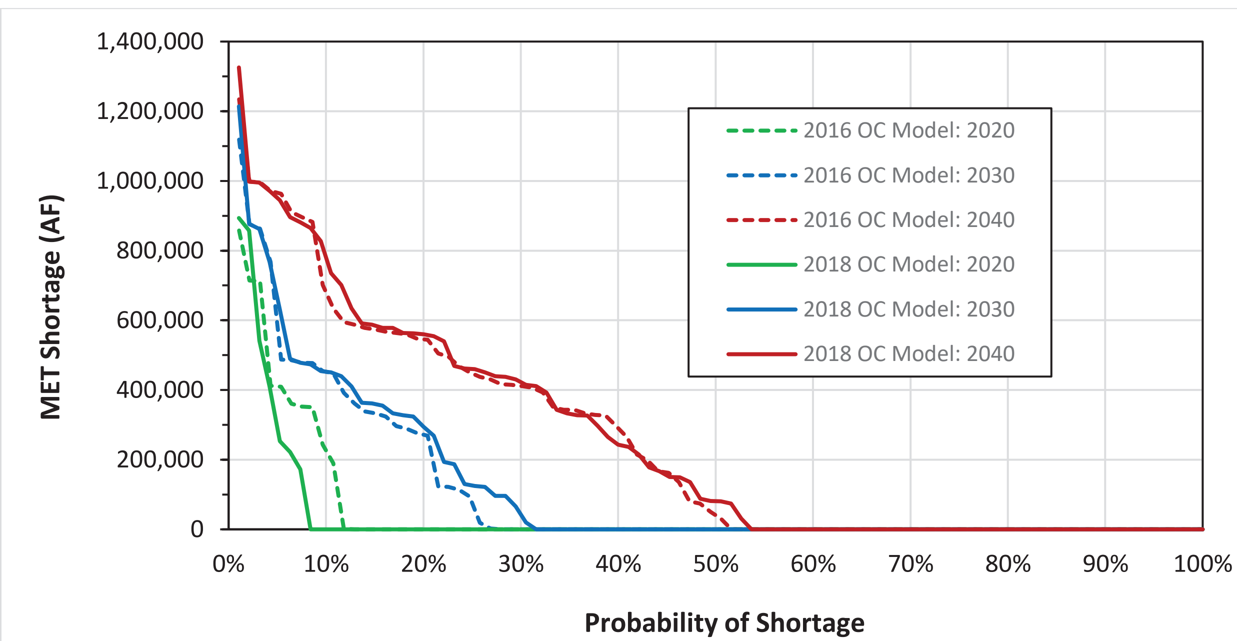


**Figure 9. Comparison of Baseline MET Reliability Under Historical Climate and No New Investments**

## 3.3 Climate Change Impacts on MET Supply Sources

The 2016 OC Study considered 6 of the 112 CMIP3 scenarios that led to decreased flows for every source water region (SWP Table A deliveries, CRA flows, and SAR stormflows) in the year 2040. Two of these scenarios were used in the 2016 analysis: sresb1.miroc3_2_medres.2, which applies emissions scenario B1 and is assumed to represent a moderate climate change scenario, and sresa2.miroc3_2_medres.2 which simulates an extreme climate change (with an emissions scenarios A2.)

The 2018 OC Model utilizes three climate change scenarios based on three CGMs from CMIP5 RCP8.5 downscaled data which have the following general attributes:

1) Slightly lower SWP deliveries (compared to historical), with significantly lower Colorado River hydrologic conditions

2) Moderately lower SWP deliveries, with slightly improved Colorado River hydrologic conditions

3) Significantly lower SWP deliveries, with significantly lower Colorado River hydrologic conditions

The delta method was utilized to calculate the future effects of the climate scenarios on observed Colorado River and State Water Project imported supplies, as well as Santa Ana River stormflow. Per the 2016 OC Study, an additive delta method is used for the updated 2018 OC Model. The delta method utilizes a first order Taylor series expansion to predict a dependent variable (for example the observed temperature record altered for climate change) from a function of the original independent variable (the observed temperature record). Depending on data availability, the delta value may be calculated using a simulation model with a base historic record different from that used in WEAP; climate change data need to be compared with the historic record to which they were calibrated. The climate change values used to calculate the delta, and the observed values to which the delta is applied, are based on percentiles in accordance with work done by the Bureau of Reclamation (2013) and personal correspondence with Yates (2015). Flows ($Q$) within the 10th percentile would be altered as shown in Equation 3-1.

**Equation 3-1:** $Q_{10th}^{CC} = Q_{10th}^{obs} + \left(Q_{modeled,10th}^{CC} - Q_{modeled,10th}^{obs}\right)$

The variables for which the deltas will be established include: temperature and precipitation for the Santa Ana River, SWP Bay-Delta exports, and Lake Mead elevations, Lake Powell inflows, and Lake Powell elevations on the Colorado River.

SWP exports under climate change generated in the SW WEAP model were calibrated to published values from the Sacramento and San Joaquin Rivers Basin Study completed by the BOR (SSJRBS; BOR, 2016.) Once the SW WEAP model was calibrated, it was used for these and other models in all three areas.

The SSJRBS models the effects of 6 individual CMIP5 climate projections on seasonal precipitation, temperature, and tropical Pacific Ocean sea surface temperatures and utilizes the CalLite planning model (DWR) to forecast impacts to SWP and CVP Delta exports.

The 6 defined CMIP5 climate forecasts published in the SSJRBS reflect a subset of the 10 GCMs (from the CMIP5 ensemble) selected by the DWR Climate Change Technical Advisory Group (CCTAG) to be used in California climate studies. The mean and range of these 6 scenarios track similarly to the 10 GCMs considered by the Climate Change Technical Advisory Group (CCTAG).

The impacts of individual CMIP5 projections are simulated for the RCP 4.5 and RCP 8.5 trajectories (for a total of 12 runs); the 2018 Updated OC Model uses the output from the six RCP 8.5 runs. The SSJRBS also documents the results for five climate model groupings representing warm dry, hot dry, hot wet, warm wet, and central tending conditions that include RCP 4.5, RCP 6.0, and RCP 8.5.

Climate results for the Sacramento hydrologic region in SW WEAP emulate those shown for the suite of six models in the SSJRBS: temperatures will increase and annual precipitation will increase in contrast with the CMIP3 forecasts which showed a decreasing trend for precipitation.

## SWP Climate Impacts

Exports to the SWP through the Harvey O. Banks Pumping Plant are tabulated out to 2099 in the SSJRBS; climate change effects are reported at approximately 30-year increments within the forecast horizon. Reference and climate-impacted MET deliveries from SW WEAP are validated with the SSJRBS results to ensure consistency with the widely-accepted Bureau of Reclamation report. A similar trend should be observed for a particular climate model in SW WEAP as is portrayed in SSJRBS.

The climate change impacts for SWP are summarized in **Table 11**.

**Table 11. Climate Change Impacts on SWP Exports (SW WEAP) for GCMs Evaluated in SSJRBS**

| | CCSM | CESM | CNRM | GFDL | HADGEM | MIROC | CSIRO |
|---|---|---|---|---|---|---|---|
| average difference (TAF) | 224 | 243 | 54 | -99 | -113 | -139 | -586 |
| percent difference | 8% | 10% | 4%<br>Used in 2018 Modeling | -2% | -4% | -2%<br>Used in 2018 Modeling | -17%<br>Used in 2018 Modeling |

For the 2018 OC Model, the CNRM, MIROC and CSIRO climate models were utilized to show a potential range of impacts on MET supply reliability. **Figure 7** shows the SWP exports for these climate models compared to updated 2018 baseline (without climate change) conditions.

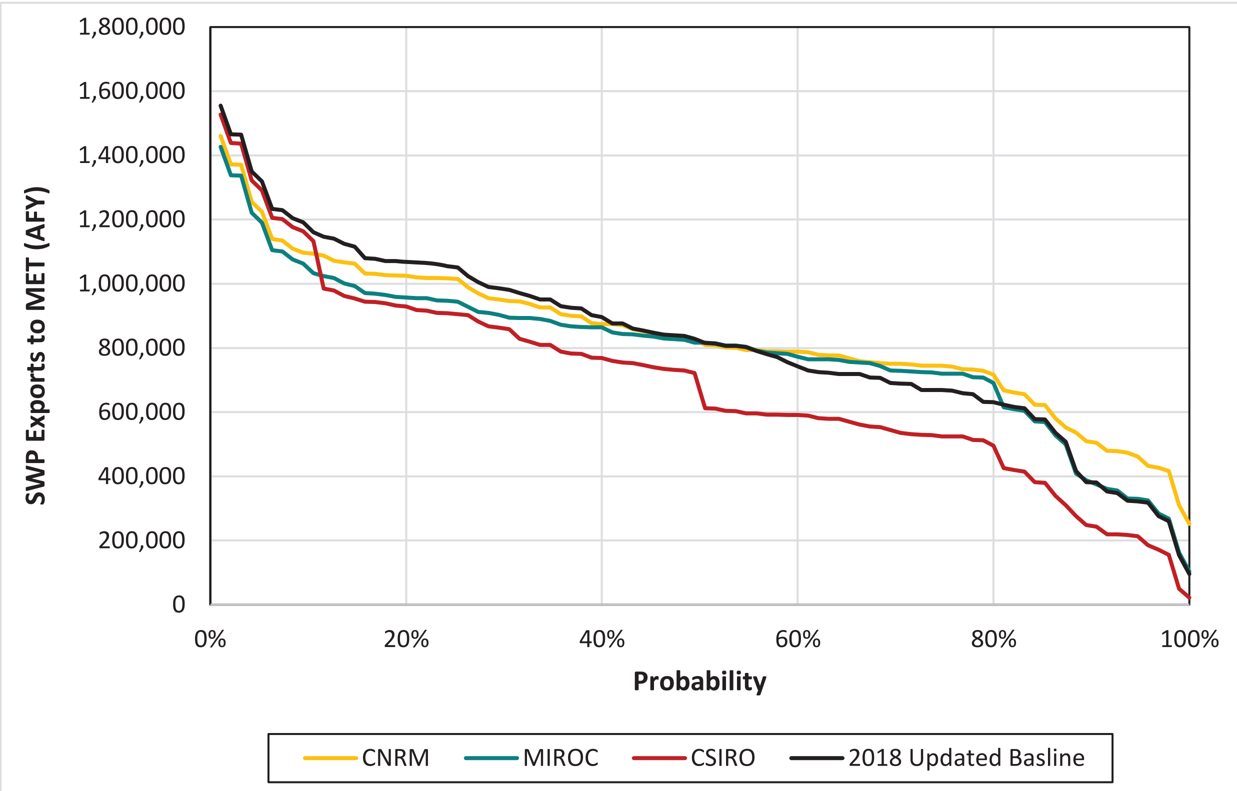


**Figure 7. SWP Table A MET Exports in 2018 OC Model for Year 2040**

## CRA Climate Impacts

Colorado River deliveries to MET are a function of Lake Powel inflows, as dictated by hydrology, and shortage declarations for Lower Basin states, as dictated by Lake Mead elevations. For the 2018 OC Study Update, the 2016 draft DCP guidelines discussions were utilized for shortage declarations. **Figure 8** shows Lake Mead elevations for historical and climate change conditions and triggered shortage declarations to MET.

Allocation reductions occur at five-foot intervals starting at 1045 down to below 1000 feet. As previously discussion, there are no hydrologic shortage allocation provisions at dead pool Lake Mead elevations below 1,000 feet (when there is insufficient water in the system even when the DCP is assumed.) For the 2018 OC Study Update, it is assumed MET would take a proportional cutback equal to its firm apportionment divided by California's firm proportional cutback.

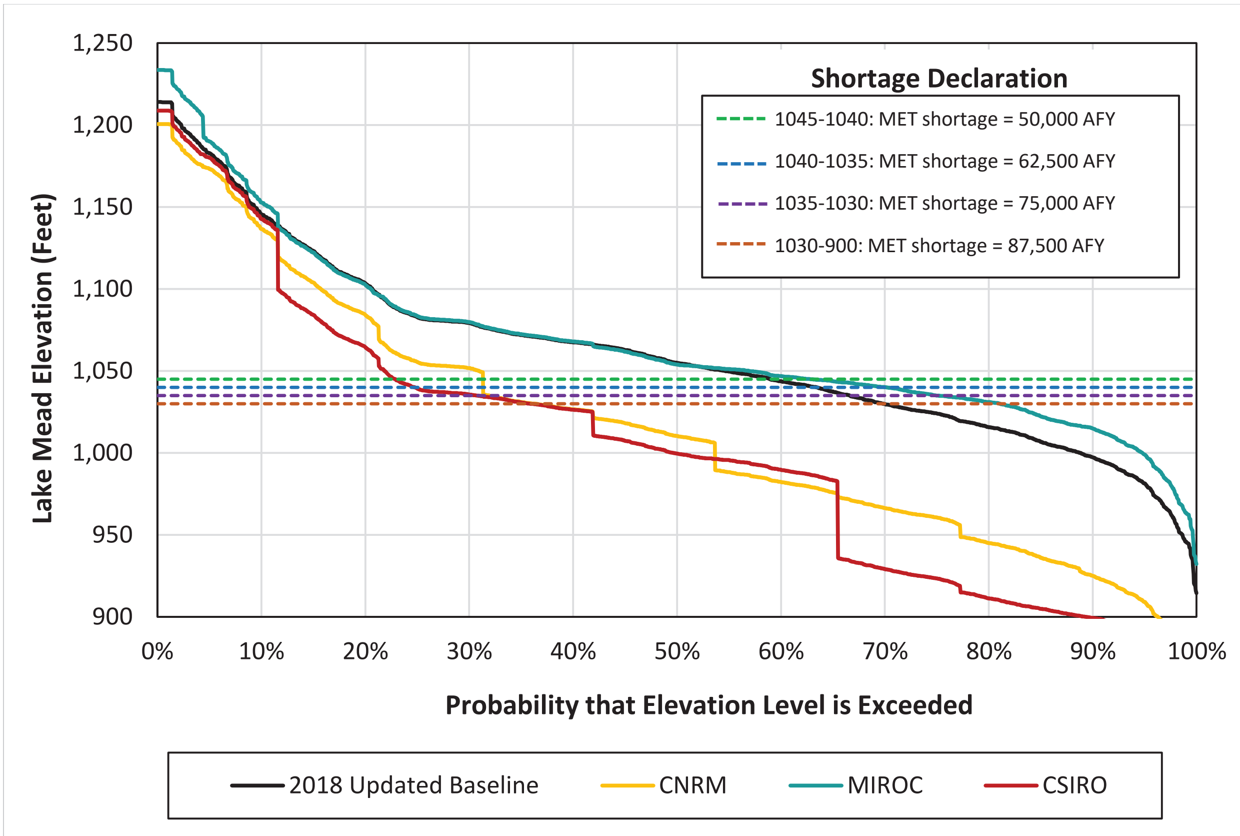


**Figure 8. Lake Mead Elevations in 2018 OC Model for Year 2040**

Using both the declared and hydrologic shortage estimates, CRA supply shortages for MET were estimated (see **Figure 9**). For the CNRM and CSIRO climate models there are both Lake Mead shortage declarations and hydrologic shortages (based on inflows to Lake Powell), but for the MIROC climate model and historical climate there are only Lake Mead shortage declarations and no hydrologic shortages, as inflows to Lake Powell are adequate. For historical and MIROC climate scenario, Lake Mead shortage declarations would occur about 53 percent of the time and reach a maximum of 88,000 AFY. For the CNRM climate scenario, total water shortages (including hydrologic shortages) would occur 65 percent of the time and reach a maximum of 278,000 AFY. For the CSIRO climate scenario, total water shortages would occur 68 percent of the time and reach a maximum of 416,000 AFY.

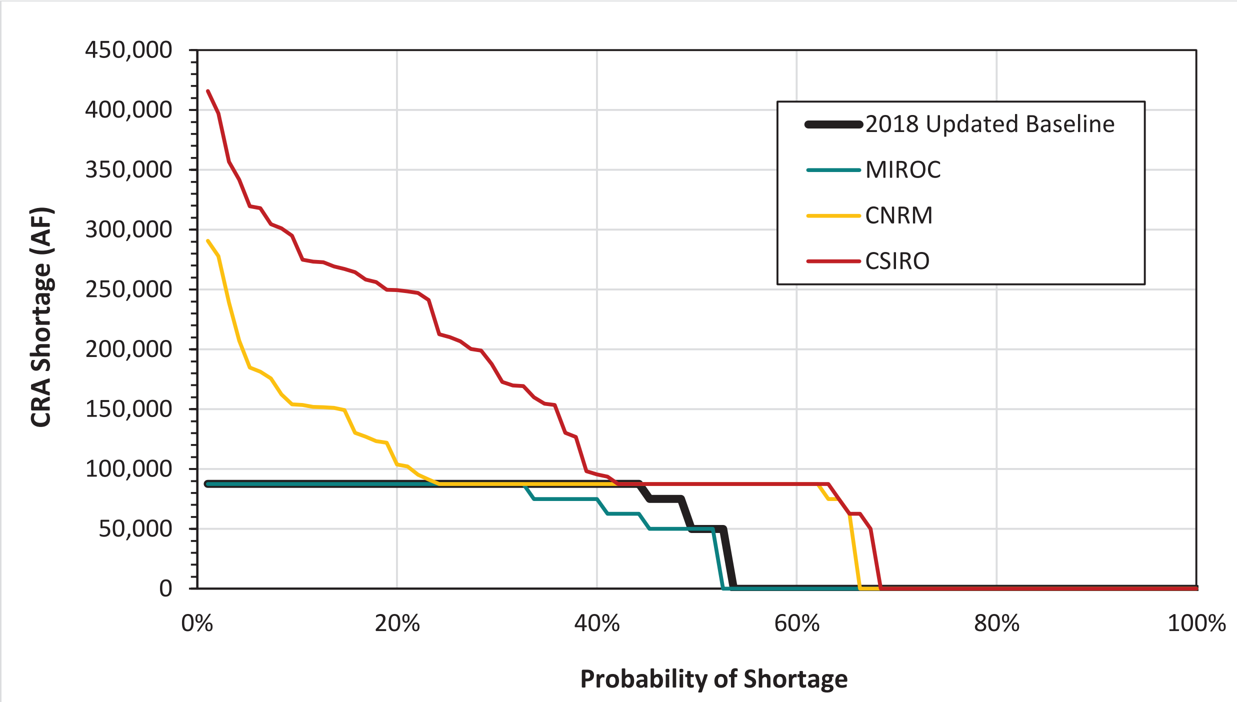


**Figure 9. MET CRA Shortages for Year 2040**

## 3.4 Updated MET Supply Reliability

Utilizing the updated baseline and climate changed conditions, the revised MET supply reliability was generated for: (1) updated baseline conditions, which represents historical climate, additional simulation years and updated MET storage conditions, and Lower Basin Colorado River shortage declarations when Lake Mead reaches elevation 1045 feet using draft DCP as guidelines; (2) the prior climate scenarios used for the 2016 OC Study, with Scenario 2 representing moderate climate change impacts and Scenario 3 representing significant climate change impacts; and (3) the three new CMIP5 climate scenarios in the 2018 OC Model. **Figure 10** presents the MET supply reliability for these three conditions for the year 2040.

The results indicate that the CMIP5 MIROC and CNRM climate models produce similar overall MET supply reliability as Scenario 2 in the 2016 OC Study, while the CSIRO climate model produces slightly better MET reliability than Scenario 3 of the 2016 OC Study.

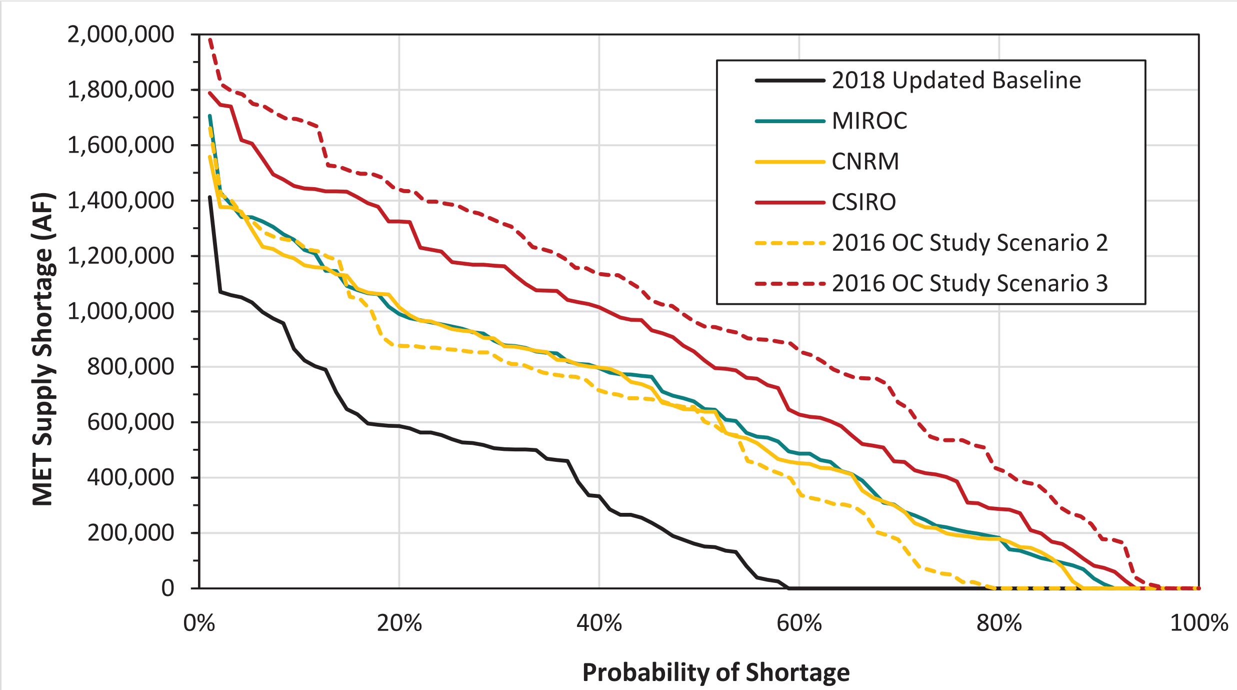


**Figure 10. MET GAP Supply Reliability in 2040 Without ANY NEW Investments**

## 4.0 Updated Orange County Supply Reliability

In addition to updating the climate change impacts on MET's water supply reliability, climate change impacts to the Santa Ana River stormflows were also updated. Santa Ana River stormflows represent the natural runoff from local rainfall and snowpack. These natural stormflows, together with upstream wastewater discharges, replenish the OC Basin. Using the delta method, climate change impacts were estimated for the Santa Ana River stormflows. **Figure 11** shows the historical and three CMIP5 climate model projections of Santa Ana River stormflows. The results show that the CNRM model closely matches historical flows, with the MIROC model showing somewhat less flows than historical. The CSIRO model shows a significant decrease in flows compared to historical conditions.

The combination of MET supply reliability and Santa Ana River stormflows are used to estimate the updated supply reliability for the OC Basin for the year 2040 (see **Figure 12**). For South Orange County, the combination of MET supply reliability and smaller amounts of local groundwater are used to estimate the updated supply reliability for South Orange County (see **Figure 13**) for year 2040. As with the revised MET supply reliability, the CNRM and MIROC climate models show similar Orange County supply reliability as Scenario 2 of the 2016 OC Study, while the CSIRO climate model shows moderately improved reliability when compared to Scenario 3 of the 2016 OC Study.

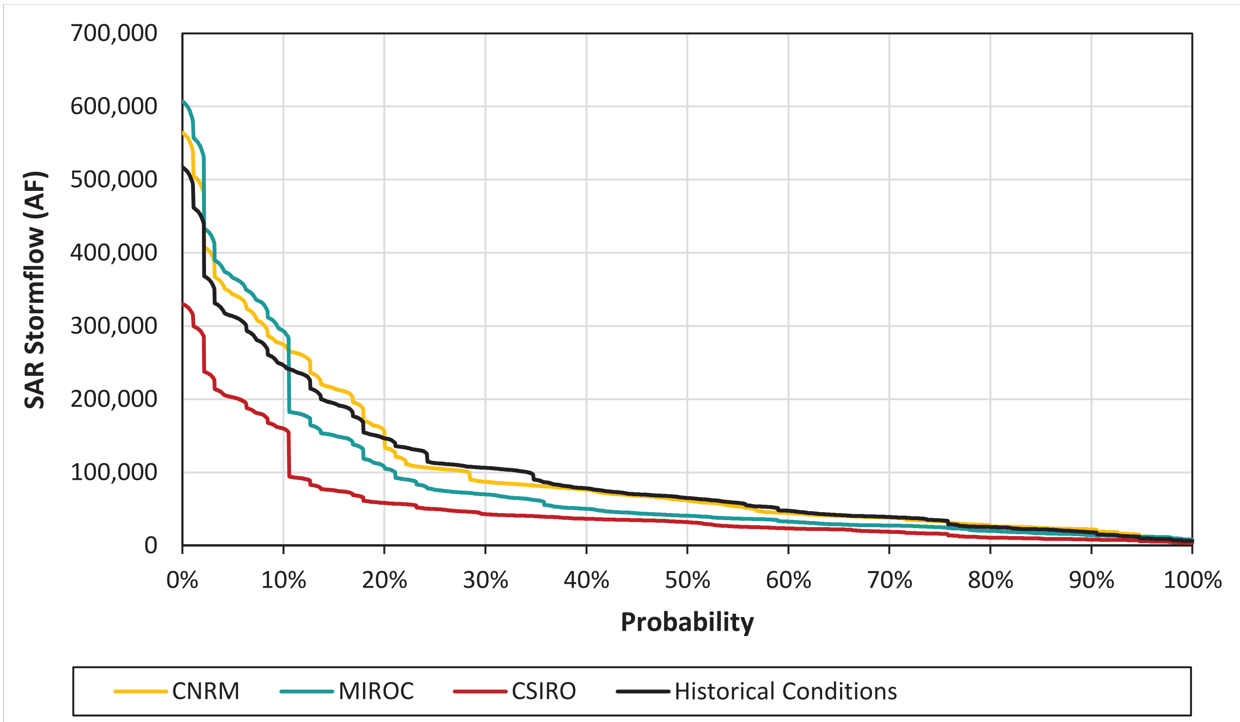


**Figure 11. Santa Ana River Stormflows in 2040**

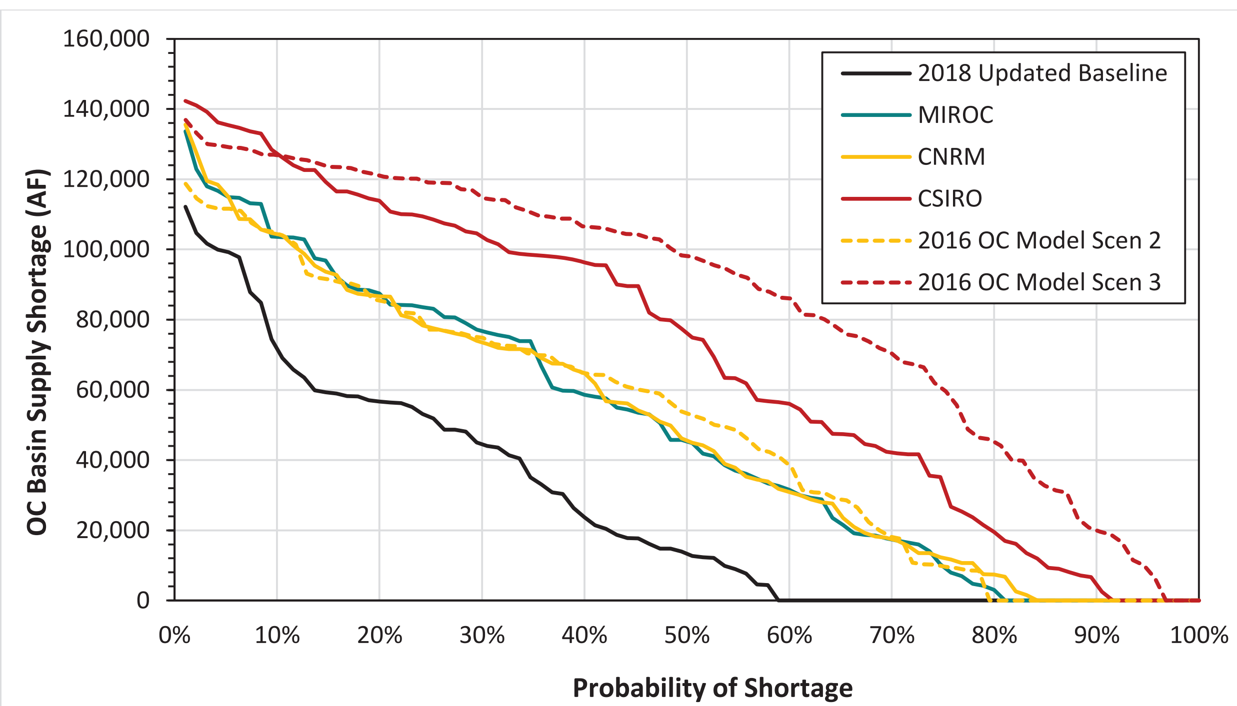


**Figure 12. OC Basin Supply Reliability for Year 2040 without New Supply Investments**

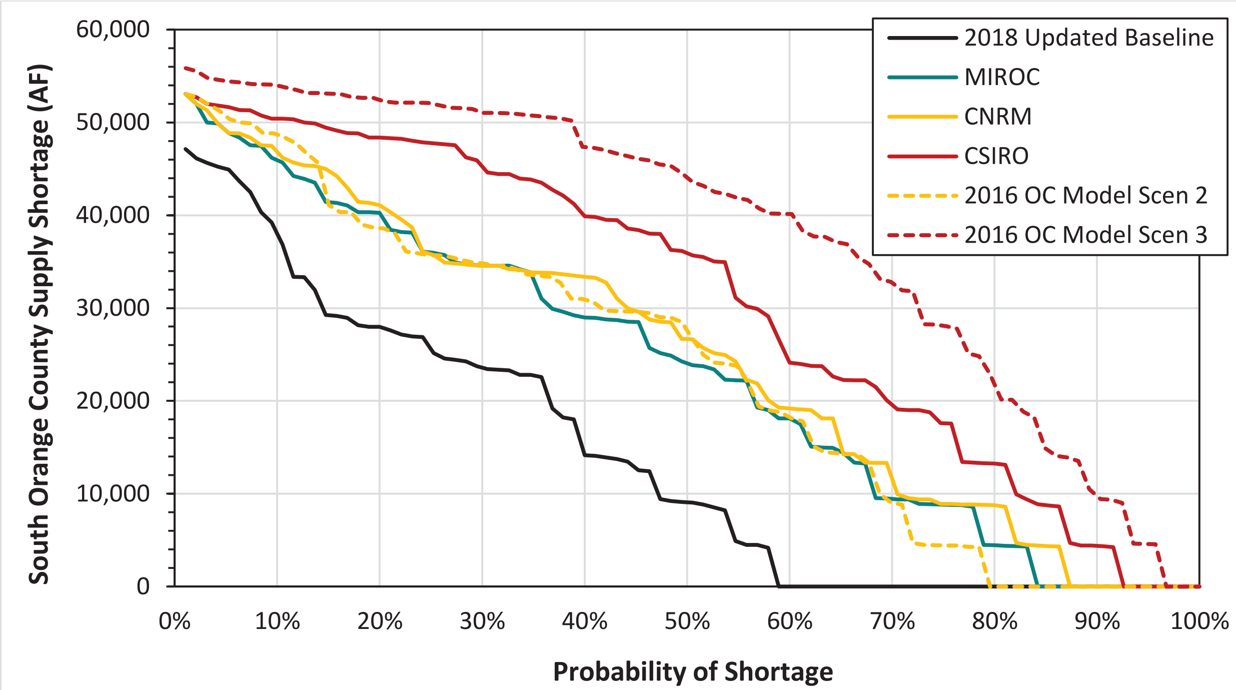


**Figure 13. South Orange County Supply Reliability for Year 2040 without New Supply Investments**

# 5.0 Conclusions

The updates made to the 2018 OC Model included: (1) updated baseline information, namely adding two more years (2015 and 2016, both wetter than the previous 3 years), updated MET storage conditions, and updated assumptions regarding Colorado River shortage declarations for the Lower Basin states and MET; and (2) incorporated new climate modeling using a range of GCMs from the newer CMIP5 RCP 8.5 that were similar in nature as the climate scenarios used for the original 2016 OC Study.

For different reasons and sometimes compensating factors, two out of the three updated CMIP5 climate scenarios produced similar supply reliability for MET, OC Basin and South Orange County as the selected planning Scenario 2 used for the 2016 OC Study. While this might suggest that there was no need to update the 2016 OC Model, it could not be known whether or not this was the case. However, CDM Smith believes that using the updated information included in the 2018 OC Model is more realistic and consistent with California and western U.S. agencies such as DWR and BOR. The more extreme CMIP5 (CSIRO) climate scenario incorporated in the 2018 OC Model produced slightly to moderately better overall supply reliability compared to the more extreme climate scenario (Scenario 3) used for the 2016 OC Study. The CSIRO modeling indicated significantly lower reliability than the other two climate models in the 2018 update. It is suggested that planning scenarios continue based on using the average of the MIROC and CNRM models, but that consideration also be given to the CSIRO model as a potential occurrence out into the future.

Based on the analysis presented in this TM, it is recommended that new planning scenarios be developed for the 2018 OC Study Update that incorporate the range of supply reliability impacts shown in Figures 12 and 13.

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# Appendix C

# Met Water Rate Projections

# Appendix C – Assumptions on MET Water Rates

*Assumptions for the MET supply investments and how costs are allocated among MET's water rate structure components to arrive at future MET water rates over time.*

The 2018 OC Study presents four planning scenarios in its evaluations. Each scenario involves the development of new water supply investments by MET, ranging from the construction and operation of the CA WaterFix to securing additional transfers both on the State Water Project and the Colorado River. Each investment comes at a cost. MET, as part of its Biennial Budget, provides an estimate of their projected water rates and charges over a 10 year period. In the recently adopted Biennial Budget for Fiscal Year 2018-2019 & 2019-2020, MET published rate projections from 2018 to 2028, which was used as our baseline starting point. For projecting water rates to the year 2050 that includes the various investments in each scenario, a number of key assumptions were made in how the costs for each of the new supplies were allocated in MET's future rates and charges. However, it is important to note, that the methodology we apply in allocating these investment costs in the projected MET's rates & charges are similar to how MET allocates its costs in its current Costs of Service approach.

Below are the four reliability scenario assumptions and the details regarding the new MET supply investments:

- 1A – MINIMAL CLIMATE CHANGE (MINIMAL) with LOW-COST MET INVESTMENTS (in addition to the WaterFix)
- 1B – MINIMAL CLIMATE CHANGE with HIGH-COST MET INVESTMENTS (in addition to the WaterFix)
- 2A – SIGNIFICANT CLIMATE CHANGE (SIGNIFICANT) with LOW-COST MET INVESTMENTS (in addition to the WaterFix)
- 2B – SIGNIFICANT CLIMATE CHANGE with HIGH-COST NEW MET INVESTMENTS (in addition to the WaterFix)

**New MET Supply Investments for 2018 OC Study Planning Scenarios**

| New MET Supply Investments (thousand acre-feet) | Planning Scenarios | | | |
|---|---|---|---|---|
| | Scenario 1. Minimal Climate Change Impacts | | Scenario 2. Significant Climate Change Impacts | |
| | A. Low-Cost | B. High-Cost | A. Low-Cost | B. High-Cost |
| WaterFix (average) | 440 | 440 | 440 | 440 |
| CRA Transfers (base loaded) | 100 | 100 | 100 | 100 |
| LRP (base loaded) | 88 | 88 | 88 | 88 |
| SWP Transfers (dry year) | 0 | 150 | 150 | 150 |
| Carson IPR (base loaded) | 0 | 168 | 0 | 168 |
| More LRP (base loaded) | 0 | 0 | 74 | 74 |
| More CRA Transfers (dry year) | 0 | 0 | 80 | 80 |
| More SWP Transfers (dry year) | 0 | 0 | 0 | 150 |
| Regional Surface Reservoir (dry year) | 0 | 0 | 0 | 400 |
| **Total Base Loaded Supplies** | **628** | **796** | **702** | **870** |
| **Total Dry Year Supplies** | **0** | **150** | **230** | **380** |
| **New Storage** | **0** | **0** | **0** | **400** |
| **Base Loaded and Dry Year** | **628** | **946** | **932** | **1,250** |

Notes: Base loaded supplies are those delivered every year, while dry year supplies are those that are utilized only when needed. The yield for the WaterFix represents the average difference between MET SWP deliveries under degraded existing conditions and deliveries with the WaterFix project.

## California WaterFix

MET's published 10-year rate forecast incorporates the early costs of the CA WaterFix for the years 2018 to 2028. Beyond 2028, we assumed MET's full share of the WaterFix costs (64.6%) to be allocated in the MET System Access Rate and the Readiness-to-Serve (RTS) Charge.

## State Water Project & Colorado River Water Transfers (Base Load & Dry Year)

For all SWP and CRA water transfers, we assumed such costs to be included in MET's Supply Program which is allocated in MET's Tier 1 Supply Rate. This is consistent with most long-term water transfer costs.

## Local Resource Program (LRP)

The additional costs of expanding the LRP budget to incentivized the further development of local resource projects are covered in MET's Demand Management Program which is allocated to the MET's Stewardship Rate.

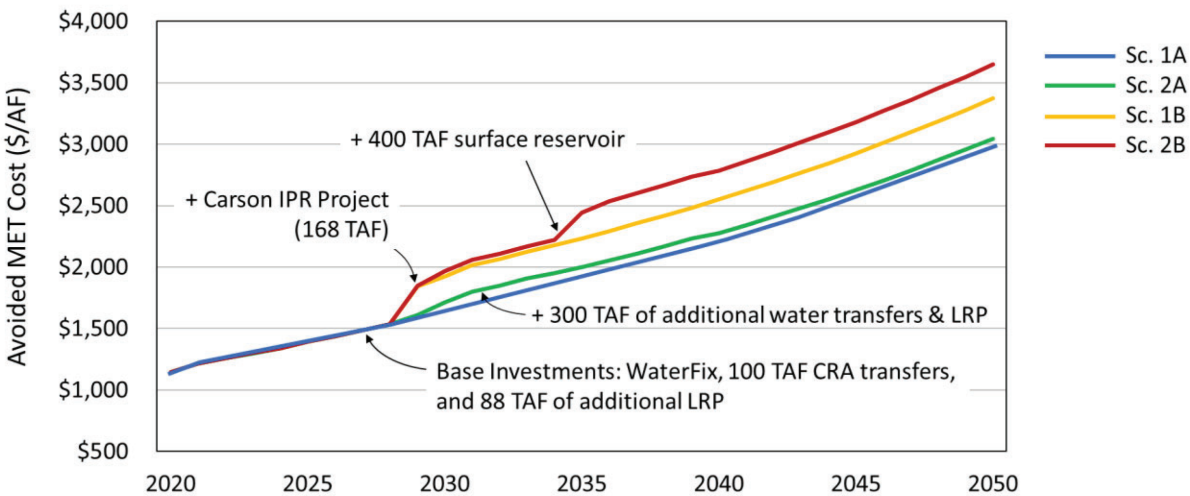
## Regional Recycled Water Program ("Carson IPR Project")

The full scale of the Carson Recycled water project costs are assumed to be allocated to MET's Tier 1 Supply Rate and Readiness-to-Serve (RTS) Charge. This appears consistent with MET's cost allocation approach to new supply projects. The Carson IPR project is only included in the "B" scenarios, 1B and 2B.

**New MET Regional Surface Reservoir**

The costs to construct and maintain a new Regional Surface Reservoir are assumed to be allocated to MET's Tier 1 Supply Rate, System Access Rate, and Readiness-to-Serve (RTS) Charge. This cost allocation approach is similar to past regional storage projects. A new 400,000 AF reservoir in Southern California is only included in Scenario 2B.

The figure below presents the MET cost of water ($/AF) to Orange County for each of the four scenarios; these same projections are also used as avoided costs when implementing local projects. The unit cost of the water shown below includes the MET rate structure components as well as the RTS and Capacity charges that would be passed on to Orange County, all wrapped into a per AF unit charge.




**Projected MET Cost of Water to Orange County Under the Four Scenarios**

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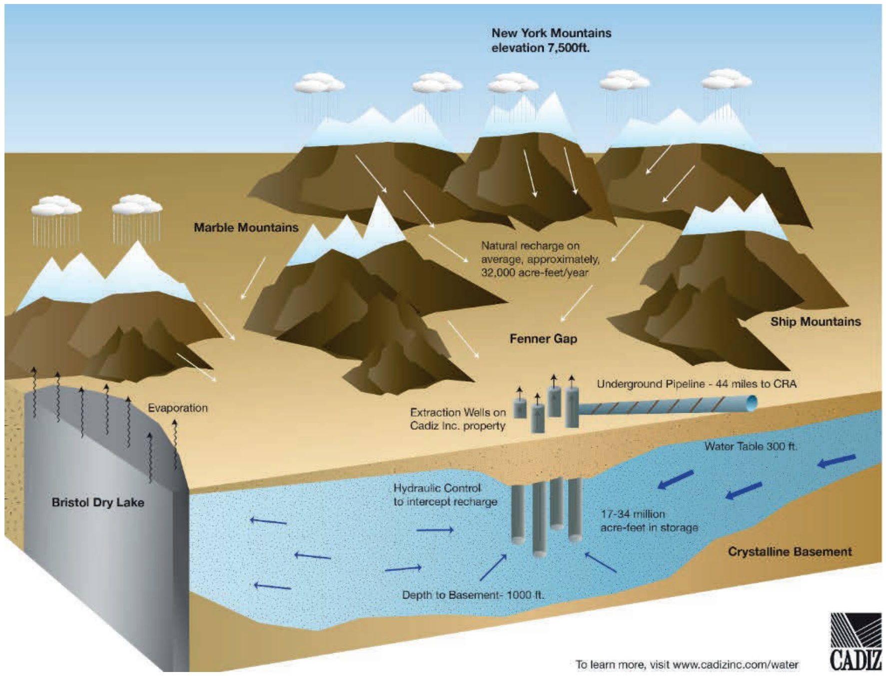
# Appendix D

# Descriptions of Projects

## Cadiz Valley Water Conservation, Recovery and Storage Project




**Location:**
Cadiz & Fenner Valleys (Mojave Desert, San Bernardino County)

**Proponent**:
Santa Margarita Water District

**Background**[1]**:**
Cadiz Inc., and Santa Margarita Water District are developing the Project to implement a long-term groundwater management program for the groundwater basin underlying Cadiz, Inc. property in Cadiz and Fenner Valleys, which holds an estimated 17 to 34 MAF of groundwater. Groundwater percolates and migrates downward from higher elevations in the watersheds into the groundwater basin and eventually flows to the low point at Bristol and Cadiz Dry Lakes; where it then evaporates.

The **Groundwater Pumping Component** includes an average of 50,000 AF per year of groundwater that would be pumped from the basin over a 50-year period, with a maximum limit of 75,000 AF in any one year. This proposed level of groundwater pumping is designed to equal the amount of groundwater that would otherwise evaporate in the Dry Lakes.

The **Water Storage Component** allows Project participants to send surplus (imported) water supplies, when available, to the Project area to be recharged via spreading basins and held in storage until needed in future years. When needed, the stored water would be pumped out of the groundwater basin and returned to the Project participant. The Project proposes to store up to 1 MAF at any given time.

The Project includes a wellfield, a manifold (piping) system, and a 43-mile water conveyance pipeline, which would tie into the Colorado River Aqueduct (CRA) for water distribution. One or more of the unused existing natural gas pipelines in the Project area may be converted for use to connect the Project to the State Water Project or to potential participants interested in storing water in the Project area.

**Analysis:**

SMWD, as the project lead agency, has rights to storage capacity in Fenner Valley basin and receives their initial 5,000 AF per year yield at a reduced cost below the retail rate of other subscribers. The analysis herein examined both the cost of water to SMWD (Cadiz – SMWD) and the cost of water to others (Cadiz-Retail). The SMWD savings over Retail costs were estimated at $253 per AF in 2020 and

[1] Adapted from Cadiz Valley Water Conservation, Recovery, and Storage Project Draft Environmental Impact Report, December 2011.

grow over time to about $614 per AF in 2050 as the cost of water from the project escalates. SMWD could proceed as a single agency beneficiary or they could increase the capacity of the project by including another 5,000 AF of supply for a total project of 10,000 AF, with supplies to be shared with other agencies in Orange County.

The project was analyzed in two increments, the first 5,000 AF at the reduced SMWD costs and another 5,000 AF at the Retail cost. SMWD can treat up to about 8,700 AF of this water at the Baker WTP. For purposes of the project analysis the treatment cost of the first 5,000 AF was estimated at the incremental O&M costs of SMWD ownership of the Baker WTP of $200 per AF in 2020 (including the pumping lift to pump the water into the South County Pipeline). This provides SMWD the ability to ability to benefit from the prior investment in the Baker Treatment Plant; the Retail water will be treated by MET at the Diemer plant at an estimated treatment rate in 2020 of $323 per AF. For SMWD and Retail customers, the Cadiz project was evaluated as a supply reliability project only.

| **SMWD Project Participant** | | | |
|---|---|---|---|
| | *2020* | *Escalation* | *2050* |
| Base Water Supply Payment | $190 | 3% | $461 |
| O&M Charge | $118 | 2.72% | $264 |
| CAP-EX recovery | $220 | NONE | 220 |
| Subtotal at Cadiz | $528 | | $945 |
| | | | |
| Wheeling to MWD | $547 | | $1,805 |
| Subtotal at MWD Facility | $1,075 | | |
| | | | |
| Treatment Cost (incremental Baker WTP cost for SMWD) | $200 | | $485.0 |
| TOTAL COST ($/AF) | $1,275 | | $3,235 |
| | | | |
| **Retail Project Participant** | | | |
| | 2020 | Escalation | 2050 |
| Base Water Supply Payment | $443 | 3% | $1,075 |
| O&M Charge | $118 | 2.72% | $264 |
| CAP-EX recovery | $220 | NONE | 220 |
| Subtotal at Cadiz | $781 | | $1,559 |
| | | | |
| Wheeling to MWD | $547 | | $1,805 |
| Subtotal at MWD Facility | $1,328 | | $3,364 |
| | | | |
| Treatment Cost (Diemer) | $323 | | $345.0 |
| TOTAL COST ($/AF) | $1,651 | | $3,709 |
| | | | |

**Assumptions:**

The following project assumptions were determined during discussions with SMWD and Cadiz, Inc.:

1. Original 2012 Water Supply Payment estimates were escalated at 3%.
2. Operations & Maintenance Costs were escalated at 2.72% based on Consumer Price Index (CPI).
3. Capital Recovery Charge $220/AF was not escalated from original 2012 estimates as projected project capital cost has remained stable (some cost savings were found to offset increases).

4. 10,000 AF per year of water was the assumed project yield in the analysis. The first 5,000 AF was analyzed at reduced SMWD costs and the second 5,000 AF was analyzed at the retail cost.
5. SMWD has 8,700 AF of treatment capacity in the Baker Water Treatment Plant for Cadiz water. The cost of treatment of the first 5,000 AF was estimated at the incremental O&M costs of the Baker WTP (including pumping lift costs to pump the water into the South County Pipeline). The treatment costs for the second 5,000 AF was estimated at the MET treatment rate.

**Other Comments:**

A key component for success of this project is an agreement with MET to allow use of its CRA to convey the water. By law, MET has to allow its unused capacity to wheel water. However, MET has indicated that it has plans to fully utilize its CRA capacity with its own water, water transfers and banking programs (or at minimum, MET cannot commit to a long-term availability of capacity to the Cadiz project, sufficient to allow financing of the project). This makes it difficult for MET to commit to a long term use of the CRA for conveyance of the Cadiz water. A number of meetings and discussions have taken place to explore conveyance of the water, but an acceptable solution has not been reached. If conditions in the Lower Colorado River Basin continue to decline, there may be more opportunities to work with MET to enable conveyance of the supply, and storage of water in Fenner Valley groundwater basin, for this project.

**Recycled Regional Water Program (Carson IPR Project)**


**Location:** Carson, CA

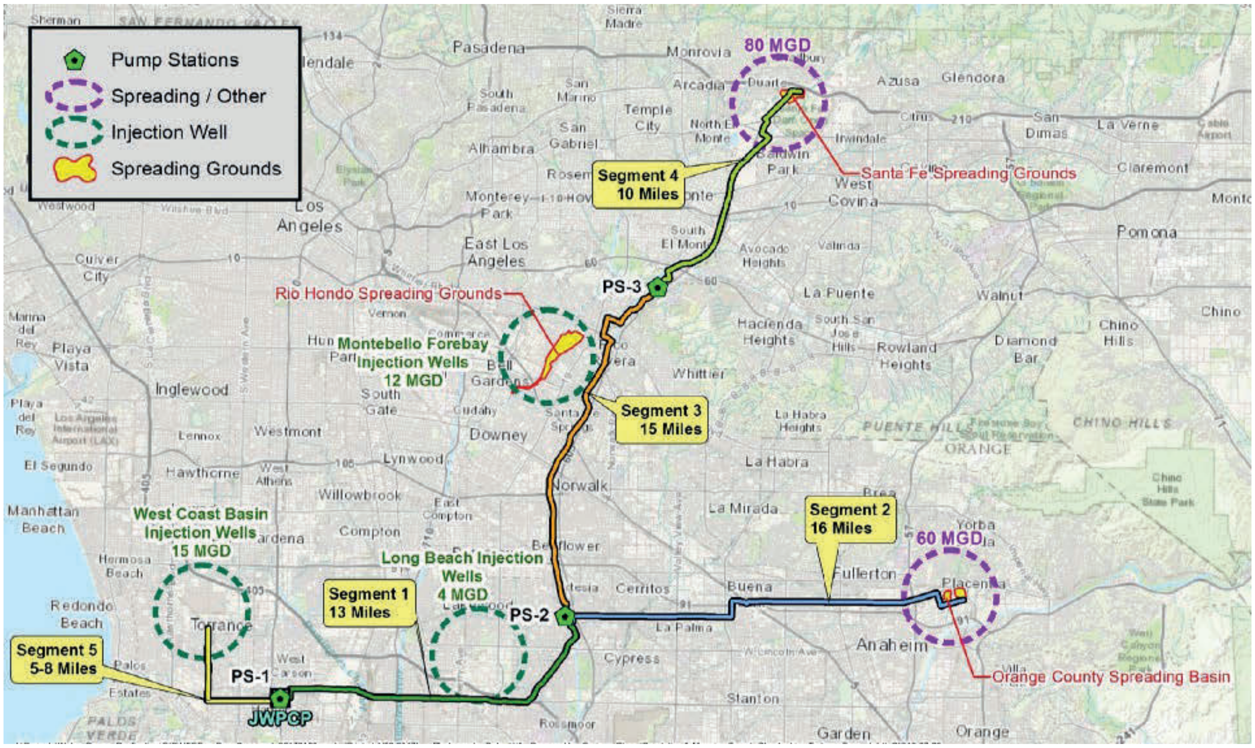
**Proponent**: MET

**Background:**[1] Metropolitan Water District of Southern California (MET), in partnership with the Sanitation Districts of Los Angeles County, is considering the development of a program to create a water resource with regional benefit for Southern California. The potential Recycled Regional Water Program (RRWP or Carson IPR Project) consists of a new Advanced Water Treatment (AWT) facility at LA Sanitation District's Joint Water Pollution Control Plant (JWPCP) in Carson.

It is estimated that up to 168,000 AFY of purified water could be produced and recharged into groundwater basins in Southern California. Initially, the facility would produce purified water to provide a reliable source of water to recharge regional groundwater basins. In the future, the facility may provide a source of water for other indirect and direct potable uses. In addition to the facility, the program would include an extensive new conveyance system to deliver the water (including pumping costs) to four groundwater basins.

| Performance | |
|---|---|
| Goal | Delivery Flexibility |
| Advanced Water Treatment Production Capacity | 150 MGD (168,000 AFY) |
| Average Daily Delivery | 144-150 MGD |
| Long-Term Annual Average Delivery | 147 MGD (164,000 AFY) |
| Minimum Day Delivery | ≥ 110 MGD |

[1] Adapted from MET, **Potential Regional Recycled Water Program Feasibility Study** November 30, 2016.




*Schematic Overview of Facilities and Infrastructure*

**2016 MET Feasibility Study Cost Estimate (in $millions):**

| **Capital Costs** | |
|---|---|
| Treatment Plant | $682 |
| Distribution | $770 |
| Injection Wells/Spreading Grounds | $155 |
| **Total Construction Costs** | **$1,606** |
| Engineering Fees (25%) | $402 |
| **Total Construction Costs w/ Eng. Fees** | **$2,008** |
| Contingency Rate | 35% |
| **Total Capital Construction Costs w/ Eng. and Contingency** | **$2,711** |

| **Annual O&M costs** | Treatment Plant | Distribution | Injection Wells/ Spreading Basins | Total O&M |
|---|---|---|---|---|
| Power Costs | $30.9 | $20.7 | 0 | $51.6 |
| Labor Costs | $11.8 | $5.7 | $0.5 | $18.0 |
| Material Costs | $56.9 | $1.7 | $0.7 | $59.3 |
| Land Use | $0.1 | | | $0.1 |
| **Sub-total** | **$99.6** | **$28.1** | **$1.3** | **$129.0** |

| Summary of the Carson IRP Project for Two Sizes of Projects<br>For the Orange County Water Reliability Study in 2018 | | | |
|---|---|---|---|
| | Delivery | Capital Cost[2] | O&M Cost |
| | (AFY) | ($M, 2016) | ($M/Y, 2016) |
| Project 1: Full-Sized Program with OC Basin | 168,000 | $2,710.63 | $ 129.00 |
| Project 2: Full-Sized Program without OC Basin | 112,000 | $1,977.70 | $88.73 |

[2] With 25% added for Project Management and Engineering and 35% added for contingency.

Using the costs above, the overall cost for producing and percolating the water into the various groundwater basins is estimated at $1,701[2] per AF (in $2016). However, it is expected that MET will meld the cost of the Carson IPR project into its overall rate structure.

The Carson IPR would include the following:

(1) an advanced water treatment (AWT) facility located at the Sanitation Districts of Los Angeles County (Sanitation Districts) Joint Water Pollution Control Plant (JWPCP) in Carson;

(2) production of up to 150 million gallons per day (mgd) of purified water;

(3) conveyance of purified water via approximately 60 miles of pipelines; and

(4) delivery of purified water to up to four groundwater basins (Orange County, Central, West Coast, and Main San Gabriel) within the Metropolitan Water District of Southern California's (MET) service area. [2]

The Carson IPR would provide up to 168,000 acre-feet per year (AFY) to recharge these basins, replacing existing and projected demand for imported water for recharge, and enabling the basins to serve their vital storage function that helps meet regional water demands during dry periods and emergencies.

Implementation of two size configurations of the Carson Indirect Potable Reuse Project (Carson IPR) are considered in this study, a full-sized project at 150 mgd (168,000 AF per year) as outlined in MET feasibility study. Information was developed for the analysis based on MET's Feasibility Study Final Draft Report No. 1530, November 30, 2016. MET is currently building a demonstration facility to begin testing various treatment operations starting in January 2019 to develop cost information regarding the cost to treat the wastewater in LA County for use in groundwater replenishment operations. A key aspect of the Carson IPR Project at the MET level is determining how the project will be included in the cost of MET water.

For purposes of this study, the project costs were allocated within the MET cost recovery model which assumes that all of the MET costs are derived from rates and charges imposed on the MET member agencies. It is our belief that the cost recovery of this project will add somewhere between $100 per AF and $200 per AF onto the cost of untreated MET water costs, but that the water will have a correspondingly higher reliability. The MET Board has not yet approved this project, but the demonstration work and the final feasibility study will be presented to the Board for action sometime in 2019. The project is not expected to come on line until about 2027.

[2] From Carson Potential Regional Recycled Water Program Feasibility Study. November 2016.

**Doheny Ocean Desalination Project**


**Location:** Doheny State Beach and Vicinity

**Proponent**: South Coast Water District

**Background:**[1] South Coast Water District (SCWD), proposes to develop an ocean water desalination facility in Dana Point, at Doheny State Beach. SCWD intends to construct a facility with an initial nominal capacity of 5 MGD (annual production of 5,321 AFY, 7.3 cfs, 4.74 MGD actual capacity), with potential for future expansions up to a nominal capacity of 15 MGD (annual production of 15,963 AFY, 22.05 cfs, 14.22 MGD actual capacity). The project would consist of the following main components:

- A **subsurface water intake system** consisting of subsurface slant wells that would draw ocean water from offshore subsurface alluvial material (located below the ocean floor), providing natural sand bed filtration and eliminating the entrainment and impingement of marine biota, consistent with the State Water Resource Control Board’s (SWRCB) recently adopted Ocean Plan Amendment.
- A **raw (ocean) water conveyance pipeline** that would deliver the subsurface intake system ocean water to the desalination facility site.
- A **desalination facility** that would receive ocean feedwater of approximately 10 to 30 MGD, with a recovery rate of ~50% resulting in up to 5 to 15 MGD of potable drinking water. The proposed desalination facility is located on SCWD’s existing San Juan Creek Property, on an industrial site located away from the beach.
- A **concentrate (brine) disposal system** that would utilize the existing San Juan Creek Ocean Outfall sewage pipeline, to return brine and treated process waste streams to the Pacific Ocean.
- A **product water storage tank** and distribution system that would feed into the local water distribution system.

**Analysis:** For the 2018 OC Study two projects were characterized:

1) A local project for SCWD with a yield of 5,300 AFY (5 MGD) coming online in year 2021; and
2) A regional project to be used by other SOC agencies with a yield of 10,600 AFY (10 MGD). Both projects would provide both system and supply reliability benefits for SOC.

The costs for the Doheny local project were provided by SCWD without modifications. The costs for the Doheny regional project were based on SCWD studies by GHD consultants, but with some modifications by MWDOC (cost of funding was increased to 4.0%, no grants were assumed, allowances were added for land costs, regional integration of the capacity to the South County Pipeline and an allowance was added for dealing with the State Parks).

[1] Adapted from Doheny Ocean Desalination Project Draft Environmental Impact Report, May 17, 2018.

**Estimated Costs at Startup (in Future Startup Year Dollars):**

| Water Project | Capital Cost in Initial Year ($M) | Annual O&M Cost in Initial Year ($M) | Total Unit Cost in Initial Year ($/AF) | Total Unit Cost in Year 2050 ($/AF) |
|---|---|---|---|---|
| Doheny Desalination – SCWD (1) (2) | $107.2 | $6.2 | $1,622 | $3,225 |
| Doheny Desalination – Regional (1) | $133.1 | $13.9 | $1,712 | $3,296 |

(1) Capital costs assumed to be financed at financing terms provided by project sponsors. Annual debt payments included in total unit costs. Projects are assumed to get maximum LRP funding from MET, which is reflected in the total unit costs.

(2) Capital cost for project reduced by $10 million of secured state grant monies.

| Water Project | Assumed Online Date | Supply Yield (AFY) | System Capacity Yield (MGD) |
|---|---|---|---|
| Doheny Desalination – SCWD | 2021 | 5,321 | 4.8 |
| Doheny Desalination – Regional | 2026 | 10,642 | 9.5 |

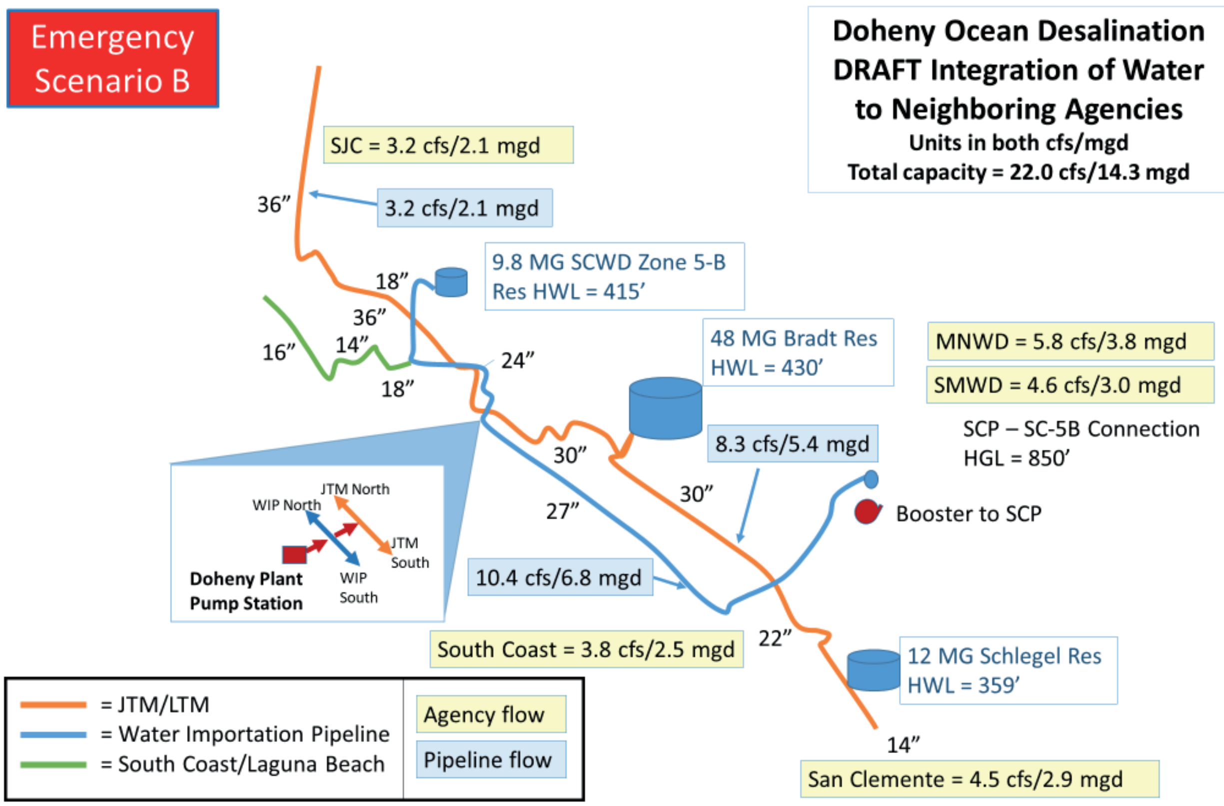
**Assumptions:**

The above project costs are based on the following assumptions:

1. Capital Finance Rate of 3.0% was assumed for the SCWD (or Local) Project Phase and included $10M reduction for a grant which has been awarded,
2. Capital Finance Rate of 4.0% was assumed for the Regional Project Phase without any grant funding.
3. Energy costs were escalated annually at a rate of 2.6%
4. O&M costs were escalated annually at a rate of 2%.
5. Lower unit costs for Regional Project Phase are partly due to oversizing of some components in the Local Project Phase. Regional Project Phase includes regional interconnections with the Joint Transmission Main (JTM) and Water Importation Pipeline (WIP).
6. An allowance for Property & State Park issues for the Regional Project Phase were estimated in the Regional Phase startup year (2026) at $155/AF and escalated at 2.5% annually.

**Other Comments:**

1. Below is an example emergency scenario schematic showing Doheny water distribution to neighboring agencies




2. Full integration work including distribution of flows to other agencies, and operations of regional pipelines, require additional investigation.

## Poseidon Ocean Desalination Project

**Location:** 21730 Newland St.
Huntington Beach

**Proponent**: Orange County Water District,
City of Huntington Beach

**Background:** Poseidon Resources L.L.C. (Poseidon) proposes to construct and operate the Huntington Beach Ocean Desalination Plant on a 12-acre parcel adjacent to the AES Huntington Beach Generating Station in Huntington Beach. The proposed ocean water desalination facility would have a capacity of 50 MGD (56,000 AF per Year). The project would consist of the following main components:

- A **water intake system** consisting of a wedgewire screened intake attached to an existing AES Power Plant cooling pipeline. The intake screens would comply with State Water Resource Control Board's (SWRCB) requirements to eliminate entrainment and impingement of marine biota. Ocean water would be pumped through the existing AES Power Plant cooling pipeline, to the desalination facility.
- A **desalination facility** that would receive ocean feedwater of approximately 100 MGD, with a recovery rate of ~50% resulting in 50 MGD of potable drinking water. The proposed desalination facility would be located immediately adjacent to the existing AES Power Plant, on an industrial site currently owned by Poseidon Resources. The desalination process consists of source water screening, coagulation, filtration, pH adjustment, chlorination, de-chlorination, reverse osmosis (RO) membrane separation, and product water chlorination and chemical conditioning.
- A **concentrate (brine) disposal system** that would utilize the existing AES Power Plant 'Once through Cooling' return pipeline, and a new diffuser to sufficiently mix the brine with seawater to California Ocean Plan Amendment requirements for Total Dissolved Solids (TDS).
- A **product water storage tank** and distribution system that would feed into the local water distribution system.

**Analysis:** The project would provide both system and supply reliability benefits to SOC and the OC Basin:

**Table 5-1. Poseidon Huntington Beach Water Integration Assumptions**

| Poseidon Huntington Beach Water Integration Assumptions | | |
|---|---|---|
| **Delivery Location** | **(AF per Year)** | **(MGD)** |
| Poseidon Production at Plant Site | 56,000 | 49.90 |
| Poseidon SOC Integration[(1)] | 15,964 | 14.22 |
| Poseidon OC Basin Integration[(2)] | 36,676 | 32.68 |
| Poseidon directly to Huntington Beach[(3)] | 3,360 | 3.00 |

(1) Selected to match the nominal production at Doheny for the 15 mgd facility for comparison purposes
(2) Full production less SOC less HB direct
(3) Supply to Huntington Beach at 95% of the MWDOC water rate

For the 2018 OC Study, MWDOC utilized several sources of information to summarize the cost of the Poseidon ocean desalination treatment, which were then 'trued-up' to information that was available in the public domain as presented by OCWD staff to OCWD Board in June 2018. MWDOC developed system integration costs to deliver the water to the OC Basin and SOC, based on information developed by MWDOC with input from OCWD.

| Poseidon Desalination Project | Main Reliability Benefit | Area of Reliability Benefit | Assumed Online Date | Supply Yield (AFY) | System Yield (MGD) |
|---|---|---|---|---|---|
| Poseidon Desalination – Plant Only | Supply (1) | OC Basin/ SOC | 2023 | 56,000 | 50.0 |
| Poseidon Desalination – OC Basin | Supply (1) | OC Basin | 2023 | 36,676 | 32.7 |
| Poseidon Desalination – SOC | System/ Supply | SOC | 2023 | 15,964 | 14.3 |
| Poseidon Desalination – HB | Supply (1) | OC Basin | 2023 | 3,360 | 3.0 |

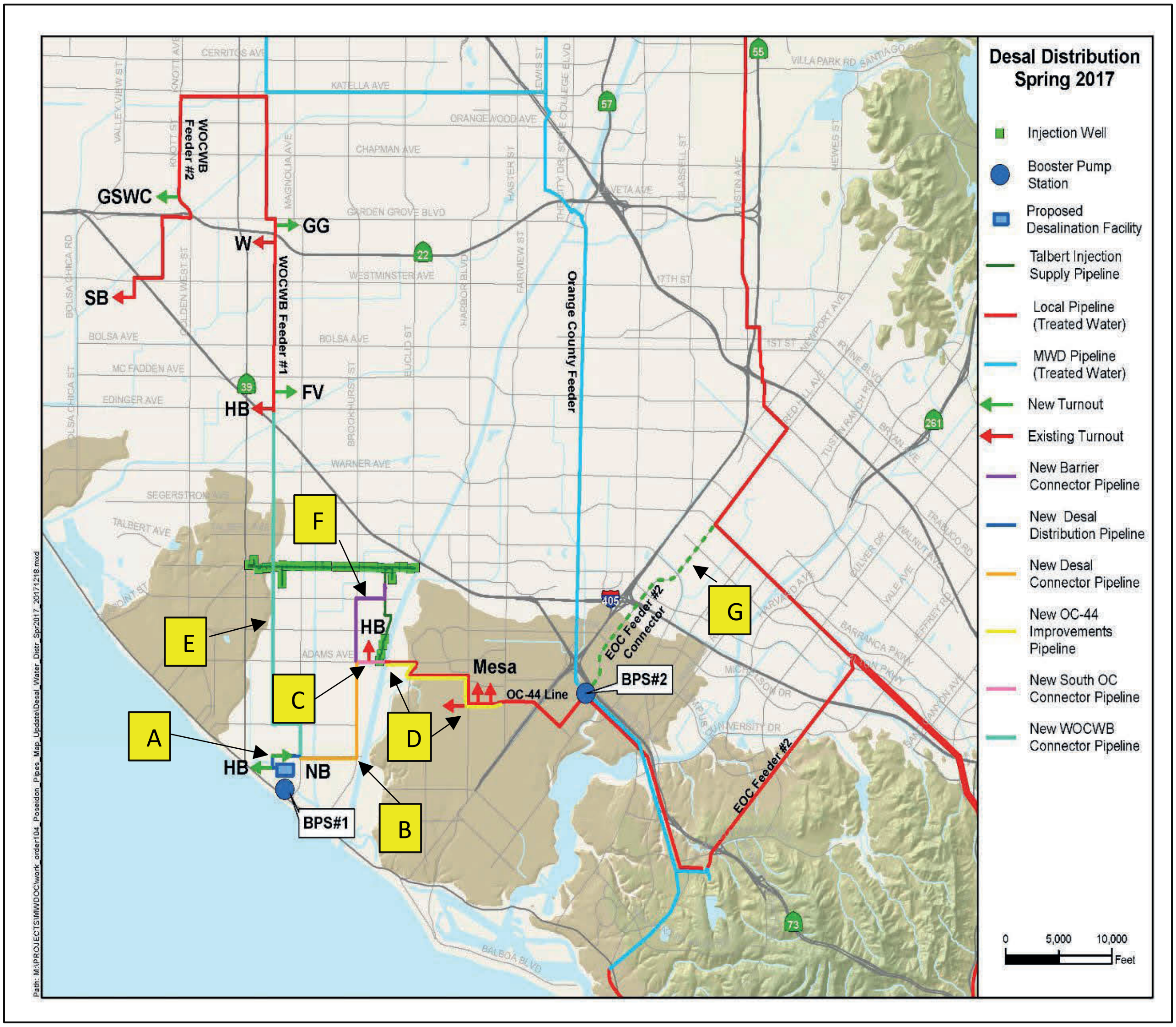
(1) While the Poseidon Desalination Project for OC Basin could provide system reliability benefits, it is not needed for this purpose as there is sufficient local groundwater that can be used if MET water was interrupted for 60 days or more.

| Poseidon Desalination Project | Capital Cost in Initial Year ($M) | Annual O&M Cost in Initial Year ($M) | Total Unit Cost in Initial Year ($/AF) | Total Unit Cost in Year 2050 ($/AF) |
|---|---|---|---|---|
| Poseidon Desalination – Plant Only (1) | $1,216.9 | $48.5 | $1,851 | $3,144 |
| Poseidon Desalination – OC Basin (1) | $196.9 | $1.1 | $2,196 | $3,519 |
| Poseidon Desalination – SOC (1) | $60.7 | $1.1 | $2,133 | $3,485 |
| Poseidon Desalination – HB(2) | $4.03 (2) | $4.0 | $1,200 | $2,837 |

(1) Capital costs assumed to be financed at financing terms provided by project sponsors. Annual debt payments included in total unit costs. Projects are assumed to get maximum LRP funding from MET, which is reflected in the total unit costs.
(2) The numbers shown for HB are essentially for purchasing the water at 95% of the rate it is sold by MWDOC as it escalates over time. The costs paid for this water by HB are part of the revenue stream to pay for the Poseidon Project; the remaining costs of the Poseidon Project for the plant and the integration costs are spread over the remaining 52,640 AF of sales from the project.

The integration systems for both the OC Basin and SOC were developed by MWDOC with input from OCWD to distribute the respective capacities being integrated. The integration with SOC was sized to be consistent with the Doheny Project for comparison purposes, with the remaining water being distributed to the OC basin. The figure below shows the integration components and costs associated with each. Pumping lifts and associated other O&M are included in the cost analysis.

**Distribution System for Poseidon Water Integration into OC System:**



| **Map Key** | **Distribution of Poseidon Water**<br>49.95 cfs (32.23 MGD) to North OC &<br>22.05 cfs (14.25 MGD) to South OC | **Capital Cost in Millions**<br>(2023 Dollars) | | |
|---|---|---|---|---|
| **Segment** | **Description** | **Total** | **NOC** | **SOC** |
| A & B | Hamilton & Brookhurst+ Pipelines<br>4,000‘ of 48” and 14,200’ of 48” | $31.8 | $19.7 | $12.1 |
| C | SOC Connector to OC-44<br>2,300’ of 30” or 36” | $2.9 | $1.0 | $1.9 |
| D | Parallel to OC-44<br>16,000 ‘ of 14” or 20” | $11.4 | $3.8 | $7.5 |
| D | Buy-In to existing OC-44 Line | $4.1 | $1.3 | $2.7 |
| E | Pipeline to WOCWB Feeders<br>32,000’ of 27” | $49.0 | $49.0 | $0.0 |
| F | Pipeline to Barrier<br>8,000’ of 30” | $122.0 | $122.0 | $0.0 |
| G | EOCF#2 Connector<br>19,500’ of 24” or 30” (& booster pump, flow control facility, chloramination & connection to EOCF#2) | $36.5 | $0.0 | $36.5 |
| | **Total** | **$257.6** | **$196.9** | **$60.7** |
| Numbers may be affected by rounding; assumes 4.64 cfs (3 MGD) goes directly to Huntington Beach | | | | |

**The San Juan Watershed Project**

**Location:** San Juan Creek

**Proponents**: Santa Margarita Water District,
South Coast Water District

**Background:**[1] The proposed San Juan Watershed Project would increase capture and storage of urban runoff and stormwater, optimize the use of recycled water for beneficial reuse, and augment local groundwater supplies of the San Juan Basin to maintain basin health. The project would be constructed in up to three phases.

*Phase I:* Anticipated production: Average of 700 Acre-Feet per Year (AFY) of potable water

Phase I would include installation of three rubber dams within San Juan Creek downstream of the confluence of Arroyo Trabuco, which would act as in-stream detention facilities for both dry and wet-weather flows. The dams would promote in-stream recharge of the groundwater basin by allowing ponded water captured behind the dams to naturally infiltrate into the stream bed. During large storm events, the rubber dams would deflate to allow full passage of the stormwater flow downstream to Doheny State Beach. Each dam would include a stilling basin and fish chute. Phase I would use existing City of San Juan Capistrano groundwater extraction wells to pull water from the basin and use existing excess capacity in the San Juan Groundwater Recovery Plant (GWRP) to treat the groundwater. Initially, the San Juan Watershed Participants would participate in the funding and operation of the San Juan Groundwater Recovery Plant (GWRP) to treat up to 5 MGD (existing plant capacity) of water combined between the City of San Juan Capistrano and what is developed via the watershed project.

*Phase II:* Anticipated production: Up to 6,120 AFY

Phase II would develop additional surface water/groundwater management practices by using stormwater and also introduce recycled water into the creek for infiltration into the groundwater basin. Phase II would include; construction of an additional four to seven rubber dams, extension of recycled water lines from existing wastewater treatment facilities to locations upstream of the dams, expansion of the GWRP treatment plant capacity, and construction of one to three additional groundwater wells. Additional recycled water would be needed as source water to for Phase II to move forward.

*Phase III:* Anticipated production: Up to 2,660 AFY

Phase III would include introduction of recycled water directly into San Juan Creek through live stream recharge. Recycled water lines would be extended to locations along the creek and one additional groundwater well may be needed to pull water from the basin. The recycled water system would need to be expanded as additional recycled water would be required as source water to complete Phase III.

**Analysis:** For the 2018 OC Study it was assumed that the full-sized project (Phases 1, 2 and 3) would be operational by year 2022 and produce approximately 9,480 AFY for both system and supply reliability benefits.

[1] Adapted from San Juan Watershed Project Draft Program Environmental Impact Report, December 2017.

All project information regarding yield, costs and timing for the San Juan Watershed Project were provided to MWDOC by SMWD.

**Estimated Costs at Startup (in Future Startup Year Dollars):**

| San Juan Watershed Project | Startup Year | Yield (AFY) | Capital Cost in Initial Year ($M) | Total Unit Cost in Initial Year ($/AF) |
|---|---|---|---|---|
| Phase I (1) | 2019 | 700 | $23.6 M | $2,156 |
| Phase II | 2022 | 6,120 | $92.6 M | $1,628 |
| Phase III | 2022 | 2,660 | $32.3 M | $1,232 |
| **Total** | **2022** | **9,480** | **$148.5 M** | **$1,521** |

(1) Phase I Cost/AF can be considered interim or startup costs as the project begins producing water prior to full development of the project.

**Assumptions:**

The above project costs are based on the following assumptions:

1. Capital Finance Rate: 4%, amortized over 30 years. MET LRP funding ($475/Yr. for 15 Yrs.) included in assumptions. Lower Cost SRF Funding and other Grants (such as BOR) may be available, but were not included in analysis.
2. Rubber Dam Replacement: (10 year life expectancy) Replacement costs are calculated assuming the rubber dam portion of the project was 20% of the original Capital Cost in 2019 and then it was escalated at 3% each year to accumulate a sinking fund.
3. Cost per AF includes annual O&M costs which were calculated at startup (2019) to be $459/AF based upon actual groundwater treatment costs of the San Juan Desalter. Salaries and benefits for 2 additional operators were added for Phase I, 1 additional operator was added for Phase II, and 0 additional operators for Phase III. O&M costs were escalated annually at a rate of 3%.
4. Recycled water cost of $350 per AF was included for Phases II & III.
5. SMWD 'assumes' responsibility for 50% of the San Juan Groundwater Recovery Plant debt in exchange for 50% of the 5.0 MGD Treatment Facility capacity (currently unused treatment capacity) of 1,000 to 2,000 AFY of local water in addition to the amount noted above, may be secured by SMWD. Results in economies of scale for the City of San Juan Capistrano due to expanded throughout capacity.

**Other Issues:**

1. Indeterminate environmental permitting process regarding installation of rubber dams in San Juan Creek. The San Diego Regional Water Quality Control Board (SDRWQCB) would have to approve the permitting of the percolation of highly treated recycled water in San Juan Creek under the assumption that the basin is already a degraded basin and requires treatment for production of potable water. The decisions by the SDRWQCB on the ultimate treatment for the water being percolated and for the water being pumped out of the basin could impact the economics of the project. The SDRWQCB has so far seemed very positive about the project.
2. Phase III requires recycled water sourced from others to meet recycled water supply requirement.

3. The City of San Juan Capistrano is currently under discussions with several agencies regarding the take-over of their water system, including SMWD. The terms and conditions for the take-over of the system could impact the project and if the take-over occurs by an agency other than SMWD, the project could be impacted.

**SOC Emergency Interconnection Expansion (SOC Emergency Water)**

**Background:** MWDOC has been working with the SOC agencies for a number of years on improvements for system (emergency) reliability primarily due to the risk of earthquakes causing outages of the MET imported water system as well as extended power grid outages. Two criteria developed by MWDOC for targeting emergency water needs are:

1. To plan for the MET system to be out of water for up to 60 days (based upon a forecasted likely outage duration by MET for the Diemer Treatment Plant); and
2. That agencies should be planning on being without the electrical grid for a minimum of one week (based upon forecasted likely outage durations by Southern California Edison and San Diego Gas & Electric).

Local agencies have the flexibility to adjust these criteria based on their own evaluation of their local system issues.

Existing regional interconnection agreements (2006 Phase 1 Emergency Service Program Participation and 2009 Operations Agreement South Orange County Irvine Ranch Water District Interconnection Projects) between Irvine Ranch Water District (IRWD) and the South Orange County (SOC) agencies provides for the delivery of water through the IRWD system to participating SOC agencies during times of emergencies. The exchange of water for emergency delivery was authorized under the earlier 2006 agreement between MWDOC, Orange County Water District (OCWD), IRWD and the SOC agencies. The 2009 agreement includes target flows to be delivered by IRWD under contractual terms and then additional flows to the best of IRWD's ability.

Recent conversations involving MWDOC and SOC agencies indicates an interest in exploring with IRWD the possibilities of providing more flow than the existing agreement provides for, and/or extending the agreement past the current expiration year of 2030.

**2009 Agreement Terms for Delivery of Emergency Water by IRWD**

| **Phase 1 Emergency Service Program Agreement Terms<br>Average IRWD Flow Rate Reserved for South County (cfs)** | | | | | | |
|---|---|---|---|---|---|---|
| | Available Supply in cfs in Calendar Years | | | | | |
| Month | 2005 - 2009 | 2010 - 2014 | 2015 - 2019 | 2020 - 2024 | 2025 - 2029 | 2030 |
| Jan | 20.0 | 25.0 | 21.5 | 18.5 | 16.0 | 0 |
| Feb | 21.5 | 26.5 | 23.0 | 20.5 | 18.5 | 0 |
| Mar | 20.5 | 25.5 | 22.0 | 19.5 | 17.0 | 0 |
| Apr | 16.5 | 20.5 | 16.0 | 12.5 | 9.0 | 0 |
| May | 14.5 | 18.0 | 12.0 | 7.5 | 3.0 | 0 |
| Jun | 12.5 | 15.5 | 7.0 | 1.5 | 0.0 | 0 |

| Phase 1 Emergency Service Program Agreement Terms<br>Average IRWD Flow Rate Reserved for South County (cfs) | | | | | | |
|---|---|---|---|---|---|---|
| | Available Supply in cfs in Calendar Years | | | | | |
| Month | 2005 - 2009 | 2010 - 2014 | 2015 - 2019 | 2020 - 2024 | 2025 - 2029 | 2030 |
| Jul | 10.5 | 13.0 | 1.5 | 0.0 | 0.0 | 0 |
| Aug | 10.5 | 13.0 | 1.5 | 0.0 | 0.0 | 0 |
| Sep | 9.0 | 12.0 | 0.0 | 0.0 | 0.0 | 0 |
| Oct | 12.0 | 15.5 | 6.5 | 1.0 | 0.0 | 0 |
| Nov | 15.0 | 18.0 | 13.0 | 8.5 | 4.5 | 0 |
| Dec | 18.0 | 22.0 | 18.0 | 15.0 | 11.5 | 0 |

= months in which IRWD has limited ability to move emergency water

**Analysis**

MWDOC and IRWD are currently studying an expansion of the current program (the study should be completed by January 2019). Included in the study efforts with IRWD is the potential East Orange County Feeder #2 pipeline (EOCF#2), which will be examined as an alternative facility whereby groundwater wells near EOCF#2 could be pumped into EOCF#2 at such times when MET water is unavailable. The EOCF#2 is a major pipeline that runs from the Diemer Water Treatment Plant in Yorba Linda to central Orange County where it connects to other pipelines that convey water into SOC (i.e. the Joint Regional Water Supply System (JRWSS) and the Aufdenkamp Transmission Main (ATM)). MWDOC is working with MET staff and legal counsel to review and determine how to address the issues of conveying non-MET water in EOCF#2.

For the 2018 OC Study, MWDOC conceptualized an expanded and scalable emergency groundwater program that would include new groundwater production wells or simply connections from local water systems to the EOCF#2, with chloramination facilities and booster pumps to convey local groundwater in the EOCF#2. The concept would be that pumpers in the OC Basin would be able to use these production wells in non-emergency periods, while SOC agencies would be able to use the wells during an unplanned system outage. SOC agencies would be responsible for the cost of the chloramination facilities, pump stations and conveyance facilities to EOCF#2, and a portion of the cost for the groundwater wells (with OC Basin pumpers responsible for the other portion of well costs). In addition, SOC would be responsible for replenishing any groundwater that is utilized during the emergency as a water exchange. This project would <u>not</u> be used by SOC for water supply reliability needs during dry years or droughts.

| SOC Emergency Interconnect | 2023 |
|---|---|
| Capital Cost ($15 Million) Amortized over 30 yrs. | $867,451 |
| Unit energy lift | $228 |
| AF of water moved in 60 days | 1,782 |
| Cost of MET Water | $2,315,165 |

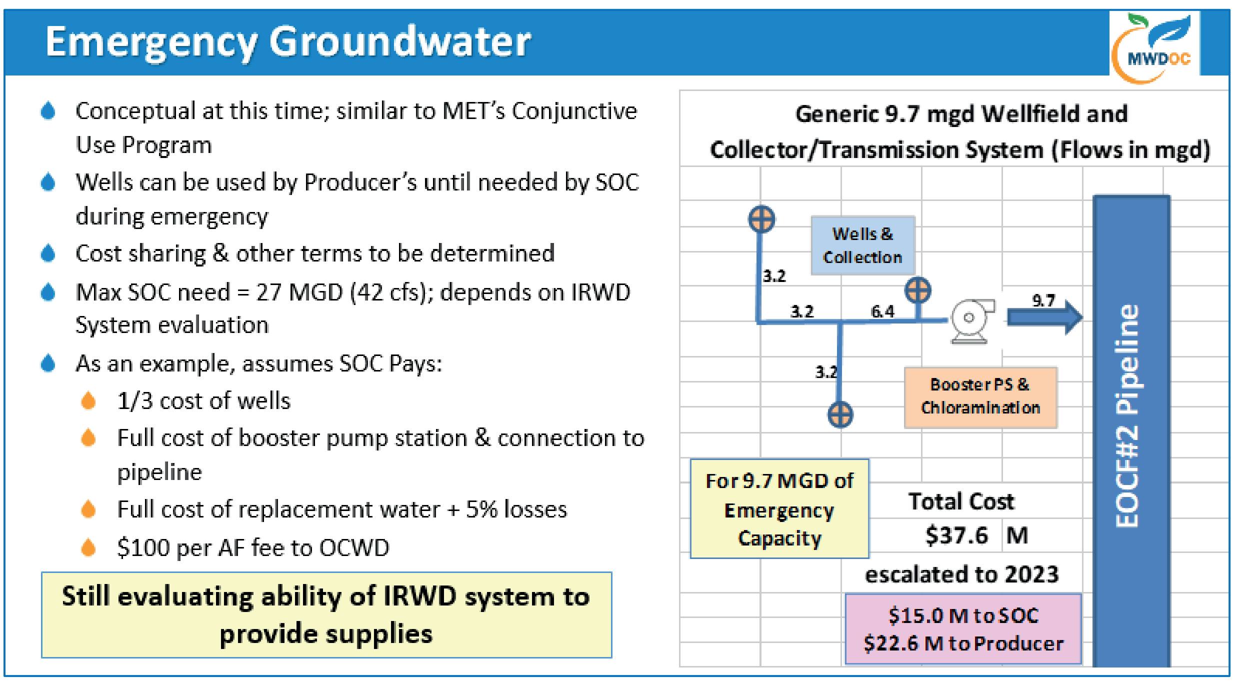
| SOC Emergency Interconnect | 2023 |
|---|---|
| 5% Losses | $115,758 |
| Energy Lift | $406,296 |
| OCWD Payment | $200,566 |
| Total Water & Energy | $3,037,785 |
| Total Including Capital | $3,905,237 |

**Assumptions:**

The above project costs are based on the following assumptions:

1. Capital Finance Rate of 4.0% was assumed over 30 years
2. Water delivery volume is based upon an assumed use of the interconnection once every 10 years (i.e. 3 times over the 30 year period)
3. Losses were assumed to be 5%
4. Energy lift per AF was calculated in 2023 at $228/AF and escalated at 2.5% annually.
5. Payment to OCWD to pump groundwater out of the basin was calculated at $100/AF in 2019 and escalated at 3.0%

**Schematic for Emergency Groundwater Pump-in to the EOCF#2**



**Water Reliability Pilot Program between MWDOC & IRWD for Extraordinary Supply during MET Allocations**

**Storage Location:**
IRWD Strand Ranch and Stockdale West properties are located approximately six miles west of the City of Bakersfield (Kern County)

**Proponent**:
Irvine Ranch Water District

**Background:**
Since 2009, Irvine Ranch Water District (IRWD) has successfully developed and is now operating its Strand and Stockdale Integrated Water Banking Projects ("Water Bank"), which are located west of Bakersfield. Operations of this Water Bank are facilitated through a 30-year agreement that IRWD has with Rosedale-Rio Bravo Water Storage District.

Groundwater banking facilities on Strand Ranch are owned by IRWD and operated and maintained by Rosedale-Rio Bravo Water Storage District (Rosedale) for the duration of the proposed project. Facilities have been constructed to recharge and recover up to 17,500 acre-feet per year (AFY) for IRWD.

A proposed pilot program between IRWD and MWDOC would allow for up to 5,000 AFY of water in Strand Ranch to be delivered to MWDOC as 'extraordinary' supply during a MET water allocation period. During periods of extreme water supply shortage MET may enter into a water allocation whereby MET member agencies (including MWDOC) are allocated a reduced amount of MET supply. If MET member agencies need and purchase water above the allocation amount, substantial surcharges are imposed (i.e., an additional charge of more than 100% the normal water price). MET water allocations have been imposed three times since 2000 with allocation reductions of 10% to 15% of baseline import water sales. It is expected that the likelihood of MET allocations will decrease after the California WaterFix project is completed (estimated 2035).

MET has strict rules as to what constitutes extraordinary supplies and these can only be accessed at such times as MET is in a water allocation; extraordinary supplies ride on top of MET's allocated imported water for what is essentially a one-to-one supply benefit. Water is categorized by MET as extraordinary supply water if it meets several MET conditions including, that it is not derived from a MET water supply and it is used only during allocations or certain emergencies. The value of extraordinary supply is that it is directly added to the utility's baseline supply (1:1) and is not discounted or reduced in the MET supply allocation calculation. IRWD's current Strand Ranch program fits this definition.

IRWD has entered into agreements with several other water districts that allow exchanges of State Water Project (SWP) and non-SWP water on a 2-for-1 basis (also referred to as "unbalanced exchanges"). These exchange agreements result in a low cost water supply to IRWD's Water Bank with IRWD retaining 50 percent of all the water delivered into storage. Currently, IRWD has about 50,000 AF in storage in their Water Bank.

Extraordinary supply is available and IRWD has proposed a plan whereby a specific amount of water can be reserved or optioned for use during an allocation. This provides insurance of an extraordinary supply if and when needed at a significantly lower cost - the reserve (or option) payment.

**Pilot Program:**

The Water Reliability Pilot Program under discussion is relatively simple in concept:

- MWDOC would contract with IRWD to reserve or option a specific amount of extraordinary supply water (up to 5,000 AFY) from the IRWD Water Bank at a specified annual reservation rate ($25/AF) for a specific period of time (7 years);
- If MWDOC determines a need to call on that extraordinary supply to meet customer demands during an allocation, then the water would be purchased, and additional costs incurred;
- If MWDOC found that there was no need to call on the reserved extraordinary supply, then no additional charges are incurred, and the annual payments could be viewed as an insurance premium (payments for coverage not exercised).

**Term:** Seven years fixed with no "opt out" provision; but leaving open the opportunity for future discussions related to extending the program to improve water supply reliability into the future. Staff believes the largest exposure under water allocations from MET will occur from now to about the time the California WaterFix begins operation in about 2035 (in 17 years). Other projects could be developed during that period to mitigate the allocation risk.

**Amount:** 5,000 AF from IRWD will be held available in its Water Bank (net of Kern County Losses) over the term of the Pilot Program.

**Annual Reservation (Option) Charges:** MWDOC would pay IRWD a $25 per AF annual reservation charge ($125,000 per year for seven years) to secure the right to call on up to 5,000 AF of Extraordinary Supply in any water allocation year or years (or during limited emergency events) within the 7 year term. MWDOC's base year allocation in the last drought was 196,560 AF.

The 5,000 AF would provide protection for MWDOC agencies beyond the "pooling" benefit provided by MWDOC. Under the pooling concept, some agencies can go over their allocations and others are under theirs and penalties are NOT imposed unless MWDOC as a whole is over its allocation with MET. The Pilot Program complements the basic MWDOC pooling by providing additional protection in case the pooled use is over the MWDOC allocation. For the benefits of the Program to be realized MET would need to be in an allocation under its Water Supply Allocation Plan (WSAP) for two consecutive years, as MET has historically cancelled the reconciliation of surcharges for single year allocations. If the pilot program extraordinary supply was called during the 2$^{nd}$ consecutive year allocation, then those MWDOC Member Agencies who exceeded their allocation would be charged for the additional Program water costs. These program costs would be less than the costs of purchasing the water from MET with the associated surcharges.

**Proposed IRWD Fees and Charges**

| | |
|---|---|
| **Up Front Fixed Costs:** | |
| Up to $5,000 One-time Program Set-up Fee | Covers IRWD's actual administrative and legal costs to develop a Pilot Program Agreement. |
| **Annual Costs:** | |
| Annual Reservation (Option) Charge of $25 per AF: | Based on IRWD's opportunity loss of 2,500 AF of water for reserving up to 5,000 AF of water in storage for MWDOC. Paid each of the seven years (no opt out). |
| **Variable $510 per AF Cost to Call on Water:** | |

| | |
|---|---|
| Actual costs estimated at $150 per AF Cost of Water | IRWD's cost of water is based on actual costs incurred to acquire water supplies through unbalanced exchanges, net of losses, and includes Rosedale's fees, Kern County Water Agency third party banking fees, share of recharge O&M costs, and Kern County conveyance costs. |
| Actual costs estimated at $100 per AF for Recovery Costs | Actual recovery costs include estimated cost of power, Rosedale's fees, share of recovery O&M costs and Kern County conveyance costs. |
| Fixed fee of $260 per AF Capital Facility Use Fee | Capital facility use fee is based on IRWD's total capital costs and the total amount of water expected to be delivered from the projects over 50 years. |
| **Other Costs:** | |
| $500 Transaction Fee Each Time Water is Called | Covers IRWD's administrative costs to coordinate recovery of water from the Water Bank, invoicing and tracking. |

**Analysis**

As the 2018 OC Study was wrapping up in the summer of 2018, MWDOC and IRWD entered into discussions regarding MWDOC offering participation in the IRWD Strand Ranch Water Banking Program under initial terms which were reviewed with the MWDOC Board and the member agencies. Based on the modeling completed in the Study, it appeared that the ability to call the 5,000 AF multiple times during the pilot program would substantially improve the economics. The modeling used 2 calls over the pilot program. MWDOC plans to conduct further work on the proposed terms and conditions for MWDOC's agencies to participate in the Program. This work should be completed in January 2019 and will likely include revisions to the initial terms developed.

The initial proposed terms and conditions as a Pilot Program included MWDOC paying IRWD a $25/AF annual reservation charge over the life of the agreement for up to a maximum of 5,000 AF to be reserved. If MWDOC reserved the entire 5,000 AF, the fixed cost payment would be $125,000 per year; the Pilot Program was suggested to extend over the next seven years; the total fixed payments over this period would be $875,000. During a MET water allocation scenario, the water can be called at an additional cost of approximately $1,776/AF in 2025, consisting of an IRWD charge of $533 per AF for facilities, the cost of water and extraction costs, plus a MET Wheeling payment of $1243 per AF (total cost is approximately $1,952/AF if the reservation fee is included). The cost of this water is about $771/AF less than the cost of purchasing MET water at the allocation surcharge water rate in 2025. MWDOC will be studying these terms and conditions to determine if this Pilot program meets the needs of its agencies. This program would only provide supply reliability benefits as the water would be treated at MET's Diemer Plant.

*Benefits:* The primary benefits of the proposed pilot program are that MWDOC and its Member Agencies obtain an appropriately sized extraordinary supply at a price well below the cost of developing a separate extraordinary supply, if utilized this supply would be 28% less than paying the MET surcharge with a savings of $3.85 million. The probability of allocations does not significantly decrease until the California WaterFix is operational (2035) or other source projects are developed. Having access to Extraordinary Supplies to mitigate a Drought Allocation will provide a significant benefit during that period. As shown above, the cost savings between the proposed pilot program and the MET allocation surcharge is estimated at $771/AF.

*Risks:* If the option is not exercised then the annual cost of $125,000 ($880,000 over 7 years) can be viewed as being forgone.

**Other Comments:**

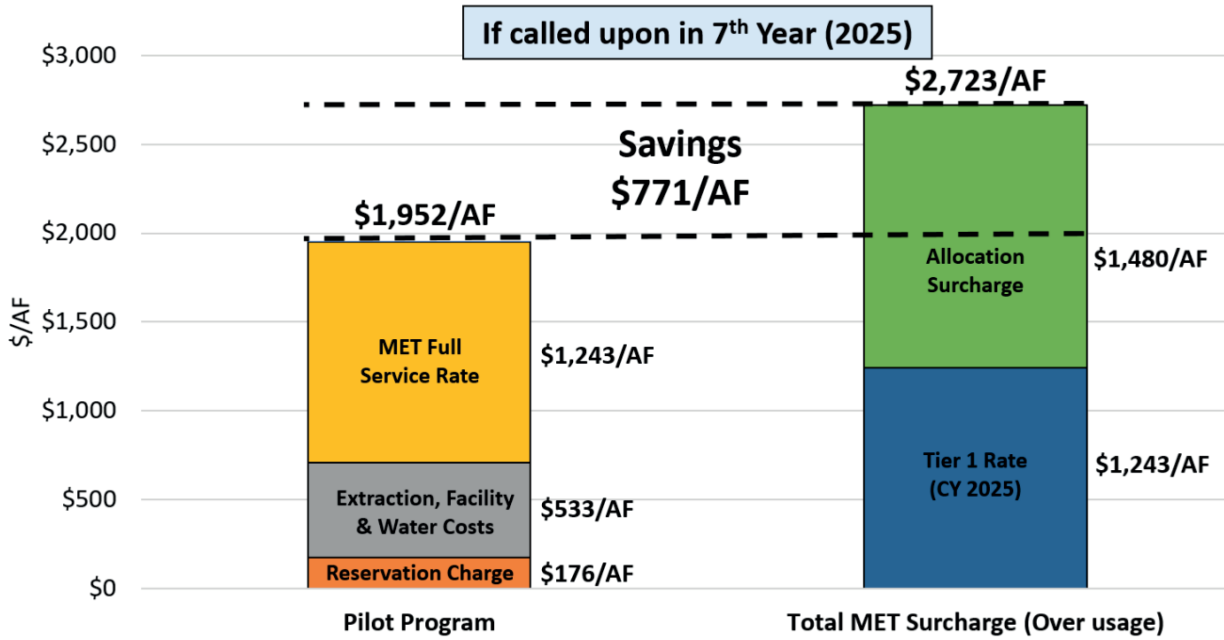
Below is a breakdown of the aggregate cost of the program per AF if MWDOC calls on the water in the last year of the seven year program (2025) along with a comparison of the Proposed Pilot Program to the MET Allocation Surcharge:

**Aggregate Cost of Program Water if Called in Seventh Year (2025)**

| | |
|---|---|
| All Reservation Charges & Set-Up Fee | $176/AF* |
| Estimated Actual Cost of the water in storage | $150/AF |
| Estimated Actual Cost of Recovery out of storage | $123/AF** |
| Fixed Fee of Capital Facility Use | $260/AF |
| **Subtotal** | **$709/AF** |
| MET Tier 1 Treated Rate (CY2025) | $1,243/AF |
| **TOTAL** | **$1,952/AF** |

*[*] $176/AF determined by dividing the total annual reservation charges over the 7 years ($875,000) plus the one-time set-up fee ($5,000) by the 5,000 AF program amount.*

*[**] Estimated using a 3% escalation rate.*




(1) MET actually has a two-tier surcharge for agencies going over their allocation. The first tier is for agencies exceeding the allocation by up to 15% (which is shown above). Under the MET WSAP, agencies exceeding their allocation by more than 15% incur an even higher surcharge (an additional $1480 is added).

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# Appendix E
# Map of Water Pipelines in OC


# OC Water Retailers and Transmission Mains

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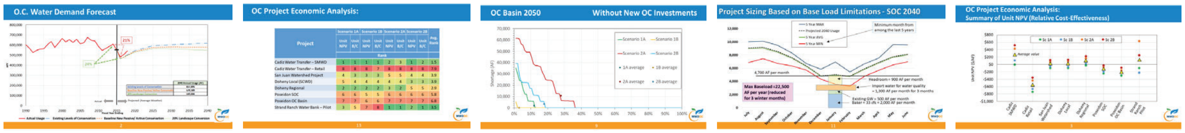
# Appendix F

# Final Powerpoint Presentation




# 2018 OC Reliability Study – Final Report

December 12, 2018

MWDOC

# Why the 2018 Water Reliability Study

MWDOC

2018 OC Reliability Study Appendix F: Final PowerPoint Presentation - December 12, 2018 2

## Changed Conditions and Need for 2018 Study

- MET financially committed to WaterFix, assumed operational date 2035
- MET completed detailed feasibility report on Carson IPR project
- Newer set of global climate models (GCMs) indicate:
  - Future temperatures will be significantly greater than GCMs used in 2016 Study
  - Future precipitation will have significantly more variability & average values greater than those used in 2016 Study
- Implementation of Bureau of Reclamation's Draft Drought Contingency Plan for Colorado River results in greater MET shortages
- Several local Orange County projects have advanced

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## Objectives for 2018 OC Study

**NOT DICTATING MEMBER AGENCY DECISIONS**

1) Determine the water supply and demand reliability impacts in Orange County due to changed conditions
2) Evaluate/rank local OC water supply projects to allow discussion and debate, and to provide comparative information to help local agencies make decisions
3) Provide information for MWDOC to advocate on policy issues regarding MET's regional projects and water rates, 2020 Integrated Resources Plan (IRP) update, Local Resources Program (LRP) funding, Water Supply Allocation Plan (WSAP) issues, and groundwater replenishment needs

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# What is Water Reliability?

## System Reliability

- How reliable is your system (can demands be met) under different emergency situations?

## Supply Reliability

- How often are you short water supplies and how much are you short (Mandatory Reductions)

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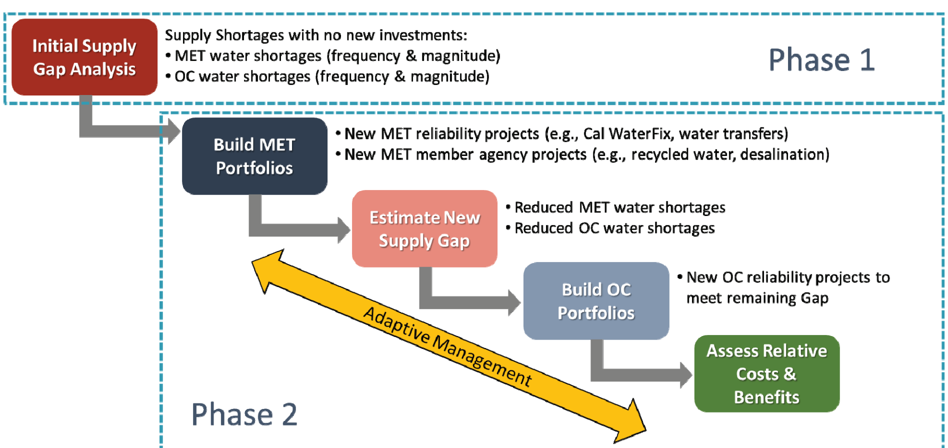
# Overview of 2016 OC Reliability Study




**Selected for 2016 Study**

**Scenario 2:** Moderate Growth and Climate Change

**MET Portfolio B:** New LRP Projects, Additional CRA & SWP Transfers, and Carson IPR project – **but without WaterFix**

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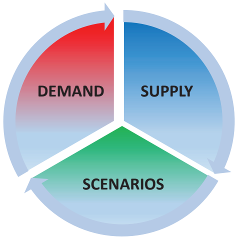
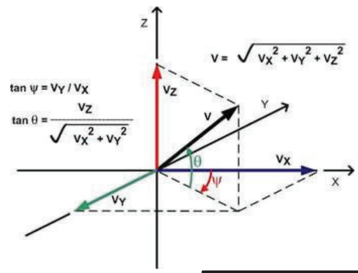
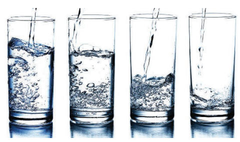
# Supply Reliability Analysis Process




DEMAND, SUPPLY & SCENARIOS → RELIABILITY MODELLING & GAPs → NEW OC WATER PROJECTS → PROJECT FINANCIAL EVALUATIONS → SYSTEM INTEGRATION

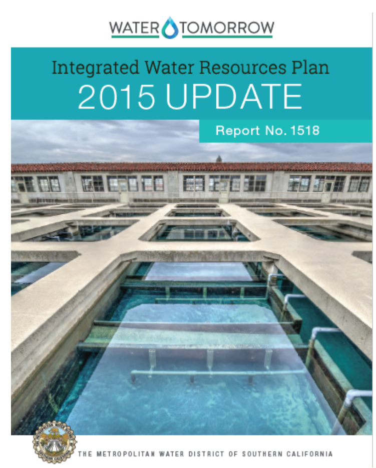


**94 Hydrologies**
**Probability & Volume of Supply Shortages**



# What it takes to evaluate our existing water supply reliability

- What supply investments will MET make over time? What will they cost?
- How will MET supplies from the State Water Project and Colorado River Aqueduct perform over time?
- What supply decisions will be made by MET's member agencies?
- What will demands do over time?
- What impacts and how quickly will Climate Change occur?
- What will be the cost of MET Water over time?
- What is the need for local supplies in Orange County?
- How does MET's Water Supply Allocation Plan (WSAP) work?
- What are the benefits of "Extraordinary Supplies"?



# CMIP5 RCP8.5 Climate Models and Impacts on Supplies


GCMs with minimal impacts on SWP and *no* impacts on CRA

GCMs with *moderate* impacts on either CRA or SWP supplies (but not both)

GCMs with *significant* impacts on both CRA & SWP supplies

MINIMAL Climate Change

SIGNIFICANT Climate Change

Used for 2018 OC Study Scenarios



# NEW Supplies Included Under the Various Scenarios (1,000's of AF per Year)

| New MET Supply Investments (thousand acre-feet) | Planning Scenarios | | | |
|---|---|---|---|---|
| | Scenario 1. Minimal Climate Change Impacts | | Scenario 2. Significant Climate Change Impacts | |
| | A. Low-Cost | B. High-Cost | A. Low-Cost | B. High-Cost |
| WaterFix (average) | 440 | 440 | 440 | 440 |
| CRA Transfers (base loaded) | 100 | 100 | 100 | 100 |
| LRP (base loaded) | 88 | 88 | 88 | 88 |
| SWP Transfers (dry year) | 0 | 150 | 150 | 150 |
| Carson IPR (base loaded) | 0 | 168 | 0 | 168 |
| More LRP (base loaded) | 0 | 0 | 74 | 74 |
| More CRA Transfers (dry year) | 0 | 0 | 80 | 80 |
| More SWP Transfers (dry year) | 0 | 0 | 0 | 150 |
| Regional Surface Reservoir | 0 | 0 | 0 | 400 |
| **Total Base Loaded Supplies** | **628** | **796** | **702** | **870** |
| **Total Dry Year Supplies** | **0** | **150** | **230** | **380** |
| **New Storage** | **0** | **0** | **0** | **400** |
| **Total Supplies and Storage** | **628** | **946** | **932** | **1,250** |

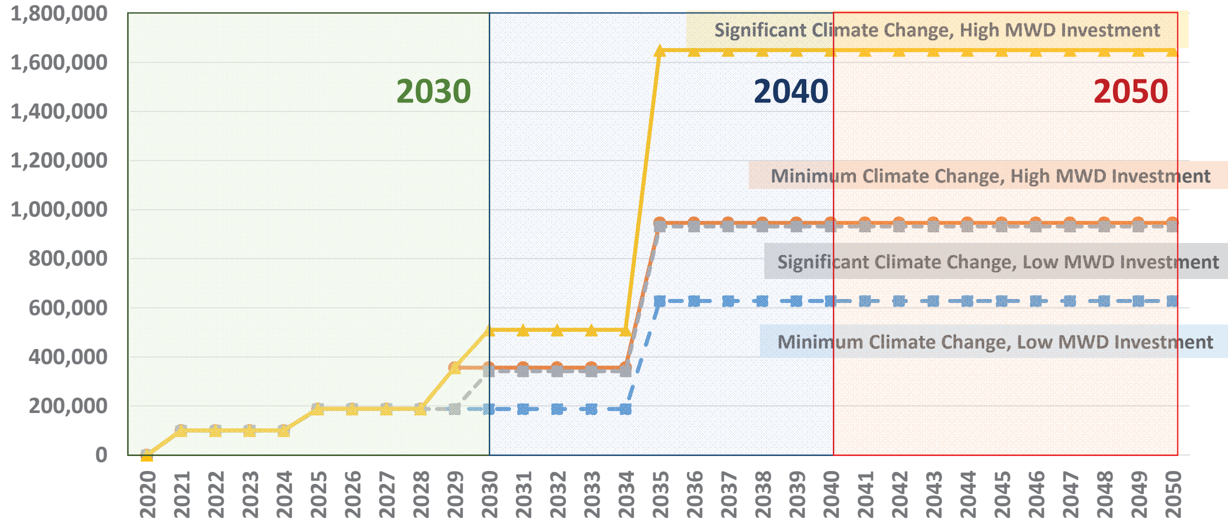
**Scenario 1A:**
**Minimal Climate Change**
**Low Cost Investments**

**Scenario 1B:**
**Minimal Climate Change**
**High Cost Investments**

**Scenario 2A:**
**Significant Climate Change**
**Low Cost Investments**

**Scenario 2B:**
**Significant Climate Change**
**High Cost Investments**

## NEW MET Supplies - Combination of Transfers, Local Projects, Carson IPR, WaterFix, & Additional Surface Reservoir (for Sc 2B) in AF per Year



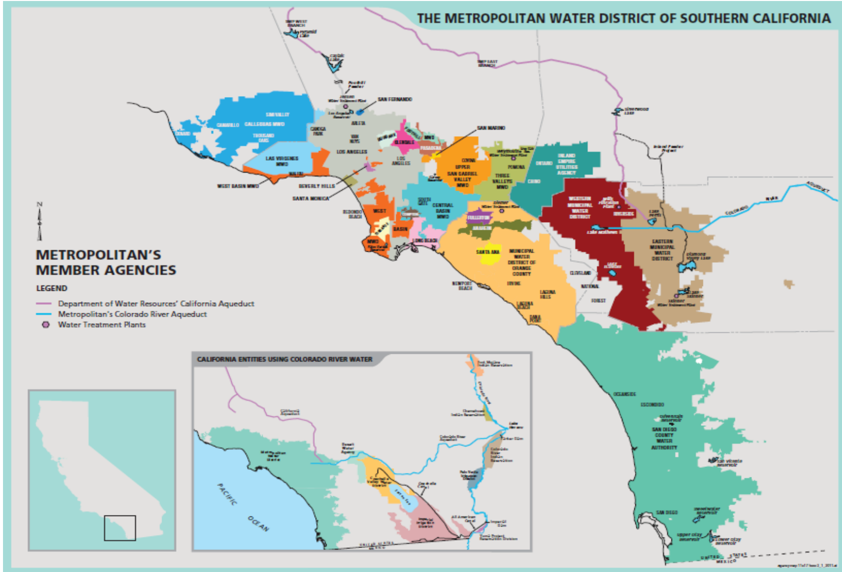



# Southern California (MET)

# MET's Integrated Resources Plan (IRP)

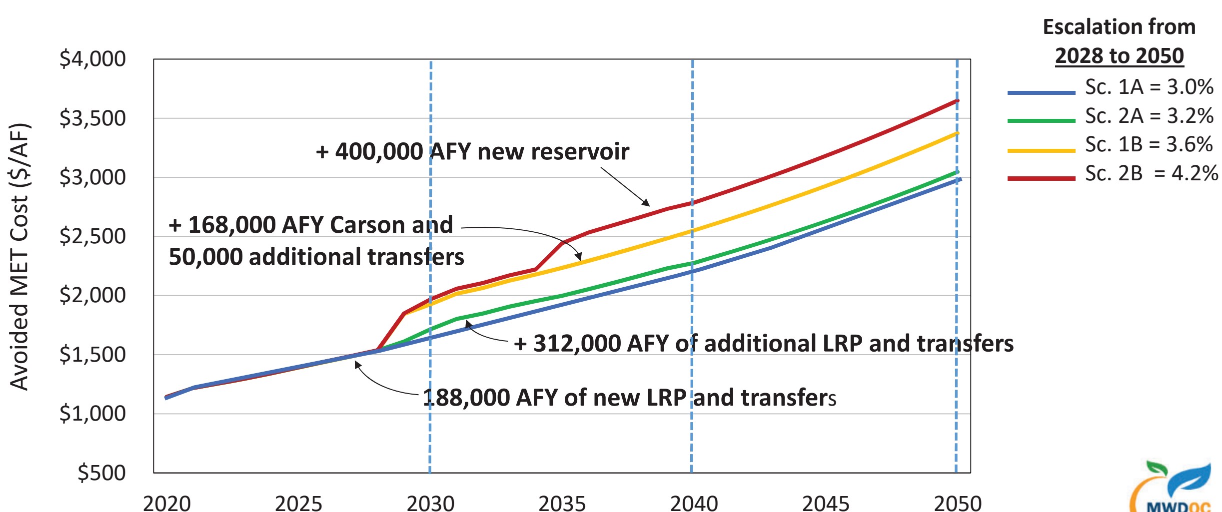
MUNICIPAL WATER DISTRICT OF ORANGE COUNTY (MWDOC)

We are part of Metropolitan Water District of Southern California (MET) - we appoint 4 of 37 directors to the MET Board

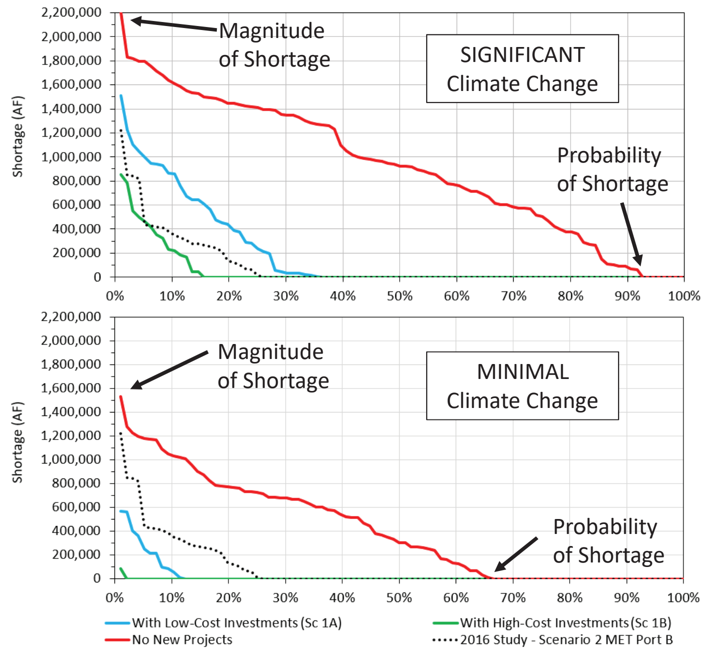





# MET Rate Projections by Planning Scenario (MET Tier 1 Treated Rate + MWDOC RTS/Capacity charge)

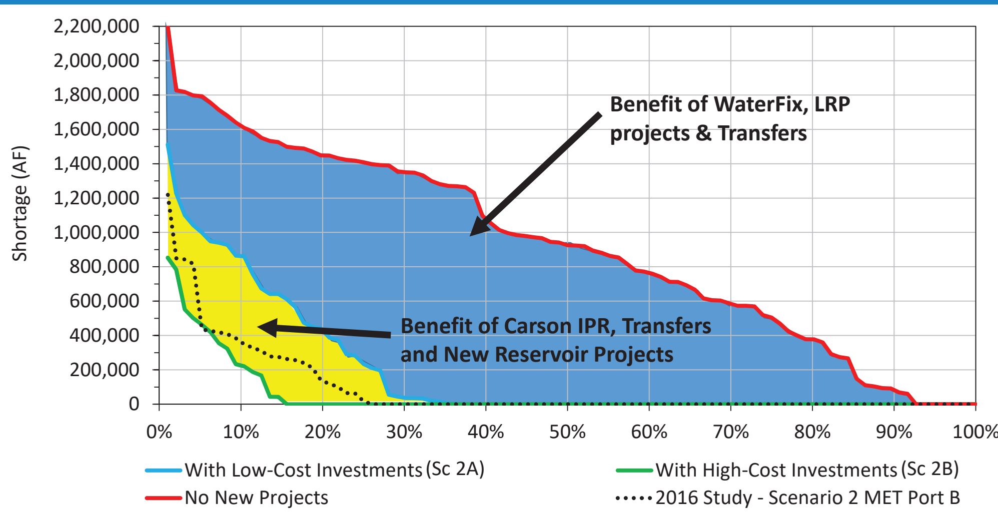


# Comparison of MET Supply Gaps in 2050 Under Different Levels of Climate Change






# MET Supply Gaps
## With Significant Climate Change Impacts in 2050

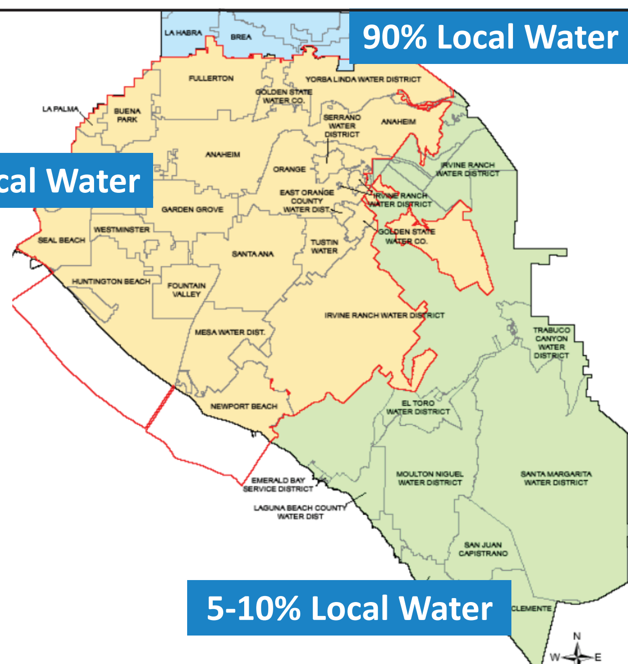


# Orange County (MWDOC)

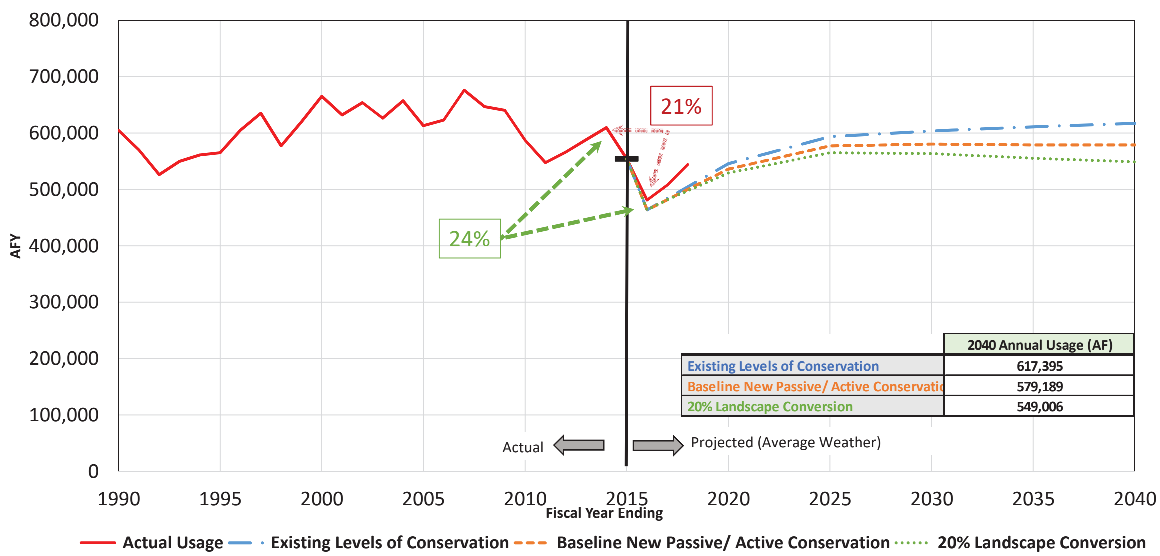


## Three Study Areas in OC

**Reliability evaluations are conducted for three regions within OC because the dependence on local groundwater sources varies considerably**



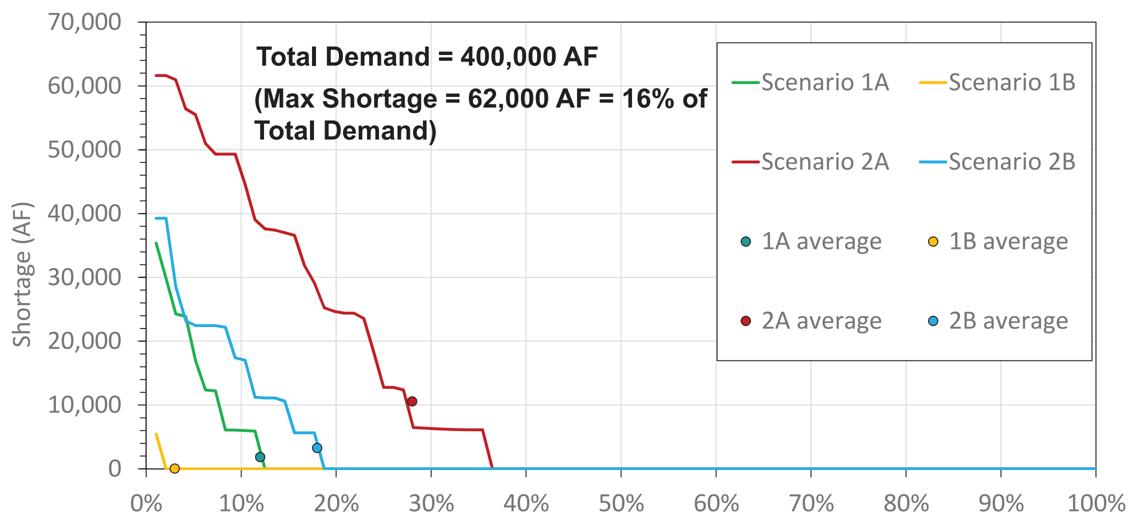
# O.C. Water Demand Forecast




MWDOC



# OC Basin 2050 Reliability Curves Without New OC Investments




MWDOC

# OC Basin - Range of Remaining Gaps after Conservation

| Scenario | 2030 Max GAP AFY | 2040 Max GAP AFY | 2050 Max GAP AFY | Max Gap | Conservation at 10% | Remaining GAP |
|---|---|---|---|---|---|---|
| 1 A) Minimal Climate Impacts with Low-Cost MET Investments | 56,000 | 35,000 | 41,000 | 56,000 | 40,000 | 16,000 |
| 1 B) Minimal Climate Impacts with High-Cost MET Investments | 22,000 | 0 | 5,000 | 22,000 | 40,000 | 0 |
| 2 A) Significant Climate Impacts with Low-Cost MET Investments | 62,000 | 62,000 | 62,000 | 62,000 | 40,000 | 22,000 |
| 2 B) Significant Climate Impacts with High-Cost MET Investments | 56,000 | 28,000 | 39,000 | 56,000 | 40,000 | 16,000 |
| | | | | | Range after conservation | 0 – 22,000 |

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# Potential Local Projects by OCWD NOT included in the modeling

| Potential Local Projects by OCWD NOT included in the Modeling | |
|---|---|
| Project | Amount (afy) |
| CADIZ for OCWD supplies | 5,000 to 10,000 |
| West Orange County Well Field | 3,000 to 6,000 |
| Prado Dam Operations to 505' year round | ≈7,000 |
| Purchasing Upper SAR Watershed Supplies | ? |
| Silting up of Prado Dam (loss of storage) | ? |
| GWRS RO Brine Recovery | 5,000 to 10,000 |
| Purchase Land for Additional Replenishment Basins | ? |
| SARCCUP – dry year yield | 12,000 |
| Chino Basin Water Bank | ? |
| Capture Urban Runoff/Shallow GW for Recycling | ? |

? = Amount not available at this time

MWDOC

# OC Project Summary for Water Supply

(all projects except Cadiz and Strand Ranch assumed to get LRP funding for 15 years at $475)

| Project | Online Date | Yield (AFY) | Startup Year Cost/AF | Year 2030 Cost/AF | Year 2040 Cost/AF | Year 2050 Cost/AF |
|---|---|---|---|---|---|---|
| Cadiz Water Bank – SMWD | 2020 | 5,000 | 1,275 | 1,768 | 2,391 | 3,236 |
| Cadiz Water Bank – Retail | 2020 | 5,000 | 1,651 | 2,165 | 2,822 | 3,710 |
| San Juan Watershed Project[1] | 2022 | 9,480 | 1,521 | 1,812 | 2,762 | 3,258 |
| Doheny Local (SCWD)[1] | 2021 | 5,321 | 1,623 | 1,894 | 2,746 | 3,224 |
| Doheny Regional[1] | 2026 | 10,642 | 1,712 | 1,856 | 2,281 | 3,296 |
| Poseidon SOC[1] | 2023 | 15,964 | 2,132 | 2,373 | 3,131 | 3,485 |
| Poseidon OC Basin[1] | 2023 | 36,676 | 2,197 | 2,431 | 3,178 | 3,519 |
| Strand Ranch Water Bank - Pilot | 2019 | 5,000 | | | | |
| MET Water – 1A | | | | 1,679 | 2,261 | 3,029 |
| MET Water – 1B | | | | 1,925 | 2,551 | 3,373 |
| MET Water – 2A | | | | 1,715 | 2,276 | 3,045 |
| MET Water – 2B | | | | 1,967 | 2,787 | 3,649 |

MET Rate Projections under Scenarios – does not include allocation surcharge

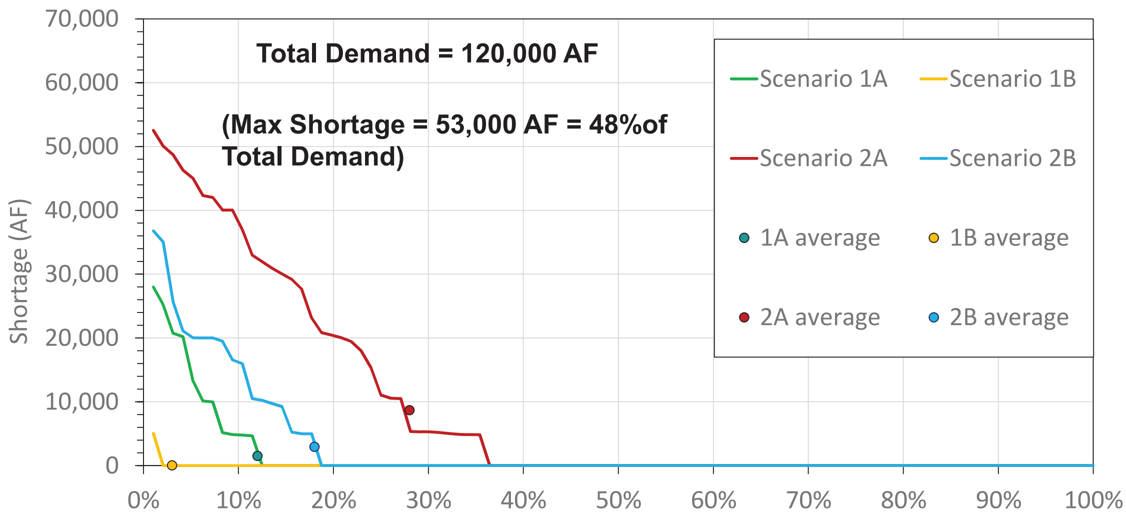
1 – Year LRP funding ends for each project: San Juan Watershed - 2035; Doheny Local - 2036; Doheny Regional - 2041; Poseidon SOC - 2038; Poseidon OC Basin - 2038



# Interpreting GAP Results for OC Basin

1) Peak shortages (max gap) happen rarely (<2% of the time)
2) Given the timing of the WaterFix (operational in 2035) and impacts of significant climate changes (for Scenario 2), the max gap from 2030 to 2050 should be used as a target for new OC projects.
3) Assuming SOC retail demand of 400,000 AFY, peak shortages can be reduced by about 40,000 AFY with targeted drought conservation (or extra-ordinary water transfers) – leaving remaining shortages that range from **0 - 22,000 AFY**, with average shortage of **14,000 AFY** between now and 2050.
4) Remaining shortages can be achieved through purchases of MET water above drought allocation (**but with significant penalty and uncertainty of availability**) or through local water projects and/or improvements in basin management.

## South OC 2050 Reliability Curves Without New OC Investments






## SOC Supply – Range of Remaining Gaps after Conservation

| Scenario | 2030 Max GAP AFY | 2040 Max GAP AFY | 2050 Max GAP AFY | Max Gap | Conservation at 10% | Remaining GAP |
|---|---|---|---|---|---|---|
| 1 A) Minimal Climate Impacts with Low-Cost MET Investments | 27,000 | 24,000 | 28,000 | 28,000 | 12,000 | 16,000 |
| 1 B) Minimal Climate Impacts with High-Cost MET Investments | 22,000 | 0 | 5,000 | 22,000 | 12,000 | 10,000 |
| 2 A) Significant Climate Impacts with Low-Cost MET Investments | 57,000 | 53,000 | 53,000 | 57,000 | 12,000 | 45,000 |
| 2 B) Significant Climate Impacts with High-Cost MET Investments | 56,000 | 26,000 | 37,000 | 56,000 | 12,000 | 44,000 |
| | | | | | Range after conservation | 10,000 – 45,000 |

## Interpreting GAP Results for SOC

1) Peak shortages (max gap) happen rarely (<2% of the time)
2) Given the timing of the WaterFix (operational in 2035) and impacts of significant climate change (for Scenario 2), the max remaining gap from 2030 to 2050 could be used to develop a target for new OC projects.
3) Assuming SOC retail demand of 120,000 AFY, peak shortages can be reduced by about 12,000 AFY with targeted drought conservation (or extra-ordinary water transfers) – leaving remaining shortages that range from 10,000 - 45,000 AFY, with average shortage of 29,000 AFY between now and 2050.
4) Remaining shortages can be achieved through purchases of MET water above drought allocation (*but with significant penalty and uncertainty of availability*) or through local water projects.



## Overview of 2016 OC Reliability Study: FINDINGS
### Assuming Scenario 2, MET Portfolio B

**OC Basin and Brea/La Habra Areas**
Remaining supply needs relatively small, and could be achieved with targeted drought conservation and basin management

**SOC Area**
Remaining supply needs moderate, especially given emergency system needs, and could not be achieved with targeted drought conservation

**SOC Local Project Assessment**
Remaining supply needs could be achieved in cost-effective manner, with various combinations of local projects – **assuming no WaterFix**

**Adaptive Management is key to addressing uncertainties, monitoring key outcomes and reducing risks**

## Agencies Can Take Different Paths to be Reliable

- Decide on the role of Demand Curtailment, at what level and frequency
- Account for integration of base loaded supplies, to minimize shutting down projects in low demand months
- Optional Paths:
  1) Base load supplies for the peak shortages (max gap); concern is over-investing
  2) Base load supplies for the average shortages; concern is under-investing
  3) Demand curtailment and use of extraordinary supplies; concern is not as reliable
  4) Middle ground: combinations of demand curtailment for rare events, extraordinary supplies for less rare but significant shortage events, and base loaded supplies for more dependability



# Potential New OC Local Projects

## OC Project Summary for Water Supply

| Project | Online Date | Yield (AFY) | Supply Project | System Emergency | Extraordinary Supply |
|---|---|---|---|---|---|
| Cadiz Water Bank – SMWD | 2020 | 5,000 | Yes | | |
| Cadiz Water Bank – Retail | 2020 | 5,000 | Yes | | |
| San Juan Watershed Project | 2022 | 9,480 | Yes | Yes | |
| Doheny Local (SCWD) | 2021 | 5,321 | Yes | Yes | |
| Doheny Regional | 2026 | 10,642 | Yes | Yes | |
| Poseidon SOC | 2023 | 15,964 | Yes | Yes | |
| Poseidon OC Basin | 2023 | 36,676 | Yes | Yes | |
| Groundwater Emergency | 2022 | Scalable | | Yes | |
| IRWD SOC Regional Interconnection | Existing/ Expansion | Under Study | | Yes | |
| Strand Ranch Water Bank - Pilot | 2019 | 5,000 | | Some | Yes |
| Santa Ana River Conservation & Conjunctive Use Program (SARCCUP) | 2019 | 36,000 AF of Storage, 12,000 AFY | | | Yes |



# System (Emergency) Needs

# MET Seismic Performance Expectations Estimated Outage Durations

| MET Seismic Performance Expectations Estimated Outage Durations | |
|---|---|
| **Facility** | **Maximum Considered Earthquake** |
| Metropolitan – CRA (Colorado River Aqueduct) | 2-6 months |
| Dept. of Water Resources – SWP (State Water Project East & West Branches) | **6-24+ months** |
| Metropolitan - Conveyance & Distribution Pipelines | 1 week to 3 months |
| Metropolitan - Treatment Plants | 1-2 months (Partial flow) Up to 6 months (Full capacity) |

**60 days without MET**

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| Summary of Emergency Reliability Needs in MGD for SOC for 60 days Assumes NO Emergency Capacity from the SOC Interconnection | | |
|---|---|---|
| | Recovery Needs MGD(1) | Recovery Needs MGD(2) |
| El Toro WD | 0.3 | 1.7 |
| Laguna Beach CWD | --- | --- |
| Moulton Niguel WD | 6.7 | 9.7 |
| San Clemente | 3.5 | 4.5 |
| San Juan Capistrano | 2.7 | 2.0 |
| Santa Margarita WD | 4.1 | 6.2 |
| South Coast WD | 2.6 | 3.3 |
| Trabuco Canyon WD | --- | --- |
| Total | 20.0 | 27.5 |

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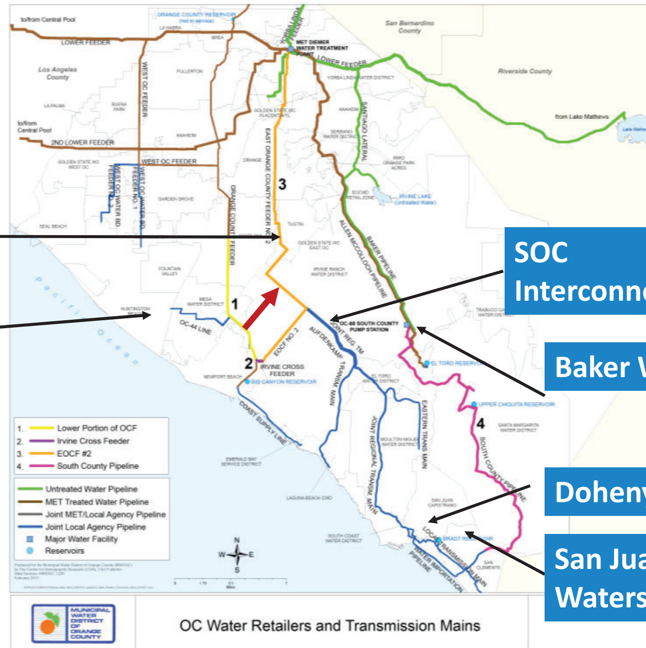
**SOC needs between 20.0 & 27.5 mgd assuming NO capacity is available through the SOC Interconnection**

**A study is underway to examine the ability of the SOC Interconnection to extend or expand deliveries to SOC**

**(1) 75% of annual average "normalized" 2017-18 demand**
**(2) 2040 indoor usage at 55 gpcd + 2040 CII demands**

# System Reliability Projects Being Discussed






# Evaluating the System Reliability of New Local Projects

**Evaluation Metric (EM) – uses Present Value Analysis for the following:**

System Reliability EM =

Avoided annual MET water purchases **MINUS** local project costs (Capital + O&M) over life of project **DIVIDED** by project capacity (MGD).

***Positive numbers are better than negative numbers and smaller negative numbers are better than larger negative numbers.***

# Ranking of SOC Local Projects for System Reliability

| Project | Max Capacity (MGD) | EM [2] 1A | EM 1B | EM 2A | EM 2B | Average EM | Project Ranking [3] |
|---|---|---|---|---|---|---|---|
| Doheny Local (SCWD) | 4.75 | -$5.9 | -$2.8 | -$5.6 | -$1.0 | -$3.8 | **4** |
| Doheny Regional | 9.50 | -$3.0 | **$0.3** | -$2.7 | **$2.3** | -$0.8 | **1** |
| San Juan Watershed Project | 8.50 | -$5.1 | -$2.3 | -$4.9 | -$0.6 | -$3.2 | **3** |
| Poseidon SOC | 14.25 | -$10.3 | -$7.0 | -$10.0 | -$5.0 | -$8.1 | **5** |
| Emergency Groundwater [1] | 9.70 | -$2.3 | -$2.3 | -$2.3 | -$2.4 | -$2.3 | **2** |

1) This project is scalable to fill remaining system reliability need.
2) Represents avoided discounted MET water purchases for different water rate scenarios LESS discounted project costs, DIVIDED by emergency capacity (MGD) = $/MGD. Positive numbers indicate that project is cheaper than purchasing MET water over the life of project. Negative numbers indicate that project is more expensive than purchasing MET water.
3) Ranking is based on average EM between four scenarios, converted to a rank score from 1 (best) to 5 (worst).

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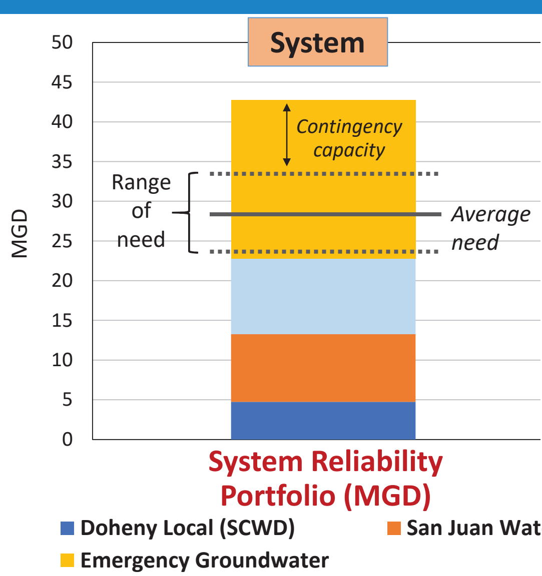
# SOC Portfolio for System Reliability




- **Doheny – SCWD is implemented first, as it is further along in its development path and has secured grant funding and it sets the stage for the Doheny Regional Project**
- **San Juan Watershed Project follows, as it is the next highest ranked project**
- **Doheny – Regional is then implemented**
- **Emergency Groundwater via the EOCF#2 fills in the remaining needs as it is a scalable project**

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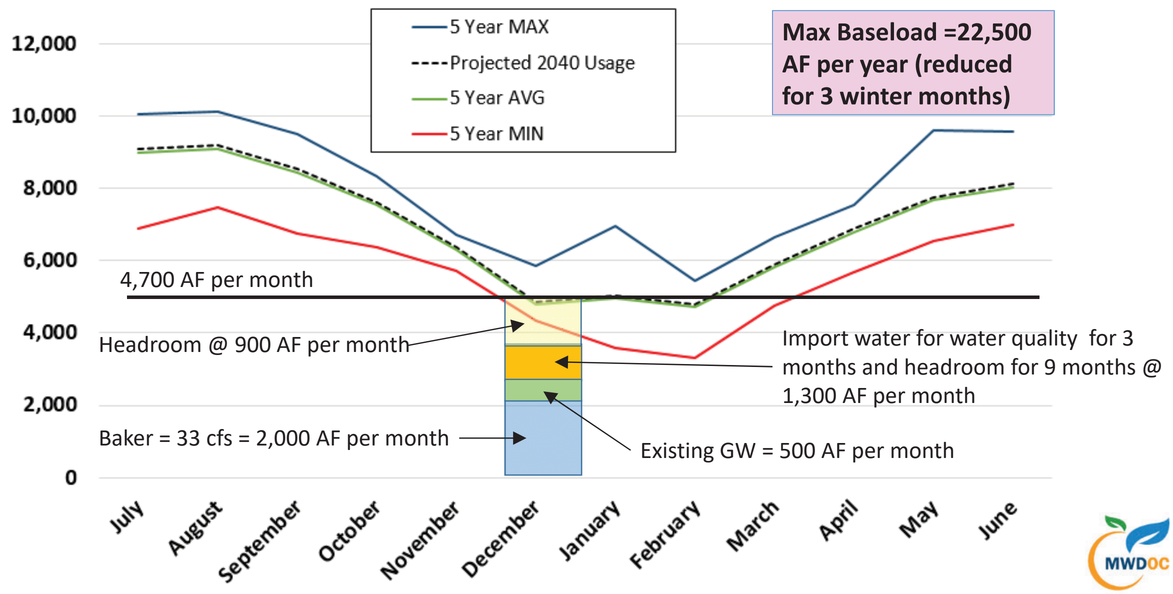
## Project Sizing Based on Base Load Limitations - SOC 2040






# Supply Needs

## Supply Reliability

***Supply Reliability during dry years is needed for long-term economic vitality and quality of life***

**<u>For SOC and OC Basin:</u>**

**Annual total water demand**

**less**

**Existing water supplies and expected MET water supplies during wet, normal and dry hydrologic periods**

**equals**

**Need for New Local Projects, Extraordinary Supplies, Basin Management, and/or Demand Curtailment**

**NOTE: Many Local Water Projects in SOC Provide Both System <u>and</u> Supply Reliability**



## Evaluating Supply Reliability of New Local Projects

- **Evaluation Metric (EM) – uses Present Value Analysis for the following**
- **Uses reliability curves to determine years and amounts of shortages**

Supply Reliability EM =

*When there are **no** expected water shortages*, EM is:

<u>Avoided annual MET water purchases **DIVIDED** by</u>

local project costs (capital and O&M) over life of project;

**BUT** *during water shortages,* EM is:

<u>Avoided annual MET water purchases **PLUS** avoided drought allocation surcharge</u>,

**DIVIDED** by local project costs (capital and O&M) over life of project.

***A ratio near or greater than 1.0 is better than a ratio less than 1.0.***

## OC Projects Supply Economic Ranking:

NPV = Net Present Value
EM = Evaluation Metric

| Project | Scenario 1A | | Scenario 1B | | Scenario 2A | | Scenario 2B | | Average |
|---|---|---|---|---|---|---|---|---|---|
| | NPV | EM | NPV | EM | NPV | EM | NPV | EM | |
| | Rank | | | | | | | | |
| Cadiz Water Transfer – SMWD | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 3 | 1.9 |
| Cadiz Water Transfer – Additional | 6 | 6 | 6 | 5 | 6 | 6 | 6 | 6 | 5.9 |
| San Juan Watershed Project | 5 | 3 | 5 | 3 | 3 | 5 | 3 | 5 | 4.0 |
| Doheny Local (SCWD) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4.0 |
| Doheny Regional | 3 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1.8 |
| Poseidon SOC | 7 | 7 | 7 | 6 | 7 | 7 | 7 | 7 | 6.9 |
| Poseidon OC Basin | 8 | 8 | 8 | 7 | 8 | 8 | 8 | 8 | 7.9 |
| Strand Ranch Water Bank – Pilot | 2 | 5 | 3 | 8 | 5 | 1 | 5 | 1 | 3.8 |



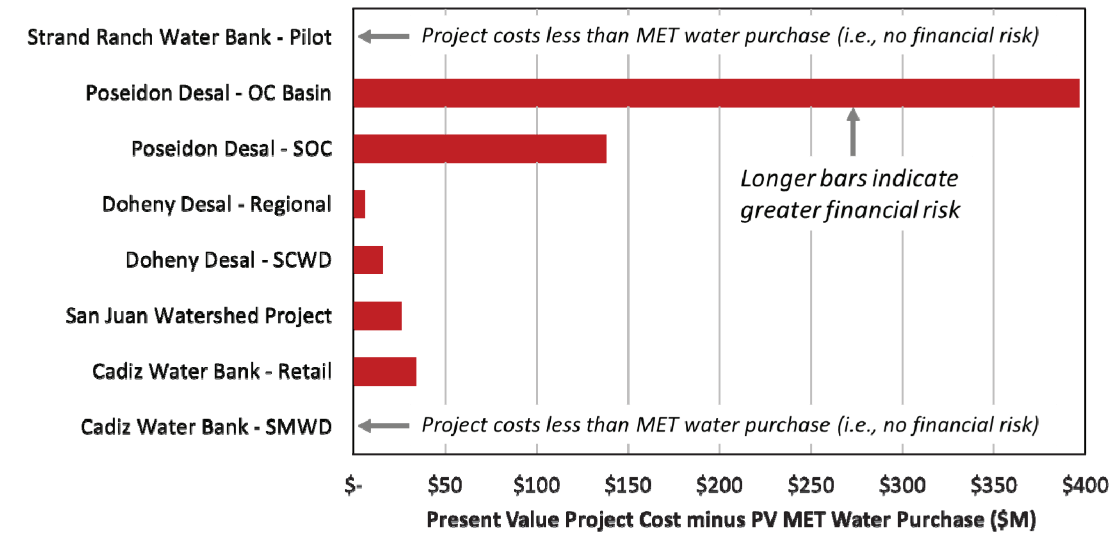
## Limitations in Economic Metrics

**This study included:**

- **Estimates of capital and O&M costs (as representative of project costs) and;**
- **Avoided MET purchases, including penalty charges above allocations (as representative of project benefits).**

**However, While the EM captures a significant portion of costs and benefits, it does not account for other factors that are important when assessing the merits of a local project, such as social/environmental, local control and system integration.**

## Potential Downside Financial Risk for Supplies
### Local investment is made, but supply reliability turns out to be good (Scenario 1B)

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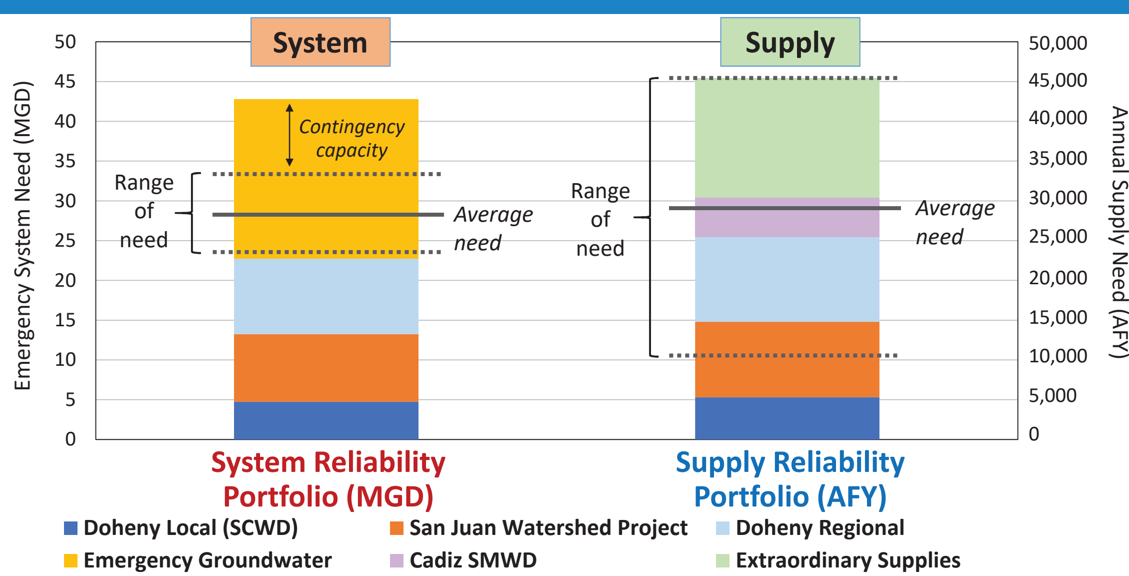
## Recommended SOC Portfolio for System and Supply Reliability

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# Conclusions & Recommendations



## 2018 OC Reliability Study Conclusions & Recommendations

1) Overview –
   - Examination of supplies and demands for MET, MET's member agencies and OC out to the year 2050
   - Four scenarios – Two Climate + Two MET levels of Investment
   - Warmer temps will result in earlier runoff and less captured flows

Critical to monitor and estimate the speed of climate changes to plan for replacement supplies

2) Brea/La Habra –
   - Potential supply shortages identified in the 2016 study were small enough to be managed by enhanced groundwater management or additional conservation.

## Findings & Recommendations – 2018 OC Reliability Study

3) Findings for the OC Basin –

- Need for additional supplies is fairly small
- OCWD has a number of pending projects that would provide sufficient supplies to meet the remaining gaps, or they can utilize demand curtailment at the level of 10% about once every 20 years to close the remaining gaps

Supply Impacts to the OC Basin are small and can be handled by OCWD projects and/or 10% demand curtailment on the order of once in 20 years



## Findings & Recommendations – 2018 OC Reliability Study

MWDOC's Recommendations for the OC Basin –

- OCWD should evaluate all of the available supply options before they move forward with future investments
- Carson Indirect Potable Reuse Project may be the next least costly supply for OCWD. MWDOC & OCWD should work together to fully evaluate this opportunity.
- OCWD is pursuing the Santa Ana River Conservation and Conjunctive Use Project (SARCCUP) to develop extraordinary supplies (drought protection). If supplies are available, OCWD and MWDOC should evaluate their use in other portions of OC.
- The study indicated minimal system (emergency) supply needs for the OC Basin, but recommends that all retail agencies review their needs for backup generators for emergency response throughout Orange County.

## Findings & Recommendations – 2018 OC Reliability Study

4) South Orange County (SOC) Findings -

- SOC is short of emergency supplies today by 20 to 27.5 MGD.
- The emergency need is the major driver of the need for new local projects in SOC. It is suggested that SOC may want to add a contingency amount on top of their emergency needs to build flexibility into the system.
- SOC needs additional supplies to deal with droughts/MET water allocations. This need can be met by way of:
  - SOC investing in additional local projects
  - Changes to MET's WSAP to provide a larger allocation credit for local supply development
  - SOC investing in "extraordinary" supplies, either from the IRWD Strand Ranch, SARCCCUP or from another source
  - MET having a higher reliability

MWDOC



## Findings & Recommendations – 2018 OC Reliability Study

MWDOC Recommendations for South Orange County (SOC) -

- The San Juan Watershed Project & Doheny Project both provide cost-effective annual supplies and emergency supplies
- These two projects should make up the core reliability improvement strategy for SOC, and should be augmented by other projects analyzed in this study.
- Additional study is recommended to determine:
  - Appropriate timing & sizing of the Doheny & San Juan Watershed Projects,
  - Better understanding of system integration issues with water quality and stranding of assets, operational issues during winter months and
  - Operational solutions to enable water to be moved through various pipelines in SOC to deal with emergency situations

MWDOC

# Findings & Recommendations – 2018 OC Reliability Study

5) Findings for MET –

Identified issues that should be discussed and addressed within MET's next IRP Update

- Evaluation of Carson Project
- Use of MET Storage
- Operational issues associated with new projects
- Stranding of MET assets
- Changes to MET's WSAP
- MET emergency storage
- Future MET rate structure & Local Resources Program
- MET Total Dissolved Solids (TDS) & Quagga Control
- Improved Groundwater Basin Management & MET Storage Programs

Goal is to protect over or under investing for the long run and to ensure full reliability

MWDOC

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# Findings & Recommendations – 2018 OC Reliability Study

6) Findings with Respect to MWDOC -

- Advocate for policies beneficial to OC
- Conduct additional work on the Strand Ranch Extraordinary Supply Project
- Work on phasing and integration of Doheny and the San Juan Watershed Projects
- Without Poseidon going to SOC, it would be more expensive to integrate into the OC Basin. Poseidon provides benefits if:
    - MET implements it
    - Climate change is more extreme than modeled
    - OC wants a higher degree of independence from MET
- Work with agencies on emergency generator capacity for use during outages

Assist agencies with meeting the Reliability Goal to Reach 60-days of Supplies Without the Import System

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# Potential New OC Local Projects

MWDOC



## Cadiz Water Bank (SMWD and Retail)

Cadiz Inc., and SMWD long-term groundwater management program in Cadiz and Fenner Valleys

**Benefits:**

An additional water supply source for Southern California.

**Risks:**

- MET has not agreed to commit to any permanent or semi-permanent capacity for Cadiz water in the Colorado River Aqueduct
- The whole project needs to go for SMWD to get supply from the project

MWDOC

# Cadiz Water Bank Terms for SMWD

| For SMWD as Co-Developer: | $2020 | |
|---|---|---|
| Base Allotment (+10,000 AF Option at Retail Rate) | 5,000 | AFY |
| Base (Water Supply) & Operating Costs | $308 | /AF |
| MET Wheeling Rate | $547 | /AF |
| Capital Recovery Charge - Cadiz | $220 | /AF |
| Delivered Cost of Untreated Cadiz Water to Baker | $1,075 | /AF |
| Baker Incremental Treatment Charge | $200 | /AF |
| Cost of Treated Cadiz Water (SMWD Rate) | $1,275 | /AF |

**Assumptions:**

1. Water Supply Cost at $190/AF escalates at 3% for future
2. Water O&M Cost at $118/AF escalates at 2.72% for future
3. Capital Recovery Charge not escalated
4. Treatment for SMWD's 5,000 AFY uses incremental Baker WTP cost of $200, escalated at 3% for future



# Cadiz Water Bank Terms – for others (Retail)

| Cadiz Retail: | $2020 | |
|---|---|---|
| Additional Retail Amount | 5,000 | AFY |
| Base (Water Supply) & Operating Costs | $561 | /AF |
| MET Wheeling Rate | $547 | /AF |
| Capital Recovery Charge - Cadiz | $220 | /AF |
| Delivered Cost of Untreated Cadiz Water to Baker | $1,328 | /AF |
| MET Water Treatment Charge | $323 | /AF |
| Cost of Treated Cadiz Water (SMWD Rate) | $1,651 | /AF |

**Assumptions:**

1. Water Supply Cost at $443/AF escalates at 3% for future
2. Water O&M Cost at $118/AF escalates at 2.72% for future
3. Capital Recovery Charge not escalated
4. Treatment for Retail of 5,000 AFY uses MET treated water rate

# Strand Ranch Pilot Program

Drought protection (insurance) program for **extraordinary supply** water from IRWD Water Bank.

**Term:** 7 years fixed (no "opt out") provision

**Amount:** 5,000 AF

**Charges:** $25 per AF annually ($125,000 per year)
$5,000 One-time Set Up Fee

**Cost to Call Water:**

Actual Cost of Water
Actual Recovery Cost Charges
Fixed Capital Facility Use Fee
MET Exchange Fee



# Strand Ranch Pilot Program

**Benefits:**

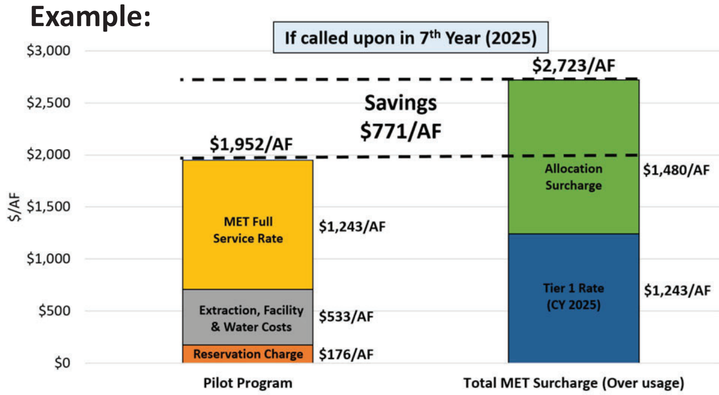
Extraordinary supply priced below MET water with allocation surcharge

- 28% less than the MET surcharge (Savings ≈ $3.85 million on 5,000 AF)
- Cost savings Pilot program vs. MET allocation surcharge ≈ $771/AF.

Risks:

- If option is not exercised then Reservation Charges are forgone ($125,000/Yr. x 7yrs = $880,000)

**Example:**




(1) MET actually has a two-tier surcharge for agencies going over their allocation. The first tier is for agencies exceeding the allocation by up to 15% (which is shown above). Under the MET WSAP, agencies exceeding their allocation by more than 15% incur an even higher surcharge (an additional $1480 is added).

* **Recovery Cost estimate based upon 3% escalation rate**

## Strand Ranch Pilot Program Over 7 Years

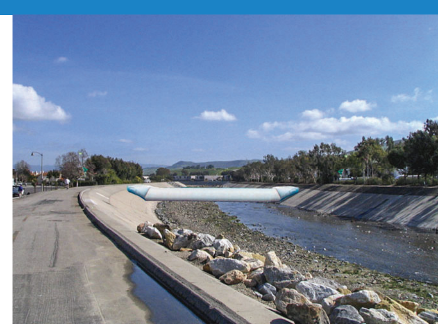
Big question in the original evaluation of the Pilot Program was "will it be needed over 7 years"?

- Used 2030 reliability results for SOC as a proxy for "need" over next 7 years:
  - Even though the "need" is relatively low, if limited to one 5,000 AF call over the 7 years, the project costs look high compared to benefits.
  - The project improves with up to two calls over the 7-year period.
  - This was used in the project evaluation.
- Additional analysis needed for evaluation of the project out to 2035 or 2040



## San Juan Watershed Project

Project proposes to increase capture and storage of urban runoff & stormwater, optimize use of recycled water for reuse, and augment San Juan Basin groundwater supplies



**Phase I:** Capture stormwater & urban runoff - 700 AFY (Avg) potable water

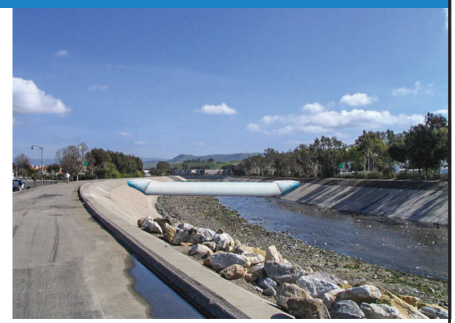
**Benefits:** Provides an additional local water resource and greater utilization of existing assets (CSJC GWRP).

Risks: Production uncertainty due to annual rainfall amounts and future climate hydrology.

| Phase | Startup Year | Capital Cost | Yield (AFY) | Cost/AF in Startup Yr. $ |
|---|---|---|---|---|
| Phase I | 2019 | $23.3 M | 700 | $2,198* |
| Phase II | 2022 | $92.6 M | 6,120 | $1,581 |
| Phase III | 2022 | $32.3 M | 2,660 | $1,200 |
| Total Project | 2022 | $148.5 M | 9,480 | $1,521 |

* Phase I Cost/AF can be considered interim or startup costs

## San Juan Watershed Project



**Phase II:** Introduce recycled water to the creek - 6,120 AFY

**Benefits:** Recycled water is a sustainable & reliable local supply source.

Risks:

- Regulations for IPR and/or DPR are not complete.
- Project costs assume recycled water can be recharged without treatment in excess of tertiary treatment levels.
- Sufficient basin detention time may not be available.
- Rubber dam permits may be difficult.
- Additional recycled water required above current levels may be limited.

**Phase III:** Live stream recharge of recycled water - 2,660 AFY

**Benefits:** Same as Phase II

Risks: Same as Phase II



## Doheny Seawater Desalination – Local by South Coast

SCWD proposed ocean water desalination facility at Doheny Beach (Phase 1)

- Initial capacity up to 5 MGD.
- Potential for future expansions up to 15 MGD.
- Sizing used in analysis:
- 5 mgd at 95% load factor = 4.75 mgd (5,321 AFY) for comparison purposes with Poseidon HB Project


| Doheny Local | Startup Year | Capital Cost | Yield (AFY) | Cost/AF in Startup Yr. $ |
|---|---|---|---|---|
| Phase 1 - 5 MGD | 2021 | $107.2 M | 5,321 | $1,623 |

**Benefits:** A reliable, locally controlled and drought-proof water supply source.

Risks: Slant well technology is a new technology that has been only been tested at a pilot scale at Doheny Beach and Cal Am.

## Doheny Seawater Desalination – Local by South Coast

**Assumptions:**

1. Capital Finance Rate: SCWD 5 MGD Project (2021)
   - Analyzed at 3% Capital Finance rate, over 30 years.
   - $10 M DWR grant,
   - MET LRP Funding ($475/Yr. for 15 Yrs.) included.
   - Note: Lower Cost SRF funding & other grants (BOR) may be available, but were not included in analysis.
2. Energy costs escalated annually at 2.6%
3. Cost/AF includes annual O&M costs calculated (in 2021) to be $491/AF. O&M costs for SCWD 5 MGD Project (2021) were escalated annually at a rate of 2%.
4. Costs include oversizing of some components for future expansions.




## Doheny Seawater Desalination – Regional

Potential expansion(s) of Local Desalination facility up to 15 MGD (at 95% load factor)

- Phase 2 expansion to 9.5 MGD (10,642 AFY)
- Phase 3 expansion to 14.25 MGD (15,963 AFY)


| Doheny Regional | Startup Year | Capital Cost | Yield (AFY) | Cost/AF in Startup Yr. $ |
|---|---|---|---|---|
| Phase 2 - 5 MGD Expansion | 2026 | $74.5 M | 5,321 | $1,712 |
| Phase 3 - 5 MGD Expansion | 2030 | $73.7 M | 5,321 | $1,648 |

**Benefits:** A reliable, locally controlled and drought-proof water supply source.

Risks: Integration issues need to be resolved

## Doheny Seawater Desalination – Regional

**Assumptions:**

1. Capital Finance Rate: SCWD 5 MGD Project (2021)
   - Phases 2 & 3 - Expansions (2026 and 2030) analyzed at 4%, amortized over 30 years.
   - MET LRP Funding ($475/Yr. for 15 Yrs.) included.
2. Energy costs escalated annually at 2.6%
3. Cost/AF includes annual O&M costs for Phases 2 & 3 Expansions (2026 & 2030) escalated annually at a rate of 3% after startup.
4. Phase 2 includes regional interconnections with JTM & WIP pipelines.




## Poseidon Seawater Desalination

Proposed ocean water desalination facility in Huntington Beach
- Capacity 50 MGD (56,000 AFY)

| | Startup Year | Capital Cost (1) | Yield (AFY) | Cost/AF in Startup Yr. $ |
|---|---|---|---|---|
| North OC | 2023 | $1,041.1 M | 36,676 | $2,197 |
| South OC | 2023 | $433.4 M | 15,964 | $2,132 |
| City of HB | 2023 | $0 | 3,360 | 95% of MET Rate |

(1) Capital costs were estimated based on July 2018 OCWD Board Presentation

**Benefits:** A reliable, drought-proof water supply source.

Risks:
- Ability to secure MET LRP Program funding.
- Currently the project is delayed due to required environmental permit renewals and the new State Ocean Plan Amendments.

# Poseidon Seawater Desalination

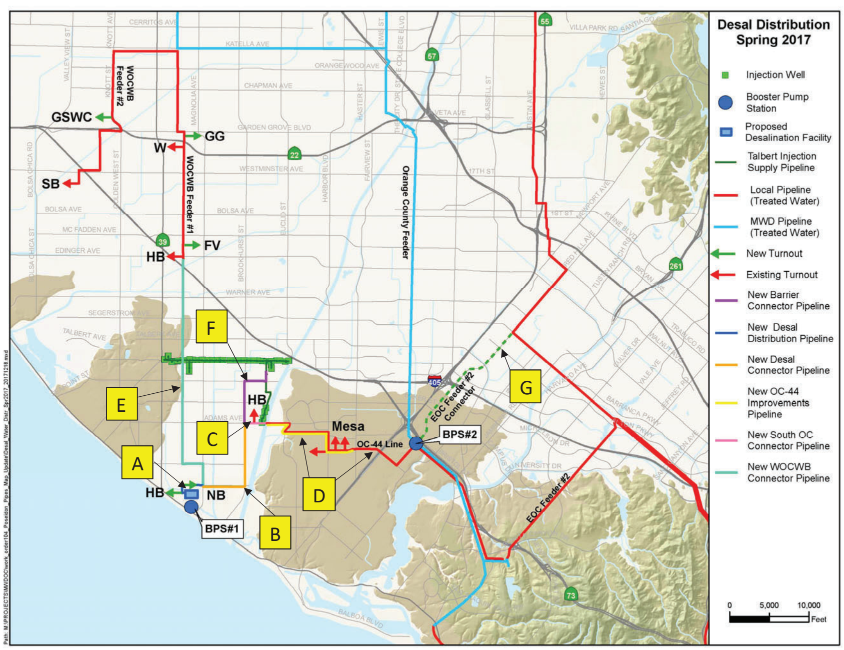
**Assumptions:**

1. MET LRP funding ($475/Yr. for 15 Yrs.) is included.
2. Cost per AF includes annual Plant and Pipeline O&M costs.

| Costs & Escalation Rates | Plant | North OC Pipelines | South OC Pipeline |
|---|---|---|---|
| Capital Finance Rate (over 30 yrs) | 4.86% | 4.0% | 4.0% |
| Energy Costs/AF (in Startup Year 2023) | $376 | | |
| Plant Energy Cost Escalation Rate | 2.5% | | |
| O&M Costs/AF (in Startup Year 2023) Includes energy lift | $545 | $31 | $62 |
| O&M Cost Annual Escalation Rate | 2.0% | 2.6% | 2.6% |



# Poseidon Seawater Desalination Integration Schematic



# Costs Estimated for Integration of Poseidon Water

| Key to Poseidon Integration Schematic | | | | |
|---|---|---|---|---|
| | | 22.05 cfs to SOC & 49.95 cfs to OCWD | | |
| | | Capital Cost in Millions 2023 Dollars | | |
| Segment | Description | Total | Basin Cost | SOC Cost |
| A & B | Hamilton & Brookhurst Pipelines 4,000' of 48" and 14,200' of 48" | $31.8 | $19.7 | $12.1 |
| C | SOC Connector to OC-44 2,300' of 30" or 36" | $2.9 | $1.0 | $1.9 |
| D | Parallel to OC-44 16,000 ' of 14" or 20" | $11.4 | $3.8 | $7.5 |
| D | Buy-In to existing OC-44 Line | $4.1 | $1.3 | $2.7 |
| E | Pipeline to WOCWB Feeders 32,000' of 27" | $49.0 | $49.0 | $0.0 |
| F | Pipeline to Barrier 8,000' of 30" | $122.0 | $122.0 | $0.0 |
| G | EOCF#2 Connector 19,500' of 24" or 30" includes booster pump, flow control facility, chloramination & connection to EOCF#2 | $36.5 | $0.0 | $36.5 |
| Total | | $257.6 | $196.9 | $60.7 |
| Numbers may be affected by rounding; assumes 5.0 cfs goes directly to Huntington Beach | | | | |

MWDOC



# Emergency Groundwater

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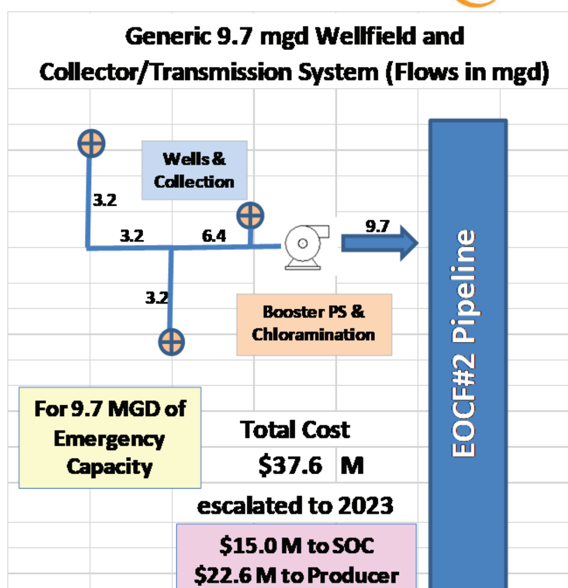
- Conceptual at this time; similar to MET's Conjunctive Use Program
- Wells can be used by Producer's until needed by SOC during emergency
- Cost sharing & other terms to be determined
- Max SOC need = 27 MGD (42 cfs); depends on IRWD System evaluation
- As an example, assumes SOC Pays:
  - 1/3 cost of wells
  - Full cost of booster pump station & connection to pipeline
  - Full cost of replacement water + 5% losses
  - $100 per AF fee to OCWD

**Still evaluating ability of IRWD system to provide supplies**



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# Appendix G

# 2018 Reliability Study Briefing Piece

# 2018

## OC Water Reliability Study

The Municipal Water District of Orange County (MWDOC) has completed the **2018 Orange County Water Reliability Study (Study)** including capturing comments by the members of the water community in Orange County (OC) and incorporating, where appropriate, into the final document.

**What is the purpose of the Study?**

The Study has been developed to present unbiased, factual information to water industry staff and elected officials throughout OC regarding **water supply reliability** (being able to meet demands during all periods of hydrologic variation) and **water system reliability** (being able to meet demands during emergency events such as major earthquakes). The information prepared will aide in the decision-making process about how to approach and manage current and expected water supply issues out to the year 2050.

- ***WATER SUPPLY RELIABILITY:*** *How often are you short water supplies, and how much are your short? (Mandatory reductions may occur)*

- ***WATER SYSTEM RELIABILITY:*** *How reliable is your system? Can demands be met under different emergency situations?*

The Study will also assist MWDOC in its role of advocating on policy issues at Metropolitan Water District of Southern California (MET) regarding regional projects, water rates, MET's Local Resources Program (LRP) funding, MET's Water Supply Allocation Plan (WSAP) issues, MET's groundwater replenishment efforts, and MET's efforts to provide regional emergency storage.

**What are the complexities in evaluating water reliability in OC?**

Estimating our future water supply reliability involves many components, including forecasting future (see Figure 1):

- Water supplies and demands as impacted by climate change using the most recent information and models available.
- Demands on MET, supplies available to MET, development of NEW supplies within MET, use of storage within MET and estimating the availability of imported water to OC along with all of the local supplies available to OC.
- Water rates at MET out to the year 2050 under each of the four planning scenarios described below.
- Water supply availability from both the State Water Project (SWP) with new California WaterFix components, and from the Colorado River Aqueduct (CRA), under the Colorado River Basin treaties and agreements.  For this update, we included the Drought Contingency Plan (DCP) anticipated to be agreed to by Arizona, California, and Nevada as the Lower Basin States. The DCP would dictate how shortages on the CRA are accommodated among the various states. Under the DCP, California has agreed to begin taking shortages sooner than previously agreed to in exchange for being able to access Intentionally Created Storage (ICS) water in Lake Mead during shortage events – a benefit not currently available.


Figure 1. **OC Water Reliability Study Flow Chart**

**What are "scenarios" and what scenarios were used in this study?**

Climate change modeling is not robust enough at this time to be predictive of specific future events. However, this information can be used to forecast plausible potential scenarios that can help us understand the implications for future water supply planning. Four planning scenarios were developed for the Study that reflect two levels of potential climate change impacts (termed Minimal and Significant), coupled with two levels of future MET regional investments (termed Low-Cost and High-Cost). These scenarios enable us to bound what might happen in the future.

The MET service area has been very reliable over time thanks to strategic investments. MET and its member agencies have historically invested in reliability projects, and we believe these investments will continue. The four planning scenarios for the Study, which all include the California WaterFix, are:

- 1A – MINIMAL CLIMATE CHANGE (MINIMAL) with LOW-COST MET INVESTMENTS
- 1B – MINIMAL CLIMATE CHANGE with HIGH-COST MET INVESTMENTS
- 2A – SIGNIFICANT CLIMATE CHANGE (SIGNIFICANT) with LOW-COST MET INVESTMENTS
- 2B – SIGNIFICANT CLIMATE CHANGE with HIGH-COST NEW MET INVESTMENTS

All four scenarios are plausible and the likelihood of one scenario occurring over another are equal. The distinction between Low-Cost and High-Cost MET supplies is not based on a specific threshold cost per acre-foot (AF), however, it is important to note that new supplies are typically more expensive than previously developed supplies. Figure 2 provides a build-up of anticipated supplies within MET over time while Figure 3 provides the associated MET water rates for each scenario out to the year 2050.

**NEW Supplies Included Under the Various Scenarios (1,000's of AF per Year)**

| New Supplies Above MET's Current | Scenario Projections to 2050 | | | |
|---|---|---|---|---|
| | 1A | 1B | 2A | 2B |
| WaterFix (approved by MET Board) | 440 | 440 | 440 | 440 |
| CRA Transfers (base loaded) | 100 | 100 | 100 | 100 |
| LRP (base loaded) | 88 | 88 | 88 | 88 |
| Carson IPR (base loaded) | 0 | 168 | 0 | 168 |
| More LRP (base loaded) | 0 | 0 | 74 | 74 |
| More CRA Transfers (dry year) | 0 | 0 | 80 | 80 |
| SWP Transfers (dry year) | 0 | 150 | 150 | 150 |
| More SWP Transfers (dry year) | 0 | 0 | 0 | 150 |
| Regional Surface Reservoir (dry year) | 0 | 0 | 0 | 400 |
| **Total Base Loaded Supplies** | **628** | **796** | **702** | **870** |
| **Total Dry Year Supplies** | **0** | **150** | **230** | **380** |
| **New Storage** | **0** | **0** | **0** | **400** |
| **Total of Base Loaded and Dry Years** | **628** | **946** | **932** | **1,250** |

**Scenario 1A:**
**Minimal Climate Change**
**Low Cost Investments**

**Scenario 1B:**
**Minimal Climate Change**
**High Cost Investments**

**Scenario 2A:**
**Significant Climate Change**
**Low Cost Investments**

**Scenario 2B:**
**Significant Climate Change**
**High Cost Investments**

Figure 2. **Four Scenarios: NEW MET Supplies Out to 2050 - Combination of Transfers, Local Projects, Carson IPR, WaterFix & Additional 400,000 AF Surface Reservoir (only for Scenario 2B) in AF per Year**

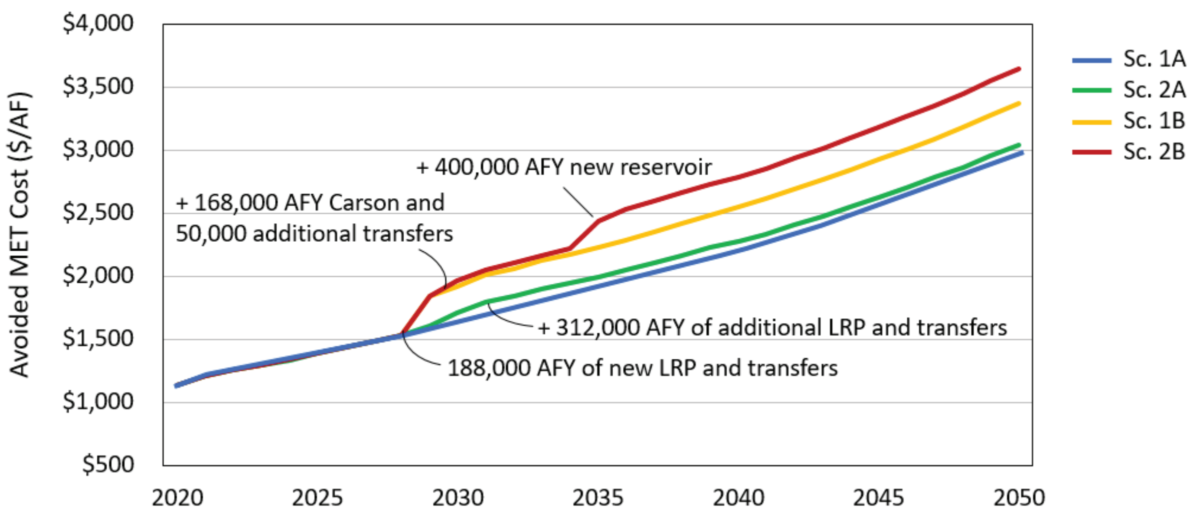


Figure 3. **MET Rate Projections under the Four Scenarios Analyzed ($ per AF in escalated dollars)**

Figure 4 provides a listing of the projects evaluated in the Study and emphasizes the types of benefits provided by each of the projects, i.e., supply, system (emergency), emergency only and extraordinary – a specific type of supply that can only be used when MET is in a water supply allocation. This increases the allocation of water from MET essentially by the amount of extraordinary supply from the project.

## OC Project Summary for Water Supply

| Project | Online Date | Yield (AFY) | Supply Project | System Emergency | Extraordinary Supply |
|---|---|---|---|---|---|
| Cadiz Water Bank – SMWD | 2020 | 5,000 | Yes | | |
| Cadiz Water Bank – Retail | 2020 | 5,000 | Yes | | |
| San Juan Watershed Project | 2022 | 9,480 | Yes | Yes | |
| Doheny Local (SCWD) | 2021 | 5,321 | Yes | Yes | |
| Doheny Regional | 2026 | 10,642 | Yes | Yes | |
| Poseidon SOC | 2023 | 15,964 | Yes | Yes | |
| Poseidon OC Basin | 2023 | 36,164 | Yes | Yes | |
| Groundwater Emergency | 2022 | Scalable | | Yes | |
| IRWD SOC Regional Interconnection | Existing/ Expansion | Under Study | | Yes | |
| Strand Ranch Water Bank - Pilot | 2019 | 5,000 | | Some | Yes |
| Santa Ana River Conservation & Conjunctive Use Program (SARCCUP) | 2019 | 36,000 AF of Storage, 12,000 AFY | | | Yes |

Figure 4. **Summary of Projects Evaluated in the Study and Type of Benefit Provided by Each**

**What were the findings from the Study?**

The 2018 OC Study has been very beneficial in examining water demands and supplies among MET, MET's member agencies and OC out to the year 2050 under four planning scenarios (representing two levels of climate change impacts and two levels of MET supply investments). The Study also provides insights with respect to upcoming issues at MET, including the update of its 2020 Integrated Resources Plan (IRP), which will help MWDOC advocate for issues beneficial to OC and Southern California. The Study has bounded what might occur in the future, and examined how demands will be met over time under these disparate but reasonable scenarios. Finally, the Study has evaluated and compared a number of new OC local water projects in terms of reliability benefits and cost-effectiveness.

**MWDOC's findings and recommendations with respect to the OC Basin:**

- Because the Study indicated only a small supply reliability gap for the OC Basin, Orange County Water District (OCWD) should evaluate all of the available supply options before they move forward with future investments.
- The Carson In-Direct Potable Reuse (IPR) project by MET may be the next least-cost supply available to the OC Basin, pending the final terms and conditions. MWDOC and OCWD should work together to fully evaluate the opportunities this project provides to the OC Basin.
- OCWD is pursuing the Santa Ana River Conservation and Conjunction Use Program (SARCCUP), which could provide significant benefits in the form of extraordinary supplies (drought protection)

for the OC Basin. If not fully needed by the OC Basin, the utilization of the supplies by others in OC should be evaluated. MWDOC and OCWD should work together on this effort.

- The Study indicated minimal system (emergency) supply needs for the OC Basin, but recommends that all retail agencies review their needs for backup generators for emergency response throughout OC.

**MWDOC's findings and recommendations with respect to South Orange County:**

- The Study noted that South Orange County (SOC) is short of emergency supplies today by 20 to 27.5 MGD (which can be met through a combination of local projects and emergency projects such as the Irvine Ranch Water District (IRWD) SOC Emergency Interconnection and the pump-in to the EOCF#2). The emergency need is the major driver of the need for new local projects in SOC.
- The Study analysis indicates that the San Juan Watershed Project and the Doheny Project both provide cost-effective annual supplies and emergency supplies as shown in the **Figure 5** below. These two projects should make up the core reliability improvement strategy for SOC, and should be augmented by other projects evaluated in this study, such as the emergency use of groundwater for system outages, Cadiz water banking and extraordinary supplies. **Figure 6** below demonstrates how SOC can meet both its system and supply reliability needs.
- Additional study is recommended to determine the appropriate timing and sizing of phases of the Doheny and San Juan Watershed Projects, to better understand system integration issues with water quality and stranding of assets, operational issues during winter months and operational issues to enable water to be moved through various pipelines in SOC to deal with emergency situations.

| Combined Benefits of the Doheny and San Juan Watershed Projects | | |
|---|---|---|
| Project | SYSTEM Peak Supply in MGD | SUPPLY Maximum Supply in AFY |
| Doheny Full Size | 14.25 | 15,963 |
| San Juan Watershed | 8.50 | 9,480 |
| Total | 22.75 | 25,443 |

**Figure 5. Combined Benefits of the Doheny and San Juan Watershed Projects**

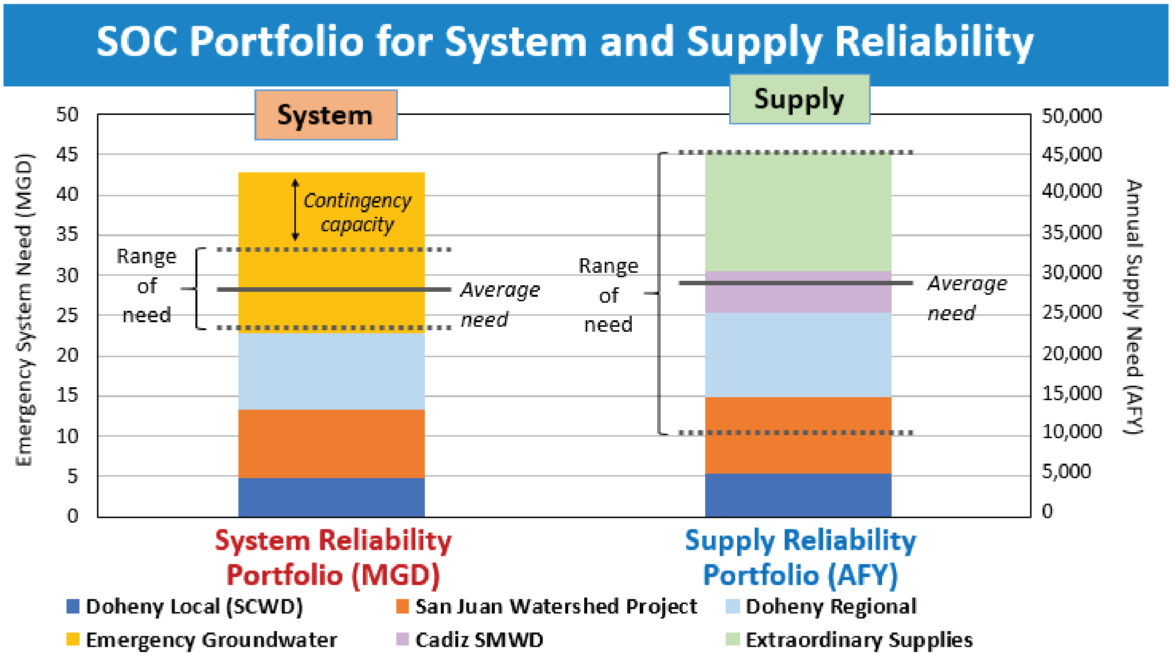


Figure 6. **Portfolio Recommendation for SOC**

**<u>MWDOC's findings and recommendations with respect to MET:</u>**

The Study, along with other recent discussions, has identified issues that should be discussed and addressed within MET's next IRP update, which is scheduled to be completed in 2020. These include:

- Evaluation of the Carson IPR
- Use of MET storage for meeting dry year needs
- Operational issues associated with new projects
- Stranding of MET assets
- Changes to MET's WSAP
- MET development of additional emergency storage
- Future MET LRP and rate structure
- MET water quality - Total Dissolved Solids (TDS) and Quagga mussel control
- Improved groundwater basin management & MET storage programs
- MET's 2020 IRP Update

**<u>Findings and recommendations with respect to MWDOC:</u>**

A number of findings were made in the Study regarding MWDOC. These include:

- Additional study is recommended to determine the appropriate timing and sizing of phases of the Doheny and San Juan Watershed Projects.
- The Strand Ranch drought protection program was evaluated as a seven-year pilot program in the study. Further work should proceed to develop terms and conditions for a potentially expanded

program with Strand Ranch or other extraordinary supply programs (e.g., SARCCUP) to develop additional drought protection until the completion of the California WaterFix.

- Advocate for policies at MET that are beneficial to OC and Southern California as we move forward at MET on reviewing the LRP, WSAP, Emergency Storage and 2020 IRP.
- Given that the Poseidon SOC project was evaluated as being less cost-effective among other SOC options evaluated in this study, a full 56,000 AFY Poseidon project for the OC Basin would incur greater system integration costs than were included in the study. This would result in a lower cost effectiveness for implementation within the OC Basin than was presented in the Study. Given the scenarios examined, the Poseidon project is a more costly option for augmenting supplies to the OC Basin than purchasing MET water or Carson water (including purchases with the allocation surcharge). The Poseidon project, however, would provide benefits under the following conditions:
    - MET implements Poseidon as a regional project.
    - Climate change is even more extreme than the most intense climate change scenario in the Study (low probability) resulting in low reliability from MET, and OC decides to implement the project.
    - OC decides that we want a higher degree of independence from MET and that the Poseidon project should be implemented regardless of cost (if this is the position taken, consideration must be given to stranding of MET assets).
- While the 2016 and 2018 study results indicated minimal emergency supply needs for the OC Basin and Brea/La Habra areas, MWDOC recommends that all retail agencies review their needs for backup generators for emergency response throughout OC and include refueling plans coordinated through Water Emergency Response Organization of Orange County (WEROC).

For more information, go to www.mwdoc.com.

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# Appendix H

# Comments on the Draft Study Presentations and Draft Documentation

**Item No. 3**

**COMMITTEE DISCUSSION ITEM**
November 13, 2018

**TO:** **Planning & Operations Committee**
(Directors Osborne, Tamaribuchi, Yoo Schneider)

**FROM:** **Robert Hunter, General Manager**

Staff Contact: Karl Seckel

**SUBJECT:** **2018 Orange County Water Reliability Study**

## STAFF RECOMMENDATION

Staff recommends the Planning & Operations Committee receive discuss and file this report. Staff also recommends that the 2018 Reliability Study be one of the topics for the next month's Elected Officials Forum.

## COMMITTEE RECOMMENDATION

Committee recommends (To be determined at Committee Meeting)

## SUMMARY

The following is a chronology of information provided and presentations given regarding the 2018 Orange County Water Reliability Study:

- September 15, MWDOC sent out an 81-page informational "Background Report" prior to the first workshop with our Member Agencies. The purpose of the background report was to provide advance information for the September 20 Workshop.

- September 20, MWDOC held a 3 ½ hour Workshop, with 26 attendees representing 20 of our Member Agencies, and included a 120-slide PowerPoint presentation on the Reliability Study. The presentation included a full description of the work

| | | | |
|---|---|---|---|
| **Budgeted (Y/N):** | Budgeted amount: | Core ✓ | Choice __ |
| **Action item amount:** | Line item: | | |
| **Fiscal Impact (explain if unbudgeted):** | | | |

completed including the approach, methodology, project evaluations, and findings. The presentation was called a “Quality Control Draft” with the purpose of providing draft study analyses and findings to our Member Agencies, in order to receive their comments and input, and to ground truth the concepts and evaluations of the draft report. Updates, corrections, and input will be incorporated into the final report.

- September 29, MWDOC sent out corrections for the Cadiz Project analysis based on an updated term sheet. MWDOC staff worked directly with Cadiz staff to produce the analysis for Santa Margarita Water District (SMWD) as a project participant and sponsor (lower cost water), and for potential retail partners that may contract for water from Cadiz (higher cost water).
- October 1, a full discussion and presentation of the draft report was held with MWDOC’s Planning & Operations Committee.
- October 5, a full discussion and presentation of the draft report was made to the Water Advisory Committee of Orange County (WACO) group.
- October 9, a short presentation and discussion was held with the Orange County Business Council (OCBC) Infrastructure Committee.
- October 19, a full discussion and presentation was held with the SMWD Board.
- October 24, a shortened presentation was held at the MWDOC/OCWD Joint Planning Committee.
- October 25, a discussion on the Reliability Study was held at the MWDOC Member Agency Managers meeting focusing on comments received to date and on next steps. Member Agencies reached agreement that additional meetings on the topic were not needed, aside from individual agency follow-up upon request.
- October 25, a short follow-up presentation was made to the South Coast Water District (SCWD) Board, as the entire Board and legal counsel had attended the October 5 WACO meeting.
- November 1, a discussion and presentation was made to the South Orange County Integrated Regional Water Management (IRWM) Executive Committee.
- November 5, a follow-up meeting was held with the SMWD General Manager and Board members Olson and Gibson to discuss the contents and implications of the Reliability Study.
- In addition, MWDOC received and responded to two requests for additional information from Poseidon Resources Corporation. During this process, the need for minor adjustments in the cost-analysis for the Poseidon Project were discovered. The adjustments did not significantly change the project evaluations, rankings, or findings.
- MWDOC staff met with OCWD staff regarding examination of additional options for moving Poseidon water to South Orange County. The need for this work by OCWD was based on recent meetings they held with the South Orange County agencies,

where the agencies requested more information regarding the cost for conveying smaller amounts of capacity for Poseidon water to South Orange County.

**Meeting Comments**

MWDOC staff compiled a summary of the comments collected at all of the above meetings from either direct discussions or from written questions submitted by the agencies during or after the meetings. A summary of the comments and responses were shared with the MWDOC Member Agencies at the October 25 MWDOC Member Agency Managers meeting. The summary is attached and includes yellow highlighted sections that are the main areas for follow-up with respect to questions that have been raised. Staff will cross-check these with the final report as well as with additional analyses based on implications from the study.

The preliminary assessment of these questions and comments has identified a number of issues and implications:

1. Evaluation of the Regional Recycled Water Program (Carson Project) – Is it a beneficial project? Who pays and who receives the benefits? Is it good for Orange County? Is it good for Metropolitan at $1,600 per AF? What does South Orange County pay, and what benefits do they receive? Should there be any specific performance terms for agencies receiving the water during allocation situations?

2. Use of Metropolitan storage – What does it look like in our modeling? Does Metropolitan need more put and take capacity? What is the split between the State Water Project (SWP) and Colorado River Aqueduct (CRA) side of Metropolitan and how do these work independently when either the SWP or the CRA are constrained in any particular year and have low flows?

3. New 400,000 AF reservoir – Further quantification required of the need, operation and benefits of the conceptual project.

4. Changes to Metropolitan's Water Supply Allocation Plan (WSAP) – The Reliability Study identified areas of conflict between local supply development and improvements or benefits under a Metropolitan allocation. Can the WSAP be improved to allow agencies to significantly improve their drought protection? Extraordinary supplies seem to be the holy grail of drought protection. How can these opportunities be opened up for agencies that want to make such investments? Should Metropolitan offer drought protection for a price? Should local projects get more of a credit under the WSAP? Do we want to remain under a "share the pain" allocation system, or is it time to go down another path?

5. Metropolitan Emergency Storage – What level of storage should Metropolitan be providing for emergency situations including for concurrent outages of the CRA, SWP, and Los Angeles Aqueduct?

6. Operational issues associated with new projects – These include a large gamut of concerns, from operational issues associated with adding new projects within Metropolitan and Orange County. Such as, issues with water moving different directions within the systems, getting approval from Metropolitan for introducing local sources into the Metropolitan system, long residence times during low demands or during periods of certain operations, chloramine residual decay, and water quality

issues from blending various sources of water. Issues can also include the stranding of assets (Metropolitan and local) and the base-loaded integration during low demand winter months. MWDOC is looking at hydraulic and water quality modeling to help provide insight on some of these issues.

7. Stranding of Metropolitan assets – How much "rolling-off" of Metropolitan supply is anticipated? How to incorporate this into planning? What are the operational and financial implications?

8. Future Metropolitan rate structure – What changes are needed or what changes can be anticipated?

9. Metropolitan long term Total Dissolved Solids (TDS) issues

    a. How are TDS control issues working on the CRA? Can additional measures be implemented?

    b. Feasibility of lowering the TDS via reverse osmosis of a portion of CRA flows? Is this the most cost effective way of managing TDS for the groundwater basins and recycling? What are the hidden costs of TDS on plumbing and other?

    c. TDS for groundwater basins with respect to replenishment water?

    d. Quagga control with respect to replenishment water?

10. Improved Groundwater Basin Management & Metropolitan Programs – How to provide better drought and emergency protection by conjunctive use or other Metropolitan programs. Historically, there have been problems with developing effective Metropolitan groundwater programs. The recent drought allocations and groundwater basins at low storage levels are situations that should be discouraged in the future. How can we help to make progress on this? Should we convene a working group of the groundwater basin managers?

11. Metropolitan's 2020 Integrated Water Resources Plan (IRP) Update – initial thoughts for the process include:

    a. Use of scenario planning to address climate issues.

    b. More clarity/specificity on what the plan is moving forward. What opportunities are there for Metropolitan and/or local investments, as well as deciding how these opportunities should be worked out.

    c. Looking at the issue of Metropolitan Member Agencies "rolling-off" the system or decreasing their dependence on Metropolitan (how can we develop an overall "low cost plan for Southern California" by working together). Of note, this was part of the origin for Metropolitan's first IRP.

    d. More definitive forecast of Local Resources projects to be included.

    e. More clarity between Water Use Efficiency investments and benefits, with evaluation separate from recycling and local projects (i.e., not grouped together).

f. More definitive evaluation of benefits that could accrue from improved groundwater management issues within Metropolitan.

g. Resolution of the Los Angeles Aqueduct as a “local project” that should stand on its own and not be included with other local projects.

h. Targeting projects to provide specific reliability benefits in certain areas of MET.

**Comment Letters**

Comment letters have been received to date from the following entities:

- East Orange County Water District (EOCWD)
- Irvine Ranch Water District (IRWD)
- Mesa Water District (Mesa Water)
- Moulton Nigel Water District (MNWD)
- Orange County Coastkeeper (OC Coastkeeper)
- Orange County Taxpayers Association (OC Taxpayers)
- Orange County Water District (OCWD) (two separate letters)
- South Coast Water District (SCWD)

The comment letters have been forwarded to the MWDOC Board of Directors and are attached.

In general, the letters included comments of appreciation for undertaking the 2018 Reliability Study, commendation for the detailed and technical analysis, and an appraisal that the study was valuable to the Member Agencies and the public in making informed decisions.

Specific comments covered a wide range of topics. In some cases, contrary comments were received on the same topic. The major themes from the comment letters and MWDOC’s staff response include:

1. Limitations of Planning and Forecast Methods

   A number of comments were related to the ability of planning studies to precisely, accurately, or reasonably produce reliable estimates of future conditions, which are then utilized to evaluate future supply needs and potential projects. Specific concerns ranged from climate change to cost estimates for projects in different stages of planning or delivery methods. There are generally recognized limitations to planning studies and there are also well developed techniques to address these limitations.

   For example, the 2018 Reliability Study utilized four scenarios to define reasonable boundaries for climate change and regional investments in water supply projects. The study projects were analyzed under all four scenarios to establish a range of probably results. Projects in different phases of development need to be evaluated and compared. Cost estimating procedures generally call for an increase in cost estimates (e.g., allowances or contingencies) for more conceptual projects. MWDOC has particularly focused on making the project cost estimates as comparable as possible. The estimates can never be 100% accurate. However, they are reasonable and useable for the purposes of the Reliability Study. Orange County needs to make decisions on water supply projects. It is not a viable argument that we should not evaluate and compare projects because we cannot precisely predict conditions in 2050. We make decisions in the present based on the best information and analyses available.

2. Concerns over Study Use and Decision Preemption

   A concern was raised that the study could potentially be used by opponents of certain projects in an attempt to convince regional permitting agencies to deny a permit or financial support for a project with an unfavorable ranking. That is certainly a possibility. MWDOC has received comments from parties in the past that our reports or letters were being used by groups to misrepresent our conclusion or statement. This has occurred simultaneously on opposite sides of the same issue. If the concern is future misrepresentation, MWDOC cannot prevent the misrepresentation, but we certainly can correct it. However, MWDOC cannot tailor our study findings or conclusions to arbitrarily support or oppose any project. A goal of this study was to perform an independent, unbiased evaluation. It is crucial that we maintain that goal and result.

   A second concern, was that MWDOC was preempting project decisions by our Member Agencies by the inclusion of project rankings. To the contrary, we have emphasized repeatedly within the draft report, that is not the intention of the 2018 Reliability Study. In fact, part of the draft report addresses conditions under which some lower ranking projects might be implemented. The evaluation and ranking of projects was included in the first presentation of the 2018 Reliability Study project scope to the MWDOC Board in February 2017 and has been a consistent element of the study design and discussion. We received suggestions to both eliminate the rankings from the final report and that they are an essential element of the report. MWDOC is providing information and analysis. The decision to implement a project is left up to the Member Agency.

3. Member Agency Participation

   A number of comment letters noted that the Member Agency participation in the 2018 study was notably less than in the 2016 study. This is true, as the 2016 and 2018 studies are fundamentally different. In 2016, we were developing methodologies and tools which were then applied to one scenario (moderate climate change with no WaterFix) and theoretical portfolios of projects were assembled to demonstrate different ways to reach water reliability. Numerous workshops were held with the MWDOC Member Agencies to discuss and evaluate the assumptions used by the reliability model.

   Coming out of the 2016 study, we had gained significant insight and developed the methods and tools for reliability analysis and scenario planning. Two major comments we received on the 2016 study were that it was (a) too restrictive in terms of planning scenarios in that only one scenario was carried forward for final analysis, and (b) its usefulness for decision making was limited in that specific projects could not be objectively compared. The 2018 study was designed to address these issues.

   The tools developed in 2016 were applied to four scenarios that were designed to bookend likely conditions of climate change and regional project investment. All four scenarios included the WaterFix becoming operational in 2035. Additionally, specific projects were then objectively evaluated to meet Orange County's water supply and system (emergency) reliability needs. MWDOC worked closely with Member Agencies and project proponents to verify assumptions, project yield, and financial information for the projects. The emphasis of this consultative effort was to make sure the information and analysis were correct.

4. Future Water Demand Levels

   There were several comments regarding MWDOC's assumptions about future demand levels. Some parties felt that we have overestimated future water demands and had not included enough analysis of more rigorous demand management programs. These topics were the focus of extensive discussion in the 2016 study, and were not appreciably changed for the 2018 study, except where there were climate change impacts. Current Orange County water demands are actually larger than those predicted, but within the expected range of weather-related variables. Additionally, three different levels of water use efficiency efforts were included in the 2016 study. While outside the scope of the 2018 study, the evaluation of additional demand management options will be considered for future work.

   There was also a question relating to the potential impacts from plans by the San Diego County Water Authority (SDCWA) and the Los Angeles Department of Water and Power (LADWP) to significant reduce the volume of water purchased from Metropolitan. The implication being that reduced water use by the SDCWA and LADWP would increase potential supplies for others. While this question was not specifically examined in the 2018 Reliability Study, by evaluating significantly different demand reductions as a variable (e.g., LADWP reducing demand by 15%, 30%, and 45%), this question is partially included in the Metropolitan regional demand projections.

5. Suggested Changes in Project Scope

   MWDOC received comments that we should both increase and reduce the scope and considerations of the 2018 Reliability Study. Scope expansions included the addition of additional projects, possible Metropolitan rate models or schedules, water quality impacts in the distribution systems from new supply projects, as well as Orange County groundwater basin management and projects. We also received comments that MWDOC should take a completely Orange County-focused approach and disregard impacts to Metropolitan water quality and the stranding of Metropolitan assets by new Orange County water supply projects. While we are evaluating if some of the additional project issues can be addressed in the final report, most of that work will need to be addressed in future efforts. The potential impacts on future project financial analyses, by significant changes in the structure of Metropolitan rates (i.e., shift from variable to fixed rate model) would be largely based on conjecture and well outside the scope of the current study. However, a great deal of attention was focused in the 2018 Reliability Study on the regional water supply investments by Metropolitan on their rates.

   The management of the Orange County groundwater basin is not the function or responsibility of MWDOC. We are appreciative of the cooperation and contribution OCWD has made to both the 2016 and 2018 Reliability Studies, and concur that the evaluation of groundwater basin management and specific groundwater projects should remain within their sphere of responsibility and not ours. We have identified a number of projects which can meet the future supply needs within the Orange County basin area in the draft report and recommend that they be evaluated. We will participate with OCWD to the degree they desire.

6. Content of Final Project Report

   MWDOC received a number of suggestions and observations relative to the final study report. It was emphasized that the report will be used by a diverse audience including water professionals, elected officials and the general public. Therefore, the final report must present information that is accessible to the entire audience. We also had requests that MWDOC more explicitly include the baseline assumptions of the study and include detailed project financial information and analyses to facilitate independent evaluation. We are currently evaluating ways to meet these requests for both simpler and more complex information.

**Next Steps**

The next steps include the following:

1. Complete the Final Report for discussion with the MWDOC Board. Staff believes they can have a Final report ready for the December 19 Board meeting (note, staff **does not** believe the report will be available for the December 3 Planning & Operation Committee meeting.
2. Complete additional analysis on the Strand Ranch Integrated Water Banking Program using the results of the study and bring back a proposal for consideration by the MWDOC Board and Member Agencies.
3. Staff to work through the list of 2018 Reliability Study implications to share with the MWDOC Board and Member Agencies. This will be targeted for the December 3 Planning & Operations Committee for discussion purposes.
4. Complete additional work on systems integration for local water in South Orange County. This includes work related to operations and water quality issues as identified in the August 2018 Local Project Integration Workshop. An item is included in this month's Planning & Operations Committee meeting on the issues identified during the Workshop. This also includes work associated with securing/developing a working hydraulic model, hopefully from Metropolitan, that can be used to evaluate various operational scenarios regarding the residence time of water delivery in Orange County as well as other water quality parameters.
5. Complete the study/evaluation of the IRWD South Orange County Interconnection delivery capacity over time, for review by South Orange County agencies, and to assist the agencies in the decision-making process regarding emergency supply projects.

**Attachments: (1) Summary of meeting comments and responses**

**(2) Comment letters received**

**To:** MWDOC Member Agencies

**From:** Karl Seckel

**Date:** October 25, 2018

**DRAFT Comments and Responses to Comments on the OC Water Reliability Study**

Attached for review and comments by the agencies is a compilation of all the comments received to date on the Reliability Study, going back to the original workshop with the agencies. I also summarized at the beginning of the comments what I thought were the major issues raised with the study. And lastly, I highlighted in yellow where I thought we had additional follow-up to do or issues to incorporate into the final report.

Please take a look to see if your issues or other issues raised were summarized properly and if you believe the responses are appropriate or if additional clarification is needed.

Some had indicated the need for additional meetings. This issue is to be discussed at today's Manager's Meeting at the MWDOC offices.

Thanks for your help.

**I need comments back by November 2 to get them into our next P&O Packet.**

# Reliability Study Comments and Responses from Various Workshops and Presentations though October 23, 2018

## Summary and Overview of Comments to Date

An overall summary of comments is as follows:

- Some are still in the mode of trying to understand the implications of the study. It should be noted that MWDOC staff is also in this mode and is examining the information developed from the study to better influence issues arising at MET that staff believes might include:
  - MET's 2020 IRP
  - Review of the LRP program at MET
  - Review of the WSAP program at MET and more specifically how local projects are counted during water shortages and how additional "extraordinary supplies" might be developed for increased drought protection
  - MET's discussion of emergency storage levels in the event of a concurrent outage of the import systems
  - Stranding of assets (local or at MET) including accommodating projects within the low demand months
  - Rolling off of MET for water supplies by the MET member agencies
    - This seemed to be a particular hot topic to better understand the distinction of where future supplies will come from (MET investments, local investments or some combination – but understand those in such a way to prevent over or under investing in future reliability).
  - MET's future rate structure and how MET will charge for water over the long run
  - Other issues
- Water quality issues seem to be of interest, including operational issues associated with integrating local projects (joint operation of the MET and Local systems) and improving the TDS of supplies used for water recycling.
- See other items highlighted in yellow in this document.

The detailed comments recorded are grouped by topical area, if applicable, and provided below, typically with responses.

### 1. Questions on the OC Water Demand Forecast

- There are many factors that can change our demands out to the year 2050. This is just an observation and a cautionary note.
  - Agreed. It should be noted that we need to make our decisions in the present using the best information we have, and do not let uncertainty bar planning, otherwise we might not make any progress.

- Does this study this fully take into account the new conservation legislation?
    - It does to a certain degree. We have not specifically modeled the compliance demands under the new state legislation, but anecdotally we believe that the demands projected herein will meet the initial standards of 55 gpcd indoor usage plus outdoor usage at an ETAF of O.70 (Evapotranspiration Adjustment Factor). Another issue for the future is how much tightening the State will do and we will have to wait and see on that.
- How confident are you in the forecast of OC demands because this plays in so many aspects of the study including the concerns with stranding of assets (we want to make sure we fully use any investments we make)?
    - Request by MWDOC to the agencies: What are you seeing in terms of rebound in demands within your agencies? It was noted that the hot weather the past several years may be why the rebound is above where we expected it to be and asked for input from the agencies.
    - One agency noted the weather plays a major factor – and also, at least within their agency, growth has been greater than expected; if the gpcd consumption is adjusted for the growth, it still shows that water use is at an efficient level even though the overall rebound is faster than expected.
- How solid are the demand projections and the accompanying need for additional investments for the service area based on economic uncertainty?
    - The water demand forecast for Orange County is based on the latest set of demographic projections from the Center for Demographic Research (an Orange County institution that specializes in projections of population, housing and employment), and is derived from a statistical analysis of weather and climate, conservation, and economy. This current demand forecast is substantially lower than prior forecasts, but much more in line with current actual water use trends. However, it is important to continue to update these demand forecasts every five or so years to reflect trends that are more difficult to predict. The tools and models used to estimate supply reliability can easily be updated with new water demand forecasts as they are prepared. .

## 2. New Supplies Included Under the Various Scenarios

- It was noted that it is likely that we will see New SWP Transfers prior to 2035 given the direction of the State Water Contract extension and other provisions included in the Extension Agreement Provisions; the Agreement in Principle dated June 2018 includes these provisions and DWR has initiated CEQA proceedings on such. This should be noted in the study.
  - Include a discussion in the report that the SWP contact amendment (anticipated in 2019) will provide increased flexibility for multi-year transfers prior to 2035 (and beyond). This will likely provide MET with increased opportunities to store water in wet years – assuming storage is available. This should potentially reduce the gaps identified in the report.
- Has there been a decision made that Carson is being built? What is the criteria being used to determine which supplies will be available and when?
  - It was noted that the MET Board has not made any commitments to Carson and that is why we had to add costs into the MET forecast whenever new supplies were added. We also decreased the MET sales whenever new LRP projects were shown coming on-line.
- It was explained that a very difficult and tricky aspect of the reliability study is estimating what MET projects will occur in the future, what local projects will occur, what LRP projects will occur and what transfers will occur, all out to 2050. These forecasts of new investments are used to evaluate the resulting reliability and cost of water within MET and how those translate to OC. And then we evaluate what improvements in reliability occur based on projects implemented in OC. If we simply looked at MET's reliability now and out to 2050 without any supply improvements, essentially any project we could identify would likely test out to be very cost effective. But that is not a reasonable approach. MET and the MET member agencies have always made investments and these strategic investments are what has made MET so reliable over time. In fact, at the October MET Board meeting, the MET Board approved staff moving forward on the Antelope Valley East Kern (AVEK) Water Bank investment that would increase MET's put and take from the water bank by 70,000 AF per year in each direction. This investment is being made because MET realized that a zero or 5% allocation is a possibility on the State Water Project (based on the 2016 experience) and it was difficult for MET, under those circumstances, to meet demands in the western portion of the MET service area. This example of adaptive management and these types of investments are expected to continue.
- With respect to developing local supplies, it was requested we add a notation that MET considers itself to be "a supplemental supplier" and this attitude is heavily imbedded among MET staff. This causes problems at times with how certain portions of the MET service area view MET as the primary supplier (such as SOC). Having such a belief seems to mean to MET that they don't have the obligation to provide water ALL the time. We

have all been meetings with MET where they have been very clear that they are a supplemental supplier.

  - It was noted that MET's IRP calls for achieving reliability collectively between MET and local agencies (a different perspective). Keeping better track of projected new supplies by others is an area of the next MET IRP update that staff believes we should influence at MET. An improved clarity in communications of intentions will help bring the planning of MET, the MET member agencies and the local agencies closer together.

- It was noted that if MET switches their rate structure (especially the fixed vs. variable coverage), it could have an impact on the development for local projects within the LRP.
  - Several noted this concern. MET has historically looked at some level of charges that may not be avoidable over the long run. Others have suggested MET match fixed charges to cover fixed costs and variable charges to cover variable costs. Each of these options will have both impacts and implications towards development of local supplies.

## 3. Methodology Examples/Questions

- It was noted that from the Policy Makers perspective, it can be difficult to differentiate between supply gaps and system gaps and which projects provide both.
  - It was noted that maybe we should flip the order when presenting to discuss system reliability before supply reliability.
  - It may be possible to develop a criteria that can be used for selecting both supply and system needs at the same time. We looked at this after the first workshop and came up with the alternative metric we tried using, called the "Evaluation Metric" (EM). It helped but did not totally solve this issue.
- A question was asked about the benefits of a project if the project costs less than the MET rate.
  - The way we are calculating the benefits in the modeling work depends on what supplies are provided by the project and whether the supplies are provided during shortages (valued at a higher amount) compared to supplies that simply offset MET water (valued at a lower amount). The benefits are independent of the cost of the project. But, our EM includes both costs and benefits.
- One participant noted that they were having trouble with understanding the difference between MET reliability vs. local reliability. When they look at MET's projections they don't know to what degree other agencies' want to roll-off the MET system and how this is accounted for.
  - In our modeling work, any time we brought more LRP supplies on, the MET sales were decreased. This handles it in the modeling, but it is an issue MWDOC has flagged – if most all MET agencies are decreasing their dependence on MET, we face the potential that MET could become an inefficient, high-priced, supply of

last resort. This would not be a good outcome and would cost all of us more in the long run. Local and regional coordination is essential. The OC Water Reliability Study is looking from the OC water perspective to evaluate the question of which sources of supply and which investments make sense regionally within OC and within Southern California. Continuing to purchase water from MET should remain a priority for all of MET's member agencies, combined with the development of local projects in a diversified portfolio when they make sense, with alignment between MET and local agencies to achieve full reliability.

- MWDOC staff intends to advocate at MET for improved clarity on this issue as MET develops its 2020 IRP.

## 4. OC Basin Building Blocks of Reliability Generalized for 2030

- The question was posed as to how you define a shortage in the Basin? This is a technical area of the modeling. The modeling assumes certain purchases of water by OCWD for groundwater replenishment up to a maximum of 65,000 AF per year when it is available. During shortages, the purchases by OCWD are limited to 25,000 AF per year. The model tries to achieve a certain BPP and when it cannot hit that BPP a shortage is registered. This is not how it happens in reality, but this methodology flags when changes in the basin management or water conservation would have to be triggered to balance the system. OCWD has several options with respect to basin management. These were deemed beyond the scope of the study. OCWD has done a good job managing the basin throughout the recent droughts.

## 5. Climate Change Issues

- Climate modeling is improving all the time -do you have a glimpse of what MET will use for Climate Change modeling coming up.
    - It was noted that staff was not entirely happy because MET had not really evaluated impacts from Climate Change in its 2015 IRP. We plan to advocate for a more robust analysis in their 2020 IRP update.
- Input was provided, based on what is going on at JPL that the climate modelers are not focusing on the right aspects of interactions of the atmospheric circulation, oceans, land surface and ice.
    - We will attempt to follow up on this issue to get more information.
- Include more discussion of the climate models and their strengths and weaknesses.
    - Because we used planning scenarios for the analysis to bracket future outcomes, this may be beyond the scope of the study. However, we are interested in any opportunities that arise to provide a more predictive aspect of what will happen in the future.

- How does the 2017-2022 hydrology get modified for Climate Change?
  - Every out year hydrology is impacted by either the Minimal or Significant climate change impacts using the delta method to modify the historical hydrology with what might occur as the future hydrology under each of the two scenarios.
  - Under all scenarios, the sequence of history from 1922 to 2016 are kept in order, although eventually, we would expect improved climate models to predict different sequences and durations of wet and dry cycles.

## 6. Potential Local Projects by OCWD NOT included in the modeling

- Several groundwater producers suggested adding a project called "Basin Management" as another project that would be appropriate by OCWD.
  - It was noted that some had misinterpreted the question marks in the table as questioning whether these projects would happen or note; it was clarified that the intent of the question marks was not whether the projects would happen or not, but coming up with a quantity forecast for project.
  - OC Basin management is the responsibility of OCWD and should be pursued as such.

## 7. Questions on Specific Projects

- Cadiz - how would it work if the overall Cadiz project did not move forward, would SMWD still receive any benefits?
  - Dan Ferons noted that SMWD would get the first 5 TAF regardless of the size of the project. The project probably won't happen if it goes much below 35 TAF.
- Pump-in to the EOCF#2 - With respect to the pump-in to the EOCF#2, it was requested to explain where the water was originating from.
  - The source of the water is groundwater that is exchanged with MET water after the emergency ends. It was explained that the concept includes wells would be cost-shared between the OCWD groundwater producers and SOC with SOC paying about 1/3rd of the cost in exchange for the groundwater producer allowing the water to flow to SOC during an emergency event. The costs were estimated based on 3 wells with an interconnection to the EOCF #2.
- Baker Treatment Plant - The question was raised about whether the Baker Treatment Plant is assumed to be operational during the emergency outage.
  - Under all emergency scenarios, the Baker Plant is operational and those supplies have already been accounted for, with water coming either from MET or from Irvine Lake, to be treated and conveyed into SOC. The net "recovery needs" outlined for the SOC agencies already has the Baker supplies subtracted.
- Direct Potable Reuse in SOC - The slide presentation did not note the extent to which direct potable reuse (DPR) might be plausible for SOC.

    - It was noted that the background report estimated a potential for SOC of about 2,000 AF. The SOC agencies felt it could be more. By way of follow-up discussions with SMWD and MNWD, it appears that within these two agencies, there may be excess wastewater in the amount of 8,000 to 10,000 AF. Assuming 80% recovery for DPR, and assuming a target amount of maybe 50% of the available wastewater, the potential for SOC for these two agencies is about 4,000 AF. They also noted that wastewater not being used by others could also be used for DPR which could increase the overall potential depending on the regulations and availability of regional storage. The discussions identified an optimistic timeline of maybe 5 years and a more realistic timeline of 10 years for DPR to come to fruition. The discussions did not suggest that all other planning and supply decisions be put on hold, but that moving forward on reliability investments, as long as they are smart ones, should continue. Staff from MNWD and SMWD provided some valuable insights into DPR. MWDOC staff will prepare a longer write up for inclusion in the final report.
  - Why not consider DPR plausible vs. 400 TAF yield surface reservoir?
    - At this point we are not forecasting the need for either one. The reservoir exercise was simply one of "testing" potential benefits. Much more work would be required before committing to a major reservoir and it would be expected to take about 15 to 20 years to develop. The development of DPR water in north OC is not needed (all wastewater is committed) and for SOC, it will depend on the regulations and the cost.
  - Some projects are based on untreated MET water costs and several noted that MET's flat projection for the treatment surcharge over the long run did not seem correct (sandbagging was the description). The rate does not even seem to increase for electricity and chemicals and manpower which increase every year.
    - MWDOC is aware of the flat forecast in the treatment surcharge by MET which is part of the Cost of Service Study by MET. MET must comply with its Cost of Service study and Proposition 26.
    - It was noted that when you look at the long-term forecast there are no capital improvements, and the treated rates are within a $1 or so each year, although the percentage increase from year to year varies between the treated and untreated rates. Staff will look into the reality of this forecast.
- Poseidon Project - With respect to the ranking of SOC local projects for system reliability, are you saying that Poseidon is not reliable? And, how did you bifurcate the costs for Poseidon (Basin only vs. SOC)
    - This system reliability ranking table focuses on the cost-effectiveness of providing reliability on a unit basis in South Orange County, not whether one project is more or less reliable. In fact, we assumed that all reliability projects were equally reliable from a performance basis. Perhaps a better title or a footnote could provide clarity.

- The Poseidon Project provides 50 mgd of supply at the plant site in Huntington Beach at one cost of water. That water was conveyed, 15 mgd to SOC and 35 mgd to the OC Basin. The capital and operating costs for integrating the costs in each direction was then added to the cost of water at the plant site to arrive at separate cost of water for SOC and the OC Basin.

- IRWD Emergency Supplies - One of the things that seems to be missing is the existing IRWD emergency water supply.
  - We did not forget it, can be found within several of the slides and it notes that we are additionally looking at the option of emergency wells. The study of the IRWD SOC Emergency Interconnection is expected to be completed in December 2018.
- For SOC, why didn't you consider a groundwater storage concept with San Mateo Basin?
  - A project was considered in the 1990's that would have required a joint venture with the Marine Corps Base Camp Pendleton; the 1990's project anticipated a potential groundwater basin yield of about 2,000 AF ± and also considered storage of imported water for use for emergency purposes in an arrangement with the Marine Base. No current discussions or contacts have been made with the Marine Base involving this expanded opportunity. Environmentalists consider this the last pristine basin in or nearby to OC and want to protect it from outside influences.
- Have you looked at raising the amount of water stored in the OC Basin or other OC Basin operational changes?
  - The evaluation of OC Basin management was not within the scope of this study and is the responsibility of OCWD.
- How were the supplies from the SOC projects anticipated to be physically integrated into the SOC water system? How did you deal with the minimum flows that have to go through the MET meters at CM-10 and CM-12?
  - It was noted that both CM-10 and CM-12 were in the process of being converted from venturi meters to mag meters to allow a lower flow to be metered and an increased flow range to be accommodated. Furthermore, MWDOC had looked conceptually at moving Doheny water into the South County Pipeline via a booster pump station and had included other costs for chloramination stations if they need to be installed to maintain water quality. It was suggested that additional work needs to be conducted in this area and that MWDOC had begun the process of seeking input from MET and water quality experts to assist in these areas so we know what to expect before we start the integration operations of local projects.
- Can additional supplies really be developed from the Colorado River?
  - We have discussed this issue at MET and the input provided is that yes, additional supplies can be secured, but they will come at an increasing cost.

With the pending Colorado River Drought Contingency Plan and the structural supply imbalance on the Colorado River, we face difficult issues.

- One participant noted that Carson is problematic from the standpoint of LA allowing water to be transferred out of LA County (out of the service area where the water was sold). I would like to see more information on the projects and time periods when the projects might come online. Perhaps you can identify additional projects as hedges in case any of the suggested projects encounter problems.
    - It was noted that the scenario options table involving MET supplies could be annotated to make the date of integration more apparent. We can also provide a list of alternative supplies that could be developed in the event the ones we forecast do not come to fruition.
    - It was noted that this is also one of the responsibilities of MET's IRP and that MWDOC would advocate for additional clarity for the 2020 MET IRP.
- It was suggested that MWDOC should model the SOC water distribution system with local projects to better understand the operational issues that might arise and to better understand water quality issues.
    - Staff has been looking into this issue with water quality experts and MET staff. A recent meeting was held with MET staff to get a preview and understanding of MET's hydraulic model and to understand it the model can be provided to us.
- What is the "regional storage reservoir" included?
    - The concept of adding a regional surface reservoir was to see if a second surface reservoir (similar to but smaller than DVL) would be beneficial based on generating additional wet year water. Conceptually, the modeling outcome was marginally beneficial.
- Where would 400 TAF surface reservoir be located?
    - To be determined; the conceptual modeling simply asked the question "if it exists and costs roughly $2B, would it be useful?"

## 8. OC Project Economic Analysis

- With respect to the analysis, what would happen if you add another 10 years to the project life to show how the projects perform when the capital cost component drops off?
    - Conceptually, the projects can begin to look more favorable, but you also need to consider additional R&R investments that would be needed to keep things running. This would offset some of the benefit. Also, because of the discounting factor and that the extension of project life is 30 years or more out into the future, it does not make a significant difference.
- This chart for ranking projects need to explicitly note whether they are for system or supply benefits. This can be confusing to the reader. This supports the earlier comment that the report should focus on system analysis prior to supply reliability.

    - Concur.
- The concept of negative NPV/AF is very abstract. I suggest focusing on NPV.
    - We tried several ways and came back to NPV, which can be either positive or negative and used a similar metric per peak capacity (mgd) for the emergency metric.
- Since there was not an attempt to identify benefits (other than cost avoidance), I would rename “Benefit/Cost Ratio” to Evaluation Metric.”
    - We moved to this terminology.

## 9. Water Use Efficiency

- Conservation will harden in the future
    - Yes, we cannot conserve the same water twice to close our gaps and conservation can reach a point of diminishing returns for a certain level of investment. That is why we talk about Water Use Efficiency and setting a scientifically based standard that we should be shooting for throughout Southern California, rather than simply conserving more water.
- Why did you only count on 10% conservation to help close future gaps – we just made it through a multi-year drought where we conserved 25% and we are no worse off – shouldn’t we use 25% reduction?
    - First, we believe that demand hardening will occur in the future with new plumbing codes making indoor use very efficient and landscape ordinances reducing how much water can be saved outdoors during mandatory water use restrictions under droughts. Our water demand forecast reflects this gain in water use efficiency but reduces the amount of drought conservation that can occur in the future without impacting public health and safety. Second, we believe that there is a cost associated with mandatory water use restrictions, such as costs of replacing landscapes, potential impacts to economy from businesses potentially leaving the area due to reliability issues, and impacts to quality of life that are difficult to quantify. And lastly, as we noted multiple times in the study effort, each local area can adopt whatever planning criteria they want as long as the expectations of the area are worked out between the provider and the customers of the provider. In discussions with our water agencies, 10% seemed to be a reasonable dividing point, with a frequency of not more than 1 in 20 years.

## 10. Roll-Off at MET

- I would like to see MET’s 1928 Laguna Declaration renewed in some way, with MET developing desalination and stormwater projects and integrating them into their existing treatment plants and/or distribution system in a way that would maximize efficiencies and costs for all. I personally think that we are going down a bad policy road to follow the concept that agencies "make their own decisions about how reliable they want to be…some may choose conservation, some may pay more for reliability." I think this is a policy that has many implications. I also have concerns about diminished property values and damaged local economies in cities that decide they can't "afford" to invest in reliability.

- I think a new Laguna Declaration would give the private industry/scientific community the push that is needed to develop treatment technologies and energy efficiencies that could be financed and brought online as the existing debt that is paying for retrofitting the system is paid off. We couldn't have gone to the moon if MET hadn't provided a secure supply of water that kept CalTech scientist here and founding JPL – which designed and built the rockets that eventually got us to there.

- In the overall MET reliability, was the intent of other agencies to roll-off of MET included into the study?
    - To the degree that additional local projects were brought on line under MET's LRP, the MET sales were decreased in our modeling. However, as has been noted several times, the local planning and MET planning are only synced to a certain degree. Staff's observation is that the linkage between the two should be improved, otherwise we will either collectively under or over invest in our water system. There should be a way of avoiding this.
- We should develop an estimate of cost impacts of stranding MET's assets and what might happen under certain scenarios.
    - Concur. We believe this is a good topic for MET's 2020 IRP.
- We need more information as to when the MET projects might come online - perhaps identify alternative projects as short-term hedge projects and long-term projects. What I thought I heard here is that the study laid out what we think will happen over time with respect to investments MET would be making via LRP Projects and direct projects in which they invest (WaterFix, transfers, banking, CRA, other) and your question was what if some of those projects hit roadblocks, are there others in standby mode? What other projects might be called upon? This was an attempt to evaluate or inject project "risk" into the analysis (risk being defined as economic risk, permitting risk, technological risk, governance risk, etc.). I'm trying to contemplate the increasing cost impacts of MET's stranded assets that are occurring at the same time we are planning and developing alternative local supplies, while at the same time we are going to experience significant levels of increased conservation (and the attendant cost impacts from that). I have often indicated that I think our studies would benefit from professional economic analysis with the goal of "smoothing" these impacts or at least providing awareness as I think the cities in particular don't well understand the unfunded liabilities that are not shown on their utilities' balance sheets. As these cost impacts hit during the "short-term" period before the WaterFix is online, while there is an impending crisis on the CRA and with little firm understanding of how the State intends to implement

SB606/AB1668, I think the water community is going to focus on year-to-year supply and reactive approaches like extreme conservation. This approach risks the trust the public has in us…they will forgive one extraordinary drought period that resulted in some dead lawns, but another one, particularly if there is a "Day Zero" aspect, will be looked at as incompetence. Hence my comment about not wanting to reject ANY local supply options.

- The issue embodied in the comment is a good one that says that coordination between local supplies, import supplies, demand and WUE investments must all be considered or we will be missing something. This, in essence, is what we have attempted to capture in the study. It is not easy to do.

## 11. Risks to Reliability

- You might want to add some discussion in the report of additional supply risks:
  - CRA shortage sharing and where this is going
  - Longer duration droughts
  - Impacts, especially to the Bay-Delta supplies from sea level rise
  - Changes to endangered species laws and the Coordinated Operations Agreement between the SWP and the CVP as the Feds seem to be taking a new direction on these issues.
  - Discussion of how the local economy is impacted by reliability (this is not accounted for in your benefit numbers)
    - These are all good topics. Some are very difficult to include in the study in a quantitative method.

## 12. Project Evaluations

- Use same cost of money for all projects; use same escalation rate for each project.
  - In carrying out the analysis, we had standard assumptions to begin with. The difficulty occurred with not wanting to make changes to certain projects, more particularly the Doheny Local and the Poseidon Project costs at the fence line. Both of these projects were formulated by others and we did not want to change the basic assumptions for these projects. Most all other projects were standardized using 4% cost of money with flat amortization over 30 years, 3% O&M escalation, 4% discount.
  - Knowing the indoor water use demands for SOC would be interesting numbers to have for the evaluation of emergency supplies.
    - Staff will develop these.
  - Capital cost components typically drop off after 30 years and the unit costs of projects become much more competitive. What happens in 2051 and beyond? Because the analysis techniques utilize Present Valuation of costs of projects,

what occurs 30 years or more into the future is not heavily weighted in the analysis (the use of PV analysis was specifically selected for this reason). Simply dropping out the capital without any additional adjustment for Rehabilitation and Replacement (R&R) costs after 30 years may not be a good assumption.
    - Normalize escalation costs across all projects and footnote if a different assumption is used than the proponent. Look at Doheny as a sample - Phase 1 uses 2% and Phases2 and 3 use 3%. Should be consistent across the county. The differences noted occurred when there was a specific project moving forward, such as the Doheny Local and the Poseidon Project. We did not want to change the assumptions of what the proponents were using and be accused of skewing the analysis. Standardization was our goal, but we got only part-way there.
- Economic Analysis – Recommend the analysis be done for SOC and OC Basin separately (for OC Basin, possibly include West OC well field, Prado Projects, SARCCUP, etc.).
    - The analyses for the SOC and OC Basin were performed separately from one another. The only overlapping projects were the Poseidon Project and the Strand Ranch Water Banking.

## General Input and Feedback

- It was noted that this was an update from 2016 - is the biggest change the inclusion of the WaterFix?
    - That is one of the main changes; the others are the update on the CRA shortage sharing, climate change and assumptions of projects by MET. In addition, this version of the study evaluated specific projects and ranking metrics for agencies to be able to use to make decisions.
- Is your board going to vote to approve this study, and if that is case is this going to be the official MWDOC stance on the various projects?
    - It was noted that the Board does not normally take actions of “approving the projects” or “approving a report” – they typically take a “receive and file” action. However, it is expected that the MWDOC and MET Directors will discuss a number of issues addressed in the study to move positions forward at MET and with MWDOC policies
- Include 2016 line on reliability graphs (shortage vs. probability).
    - These were provided but on only two graphs at the MET level.
- Tie or compare 2018 findings back to 2016 findings.
    - The reliability curves were compared to 2016 results for two graphs at the MET level. The two studies were quite different. Adaptive management is included in both for the long run, but the 2018 study approached more specific local project recommendations compared to the 2016 study. The results coming out of the 2018 study are what should be used for any future planning.
- “No New Projects” – should be modified to include WaterFix only, or add a line for WaterFix only.

    - We will provide a footnote for clarity purposes.
- I think you should craft a clear recommendation/finding related to "Extraordinary Supplies" for SOC.
    - We believe we have, but more work on the concept needs to occur, both for the Strand Ranch and for SARCCUP.
- I suggest adding a finding that OCWD should consider opportunities for improved "Basin Management" strategies that would eliminate shortages.
    - This was deemed beyond the scope of the study and was specifically requested by OCWD to not be evaluated by MWDOC as it is beyond MWDOC's responsibility.
- Include a discussion of how the CRA drought contingency plan is incorporated or not.
    - The recent releases on the Drought Contingency Plan for the Colorado River supplies is almost identical to the modeling we performed. For our modeling, we used the draft DCP from a year ago and the additional shortage contributions from all the parties were the same as they are in the current document.
- The OCWD groundwater basin is very reliable and has been successful - why have you included it in the study?
    - It is important to take a collective look of what water supplies will be needed for the future as a MET region and locally within Orange County. The OCWD Basin is an important piece of this puzzle. For those MWDOC agencies (as well as the Cities of Anaheim, Fullerton, and Santa Ana) that draw from the OCWD Basin, it is important to assess the reliability of imported water from MET that makes up the rest of water demands. Congratulations are in order to OCWD for what it has accomplished in terms of firming up groundwater over the years and for continuing to make needed investments in the coming future.
- Is this being type of work being done other places?
    - The use of scenario planning is becoming more and more the standard practice, especially given that we cannot predict the future with absolute accuracy. Scenario planning helps us to understand the implications of what might occur in the future. The OC Reliability study goes even further by integrating reliability planning to define the "need" for projects along with economics of projects and may be the first of its type.
- To gain public approval, have you looked at the carbon emission from each project?
    - The primary purpose for the 2018 OC Reliability Study is to evaluate water supply reliability and the economics of various local water supply projects that can best achieve the reliability. While carbon emissions are an important element when considering projects, it was not factored into this study.
    - It should be noted that studies conducted by MET and others have shown that the energy use (and by way of extension carbon emissions) for importing water

from SWP and CRA to Southern California are on par with advanced water treatment for water reuse and desalination.

- Does this study consider locally created pump generation storage for electrical generation?
  - No, it does not. We are aware of discussions involving pumped-storage energy generation at Lake Mead, but we did not look at energy generation in this study.
- We are affected by the agricultural use.
  - Agricultural water use is the major water use in the State. A large issue coming to roost is the over-drafting of the Central Valley groundwater system that has been going on for 70 years or more. We have to bring the system into balance and that will likely be done by a combination of taking some lands out of production, and better water management brought together under the Sustainable Groundwater Management Act.
- I thought I heard you say there was a goal for each agency to get to a 60-day emergency supply. Where is each agency at now?
  - The OC basin area and Brea/La Habra are mostly compliant already, although they may want to look at back-up energy sources to help local production and pumping when there is a grid outage. For SOC, it was not that long ago that problems were created with winter period shutdowns of 5 days. Many strategic investments have been made for SOC and today, my guess is collectively, SOC stands at approximately 20 to 30 days.
- For impacts from major earthquakes, has any work been done on "bypasses" to allow the major conveyance systems (Colorado River Aqueduct, State Water Project and Los Angeles Aqueduct) to be re-routed to alternate systems to circumvent impacts from the earthquakes?
  - No, based on the size and logistics issues involved, it would be incredibly expensive. The current thinking is to store sufficient water in Southern California to allow us to survive until the large conveyance systems can become operational again.
- I hope that we can have more meetings on the study to further refine the outcomes. While what was stated regarding the ever increasing demands, I tend to focus more on the green projection line. The decisions need to be made with respect to continued conservation. I know that SOC has a significant emergency supply deficit. I find Local Reliability important.
  - We will consider additional meetings with the member agencies.
- You mentioned independence. One way to do so is to keep in in local water production the public hands and not private.
- We believe the report went too far in indirectly telling the agencies what projects should be implemented.

  - All the member agencies have their own authority to decide what they would like to implement. Our goal was to provide unbiased information for the member agencies to make their own decision, or our Board to make their own decisions.
- How can we lose more than half of the MET supply 35% of the time; what is the scenario and duration?
  - The Red line is the baseline without any new projects including the WaterFix. Extreme shortage events would result in very low State Water Project allocations of 0 to 5% and with the more drastic shortage provisions on the Colorado River, MET could find itself primarily utilizing water pulled from storage.
- We should be invited to watch and participate in all of the study discussion meetings in the future. We would like live streaming of the meetings. We would like OCWD to utilize this study in their discussion.
- This study is a tool and a snapshot in time. I think it is one of the more useful things we have done and will help up with advocating at MET.
- Provide a list of those areas where the OC Reliability Study has highlighted an action or follow-up issue with MET.
  - MWDOC staff is currently compiling such a list.
- Need more meetings to further understand the implications of the study; I'm struggling with trying to understand the implications of the analyses you've conducted. It's a lot to take in, and that's where I thought more meetings would be helpful. Some of the projects you analyzed haven't proceeded past a conceptual stage and some are full-fledged projects with completed EIR's.
  - If agreed to by the larger MWDOC member agency workgroup, MWDOC staff is more than willing to conduct additional meetings. This issue will be discussed at the October 25 MWDOC Manager's group to see what level of interest there is. Furthermore, MWDOC is willing to meet and discuss any aspects of the project with any agencies desiring such, so if a collective workgroup is not arranged, staff are available to meeting one on one with our agencies.
- Note the receipt of the letter from OCWD and the MWDOC response back on various issues with respect to the 2018 Study.
  - Copies of the letters can be provided upon request.
- TDS is a major water quality issue with respect to water recycling and there are hidden costs to the consumer from having high TDS supplies. Can you quantify the costs involved? What will MET do about the high TDS on the CRA supplies? Can they do more work on limiting natural TDS sources within the Colorado River watershed?
  - This issue needs to be resolved for the long run to enable recycling of supplies with a reasonable TDS limit and to limit the build-up of salts in groundwater basins that if not dealt with, could result in the need for desalination of future groundwater supplies. It is unknown which point of intervention (treat or divert high TDS supplies from getting in the Colorado River, treating say the MET

Colorado River Aqueduct, or treating recycled supplies to knock down the TDS of the water) would be the best investment for the long run. We will attempt to develop information on such.

- Concerns were raised with developing sufficient storage resources to protect OC for six months with respect to emergency supplies.
    - It was indicated that MET has a study underway on the amount of emergency storage required in the MET system (currently 630,000 AF) to deal with outage and recovery durations for various earthquakes impacting the importation of water into Southern California.
- Will the MWDOC Board support any LRP applications submitted by its agencies?
    - MWDOC's policy has been that MWDOC will forward any LRP project for consideration to MET assuming they meet the MET guidelines for the program. If the projects move on for consideration at the MET board, it does not necessarily mean that our MET directors will absolutely support every project that is moving forward (our MET directors who also sit on the MWDOC Board cannot participate in the discussions because of conflict rules at MET). The recent criteria for support of LRP projects at MET has more conditions than the previous criteria of first come first served.
- There is a lot of confusion regarding the industry meaning of the phrase "New Water;" perhaps a clear definition can be developed for inclusion in a glossary.
    - New water indicates that the water source has not yet been developed or used for potable water purposes (or is not currently offsetting the need for) potable water and would include (i.e. ocean desalination, stormwater capture, recycled water, DPR, IPR or groundwater production over and above what is currently being produced).
- During the development of MWDOC's Water Conservation Master Plan, definitions and distinctions were developed for various "conservation terms" outlined below. The definitions of use for purposes of the reliability study should be provided so all know and understand the use of the various terms:
    - Water conservation – typically a general term that can be confusing because it can mean many things. It typically refers to a beneficial reduction in water use, whether for an emergency situation or for long term demand reductions. It can include both passive and active conservation (passive occurs due to plumbing code changes and regulations, whereas active conservation results from specific investments that result in reductions in water use). The problem with the term is it means so many things. In the study, we have developed the terms noted below that we believe are more descriptive. The other issue with the term is that it has no dimension of efficiency and so everyone is treated the same whether they are currently being water conscious or not.
    - Water use efficiency - long term beneficial reductions in water use or increased efficiency of water use over the long term due to investments, plumbing code changes or behavioral changes. These are based on scientific estimates of what

levels of use for a specific purpose are reasonable or efficient (indoor use, landscape irrigation per unit of landscape, etc.) and are judged on an efficiency basis instead of simply using "less."

  - Demand curtailment – for our study, this term is used to describe consumer responses to requests for beneficial reductions in water use to deal with short term emergencies or droughts lasting one to several years. These are typically short term responses to "specific water agency requests for reduced use" because of a problem with water supplies. We also use the term of consumer response or consumer cutback.
  - Demand management – a general term similar to water conservation; we believe the terms water use efficiency and demand curtailment or demand cutback are more appropriate for the study discussions.
  - These terms will be added to our glossary.
- A better definition/explanation of the Doheny Regional project is needed, including the needs for regional buy-in/fiscal support, purchasing/distribution agreements (partnerships), helping water reliability education/promotion by participating entities.
  - In the study effort, Doheny Local was used to describe the project currently being pursued by South Coast Water District. By way of the study effort, we did not want to imply any changes in what South Coast is permitting or proposing and simply provided it as "what is happening" at this time.
  - In the study effort, the Doheny Regional was specifically described as the remaining amount of capacity that could be developed in the Doheny Desalination Project over and above what is being developed by South Coast Water District. The full scale project was nominally estimated at 15 mgd; this would allow development of 10 mgd above and beyond what is being developed by South Coast Water District. Other variations are possible such as a 5 mgd expansion. A proposal or proposed structure for such a project as far as actual participation by local entities has not yet been developed. The study assumed the structure would be put together by a number of agencies and the participating agencies would develop terms and conditions for such a proposal including assessment of the integration needs to distribute the water during normal operations and during emergency operations. MWDOC conducted work in the area of integration to look at optional delivery paths for the water including to the Joint Regional Transmission line heading north, the Local Transmission main heading south and the Water Importation Pipeline heading south with additional pumping provided to boost the Doheny Desal water into the South County Pipeline.
  - These definitions will be added to our report.
- Input was received that projects are at different levels of development and so a comparison of projects to one another is not appropriate or could cause the evaluation of projects to be skewed.

- This issue is inherent in any type of planning related study when projects are in different stages of development. In fact, the Study Limitations section of our background report made specific reference to this issue, as noted below. The MWDOC study utilized the latest information from various sources, including from our member agencies, and we believe the study meets the overall goal of providing an accurate comparison of the benefits provided by the various projects analyzed.

**Study Limitations (from the Background Report)**

Most of the MET and local water supply project information (e.g., supply yield, cost, project terms, potential operational dates) has advanced from a conceptual level used in the 2016 OC Study to a feasibility level for this study. And while this has resulted in improved understanding of these projects and their potential costs and benefits, preliminary and final designs for these projects are still several years out (i.e. the economics presented in this Study could change prior to final project implementation). Most of the project assumptions are based on published reports, evaluation summaries and contract terms provided by project sponsors—with MWDOC conducting supplemental analyses on regional projects. Given these caveats, MWDOC believes that the project information used for the 2018 OC Study is adequate for understanding the relative benefits, trade-offs, and potential financial consequences of implementing local projects in Orange County given our current understanding of hydrologic and regulatory risks.

Irvine Ranch
WATER DISTRICT

October 25, 2018

Mr. Rob Hunter
General Manager
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley, CA 92708

Subject: IRWD Comments on 2018 Update to Orange County Water Supply Reliability Study

Rob:

The Municipal Water District of Orange County (MWDOC) has recently completed its draft 2018 Update to the Orange County Water Supply Reliability Study (2018 Study). This study is an important, objective, and comprehensive evaluation of how gaps in future water supplies can be met with different local and regional water supply projects. Irvine Ranch Water District (IRWD) appreciates the hard work that MWDOC staff and consultants have put into this study and compliments the team for objectively comparing project alternatives. We also commend MWDOC staff for encouraging and incorporating input received from its member agencies. The purpose of the letter is to provide the following IRWD comments on the study.

IRWD's comments, which have been reviewed with and approved by the IRWD Board of Directors, are as follows:

1. The future demand forecasts that were developed for the initial Supply Reliability Study (completed in 2016), with the input of MWDOC's member agencies, are reasonable. These demands adequately reflect the expected impacts of the State imposing water budgets on retail water agencies throughout the County. The study adequately demonstrates that water demands are not likely to increase in Orange County in the future.

2. The project evaluation metrics that are used in the updated 2018 Study provide a good method of comparing the benefits and costs of the projects. IRWD supports the comparison of the projects based on the metrics used in the study. Comparing the benefits and costs of alternatives is an essential component of water supply reliability planning. Even though not all the potential indirect benefits of the projects have been identified, IRWD supports MWDOC's efforts is applying this water supply reliability planning method.

3. The study should include the objective evaluation and comparison of the extension of the existing South County Interconnect Agreement between MWDOC, OCWD, IRWD and other South County Agencies. Evaluation of the extension of this agreement should take into consideration the results of MWDOC's ongoing hydraulic evaluation of the affected facilities in coordination with input provided by IRWD engineers. This common sense alternative needs to be included for the consideration of those agencies that deem it important, regardless of potential changes to a new South County Interconnect Agreement. Without consideration of this alternative, the 2018 Study is incomplete.

4. The 2018 Study references only briefly that the water supply reliability of the Orange County Groundwater Basin (Basin) area could be improved by changing the way that the Basin is managed. The study should be expanded to include an objective evaluation of implementing basin management improvements including expanded purchases of available supplies from Metropolitan Water District of Southern California (Metropolitan) for direct or in-lieu recharge in the Basin. It needs to be recognized that optimizing the purchases and recharge of water available from Metropolitan is among the most economical alternatives for improving the water supply reliability of areas reliant on the Basin and meeting the emergency needs of South County. Maintaining the Basin about 150,000 AF from being full, would benefit the entire county. Without consideration of this alternative, the 2018 Study is incomplete. IRWD encourages MWDOC and OCWD to work together on developing this evaluation.

5. It is our understanding that the study incorporates, as a baseline, the use of water supplies from Irvine Lake to provide system reliability improvements to the capacity owners in the Baker Water Treatment Plant. The 2018 Study should include a description of the assumptions included in this baseline project. IRWD and the other partners in the Baker Plant have recently initiated discussions whereby Irvine Lake could supply up to 60 days of emergency water for the Baker Plant. IRWD and the other Baker Plant partners are willing to confer with MWDOC to assist in finalizing its baseline study assumptions for this use of Irvine Lake.

6. The study should incorporate an analysis of the potential improvements in water supply reliability that might be achieved in Orange County should Los Angeles Department of Water and Power and the San Diego County Water Authority succeed in becoming less reliant on supplies from Metropolitan. Such efforts by these agencies to become more self-reliant could reduce the need to invest in future local water supply projects in Orange County.

7. Recently, other MWDOC member agencies have commented on the importance of each agency having the ability to opt out of participation in specific projects evaluated in the 2018 Study. IRWD agrees with this principle when any of the following are expected to occur as a result of a project:

a. Significant financial impacts with no improvement in water supply reliability;
b. Detrimental impacts to water quality;
c. Impacts to investments in other infrastructure;
d. System integration issues;
e. Operational challenges;
f. Infringements on capacity rights;
g. Requirements for an agency to give up existing supplies; or
h. MWDOC member agencies subsidizing the cost of supplies available to other Metropolitan member agencies.

IRWD recommends that MWDOC include in its 2018 Study a discussion of the importance of agencies being able to opt out of a project under any of the conditions listed above.

IRWD greatly appreciates the opportunity to provide the comments listed above. We request that you provide a copy of this letter to each of your Board members in advance of MWDOC's November 13, 2018 Planning and Operations Committee meeting. Please contact me at (949) 453-5590 if you have any questions or if you would like to meet to discuss these comments further.

Sincerely,

Paul A. Cook
General Manager

Enclosure

cc: IRWD Board of Directors
MWDOC Board of Directors

MesaWater
DISTRICT®

*Dedicated to Satisfying our Community's Water Needs*




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October 25, 2018

Robert J. Hunter
General Manager
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley, CA 92708

SUBJECT: Municipal Water District of Orange County – Orange County Water Reliability Study

Dear Mr. Hunter:

Mesa Water District (Mesa Water®) would like to acknowledge the leadership that the Municipal Water District of Orange County (MWDOC) has taken to ensure that water reliability is being strategically considered across MWDOC's member agencies through the 2018 Orange County Water Reliability Study (Study). Additionally, Mesa Water commends MWDOC on the tremendous effort of developing a Study that attempts to address the specific water supply needs for each of Orange County's regions and the difficulties involved in meeting all of their member agencies' needs.

Regarding the Study and the supporting development approach, Mesa Water offers the following comments for consideration:

1. **Project Ranking**: The Study (PowerPoint slide 94) attempts to rank various Orange County water supply projects based on cost and other unknown factors. Mesa Water believes MWDOC should be supportive of any project that would alleviate the identified potential water supply gap without prejudice of one type of project over another.

Each MWDOC member agency has the responsibility to approach water supply reliability based on the water supply conditions and philosophies set by its governing Board. Thus, a one size fits all ranked solution does not translate into meaningful water supply reliability for all MWDOC member agencies. Further, the water supply reliability needs of south Orange County MWDOC member agencies are significantly different than Orange County Water District's member agencies (Basin members). MWDOC is encouraged to support any water supply reliability project that those regions believe will support their long-term water supply needs.

***Recommendation***: Please consider removing the project rankings from PowerPoint slide 94 of the Study, and providing support to the respective MWDOC member agencies for the regional water supply projects they choose to pursue.

MesaWater DISTRICT®

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2. **Water Supply Assumptions**: While the Study does a good job in trying to identify future water supply conditions, it appears that minimal input has been requested from MWDOC's member agencies. Several assumptions have been made in the Study that could dynamically change the findings and conclusions of the Study based on the information that should be provided by each of MWDOC's member agencies. In completing the 2016 Orange County Water Reliability Study, MWDOC took great efforts to engage MWDOC's member agencies to ensure that future water supply conditions were well vetted.

***Recommendation***: Please consider approaching the 2018 Study in the same manner as the 2016 Study by facilitating a series of workshops to vet each member agency's water demands and supply challenges.

3. **Metropolitan Water District of Southern California (MWD) Stranded Assets/Water Quality**: Findings 4, 5, and 6 on Power Point slide 114 indicate that large-scale local supply development could potentially strand MWD's assets and such projects should consider a reduced size to ensure they would not negatively impact MWD's operations. The Study should primarily consider Orange County water reliability development, and consider MWD operational protocols as a secondary need. While it is understood there are MWD feeder water quality challenges associated with reduced base flows, that is an operational challenge for MWD to address. This issue should not be a limiting factor in the development of a regional Orange County water supply development project.

***Recommendation***: Please consider removing Findings 4, 5 and 6 on PowerPoint slide 114, and using this as a criterion to support future Orange County water supply reliability projects.

Thank you for the opportunity to comment on the Orange County Study. Mesa Water looks forward to ongoing collaboration with MWDOC and its member agencies on future Reliability Studies. Should you have questions or need further clarification on our comments, please contact me.

Sincerely,

Paul E. Shoenberger, P.E.
Mesa Water District General Manager

Cc: Mesa Water District Board of Directors
MWDOC Board of Directors

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**SOUTH COAST WATER DISTRICT**

November 6, 2018



Mr. Rob Hunter
General Manager
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley, CA 92708

Subject: SCWD Comments to the 2018 Orange County Water Reliability Study

Dear Mr. Hunter:

The South Coast Water District (SCWD) entrusts the Municipal Water District of Orange County (MWDOC) as a wholesale water supplier to 2.3 million residents in Orange County and resource planning agency whose efforts focus on sound planning and appropriate investments in water supply development, water use efficiency, public information, legislative advocacy, water education and emergency preparedness. As such, SCWD appreciates the effort that went into the 2018 OC Reliability Study, to specifically account for the WaterFix as a 2035 base condition, implementation of a Drought Contingency Plan for the Colorado River, new climate change modeling, and other relevant factors. It's also valuable that the 2018 OC Reliability Study reviewed the water needs and supply options for the entire County to determine possible projects for the future and to enable informed decision making.

South Coast Water District offers the following comments on the Study:

1. It is imperative that any potential water reliability projects be rated through a system which brings to light the projects which best meet the needs of the region as a whole. As the report is quite lengthy and provides a detailed analysis, the ranking portion of the report is quite clear and easily understood by water professionals and the public alike. SCWD fully encourages MWDOC's rankings of potential water supply and system reliability projects, as MWDOC represents a neutral 3rd party expert ranking of these projects. As such, SCWD requests that rankings stay in this and subsequent OC Reliability studies.

2. Through a collaborative process, the MWDOC member agencies provided input to determine water demand forecasts for the Reliability Study. SCWD is supportive of the future demand forecasts and thinks it adequately addresses the future impacts of proposed State imposed water use efficiency and conservation targets.

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3. This 2018 update contains facts, figures, information and analysis that have changed since the initial 2016 Water Reliability Study. In upcoming years, additional projects, updates to legislations such as potable reuse, and updates to demand management will be available. We encourage MWDOC to update the OC Water Reliability Study on a regular basis (perhaps biennially) and include any future projects to ensure the regional outlook is continually reviewed.

4. South Orange County faces different challenges than north and central Orange County, such as enhanced water system reliability challenges during catastrophic interruptions of MWD imported supplies. SCWD understands that all MWDOC member agencies and affected parties may not completely agree with the full results of the OC Reliability Study.

   In fact, in 2016, SCWD decided that further detailed analyses and scenarios were needed in addition to the 2016 OC Reliability Study for SCWD to properly evaluate our water supply reliability needs. Hence, SCWD commissioned its own reliability study (also performed by CDM Smith), using the 2016 MWDOC study as a starting point. This study focused on rankings of the potential south Orange County water reliability projects that would best meet the needs of the SCWD ratepayers. SCWD then assembled a community-based stakeholder group to participate in an integrated dialogue as part of the Water Reliability Working Group. The purpose of the Water Reliability Working Group was to solicit input on South Orange County water reliability challenges, to provide to the SCWD Board of Directors for review and consideration. Additional information can be found at: https://www.scwd.org/services/drinking/supply/water_reliability/default.htm

   We encourage MWDOC staff to provide support and assistance to any member agency interested in performing their own reliability study to further understand their specific local challenges and solutions.

Thank you again for routing this 2018 OC Reliability Study for member agency review, along with conducting a thorough workshop with the member agency managers to discuss the draft study. Please feel free to contact me at rshintaku@scwd.org with any questions or comments.

Sincerely,

Rick Shintaku, General Manager
South Coast Water District

cc: South Coast Water District Board of Directors

EAST ORANGE COUNTY WATER DISTRICT

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October 26, 2018

Mr. Robert Hunter
General Manager
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley, CA 92807

RE: Draft 2018 MWDOC Water Reliability Study

Dear Mr. Hunter:

East Orange County Water District (EOCWD) would like to thank Municipal Water District of Orange County (MWDOC) for its continued leadership as a water resource planning agency and as a facilitator of water management projects and programs that benefit Orange County and its member agencies. The Draft 2018 MWDOC Water Reliability Study is an excellent example of the type of quality work MWDOC produces, something that can serve as a valuable planning document and help agencies make informed decisions as they seek to address their water reliability needs and challenges, particularly as we work to comply with the new requirements required under SB606 and AB1668.

In reviewing the draft study, EOCWD appreciates the depth of MWDOC's evaluation and analysis of many potential projects, located within and outside of Orange County. However, EOCWD following comments:

- Provide further information on the short-term and long-term projects and their attendant feasibility, risks, economic impacts/drivers, politics, and where they are in their respective project "life-cycles." Some may be near-term projects that could be constructed soon to "hedge" against certain events, some may be long-term projects due to their uncertain feasibility (e.g., new regional storage). Additionally, have all potential reliability projects been identified and analyzed?

- Re-evaluate the need to "rank" projects. As noted above, there are varying feasibilities in each of the identified projects; it may be presumptuous to rank projects as doing so could distort the perception of the value of a project precipitously.

- Provide a summary of changes from the 2016 Study to understand basic assumptions that may have changed as well as changes to the recommendations that were made at that time.

- Provide additional meetings to drill down into some of the near-term issues that were identified in the 2016 Study and where we have additional clarity now; e.g., realistic conservation quantities during "normal" periods versus "drought" periods, MET's supply plans for varying CRA and SWP delivery conditions (2019-2035) as well as OCWD's supply plans for this same time period.

Thank you, again, for your continued leadership and for your excellent work on the Draft 2018 MWDOC Water Reliability Study. EOCWD appreciates the opportunity to provide comment and looks forward to ongoing dialogue and collaboration with MWDOC on county water reliability issues. If you have any questions or need for clarification, please contact me at 714.538.5815 or lohlund@eocwd.com.

Sincerely,

Lisa Ohlund
General Manager
East Orange County Water District

cc: Karl W. Seckel, P.E., Assistant General Manager/District Engineer, MWDOC
MWDOC Board of Directors

October 25, 2018

Rob Hunter
General Manager
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley, California 92708

**SUBJECT: Municipal Water District of Orange County 2018 Water Reliability Study Comments**

Dear Mr. Hunter:

Moulton Niguel Water District appreciates the Municipal Water District of Orange County (MWDOC) studying the long-term reliability of Orange County and providing agencies with the opportunity to provide input on the draft report released in September. The District has reviewed the draft 2018 Water Reliability Study and has several comments:

1. In the 2016 Water Reliability Study by MWDOC, local agencies were provided the opportunity to participate in an iterative process to work collaboratively with MWDOC to ensure that an alignment in approach across local agencies and MWDOC was developed. This resulted in a successful planning document that provided a tool that local agencies could then utilize to inform their own local planning decisions. The 2018 Study update skipped this important iterative process and ignored the feedback provided by multiple agencies to avoid ranking projects due to the local policy and decision making intrinsic to any ranking methodology. Moulton Niguel Water District asks MWDOC to remove the sections that provide project rankings which is fundamentally a local decision to determine approach in evaluating which projects to participate in or pursue.

2. Increasing the local production of water in South Orange County will decrease water flows through existing transmission mains, most notably the East Orange County Feeder #2, Joint Transmission Main and Allen McCullough Pipelines. It is imperative than any cost-benefit analysis of local projects also include the necessary facilities to ensure that water quality regulations are met, especially during the winter months (December through February). The decreased flows through those pipelines would impact the disinfection degradation and create necessary improvements at additional costs which was not included in the 2018 Study. There are also contractual flow obligations through the CM-10 takeout which need to be accounted for in the project cost evaluation.

3. The Study also does not analyze the impacts of local agencies taking more aggressive actions towards demand management. As MWDOC staff is aware, meeting long term supply reliability goals has two broad strategy alternatives: reducing demands or increasing water supplies. The focus of the study is on evaluating new water supply projects to meet the overall gap. Agencies

could also implement more aggressive demand management programs through pricing, marketing, education and other efficiency incentives to reduce demands to prepare for future droughts through extending storage further than would be otherwise. The study included mention of water demands under a 20 percent landscape conversion but fails to account for local agencies implementing further efforts to reduce demands, especially considering the State of California's passage of AB 1668 and SB 606. Moulton Niguel Water District is happy to share some research we've done on the success and cost-effectiveness of water efficiency as an alternative to solely focusing on new water supplies.

4. Direct potable reuse was notably omitted as a potential local new supply in the 2018 Water Reliability Study's project list. Moulton Niguel Water District currently reclaims between 60 and 70 percent of the treated wastewater produced in our service area for beneficial use. As the State develops standards for direct potable reuse by its 2023 deadline, the option to beneficially reuse treated wastewater directly into the potable water system could provide a key strategy towards meeting both supply and system reliability goals. This could provide upwards of approximately 4,000 acre-feet per year of new local potable water supplies for Moulton Niguel Water District alone.

5. Metropolitan Water District currently collects the majority of its revenue on a volumetric basis and its costs are primarily fixed regardless of the amount of water sold. Metropolitan in the past has reviewed and discussed shifting towards a higher fixed cost recovery rate structure. In order to ensure the study provides agencies with a full picture of potential outcomes, MWDOC should also evaluate the impact of Metropolitan shifting towards more of a fixed cost-based rate structure to ensure agencies have the complete picture in evaluating the financial risk associated with their projects.

We appreciate the efforts by MWDOC staff to engage with local agencies and solicit input into the planning process. However, before the MWDOC Board takes any actions on the draft study, we respectfully request that the updates referenced be made to ensure a robust planning document that recognizes local decision making in implementing any new projects.

Thank you for your consideration.

Sincerely,

Joone Lopez

Joone Lopez
General Manager

OCTax.org
OCTAX
Orange County Taxpayers Association

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October 31, 2018

Mr. Rob Hunter

General Manager

Municipal Water District of Orange County

18700 Ward Street
Fountain Valley, CA 92807

Dear Mr. Hunter:

I am writing to provide comments on the Municipal Water District of Orange County's ("MWDOC's") draft Water Reliability Study Update ("Update").

Access to safe, clean and affordable water is a critical component of the Orange County economy. Despite past investments in local water supplies, Orange County must still import approximately half of its water supply from climate-dependent sources that have significant legal, political and regulatory constraints. This makes it imperative that Orange County continue to invest in county-based, local water supplies that enhance water supply reliability and independence in a financially responsible manner.

The Orange County Taxpayer's Associations' ("OCTax") interest in the Update is to ensure that the economic analysis of public-serving infrastructure projects is done in an accurate and transparent manner. The Update acknowledges that the economic analysis has multiple limitations due to a number of different factors. In this regard, OC Tax offers the following comments and suggested edits:

1. The Update should include detailed financial information that serves as the basis for each project's cost estimate. Absent such transparency it is not possible for stakeholders to ensure with any level of certainty that the cost estimates for each project are accurate or that the projects' financial appraisal is reasonably comparable.

   OCTAX has found that the means of delivering a project can result in disparate financial accounting. Projects delivered under a stand-alone project finance structure differ from traditional publicly financed projects.

   Projects not undertaken on a stand-alone project finance basis sometimes treat costs such as land acquisition, permitting, financing and staff time as "sunk." Costs for projects in early development stages are often internalized by the agency/utility. Therefore, it is important for stakeholders to understand whether project costs relied upon by the Update reflect the ratepayer's "all-in" costs.

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2. The Update attempts to provide a cost comparison among projects that are in different phases of development, and many of the projects evaluated in the Update may never be built. Project's in early phases of development typically only have engineering level cost estimates while projects in later stages of development likely have cost estimates based on a formal construction bidding and procurement process. Adjusting for inflation factors alone to account for the time a project requires to reach construction cannot account for the disparity in the accuracy of project cost estimates. In this regard, the Update should assign each project a level of cost certainty commensurate with the development status of the project.

3. The Update should distinguish between projects proposed to be delivered under a Public Private Partnership ("P3") and those proposed to be delivered under a public agency Design Bid Build ("DBB") project delivery method.

   OC Tax supports P3 public infrastructure projects because of the financial protections afforded taxpayers/ratepayers. According to a 2016 *Ernst & Young* report, 74% of large water infrastructure projects are over budget by an average of 49%; and large infrastructure projects in North America are delayed by an average of 33 months prior to the start of operations. According to data from the Congressional Budget Office, operations & maintenance costs are, on average over a 30-year project, 69% higher than costs during the first year of operations excluding inflation.

   Concern about a project's operational financial risk is illustrated by the Update's risk assessment of the Doheny desalination project, which states: *"Slant well technology is a new technology that has only been tested at a pilot scale at Doheny Beach and Cal Am."*

In closing, it is important that stakeholders do not misrepresent the contents or conclusions of the Update and that its limitations be clearly identified early and often throughout the report.

Sincerely,

Carolyn Cavecche

President and CEO

Orange County Taxpayers Association

cc: MWDOC Board of Directors

MWDOC

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October 9, 2018

Mr. Michael Markus General Manager
Orange County Water District
18700 Ward Street
Fountain Valley, CA 92708

RE: MWDOC 2018 Orange County Reliability Study
OCWD Letter of September 28, 2018

Dear Mr. Markus

Thank you for your letter of September 28th. We appreciate your quick preliminary comments on the 2018 Reliability Study after the Member Agency Workshop of September 20, 2018. The comment period will remain open until October 26, 2018, thereby allowing all parties five weeks after the workshop to review and comment. We anticipate having the study back in the Planning and Operations Committee on November 5, 2018.

Let me address each of your comments in order.

1. <u>MWDOC Member Agencies have not been fully engaged in the development of this study as previously occurred with the earlier 2016 version.</u>

   This is true as the 2016 and 2018 studies are fundamentally different. In 2016, we were developing methodologies and tools which were then applied to one scenario (moderate climate change with no WaterFix). Also theoretical portfolios of projects were assembled to demonstrate different ways to reach water reliability. As you state, "numerous workshops were held with the MWDOC Member Agencies to jointly discuss and evaluate the assumptions ultimately used by the model." Coming out of the 2016 study, we had gained significant insight and developed the methods and tools for reliability analysis and scenario planning. Two major comments we received on the 2016 study were that it was (a) too restrictive in terms of planning scenarios in that only one was carried forward for final analysis, and (b) the study's usefulness for decision making was limited in that specific projects could not be objectively compared. The 2018 study was designed to address these issues. The tools developed in 2016 were applied to four scenarios that were designed to bookend likely conditions of climate change and regional project investment. All four scenarios included the WaterFix becoming operational in 2035.

Additional, specific projects were then objectively evaluated to meet Orange County's water supply and system (emergency) reliability needs. MWDOC worked closely with Member Agencies (including OCWD) and project proponents to verify assumptions, yield, and financial information for the projects. The emphasis of this consultative effort was to make sure the information and analysis were correct. MWDOC will continue to entertain input, suggestions and collaboration discussion with its agencies regarding the study results and any updates that may be required from time to time.

2. Numerous assumptions also need to be made to project future water supply conditions and future water demands and those assumptions should be fully discussed and vetted with your Member Agencies.

   I agree that future water demand and supply conditions should be discussed. Part of the discussion occurred during the 2016 study. For example, the demand projections in 2018 are essentially those of 2016, and extensive discussions were held as part of that study. Discussions with Member Agencies were held to identify and quantify future water supply projects. The discussions with OCWD resulted in the final expansion of the GWRS system being included in the supply baseline. However, other groundwater basin projects were not included in the project analysis based on your specific request. The September 20, 2018 Member Agency workshop was designed to facilitate this same discussion along with the stated offer to meet with each individual Member Agency to answer questions and discuss the study.

3. MWDOC should not be ranking and in effect telling its Member Agencies what future water supply projects they should be implementing for the following reasons: (four bullet points follow)

   MWDOC is not telling our Member Agencies what projects implement. We make this very clear at several points in the presentation. What the 2018 study does do is develop a range of reliability needs under different scenarios, details information on several prominent projects, evaluates those projects, and presents MWDOC's findings based on those analyses. As clearly stated, each agency makes its own decisions and can come to other decisions based on their own priorities (please refer to slide #44 of the 2018 Reliability Study PowerPoint presented in the September 20, 2018 Workshop, that notes "Agencies can take different paths to be reliable" and it outlines optional paths within that slide). The MWDOC Board of Directors clearly has the right, if not the obligation, to request both the analysis and the ranking to make their own informed decisions.

   a. No one can predict water supplies and demands with specificity and certainty.

      I agree; and especially when the planning period is greater than 30-years, but that does not mean we should do "nothing" with respect to future planning. Therefore, the 2018 study uses scenarios to evaluate likely ranges of water supplies and demands. While we cannot predict with certainty, we can develop regional ranges for planning to better inform us regarding potential future impacts. As various proponents seek to move projects forward, we are often asked, "will MET be reliable" and what will MET water cost over time. The study provides both answers. Our working concept is that it is better to move forward with reasonable and workable estimates than without any estimates.

b. It is up to the governing body of each water agency in Orange County to decide what projects they desire to develop and/or participate in.

I agree that it is up to the governing body of each water agency to decide what projects they desire to develop. Although I think you would agree with me that there are some problems with project opt-out provisions. We make your exact point related to demand curtailment; that it is up to each agency to decide "what level of demand curtailment" works in their service area. In the 2018 study, we assumed that with demand hardening a reasonable working limit was for agencies to ask their customers to reduce water use by 10% every 20 years. But, like you, we make the point that a utility could decide that it is an acceptable level of service to request a 25% reduction every three-years. This would have the result of requiring significantly less new supply development. However, it is highly probable that customer support would be limited for the size and frequency of those reductions. But it is the individual utility's decision.

c. Each MWDOC member agency governing body is responsible for allocating financial resources in the best manner possible for its individual agency. Having the MWDOC Study in effect telling your Member Agencies how they should spend their money is not appropriate.

Again, we agree with the responsibilities of each agency, and that also applies to MWDOC. In your opening paragraph you write "the study provides a good analysis of future water supply needs for the region that MWDOC Member Agencies can use in evaluating potential future projects and water supply strategies." That is exactly what the study was designed to do; not dictate Member Agency actions.

d. The various potential future water supply projects and programs being evaluated are in different stages of development and can be different in nature. Additionally, the nature of the projects can be different. Some are storing water. Some are creating new annual supplies, while another project relies upon capturing intermittent rainwater.

Absolutely. Because the projects are in different stages of development and provide different benefits, we closely reviewed costing assumptions and contingencies. There is no guarantee that any project will be constructed. Therefore, the study looks at what projects could substituted for projects that do not move forward. Because the projects are different in nature, we considered how different types of projects could meet specific needs and integrate into a comprehensive system.

In your closing paragraph you request that any sections of the MWDOC Study ranking or recommending projects be removed. I have passed this request on to my Board of Directors.

Thank you for your ongoing review and active participation.

Sincerely,

Robert J. Hunter
General Manager

cc: MWDOC Board of Directors
MWDOC Member Agencies
OCWD Board of Directors
OCWD Producers

ORANGE COUNTY COASTKEEPER.
3151 Airway Avenue, Suite F-110
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Phone 714-850-1965
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October 26, 2017

Via email to:
Mr. Rob Hunter
General Manager
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley, CA 92708

**Subject: Comments on 2018 Update to Orange County Water Supply Reliability Study**

Dear Mr. Hunter,

Orange County Coastkeeper is a nonprofit environmental organization that believes all people have the inalienable right to clean water. Coastkeeper's work promotes and restores water resources that are Drinkable, Fishable, Swimmable, and Sustainable. After reviewing the documents for the Municipal Water District of Orange County (MWDOC) 2018 Water Reliability Study we have the following comments:

1. MWDOC staff have done a great job collecting, consolidating and analyzing the data for this report. The background document and presentations produced for the study provide an objective, science based review of the reliability needs and water supply options for Orange County. As the only Orange County water district covering all of Orange County, MWDOC has the unique ability and obligation to analyze these issues. By nature the individual cities and water districts that provide Orange County's water are focused on their own service area and the specific projects they are interested in. As explained in the draft study, some projects considered by individual suppliers may have negative implications for the rest of the county, including stranded assets and unwanted impacts to water quality, the environment and ratepayers. The narrow focus of the local districts makes it critical that MWDOC maintain its independent county wide perspective in the study to insure that the public and decision makers get objective information free from local agency bias.

2. The final document must be designed for use by the general public as well as agency staff and elected officials. The draft background document states "The purpose of the 2018 OC Reliability Study is to develop and present information that will enable informed decision making by staff and elected officials….." The ratepayers that provide the funding for MWDOC and all of the other water suppliers also have a need for and right to objective information on their water supply. This information is necessary for the public to participate in the decision making process at MWDOC and the local water suppliers. Also, this is complicated information and from comments expressed already it is clear that even some Water District Directors and staff do not understand the underlying concepts or see the big picture. A clear and understandable final report with an executive summary is necessary to insure that the main points of the report are understood by all.

3. The rankings of projects must stay in the final report and be expanded to include projects that were not ranked in the draft report. The rankings are the most understandable and important part of the report. This much needed simplification of the complicated data in the report clarifies economic, supply and reliability realities and gives important insight into the variety of options for future water supplies. It is not

surprising that proponents of some of the projects that did not rank well are calling for the ranking to be eliminated in the final report. MWDOC should not bow to these narrow interests. The final report should also include rankings for the Carson recycling, West Orange County Wellfield, Prado Dam Stormwater Capture and the SARCCUP projects. The pilot version of the Carson project is already under construction and feasibility studies are complete for the West OC and Prado projects. The SARCCUP project is already funded through a state grant program.

4. As mentioned in the 2018 draft background report a 2016 water supply analysis produced for Coastkeeper by James Fryer suggested that the water demand projections used in the 2016 report (and again in the 2018 draft) are too high. That is still our opinion. The 2018 draft MWDOC report talks about a hardening of demand going forward due to many indoor water conservation improvements having been made. We believe that there is still huge potential for conservation improvements not only indoors but through outdoor landscape improvements. There are over one million housing units in Orange County and with landscaping consuming 60%-70% of our water supply there are plenty of water conservation opportunities still available.

5. The final report should combine the primary and additional findings and incorporate them into the report simply as findings. A review of the "additional" findings does not show them to be less important than the others, all of the findings are significant and provide needed information to the reader.

6. All written comments on the MWDOC 2018 Water Reliability Study should be posted on the MWDOC website similar to how the Regional Water Boards post information on their projects.

Thank you for your consideration.
Regards,

Raymond Hiemstra
Associate Director
Orange County Coastkeeper

SINCE 1933

**ORANGE COUNTY WATER DISTRICT**

ORANGE COUNTY'S GROUNDWATER AUTHORITY



September 28, 2018

Rob Hunter
General Manager
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley CA 92708

SUBJECT: Municipal Water District of Orange County - Orange County Water Reliability Study

Dear Mr. Hunter:

The Municipal Water District of Orange County (MWDOC) is in the process of preparing and finalizing the 2018 Orange County Water Reliability Study (Study). The Study provides a good analysis of future water supply needs for the region that MWDOC member agencies can use in evaluating potential future projects and water supply strategies.

A draft of the Study was recently presented to and discussed with the MWDOC member agencies on September 20, 2018. The Study will be discussed with the MWDOC Policy and Operations Committee on October 1, 2018.

The Orange County Water District (OCWD) has not had sufficient time to analyze all of the information in the Study and respectfully requests the MWDOC Board to provide your member agencies additional time to review and provide comments on the Study prior to the MWDOC Board taking any final action on the document. At this time, OCWD provides the following preliminary comments on the Study:

1. The MWDOC member agencies have not been fully engaged in the development of this Study as previously occurred with the earlier 2016 version. The Study relies upon a model developed by CDM Smith to assess the potential benefits of possible future projects. For the 2016 Study version, numerous workshops were held with the MWDOC member agencies to jointly discuss and evaluate the assumptions ultimately used by the model. Workshops of this nature have not occurred with the 2018 Study.

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2. Numerous assumptions also need to be made to project future water supply conditions and future water demands and those assumptions should be fully discussed and vetted with your member agencies. Minor reasonable changes to the assumptions currently being made can have major impacts to the Study results. OCWD believes the MWDOC member agencies should have the opportunity to participate in those types of decisions.

3. MWDOC should not be ranking and in effect telling its member agencies what future water supply projects they should be implementing for the following reasons:

   - No one can predict future water supplies and demands with specificity and certainty. The MWDOC Study does a good job of highlighting the many variables that could impact our future water resources and makes reasonable estimates in attempting to assess future water supply conditions. However, reasonable changes can be made to the MWDOC Study assumptions that result in different future water supply conditions for our region. If our future is different from what is being projected in the Study, then MWDOC could be telling its member agencies to fund and implement the wrong projects.

   - It is up to the governing body of each water agency in Orange County to decide what projects they desire to develop and/or participate in. Each water agency governing body has a duty to represent its constituents in the best manner possible. Governing bodies can have different water reliability philosophies and different financial resources. One governing body could decide it never wants its constituents to be called upon to temporarily reduce their water demands during a drought period while another governing body could decide that asking its constituents to reduce their demands by up to 25% three out of every ten years is acceptable. One governing body could decide it is willing to reduce future water supply uncertainty by developing a new local water supply project while another governing body could decide it is willing to accept a certain level of uncertainty. One governing body could decide it wants to develop a project it knows it can permit while another governing body could decide to attempt to develop a less expensive project that may not be permittable. The MWDOC Study and project recommendations are making these types of decisions for Orange County water agencies which is not appropriate nor under MWDOC's or any other water agency's authority.

   - Each MWDOC member agency governing body is responsible for allocating financial resources in the best manner possible for its individual agency. Having the MWDOC Study in effect telling your member agencies how they should spend their money is not appropriate

- The various potential future water supply projects and programs being evaluated are in different stages of development and can be different in nature. The estimated cost of the projects vary in refinement and accuracy. This makes it difficult to compare the projects. Some of the projects are only concepts. Some of the projects have had CEQA completed. It is also debatable if some of the projects even have a chance of occurring due to regulatory and institutional issues - while other projects may be relatively easy to permit. It is unreasonable to assume all the projects will eventually obtain the permits necessary for their construction. Additionally, the nature of the projects can be different. Some are storing water. Some are creating new annual supplies, while another project relies upon capturing intermittent rainwater. Again, each MWDOC member agency governing body needs to evaluate these types of issues and make decisions that are best for its service area.

Given these issues, OCWD respectfully requests that any sections of the MWDOC Study ranking or recommending projects be removed.

Thank you for your consideration.

Sincerely,

Michael R. Markus, P.E., D.WRE, BCEE, F.ASCE
General Manager

Cc: OCWD Board of Directors
OCWD Groundwater Producers
MWDOC Board of Directors

SINCE 1933

**ORANGE COUNTY WATER DISTRICT**

ORANGE COUNTY'S GROUNDWATER AUTHORITY



October 26, 2018

Rob Hunter
General Manager
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley CA 92708

SUBJECT: Municipal Water District of Orange County - Orange County Water Reliability Study

Dear Mr. Hunter:

The Municipal Water District of Orange County (MWDOC) is in the process of preparing and finalizing the 2018 Orange County Water Reliability Study (Study). The Study provides a good analysis of future water supply needs for the region that MWDOC member agencies can use in evaluating potential future projects and water supply strategies. MWDOC has indicated that comments on the Study will be received until October 26, 2018.

Orange County Water District (OCWD) provided preliminary comments on the Study via a letter dated September 28, 2018. OCWD's primary comment with that letter was MWDOC is in effect telling its member agencies what future water supply projects they should be implementing. By ranking projects and presenting them in the manner chosen in the Study, it will be difficult for your member agencies to implement projects not favorably described therein. OCWD again respectfully request MWDOC to remove any portions of the Study discussing project rankings and offers the following to support this request.

- MWDOC's member agencies may have different water reliability objectives than what is assumed in the Study. Changing the reliability objectives of the Study could change the project rankings table.
- Orange County's water supply future could be different than the scenarios used in the Study. The Study attempts to "bookend" possible future conditions of climate change and regional water supply project investments to evaluate what future local projects should be considered. Due to the numerous variables that will impact future water supplies, OCWD suggests that actual 2040 water supply conditions in our region could easily fall outside these bookends. The project rankings table could then significantly change.
- MWDOC should recognize the inherent nature and uncertainty of any study attempting to predict the future and the need to acknowledge the limitations of such an effort and to avoid making any absolute conclusions about potential projects.
- It is difficult to compare many of the potential future projects being ranked in the Study as they are in various stages of development, different in nature, provide

different direct and indirect benefits, and some projects may not be viable and/or permittable.

- The Study could potentially be used by opponents of certain projects in an attempt to convince regional permitting agencies to deny a permit or financial support for projects with an unfavorable ranking that are being considered by your member agencies. Such a scenario would be particularly frustrating to your member agencies.

OCWD also suggests it would be helpful to your member agencies if one comprehensive final document could be prepared regarding the Study that also provides the technical data and assumptions used in its preparation. Currently, MWDOC has only provided a Background Report and a PowerPoint presentation for review and comment. For example, no technical backup data has been provided to support the financial analysis presented in the Study. This element of the Study is new to your member agencies. This data should be provided for review prior to any type of board action.

In summary, OCWD believes the MWDOC study provides good information to your member agencies to assist them in evaluating the future reliability of imported water supplies to help determine what future water supply projects they should consider for implementation. However, for the reasons provided in this letter and our previous letter, OCWD believes the study goes too far in attempting to compare and rank a variety of projects in an uncertain future. By doing such MWDOC is indirectly telling its member agencies what projects they should implement and is making it difficult for its member agencies to consider projects not ranking high with this specific analysis under your assumed future conditions. For these reasons OCWD again respectfully requests MWDOC to delete any sections of the Study ranking or indirectly recommending projects.

Thank you for your consideration of our comments.

Sincerely,

Michael R. Markus, P.E., D.WRE, BCEE, F.ASCE
General Manager

Cc: OCWD Board of Directors
OCWD Groundwater Producers
MWDOC Board of Directors

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