ECONOMIC ANALYSIS OF THE CHINO BASIN PROGRAM AND ITS ALTERNATIVES FOR CONSIDERATION BY THE CALIFORNIA WATER COMMISSION

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Acronyms and Abbreviations

1,2,3-TCP	1,2,3-Trichloropropane
AWPF	Advanced Water Purification Facility
BC	benefit-cost
CBP	Chino Basin Program
CDFW	California Department of Fish and Wildlife
CEC	contaminant of emerging concern
CVP	Central Valley Project
CVWD	Cucamonga Valley Water District
Delta	Sacramento-San Joaquin Delta
DWR	California Department of Water Resources
FWC	Fontana Water Company
FY	fiscal year
IEUA	Inland Empire Utilities Agency
IRP	Integrated Resources Plan
IW	imported water
Metropolitan	Metropolitan Water District of Southern California
NPDES	National Pollutant Discharge Elimination System
NPV	net present value
NRW	non-recoverable wastewater
OBMP	Optimum Basin Management Program
PFOA	perfluorooctanoic acid
RMP	Recharge Master Plan
RP	recycling plant
RWQCB	Regional Water Quality Control Board
SCRB	separable cost remaining benefit
SWP	State Water Project
TAF	thousand acre-feet
TAFY	thousand acre-feet per year
TDS	total dissolved solids
TM	technical memorandum
TYF	Ten Year Forecast
USBR	United States Bureau of Reclamation
UWMP	Urban Water Management Plan
WFA	Water Facilities Authority
WSIP	Water Storage Investment Program
WUE	Water Use Efficiency

Executive Summary

> This Technical Memorandum provides an update to the Chino Basin Program Economic Analysis Technical Memorandum completed in June 2021. It includes a refined set of program alternatives and improved methodologies for estimating project costs and benefits. The quantified costs and benefits presented here are valued from a statewide perspective and are intended to support a finding by the California Water Commission that the Chino Basin Program is feasible and qualified to receive Proposition 1 Water Storage Investment Program funding. These costs and benefits do not necessarily reflect specific financial impacts to IEUA or its member agencies that could affect investment decisions by those agencies.

The Inland Empire Utilities Agency (IEUA) strives to secure a reliable, high-quality water supply through the use of various water sources, including imported water, stormwater, groundwater, and recycled water for its member agencies. The use of groundwater and recycled water within the region is constrained by the Regional Water Quality Control Board (RWQCB) and the State Water Resources Control Board – Division of Drinking Water, which define limits for total dissolved solids (TDS) and contaminants of emerging concern (CECs), such as 1,2,3-Trichloropropane (1,2,3-TCP), perfluorooctanoic acid (PFOA), and microplastics in IEUA's recycled water and groundwater.

These water quality challenges inform water supply reliability within the region. Rising levels of TDS and CECs threaten the continued use and recharge of recycled water, which accounts for 20 percent of IEUA's water supply portfolio. This supply is critical for the region as imported water supplies, which account for 25 percent of the region's water supply, become less reliable due to climate change and drought.

Recent projections indicate that no new supplies will be needed over the next 25 years to meet future demands. This assumes that all sources used by IEUA, including recycled water, are reliable through this timeframe. However, IEUA estimates that without taking additional action, TDS limits for recycled water direct non-potable use and groundwater recharge may be exceeded within the next 10 years. Additionally, CECs such as 1,2,3-TCP and PFOA are entering IEUA's regional water recycling facilities, which are not designed for their removal. Together, these concerns threaten the reliability of recycled water within the region.

As a result, the region's focus for the next 25 years is to enhance water supply reliability through the implementation of various management strategies, including advanced water purification. By treating recycled water to meet regulatory compliance limitations for TDS and other contaminants, the region is able to secure this resource, which both enhances water supply resiliency and protects the investments that the region has been making for over 20 years in the recycled water program.

Beyond 2050, IEUA has prioritized securing additional water supplies to support flexible resource management in light of the increased likelihood of drought and potential interruptions to imported water supplies due to catastrophic events. This requires additional investments in infrastructure to produce more local supplies within the region, such as groundwater and recycled water.

Alternatives that could address these needs over the next 50 years have been developed and refined over the past several years. An economic analysis of alternatives evaluated in 2020 is documented in the Chino Basin Program Economic Analysis Technical Memorandum, June 2020. Since that report was completed, outreach has continued with IEUA member agencies, the Metropolitan Water District of Southern California (Metropolitan), and California state agencies. Through this engagement, project alternatives have been refined and now include:

- Baseline Compliance Plan
- Regional Water Quality and Reliability Plan
- Chino Basin Program (CBP)

The Baseline Compliance Plan addresses water quality challenges in the region through implementation of a 15 thousand acre-foot per year (TAFY) advanced water purification facility (AWPF). The full capacity would be constructed in two phases, with the first phase providing 9 TAFY of AWPF capacity to be online by 2030 and the second phase providing an additional 6 TAFY of AWPF capacity to be online by 2040. The Regional Water Quality and Reliability Plan builds upon this alternative to address both water quality and water supply challenges through a 15 TAFY AWPF, additional recycled water supplies, groundwater injection infrastructure, and extraction facilities with 15 TAFY capacity, all to be online by 2030. Similarly, the CBP builds upon the Regional Water Quality and Reliability Plan to address water quality and supply challenges, provide public benefits through ecosystem and water quality improvements, and additional supplies for emergency response. This is accomplished through increasing total groundwater extraction capacity to 40 TAFY and introduction of a pipeline distribution network that provides capability for local use of CBP water supplies in lieu of deliveries from Metropolitan and an interconnection to allow direct pump in to Metropolitan's water distribution system. These features facilitate a water exchange between Metropolitan and the State Water Project (SWP). The CBP is assumed to be online by 2028. Maximum conditional funding for this alternative in the amount of $206.9 million funded by the Proposition 1 Water Storage Investment Program (WSIP) was approved by the California Water Commission (CWC) in 2018 and increased to $212.1 million by the CWC in 2021.

An economic evaluation was performed to assess the feasibility of these alternatives in addressing regional water quality and water supply challenges. This evaluation addressed several key questions, including:

- What are the consequences of No Action?
- Should IEUA implement a single-purpose Baseline Compliance Plan or pursue a multipurpose project that also addresses water supply reliability and other objectives?
- If IEUA chooses to pursue a multipurpose project, should IEUA accept Proposition 1 WSIP funding and move forward with the CBP, or does it make more economic and financial sense to forego the funding and pursue the Regional Water Quality and Reliability Plan?
- What are the most sensitive assumptions and how do they affect the comparison of alternatives?

Benefits for each alternative were monetized and cost components were quantified to estimate the life cycle net present value (NPV) of each alternative. Benefit-cost (BC) ratios were also calculated for each alternative. These costs and benefits are evaluated from a statewide perspective that considers comprehensive costs and benefits accruing to the state or nation as a whole. Under this approach, not all costs and benefits would accrue to IEUA or its member agencies; therefore, this evaluation does not specifically address investment decisions by these agencies. Rather, this evaluation is intended to support a finding by the CWC that the Chino Basin Program is economically feasible and qualified to receive WSIP funding. A graphical depiction of the results of this analysis over a life-cycle period of 50 years is provided in **Figure 1**.

Overall, the Baseline Compliance Plan provides less benefits to the region because this alternative addresses only water quality-related regulatory challenges and does not include any project components to enhance regional water supply. Because the benefits of compliance with water quality regulations are assumed to be equivalent to costs of implementing the Baseline Compliance Plan for this economic evaluation, the NPV is estimated at $0. The Regional Water Quality and Reliability Plan and the CBP both provide equivalent water quality benefits in comparison to the Baseline Compliance Plan, but also result in other significant benefits that increase the NPV values of these alternatives.

In comparison to the CBP, the Regional Water Quality and Reliability Plan provides greater water supply benefits over the life cycle of the alternatives. During the first 25 years of the project life when the CBP is committed to the Proposition 1 WSIP water exchange, CBP water supply benefits are achieved through pump in and in-lieu delivery to Metropolitan. A smaller portion of the new AWPF water supply is available exclusively for local use during this period, and provides Metropolitan demand offset benefits. Under the Regional Water Quality and Reliability Plan, all new AWPF water supply is available for local use and is valued as Metropolitan demand offset. Both alternatives also offer similar shortage avoidance benefits based on the access provided to new replacement supplies during years that Metropolitan imported water supplies are curtailed. In total, the life cycle present value water supply benefits of the Regional Water Quality and Reliability Plan are about 28 percent higher in comparison to the CBP.

In comparison to the Regional Water Quality and Reliability Plan, the CBP provides greater emergency water supply benefits due to the greater groundwater extraction capacity, which would provide greater access to needed water supplies during a critical infrastructure failure that curtailed normal delivery of imported water supplies. The life cycle present value emergency water supply benefits of the CBP are over twice the value of those provided by the Regional Water Quality and Reliability Plan.

The CBP also provides ecosystem benefits valued at about $120 million over the life cycle of the alternative. These benefits accrue as a result of the Proposition 1 WSIP water exchange over the first 25 years of the project life.

The Baseline Compliance Plan represents the least cost alternative for achieving IEUA's single purpose water quality improvement objective in this economic evaluation and has lower capital and life cycle costs in comparison to the Regional Water Quality and Reliability Plan and the CBP. Total life cycle costs for the CBP are about 20 percent higher than the Regional Water Quality and Reliability Plan. Total life cycle present value benefits of the CBP are greater than the Regional Water Quality and Reliability Plan by about six percent.

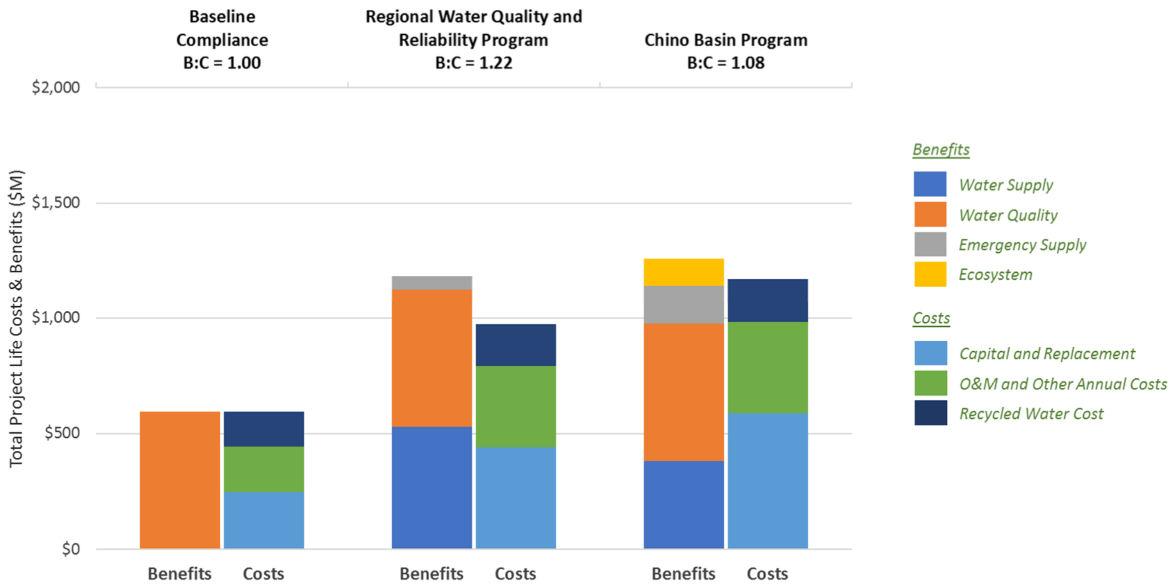

Figure 1: Life Cycle Benefits and Costs Analysis of Alternatives

This economic analysis suggests the following in response to the key questions:

- **What are the consequences of No Action?** IEUA estimates that without taking additional action, TDS limits for recycled water direct non-potable use, groundwater recharge, and effluent discharge may be exceeded within the next 10 years. This exceedance will affect IEUA's ability to continue its groundwater recharge program and reuse of recycled water, substantially increasing dependence on imported water supplies. As imported supplies become less reliable, more frequent severe water shortages will occur in the region. A No Action approach results in the Chino Basin being out of regulatory compliance, threatens water supply, and does not meet IEUA's objectives. Therefore, No Action is not considered as to be a feasible alternative and is not considered further in this economic evaluation.

- **Should IEUA implement a single-purpose water quality Baseline Compliance Program, or pursue a multipurpose project that also addresses water supply reliability and other objectives?** There is significant value for IEUA in pursing either multipurpose project alternative, the Regional Water Quality and Reliability Plan or the CBP, in comparison to the single purpose Baseline Compliance Program. Both the Regional Water Quality and Reliability Plan and the CBP provide cost-effective approaches to providing for future regional water needs and shoring up the reliability of existing water supply portfolios.

- **If IEUA chooses to pursue a multipurpose project, should IEUA accept Proposition 1 WSIP funding and move forward with the CBP, or does it make more economic and financial sense to forego the funding and pursue the Regional Water Quality and Reliability Plan?** Both the Regional Water Quality and Reliability Plan and the CBP are economically feasible and provide value for their required investment. Both alternatives expand regional water supply portfolios and provide the means to avoid water shortages due to decreasing reliability of imported water supplies. The primary differences in the alternatives are 1) the Regional Water Quality and

Reliability Plan provides a supplemental water source over the first 25-years of the project life while much of the new water supply under the CBP would be used in place of imported supplies and 2) the CBP provide greater ability to optimize water management due to its substantially greater groundwater extraction capacity compared to the Regional Water Quality and Reliability Plan. IEUA Urban Water Management Plans project a low need for new water supplies over the next 25 years to meet projected regional demands under hydrologically normal conditions. If the supplemental water supply provided by the Regional Water Quality and Reliability Plan over the first 25 years of the project life is not required to meet growing demands, then both alternatives offer similar water supply benefits due to their ability to help avoid regional water shortages over that period. During the second 25 years of project life, the CBP provides a lower cost approach to securing an equivalent level of water supply benefit as the Regional Water Quality and Reliability Plan, while providing greater flexibility for groundwater management due to the increased groundwater extraction capacity and water system interconnection infrastructure provided by the alternative.

- **What are the most sensitive assumptions and how do they affect comparison of alternatives?** Due to the similarities in the infrastructure included in the Regional Water Quality and Reliability Plan and the CBP, variation in assumptions regarding future escalation of capital costs, operations and maintenance (O&M) costs, and Metropolitan water costs has little effect on the economic ranking of project alternatives. However, variations in these assumptions significantly affect the absolute value of both the Regional Water Quality and Reliability Plan and the CBP. Considerable attention should be given to these assumptions to ensure they reflect the project participants' perspective regarding future economic conditions, future water supply availability for water sources dependent on hydrology or subject to infrastructure failure, and risk tolerance. Overall, the range of assumptions considered does not significantly affect the economic ranking of project alternatives, and all project alternatives retain value relative to costs even under the extremes considered.

As a result, the following recommendations are provided:

- Methodologies and assumptions applied in this economic evaluation should be closely considered.
- Projections for near-term regional water supply needs should be reviewed and refined. A projected need for increased regional new water supplies over the next 25 years could affect the comparison of the Regional Water Quality and Reliability Plan and CBP alternatives.
- In comparing project alternatives, consider the value of benefits that were not monetized for this economic evaluation, including added flexibility for groundwater management to avoid land subsidence impacts or water quality issues from contaminants of emerging concern.
- Potential partnerships on a broader regional basis with Metropolitan or others could provide additional return on investments made in either the Regional Water Quality and Reliability Plan or the CBP, through groundwater banking or other mutual aid opportunities.

1 Introduction, Background, and Purpose

1.1 Introduction

Inland Empire Utilities Agency (IEUA), located in western San Bernardino County, serves approximately 875,000 residents in a 242-square-mile service area. As a regional wastewater treatment agency, IEUA provides sewage utility services to seven contracting agencies under the Chino Basin Regional Sewage Service Contract: the cities of Chino, Chino Hills, Fontana, Montclair, Ontario, Upland, and Cucamonga Valley Water District (CVWD) in the city of Rancho Cucamonga. In addition to the contracting agencies, IEUA provides wholesale imported water (IW) from Metropolitan Water District of Southern California (Metropolitan) to the Water Facilities Authority (WFA), CVWD in the city of Rancho Cucamonga, and Fontana Water Company (FWC) in the city of Fontana; the Water Facilities Authority then serves imported water to the cities of Chino, Chino Hills, Ontario, Upland, and Monte Vista Water District in the city of Montclair (**Figure 2**).

Figure 2: IEUA Service Area

IEUA and local partners have long-term plans to implement a variety of new infrastructure to meet future needs for wastewater treatment and potable water supplies, while increasing resiliency and sustainability of regional water resources management. Some of the facilities included in these plans are addressed in IEUA's Ten Year Forecast (TYF) and Integrated Water Resources Plan (IRP). The Chino Basin Program (CBP) provides an opportunity to implement critical components of these plans, addressing local, regional, and potentially statewide and federal water resources management issues. The CBP is a revolutionary, first-of-its-kind program designed to help the region move beyond traditional water management practices into a new era of water use optimization. The CBP promotes proactive investment in managing the water quality of the Chino Groundwater Basin (Basin) and meeting regional water supply reliability needs in the face of climate change, while leveraging California's interregional plumbing system and the Chino Basin's future potential for water recycling to produce benefits to local, State, and federal interests. This technical memorandum (TM) describes the CBP and these benefits and summarizes its feasibility relative to other alternatives for addressing the region's needs.

1.2 Chino Basin Program Background

IEUA's CBP is an innovative approach to addressing local, regional, and statewide water resources management issues through strategic partnerships, creative water exchanges, and deployment of new critical infrastructure.

The CBP would be developed to provide flexibility to regional and local water operations, particularly during future extended droughts expected to impact California as climate change continues. New groundwater recharge and extraction facilities, conveyance facilities, and water system interconnections would allow more optimal management of local water supplies, including improved storage and recovery operations, as well as redundancies in water delivery infrastructure that will facilitate future rehabilitation and replacement needs. The CBP would also develop new southern California advanced water treatment supplies to be stored in the Chino Groundwater Basin and exchanged in dry years for southern California-bound State Water Project (SWP) supplies stored in northern California. The stored northern California water would subsequently be released as multi-day pulse flows to support anadromous fish populations in the Feather River and the Sacramento-San Joaquin Delta (Delta), providing a statewide public benefit. The term for this exchange would be fixed at 25 years, after which time the CBP infrastructure would be devoted to meeting local water management needs while fulfilling WSIP commitments to improve water quality in the Chino Groundwater Basin and provide a source of emergency water supply.

Under the CBP, IEUA would operate an advanced water purification facility (AWPF) with 15 thousand acre-feet per year (TAFY) capacity that can remove total dissolved solids (TDS) and other contaminants of emerging concern (CEC), to meet Santa Ana Regional Water Quality Control Board (RWQCB) water quality objectives. Other key project components would include groundwater injection facilities and infrastructure to convey the AWPF's treated effluent to the recharge facilities, production wells to extract stored groundwater, and infrastructure to connect the production wells and treatment facilities to a pipeline distribution network to deliver water to local agencies and pump in to Metropolitan's water distribution system.

The capacity and operation of the production wells would be designed to perform the maximum annual water exchange during a dry year (i.e., 40 TAFY). Mechanisms for meeting this annual water exchange include a combination of pumping locally stored and treated groundwater directly back into the Metropolitan system and in-lieu pumping where groundwater is pumped locally in place of Metropolitan supplies that would otherwise be delivered locally.

1.3 Economic Analysis Purpose

IEUA and its member agencies face several water-reliability challenges within the region. As the demand for water increases with population growth, climate change is expected to increase the frequency of droughts and degrade the reliability of both imported and local water supplies. Furthermore, there is a regional need to improve the capability to respond to emergency events and water supply disruptions. Combined, these challenges call for a more diverse water supply portfolio by maximizing recycled water use, while reducing dependence on imported water.

The use of recycled water within the region hinges on compliance with regulatory limitations for TDS in IEUA's recycled water. Today, IEUA estimates that without taking additional action, these limits may be exceeded within the next 10 years. Together with other water quality challenges, such as responding to future water quality regulations for CECs, advanced treatment has emerged as an optimal solution to address water supply and water quality needs in an integrated manner.

A number of objectives, as further described in Section 2.1, have been established to address these challenges on a regional scale and guide development of project alternatives. A typical first step in determining the viability of project alternatives is to conduct an economic evaluation by quantifying benefits and costs of each alternative from a societal point of view. An economic evaluation is followed by a financial analysis to assess project alternatives from the project proponent's viewpoint, including potential effects on ratepayers and return on investment.

Economic analyses must attempt to fully capture the value of all potential benefits associated with investments in new infrastructure. Water supply reliability benefits resulting from new supplies generated by proposals involving new recharge, extraction, and water system interconnection infrastructure can be partially valued based on using new supplies to reduce water purchases from Metropolitan, reducing the quantity of imported water supplies delivered to the region. Access to new supplies can also provide significant value by reducing economic impacts resulting from water supply shortages, when imported supplies provided by Metropolitan are less available and a premium is applied to delivery of water over allocation thresholds or emergency events significantly curtail water deliveries for an interim period. Moreover, value is also realized through use of the proposed facilities to provide alternative water supply during the planned Rialto Pipeline Rehabilitation and through operational flexibility to reduce risk of subsidence-related damage to regional infrastructure.

The purpose of this economic analysis is to perform a refined economic analysis of the alternatives developed to respond to water quality and supply challenges within the region while considering the potential to contribute to ecosystem improvements in northern California. This analysis is performed by quantifying benefits and costs of each of the alternatives, along with other decision-support criteria (i.e., BC ratio) that are used to identify tradeoffs. Together with an evaluation of how well each alternative meets the program objectives, project participants can use this information to help determine the feasibility of alternatives and an investment strategy for meeting the program objectives.

1.4 TM Organization

The following information is presented in this TM:

- **Section 1: Introduction, Background, and Purpose** – provides an introduction, CBP background, and the purpose of the economic analysis
- **Section 2: Regional Conditions Summary –** provides information related to existing conditions and water resources challenges within the region, along with a summary of regional planning efforts
- **Section 3: Economic Evaluation Methodology** – summarizes regional objectives, key questions to be answered, and specifies project alternatives along with the general methodology for the economic evaluation
- **Section 4: Comparison of Alternatives** – compares project alternatives in terms of costs, benefits, net present value, and cost allocation

- **Section 5: Sensitivity and Uncertainty** – explores the sensitivity of various parameters on benefits, costs, and BC ratios
- **Section 6: Conclusions and Recommendations** – provides conclusions and recommendations from the economic evaluation

2 Regional Conditions Summary

2.1 Existing Conditions and Water Resources Challenges

The Chino Basin is an integral part of the regional and statewide water supply system and is one of the largest groundwater basins in southern California with about 5,000,000 acre-feet of groundwater and an unused storage capacity of about 1,000,000 acre-feet. Cities and other water supply entities produce groundwater for all or part of their municipal and industrial supplies and about 300 to 400 agricultural users also produce groundwater from the Basin.

Formed in 1950, IEUA is a member of the Metropolitan and thus acts as a supplemental water provider. The water resource inventory for the IEUA service area is made up of stormwater, local surface water, groundwater, imported water, and recycled water.

- Stormwater comes primarily from rain and snow starting in the San Gabriel Mountains, moves down through the Santa Ana watershed, and is diverted into groundwater recharge basins.
- Local surface water is similar to stormwater, but the water is diverted and treated at a water treatment facility within the service area.
- Groundwater makes up the majority of the area's annual water supply and comes primarily from the Chino Groundwater Basin and adjacent basins. These basins include Cucamonga, Rialto, Lytle Creek, Colton, and the Six Basins groundwater basins.
- Imported water is purchased from Metropolitan.
- Recycled water is generated from IEUA's four recycling plants.

The four regional water recycling plants used to treat wastewater from IEUA's service area include: Regional Water Recycling Plant No. 1 (RP-1), located in the city of Ontario; Regional Water Recycling Plant No. 4 (RP-4), located in the city of Rancho Cucamonga; Regional Water Recycling Plant No. 5 (RP-5), located in the city of Chino; and Carbon Canyon Water Recycling Facility, located in the city of Chino. In conjunction with these facilities, IEUA maintains and operates a desalter facility, Chino I Desalter, in the city of Chino and a biosolids composting facility, Inland Empire Composting Facility, in the city of Rancho Cucamonga on behalf of the Chino Basin Desalter Authority and Inland Empire Regional Composting Authority, respectively (**Figure 3**).

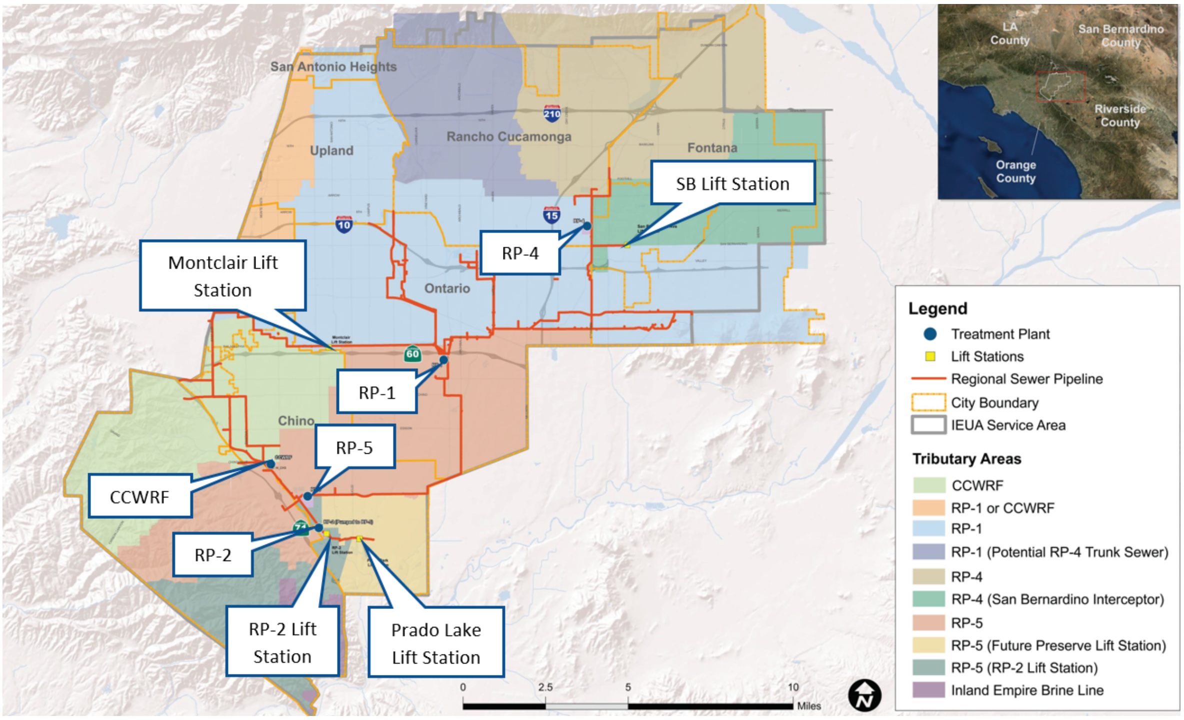

Figure 3: IEUA Facility Locations

As one of the stewards responsible for managing water and wastewater in the region, IEUA continuously evaluates challenges and develops solutions to address them, all with the goal of securing a reliable, high-quality water supply in a cost-effective manner. This goal involves the use of various water sources, including imported water, stormwater, groundwater, and recycled water.

For many years IEUA has led comprehensive water resources planning for its service area. IEUA's 2015 IRP was developed "*to integrate and update water resources planning documents in a focused, holistic manner and to develop an implementation strategy that will improve near-term and long-term water resources management for the region*." The IRP recognized the increasingly uncertain future of imported water supplies due to climate and environmental factors, the importance of enhancing local water supplies, and the Chino Groundwater Basin water quality challenges, and outlined a roadmap to guide regional investments over the next 25 years. The following is a summary of major water sources' problems, needs, and opportunities in the Chino Basin region.

<u>Water Quality</u>

Although California water quality standards are maintained by IEUA and its municipal partners, the quality of water supplies in the region has generally declined due to increases in salinity concentrations in imported water, recycled water, groundwater supply sources (polluted runoff from urban, agricultural, and other development), and changes in the physical environment.

Approximately 25 percent of the water used in the region is imported by Metropolitan through the SWP. While Metropolitan provides imported water to its member agencies from both the Colorado River and the SWP, IEUA only purchases water from Metropolitan that originates from the SWP due to water quality limitations and operation of the regional recycled water program. Water imported from the Colorado River system has increased TDS and would cause IEUA to exceed permit limits for recycled water reuse consistent with the goals set within the Santa Ana River Water Quality Control Plan (Basin Plan) and maximum benefits as defined in the Optimum Basin Management Program (OBMP).

On average, groundwater from the Chino Groundwater Basin accounts for approximately 36 percent of the total water used in IEUA's service area. Although groundwater is an important local supply source, the water quality of the lower Chino Groundwater Basin has been impacted by historical agricultural uses and now has high levels of nitrate and TDS. There are also areas that exceed standards for perchlorate and volatile organic compounds. Due to the water quality in the lower Chino Groundwater Basin, in some areas, additional treatment and/or blending with higher quality imported water is required before it can be used as potable water.

Recycled water is an increasingly essential asset to the region, particularly with the growing uncertain reliability of imported water supplies due to climate change and environmental factors. Recycled water is the region's most climate resilient water supply because the amount of water available is not directly affected by precipitation and runoff. Today, recycled water makes up approximately 15 percent of IEUA's water supply portfolio and hundreds of millions of dollars have been invested into the regional recycled water program. It is critical for IEUA to maintain this resource within the region. The continued use of recycled water is compliance driven, with regulatory limitations for TDS in IEUA's recycled water and groundwater recharge. Levels of TDS in recycled water have been increasing, exacerbated by conservation and episodic periods of drought over the last 20 years. In 2015, IEUA's recycled water neared the permit limit for TDS. Today, IEUA estimates that without taking additional action, TDS limits for recycled water direct non-potable use and groundwater recharge may be exceeded within the next 10 years.

In addition to the challenges associated with TDS, IEUA is facing regulatory challenges with 1,2,3-TCP, PFOA, microplastics, and other CEC associated with Title 17 and Title 22. These contaminants are making their way into IEUA's recycling plants, which are not designed for their removal. In 2019, recycled water used for groundwater recharge exceeded the 1,2,3-TCP maximum contaminant level and PFOA notification level.

These water quality challenges, further detailed in IEUA's April 2020 *Regulatory Challenges Report,* underscore IEUA's need for a long-term solution to mitigate water quality risks. Consistent with IEUA's water and wastewater management goals for its service area, a major conclusion of the report was the recommendation to construct an AWPF and have it online by 2030 to address the regulatory challenges.

Water Supply Reliability

A diverse portfolio of water supply sources has been developed within IEUA's service area. The region relies on groundwater from the Chino Groundwater Basin and other basins (Cucamonga, Rialto, Lytle Creek, Colton, and the Six Basins groundwater basins), local surface water from creeks originating in the San Gabriel Mountains, recycled water produced locally, and imported water from SWP via Metropolitan.

As noted previously, imported water, groundwater, and recycled water make up a majority of the region's water supply portfolio. The water quality conditions of these sources combined with other factors that impact their reliability, such as climate change, require an integrated approach to ensuring the long-term reliability of these supplies for the region. Without action, violation of regulatory standards, such as IEUA effluent TDS limits, could affect IEUA's ability to continue the groundwater recharge program and reuse of recycled water, resulting in greater dependence on other supplies such as imported water, which can be highly variable depending on hydrologic conditions and other factors that could interrupt delivery. The 2015 IRP is the region's blueprint for ensuring reliable and cost-effective water supplies. The core findings from the IRP revealed that investments in local water supplies and diversification of available water resources position the region well for addressing future impacts of climate change and extreme drought conditions, and portfolios that combine water supply and water efficiency management provide the most adaptive strategies especially when recycled water management was maximized. These findings translated into recommendations for continued investment in recycled water and water use efficiency projects, maximizing recharge projects with stormwater and other supplies, and external supplies for treatment and recharge.

Recent evaluations further support the priority of enhancing water supply reliability in comparison to increasing the amount of the region's baseline water supply. Using projected demands, the 2015 IRP established a water supply forecast through 2040. Except for increased supply from water use efficiencies, no additional supplies were forecasted to be needed to meet future demands between 2025 and 2040. More recently, water demand projections updated from the 2015 IRP indicate that water demands in 2040 are likely to be 15 percent lower than those previously expected. Additionally, 2018/2019 demands are over 160,000 acre-feet less than IEUA's forecasted values from the 2015 Urban Water Management Plan (**Figure 4**). This further emphasizes that the region does not anticipate the need to develop new supplies in response to future demands for the next 25-year period, and that emphasis within the region should be placed on maintaining access to existing supplies, ensuring operational flexibility and overall water supply reliability. This need is underscored when the vulnerability of imported water supplies due to drought, climate change, and risk of catastrophic failure of infrastructure is considered.

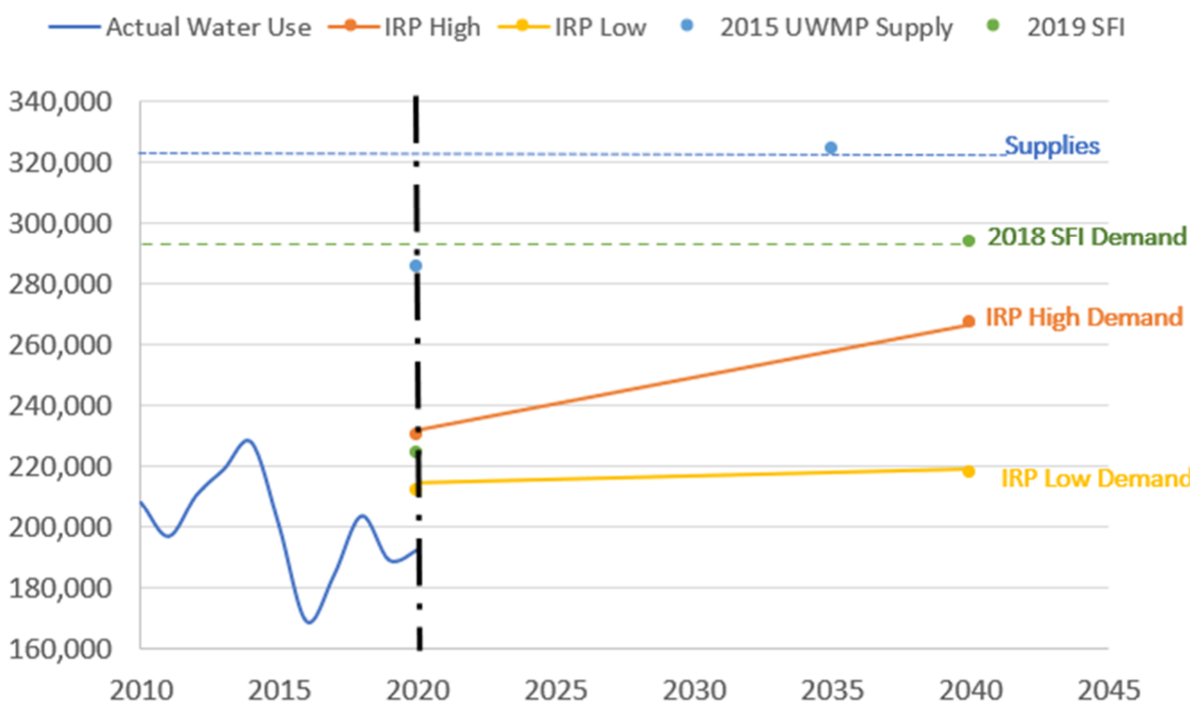

Figure 4: IEUA Service Area Water Supply Needs

2.2 Related Plans, Programs, and Studies

IEUA, in conjunction with its member agencies, conducts a series of regional planning efforts to better prepare for the region's future needs. These efforts date back to 2000 and continue through the present (**Figure 5**). Each planning report is backed by technical studies and supporting documentation to ensure regional planning efforts are well informed. Through these planning documents IEUA has identified future needs that must be met to continue its track record of providing reliable, clean, and sustainable water to the region.

While each planning report is unique, there are shared themes, including the following:

- The need to diversify water supplies and reduce dependency on imported water
- The negative impacts of climate change on water reliability
- An increasing need for advanced water treatment
- Furthering the beneficial use of water to restore natural populations and habitats

These themes have been intentionally addressed by components of the CBP and other developed regional alternatives. Provided below, and as highlighted in **Figure 5**, is a discussion of pivotal regional plans, programs, and studies that have been prepared to address regional water challenges.

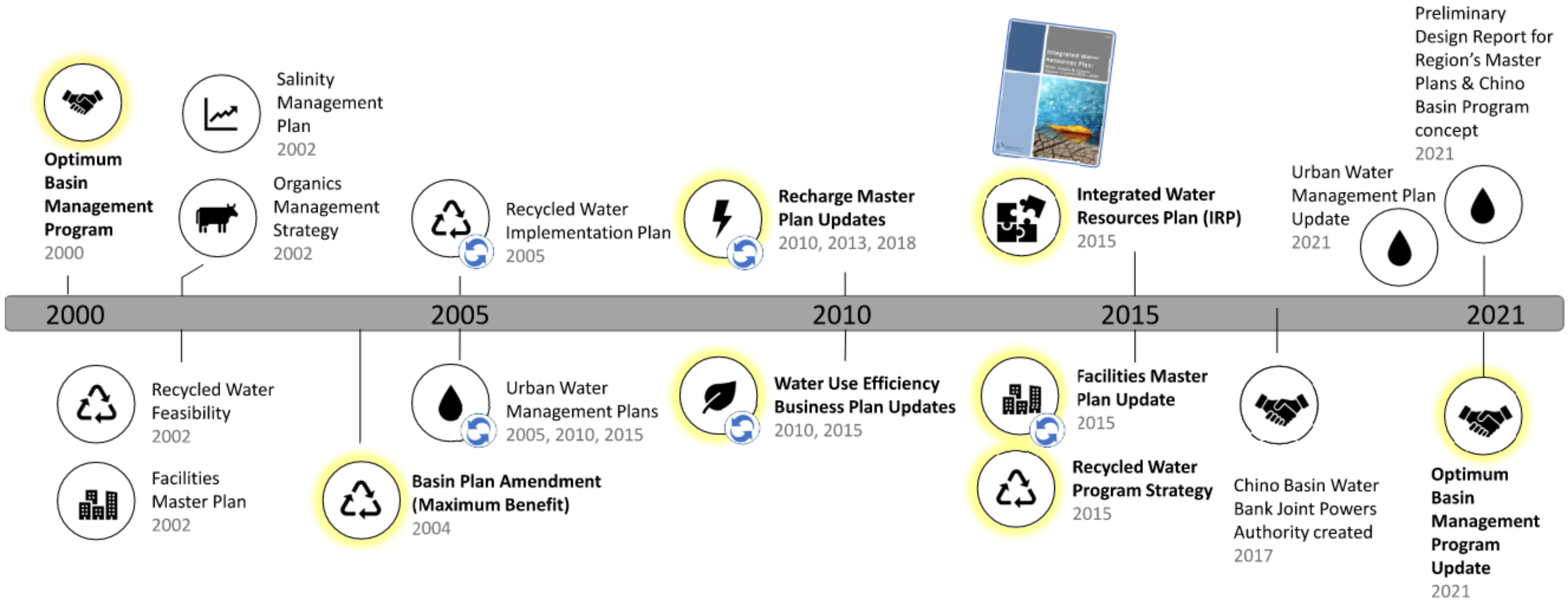

Figure 5: Progression of IEUA Regional Planning Efforts

2.2.1 Ten Year Forecast

The purpose of the TYF is to catalog and schedule capital improvement projects over a multiyear period. Each year, pursuant to the terms of the Regional Sewage Service Contract, IEUA submits a TYF of capacity demands and capital projects to the Regional Technical and Policy Committees. This TYF identifies projects for the subsequent 10 Fiscal Years (FY) that are needed for the rehabilitation, replacement, or expansion of the facilities owned or operated by IEUA to provide sufficient capacity to accommodate the anticipated growth within the region.

Projects identified in the TYF are necessary to accomplish IEUA's goals based on the physical conditions of assets and forecasted regional projections of water and wastewater needs. Based on these projections, the TYF proposes a schedule for the implementation of projects based on necessity. The timing of the projects identified in the TYF are further refined during the Capital Budget based on the availability of financial resources.

The FY2020/2021 TYF identified over $90 million in capital projects through FY2030. These projects include recycled water capacity improvements and recharge improvements in support of increasing regional resiliency against droughts, and the regional water supply portfolio and developing programs for long-term water use efficiency.

2.2.2 Optimum Basin Management Program

Pursuant to the 1998 Judgement that created the Chino Basin Watermaster (Watermaster), the development of a plan to manage the Chino Groundwater Basin was created. The OBMP consists of nine key elements, including: comprehensive monitoring, comprehensive recharge, water supply planning for impaired areas, regional supplemental water programs, groundwater management, cooperation to improve basin management, salt management program, groundwater storage program, and a storage and recharge program.

The OBMP State of the Basin Report is updated every two years to reflect any changes to the Basin with respect to groundwater levels, groundwater quality, groundwater production and recharge, and hydrologic conditions. The most recent update was completed in June 2021.

2.2.3 Santa Ana River Water Quality Control Plan (Basin Plan)

The regulatory framework that establishes the salinity management requirements and permit limitations are derived primarily from the Basin Plan. Based on the objectives that are established in the Basin Plan, IEUA's National Pollutant Discharge Elimination System (NPDES) permit conditions and recycled water groundwater recharge requirements are established by the RWQCB.

The RWQCB developed the first Basin Plan in 1975 and has updated it several times since then. The plan defined TDS objectives ranging from 220 to 330 milligrams per liter (mg/L) over a substantial portion of the Chino Basin. The ambient TDS concentrations in these areas exceeded the objectives and, therefore, restricted the use of IEUA's recycled water for irrigation and groundwater recharge.

To address this and similar regulatory compliance challenges across the groundwater basins in the Santa Ana Watershed, in the mid-1990s a Task Force consisting of 22 water resources agencies in the Santa Ana River Watershed was formed, which, along with the RWQCB, studied the impacts of Total Inorganic

Nitrogen and TDS on water resources in the watershed. This culminated in the RWQCB's adoption of the 2004 Basin Plan amendment. This amendment included revised TDS and nitrogen objectives and beneficial uses for specific surface waters.

To promote the use of recycled water and manage artificial recharge of storm, imported, and recycled water, IEUA and Watermaster proposed less stringent TDS limits. IEUA and Watermaster also proposed a set of nine commitments that when combined with proposed TDS limits, provided the "maximum benefits" to the State. The RWQCB approved IEUA and Watermaster's proposal and less stringent objectives. These less stringent limits, known as the "maximum benefit" objectives, were adopted by the RWQCB in 2004 and effectively allowed for recycled water reuse and recharge by defining assimilative capacity within the Basin. The maximum benefit objectives are contingent upon IEUA and Watermaster meeting the nine maximum benefit commitments as outlined in the Basin Plan and IEUA's NPDES permit. Specifically, numeric limitations for TDS are imposed upon recycled water (550 mg/L) and groundwater recharge (420 mg/L). Actions that must be performed when the ambient water quality of the Chino Groundwater Basin exceeds the maximum benefit objective (420 mg/L) are also defined.

Under the CBP, an AWPF would be constructed to ensure compliance with the water quality objectives prescribed in the Basin Plan.

2.2.4 Integrated Water Resources Plan

The 2015 *Integrated Water Resources Plan: Water Supply and Climate Change Impacts 2015-2040* details the region's plan for ensuring reliable, cost effective, and environmentally responsible water supplies for the next 25 years. The IRP takes into consideration the availability of current and future water supplies and accounts for possible fluctuations in demand forecasts and climate change impacts. The two key goals of the IRP are to integrate and update water resource planning documents in a focused and holistic manner and develop an implementation strategy that will improve near-term and long-term water resources management for the region.

Based on projected water needs and available water supplies through 2040, the IRP utilized a modeling framework to analyze the effectiveness of adaptive strategies or water development actions. From this modeling effort, the core findings include the following:

- The region's past investments in local water supplies and the diversification of the available water resources will serve the region well for the next 25 years. However, increased use of recycled water, continued investments in water use efficiency, addressing groundwater quality, and increasing groundwater storage flexibility are needed to address future climate uncertainties and catastrophic events that could result in a loss of imported supplies. To secure these resources, additional investments in water supplies and related infrastructure must be made.
- Portfolios that combine water supply and water efficiency actions yield the most adaptive strategies for the region, especially when recycled water programs are maximized.

Consequently, the following core recommendations for the IRP were adopted by the region:

- **Enhance water supply reliability through increased groundwater storage** to address future climate uncertainties or catastrophic events
- **Continue investment in recycled water** projects to maximize the beneficial reuse
- **Implement water use efficiency measures** to reduce current urban demand by at least 10 percent to enhance water supply resiliency
- **Strategically maximize the purchase of supplemental water** for recharge or in-lieu when available
- **Continue to maximize stormwater recharge projects**, including rainwater capture and infiltration
- **Include external supplies**, consisting of exchanges, storage, and water transfers, **strategically in combination with conservation** to augment groundwater recharge, recycled water, **and build storage reserves**. External supplies include surface, imported, and non-potable water
- **Acquire low TDS supplemental water to enhance groundwater quality** to sustain production and reduce salinity

2.2.5 Metropolitan IRP

Metropolitan is in the process of developing an update to its 2015 IRP. Similar to IEUA's IRP planning efforts, Metropolitan's update to its 2015 IRP is used to guide water supply investments, programs, and policies by analyzing factors that could challenge or benefit Metropolitan's water supply. In developing this update, Metropolitan has developed four scenarios to describe alternative future conditions that result in four levels of frequency and a magnitude of projected shortages. This approach evaluates a broader view of potential outcomes in an effort to establish an adaptive management strategy which can help to enhance water supply reliability. The four scenarios used in this study to estimate the frequency and magnitude of future shortages are summarized in **Figure 6**.

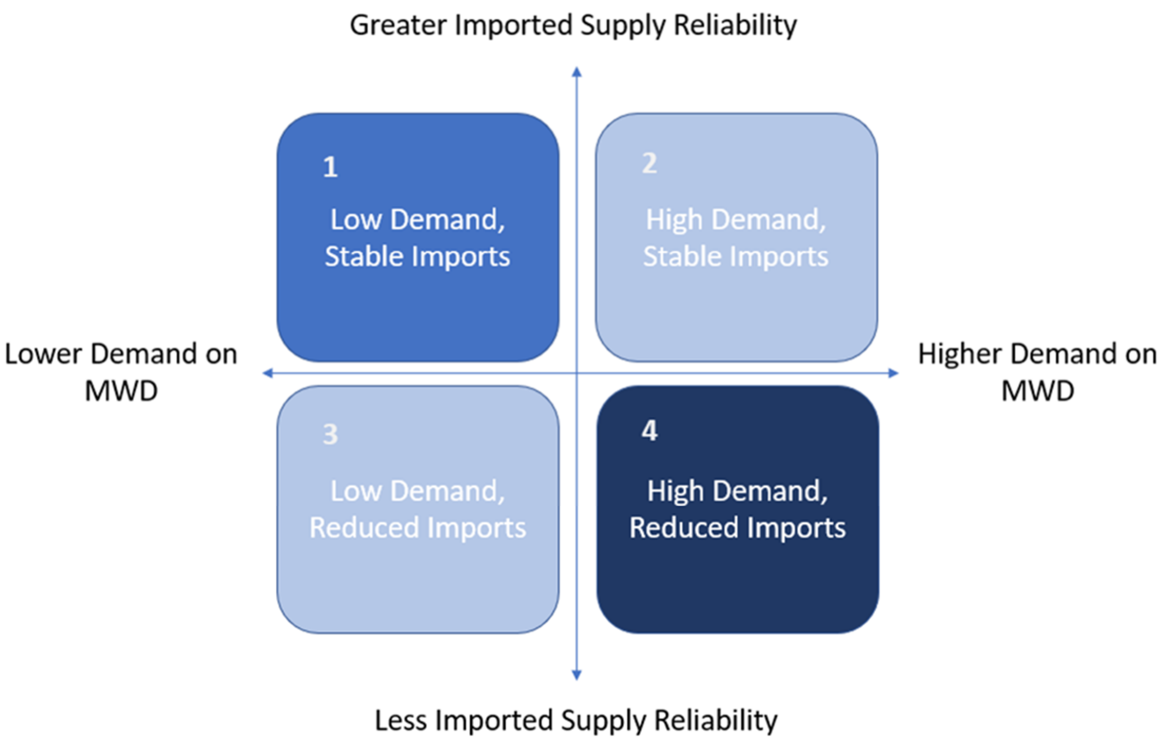

Figure 6: Metropolitan 2015 IRP Update Future Conditions Scenarios (Metropolitan, 2021)

2.2.6 Recharge Master Plan

Chino Basin Watermaster's *Recharge Master Plan* (RMP) was originally prepared in 2001 and updated in 2010, 2013, and 2018. The RMP and its updates are prepared in support of the OBMP, which requires that IEUA and Watermaster develop and implement a comprehensive recharge program. The 2001 RMP assessed existing recharge facilities and identified recharge opportunities to increase groundwater recharge within the Chino Groundwater Basin. With each update, IEUA and Watermaster continue to develop groundwater production and replenishment projections, evaluate recharge needs, and identify and evaluate potential new recharge facilities in order to meet future recharge and replenishment obligations and other OBMP requirements.

2.2.7 Recycled Water Program Strategy

IEUA's *Recycled Water Program Strategy* was prepared in 2015. This planning document updated supply and demand forecasts and identified improvements to maximize recycled water use throughout the region. This approach was consistent with prior commitments of the region to 1) maximize the beneficial use of recycled water to enhance local water supply and reduce dependence on imported water, and 2) continue the development of regional infrastructure to meet the delivery of 50,000 acre-feet per year by 2025 (Stantec, 2015).

2.2.8 Water Use Efficiency Business Plan

The *Water Use Efficiency Business Plan* (WUE Plan) prepared in 2010 and updated in 2015 serves as a blueprint to help IEUA and its member agencies comprehensively plan for and implement future active conservation activities and programs. The WUE Plan and its update were prepared in support of various compliance requirements that call for per-capita water demand reduction by targeted dates. The 2010 WUE Plan developed a regional strategy that emphasized landscape water use efficiency and other regional programs and provided a documented plan that identified the steps necessary to launch these programs. This strategy was updated with the 2015 WUE to be consistent with the established IRP goals by recognizing the need to seek out and educate inefficient water use customers. As a result, the 2015 WUE continued to emphasize landscape opportunities to reduce per-capita water demand, modified water rate structure program assistance for member agencies, and identified a number of new technologies for program outreach and pilot programs.

2.2.9 Wastewater Facilities Master Plan Update

The 2015 *Wastewater Facilities Master Plan Update* was prepared as an update to the 2002 *Wastewater Facilities Master Plan*. The report was prepared as a series of TMs to create a 20-year Capital Improvement Plan for IEUA's regional water recycling plants, collection system, and organics management. In particular, RP-5 expansion, RP-1 capacity recovery, AWPF, and RP-4 expansion were identified to meet projected capacity goals within the region in support of investing in infrastructure to support long-term Chino Basin needs.

3 Economic Evaluation Methodology

3.1 Regional Objectives

The formulation of planning objectives is a key step within the context of a regional feasibility study. Planning objectives presented here are formulated in response to existing conditions and related water resources problems, needs, and opportunities for the region. The planning objectives are used to guide the development and evaluation of alternatives to address these water resources management needs.

As previously discussed, water quality is a key constraint to addressing water reliability challenges within the region. As regulatory concerns associated with TDS and CECs mount, recycled water and groundwater supply sources become less reliable without additional action. To secure these resources for the future, IEUA has prioritized enhancing water supply reliability over the next 25 years through a suite of solutions targeted at maintaining regulatory compliance.

Beyond these 25 years, and in light of the increased likelihood of extreme droughts and the risk of catastrophic events that could interrupt delivery of critical supplies to the region, IEUA has prioritized investment in water supply sources that promote flexible resource management. By investing in infrastructure that enhances local water supplies, such as groundwater and recycled water, IEUA's water supply portfolio becomes more resilient and less susceptible to catastrophic events and the effects of climate change.

To address IEUA's priority in the next 25 years of enhancing water supply reliability, the region must protect and enhance regional water quality. This includes protecting and improving groundwater quality in the Chino Groundwater Basin and improving recycled water quality. Beyond these 25 years, flexible resource management is achieved by improving regional water supply reliability and resiliency. This is done by developing basin-wide water supply infrastructure and local supplies for emergency response and enhancing recharge and/or reducing groundwater production to address subsidence concerns. These objectives are summarized below.

Protect and Enhance Regional Water Quality

- **Meet Permit Compliance for the Continued Use of Recycled Water in the Chino Groundwater Basin**

  Groundwater is the most heavily relied on local water supply type, and the Chino and non-Chino groundwater supplies account for 53 percent of the regional water supply portfolio over the last decade. The vulnerability assessment for IEUA's *Regional Drought Contingency Plan* illustrated how compromised groundwater quality poses a significant threat to local water supply reliability and can be compounded as other supplies currently used for blending, such as imported water, become less reliable. Thus, it is critical to enhance local groundwater treatment to help the region achieve its water reliability and resiliency objectives.

- **Maintain Commitments for Salt Management to Sustain and Enhance the Safe Yield of the Chino Groundwater Basin**

  Recycled water is an increasingly essential asset to the region particularly with the uncertain future of imported water supplies due to climate change and environmental factors. Since 2000, recycled water use within the region has increased by as much as seven times, with recharge of this water also increasing over the last 10 years. Recycled water is the region's most climate resilient water supply because the amount of water available is not affected by dry years. Today, recycled water makes up approximately 15 percent of IEUA's water supply portfolio and hundreds of millions of dollars have been invested into the regional recycled water program. Applications for recycled water face challenges in terms of changing wastewater quality and treatment requirements due to increases in indoor water use efficiency and outdoor water use efficiency standards and increasing regulatory and environmental requirements. Additionally, the use of recycled water is impacted by the groundwater quality of the Chino Groundwater Basin. Specifically, the applications for recycled water become constrained if the salinity in the Basin rises beyond specified regulatory limits. Maintaining and expanding recycled water projects to manage these challenges will both increase the resiliency of the regional water supplies and help to augment safe yield of the Chino Groundwater Basin through increased recharge of high-quality recycled water. Expansion of these projects is targeted for the next 10 years, and could have side stream treatment to reduce recycled water TDS levels to 100 mg/L, with an overall blended target of 500 – 515 mg/L.

Improve Regional Water Supply Reliability and Resiliency

- **Develop Infrastructure that Addresses Long-Term Supply Vulnerabilities**

  Historical planning documents recognize the increasingly uncertain future of imported water supply availability and the importance of local water supplies, particularly with changing climate conditions. In developing an update to its IRP, Metropolitan has identified a set of future scenarios for evaluating potential actions that incorporate the potential for reductions in imported water supplies and resulting potential future shortages in Metropolitan water supply deliveries. In addition to Metropolitan's efforts to reduce these shortages, IEUA can take action to reduce economic impacts when shortages do occur. Moreover, the anticipated rehabilitation of the Rialto Feeder in 2028 could result in water supply interruptions of up to 18 months. IEUA's imported water supply is 100 percent provided by the Rialto Feeder and alternative options are not available for IEUA and its agencies. To reduce dependence on imported water, IEUA and its member agencies aim to enhance the current IEUA recycled water and groundwater recharge programs by developing basin-wide infrastructure, thus enhancing regional water supply reliability and resiliency. Such infrastructure would improve the use of recycled water at a regional level through interagency connections and would enhance the local groundwater supplies through additional groundwater wells and wellhead treatment.

- **Provide a Source of Water for Emergency Response**

  Regional water supply flexibility and redundancy enables the region to adapt to changes that limit, reduce, or make water supplies unavailable. Given the great distances that imported supplies travel to reach the Inland Empire, the region is vulnerable to interruptions along hundreds of miles of aqueducts, pipelines, and other facilities associated with delivering the supplies to the region. This infrastructure that the region relies on to deliver imported supplies is also susceptible to damage from earthquakes and other disasters. Unplanned or catastrophic occurrences could cut off the supply of imported water, which makes up 25 percent of the Basin's water supply portfolio. Further, groundwater supplies are likely to be adversely impacted by climate change-induced temperature increases and drought. Together, as documented in IEUA's 2020 Urban Water Management Plan (UWMP), severe droughts or emergency circumstances could require demand reductions within the region between 10 and 50 percent. A key conclusion drawn from IEUA's IRP is that it is important to secure supplemental water when available to recharge the Chino Groundwater Basin (through direct or in lieu practices) to enable increased groundwater production during droughts or emergencies.

- **Enhance Recharge and/or Reduce Groundwater Production to Address Subsidence**

  The Chino Basin OBMP, as overseen by the Chino Basin Watermaster, was adopted in 2000 to provide a framework to maximize recycled water use within the region. Included in the OBMP are four broad goals to address regional issues, needs, and interests. Goal 3, Enhance Management of the Basin, calls for the development and/or encouragement of "production patterns, well files, treatment and water transmission facilities and alternative water supply sources to ensure maximum and equitable availability of groundwater and to minimize land subsidence." To minimize land subsidence, Chino Basin parties must enhance groundwater recharge and/or reduce localized groundwater production in specific areas. In doing so, this helps secure the reliability of groundwater supplies, since future extraction could be curtailed to reduce subsidence.

3.2 Alternatives Description

To address these regional objectives, IEUA and its partners explored different alternatives to address the region's regulatory challenges and long-term water supply reliability needs. Alternatives defined in 2020 have been refined over the past year through extensive engagement with IEUA member agencies, Metropolitan, and state agencies. This refinement has produced three project alternatives that address one or more of the objectives discussed above. Features of the project alternatives, along with the no action alternative, are summarized in **Table 1** below. The alternatives were developed in a progressive manner. The Baseline Compliance Plan was developed to address regional water quality challenges. The Regional Water Quality and Reliability Plan builds upon the Baseline Compliance Plan to address regional water quality and water supply challenges. Finally, the CBP builds upon the Regional Water

Quality and Reliability Plan to address regional water quality and water supply challenges, provide additional flexibility for groundwater management in the Chino basin, and provide statewide benefits through a water exchange with the SWP. A summary of each of the alternatives is further described in each of the subsections below.

Table 1: Summary of Water Quality and Water Supply Infrastructure Included in Project Alternatives

	Infrastructure	No-Action	Baseline Compliance Plan[1]	Regional Water Quality and Reliability Plan	CBP
Water Quality	AWPF & Injection Wells	-	15 TAFY	15 TAFY	15 TAFY
Water Supply	Imported Recycled Water Supplies	-	6 TAFY	6 TAFY	6 TAFY
	Regional Water Pipeline	-	-	✔	✔
	Exchange with SWP	-	-	-	✔
	Groundwater Storage	-	-	✔	✔
	Groundwater Extraction	-	-	15 TAFY	40 TAFY

Facilities for the CBP include PUT and TAKE facilities. PUT facilities are those that are associated with the recharge of purified water into the Chino Basin and include:

- 15 TAFY AWPF at RP-4 and accompanying pump station to pump water from the AWPF
- Purified water conveyance
- Brine conveyance
- 6 TAFY of imported recycled water supplies

Figure 7 shows the location of the AWPF at RP-4 which is common to all three alternatives. The selection of the location of the AWPF at RP-4 is summarized in Section 3.2.2. The purified water conveyance pipelines and injection wells common to the Regional Water Quality and Reliability Plan (Alternative 2) and the CBP (Alternative 3) are also shown in **Figure 7**.

TAKE facilities are those that are associated with the extraction of groundwater from the Chino Basin and the conveyance of potable water supply and include:

- Turnouts and connections
- Collector pipelines and a potable pipeline network
- Extraction wells
- Pump stations
- Water storage tanks

[1] The Baseline Compliance Plan would be constructed in two phases. The capacities shown in Table 1 are the totals for the two phases.

Of these facilities, **Figure 8** depicts the potential location(s) of the pipelines, extraction wells, pump stations, and water storage tanks. These facilities are common to the Regional Water Quality and Reliability Plan and the CBP (there are no TAKE facilities associated with the Baseline Compliance Plan); however, the number of extraction wells and the size/length of pipelines is only applicable to the CBP. With a total extraction capacity of 40 TAFY, these facilities are assumed to be scaled for the Regional Water Quality and Reliability Plan to result in a total extraction capacity of 15 TAFY. The CBP also includes additional facilities to connect its pipeline distribution network to Metropolitan's water distribution system, which is not included as part of the Regional Water Quality and Reliability Plan.

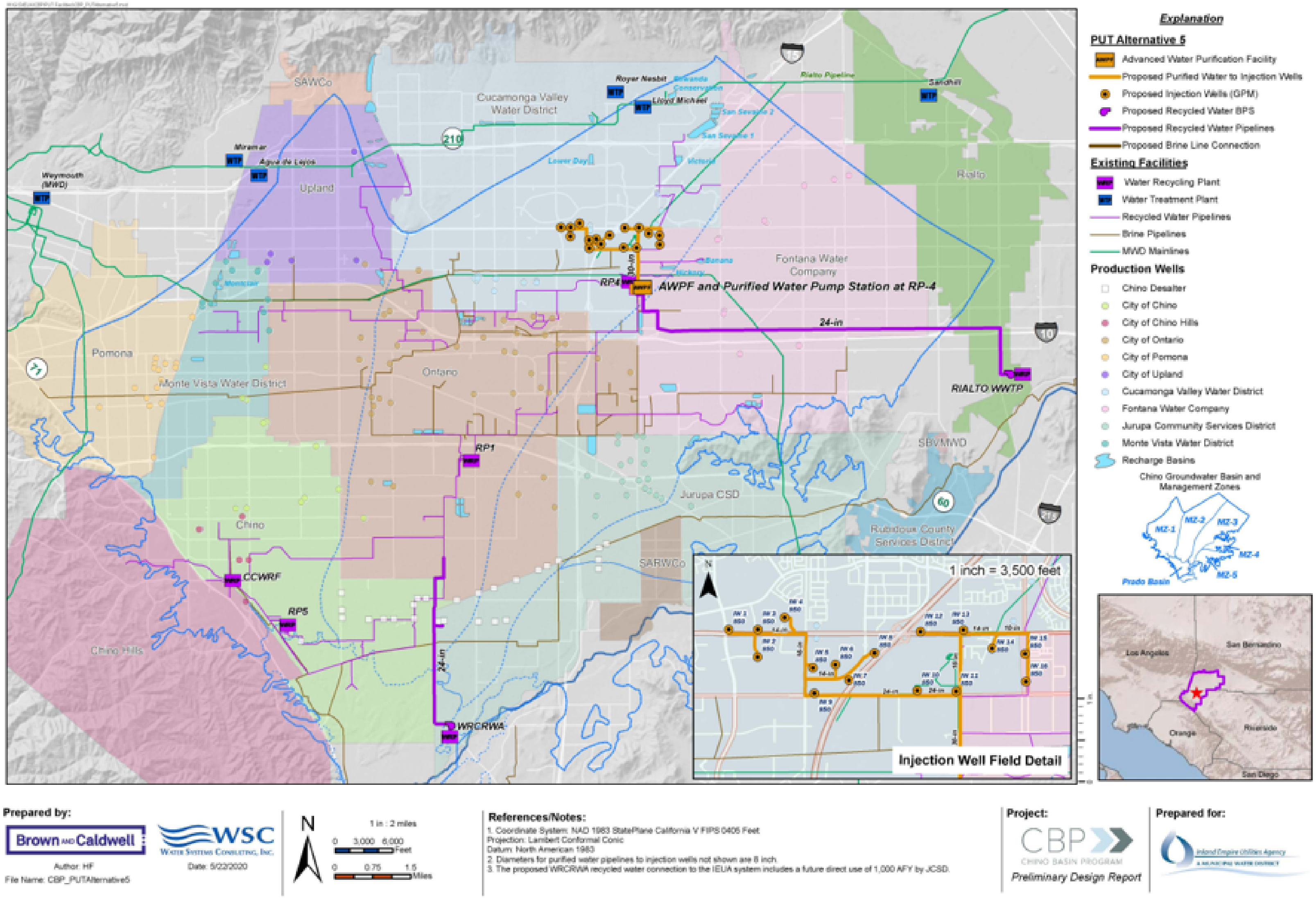

Figure 7: Location of Potential PUT Facilities Associated with Project Alternatives

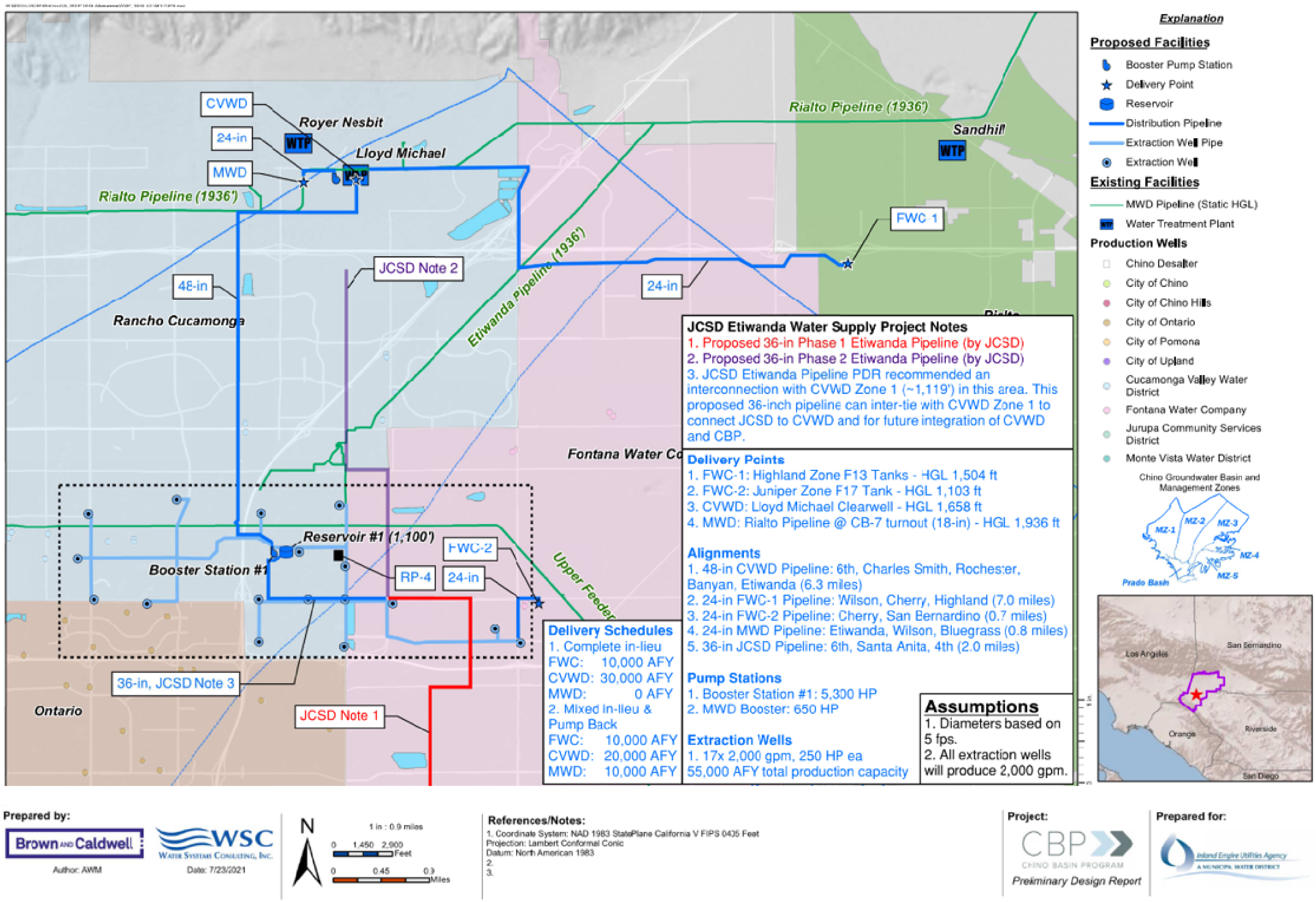

Figure 8: Location of Potential TAKE Facilities Associated with Project Alternatives

3.2.1 No Action Alternative

An evaluation was performed in 2016 of Agency-wide TDS for water supply and plant effluent. Further analysis was recently completed to update the TDS evaluation in support of further advancing regional planning efforts. The primary objective for these analyses was to forecast the future TDS trends and identify potential TDS compliance challenges. The findings indicated that levels of TDS in recycled water have been increasing, exacerbated by climate change, conservation, and episodic periods of drought over the last 20 years. In 2015, IEUA's recycled water and effluent discharge neared the permit limit for TDS. Today, IEUA estimates that, without taking additional action, TDS limits for recycled water direct non-potable use, groundwater recharge, and effluent discharge may be exceeded within the next 10 years. This exceedance will affect IEUA's ability to continue its groundwater recharge program and reuse of recycled water, especially in prolonged periods of drought where an increase in salinity was found in all sources of water. IEUA's recycled water program and effluent discharges to the Santa Ana River will be affected when no action is taken to reduce TDS in the Chino Groundwater Basin. If the ambient water quality in the Basin is not maintained per the RWQCB's TDS limit, recycled water use within the basin will be suspended with a greater dependence on imported water and local stormwater supplies, which are less reliable and impacted by climate change. Since the Chino Groundwater Basin only receives imported water from one regional pipeline that is owned and operated by Metropolitan, an unplanned or catastrophic occurrence could cut off 25 percent of the Basin's water supply.

Costs associated with the No Action alternative were estimated by assuming recycled water supplies would have to be replaced by new Metropolitan imported supplies beginning in 2031. The annual quantities of required water supply were taken from IEUA's UWMP, which projects 30.5 TAFY of recycled water used in 2020 would increase to 44.7 TAFY by 2045. These UWMP projections were interpolated to estimate quantities for each year beginning in 2031 over the project life cycle. These annual quantities were valued at Metropolitan's Tier 1 Untreated Water Rate together with proportional Ready-to-Serve and Capacity Charges.

The total life cycle water supply cost of the No Action alternative is calculated as the present worth of the annual costs associated with replacing recycled water supplies over the project life, discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation) accounting for the assumed escalation in Metropolitan water supply rates. The total present value cost of the No Action alternative is $1,058.2 million. No benefits are associated with this alternative.

The No Action alternative results in the Basin being out of regulatory compliance, threatens water supply, and does not meet the objectives of the program. Therefore, the No Action alternative is not considered as to be a feasible alternative and is not considered further in this economic evaluation.

3.2.2 Baseline Compliance Plan Alternative

As discussed, issues of rising TDS concentrations in recycled water nearing compliance levels and other regulatory challenges associated with CEC puts the region at great risk. IEUA and its partners have invested significant time and money to identify solutions to address these challenges. A number of options have been considered:

- Since groundwater recharge is a blend of imported water, recycled water, and stormwater, IEUA could purchase more low-TDS imported SWP water to offset the high TDS concentration in recycled water, bringing the groundwater recharge into compliance. This solution does not help achieve IEUA's and the region's goal of reducing dependence on imported water supplies.

- Another option is a reduction in recycled water that is recharged. This is not a prudent option since recycled water is a secure water supply and imported water supplies are expensive and vulnerable to drought and climate change.
- A third option is to increase the recharge of stormwater, which is also low in TDS in comparison to recycled water; however, this is not a viable option as stormwater is a variable and unreliable water supply.
- A fourth option would be to pursue an NPDES permit modification with the RWQCB. Though this option doesn't directly control TDS concentrations in groundwater recharge or recycled water, it might provide some temporary relief in terms of exceeding recycled water TDS concentration limits. It also does not address CEC in groundwater recharge of recycled water.
- Finally, advanced water purification as a solution would address rising TDS levels and CEC.

Though there are a number of solutions that IEUA could implement to address the groundwater recharge challenges associated with TDS and the emerging constituents, none are as optimal as implementation of advanced water purification. This solution would address TDS levels for both direct non-potable use of recycled water and groundwater recharge and could also help address the challenges associated with Title 17 and Title 22 regulations. The advanced water purification solution can be implemented as satellite facilities for specific recycled water recharge compliance. However, a centrally located advanced water purification system can be linked with the existing distribution system providing greater flexibility for use of the advanced treated water, thus providing greater benefit to the region as an available supply. Also, it has the potential to be integrated in the future as direct potable reuse.

IEUA owns and operates four regional water recycling plants shown in **Figure 3** as RP-1, RP-4, RP-5, and the Carbon Canyon Water Recycling Facility. These facilities provide tertiary-treated wastewater, also known as recycled water. Recycled water supplies can be used for direct non-potable uses, groundwater recharge, and Santa Ana River regional discharge obligations. IEUA completed its Wastewater Facilities Master Plan Update Report in 2015 to identify capital improvement plans for these recycling plants. RP-1 and RP-4 were identified as preferred options for expansion to include advanced water purification as part of the CBP because of their advantages relative to operational flexibility and compatible future expansion plans. RP-5 was also considered because of an ongoing expansion project. However, because RP-5 is situated hydraulically low in the IEUA recycled water distribution system, the use of its advanced treated water would be limited to direct use customers for landscape and industrial uses and effluent discharges to the Santa Ana River and would not provide the same operational flexibility and benefits that RP-1 and RP-4 offer. RP-4 was ultimately selected as a preferred location for AWPF over RP-1 due to its closer proximity to recharge basins, its greater capacity to pump to these basins, proximity to surface water treatments for future direct potable reuse, and overall operational flexibility. For these reasons, RP-4 is the assumed location for the AWPF for the Baseline Compliance Plan Alternative.

The Baseline Compliance Plan includes advanced water treatment facilities that would be constructed in two phases to collectively treat a total of 15 TAFY of recycled water in the Chino Groundwater Basin with 9 TAFY to be online by 2030 and the remaining 6 TAFY by 2040. Approximately 2 TAFY of water will be lost through the AWPF process, requiring that 17 TAFY of source water supply to the AWPF be made available for treatment. To supplement sources available within IEUA, the Baseline Compliance Plan also includes projects that would provide 6 TAFY of additional external supplies obtained from neighboring agencies and imported to the region as a new supply to be online by 2040. Brine pipelines and appurtenant facilities are also included as part of the Baseline Compliance Plan. The locations of these facilities are largely shown in **Figure 7**. The Baseline Compliance Plan does not include groundwater injection facilities, new extraction wells, or related interconnections, and does not create a new local water supply. However, the production of high-quality water in the Chino Groundwater Basin will deliver regulatory compliance and regional benefits in the form of enhanced water quality.

3.2.3 Regional Water Quality and Reliability Plan Alternative

The Regional Water Quality and Reliability Plan alternative includes the same AWPF, imported recycled water projects, recycled water and brine pipelines, and appurtenant facilities as the Baseline Compliance Plan alternative. These facilities would not be phased, and the full capacity would be online by 2030. Additionally, this alternative differs from the Baseline Compliance Plan with the introduction of groundwater injection facilities, extraction wells, groundwater treatment facilities, purified water pipelines, and connections that are integrated with the AWPF and injection well system. Similar to the Baseline Compliance Plan, approximately 2 TAFY of water will be lost through the AWPF process, requiring that 17 TAFY of supply be made available for treatment. Various sub-alternatives were evaluated that would achieve the conditions described above. The sub-alternatives considered:

- Location of the AWPF (RP-4 was selected as discussed under the Baseline Compliance Plan)
- Location and number of injection wells and or recharge basins
- The external sources of water supply
- Location and number of extraction wells

The infrastructure details were evaluated based on the objectives previously defined. The preferred infrastructure design that best met the objectives defines the Regional Water Quality and Reliability Plan and are shown in **Figure 7** and **Figure 8**. This system would collectively treat and store up to 15 TAFY of advanced-treated water in the Chino Groundwater Basin, creating a new local water supply. This water will be available for local use for the 50-year project life of the alternative, therefore reducing dependence on imported water, improving water quality, and providing a new local water supply for the Basin. The Regional Water Quality and Reliability Plan would include a total extraction capacity of 15 TAFY connected to a network of regional pipelines that would provide the ability for IEUA and its member agencies to access stored water in the Chino Groundwater Basin, connecting these new potable water supplies for use in place of planned imported water deliveries from Metropolitan. These new water conveyance and water system interconnections also provide an alternative source of water supply to IEUA and its member agencies during any required shutdown of Metropolitan's major pipelines delivering water to the region, such as the Rialto Pipeline, which is planned for rehabilitation as part of a larger rehabilitation plan of Metropolitan's pipelines within their service area.

Similar to the Baseline Compliance Plan, the production of high-quality water in the Chino Groundwater Basin will deliver regional benefits in the form of enhanced water quality. The Regional Water Quality and Reliability Plan will also deliver regional benefits in the form of local water supply benefits available annually to offset the need for imported water from Metropolitan as well as to reduce the economic impact of supply shortages when Metropolitan is unable to deliver full water supplies.

In addition, the Regional Water Quality and Reliability Plan provides local emergency supply benefits in years when planned or unplanned service disruptions occur, and land subsidence mitigation benefits are achieved through new operational flexibility that will allow using recharged supplies to better manage groundwater pumping in areas sensitive to subsidence. These benefits are discussed further and compared with those provided by the other alternatives in subsequent sections.

3.2.4 Chino Basin Program Alternative

In August 2017, IEUA submitted a WSIP application for the CBP. In July 2018, the CWC approved maximum conditional funding for the proposal in the amount of $206.9 million. In 2021, the CWC increased this maximum conditional funding to $212.1 million. In return for this funding, the CBP will provide water supplies for public benefits as defined by WSIP, including ecosystem improvement, water quality improvement, and emergency response benefits.

Similar to the Regional Water Quality and Reliability Plan, the CBP will consist of AWPF, injection wells, extraction wells, groundwater treatment facilities, external recycled water supplies, and a pipeline distribution network connecting the facilities to local agencies. The CBP differs from the Regional Water Quality and Reliability Plan by increasing the total extraction capacity from 15 TAFY to 40 TAFY and with the introduction of facilities connecting the CBP pipeline distribution network to Metropolitan's water distribution system to allow for a portion of the water supply developed by the CBP to be pumped to Metropolitan to offset SWP Table A water supplies that would instead be released from Lake Oroville to create pulse flows in the Feather River for ecosystem benefit.

Like the Regional Water Quality and Reliability Plan, various sub-alternatives were evaluated that would achieve the conditions described above. The sub-alternatives considered:

- Location of the AWPF (RP-4 was selected)
- Location and number of injection wells and or recharge basins (same as identified under the Regional Water Quality and Reliability Plan)
- The external sources of water supply
- Location and number of extraction wells
- Connections to provide pump into Metropolitan's distribution system
- Ratio of direct pump into Metropolitan local use of new CBP water supplies in-lieu of Metropolitan deliveries

The infrastructure details were developed based on the objectives discussed above. The preferred infrastructure design that best meets the objectives defines this alternative and are shown in **Figure 7** and **Figure 8**. Like the Regional Water Quality and Reliability Plan, a similar system would collectively treat and store up to 15 TAFY of advanced-treated water in the Chino Groundwater Basin, creating a new local water supply. The CBP would also include a regional pipeline connecting CBP potable water facilities to the region to provide for up to 40 TAFY of in lieu use of CBP supplies, as well as connections to Metropolitan with the ability to pump up to 10 TAFY of CBP potable supplies into Metropolitan's water distribution system. This in lieu and direct pump in use of CBP water supplies would facilitate the Proposition 1 WSIP water exchange by allowing the CBP to make 40 TAFY available to Metropolitan in drier years in exchange for the same amount of supply that would otherwise be delivered by the SWP to Metropolitan. In return, 40 TAFY that would otherwise have been exported to Metropolitan would be stored in Lake Oroville and used together with Delta carriage water savings to enhance instream flows in the Feather River.

Delta carriage water savings is an additional benefit of the Proposition 1 WSIP water exchange. SWP operations that transfer water across the Delta from upstream storage facilities to Delta export pumps under balanced conditions require additional upstream releases to maintain water quality in the Delta. This additional flow, known as "carriage water," is generally estimated by the California Department of Water Resources (DWR) to be between 20 and 30 percent of the amount of water exported. Under Proposition 1 WSIP water exchange operations, SWP releases from Lake Oroville and Delta export pumping would be reduced compared to planned operations, and a carriage water savings would accrue in Lake Oroville. IEUA has proposed that 20 percent of pulse flow releases be accounted for as carriage water savings and applied towards the total pulse flow quantity. Any additional carriage water savings would accrue to the SWP for other purposes as a hedge against possible operational impacts caused by the exchanges. This proposal would reduce the required capacity and capital cost of the extraction facilities to be constructed be IEUA for the CBP, allow 20 percent of new CBP AWPF supplies to be used locally, and support total maximum annual environmental pulse flows from Lake Oroville of 50 TAFY.

This exchange element would be in operation during the first 25 years of the CBP, administered through agreements with DWR, the California Department of Fish and Wildlife (CDFW), and Metropolitan. The total production of CBP water supplies over 25 years is 375 thousand acre-feet (TAF). Of this sum, 75 TAF is assumed to be available for local use and emergency response. The remaining 300 TAF would be used for in lieu and pump in water deliveries to Metropolitan. Together with projected Delta carriage water savings, a total of 375 TAF would be available in Lake Oroville over the 25-year period for ecosystem improvement in the Feather River. After the 25-year period, the full 15 TAFY of CBP supply would be available for local use, further reducing dependence on imported water supplies, improving water quality, and providing a new local water supply for the region.

In addition to the ecosystem improvement benefits provided by this dedicated water supply, the production of high-quality water in the Chino Groundwater Basin will deliver benefits in the form of enhanced water quality (similar to the Baseline Compliance Plan and Regional Water Quality and Reliability Plan) and local water supply available to offset the need for imported water from Metropolitan and to reduce the economic impact of water supply shortages.

The CBP also provides emergency supply benefits in years when planned or unplanned service disruptions occur, and land subsidence mitigation benefits are achieved through new operational flexibility that will allow using recharged supplies to better manage groundwater pumping in areas sensitive to subsidence. These benefits are discussed further and compared with those provided by the other alternatives in subsequent sections.

Metropolitan is a vital partner in implementing the CBP. Metropolitan is a SWP Water Supply Contract holder and would serve as a fundamental party in completing the proposed water exchange between supplies stored locally in the Chino Groundwater Basin and SWP supplies stored in Lake Oroville. A principle for Metropolitan participation is that no adverse impacts should occur to Metropolitan or other Metropolitan member agencies due to CBP operations. Because real-time extraction capacity from the Chino Groundwater Basin will be limited in comparison to SWP delivery capability to Metropolitan, some reoperation of the Metropolitan distribution system will be necessary. Operations plans will be developed to minimize the potential for any impacts due to reoperations and provide value to Metropolitan by providing the capability to access CBP water supplies in years of greatest operational benefit to the Metropolitan service area. Planned operations include IEUA member agencies accessing up to 30 TAFY of stored water in the Chino Groundwater Basin in lieu of planned water deliveries from Metropolitan. In addition, the CBP would have the ability to extract stored water, treat it to meet all water quality requirements, and pump up to 10 TAFY into Metropolitan's water distribution system. This direct delivery will utilize new interconnection infrastructure. These new water conveyance and water system interconnections also provide an important alternative source of water supply to IEUA and its member agencies during any required shutdown of Metropolitan's major pipelines delivering water to the region, such as the Rialto Pipeline, which is planned for rehabilitation as part of a larger rehabilitation plan of Metropolitan's pipelines within their service area.

DWR's SWP infrastructure provides the basis for the Feather River Ecosystem Water Exchange proposed by the CBP. Water supplies for Feather River pulse flows would be released by DWR, under terms of agreements with CDFW and Metropolitan from Lake Oroville. Similar to Metropolitan's participation conditions, a principle for CBP operations is that no adverse impacts should occur to the SWP or SWP Water Supply Contract holders. Preliminary operations analyses of water exchange operations were conducted by IEUA to demonstrate proof-of-concept and inform more in-depth development of operational protocols that could minimize the risk of impacts to the SWP while implementing the proposed exchange. Based in part on this work, DWR is currently developing procedures to minimize the potential for SWP reoperations that result in adverse impacts to other SWP purposes, including water deliveries to SWP water supply contract holders. IEUA is working with DWR as they conduct SWP operations analyses to identify potential impacts and develop operational parameters to avoid them. The SWP will develop a conservative forecasting procedure that will govern what years exchanges can be accommodated with low risk of potential water supply impacts to the SWP and its contractors.

3.3 Approach

An enhanced decision-support tool was developed for the purposes of this economic evaluation to estimate the economic value of the benefits associated with each alternative and provide a comprehensive evaluation of the regional benefits of the proposed alternatives relative to their costs. An overview of the tool is provided as **Appendix A**. The tool aggregates assumptions to calculate the present value of the costs and benefits for each alternative. Key assumptions used in these calculations are provided in **Appendix B** and are further detailed in the *Chino Basin Program Assumptions: Technical Memorandum No. 1* and *Chino Basin Program PUT, TAKE, and Program Alternatives Evaluation: Technical Memorandum No. 2*. The present value cost and benefit are then used to calculate the benefit-cost (BC) ratio and the comprehensive net present value (NPV) for each alternative. The tool also allows for a cost allocation analysis to derive an equitable distribution of costs among project purposes. Together, this analysis, along with a comparative analysis of cost and benefit components, is used to evaluate project feasibility. Parameters used in the tool, such as escalation rates for capital costs, operation and maintenance (O&M) costs, and future costs of Metropolitan water deliveries, are also varied through a sensitivity analysis to define those parameters that are most sensitive to change.

This economic evaluation was performed to assess and compare the economic feasibility of project alternatives formulated to address regional water quality and water supply challenges and to address several key questions, including:

- Should IEUA implement a single-purpose water quality Baseline Plan, or pursue a multipurpose project that also addresses water supply reliability and other objectives?
- If IEUA chooses to pursue a multipurpose project, should IEUA accept Proposition 1 WSIP funding and move forward with the CBP, or does it make more economic and financial sense to forego the funding and pursue the Regional Water Quality and Reliability Plan?
- What are the most sensitive assumptions and how do they affect the comparison of alternatives?

3.4 Cost Components

Cost components are described below and include:

- Capital cost
- Replacement cost
- O&M cost
- Non-recoverable wastewater (NRW) disposal cost
- Imported recycled water cost

3.4.1 Capital Cost

Capital costs are those upfront investments needed to construct the treatment, storage, conveyance, and other facilities identified for each project alternative.

Each project alternative's estimated capital cost, including engineering, design, construction management, and construction cost, is distributed over an assumed design and construction period using an assumed cost incurrence schedule. In this evaluation, the design and construction period is assumed to span 7 years for project alternative and 3 years for imported recycled water projects. If applicable, the projected annual costs are then escalated per an assumed capital cost escalation rate (no escalation relative to inflation is used in the base evaluation) to estimate the actual cumulative cost of the project in base year dollars. If external funding is available under the project alternative, including grants, Proposition 1 WSIP funds, or funds from other sources, a proportional fraction of the grant is deducted from the actual cost to estimate the loan amount required to complete the construction. The annual loan payment costs are then calculated based on assumed loan terms (2 percent annual interest rate and 30-year repayment period in this evaluation). Finally, the life cycle capital cost for each project alternative is calculated as the present value of the annual loan payment costs over the project life discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation).

3.4.2 Replacement Cost

Replacement cost is the annual contribution to a fund for replacing the mechanical, electrical, and structural components of the project over time. It is assumed that this fund can be built by investing an annual amount including any assumed capital escalation relative to inflation over the component's replacement life cycle.

For the calculation process, the project components are categorized as:

- Mechanical/electrical (e.g., pump stations)
- Infrastructure (e.g., pipelines)
- Injection, extraction, or monitoring wells
- Treatment facilities (AWPF)

Annual replacement costs are estimated using an assumed life cycle for each component. The total life cycle replacement cost is then calculated as the present worth of the annual replacement costs over the project life discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation) accounting for assumed escalation of capital costs (no escalation relative to inflation is assumed in this base evaluation).

3.4.3 O&M Cost

O&M cost is the annual cost for maintaining and operating project alternative facilities. The estimated O&M costs for the various project alternatives and components were developed by the CBP Predesign Team. These costs are summarized in the *Chino Basin Program Put, TAKE, and Program Alternatives Evaluation: Technical Memorandum No. 2*.

O&M costs are categorized as fixed O&M and variable O&M. Fixed O&M costs are estimated based on the capacity of infrastructure components included in each project alternative. Variable O&M costs (including energy costs) are estimated based on the projected use of this infrastructure. The total life cycle O&M cost is then calculated as the present worth of the annual O&M costs over the project life discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation) accounting for assumed escalation of O&M costs (no escalation relative to inflation is assumed in this base evaluation).

3.4.4 Non-Recoverable Wastewater Disposal Cost

The NRW disposal cost is the annual cost for disposal of the brine produced by the AWPF to the regional wastewater system. The NRW disposal has two cost components:

- An initial connection fee, which is included as a capital cost
- An annual disposal cost, which is based on the average disposal volume, the peak volume, and the effluent COD and TDS concentration

The life-cycle NRW cost is calculated as the present worth of the annual NRW costs over the project life discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation) accounting for assumed escalation of NRW costs (no escalation relative to inflation is assumed in this base evaluation).

3.4.5 Recycled Water Source Cost

As described earlier, 17 TAFY of recycled water will be required as influent to produce 15 TAFY of AWPF effluent. Of the 17 TAFY total influent recycled water, 6 TAFY will be imported from neighboring agencies (Rialto and Western Riverside County Regional Wastewater Authority). Costs for imported recycled water are based on the terms of agreements between IEUA and each source agency and include investment in required infrastructure to convey the supplies, as well as a value for the existing use of the recycled water ($225 per acre-foot).

The remaining 11 TAFY of influent recycled water will come from existing sources within IEUA. These supplies are currently discharged to the Santa Ana River at times when minimum flow requirements are exceeded and are available at RP-4 at no additional operational cost. Some or all of these surplus flows are used downstream outside of IEUA's service area. As a conservative valuation of the existing use for this economic evaluation, it is assumed that all surplus flows that would be repurposed as AWPF influent are used by other agencies downstream and are valued at the rate negotiated for external recycled supplies from the Western Riverside County Regional Wastewater Authority ($225 per acre-foot).

Because each recycled water source involves unique operation costs, the decision-support tool includes a separate worksheet for each recycled water source. Each worksheet includes estimated capital costs, resulting annual loan payment costs, replacement costs, O&M costs, and a valuation for the existing use of the source recycled water. Total life-cycle costs for each imported recycled water source are calculated as the present worth of annual costs over the project life discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation), accounting for assumed escalation for each recycled water source. These costs are included in total present value costs, as applicable, for each project alternative.

3.5 Benefits Components

Benefit components are described below and include:

- Water supply benefits
- Water quality benefits
- Emergency water supply benefits
- Other tangential benefits

3.5.1 Water Supply Benefits

Both the Regional Water Quality and Reliability Plan and the CBP include advanced water purification facilities, groundwater recharge facilities, groundwater extraction facilities, and other infrastructure necessary to provide a new average annual water supply of 15 TAFY. For the first 25 years of the CBP's project life, the new water supplies would be committed to environmental purposes as proposed under the Proposition 1 Water Storage Investment Program through an exchange for SWP water supplies currently delivered to Metropolitan. During that time, economic water supply benefits would be produced through savings associated with use of local water supplies in place of imported SWP supplies and reductions in economic impacts incurred during shortages in water deliveries from Metropolitan.

Water supply benefits for the CBP during the 25-year water exchange commitment are estimated for two types of water management, referred to as “CBP Pump-In Delivery” and “In-Lieu Delivery.” CBP Pump-In Delivery refers to new water supplies produced by the CBP that would be delivered back to the Metropolitan distribution system to directly replace SWP supplies that would otherwise have been delivered to Metropolitan. In-Lieu Delivery refers to new water supplies produced by the CBP that are used locally by IEUA member agencies in place of deliveries from Metropolitan, thereby reducing Metropolitan’s commitment to deliver supplies to those agencies and indirectly replacing SWP supplies that would otherwise have been delivered to Metropolitan.

For the CBP formulation used in this analysis, during the 25-year water exchange commitment an average of 3 TAFY would be provided to Metropolitan as CBP Pump-In Delivery. For this analysis, a value of $221 per acre-foot (in 2019 dollars) is applied as the economic value of those supplies. This value represents an approximation of SWP power cost savings that would accrue by reducing the quantity of imported SWP supplies and is estimated by averaging SWP power costs for delivering water to the east branch of the California Aqueduct between 2015 and 2021.[2] Similarly, under the CBP formulation used in this analysis, during the 25-year water exchange commitment an average of 9 TAFY would be used as In-Lieu Delivery. For this analysis, the same SWP power costs savings estimated for Pump-In delivery are applied, as well as the treatment surcharge of $319 per acre-foot (in 2019 dollars) included in Metropolitan’s rate structure as the economic value of those supplies. Estimated losses during groundwater storage (estimated at 5 percent in this evaluation) are also accounted for.

After the 25-year water exchange commitment for the CBP and for the entire project life of the Regional Water Quality and Reliability Plan, all new water supplies produced by new infrastructure would be available for use by IEUA and its member agencies. These new supplies could be used annually as a replacement for imported water deliveries from Metropolitan. This type of water supply benefit is referred to as “Metropolitan Demand Offset.” For this analysis, because the least-cost alternative would require purchasing new imported supplies, Metropolitan’s Full-Service Tier 1 Treated Water Rate together with Ready to Serve and Capacity Charges (a total of $1,157 per acre-foot in 2019 dollars) is applied as the economic value of those supplies.

With the capability to store water in the Chino Groundwater Basin, CBP supplies could also be accessed to avoid economic losses associated with shortages in water supplies during critical droughts that reduce availability of Metropolitan’s imported water supply. This type of water supply benefit is referred to as “Shortage Avoidance.” The frequency and magnitude of future shortages were estimated from work completed by Metropolitan in updating its IRP in 2021. Metropolitan developed four scenarios to describe alternative future conditions that result in four levels of frequency and magnitude of projected shortages. For this evaluation, the scenario that projected the least degree of future

[2] Metropolitan Water District of Southern California, FISCAL YEARS 2020/21 and 2021/22 COST OF SERVICE REPORT FOR PROPOSED WATER RATES AND CHARGES, May 2020, Table 14. For this evaluation, hydrologically wet years are excluded from the averaging because plentiful SWP hydropower reduces power costs in those years and this relationship is inapplicable to the drier years contemplated for the WSIP exchange.

shortages and the scenario that projected the greatest degree of future shortages were averaged. The averaged frequency and magnitude of those shortages were then used to estimate an annual average shortage. The magnitude of the projected regional imported supply shortages resulting from this evaluation are generally small in comparison to the AWPF supplies produced under the project alternatives under consideration. Therefore, it is generally assumed that all forecasted shortages could be avoided by the project alternatives that provide a water supply benefit. The economic value of avoiding those shortages was established by applying Allocation Surcharge rates developed by Metropolitan for their Water Supply Allocation Plan in 2014.[3] These Allocation Surcharge rates replaced previously applied penalty rates and are based on the marginal cost of conservation programs, as realized as the costs that Metropolitan and its member agencies incur to implement outdoor water use reductions through turf removal programs. Revenues collected from the Allocation Surcharge are to be used to fund future turf removal or other similar programs designed to conserve water and reduce future demands. The Allocation Rate structure calls for an additional $1,480 per acre-foot (in 2015 dollars) for any additional deliveries up to 115 percent of allocated supplies and two times the Allocation Surcharge ($2,960 per acre-feet in 2015 dollars) for any additional deliveries over 115 percent of allocated supplies. These rates were discounted to 2019 dollars to serve as a basis for shortage avoidance water supply benefits in this evaluation.

For all water supply benefits that use Metropolitan water delivery rates as a basis for establishing economic value, future escalation of those rates was estimated by applying Metropolitan's published 10-year projected rates through 2028. An assumed general inflation rate was applied to decrease these rates and maintain constant 2019 dollars (the general inflation rate was assumed to be 2.5 percent per year for this evaluation.) Assumed escalation rates were then applied for the periods between 2029 and 2050 and for 2051 until the end of the project life cycle. The two escalation rates are used to provide flexibility to consider higher near-term increases that might be necessary for Metropolitan to invest in SWP Delta conveyance improvements or other significant projects to address the effect of climate change on imported water supplies (the Metropolitan escalation rate between 2029 and 2050 was assumed be 1 percent per year relative to general inflation while the rate between 2051 and the end of project life was assumed to be 0.5 percent per year relative to general inflation for this evaluation.)

The total life-cycle water supply benefit is calculated as the present worth of the average annual water supply benefit values for each type of water management applicable to each project alternative over the project life, discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation) accounting for the assumed escalation in Metropolitan water supply rates.

3.5.2 Water Quality Benefits

The production of high-quality water in the Chino Groundwater Basin will deliver public benefits in the form of enhanced water quality. As previously discussed, TDS is one of the primary water quality constituents of concern in the Chino Groundwater Basin. Each of the alternatives will utilize advanced water treatment technology to help remove TDS in recycled water prior to recharging in the Chino

[3] Metropolitan Water District of Southern California, Board Action Memorandum for Water Planning and Stewardship Committee, December 9, 2014. Note that the staff recommendations included in this memorandum were approved, as indicated in the meeting minutes.

Groundwater Basin, which helps to ensure water quality objectives are met and local groundwater is sustainable.

Because the Baseline Compliance Plan is assumed to be the least cost approach for meeting the project's water quality purposes, its total present value cost was used as a basis for monetizing the water quality benefits for all project alternatives.

3.5.3 Emergency Water Supply Benefits

New water stored in the Chino Groundwater Basin will enhance emergency response water supply availability for IEUA and other participating agencies during crises such as flood or seismic events that disable imported water infrastructure. This benefit is differentiated from the water shortage avoidance benefits described earlier, based on the extreme severity of the circumstances of the emergency considered in this benefit category. While drought conditions are expected to result in moderate water shortages over the life cycle of CBP project alternatives, extreme shortages due to infrastructure failure could also occur with a duration of a year or longer. While the frequency of these events is expected to be low, the magnitude of the economic impacts could be great.

The CBP would include provisions to provide up to 40 TAFY of stored water in the Chino Groundwater Basin under emergency conditions to local agencies or regionally by utilizing Metropolitan's water distribution system. For this evaluation, it is assumed that the entire new groundwater extraction capacity of any project alternative would be prioritized for responding to an emergency event over a full year. During an emergency event that results in a southern California community having a critical need for supplies, a participating agency could borrow water stored in the Chino Groundwater Basin to be repaid when conditions are stabilized.[4] This action could result in a temporary deferral of other uses of water supplies developed by program alternatives, including the WSIP water exchange for environmental benefits. All other potential uses would be restored after the emergency water supplies are repaid. In the case of the WSIP water exchange, the 25-year commitment of pulse flows totaling 375 TAF would be maintained, and the 25-year term extended, if necessary, in accordance with the time-period of the emergency action.

Since the Baseline Compliance Plan does not include any groundwater extraction infrastructure, these benefits are only realized through the Regional Water Quality and Reliability Plan and CBP alternatives. These benefits are monetized for each alternative by multiplying Metropolitan's rate for delivery of water supplies during shortages of two times Metropolitan's WSAP Allocation Surcharge for any additional deliveries over 115 percent of allocated supplies (see description of shortage avoidance benefits above) by the total emergency water supply estimated to be available (assumed to be the total annual extraction capacity of the project alternative). This total is then multiplied by the annual probability of a levee failure in the Delta that would result in multiple Delta island levee failures (assumed to be 4.2 percent per year in this evaluation) to arrive at the expected annual benefit. The

[4] This emergency action could result in a temporary deferral of other uses of water supplies developed by program alternatives, including the WSIP water exchange for environmental benefits. All other potential uses would be restored after the emergency water supplies are repaid. In the case of the WSIP water exchange, the 25-year commitment of pulse flows totaling 375 TAF would be maintained, and the 25-year term extended, if necessary, in accordance with the length of time of the emergency action. No significant economic impact is anticipated from any potential deferral.

total life-cycle emergency water supply benefit is calculated as the present value of the average annual emergency water supply benefit values over the project life discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation) accounting for the assumed escalation in Metropolitan water rates.

3.5.4 Environmental Benefits

Evaluations conducted while formulating the CBP revealed the potential to support pulse flows of up to 50 TAFY originating in Lake Oroville in the spring of drier water years, for up to three consecutive years. These releases would be designed to improve the survival rate of emigrating juvenile spring-run Chinook salmon. These pulse flows would be optimized to benefit the spring-run Chinook salmon but would also provide benefits to other threatened and endangered native species (Central Valley steelhead and the Southern Distinct Population Segment of North American Green Sturgeon). In its Proposition 1 WSIP application, IEUA proposed that the CBP could support pulse flows of total volume of 375 TAF over 25 years. If the largest magnitude of annual pulse flows is implemented, this would result in 7.5 pulse flows of 50 TAF each, occurring in 30 percent of all years over the 25-year time frame.

These environmental benefits are monetized by applying procedures included in CWC guidelines for the WSIP application process. While a willingness-to-pay evaluation for increased populations of spring-run Chinook salmon provided a substantially higher estimate of the value of the proposed pulse flows, the CWC required a least cost alternative approach for this valuation, using projected rates included in WSIP guidelines for purchasing water on the transfers market as a source of water to perform pulse flows. During the application review process, the CWC considered testimony from applicants regarding the unit values for water transfers included in the WSIP guidelines and ultimately adopted marginally higher rates for future Sacramento Valley water purchases. The CWC provided projected unit values for various hydrologic year types for 2030 and 2045, both in 2015 dollars. An additional annual cost for purchasing an option to improve the reliability of these transfers is added in this evaluation, based on transfer agreements completed in 2005 and 2008. These additional costs provide a method for valuing the high reliability of CBP water supplies in comparison to relying on availability of water from a spot market for water transfers. For this evaluation, these unit costs are discounted to 2019 dollars using the assumed annual economic growth rate (2.5 percent per year).

Pulse flows are assumed to be most beneficial to spring-run Chinook salmon in the driest hydrological years. However, operational evaluations conducted by DWR have revealed the potential for some operational impacts to the SWP during pulse flow exchanges in many critically dry years, as classified by the Sacramento River Index (SRI). For this evaluation, it is assumed that pulse flow exchanges would be approved by DWR in only 20 percent of SRI critically dry years. The frequency of years classified as various year types by the SRI is estimated based on historical data used in DWR's CalSim Central Valley Project (CVP) and SWP operations model (CalSim) by DWR. Using these frequencies and limiting pulse flow exchange to 20 percent of critically dry years results in an estimate of 9 percent of pulse flows occurring in critically dry years. The next highest priority for pulse flows would be years classified as dry by the SRI. Assuming pulse flows exchanges in all dry years results in an estimate of 71 percent of pulse flows occurring in dry years. The remaining 20 percent of pulse flows are assumed to occur in years classified as below normal by the SRI.

Applying unit costs for different year types to these frequencies provides a weighted unit cost for pulse flow transfers in 2030 and 2045 of $360 and $371 per acre-foot in 2019 dollars, respectively. These unit values are used to interpolate annual values over the 25-year WSIP exchange period multiplied by the average annual amount of the pulse flow volume. The total life-cycle environmental benefit is calculated as the present value of the average annual environmental benefit values over the project life discounted at the assumed annual economic growth rate (2.5 percent per year in this evaluation).

While providing broad public benefits to all Californians by aiding spring-run Chinook salmon populations, pulse flows will also improve the resiliency of the SWP and indirectly provide water supply reliability benefits to Metropolitan and IEUA. However, this indirect water supply reliability benefit is difficult to monetize. For this evaluation, the monetized environmental benefits described in this section are included only in NPV and BC-ratio estimates for the CBP conducted from a statewide perspective.

3.5.5 Other Non-Monetized Benefits

Other benefits considered in this analysis that are not monetized:

- Water supply resiliency
- Water quality resiliency
- Subsidence avoidance
- Environmental benefits

3.5.5.1 Water Supply Resiliency

As previously discussed, regional water supply flexibility and redundancy enables the region to adapt to changes that limit, reduce, or make water supplies unavailable, making the water supply more resilient. This resiliency provides benefits by making the region less vulnerable to planned and unplanned supply interruptions. While this evaluation includes estimates of the monetized value of avoiding water supply shortages during severe drought and during emergencies that disrupt imported water supplies, additional water supply resiliency benefits might be realized through the use of new infrastructure included in the project alternatives to facilitate broader regional water markets or mutual aid strategies, avoid impacts during planned or unplanned maintenance of existing water management infrastructure, and advance use of the Chino Groundwater Basin as a regional water bank.

3.5.5.2 Water Quality Resiliency

In periods of drought, recycled water TDS is susceptible to increase due to elevated TDS levels in imported water and TDS contributions from IEUA's desalter. This demonstrates the lack of assimilative capacity to respond to effluent limitations during drought conditions, which is further exacerbated by the steadily increasing ambient water quality of the Chino Groundwater Basin and a heavier reliance on recycled water. With AWPF, the region is better equipped to ensure certain and reliable compliance during varying conditions, which further secures the use of recycled water within the region.

This evaluation includes the cost of implementing the Baseline Compliance Plan as an assumed least cost alternative for meeting IEUA's water quality objectives and as a value of water quality benefits provided by the Regional Water Quality and Reliability Plan and CBP. Because an equivalent capacity of new AWPF production is included in each project alternative, any alternative methodology for estimating water quality benefits would not likely affect the relative comparison of these alternatives. However, the absolute long-term benefits to the Chino Basin of managing TDS and maintaining the viability of both recycled water and groundwater as regional water supply sources are potentially much greater than the value applied in this evaluation.

3.5.5.3 Subsidence Avoidance

Groundwater is an important component of IEUA's water supply. Groundwater extractions have historically resulted in land subsidence, threatening major infrastructure in the region. The Regional Water Quality and Reliability Plan and CBP alternatives will include new groundwater recharge and extraction capacity, strategically located to avoid subsidence-related impacts. This new flexibility will allow for enhanced groundwater management, which will improve the sustainability and reliability of groundwater supplies. The CBP provides greater flexibility in comparison to the Regional Water Quality and Reliability Plan due to its greater groundwater extraction capacity.

The benefit of avoiding impacts of subsidence through use of new groundwater management flexibility might be monetized by assuming that additional water supply purchases from Metropolitan would be required to avoid groundwater pumping that results in subsidence. However, the frequency and magnitude of these potential issues are difficult to predict. For this evaluation, avoiding groundwater subsidence is considered a non-monetized tangential benefit of both the Regional Water Quality and Reliability Plan and CBP alternatives.

3.6 SWP and Groundwater Banking Operations Analysis

A SWP and groundwater banking operations analysis tool is used to evaluate reoperations necessary to perform the water exchange element of the CBP under the Proposition 1 WSIP proposal. This tool can also be used to estimate the potential benefits of Chino Groundwater Basin banking operations using available new AWPF supplies or other sources of imported water. These banking operations are not considered in this evaluation but could potentially add value in the future if either the Regional Water Quality and Reliability or CBP alternatives are implemented.

An analysis of the required SWP reoperations necessary to facilitate the proposed WSIP water exchange and pulse flows was conducted to confirm the feasibility of these operations. The necessary actions include virtually moving water that would otherwise have been delivered to Metropolitan back up the SWP system to San Luis Reservoir, across the Delta, and finally to storage in Lake Oroville. Using monthly time steps, the tool considers available conveyance and storage capacities in the SWP system to determine the feasibility of performing the proposed water exchange without impacting other SWP operations. The tool is also used to evaluate potential Chino Groundwater Basin groundwater banking operations. Key parameters for this analysis include AWPF production and groundwater recharge capacity, groundwater extraction capacity, and groundwater basin storage capacity allocated to banking operations.

The tool uses modeling results from the CalSim operations model as a baseline. CalSim employs an 81-year historical hydrologic record to simulate CVP and SWP operations to project future water supply conditions. The CalSim modeling results used in this evaluation were provided by the CWC for the

Proposition 1 WSIP application process and include four scenarios depicting different water supply development conditions and climate change assumptions. Results from analyses using the tool have been used in discussions with DWR, CDFW, and Metropolitan to help define conditions and terms under which the proposed water exchange could occur. DWR has preliminarily concluded that the exchange operations are feasible in all but the most extremely dry hydrological years and is developing a forecasting and approval process that will ensure a very low risk of impacts to the SWP. Metropolitan has agreed to backstop the exchange, such that SWP deliveries to Metropolitan would be reduced without regard to the schedule for CBP replacement deliveries. This significantly reduces the complexity of SWP actions necessary to implement the exchange while protecting other SWP operations. Metropolitan is also considering ways that Chino Basin exchange schedules might be modified to provide comprehensive water supply reliability benefits to the Metropolitan service area.

3.7 NPV Analysis

After all annual cost and benefit components are estimated for each year of the project life and component cost and benefit present value calculations are completed as described above, a comprehensive NPV for each project alternative is calculated as the sum of the present value of benefit components less the sum of the present value of cost components. The comprehensive NPV represents the total value of investment over the life cycle to IEUA for each project alternative. As a key output of this economic analysis for comparing project alternatives, the BC ratio for each alternative is also calculated as the sum of present value benefit components divided by the sum of present value cost components. Alternatives with positive NPVs and BC ratios greater than 1.0 are deemed economically feasible, in consideration of the assumptions inherent to the analysis. These assumptions are detailed in **Appendix A** and **Appendix B**, and the sensitivity of these assumptions is further explored in Section 5.

3.8 Cost Allocation Analysis

An initial cost allocation analysis was conducted to derive an equitable distribution of costs among the project purposes. This analysis is intended to support evaluation of the financial feasibility of the project and potentially serve as a starting place for a more formal cost allocation for compliance with federal feasibility study requirements. The Separable Costs – Remaining Benefits (SCRB) method, a widely used approach for cost allocation in federal water resources projects, was applied using the previously developed detailed project cost information and estimates of monetized benefits for four project purposes: water supply reliability, water quality improvement, emergency water supply, and subsidence avoidance for each alternative.

The SCRB method distributes costs among the project purposes by identifying separable costs and allocating joint costs in proportion to each purpose's remaining benefits. Separable costs for a project purpose are estimated as the incremental reduction in project costs that would result if that purpose is excluded from the multipurpose project. Joint costs are the remaining project costs after all separable costs are subtracted.

The SCRB method starts by identifying the separable costs for each project purpose. Separable costs are subtracted from the lesser of benefits or single-purpose alternative project costs to derive remaining benefits. Next, joint costs are allocated in proportion to the distribution of remaining benefits. Joint project costs are then assigned to a project purpose based on the proportion of their remaining benefits (i.e., total benefits less the separable costs of each project purpose). Total cost allocated to a project purpose is the sum of its separable and apportioned joint costs.

3.9 Cash Flow Analysis

To provide additional and more accessible information to support a financial analysis of project alternatives, projected cash flows for each alternative were compared from IEUA's perspective. The gross cash flow estimates include financing costs for capital improvements with assumed terms of a 2 percent annual interest rate and 30-year repayment term, capital replacement costs amortized at 2 percent over the life of specific project components, and average annual O&M costs. For this analysis, the existing value of IEUA recycled water supplies to be used as AWPF influent is not included as a cost for all alternatives and the conditional Proposition 1 WSIP investment of $212 million is deducted from capital costs for the CBP. These costs are not discounted, and a general inflation rate, assumed at 2.5 percent per year, is applied together with other rate escalation assumptions described earlier. While these estimates provide perspective on relative costs over time and required repayment revenue, real-time costs would be more variable from year to year and dependent on the required quantities of groundwater extraction in any given year.

To provide additional context, net cash flow estimates are also evaluated by subtracting cost offsets from reducing Metropolitan water supplies that would be possible under each alternative. These costs include those water supply cost savings described in Section 3.5.1 as In-Lieu Delivery and Metropolitan Demand Offset. For this analysis, the societal economic value for In-Lieu Delivery is replaced by the projected cash flow savings to IEUA – Metropolitan's Full Service Tier 1 Treated Water rate. While other benefits would accrue under each alternative, these categories of water supply benefit are most directly tied to cash flow and are the only benefits considered in this net cash flow evaluation.

4 Comparison of Alternatives

4.1 Summary of Cost Components

Cost components identified in Section 3.4 are provided for each of the feasible alternatives in **Table 2**.

Table 2: Costs Comparison of Alternatives

	Baseline Compliance Plan	Regional Water Quality and Reliability Plan	Chino Basin Program
Total Capital Cost (2019 $ million)	$355.8	$538.9	$665.9
PV Cost (2019 $ million)[5]	$593.8	$972.2	$1,171.0
Capital and Replacement Cost	*$246.2*	*$441.2*	*$589.2*
- Loan Payment	$191.6	$349.8	$469.0
- Replacement Cost	$54.6	$91.4	$120.2
Annual Costs	*$196.4*	*$351.8*	*$393.5*
- O&M Cost	$171.1	$324.1	$364.4
- NRW Cost	$25.3	$27.7	$29.1
Recycled Water Cost	*$151.2*	*$179.2*	*$188.3*

The Baseline Compliance Plan has lower capital and life cycle present value costs as compared with the Regional Water Quality and Reliability Plan and the CBP since the alternative has a single purpose and does not include project components integrated to meet multiple purposes including enhancing regional water supply reliability. As a result, the capital cost for the Baseline Compliance Plan is 34 percent lower than the Regional Water Quality and Reliability Plan and 47 percent lower than the CBP. The capital cost of the Regional Water Quality and Reliability Plan is 19 percent lower than the CBP. The total life-cycle present value cost for the Baseline Compliance Plan is 39 percent less than the Regional Water Quality and Reliability Plan. The total life cycle present value cost of the Regional Water Quality and Reliability Plan is 17 percent lower than the CBP (without considering Proposition 1 WSIP funds as a cost deduction).

[5] Present value: capital and O&M costs evaluated for 50 years and discounted to 2019 dollars

4.2 Summary of Benefits

Benefit components identified in Section 3.5 are provided for each of the alternatives in **Table 3**.

Table 3: Benefits Comparison of Alternatives

	Baseline Compliance Plan	Regional Water Quality and Reliability Plan	Chino Basin Program
PV Benefit ($ million)	$593.8	$1,182.9	$1,259.8
Water Supply Benefits	-	*$529.1*	*$380.8*
- Pump-In Benefit	-	-	$10.0
- In-Lieu Benefit	-	-	$62.5
- Metropolitan Demand Offset	-	$469.9	$249.5
- Shortage Avoidance Benefit	-	$59.2	$58.8
Water Quality Benefits	*$593.8*	*$593.8*	*$593.8*
Emergency Supply Benefits	-	*$59.9*	*$165.4*
Ecosystem Benefits	-	-	*$119.7*

In total, the Baseline Compliance Plan provides less benefits to the region because the alternative is only designed to meet water quality-related regulatory challenges and does not include any infrastructure to enhance regional water supply. As a result, no water supply, emergency supply, or ecosystem benefits are realized through the Baseline Compliance Plan and the total present value benefit of the Regional Water Quality and Reliability Plan and the CBP are over twice as much as the Baseline Compliance Plan.

In comparison to the CBP, the Regional Water Quality and Reliability Plan provides 28 percent greater water supply benefits to the region due to the additional flexibility to use new AWPF water supplies for local uses during the first 25-years of the project life while the CBP is committed to the Proposition 1 WSIP water exchange. The CBP provides significantly greater emergency supply benefits compared to the Regional Water Quality and Reliability Plan due to the greater groundwater extraction capacity provided by this alternative. Ecosystem benefits are only provided by the CBP. In total, the CBP provides six percent greater benefits than the Regional Water Quality and Reliability Plan.

4.3 Net Present Value Assessment

A comparison of total life-cycle benefits and costs and BC ratios for each of the alternatives is shown in **Table 4** and provided graphically in **Figure 9.** NPV is calculated as the total present value benefits less the total present value costs and represents the total value of investment over the life cycle for each alternative. The BC ratio for each alternative is calculated as the total present value benefits divided by the total present value costs. Alternatives with positive NPV and BC ratios greater than 1.0 are deemed economically feasible, in consideration of the assumptions inherent to the analysis. In this evaluation, the Baseline Compliance Plan has a BC ratio of 1.00 due to the assumption that this alternative represents the least cost plan for achieving the water quality improvement purposes of the project and its present value costs are used to monetize the water quality improvement benefits of all project alternatives. The NPV and BC ratios for the Regional Water Quality and Reliability Plan and the CBP are positive and greater than 1.00, respectively, indicating both alternatives are economically feasible. The Regional Water Quality and Reliability Plan provides an NPV of $210.7 million and BC ratio of 1.22, while the CBP provides an NPV of $88.7 million and a BC ratio of 1.08.

Table 4: Life Cycle Present Value Benefits and Costs of Alternatives ($ million)

	Baseline Compliance Plan	Regional Water Quality and Reliability Plan	Chino Basin Program
PV Cost	$593.8	$972.2	$1,171.0
Capital and Replacement Cost	*$246.2*	*$441.2*	*$589.2*
- Loan Payment	$191.6	$349.8	$469.0
- Replacement Cost	$54.6	$91.4	$120.2
PV of Annual Costs	*$196.4*	*$351.8*	*$393.5*
- O&M Cost	$171.1	$324.1	$364.4
- NRW Cost	$25.3	$27.7	$29.1
Recycled Water Cost	*$151.2*	*$179.2*	*$188.3*
PV Benefit	$593.8	$1,182.9	$1,259.8
Water Supply Benefits	-	*$529.1*	*$380.8*
Water Quality Benefits	*$593.8*	*$593.8*	*$593.8*
Emergency Supply Benefits	-	*$59.9*	*$165.4*
Ecosystem Benefits	-	-	*$119.7*
Net Present Value	-	$210.7	$88.7
Benefit – Cost Ratio	1.00	1.22	1.08

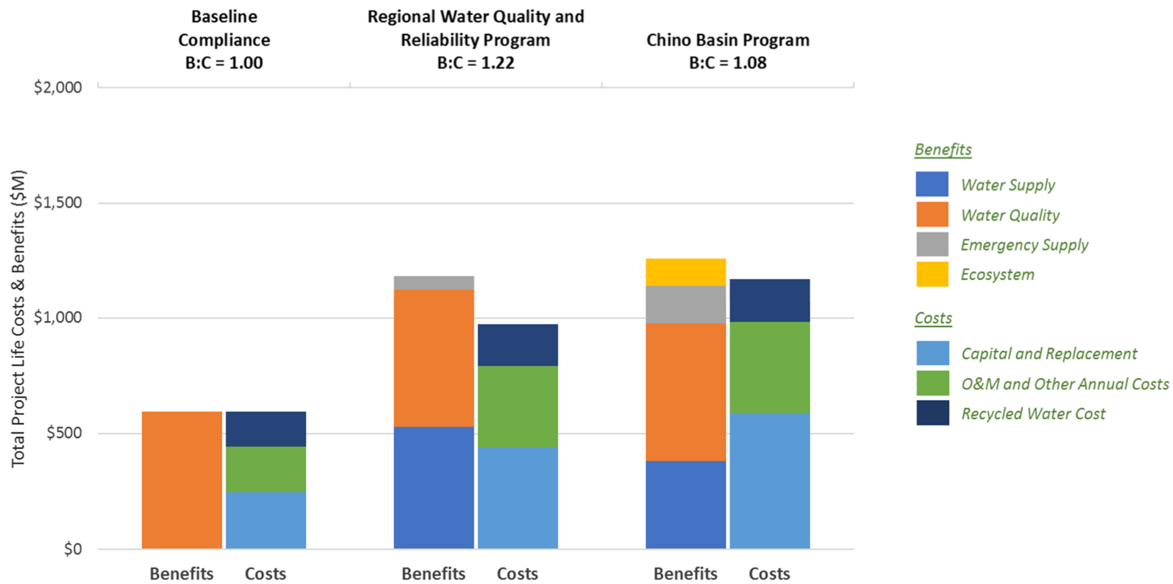

Figure 9: Life-Cycle Benefits and Costs Analysis of Alternatives

4.4 Cost Allocation Analysis

The results of the cost allocation analysis described in Section 3.8 are delineated in **Table 5**. The Baseline Compliance Plan is a single-purpose water quality improvement project; subsequently, all costs are allocated to the water quality improvement purpose. The Regional Water Quality and Reliability Plan and CBP are multipurpose projects with water supply reliability and water quality improvement primary project purposes, and subsidence avoidance and emergency water supply secondary project purposes. The cost allocation analysis, which considers separable costs assignable to single purposes and allocates remaining joint costs in recognition of monetized benefits for each project purpose, results in the largest assigned portion of project costs to water quality improvement purposes for the Regional Water Quality and Reliability Plan and the CBP (62 and 58 percent, respectively). Water supply reliability is assigned the next greatest portion of project costs for both the Regional Water Quality and Reliability Plan and the CBP (34 and 36 percent, respectively). Finally, emergency water supply and environmental improvements are allocated relatively minor amounts of total project costs.

Table 5: Allocated Annualized Life Cycle Costs by Project Purpose ($ million)

	Baseline Compliance Plan		Regional Water Quality and Reliability Plan		Chino Basin Program	
Project Purpose	Annualized Cost	Percent of Total	Annualized Cost	Percent of Total	Annualized Cost	Percent of Total
Water Supply	-	0%	$11.6	34%	$12.6	36%
Water Quality	$21.1	100%	$21.4	62%	$20.4	58%
Emergency Supply	-	0%	$1.3	4%	$1.3	4%
Environmental	-	0%	-	-	$1.0	3%
Total	$21.1		$34.3		$35.3	

4.5 Cash Flow Analysis

As described in Section 3.9, the cash flow associated with each of the project alternatives was compared to provide a more accessible context for the required investments. Gross cash flow for the Baseline Compliance Plan, the Regional Water Quality and Reliability Plan, and the CBP are displayed graphically in **Figure 10**, including the components of annual loan payment, fixed O&M cost, variable O&M cost, replacement cost, and other costs. These costs are not discounted, and an assumed general inflation rate of 2.5 percent per year is applied together with other assumed escalation rates. As shown, annual loan payment and variable O&M costs (including energy costs) are the largest cost components of each alternative. Fixed O&M costs, replacement costs, and other costs (including NRW disposal costs and groundwater replenishment costs when applicable) represent smaller components of the total annual costs for each alternative.

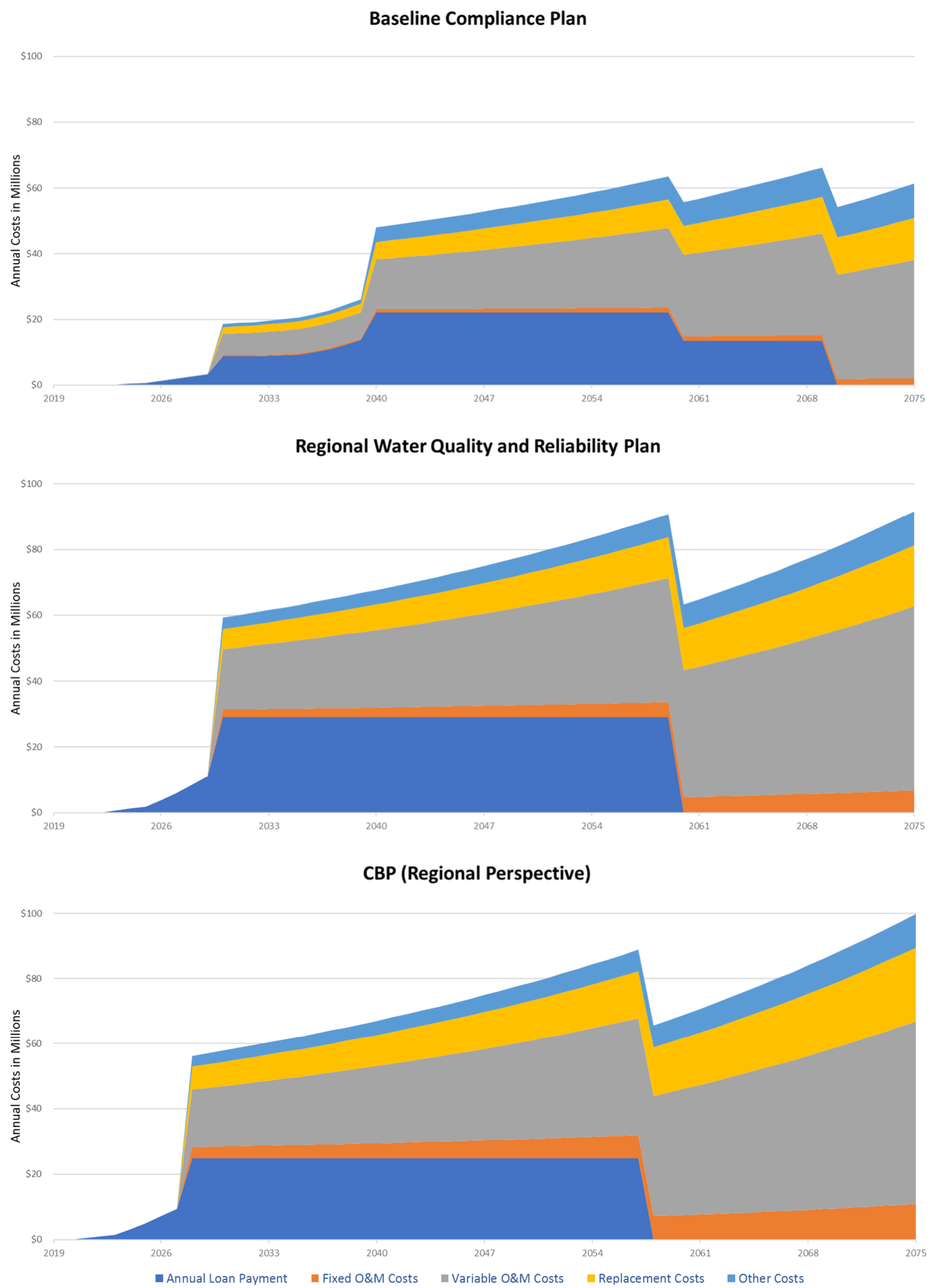

Figure 10: Cash Flow for Project Alternatives (No discounting, assuming 2.5% general inflation)

Total gross cash flow for all three project alternatives is compared graphically in **Figure 11**. As shown, the Baseline Compliance Plan requires the lowest cash flow with annual gross costs of $55.2 and $54.2 million in 2050 and 2070, respectively. The Regional Water Quality and Reliability Plan and CBP have similar higher cash flow requirements with annual gross costs of $78.7 and $78.5 million, respectively, in 2050, and $81.0 and $88.2 million, respectively, in 2070.

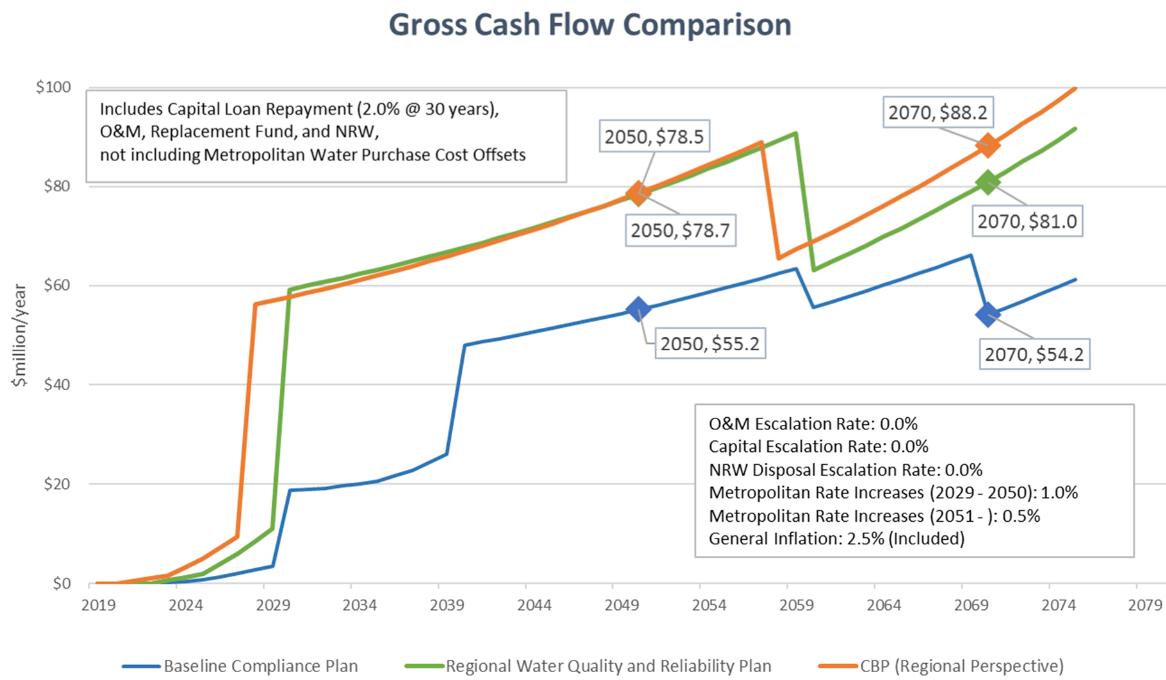

Figure 11: Gross Cash Flow Comparison for Project Alternatives

When cost offsets made possible by reducing Metropolitan water purchases under each alternative are considered to estimate net cash flow, the comparison is dramatically different. Net cash flow for all three project alternatives is compared graphically in **Figure 12**. Annual net costs are calculated by subtracting the cost of Metropolitan supply replaced by In-Lieu Delivery and Metropolitan Demand Offset cost savings to IEUA for each project alternative. Assumed Metropolitan rate escalation is included in these cost offsets together with an assumed general inflation rate of 2.5 percent per year.

As shown, the Baseline Compliance Plan does not include water supply benefits and net costs are equivalent to the gross costs described above. The Regional Water Quality and Reliability Plan and CBP have similar lower net cash flow requirements with annual net costs of $31.6 and $45.3 million, respectively, in 2050 and dropping to -$3.7 and $3.6 million, respectively, in 2070. The dramatic decrease in net costs for these two alternatives occurs as debt for capital investments is paid off and Metropolitan rates continue to escalate slightly higher than general inflation (as assumed in this evaluation). As the WSIP water exchange commitment is fulfilled after 25 years in 2054 under the CBP alternative, all new AWPF supplies are made available for local use. This results in a decline in net cash flow requirement for the CBP to a similar level as the Regional Water Quality and Reliability Plan for several years during the middle years of their project life cycles. Higher costs requirements in the last 20 years of the project life cycle of the CBP as comparted to the CBP Regional Water Quality and Reliability Plan are attributable to higher fixed O&M costs and replacement costs due to the greater capacity of the groundwater extraction facilities included in the CBP.

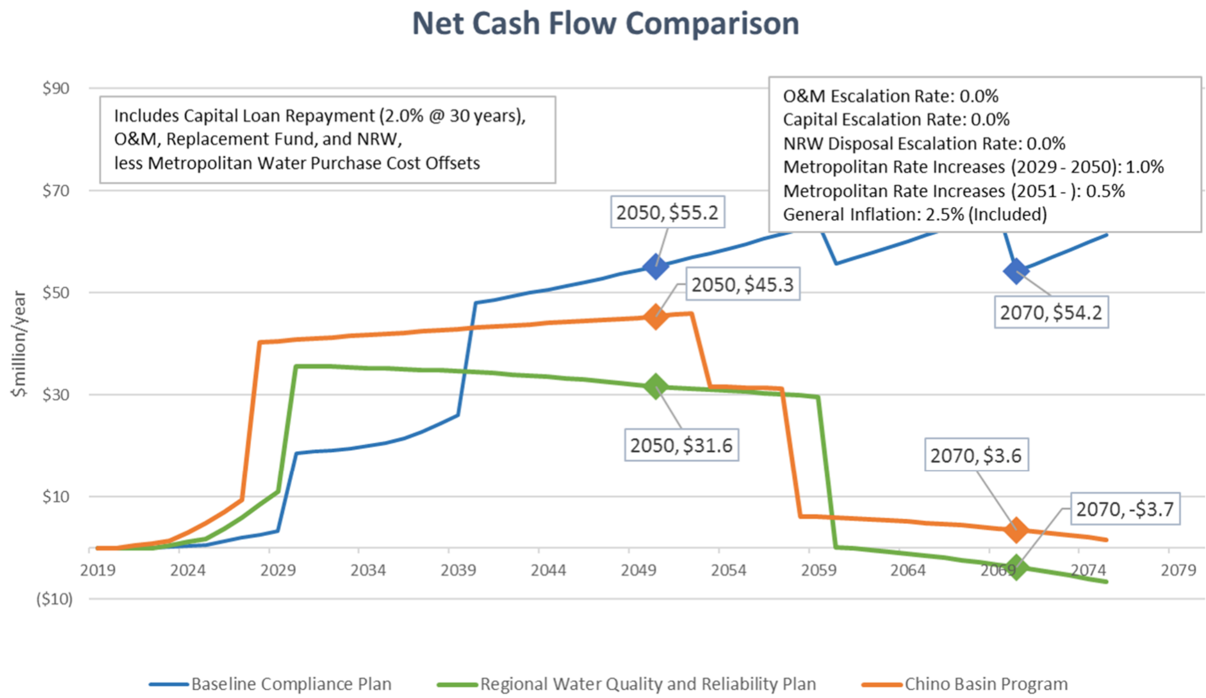

Figure 12: Net Cash Flow Comparison of Project Alternatives

4.6 Summary of Results

4.6.1 Cost Components

Because the Baseline Compliance Plan alternative only addresses water quality improvement project purposes and does not include infrastructure necessary for water supply improvement and other project purposes, its capital cost of $355.8 million is considerably less than both the Regional Water Quality and Reliability Plan and CBP, which have capital costs of $538.9 million and $665.9 million, respectively. Similarly, the total present value cost of the Baseline Compliance Program is $593.8 million, considerably less than total present value costs for the Regional Water Quality and Reliability Plan and CBP at $972.2 and $1,171.0 million, respectively. The greater total present value cost of the CBP, 20 percent greater than the Regional Water Quality and Reliability Plan, provides significantly increased groundwater extraction capacity and improved water management operational flexibility.

4.6.2 Benefits

As described earlier, the Baseline Compliance Plan is assumed in this evaluation to represent the least cost alternative for achieving IEUA's single-purpose water quality improvement objectives and its total present value cost is used as an estimate of present value water quality benefits for all project alternatives. The Baseline Compliance Plan does not contribute to other project purposes and includes no other monetized benefits in the analysis.

Water supply benefits are provided by the Regional Water Quality and Reliability Plan through Metropolitan Demand Offset and Shortage Avoidance water supply improvements. The present value of these water supply benefits totals $529.1 million over the 50-year project life cycle. Water supply benefits for the CBP during the first 25years of the project life cycle (while the Proposition 1 WSIP water exchange commitment is fulfilled) are provided by cost offsets associated with pump in of new AWPF water supplies to Metropolitan to replace a portion of Metropolitan's SWP Table A delivery, local use of new AWPF supplies in lieu of deliveries from Metropolitan to replace the remainder of Metropolitan's SWP Table A delivery, Metropolitan demand offset for the portion of new AWPF supplies that are not committed to the Proposition 1 WSIP exchange, and by avoiding shortages in Metropolitan deliveries during severe drought. During the second 25 years of the CBP project life cycle (after fulfillment of the Proposition 1 WSIP exchange commitment) water supply benefits are increased due to the ability to use all new AWPF supplies for Metropolitan Demand Offset and Shortage Avoidance water supply improvements. The total present value of these water supply benefits is $380.8 million. This value is 28 percent less than the total present value of the water supply benefit for the Regional Water Quality and Reliability Plan, due to the commitment of water supply for the Proposition 1 WSIP exchange.

The present value of emergency supply benefits for the Regional Water Quality and Reliability Plan and the CBP are $59.9 and $165.4 million, respectively. The difference in magnitude of these benefits is driven by the greater groundwater extraction capacity of the CBP compared to the Regional Water Quality and Reliability Plan.

The CBP also provides $119.7 million in ecosystem benefits through the WSIP water exchange. If that value is added to other CBP water supply benefits and emergency supply benefits, the total present value is $665.9 million, compared to the total present value of water supply benefits and emergency supply benefits of $589.1 million provided by the Regional Water Quality and Reliability Plan.

The total present value benefit of the Baseline Compliance Plan, the Regional Water Quality and Reliability Plan, and the CBP are $593.8 million, $1,182.9 million, and $1,259.8 million. As expected, total benefits are significantly lower for the Baseline Compliance Plan because it only addresses water quality improvement benefits. The total present value of benefits for the CBP is about six percent greater than that of the Regional Water Quality and Reliability Plan.

4.6.3 Net Present Value Assessment

As an assumption used in this analysis, the total present value costs are equivalent to the present value benefits estimated for the Baseline Compliance Plan, resulting in a NPV of 0 and a BC ratio of 1.0 for this alternative. Total present value benefits exceed total present value costs for both the Regional Water Quality and Reliability Plan and the CBP, with a NPV of $210.7 million and a BC ratio of 1.22 for the Regional Water Quality and Reliability Plan, a NPV of $88.7 million and BC ratio of 1.08 for the CBP. These results indicate that from a regional perspective, both the Regional Water Quality and Reliability Plan and the CBP provide return on investment, with the Regional Water Quality and Control Plan alternative showing the strongest performance under these assumptions. However, in consideration of non-monetized benefits and the additional operational flexibility provided by the CBP, both the CBP and the Regional Water Quality and Reliability Plan return significant value for their required investments.

4.6.4 Cost Allocation

The Baseline Compliance Plan provides for only water quality improvement benefits and all alternative costs are allocated to this project purpose. Allocated costs for the Regional Water Quality and Reliability Plan and the CBP are similar, with the majority of costs allocated to the water quality project purpose (62 percent for the Regional Water Quality and Reliability Plan and 58 percent for the CBP), followed by costs allocated for the water supply project purpose (34 percent for the Regional Water Quality and Reliability Plan and 36 percent for the CBP). Emergency water supply and environmental improvement project purposes are allocated relatively small percentages of costs (four percent or less). These preliminary costs allocations are consistent with IEUA's water management priorities, as described earlier.

4.6.5 Cash Flow Analysis

The cash flow analysis conducted for this evaluation provides context for the investment decisions before IEUA and its member agencies. The Regional Water Quality and Reliability Plan and the CBP have similar gross cash flow requirements over their respective project live cycles. The gross cash flow requirements of the Baseline Compliance Plan are considerably less -- on the order of 25 percent lower through much of the project's life cycle. However, the value of both the Regional Water Quality and Reliability Plan and the CBP are demonstrated when the potential cost offsets of reducing water purchases from Metropolitan are considered. The net cash flow requirements of both the Regional Water Quality and Reliability Plan and the CBP decline significantly over the last 20 years of the 50-year life cycles. The Baseline Compliance Plan provides no water supply cost offsets, and its net costs are equivalent to its gross costs, generally increasing over the project's life cycle due to assumed general inflation and escalation rates. During the last 20 years of the 50-year life cycle, the annual cash flow requirement of the Baseline Compliance Plan is on the order of five to ten times greater than that of the Regional Water Quality and Reliability Plan and the CBP.

4.6.6 Summary of Alternative Comparison

Present value costs and benefits of the Baseline Compliance Plan are significantly less than both the Regional Water Quality and Reliability Plan and the CBP due to its formulation as a single purpose water quality project. The present value cost of the Regional Water Quality and Reliability Plan is about 20 percent less than the CBP while the present value benefits of the CBP are about six percent greater than the Regional Water Quality and Reliability Plan. With BC ratios of 1.22 and 1.08, and in consideration of non-monetized benefits, both the Regional Water Quality and Reliability Plan and the CBP from a regional perspective are deemed economically feasible. Finally, the comparative gross and net cash flow of the project alternatives demonstrate the long-term returns of investing in the water supply benefits offered by either the Regional Water Quality and Reliability Plan and the CBP multipurpose project in comparison to the single-purpose Baseline Compliance Plan.

5 Sensitivity and Uncertainty

5.1 Escalation Rates for O&M and Capital Costs

Annual escalation rates for O&M and capital costs were set at 0 percent relative to general inflation to generate the total present value costs and benefits of project alternatives previously described. These escalation rates were increased to 2 percent per year and 4 percent per year to evaluate the sensitivity of increased capital and O&M costs over the project life cycle of the alternatives. As shown in **Figure 13**, increasing these escalation rates reduces the BC ratio for the Regional Water Quality and Reliability Plan and the CBP. Under each set of escalation rate assumptions, the BC ratio for the Baseline Compliance Plan remains at 1.00 (by definition in this economic evaluation), while the BC Ratio for the Regional

Water Quality and Reliability Plan and the CBP decrease as the escalation rate increases in relative proportion to one another.

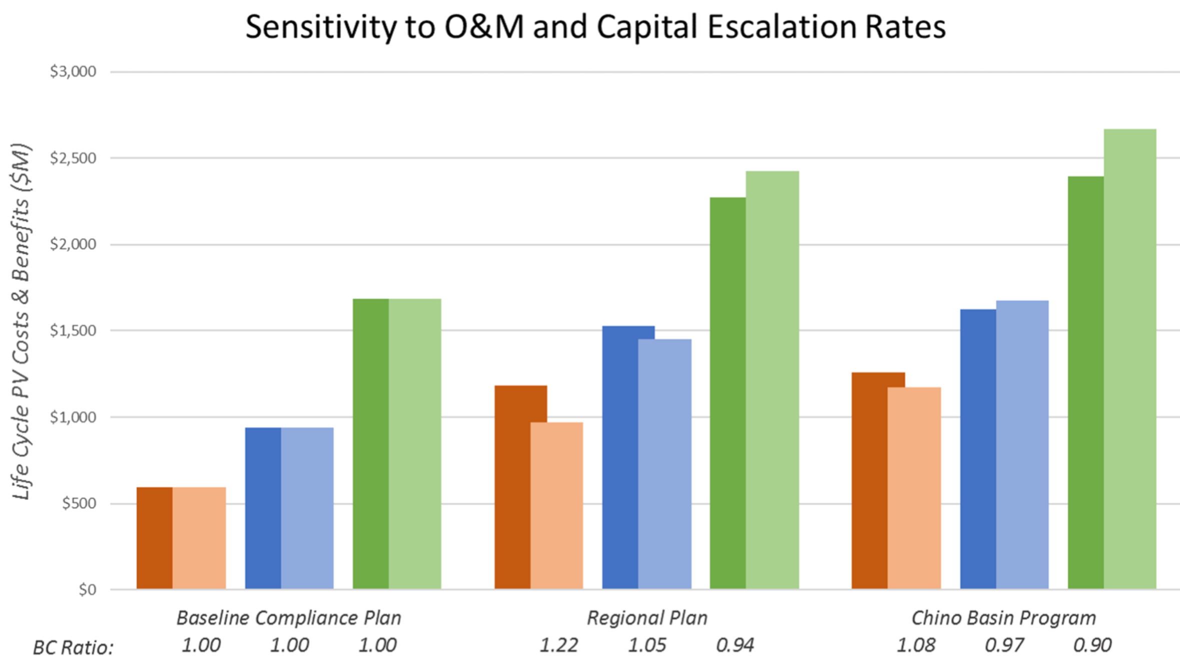

Figure 13: Effect of O&M and Capital Escalation Rates on Benefits and Costs of Project Alternatives

While capital and O&M cost escalation rates have little effect on the economic ranking of project alternatives, these rates do have a dramatic effect on the absolute costs and benefits of each project alternative. These effects are more pronounced for costs than benefits, largely due to the structure of this economic evaluation, which ties the majority of Water Supply and Emergency Supply benefits to Metropolitan's rate structure. Metropolitan rates are not varied in this comparison, leading to relative stability of total benefits in comparison to costs. Increasing escalation rates from 0 percent to 4 percent increases costs by roughly 180 percent, 150 percent, and 130 percent for the Baseline Compliance Plan, Regional Water Quality and Reliability Plan, and CBP, respectively. Meanwhile, benefits are increased by roughly 180 percent, 90 percent, , and 90 percent for the Baseline Compliance Plan, Regional Water Quality and Reliability Plan, and CBP, respectively. As a result, the BC ratio for the Regional Water Quality and Reliability Plan and the CBP is reduced when higher O&M and capital escalation rates are used. Because benefits are equivalent to costs for the Baseline Compliance Plan by assumption, these effects do not apply to that project alternative. As O&M costs are a major component of costs, assumptions about future escalation could affect the economic and financial feasibility of all project alternatives.

5.2 Escalation Rates for Metropolitan Water Deliveries

As described in Section 3.5.1, various categories of water supply benefits are identified and quantified for this economic evaluation. “CBP Pump-In Delivery,” “In-Lieu Delivery,” and “Metropolitan Demand Offset” all describe different management approaches that provide cost savings through use of local supplies in place of imported supplies but do not increase total water supply within IEUA as compared to no action. These categories of water supply benefits include escalation rates associated with Metropolitan’s water delivery rate structure, as described in Section 3.5.1.

Annual escalation rates for Metropolitan water deliveries are set for three time periods within the life cycle of the project alternatives. Published rates, less the assumed general inflation rate (2.5 percent per year in this evaluation), are applied between the year of the alternative coming online through 2028. Rates for this time period were not varied in this sensitivity analysis. Assumed escalation rates of 1.0 percent per year between 2029 and 2050, and 0.5 percent per year between 2051 and the end of the project life cycle (both relative to assumed general inflation) were applied to generate the total present value costs and benefits previously described. These escalation rates were varied to 0 percent per year for both time periods and to 3.5 percent per year and 1.5 percent per year for 2029 – 2051 and 2051 until the end of the life cycle, respectively, for this sensitivity analysis.

As shown in **Figure 14**, total present value benefits for the Regional Water Quality and Reliability Plan and the CBP are affected significantly by adjusting Metropolitan escalation rates. Increasing these escalation rates from 0 percent per year for both time periods to 3.5 percent per year and 1.5 percent per year for 2029 – 2051 and 2051 until the end of the life cycle increases total benefits by 49 and 46 percent for the Regional Water Quality and Reliability Plan and the CBP, respectively, while costs remained unchanged. As a result, BC ratios increase from 1.10 to 1.64 for the Regional Water Quality and Reliability Plan, and from 0.98 to 1.44 for the CBP. The Baseline Compliance Plan does not include water supply benefits and is not affected by variation of the Metropolitan rate escalation.

As with the sensitivity analysis of other factors presented here, variation of the assumed future value of water has little effect on the relative economic ranking of project alternatives but does have a significant effect on the absolute NPV provided by both the Regional Water Quality and Reliability Plan and the CBP. This underscores the general conclusion that to the extent future water scarcity is assumed to increase and risk tolerance for incurring water shortages is low, the greater the value of investing in infrastructure that facilitates decreasing reliance on imported water supplies.

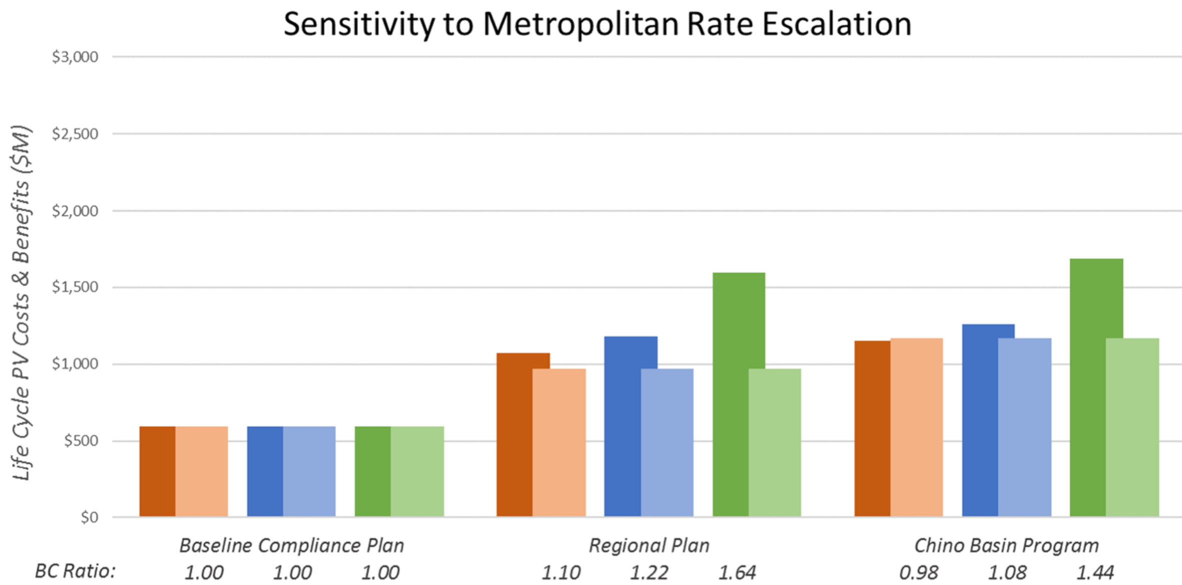

Figure 14: Effect of Metropolitan Escalation Rates on Benefits and Costs of Project Alternatives

5.3 Concurrent Escalation of O&M, Capital, and Metropolitan Rates

The sensitivity analysis for escalation of O&M and capital rates and for escalation of Metropolitan rates described above has greater effects on the costs and benefits, respectively, of project alternatives. While future water scarcity may affect the type and magnitude of needed investment in water projects by Metropolitan and result in rate increases, O&M and capital costs are also likely to affect Metropolitan rates, so these factors are not completely independent. To evaluate the sensitivity of the effects of concurrent escalation of O&M, capital, and Metropolitan rates, an additional evaluation was performed. The escalation rates described in the previous sections were combined for this evaluation.

As shown in **Figure 15**, a concurrent escalation of O&M, capital, and Metropolitan rates affect both the present value of total life-cycle benefits and costs of all project alternatives. Comparing effects from the lowest set of escalation rates to the highest set of escalation rates results in comparable increases in benefits and costs for each alternative, ranging from roughly 180 percent for both the benefits and costs of the Baseline Compliance Alternative to roughly 140 percent for the CBP. The BC ratio of the Regional Water Quality and Reliability Plan and the CBP are affected by the escalation rate assumption set, with no obvious pattern. This evaluation underscores the significance of future absolute and relative changes in O&M, capital, and Metropolitan escalation rates. While this sensitivity analysis does not suggest that any project alternative performs relatively better under this variation of escalation rates, it is clear that these factors will have a significant effect on absolute life-cycle benefits and costs under all project alternatives.

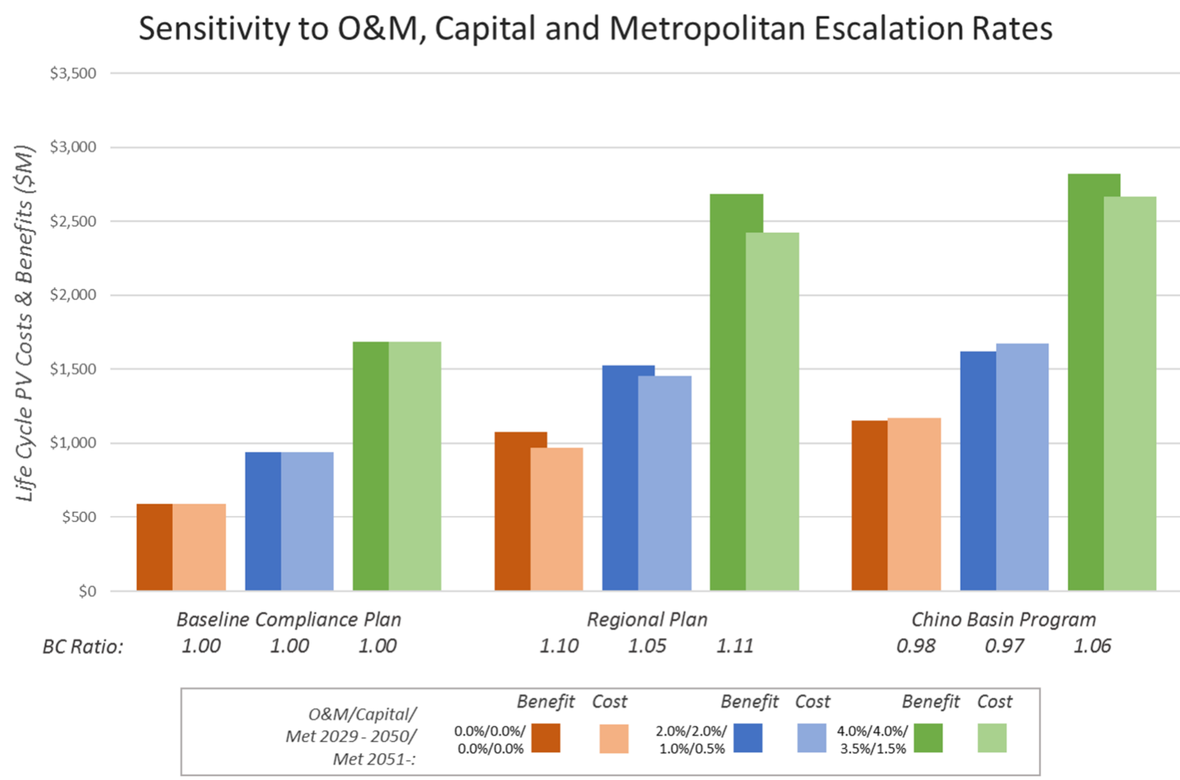

Figure 15: Effect of Concurrent Escalation of O&M, Capital, and Metropolitan Rates on Project Alternatives

5.4 Summary of Results

This economic evaluation includes many assumptions that should be understood and scrutinized as decision-makers and interested parties consider its results. The sensitivity analysis provided here considers some of the key assumptions, including O&M, capital, and Metropolitan rate escalation. As a construct of this economic evaluation, future O&M and capital costs have a greater effect on project costs while future Metropolitan rates have a greater effect on project benefits. Variation in assumptions regarding escalation of these rates has little effect on the economic ranking of project alternatives, as measured by comprehensive NPV and BC ratio. However, variations in these assumptions do have a significant effect on the absolute value of both the Regional Water Quality and Reliability Plan and the CBP, and significant variation in these key assumptions could affect the economic and financial feasibility of these project alternatives. Depending on perspectives regarding future economic conditions, future water supply availability for water sources dependent on hydrology or subject to infrastructure failure and risk tolerance, the value of the project alternatives considered in this economic evaluation ranges from a low end where benefits are approximately equal to costs, to a high end where benefits greatly exceed costs.

6 Conclusions and Recommendations

6.1 Conclusions

This economic evaluation was performed to assess and compare the economic feasibility of project alternatives formulated to address regional water quality and water supply challenges and to address several key questions, including:

- What are the consequences of No Action?
- Should IEUA implement a single-purpose water quality Baseline Compliance Plan alternative, or pursue a multipurpose project that also addresses water supply reliability and other objectives?
- If IEUA chooses to pursue a multipurpose project, should IEUA accept Proposition 1 WSIP funding and move forward with the CBP, or does it make more economic and financial sense to forego the funding and pursue the Regional Water Quality and Reliability Plan?
- What are the most sensitive assumptions and how do they affect comparison of alternatives?

Benefit and cost components were identified, quantified, and monetized to estimate the present value of the benefits and costs associated with each alternative. BC ratios were also calculated for each project alternative. A graphical depiction of the results of this analysis over a life cycle period of 50 years is provided in **Figure 9**.

6.1.1 Consequences of No Action

IEUA estimates that without taking additional action, TDS limits for recycled water direct non-potable use, groundwater recharge, and effluent discharge may be exceeded within the next 10 years. This exceedance will affect IEUA's ability to continue its groundwater recharge program and reuse of recycled water, substantially increasing dependence on imported water supplies. As imported supplies become less reliable, more frequent severe water shortages will occur in the region. A No Action approach results in the Chino Basin being out of regulatory compliance, threatens water supply, and does not meet IEUA's objectives. Therefore, No Action is not considered to be a feasible alternative.

6.1.2 Single-Purpose vs. Multipurpose Projects

A key assumption in this economic evaluation is that the Baseline Compliance Plan represents the least cost alternative approach for meeting IEUA's long-term water quality objectives. Because this alternative does not include any project components to enhance regional water supply, the present value benefits of the Regional Water Quality and Reliability Plan and the CBP are about twice as much as the Baseline Compliance; the comprehensive NPVs of the Regional Water Quality and Reliability Plan and the CBP are $210.7 million and $88.7 million, respectively, compared to the Baseline Compliance Plan's assumed NPV of 0; and the BC ratios of the Regional Water Quality and Reliability Plan and the CBP are 1.22, and 1.08, respectively, compared to the Baseline Compliance Plan's assumed BC ratio of 1.0. A key conclusion from this economic evaluation is that there is considerable value for IEUA in pursing either multipurpose project alternative, Regional Water Quality and Reliability Plan or the CBP, in comparison to the single-purpose Baseline Compliance Plan. In consideration of non-monetized benefits, both the Regional Water Quality and Reliability Plan and the CBP provide cost-effective approaches to providing for future regional water needs and shoring up the reliability of existing water supply portfolios.

6.1.3 Regional Water Quality and Reliability Plan vs. CBP

In comparison to the CBP, the Regional Water Quality and Reliability Plan provides about 28 percent greater total water supply benefits to the region due to the additional water supply benefits provided during the first 25 years of the project life when the CBP is committed to the Proposition 1 WSIP water exchange. The total present value of these water supply benefits over the 50-year project life cycle are $529.1 million and $380.8 million for the Regional Water Quality and Reliability Plan and CBP, respectively. However, because of its significantly greater groundwater extraction capacity, the CBP provides roughly 170 percent greater emergency supply benefits than the Regional Water Quality and Reliability Plan. In addition, the CBP exclusively provides $119.7 million in ecosystem benefits. The total life cycle present-value benefits for the Regional Water Quality and Reliability Plan and the CBP are $1,182.9 million and $1,259.8 million, respectively, with the CBP demonstrating about six percent greater benefits.

Capital costs for constructing the Regional Water Quality and Reliability Plan and the CBP are $538.9 million and $665.9 million, respectively, or about 24 percent higher for the CBP. Combining present value benefits and costs for the Regional Water Quality and Reliability Plan and the CBP results in comprehensive NPVs of $210.7 million and $88.7 million, respectively, and BC ratios of 1.22 and 1.08, respectively.

An important consideration in comparing the Regional Water Quality and Reliability Plan and the CBP is the effect of costs on IEUA's rate payers. The cash flow analysis described in Section 4.5 provides comparative cashflow requirements for all project alternatives, not including discounting and accounting for an assumed 2.5 percent per year general inflation rate. This evaluation indicates that gross cash flow requirements are similar for the Regional Water Quality and Reliability Plan and the CBP, and roughly 35 to 50 percent higher than the Baseline Compliance Plan over much of the project life cycle. However, when cost savings associated with reductions in required purchases are considered, net cash flow for both the Regional Water Quality and Reliability Plan and the CBP are dramatically lower than the Baseline Compliance Plan.

These results support a key conclusion that both the Regional Water Quality and Reliability Plan and the CBP are economically feasible and provide value for their required investment. In comparison to the Regional Water Quality and Reliability Plan, the CBP provides similar water quality and water supply benefits at similar life-cycle costs, while also providing additional benefits through the flexibility offered by the greater groundwater extraction capacity included with this project alternative. It is important to note that a key premise of this evaluation is the region will experience a low need for new water supplies to meet projected demands during hydrologically normal conditions over the next 25 years, as projected in IEUA Urban Water Management Plans, and that the primary water management objective for this period is to expand regional water supply portfolios to improve water supply reliability and avoid water shortages during hydrologically drier periods.

6.1.4 Sensitivity of Key Assumptions

The sensitivity analysis conducted as part of this economic evaluation considers some of the key assumptions, including O&M, capital, and Metropolitan rate escalation. Variation in assumptions regarding escalation of these rates has little effect on the economic ranking of project alternatives, as measured by comprehensive NPV and BC ratios. However, variations in these assumptions do have a significant effect on the absolute value of both the Regional Water Quality and Reliability Plan and the CBP, and significant variation in these key assumptions could affect the economic and financial feasibility of these project alternatives. Depending on perspective regarding future economic conditions, future water supply availability for water sources dependent on hydrology or subject to infrastructure failure and risk tolerance, the value of the project alternatives considered in this economic evaluation ranges from a low end where benefits are approximately equal to costs, to a high end where benefits greatly exceed costs. This sensitivity analysis supports a key conclusion that the range of assumptions considered does not significantly affect the economic ranking of project alternatives and that all project alternatives retain value relative to costs even under the extremes considered.

6.1.5 Summary of Conclusions

In this economic evaluation, it is assumed that the Baseline Compliance Plan represents the least cost alternative for achieving IEUA's single-purpose water quality improvement objective. While this project alternative may represent the minimum required action by IEUA, this evaluation demonstrates that considerable additional value can be secured by IEUA by pursing either multipurpose project alternative, the Regional Water Quality and Reliability Plan with a BC ratio of 1.22 or the CBP with a BC ratio of 1.08. The conditional Proposition 1 WSIP funding available for the CBP results in lower costs to IEUA over the 50-year project life but provides marginally reduced water supply benefits over the first 25 years of implementation compared to the Regional Water Quality and Reliability Plan. If the supplemental water supply provided by the Regional Water Quality and Reliability Plan for these first 25 years of the project life is not required to meet growing demands, then both alternatives offer similar water supply benefits due to their ability to help avoid regional water shortages over that period. During the second 25 years of project life, the CBP offers a lower cost approach to IEUA to securing an equivalent level of water supply benefit as the Regional Water Quality and Reliability Plan, while providing greater flexibility for groundwater management due to the increased groundwater extraction capacity and water system interconnection infrastructure provided by the alternative.

For consideration by the CWC, the CBP provides life cycle present value public benefits as defined by Proposition 1 WSIP valued at $593.8 million for water quality improvements, $165 million for emergency water supplies, and $119.7 million for ecosystem improvements. This total of $879.0 million in public benefits would be achieved with a state investment of $212 million in Proposition 1 WSIP funds, a four to one return on the State's investment.

6.2 Recommendations

The following recommendations are provided to advance consideration of alternatives for meeting IEUA's water management objectives:

- Closely consider the methodologies and assumptions applied in this economic evaluation and consider the effects of alternative assumptions, as necessary.
- Review and refine projections for regional water supply needs to confirm near-term water supply objectives. A projected need for increased regional new water supplies over the next 25

years could affect the comparison of the Regional Water Quality and Reliability Plan and CBP alternatives.

- In comparing project alternatives, consider the value of benefits that are not monetized in this evaluation, including added flexibility for groundwater management to avoid land subsidence impacts or water quality issues from contaminants of emerging concern.
- Consider and refine possible partnerships on a broader regional basis with Metropolitan or others that might provide additional value from investments under either the Regional Water Quality and Reliability Plan or the CBP, including potential groundwater banking or other mutual aid opportunities.

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Appendices

Appendix A: Overview of the CBP and Non-CBP Net Present Value Cost Analysis Tool

Technical Memorandum

Date: October 2021

Re: **Overview of the CBP Alternatives Economic Analysis Tool**

IEUA Chino Basin Program (CBP) Economic Analysis

Chino Hills, CA

Introduction

The objective of this memorandum is to provide an overview of the ***CBP Alternatives Economic Analysis Tool (Econ Tool)*** developed to compare alternatives to meet Inland Empire Utilities Agency's (IEUA) long-term water management objectives, including alternative formulations of the Chino Basin Project (CBP) and other regionally implemented alternatives that would not include participation in the Proposition 1 Water Storage Investment Program (WSIP). The Econ Tool is an Excel spreadsheet, titled "*IEUA CBP Alternatives Economic Analysis Tool v*.*.xlsm*", that contains all the assumptions, input (e.g., the estimated project costs for all components of the alternatives), present value calculations, and benefit-cost analysis (BC analysis) of the CBP and other alternatives.

This memorandum does not delineate all the assumptions incorporated into the Econ Tool, but instead describes how key assumptions are used in the present value calculations, BC analysis, and alternative comparisons in version 7.1 of the tool.

Economic Analysis Assumptions

The Econ Tool includes an "Assumptions_Gen" tab (General Assumptions) that lists most of the input and assumptions used in the present value calculations and BC analysis that is appliable to all project alternatives. The tool also includes an "Assumptions_Alts" tab (Alternative Assumptions) that lists most of the input and assumptions used in the present value calculations and BC analysis that is appliable to specific "Put" components (AWPF and groundwater injection facilities) and "Take" components (groundwater extraction and system interconnections facilities) that are used to form project alternatives. These Put and Take components are assembled as project alternatives in a "Program_Alts" tab that also includes relevant inputs such as project implementation dates and settings regarding the ability of alternatives to deliver various benefits. Finally, a "Delivery Scenarios" tab lists input and assumptions about how categories of water supply benefits are delivered under various alternatives. The Delivery Scenario for each project alternative is selected in the Take component settings in the Assumptions_Alts tab (Item 10.3.1).

The primary assumptions that are relevant to present value and BC analysis calculations are listed In Section 2.0 of the Assumptions_Gen tab. Other inputs, such as escalation rates for various components of project benefits are listed elsewhere in this tab. These variables should be carefully reviewed to ensure they include the most applicable settings and values. The following is an overview of some of the most pertinent assumptions that apply to the present value calculations and the BC analysis of alternatives:

Present Value Calculation Input

The syntax for the Excel NPV formula is as follows:

$$Y_{npv} = NPV(rate, Value1, Value2, \ldots)$$

Where

$rate$ = the discount rate for one period

$Value1, Value2, \ldots$ = an array of payment or income values for each period

NOTE: The array of payments or income values MUST include a value for each period in the sequence even if the income or payment is zero. Blank cells will be ignored by Excel in this calculation.

Annual values are escalated from the base year for NPV Calculations (Item 2.2, input as 2019 in this evaluation) based on any applicable escalation rates included in the assumptions. These include Items 2.4.5 and 2.4.6, escalation for capital costs and O&M costs, respectively. These rates are assumed to be relative to general inflation. A general inflation rate is included as item 2.4.4. This value is not added to escalation rates included in the economic analysis if Item 2.4.3 is set for "Economic" analysis type. For escalation rates that implicitly include general inflation, general inflation is subtracted prior to application of that rate with the Economic option selected. If Item 2.4.3 is set for "Financial" analysis type, the general inflation rate is added to all escalation rates. This option is intended to be used for cash flow projections only.

The mathematical equation for this formula is:

$$Y_{npv} = \sum_{i=1}^{n} \frac{value_i}{(1 + rate)^i}$$

If the payments or income start at the base year (i.e., period $i = 0$), the value should not be discounted, and the formulas are as follows:

$$Y_{npv} = Value0 + \ NPV(rate, Value1, Value2, \ldots)$$

Or

$$Y_{npv} = value_0 + \sum_{i=1}^{n} \frac{value_i}{(1 + rate)^i}$$

In this equation, the discounted rate is that rate at which future income or payments are discounted to their present value. This is typically expressed as the rate of financial growth in the economy (the rate at which money increases over time).

Inputs in Section 2.4 include key the assumptions made regarding these rates. The key rates are the following:

- *Item 2.4.2 – Discount Rate*: The assumed annual economic growth rate of money over the project life. As a base assumption for this evaluation, it is set at the discount rate for federal water resources planning for fiscal year 2021 used in federal feasibility studies, 2.5 percent per year.
- *Item 2.4.5 – O&M Escalation Rate*: The annual escalation specific to O&M costs relative to inflation – driven by the more rapid increase of energy costs. As a base assumption for this evaluation, it is set at 0 percent, but varied for sensitivity analyses.
- *Item 2.4.6 – Capital Cost Escalation Rate*: The annual escalation rate for construction costs relative to the general inflation rate. As a base assumption for this evaluation, it is set at 0 percent, but varied for sensitivity analyses.

Some cost and benefit categories include component-specific escalation rates, which need to be handled on a case-by-case basis. These escalation rates are discussed later.

NPV Calculation and Project Timelines

In the *Econ Tool* there are several dates and durations that impact the NPV calculations. These dates and durations are all variable that can be set in the Assumptions_Gen tab and include the following:

- *Item 2.1 Base Year for Capital and O&M Cost*: The base year of the project cost estimates. All cost or benefit estimates are discounted to this base year if they were developed for a different economic base year.
- *Item 2.2 Base Year for NPV Calculations*: The year for which the NPV is calculated. All costs are discounted to the base year using the assumed discount rate.
- *Item 2.3 Project Life Duration*: The life of the project after construction and the beginning of operations, from the *Project Life-Cycle Start Year* to the *Project Life-Cycle End Year*.
- The table also includes the following project-specific timeline parameters, with separate inputs for CBP and Non-CBP Alternatives:
- *Item 3.1.1 Design and Construction Start Year*: The year at which the project design and construction starts.
- *Item 3.1.2 Project Design & Construction Period*: The number of years required to complete a project's design and construction.
- *Item 3.1.3 Project Life Cycle Start Year*: The start of the Project Life when the project starts accruing costs and benefits (other than construction costs). In this evaluation, this date is the year after completion of the *Project Design & Construction Period. However, these inputs can include* delays if the startup of the project must be synchronized with completion of other project components.

NOTE: The NPV values are calculated for the period starting at the Base Year for NPV Calculations and ends at the End Year for NPV Calculations (i.e., the Project Lifecycle Start Year plus the Project Life Duration).

Common Alternative Assumptions

The Econ Tool's *Assumptions* tab also includes a summary of common assumptions that apply to all the alternatives that are listed in the *Economic Analysis Assumption* table. These common assumptions include the following:

- ***Item 3.0 PUT and TAKE Alternatives Assumptions:*** Assumptions used in the capital and O&M cost estimates of the project alternatives.
- ***Item 4.0 Metropolitan Water Supply Costs & Benefits Assumptions:*** Assumptions used in calculating the present value and NPV of the purchase of water from Metropolitan Water District of Southern California (Metropolitan) and other terms related to the Proposition 1 WSIP water exchange.
- ***Item 5.0 NRW Disposal Costs:*** Assumptions used to estimate the unit cost for Non-Recoverable Water [NRW] disposal and rate escalation assumption.
- ***Item 6.0 Recycled Water Resources Assumptions:*** Assumptions used in estimating the *Imported Recycled Water* project costs, which include the projects for importing recycled water from Rialto, Jurupa Community Services District (JCSD), and Riverside Public Utility. This section also includes assumptions regarding any additional capital or O&M costs associated with use of recycled water generated within IEUA's service area, as well as the assumed valuation for the existing use of this recycled water.
- ***Item 7.0 Water Management Benefit Assumptions:*** Assumptions for estimating the costs and benefits related to water banking operations, Emergency Water Supply Benefits, Water Quality Improvement Benefits, and Subsidence Avoidance Benefits, Ecosystem Improvement Benefits, and Water Shortage Avoidance Benefits.

The Assumptions_Gen tab also includes assumptions for estimating the cost of the No Action Alternative in Item 8.0.

For ease of use, sets of assumptions are compiled in columns alongside the input column in the Assumptions_Gen tab. These assumptions sets can be used to populate the input column using macros assigned to buttons located at the top of each column.

Alternative-Specific Assumptions

The Econ Tool's Assumptions_Alt tab includes two tables that summarize the cost estimates and operation conditions for each alternative configuration of Put and Take facilities. These assumptions are summaries of more detailed alternative-specific input developed in other tabs in the Econ Tool workbook, including "CbpPutCosts", "CbpTakeCosts", and "BankOps." ***Appendix A*** includes the parameter description for each line-item of these tables.

Projected MWDSC Water Supply Cost

The Metropolitan rates used in the NPV calculations are based on the published "2018 10-Year MWDSC Water Rates & Charges Projection", which are summarized in the "MWD10YrProj" tab. For years between 2029 and 2050, specific rate components are calculated by escalating the 2028 charges and rates using the annual rate escalation assumptions summarized in Items 4.5.1 through 4.5.7 in the Assumptions_Gen tab. For all years beyond 2050, all rate components are escalated by the rate specified in Item 4.5.8 in the Assumptions_Gen tab.

The "MWDRates" tab includes the projected annual Metropolitan rates and charges over the project alternative life cycle using the information in the MWD10YrProj tab and escalation rates described above. Because the rates taken from the "2018 10-Year MWDSC Water Rates & Charges Projection" are assumed to include general inflation, the rates and charges are deescalated by the assumed general inflation rate input in Item 2.4.4 described earlier.

Items 4.5.13 and 4.5.14 include assumptions for allocation surcharges implemented by Metropolitan to set price incentives for conserving water during shortages. These values are used to estimate water supply shortage avoidance benefits and emergency supply benefits.

Item 4.5.15 provides the assumed SWP power costs to Metropolitan for delivery of SWP water to the east branch of the California Aqueduct. This estimate is used in valuing In Lieu and Pump-In water uses that reduce SWP imports by Metropolitan.

Net Present Value Calculation Methodology

The Econ Tool contains several sheets for calculating the present value of the costs and benefits identified for the project alternatives, the Imported Recycled Water (IRW) Sources, and the least cost single-purpose water quality alternative used to estimate water quality benefits. Each sheet contains one or more tables with the annual estimates for various cost and benefit components that are then used to calculate the present value of each component. These cost and benefit components are then summarized in the "BC_Analysis" tab to calculate the present value of all cost and benefit components, the NPV, benefit-cost ratio, and other parameters that are used in comparing selected project alternatives.

The following is an overview of each of these cost and benefit components, including the methodology used in estimating the annualized cost and the assumptions made in calculating the NPV of each component.

Project Cost Components

For the BC Analysis the following cost components are considered:

- **Capital Cost:** The upfront investment to construct the treatment, storage, conveyance, groundwater injection, groundwater extraction, and other appurtenant facilities identified for each project alternative. The annualized present value cost of this investment is based on the annual payments on a construction loan based on the assumed terms.

- **Replacement Cost:** The annual contribution to a fund for replacing the mechanical, electrical, and structural components of the project over time.
- **O&M Cost:** The annual cost for maintaining and operating the facilities. Separate calculations are made for fixed O&M and variable O&M costs for facilities associated with advanced water purification facilities (AWPF), Put, and Take operations and then aggregated to a total O&M cost.
- **NRW Disposal Cost:** The annual cost for disposing of the brine produced by the AWPF to the regional NRW system.
- **Imported Recycled Water Cost:** The cost of importing recycled water from external sources (e.g., Rialto, JCSD, and Riverside Public Utilities).
- **Supplemental Banking Cost:** This includes the Put and Take O&M costs for a supplemental banking program as well as the additional Banking Imported Put Supply cost. (Note that this feature was not employed in this evaluation).
- **Groundwater Replenishment Cost:** This cost is only applicable for alternatives that do not include an imported water source to make up for the recycled water (RW) that is lost through the AWPF process. The cost is to purchase untreated water from Metropolitan for groundwater recharge to make up the RW losses through the AWPF process.

The following is an overview of the Econ Tool assumptions, input, and calculations for each of these cost components.

Capital Cost and Cash Flow

The project cost estimates for Imported Water Sources and the Put and Take project components were developed by the CBP Predesign Team. The CbpPutCosts and CbpTakeCosts tabs contains these costs by project component. These costs are rolled up into the two tables, "CBP PUT Alternative Assumptions" and "CBP TAKE Alternative Assumptions" in the Assumptions_Alts tab. The values in these assumption summary tables are then used as input to the annual capital cost calculations in the "NPV_CBP" tab.

For the present value calculations, each project's capital cost, which includes the engineering, design, construction management, and construction cost is distributed as an annual cash flow over the project's planning, design, and construction (implementation) period. The start of the implementation period and estimated duration of the project are defined for each project in the Assumptions_Gen tab. The annual cash flow during implementation period is calculated using the assumed schedules included in lookup tables defined in the "ConstCashFlow" tab.

The projected cash flow is then escalated by the assumed capital escalation rate (Item 2.4.6) to estimate the actual cumulative cost of the project. If external funding is available, the applicable proportion of the external funding is deducted from the actual cost to estimate the loan amount required to complete the construction. These costs are applicable to NPV estimates from IEUA's regional perspective. Total costs excluding any external funding are also calculated to provide costs that are applicable to NPV estimates from a broader, statewide perspective.

Loan Interest and Loan Payments

The previous section outlines how the required loan amounts are estimated. It is assumed that the annual loan payment is not initiated until the start of the project life cycle. It is also assumed that prior to the start of the loan payment, the interest on the distributed loan amount will be paid annually and will not be added to the final loan amount.

For project alternatives that include supplemental banking operations, the capital cost for installing additional Banking Put capacity is added to the total project cost.

The assumptions for calculating loan payments are defined in Item 2.6 in the Assumptions_Gen tab.

Replacement Costs

The NPV calculation includes an allowance for building a fund to replace mechanical, electrical, and structural components of the project over time. It is assumed that this fund can be built by investing an annual amount at the assumed loan rate for construction loans (Item 2.6.2) over the components replacement life cycle.

For the NPV calculation process, the project components – as defined in the CbpPutCosts and CbpTakeCosts tabs are categorized as:

- Mechanical/Electrical Component (of pump station)
- Infrastructure Component (e.g., pipelines)
- Injection, extraction, or monitoring wells
- Treatment Facilities (AWPF)

For each of these components, Item 2.6 of the Assumptions_Gen tab, includes two parameters that are used in calculating the estimated replacement cost:

1. The percent of the capital cost assumed as the required replacement cost
2. The assumed life cycle for replacing the components

Two tables, "CBP PUT Alternative Assumptions" and "CBP TAKE Alternative Assumptions" in the Assumptions_Alts tab, provide summaries of the calculated annual replacement fund contribution necessary for the Put and Take components of each project alternative. If applicable, these replacement costs include the cost of replacement of Supplemental Banking Put facilities. For the Imported Recycled Water projects, the assumed replacement costs are summarized in the Assumptions_Gen tab in Items 6.1.3 and 6.3.3

For the NPV calculation, the capital cost escalation rate, (Item 2.4.6) is applied to calculate the annual replacement costs. These annual costs are then used to calculate the total present value of replacement costs as described earlier.

PUT and TAKE O&M Costs

The estimated O&M costs for the various project alternatives and components were developed by the CBP Predesign Team. For the project alternatives, the O&M costs are summarized in two tables, "CBP Put Alternative Assumptions" and "CBP Take Alternative Assumptions" in the Assumptions_Alts tab. For the Imported RW projects, O&M costs are summarized in the Assumptions_Gen tab.

For the NPV calculation, the O&M costs for the CBP alternatives include line items for fixed and variable O&M for AWPF, Put, Take, and Supplemental Banking facilities. Fixed O&M costs were estimated by the CBP Predesign Team based on the size and capacity of various facilities, while variable O&M costs account for the actual use of the facilities, including energy costs.

As described above, all O&M costs are assumed to escalate relative to general inflation at the O&M escalation rate input as Item 2.3.5 in the Assumptions_Gen tab.

NRW Disposal Cost

NRW disposal – for disposing the brine produced by AWPF – has two cost components: an initial connection fee, which is included as a capital cost, and an annual disposal cost, which is based on the average disposal volume, the peak volume, and the effluent chemical oxygen demand (COD) and total dissolved solids (TDS) concentration.

The input parameters for estimating the NRW disposal rate, as well as the base year for the estimated annual cost, are input in Item 5 of the Assumptions_Gen tab in the "*Economic Analysis Assumptions*" table under item *5.3.6 NRW Disposal Cost Projections* and *5.4 PUT NRW Assumptions*.

An NRW-specific escalation rate is input as Item 5.6.2. This escalation rate is assumed to include general inflation, so the assumed general inflation rate (Item 2.4.4) is subtracted from the Item 5.6.2

input value before applying to the base rate to calculate annual costs. These annual costs are then used to calculate the total present value of NRW disposal costs as described earlier.

Recycled Water Source Cost

The cost of the Imported RW sources depends on specific agreements between IEUA and the source agencies. These agreements include a current unit value for the recycled water supply and an escalation rate for the recycled water value over time. The terms of these agreements are summarized in Item 6 of the Assumptions_Gen tab.

Because each imported RW source involves a separate agreement with its own unique operation costs, the Econ Tool includes a separate NPV worksheet for each imported RW source. If imported RW is included in a project alternative, the total capital cost of the imported RW projects is included in the total capital cost for that project alternative reported in Item 2.1 of the BC_Analysis tab, while the total present value life cycle costs of the imported RW projects is included as a separate line item in the tabulation of present value costs in Item 3.3 in the BC_Analysis tab.

An additional tab, "NPV_RW_IEUA," includes present value calculations for any capital or annual costs associated with repurposing RW from internal IEUA sources as AWPF influent. This tab also calculates the present value of existing uses of RW.

Project Benefit Categories

For the BC Analysis, four primary categories[1] of project benefit types are considered in the Econ Tool:

- **Water Supply Benefits:** Benefits associated with use of new AWPF supplies. These benefits are estimated for 1) water supplies subject to a WSIP exchange commitment and 2) water supplies not subject to a WSIP exchange commitment. Additionally, benefits are estimated based on the project alternative's ability to avoid shortages in deliveries from Metropolitan due to drought conditions that limit imported water supplies.
- **Water Quality Benefits:** Benefits associated with reducing TDS of recycled water supplies, maintaining regulatory compliance, and protecting future use of recycled water.
- **Emergency Supply Benefits:** Benefits associated with avoiding severe water shortages during low probability infrastructure failure or disruptions that curtail delivery of imported supplies for limited periods of time.

Ecosystem Benefits: Benefits produced by project alternatives that include a WSIP water exchange commitment, with exchanged water used for pulse flow releases from Lake Oroville to benefit spring-run Chinook salmon in the Feather River and Bay-Delta watershed.

The following is an overview of the Econ Tool assumptions, input, and calculations for each of these benefit categories.

Water Supply Benefits of Project Alternatives

The project alternatives that include Put and Take components generate different categories of water supply benefits depending on choices of how new water supplies would be managed and if the alternative includes a commitment to a water exchange as part of the Proposition 1 WSIP. The Econ Tool includes procedures for valuing routine water supply benefits (those benefits that would occur on a regular schedule) with and without a WSIP exchange commitment, as well as more extraordinary benefits associated with avoiding water supply shortages during severe drought when deliveries to IEUA from Metropolitan are limited because of reductions in imported supplies. Methodologies used in the Econ Tool for valuing each of these water supply benefit categories is described below.

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[1] The Econ Tool also includes the capability to estimate benefits associated with avoiding impacts from land subsidence. These benefits are not currently monetized for feasibility study proposes and are not discussed further here.

Routine Water Supply Benefits Concurrent with a WSIP Exchange Commitment

The WSIP exchange commitment provides for exchange of the total expected AWPF production over 25 years, 375 thousand acre-feet (TAF), less the portion of that volume that would be provided by carriage water savings to the State Water Project (SWP). An assumption for carriage water savings, expressed as a percentage of pulse flow, is input as Item 1.2.5 in the Assumptions_Gen tab. The maximum volume for an annual pulse flow would be 50 TAF, with the exchange amount computed as:

$$Vol_{Exchange=} Vol_{pulse\ Flow} \times (1 - Carrriage\ Water\ Savings)$$

During call years, Metropolitan's SWP water supply will be reduced by the exchange volume. To offset the reduction in SWP water supply, CBP water supply would be provided to Metropolitan. Depending on terms developed in final agreements, the CBP water might be provided in the same year as the pulse flow, or on another schedule that would provide additional conjunctive use opportunities to Metropolitan and contribute to regional water supply reliability. Regardless of these terms, the absolute schedule for future exchanges is dependent on future hydrology, and unknown at this time. For the purposes of this Econ Tool an average annual normalized exchange volume is used, based on the volume of AWPF production (15 TAF per year) less the carriage water savings percentage.

Discussions with Metropolitan have identified two approaches[2] for the CBP – Metropolitan element of the WSIP exchange that provide different types of benefits:

- **Pump-In Delivery TAKE Benefit:** This benefit is for the volume of water pumped into to the Metropolitan system as part of the WSIP Exchange during call years or as pre-delivery. Item 4.1 in the Assumptions_Gen tab incudes three options for valuing these deliveries: 1) Metropolitan Tier 1 Untreated Water Rate, 2) MWD SWP Power Rate, and 3) Negotiated Credit by Metropolitan. For the first option, annual values are taken from the MWDRates tab, developed as discussed earlier. For the second option, the unit value of energy savings for not importing SWP water, provided in Item 4.5.15, is applied. For the third option, a unit value for the negotiated credit based on savings to Metropolitan in SWP transportation costs is input as Item 4.2.3, and an annual escalation rate is input as Item 4.2.3. Annual unit values are multiplied by the annual volume of water provided as Pump-In Delivery, calculated in Item 10.3.6.2 in the Assumptions_Alts tab for each alternative, based on input in the Delivery_Scenarios tab. These annual values are then used to calculate the total present value of Pump-In Delivery benefits in the NPV_CBP tab as described earlier.
- **In-Lieu Delivery Benefit:** This benefit is for the volume of water extracted, treated, and distributed directly to IEUA member agencies instead of pumping it back to Metropolitan. IEUA's treated water deliveries from Metropolitan will be reduced by this volume. Item 4.3 in the Assumptions_Gen tab incudes three options for valuing these deliveries, 1) Metropolitan Tier 1 Treated Water Rate, 2) MWD SWP Power Cost+Treatment Surcharge, and 3) Negotiated Credit by Metropolitan. For the first options, annual values are taken from the MWDRates tab, developed as discussed earlier. For the second option, the MWD Power Rate assumption described above is added to the treatment surcharge taken from the MWDRates tab, For the third option, a unit value for the negotiated credit is input as Item 4.3.3, and an annual escalation rate is input as Item 4.3.3. For all options, a loss factor is applied, input as Item 4.5.12 in the Assumptions_Gen tab. Annual unit values are multiplied by the annual volume of water provided as In-Lieu Delivery, calculated in Item 10.3.6.3 in the Assumptions_Alts tab for each alternative, based on input in the Delivery_Scenarios tab.

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[2] The Econ Tool includes capability for a third category of water supply benefits during the WSIP water exchange, described as "Pre-Delivery" benefits. This approach is not currently under consideration and is not discussed here.

These annual values are then used to calculate the total present value of In-Lieu Delivery benefits in the NPV_CBP tab as described earlier.

Routine Water Supply Benefits without a WSIP Exchange Commitment

For alternatives that include a WSIP exchange commitment, any new AWPF supplies that are not required for the WSIP exchange due to carriage water savings assumptions are available for local use. Moreover, after completion of the WSIP exchange commitment or for the entire life cycle of the alternatives that do not include a WSIP exchange commitment, all new AWPF supplies are available for local use. This AWPF supply is stored in the Chino Groundwater Basin and available to IEUA member agencies as an additional water source that can be used annually in place of Metropolitan supply or banked for use as a supplemental water supply source during drought or other conditions that affect the availability of imported water supplies.[3] For this evaluation, water supply benefits are valued based on the avoided cost of purchasing Metropolitan water supplies and is termed **Metropolitan Demand Offset.**

Metropolitan Demand Offset Benefit: This benefit is valued based on the avoidance of costs of purchasing Metropolitan supplies. Item 4.4 in the Assumptions_Gen tab incudes three options for valuing these deliveries: 1) Metropolitan Tier 1 Untreated Water Rate, 2) Metropolitan Tier 1 Treated Water Rate, and 3) Metropolitan Tier 1 Treated Water Rate plus capacity charges and readiness-to-serve charges. Annual values for all three options are taken from the MWDRates tab, developed as discussed earlier. Annual unit values are multiplied by the annual volume of water provided as Metropolitan Demand Offset, calculated in Item 10.3.6.4 and 10.5.3.8 in the Assumptions_Alts tab, for time periods that include and do not include the WSIP exchange commitment, respectively. These values are calculated for each alternative, based on input in the Delivery_Scenarios tab. These annual values are then used to calculate the total present value of Metropolitan Demand Offset benefits in the NPV_CBP tab as described earlier.

Water Supply Shortage Avoidance Benefits

In addition to providing routine water supply benefits as described above, all project alternatives that include access to new AWPF supplies could also reduce economic losses associated with water supply shortages when, due to severe drought that limits imported water supplies, deliveries are curtailed. This type of water supply benefit is referred to as “Shortage Avoidance” in the Econ Tool. The frequency and magnitude of future shortages was estimated from work completed by Metropolitan in updating its Integrated Resources Plan in 2021. Metropolitan developed four scenarios to describe alternative future conditions that result in four levels of frequency and magnitude of projected shortages, as depicted in Figure 1.

The Econ Tool uses the scenario that projected the least degree of future shortages (Scenario A) and the scenario that projected the greatest degree of future shortages (Scenario D) to forecast future conditions. Because Scenario A includes no shortages, the frequency and magnitude of shortages developed for Scenario D are reduced to produce inputs for the Econ Tool. Item 7.6.1 in the Assumptions_Gen tab provides an input factor for reducing the Scenario D shortages and melding with Scenario A (no shortages). An input value of 50 percent effectively averages the shortages described by the two scenarios.

The frequency and magnitude of these melded shortages under Scenario D projected to 2045 by Metropolitan (shown in **Error! Reference source not found.**) were used to interpolate the frequency and magnitude of shortages in years between the start of the alternative project life cycle and 2045. After 2045, the frequency and magnitude of shortages is held constant for this evaluation. The “Shortage_Avoid_Benefit” tab includes calculations for converting the absolute shortage magnitudes

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[3] The Econ Tool includes the capability for considering the value of a water banking program that delivers available water supplies during dry and crucial years, as estimated in a separate groundwater banking operations analysis tool. This approach to valuing water supply benefits is not currently under consideration and is not discussed here.

shown in Figure 2 to percentages, based on the total Metropolitan demand of about 2,000 TAF per year described for Scenario D.

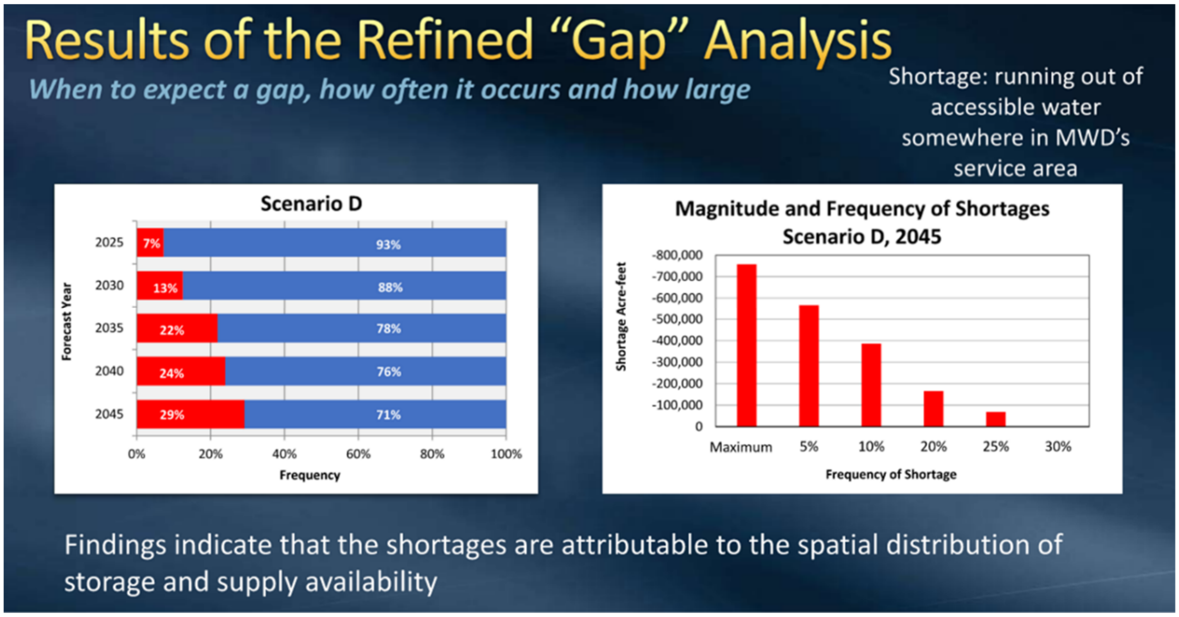

Figure 1: Metropolitan Gap Analysis Scenarios

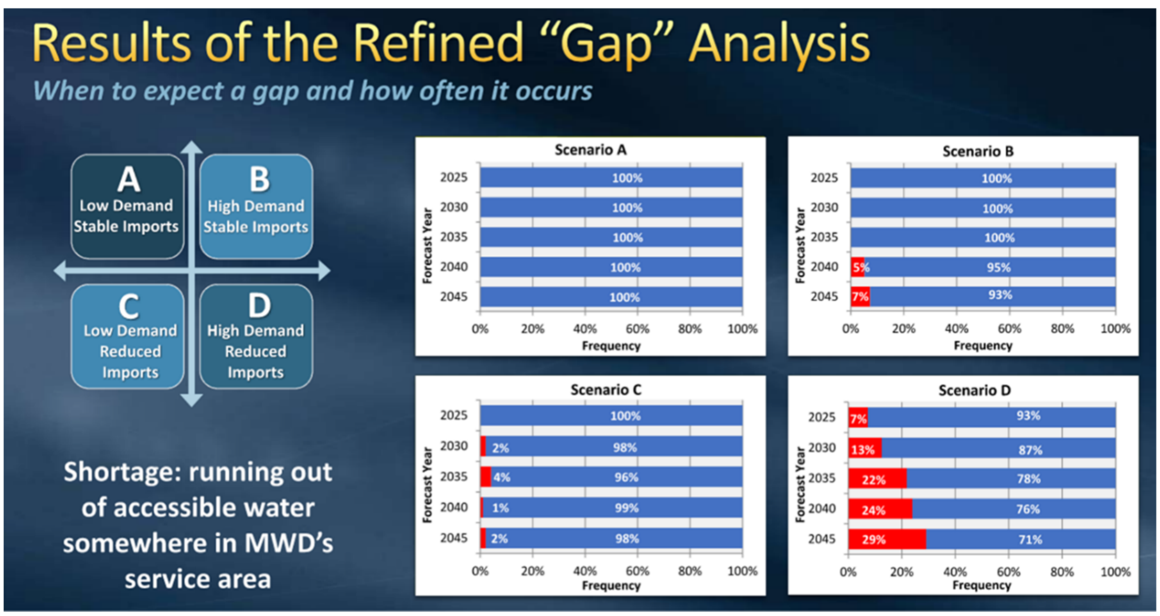

Figure 2: Frequency and Magnitude of Shortages in 2045

Based on the frequencies of various magnitude shortages, also shown in Figure 2, shortages applicable to IEUA are calculated based on IEUA's contracted supply with Metropolitan, input as Item 4.5.11 in the Assumptions_Gen tab. Shortages within and above 115 percent of Metropolitan's allocation for any year are computed separately for valuing purposes, as described below. Similarly, frequency and magnitude of shortages for 2025 and 2035 are calculated in the Shortage_Avoid_Benefit tab by applying the frequency of any shortage for those years, as shown in Figure 1, and assuming the exceedance curve defined by the 2045 data is lowered until the probability of any frequency intercepts the y axis at the data point provided for that year. These frequencies and magnitude are then used to calculate the normalized average annual shortages by approximating the area under each curve. These values are then reduced by the factor input as Item 7.6.1 in the Assumptions_Gen tab to meld with Scenario A (no forecasted shortages) to produce final forecasted shortages. This process results in a Summary of Interpolation Points, included in the Shortage_Avoid_Benefit tab, for the first year of the NPV analysis (assumed as no shortages), 2025, 2035, and 2045. Years after 2045 are held at 2045 values. Annual shortage values for each year of the alternative life cycle are then computed by interpolating these data points.

The magnitude of the estimated shortages resulting from this process is generally small in comparison to the AWPF supplies produced under the project alternatives under consideration. Therefore, it is generally assumed that all forecasted shortages could be avoided by the project alternatives that provide a water supply benefit. However, the Econ Tool provides an input for each program alternative in the Program_Alts tab to define its effectiveness in avoiding shortages. This input could be reduced from 100 percent to account for inability of any alternative to fully respond to forecast shortages.

The economic value of avoiding these shortages is established by applying the existing Metropolitan Water Supply Allocation Plan (WSAP) rate structure that calls for an additional allocation surcharge, input as Item 4.5.13. for any additional deliveries up to 115 percent of allocated supplies and two times the allocation surcharge for any additional deliveries over 115 percent of allocated supplies, in addition to normal delivery costs. This is assumed to be the rate at which Metropolitan customers are willing to pay to avoid impacts of water shortages. Only the penalty portion is applied, because the normal costs are previously captured in the routine water supply benefit estimates described above. Unit rates are taken from the MWDRates tab, including assumed escalation. Annual benefit values are calculated by multiplying annual shortage amounts by the applicable rates. These values are then used to calculate the total present value of Water Supply Shortage Avoidance Benefits, as described earlier.

Water Quality Benefits of Project Alternatives

A primary project objective for the CBP and project alternatives is to reduce the TDS of recycled water supplies to maintain compliance with water quality regulations and sustain the viability of recycled water as a regional resource. Methodologies for monetizing the physical benefit of reducing TDS of recycled water were explored, but as a conservative approach for valuing these benefits, a least cost alternative approach was adopted. For the Econ Tool, the cost of a single-purpose water quality project is used to monetize the water quality benefits of all project alternatives that provide a similar level of reduction in risk of IEUA exceeding TDS regulations for the Chino Basin.

Costs of this single-purpose water quality project are established in the NPV_WQBenefit tab. The calculations in this tab used the same methodologies for estimating present value costs for project alternatives described earlier. The alternative to be evaluated is selected in Item 7.3.1 in the Assumptions_Gen tab. A second alternative selection is provided in Item 7.3.2 of the Assumptions_Gen tab if the single-purpose water quality project is expected to be constructed in phases to provide lower up-front costs yet maintain regulatory compliance over the project alternative life cycle. The start dates for the Phase 1 and Phase 2 project (if appliable) are input in the Program_Alts tab. These start dates are used to develop the annual loan payment costs, O&M costs, and NRW costs for each alternative, using the same escalation rates and methodologies used for project alternatives. Annual costs are used to compute the total present value life cycle cost for the Phase 1 and Phase 2 projects separately.

The level of water quality benefit estimated for any project alternative is based on if the alternative will achieve the same water quality improvements of either or both the Phase 1 and Phase 2 single purpose water quality projects. This level of expected benefit is selected as input for each project alternative in the Program_Alts tab. Based on this input, either the Phase 1 present value cost or total Phase 1 and Phase 2 present value costs calculated in the NPV_WQBenefit tab are transferred to the BC_Analysis tab as Item 4.3. For cash flow purposes, the present value total life cycle water quality benefit is also used to calculate equivalent annualized benefits in the NPV_WQBenefit tab, using the life cycle of the selected project alternative and the discount rate input as Item 2.4.2 in the

Assumptions_Gen tab. These annualized benefits are transferred to the NPV_CPB tab to be included in the tabulation of all project alternative benefits.

Emergency Supply Benefits of Project Alternatives

New water stored in the Chino Groundwater Basin will enhance emergency response water supply availability for IEUA and other participating agencies during crises such as flood or seismic events that disable imported water infrastructure. This benefit is differentiated from the water shortage avoidance benefits described earlier, based on the extreme severity of the circumstances of the emergency considered in this benefit category. While drought conditions are expected to result in moderate water shortages over the life cycle of CBP project alternatives, extreme shortages due to infrastructure failure could also occur with a duration of a year or longer. While the frequency of these events is expected to be low, the magnitude of the economic impacts could be great.

CBP project alternatives would include provisions to provide stored water in the Chino Groundwater Basin under emergency conditions to local agencies or regionally by utilizing Metropolitan's water distribution system. During an emergency event that results in a southern California community having a critical need for supplies, a participating agency could borrow water stored in the Chino Groundwater Basin to be repaid when conditions are stabilized. For the Econ Tool, it is assumed that the entire new groundwater extraction capacity of the project alternative would be prioritized for responding to an emergency event over a full year.

To monetize this benefit for the Econ Tool, projections included in the Delta Risk Management Strategy (DWR, USACE, and DFG, 2009) were applied in this analysis, but other estimate sources could also be substituted. In the "Emergency_Supply_Benefit" tab, the annual probability of an event is taken as the average probability of 20- and 30-Delta island breech scenarios, due to seismic, flood, and sunny-day levee failures (4.2 percent per year). The value of these supplies is based on the existing Metropolitan rate structure for providing water supplies under shortage conditions, as described for the water shortage avoidance benefit above. Item 7.2.1 in the Assumptions_Gen tab provides two input choices: 1) MWD WSAP Rate <= 115% and 2) MWD WSAP Rate > 115%. The selected rate applies the MWD WSAP alloction rates as described for shortage avoidance benefits, above. These values reflect the willingness to pay to avoid impacts of severe water shortages.

The annual Emergency Supply Benefit value is calculated for the selected project alternative in the NPV_CBP tab by multiplying the annual probability of an emergency event by the value of avoiding the event based on the rate selected in Item 7.2.1 by the annual groundwater extraction capacity of the project alternative. The Econ Tool also includes the capability to further escalate these values to account for increasing scarcity of emergency supplies and increasing risk of an emergency event over the project alternative life cycle, input as an additional escalation rate relative to general inflation in Item 7.2.4 in the Assumptions_Gen tab. The resulting annual values are then used to calculate the total present value of Emergency Supply Benefits, as described earlier.

Ecosystem Benefits of Project Alternatives

CBP project alternatives that include the WSIP water exchange commitment will produce ecosystem benefits by supporting pulse flows in the Feather River, improving the survival rate of emigrating juvenile spring-run Chinook salmon. In its Proposition 1 WSIP application, IEUA proposed that the CBP could support pulse flows of a total volume of 375 TAF over 25 years. If the largest magnitude of annual pulse flows is implemented, this would result in 7.5 pulse flows of 50 TAF each, occurring in 30 percent of all years over the 25-year time frame.

These environmental benefits are monetized in the Econ Tool by applying procedures included in California Water Commission guidelines for the WSIP application process. Four alternative valuation methodologies are provided, with selection based on input in Item 7.5.1 in the Assumptions tab. The first three choices, "Sac Valley," "Delta Export," and "Staff Rates," refer to alternative unit values for water supplies that might be acquired as a least cost alternative valuation methodology for this benefit. The fourth choice, "Physical Benefit," refers to a willingness-to-pay valuation methodology that estimates the value of improving spring run Chinook salmon populations.

For the three least cost alternative methodology selections, unit costs of acquired water from the transfers market were provided by the California Water Commission based on economic modeling. These rates are differentiated by hydrologic year type and for forecasts in 2030, 2045, and 2070, all in 2015 dollars.

Pulse flows are assumed to be most beneficial to spring-run Chinook salmon in the driest hydrological years. However, operational evaluations conducted by DWR have revealed the potential for some operational impacts to the SWP during pulse flow exchanges in many critically dry years, as classified by the Sacramento River Index (SRI). For this evaluation, an assumption regarding the percentage of critically dry years that would be approved by DWR is entered in the "WSIP_Env_Benefit" tab. The frequency of years classified as various year types by the SRI is calculated in the WSIP_Env_Benefit tab based on historical data used in DWR's CalSim Central Valley Project and SWP operations model (CalSim) by DWR. Using these frequencies and limiting pulse flow exchange to the specified percentage of critically dry years, the frequency of pulse flows occurring in critically dry, dry, and below normal years is calculated, assuming priority use of pulse flows in the driest years. An average annual value is then calculated by multiplying the estimated frequency of year type by the corresponding unit values, for 2030, 2045, and 2070, and discounting from 2015 to the NPV year selected in the Econ Tool.

The Econ Tool includes the capability to add an additional annual cost for purchasing an option to improve the reliability of these transfers, to better approximate the reliability provided by CBP alternatives. Option cost data from actual transfer agreements is included in the WSIP_Env_Benefit tab, averaged, and discounted to the NPV year selected in the Econ Tool. Input from Item 7.5.4 in the Assumptions_Gen tab is used to determine if these option costs are included in the valuation. Total unit values are then calculated for 2030, 2045, and 2070.

If the Physical Benefit methodology is selected, a single annual benefit value is calculated for 2030, 2045, and 2070 in the WSIP_Env_Benefit tab, based on estimates of increased spring run chinook salmon populations resulting from a 50 TAF pulse flow and unit values of those population improvements provided by the California Water Commission. Unit values are calculated and multiplied by the normalized average annual value of pulse flows provided by the project alternative. These values are discounted to the NPV year selected in the Econ Tool, based on the basis year of the physical valuation input as Item 7.5.2 in the Assumptions_Gen tab.

In the CBP_NPV tab, annual ecosystem benefit values are calculated for each year of the project alternative life cycle that includes the WSIP exchange commitment, based on interpolating the values for 2030, 2045, and 2070 estimated in the WSIP_Env_Benefit tab. These annual values include annual escalation as input in Item 7.5.5 for the least cost alternative water transfer methodology or Item 7.5.3 for the physical benefit valuation methodology. These escalation rates are intended to account for increasing scarcity of water available on the transfer market and increasing value for improving salmon populations due to the pressures of climate change. The resulting annual values are then used to calculate the total present value of Ecosystem Improvement Benefits, as described earlier.

While providing broad public benefits to all Californians by aiding spring-run Chinook salmon populations, pulse flows will also improve the resiliency of the SWP and indirectly provide water supply reliability benefits to Metropolitan and IEUA. However, this indirect water supply reliability benefit is difficult to monetize. For this evaluation, the monetized environmental benefits described in this section are included only in NPV and BC-ratio estimates for project alternatives conducted from a statewide perspective.

Benefit-Cost Analysis

The NPV_CBP tab calculates the present value of costs and benefits of project alternatives as described above. Summary results of total life cycle present value costs and benefits, NPV, and BC ratio are included in the BC_Analysis tab. After composing compete alternatives with entries in the Assumptions_Alts, Program_Alts, and Delivery_Scenario tabs, those alternatives can be selected for full evaluation using the input in cell C3 of the BC_Analysis tab. Alternatively, all alternatives can be evaluated for sets of assumptions selected in the Assumptions_Gen tab using the Excel what-if tables included in the BC_Analysis tab and the “Calculate All” command.

Appendix A - Parameter Descriptions for the Econ Tool Assumptions

Table A-1 Parameter Description for General Assumptions in Assumptions_Gen Tab

Note#	Assumption Description
1.0 Chino Basin Program Funding Assumptions	
1.1	**Grants & Financing by Others**
1.1.1	- Prop 1 WSIP
1.1.2	- WIIN Act Grant
1.1.3	- Title XVI USBR Grant
1.1.4	- SWRCB Grant
1.1.5	***Local Funds (Connection Fees, Property Tax)***
1.1.5.1	- One-Water and Wastewater Connection Fees
1.1.5.2	- Property Taxes
1.1.5.3	- Other Local Funds
1.2	**Prop 1 Water Exchange Assumptions**
1.2.1	- WSIP Investment Amount
1.2.2	- Average Annual Exchange Quantity
1.2.3	- Prop 1 Water Exchange Period
1.2.4	- Number of Call Events
1.2.5	- Assumed SWP Carriage Water Savings Allocated to CBP
1.3	**Design Assumptions**
1.3.1	Maximum AWPF/PUT Capacity
2.0 Economic Analysis	
2.1	Base Year for Capital and O&M Cost
2.2	Base Year for NPV Calculations
2.3	Project Life Duration
2.4	**Discount, Inflation, and Escalation Rates**
2.4.2	- Economic Discount Rate
2.4.3	- Treatment of Inflation based on Analysis Type
2.4.4	- General Inflation Rate
2.4.5	- O&M Escalation Rate
2.4.6	- Capital Cost Escalation Rate
2.5	**Construction Cost Markups**
2.5.1	- Capital Cost Contingency

Note#	Assumption Description
2.5.2	- Engineering, Admin & CM
2.6	**Project Replacement Cost**
2.6.3	- Mech./Electrical Replacement Percent
2.6.4	- Mech./Electrical Replacement Period
2.6.5	- Infrastructure Replacement Percent
2.6.6	- Infrastructure Replacement Period
2.6.7	- Well Replacement Percent
2.6.8	- Well Replacement Period
2.6.9	- AWPF Replacement Percent
2.6.10	- AWPF Replacement Period
2.6	**Construction Loan Terms**
2.6.1	- Loan Period
2.6.2	- Loan Interest
3.0 PUT and TAKE Alternatives Assumptions	
3.1	**Project Schedule**
3.1.1	- Design and Construction Start Year
3.1.2	- Project Design & Construction Period
3.1.3	- Project Life Cycle Start Year
3.2	**Construction Cost Extrapolation Parameters for Secondary Project Alternatives**
3.2.1	- Exponent Factor for Economies of Scale Cost Extrapolation
3.2.2	**Put Alternative Cost Scaling**
3.2.2.1	-Base Alternative for Put Scaling
3.2.2.2	-Base Put Alternative Physical Capacity
3.2.2.3	-Base Put Alternative Throughput
3.2.3	**Take Alternative Cost Scaling**
3.2.3.1	-Base Alternative for Take Scaling
3.2.3.2	-Base Take Alternative Capacity
4.0 Metropolitan Water Supply Costs & Benefits Assumptions	
4.1	**Pre-Delivery Terms**
4.1.1	Pre-delivery Benefits and Costs
4.1.2	Negotiated Predelivery MWD Credit Amount (in NPV Year $s)
4.1.3	Negotiated Predelivery MWD Credit Escalation

Note#	Assumption Description
4.2	**Pump-In Terms**
4.2.1	Pump-In Delivery Benefits and Costs
4.2.2	Negotiated Pump Back Delivery MWD Credit Amount (in NPV Year $s)
4.2.3	Negotiated Pump Back Delivery MWD Credit Escalation
4.3	**In Lieu Terms**
4.3.1	In Lieu Delivery Benefits and Costs
4.3.2	Negotiated In Lieu Delivery MWD Credit Amount (in NPV Year $s)
4.3.3	Negotiated In Lieu Delivery MWD Credit Escalation
4.4	**Demand Offset Terms**
4.4.1	Demand Offset Benefits
4.5	**Metropolitan Water Rate Assumptions - Assume Inflation is included in escalation rates**
4.5.1	Full Service (Tier 1) Untreated Rate Increase (Until 2050)
4.5.2	Full Service (Tier 1) Treated Rate Increase (Until 2050)
4.5.3	Readiness-to-Serve Charge Increase (Until 2050)
4.5.4	Capacity Charge Increase (Until 2050)
4.5.5	System Access Rate Increase (Until 2050)
4.5.6	Water Stewardship Rate Increase (Until 2050)
4.5.7	Wheeling Service Rate Increase (Until 2050)
4.5.8	All MWD Rates Escalation after 2050
4.5.9	Readiness-to-Serve Percentage
4.5.10	Capacity Charge Flow Rate
4.5.11	IEUA MWD Allocation
4.5.12	Water Loss Factor
4.5.13	Allocation Surcharge for 100% to 115% of WSAP allocation
4.5.14	Allocation Surcharge for over 115% of WSAP allocation
4.5.15	SWP Unit Power Costs for East Branch Deliveries
5.0 NRW Disposal Cost	
5.1	- Average Disposal Rate
5.2	- Peak Disposal Rate
5.3	- COD Strength Rate
5.4	- TSS Strength Rate

Note#	Assumption Description
5.5	- Agency O&M and CIP Charges
5.6	*NRW Disposal Cost Projections*
5.6.1	- Base Year of Disposal Rates
5.6.2	- Escalation Rate of Disposal Cost
5.7	**PUT NRW Assumptions**
5.7.1	- NRW Capacity Units
5.7.2	- Average Disposal Volume
5.7.3	- Peak Disposal Volume
5.7.4	- COD Load
5.7.5	- TSS Load
5.7.6	- Annual NRW Cost
6.0 Recycled Water Resources Assumptions	
6.1	**JCSD RW Supply to 930 PZ (WRCWRA)**
6.1.1	**Project Schedule**
6.1.1.1	- Design and Construction Start Year
6.1.1.2	- Project Design & Construction Period
6.1.1.3	- Project Life-Cycle Start Year
6.1.2	**Project Cost**
6.1.2.1	- Pipe Lines
6.1.2.2	- Pumping Station
6.1.2.3	- Eng., Admin & CM Cost
6.1.2.4	- Land Acquisition
6.1.3	**Calculated Annual Cost**
6.1.3.1	- Infrastructure Replacement
6.1.3.2	- Mechanical/Electrical Replacement
6.1.3.3	- O&M Cost
6.1.3.3.1	- O&M Cost Variable
6.1.3.3.2	- O&M Cost Fixed
6.1.4	**Imported RW Acquisition**
6.1.4.1	Annual Import
6.1.4.2	Unit RW Cost Base Year
6.1.4.3	Unit RW Cost Increase
6.1.4.4	RW Purchase Rates

Note#	Assumption Description
6.2	**Riverside RW Project**
6.2.1	Capital Investment in RPU Project
6.2.2	**Investment Schedule**
6.2.2.1	- Year of Project Investment
6.2.2.2	- Project Life-Cycle Start Year
6.2.3	**Imported RW Acquisition**
6.2.3.1	Annual Recycle Water Allocation
6.2.3.2	Unit RW Cost Base Year
6.2.3.3	Unit RW Cost Increase
6.2.3.4	RW Purchase Rates
6.3	**Rialto RW Supply to 1158 PZ**
6.3.1	**Project Schedule**
6.3.1.1	- Design and Construction Start Year
6.3.1.2	- Project Design & Construction Period
6.3.1.3	- Project Life-Cycle Start Year
6.3.2	**Project Cost**
6.3.2.1	- Pipe Lines
6.3.2.2	- Pumping Station
6.3.2.3	- Eng., Admin & CM Cost
6.3.2.4	- Land Acquisition
6.3.2.5	- Santa Ana River Well
6.3.3	**Calculated Annual Cost**
6.3.3.1	- Infrastructure Replacement
6.3.3.2	- Mechanical/Electrical Replacement
6.3.4	- O&M Cost
6.3.4.1	- O&M Cost Variable
6.3.4.2	- O&M Cost Fixed
6.3.4	**Imported RW Acquisition**
6.3.4.1	*Annual Import*
6.3.4.1.1	- Summer Import
6.3.4.1.2	- Winter Import
6.3.4.2	Unit RW Cost Base Year
6.3.4.3	Unit RW Cost Increase

Note#	Assumption Description
6.3.4.4	Summer RW Purchase Rates
6.3.4.5	Winter RW Purchase Rates
6.4	**Additional Costs for Internal RW and Transport in IEUA System**
6.4.1.1	- Design and Construction Start Year
6.4.1.2	- Project Design & Construction Period
6.4.1.3	- Project Life-Cycle Start Year for CBP Alternatives
6.4.2	- Construction Cost
6.4.3	- O&M Cost
6.4.4	- Internal Recycled Water Commodity Value
6.4.5	- Annual Internal RW Supplies
6.5	**CBP PUT Alternative for RW O&M Costs**
6.5.1	CBP PUT Alternative for RW O&M Costs Data
7.0 Water Management Benefit Assumptions	
7.1	**Water Banking Analysis Assumptions**
7.1.1	**Modeling Assumptions**
7.1.1.1	CalSim Hydrology for Banking Ops
7.1.2	**Water Value Ratios by Water Year Type**
7.1.2.1	- Dry Year Value Ratio
7.1.2.2	- Critical Year Value Ratio
7.1.3	**Water Value Assumptions**
7.1.3.1	- PUT Water Value to Cost Ratio
7.1.3.2	- TAKE Water Value to Cost Ratio
7.1.3.2	-Water Value Escalation
7.2 Emergency Water Supply Assumptions	
7.2.1	Value of Emergency Water
7.2.3	Annual Probability of Emergency Event
7.2.4	Emergency Water Escalation Rate
7.3 Water Quality Improvement Assumptions	
7.3.1	WQ Single Purpose Alternative (Initial Phase)
7.3.2	WQ Single Purpose Alternative (Secondary Phase)

Note#	Assumption Description
7.4 Subsidence Avoidance Assumptions	
7.4.1	Avoided Groundwater Delivery Cost
7.4.2	Effectiveness Factor
7.5 Ecosystem Improvement Assumptions	
7.5.1	Alternative Ecosystem Valuation Methodology
7.5.2	CWC Ecosystem Benefit Valuation Base Year
7.5.3	Physical Benefit Escalation Rate
7.5.4	Include Water Transfer Option Cost
7.5.5	Transfer Cost Escalation Rate
7.6 Water Shortage Avoidance Assumptions	
7.6.1	Reduction Factor for Shortage Estimates
8.0 No Action Alternative Assumptions	
8.1	Year New Imported Water Supply is Required
8.2	Option for Volume of Required Imported Water
8.2	Static Volume of Required New Imported Water Supply
8.3	Cost Basis of New Imported Water Supply

Table A-2 Parameter Description for Alternative-Specific Assumptions in Assumptions_Alts tab

Note#	Assumption Description
9.0 Project PUT Assumptions	
9.1	**PUT Alternative Construction Cost**
9.1.1	- AWPF and PUT Infrastructure
9.1.1.1	- AWPF Infrastructure
9.1.1.2	- PUT Infrastructure
9.1.2	- Imported RW Facilities
9.2	**Annual PUT Cost Assumptions**
9.2.1.1	Fixed O&M Cost
9.2.1.2	Variable O&M Cost (per TAFY)
9.2.1.3	Annual NRW Disposal Costs
9.2.2	*Replacement Cost*
9.2.2.1	- Infrastructure Replacement
9.2.2.2	- Mechanical/Electrical Replacement
9.2.2.3	- Well Replacement
9.2.2.4	- AWPF|Treatment Replacement
9.3	**Unit Supplemental Banking Costs**
9.3.1	Supplemental Banking Facilities Construction Cost[1)]
9.3.1.1	Supplemental Banking Unit O&M Costs (PUT Facilities)
9.3.1	- Banking PUT Fixed O&M (per TAFY Capacity)[2)]
9.3.1.2	- Banking PUT Variable O&M (per TAFY)[3)]
9.3.2	*Supplemental Banking Replacement Cost (PUT Facilities)*
9.3.2.1	- Infrastructure Replacement
9.3.2.2	- Mechanical/Electrical Replacement
9.3.2.3	- Well Replacement
9.3.2.4	- Treatment Replacement
9.4	**CBP PUT Alternative Capacity (without Supplemental Banking)**
9.4.1	AWPF Product (TAFY)
9.4.2	Recharge (PUT) Capacity (TAFY)

NOTES:

1) PUT Facilities only, exclude AWPF. Construction cost per TAFY capacity, scaled from each alternative PUT construction cost.

2) Unit Fixed O&M per TAFY capacity.

3) Unit Variable O&M per TAFY throughput.

CBP TAKE Alternative Assumptions

Note#	Assumption Description
10.0 Project TAKE Assumptions	
10.1	Take Infrastructure Cost
10.2	**Annual TAKE Cost Assumptions**
10.2.1.1	Fixed O&M Cost
10.2.1.2	Variable O&M Cost (per TAFY)[1)]
10.2.1.3	Include Pumping Station Costs in Banking Variable O&M
10.2.2	*Replacement Cost*
10.2.2.1	- Infrastructure Replacement
10.2.2.2	- Mechanical/Electrical Replacement
10.2.2.3	- Well Replacement
10.2.2.4	- AWPF|Treatment Replacement
10.3	**CBP Pump Back and Pre-delivery Options**
10.3.1	TAKE Delivery Scenario
10.3.2	Total New Take Capacity
10.3.3	Total Use of Existing Take Capacity
10.3.4	Take Capacity with WSIP in Non-Call Years
10.3.5	GW Production after WSIP Exchange
10.3.6	Annualized WSIP Exchange Parameters (after Carriage Water Savings)
10.3.6.1	- Annualized Pre-delivery Volume
10.3.6.2	- Annualized Pump-Back Volume
10.3.6.3	- Annualized In-Lieu Volume
10.3.6.4	- Max Annual Demand Offset (Including Carriage Water Savings)[6]
10.4	**CBP Banking Analysis Assumptions**
10.4.1	Allow AWT Banking Ops
10.4.2	Allow Supplemental Water Banking Ops
10.5	**CBP Banking Operations Results**
10.5.1	Supplemental Water Banking PUT Capacity (Selected in BC_Analysis)
10.5.2	**With WSIP Exchange Operations**
10.5.2.1	Banking Operations Data Set
10.5.2.2	Carriage Water Savings Banking
10.5.2.2.1	- Critical Year Supply
10.5.2.2.2	- Dry Year Supply
10.5.2.2.3	- Below Normal Year Supply
10.5.2.2.4	- All Year Type Supply
10.5.2.3	Imported Supply Banking
10.5.2.3.1	- Critical Year Supply

Note#	Assumption Description
10.5.2.3.2	- Dry Year Supply
10.5.2.3.3	- Below Normal Year Supply
10.5.2.3.4	- All Year Type Supply
10.5.2.4	Total Banking Supply
10.5.2.4.1	- Critical Year Supply
10.5.2.4.2	- Dry Year Supply
10.5.2.4.3	- Below Normal Year Supply
10.5.2.4.4	- All Year Type Supply
10.5.2.5	Gross Average Annual Imported Supply PUT
10.5.2.6	Banking Water Supply Modeling Normalization
10.5.2.6.1	- Net Added AWT Bank Storage
10.5.2.6.2	- Net Added IS Bank Storage
10.5.2.6.3	- Excess AWT Production due to Bank Capacity Constraint
10.5.2.7	Normalized Average Annual Imported Supply PUT
10.5.2.8	Annual GW Supply Available for Demand Offset
10.5.3	**Post WSIP Exchange Operations (Without AWT Banking)**
10.5.3.1	Banking Operations Data Set
10.5.3.2	AWT Banking
10.5.3.2.1	- Critical Year Supply
10.5.3.2.2	- Dry Year Supply
10.5.3.2.3	- Below Normal Year Supply
10.5.3.2.4	- All Year Type Supply
10.5.3.3	Imported Supply Banking
10.5.3.3.1	- Critical Year Supply
10.5.3.3.2	- Dry Year Supply
10.5.3.3.3	- Below Normal Year Supply
10.5.3.3.4	- All Year Type Supply
10.5.3.4	Total Banking Supply
10.5.3.4.1	- Critical Year Supply
10.5.3.4.2	- Dry Year Supply
10.5.3.4.3	- Below Normal Year Supply

Note#	Assumption Description
10.5.3.4.4	- All Year Type Supply
10.5.3.5	Gross Average Annual Imported Supply PUT
10.5.3.6	Banking Water Supply Modeling Normalization
10.5.3.6.1	- Net Added AWT Bank Storage
10.5.3.6.2	- Net Added IS Bank Storage
10.5.3.6.3	- Excess AWT Production due to Bank Capacity Constraint
10.5.3.7	Normalized Average Annual Imported Supply PUT
10.5.3.8	Annual GW Supply Available for Demand Offset

NOTES:

1) Exclude NRW Monthly Discharge Cost.

2) PUT Facilities only, exclude AWPF. Construction cost per TAFY Capacity, scaled from NCBP 5 costs for all NCBP alternatives.

3) Unit Fixed O&M per TAFY capacity.

4) Unit Variable O&M per TAFY throughput.

5) Replenishment of RW designated for GW recharge that is lost from the system due to river or brine discharges.

6) Maximum Demand Offset could be limited by Annual AWPF production.

Appendix B: Parameter Assumptions for the Economic Alternatives Analysis

Appendix B: Parameter Assumptions for the CBP Alternatives Economic Analysis

Chino Basin Program Economic Analysis - General Assumptions

Note#	Assumption Description	Value	Notes
1.0 Chino Basin Program Funding Assumptions			
1.1	**Grants & Financing by Others**	***$212.0 mil***	2019 Total Grants and Financing by Others (no escalation or interest)
1.1.1	- Prop 1 WSIP	$212.0 mil	2019 Investment Amount (no escalation or interest)
1.1.2	- WIIN Act Grant	-	2019 Grant Amount (no escalation or interest)
1.1.3	- Title XVI USBR Grant	-	Grant Amount (no escalation or interest)
1.1.4	- SWRCB Grant	-	Grant Amount (no escalation or interest)
1.1.5	***Local Funds (Connection Fees, Property Tax)***	**-**	
1.1.5.1	- One-Water and Wastewater Connection Fees	-	2019 Estimate (no escalation or interest)
1.1.5.2	- Property Taxes	-	2019 Estimate (no escalation or interest)
1.1.5.3	- Other Local Funds	-	
1.2	**Prop 1 Water Exchange Assumptions**		
1.2.1	- WSIP Investment Amount	$212.0 mil	Prop 1 WSIP Investment Amount conditionally awarded by CA Water Commission
1.2.2	- Average Annual Exchange Quantity	15,000 AF	Average Annual State Water Project Exchange per WSIP Application (without carriage water savings)
1.2.3	- Prop 1 Water Exchange Period	25 years	Period during which Water Exchanges will occur per WSIP Application
1.2.4	- Number of Call Events	7.5	Average number of Call Events over Exchange Period per WSIP Application
1.2.5	- Assumed SWP Carriage Water Savings Allocated to CBP	20%	SWP Delta Operations carriage water savings percentage allocated to CBP reducing total exchange obligation.
1.3	**Design Assumptions**		
1.3.1	Maximum AWPF/PUT Capacity	1.25 TAFM	Maximum AWPF and Injection Well Capacity for Program Alternatives (15.0 TAFY)
2.0 Economic Analysis			
2.1	Base Year for Capital and O&M Cost	2019	Base year of the capital and O&M cost estimates.
2.2	Base Year for NPV Calculations	2019	Base year for Net Present Value analysis.
2.3	Project Life Duration	50 years	Project life (after construction) for Net Present Value analysis.
2.4	**Discount, Inflation, and Escalation Rates**		
2.4.2	- Economic Discount Rate	2.50%/yr	Economic Discount Rate (2.5% Default - 2021 Federal Water Project Discount Rate)
2.4.3	- Treatment of Inflation based on Analysis Type	Economic (Remove Inflation)	Adjustment to remove general inflation in estimates for Economic Analysis
2.4.4	- General Inflation Rate	2.50%/yr	General annual inflation, used for financial analysis. (Removed from specific escalation rates for economic analysis.)
2.4.5	- O&M Escalation Rate	0.00%/yr	Annual escalation rate for O&M costs relative to inflation.
2.4.6	- Capital Cost Escalation Rate	0.00%/yr	Annual escalation rate for capital costs relative to inflation.
2.5	**Construction Cost Markups**		
2.5.1	- Capital Cost Contingency	30%	Contingency for unknown costs to be added to the project cost.
2.5.2	- Engineering, Admin & CM	28%	Engineering, Admin, and CM cost to be added to the project cost.
2.6	**Project Replacement Cost**		
2.6.3	- Mech./Electrical Replacement Percent	60%	Percentage of capital cost used as replacement cost estimate.
2.6.4	- Mech./Electrical Replacement Period	25 years	Life cycle of mechanical and electrical equipment.
2.6.5	- Infrastructure Replacement Percent	60%	Percentage of capital cost used as replacement cost estimate.
2.6.6	- Infrastructure Replacement Period	50 years	Life cycle of infrastructure (e.g., pipe lines).
2.6.7	- Well Replacement Percent	40%	Percentage of capital cost used as replacement cost estimate.
2.6.8	- Well Replacement Period	25 years	Life cycle of well equipment.
2.6.9	- AWPF Replacement Percent	40%	Percentage of capital cost used as replacement cost estimate.
2.6.10	- AWPF Replacement Period	25 years	Life cycle of replacement components of the plant.
2.6	**Construction Loan Terms**		
2.6.1	- Loan Period	30 years	Payback period of capital loans.
2.6.2	- Loan Interest	2.00%/yr	Interest rate on capital loans.
3.0 PUT and TAKE Alternatives Assumptions			
3.1	**Project Schedule**		
3.1.1	- Design and Construction Start Year	2021	Start year of the predesign, design, and construction phase. (Input by Project Alterative in Program_Alts tab)
3.1.2	- Project Design & Construction Period	7 years	Estimated number of years to complete construction of project.

Chino Basin Program Economic Analysis - General Assumptions

Note#	Assumption Description	Value	Notes
3.1.3	- Project Life Cycle Start Year	2028	Start year of project life-cycle
3.2	**Construction Cost Extrapolation Parameters for Secondary Project Alternatives**		
3.2.1	- Exponent Factor for Economies of Scale Cost Extrapolation	0.60	$C_1/C_2 = C1(X_1/X_2)^{\alpha}$ where α denotes the scale coefficient, C denotes Cost, and X denotes capacity.
3.2.2	**Put Alternative Cost Scaling**		
3.2.2.1	-Base Alternative for Put Scaling	Put_5	Put alternative from PDR to use for construction cost scaling of secondary alternatives.
3.2.2.2	-Base Put Alternative Physical Capacity	15 TAFY	Physical Capacity of Base Put Alternative for Scaling.
3.2.2.3	-Base Put Alternative Throughput	15 TAFY	Throughput of Base Put Alternative for Scaling.
3.2.3	**Take Alternative Cost Scaling**		
3.2.3.1	-Base Alternative for Take Scaling	Take_7b	Take alternative from PDR to use for construction cost scaling of secondary alternatives.
3.2.3.2	-Base Take Alternative Capacity	40 TAFY	Physical Capacity of Base Take Alternative for Scaling.
4.0 Metropolitan Water Supply Costs & Benefits Assumptions			
4.1	**Pre-Delivery Terms**		
4.1.1	Pre-delivery Benefits and Costs	Negotiated Credit by MWD	Options for valuing predelivery water to MWD
4.1.2	Negotiated Predelivery MWD Credit Amount (in NPV Year $s)	$150/AFY	Credit/Payment by MWD for Predelivered Water in NPV Year $ (Consider energy savings and reoperation costs)
4.1.3	Negotiated Predelivery MWD Credit Escalation	2.50%	Annual Escalation of Credit by MWD for Predelivered Water (Includes inflation)
4.2	**Pump-In Terms**		
4.2.1	Pump-In Delivery Benefits and Costs	Negotiated Credit by MWD	Options for valuing Direct Delivery water to MWD
4.2.2	Negotiated Pump Back Delivery MWD Credit Amount (in NPV Year $s)	$250/AFY	Credit/Payment by MWD for Direct Delivery Water in NPV Year $
4.2.3	Negotiated Pump Back Delivery MWD Credit Escalation	2.50%	Annual Escalation of Credit by MWD for Direct Delivery Water (Includes inflation)
4.3	**In Lieu Terms**		
4.3.1	In Lieu Delivery Benefits and Costs	MWD TW Rate	Options for valuing In Lieu Delivery water in place of MWD deliveries
4.3.2	Negotiated In Lieu Delivery MWD Credit Amount (in NPV Year $s)	$800/AFY	Credit/Payment by MWD for In Lieu Delivery Water in NPV Year $ (Only used if negotiated rate option is selected in 5.2.3.1)
4.3.3	Negotiated In Lieu Delivery MWD Credit Escalation	2.50%	Annual Escalation of Credit by MWD for Direct Delivery Water (Includes inflation)
4.4	**Demand Offset Terms**		
4.4.1	Demand Offset Benefits	MWD TW Rate	Options for valuing Demand Offset of MWD deliveries
4.5	**Metropolitan Water Rate Assumptions - Assume Inflation is included in these escalation rates**		
4.5.1	Full Service (Tier 1) Untreated Rate Increase (Until 2050)	3.5%/yr	Escalation after 2028 - Use published rates for 2018-2028
4.5.2	Full Service (Tier 1) Treated Rate Increase (Until 2050)	3.5%/yr	Escalation after 2028 - Use published rates for 2018-2028
4.5.3	Readiness-to-Serve Charge Increase (Until 2050)	3.5%/yr	Escalation after 2028 - Use published rates for 2018-2028
4.5.4	Capacity Charge Increase (Until 2050)	3.5%/yr	Escalation after 2028 - Use published rates for 2018-2028
4.5.5	System Access Rate Increase (Until 2050)	3.5%/yr	Escalation after 2028 - Use published rates for 2018-2028
4.5.6	Water Stewardship Rate Increase (Until 2050)	3.5%/yr	Escalation after 2028 - Use published rates for 2018-2028
4.5.7	Wheeling Service Rate Increase (Until 2050)	3.5%/yr	Escalation after 2028 - Use published rates for 2018-2028
4.5.8	All MWD Rates Escalation after 2050	3.0%/yr	Escalation for all rate after 2050
4.5.9	Readiness-to-Serve Percentage	3.75%	FY 2019/20 MWD Rate Structure Administrative Procedures Handbook
4.5.10	Capacity Charge Flow Rate	148 cfs	FY 2019/20 MWD Rate Structure Administrative Procedures Handbook
4.5.11	IEUA MWD Allocation	58,335 AF	Rolling Ten-Year Average Firm Deliveries FY08/09 - FY17/18
4.5.12	Water Loss Factor	5.0%	Percentage of treated water distribution losses in the MWD system.
5.0 NRW Disposal Cost			
5.1	- Average Disposal Rate	$940/MG	Volumetric charge for monthly average discharge flow.
5.2	- Peak Disposal Rate	$357/MG	Volumetric charge for peak monthly discharge flow.
5.3	- COD Strength Rate	$166/Klb	COD load charge (per 1,000 lb. dry weight).
5.4	- TSS Strength Rate	$470/Klb	TSS load charge (per 1,000 lb. dry weight).
5.5	- Agency O&M and CIP Charges	$28.25/CU	Connection fee per NRWCU/Month.
5.6	*NRW Disposal Cost Projections*		
5.6.1	- Base Year of Disposal Rates	2019	Base year for the listed NRW Disposal Cost rates.
5.6.2	- Escalation Rate of Disposal Cost	2.5%/yr	Estimated annual increase in the NRW Disposal rates (including inflation).

Chino Basin Program Economic Analysis - General Assumptions

Note#	Assumption Description	Value	Notes
5.7	**PUT NRW Assumptions**		
5.7.1	- NRW Capacity Units	2,602 CU	AWPF's assessed NRWCUs
5.7.2	- Average Disposal Volume	31.2 MG	Average month NRW discharge flow.
5.7.3	- Peak Disposal Volume	0.0 MG	Peak month NRW discharge flow.
5.7.4	- COD Load	7939 lb	Monthly COD Load (dry weight).
5.7.5	- TSS Load	33 lb	Monthly TSS Load (dry weight).
5.7.6	- Annual NRW Cost	$1,251,000/yr	Estimated 2019 NRW brine disposal cost for 15 TAFY AWPF (not including NRWSCU Acquistion).
6.0 Imported Recycled Water Resources Assumptions			
6.1	**JCSD RW Supply to 930 PZ (WRCWRA)**		
6.1.1	**Project Schedule**		
6.1.1.1	- Design and Construction Start Year	2024	Start year of the predesign, design, and construction phase. (INPUT by Alternative in Program_Alts tab.)
6.1.1.2	- Project Design & Construction Period	4 years	Estimated number of years to complete construction of the project.
6.1.1.3	- Project Life-Cycle Start Year	2028	Start year of project life-cycle (≥ Project Start Year + const. period).
6.1.2	**Project Cost**	**$26.16 mil**	Total Project Capital Cost (Updated 3/2021)
6.1.2.1	- Pipe Lines	$16.08 mil	Cost of pipe line from WRCRWA plant to the 930 PZ
6.1.2.2	- Pumping Station	$4.36 mil	Two Pumping Station - at WRCRWA Plant and at Heros Park
6.1.2.3	- Eng., Admin & CM Cost	$5.72 mil	Engineering, administration and CM cost.
6.1.2.4	- Land Acquisition	$0.00 mil	Land acquisition cost for pumping stations.
6.1.3	**Calculated Annual Cost**		
6.1.3.1	- Infrastructure Replacement	$114,070/yr	Infrastructure replacement cost.
6.1.3.2	- Mechanical/Electrical Replacement	$81,673/yr	Mechanical and electrical replacement cost.
6.1.3.3	- O&M Cost	$663,000/yr	System operation and maintenance cost. (Costs from CBP PUT 5 O&M Breakdown)
6.1.3.3.1	- O&M Cost Variable	$537,000/yr	System operation and maintenance cost.
6.1.3.3.2	- O&M Cost Fixed	$126,000/yr	System operation and maintenance cost.
6.1.4	**Imported RW Acquisition**		
6.1.4.1	Annual Import	2.50 TAFY	Annual average volume of imported recycled water (RW) - year round.
6.1.4.2	Unit RW Cost Base Year	2019	Base year of RW Purchase Agreement Terms.
6.1.4.3	Unit RW Cost Increase	2.50%/yr	Annual escalation in RW Cost per IEUA-JCSD Agreement (includes inflation)
6.1.4.4	RW Purchase Rates	$225.00/AF	Unit RW Rate per IEUA-JCSD Agreement
6.2	**Riverside RW Project**		
6.2.1	Capital Investment in RPU Project	$0.00 mil	Investment amount in Riverside Public Utility project.
6.2.2	**Investment Schedule**		
6.2.2.1	- Year of Project Investment	2027	Year of investment in the project (INPUT by Alternative Selection in BC_Analysis)+ 3 years
6.2.2.2	- Project Life-Cycle Start Year	2028	Start year of project life-cycle (≥ Project Investment Year).
6.2.3	**Imported RW Acquisition**		
6.2.3.1	Annual Recycle Water Allocation	-	Annual average volume of recycled water allocated as a IEUA Benefit.
6.2.3.2	Unit RW Cost Base Year	2019	Base year of RW Purchase Agreement Terms.
6.2.3.3	Unit RW Cost Increase	0.00%/yr	Annual escalation in RPU RW Cost per IEUA-RPU Agreement (includes inflation)
6.2.3.4	RW Purchase Rates	$0.00/AFY	Unit RW Rate per IEUA-JCSD Agreement
6.3	**Rialto RW Supply to 1158 PZ**		
6.3.1	**Project Schedule**		
6.3.1.1	- Design and Construction Start Year	2024	Start year of the predesign, design, and construction phase.
6.3.1.2	- Project Design & Construction Period	4 years	Number of years to complete the project.
6.3.1.3	- Project Life-Cycle Start Year	2028	Start year of project life-cycle
6.3.2	**Project Cost**	$52.83 mil	Total Project Capital Cost (Updated 3/2021)
6.3.2.1	- Pipe Lines	$38.47 mil	Cost of pipe line from WRCRWA plant to the 930 PZ
6.3.2.2	- Pumping Station	$2.80 mil	Two Pumping Station - at WRCRWA Plant and at Heros Park
6.3.2.3	- Eng., Admin & CM Cost	$11.56 mil	Engineering, administration and CM cost.

Chino Basin Program Economic Analysis - General Assumptions

Note#	Assumption Description	Value	Notes
6.3.2.4	- Land Acquisition	$0.00 mil	Land acquisition cost for pumping stations.
6.3.2.5	- Santa Ana River Well	$0.00 mil	Allowance for a well adjacent to the Santa Ana River per Agreement.
6.3.3	**Calculated Annual Cost**		
6.3.3.1	- Infrastructure Replacement	$272,903/yr	Infrastructure replacement cost.
6.3.3.2	- Mechanical/Electrical Replacement	$52,450/yr	Mechanical and electrical replacement cost.
6.3.4	- O&M Cost	$444,000/yr	System operation and maintenance cost.
6.3.4.1	- O&M Cost Variable	$323,000/yr	System operation and maintenance cost.
6.3.4.2	- O&M Cost Fixed	$121,000/yr	System operation and maintenance cost.
6.3.4	**Imported RW Acquisition**		
6.3.4.1	*Annual Import*		
6.3.4.1.1	- Summer Import	3.50 TAFY	Annual average volume of imported water during the summer.
6.3.4.1.2	- Winter Import	-	Annual average volume of imported water during the winter.
6.3.4.2	Unit RW Cost Base Year	2019	Base year of RW Purchase Agreement Terms.
6.3.4.3	Unit RW Cost Increase	2.50%/yr	Annual increase in Rialto RW Cost per IEUA-Rialto Agreement (Assume includes Inflation)
6.3.4.4	Summer RW Purchase Rates	$225.00/AF	Summer rates applicable from 2028 to 2078.
6.3.4.5	Winter RW Purchase Rates	$300.00/AF	Winter rates applicable from 2028 to 2078.
6.4	**Additional Energy Costs for RW Transport in IEUA System**		
6.4.1.1	- Project Life-Cycle Start Year for CBP Alternatives	2028	Start year of project life-cycle (Use project start year for Rialto - CBP)
6.4.2	- Construction Cost	$0.00 mil	No Capital Costs in current formulation.
6.4.3	- O&M Cost	-	O&M Data for Recycled Water in Cbp_PUTCosts Tab.
6.5	**CBP PUT Alternative for RW O&M Costs**		
6.5.1	CBP PUT Alternative for RW O&M Costs Data	1	Source of O&M Data for Imported Recycled Water Projects (in Cbp_PUTCosts Tab)
7.0 Water Management Benefit Assumptions			
7.1	**Water Banking Analysis Assumptions**		
7.1.1	**Modeling Assumptions**		
7.1.1.1	CalSim Hydrology for Banking Ops	CALSIM 2030	Selected CALSIM Hydrology to use for Banking Analysis.
7.1.2	**Water Value Ratios by Water Year Type**	Custom	Ratios for WY Type Value vs. Average Annual Value used for Banking Benefits
7.1.2.1	- Dry Year Value Ratio	1.250	Dry Year Value Ratio for Cost Ratio Set 'Custom'.
7.1.2.2	- Critical Year Value Ratio	1.500	Critical Year Value Ratio for Cost Ratio Set 'Custom'.
7.1.3	**Water Value Assumptions**		
7.1.3.1	- PUT Water Value to Cost Ratio	0.80	Imported water value relative to the MWD Tier 1 Untreated Water Rate.
7.1.3.2	- TAKE Water Value to Cost Ratio	1.00	Banked water value relative to the MWD Tier 1 Treated Water Rate.
7.1.3.2	-Water Value Escalation	0.00%/yr	Escalation for water supply value for Dry and Critical Year Banking Delivery above Inflation and MWD Rate escalation.
7.2 Emergency Water Supply Assumptions			
7.2.1	Value of Emergency Water	4 X MWD Tier 2 Untreated Rate	The estimated value of the Emergency Water Supply (see notes)
7.2.3	Annual Probability of Emergency Event	4.20%	The estimated annual probability the an "All Hazard" event could occur.
7.2.4	Emergency Water Escalation Rate	0.00%/yr	Escalation of Emergency Water valuations above general inflation rate, MWD escalation rates, and Water Value Escalation Rate.
7.3 Water Quality Improvement Assumptions			
7.3.1	WQ Single Purpose Alternative (Initial Phase)	NWSIP:Put_A|Take_0|NB-0	Alternative used to establish single purpose WQ Project Cost - Initial Phase used for 1st level Water Quality benefits.
7.3.2	WQ Single Purpose Alternative (Secondary Phase)	NWSIP:Put_AP|Take_0|NB-0	Alternative used to establish single purpose WQ Project Cost - Secondary Phase used for 2nd level Water Quality benefits.
7.4 Subsidence Avoidance Assumptions			
7.4.1	Avoided Groundwater Delivery Cost	$250/AF	Estimated cost to deliver groundwater. (Avoided cost when replaced by MWDSD deliveries.)
7.4.2	Effectiveness Factor	50%	Assumed effectiveness of imported water supplies replacing groundwater extractions in avoiding subsidence.
7.5 Ecosystem Improvement Assumptions			
7.5.1	Alternative Ecosystem Valuation Methodology	Physical Benefit	Approach for valuing Base Year ecosystem benefits
7.5.2	CWC Ecosystem Benefit Valuation Base Year	2015	Date of Ecosystem Improvement Valuations provided by CWC.
7.5.3	Physical Benefit Escalation Rate	0.0%/yr	Escalation of Ecosystem Valuations above general inflation rate.
7.5.4	Include Water Transfer Option Cost	TRUE	Include Water Transfer Option Cost for least Cost Alternative Methodology
7.5.5	Transfer Cost Escalation Rate	0.0%/yr	Escalation of Transfer Water Costs above general inflation rate.
7.6 Water Shortage Avoidance Assumptions			
7.6.1	Reduction Factor for Shortage Estimates	50%	Factor for reducing MWD IRP Scenario D shortages for melding with Scenario A (no shortage) estimates.
8.0 No Action Alternative Assumptions			
8.1	Year New Imported Water Supply is Required	2031	Assumed date new imported water supply is required due to groundwater quality degradation.
8.2	Option for Volume of Required Imported Water	UWMP Values	Select static value of impacted RW water or future interpolated values from UWMP.

Chino Basin Program Economic Analysis - General Assumptions

Note#	Assumption Description	Value	Notes
8.2	Static Volume of Required New Imported Water Supply	35 TAFY	Required annual volume of new imported water supply for use if "Static Amount" is selected in 8.2.
8.3	Cost Basis of New Imported Water Supply	MWD UW Rate +RTS +CC	MWDSC rate basis for required new imported water supply.