THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Report

Water Resource Management

- **White Paper on Scenario Planning**

Summary

To support the policy development and technical analysis in the 2020 IRP, Metropolitan is employing a Decision Support Planning Method called Scenario Planning. In Scenario Planning, important and uncertain Drivers of Change are identified and used to envision multiple alternative futures. Planning over these multiple alternative futures helps to explore a much wider range of needs and impacts than traditional single-path deterministic planning can do.

The Scenario Planning process for the 2020 IRP will involve four key steps: Identifying Drivers of Change that will affect the future, constructing Learning Scenarios that reflect alternative outcomes of the future, developing Resource Mixes that combine resource and policy approaches to addressing the future scenarios, and developing an Adaptive Management Strategy.

The primary product from the analysis of each individual scenario is a Resource Mix that specifically addresses the water supply goals for that scenario. Each Resource Mix is a plan that describes the resource development needs, timing and cost that would be needed to meet policy goals within a scenario. Comparing the elements of the various Resource Mixes developed across the multiple alternative scenarios will provide two key types of information. The first is the identification of Resource Mix actions that are common in many or all scenarios. The second is the identification of actions that are unique but effective for specific future outcomes. Information on both types of actions will be useful in determining an IRP Adaptive Management Strategy that will develop the common actions while monitoring ongoing conditions that may indicate the need for implementing actions to adapt to a more specific future.

Purpose

Informational

Attachments

ATTACHMENT 1 - IRP Scenario Planning

Detailed Report

Detailed White Paper is provided with this report as Attachment 1

Date of Report: 5/12/2020

Scenario Planning in the 2020 IRP – An Approach for Exploring Uncertainty for Water Planning and Policy Discussion

Summary

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Background

"The future ain't what it used to be" – Yogi Berra

The year 2020 marks the conclusion of a 25-year planning cycle that was first envisioned by Metropolitan's inaugural 1996 Integrated Resources Plan. As such, the 2020 IRP provides a unique opportunity to reflect on the lessons learned and outcomes of decisions made over the planning horizon.

The 1996 IRP and subsequent IRPs recognized that planning for uncertainty was important and that the region's plans would need to account for a range of demands and water supplies. However, at that time, uncertainty was mostly focused on year-to-year hydrologic and weather-based impacts. This resulted in "deterministic" forecasting, which essentially generated a single "best path" for

forecasted water supplies and demands, with estimated variation from wet/dry and hot/cold conditions. Underlying drivers such as demographic growth, regulatory change, and consumer behavior were treated more as predictable forecasts and not as the uncertain factors that they proved to be over that period. Although the range of water supply and demand forecasts mostly covered the range of actual water supplies and demands experienced in the planning cycle, there is a recognition that future ranges may be more uncertain.

A major lesson learned from the planning cycle is that these underlying drivers of supply and demand are not readily predictable and that their outcomes have a significant impact on the region's water supply reliability. Project implementation, regulatory risk/reduction, economic recession/growth, demographic growth, end-use consumer behavior, extreme weather/hydrology were all more unpredictable over the past 20 years than forecasted. Project Implementation decisions, financial investment and other policy outcomes were all affected by the combination of actual outcomes of these different drivers.

The 2020 IRP will build on lessons learned by using a Decision Support Planning Method known as Scenario Planning. In a Scenario Planning approach, multiple alternative futures are envisioned and explored. This approach results in a greater understanding of a wider range of potential outcomes. In turn, those outcomes will allow a greater understanding of potential challenges to water supply reliability and the impacts of potential policy direction. In Scenario Planning, the primary goal and outcome is improved learning. The learning takes place over a wider range of uncertain outcomes, resulting in a better understanding of the needs and impacts of investments and policy decisions.

Glossary of Terms

The following are key terms that are used throughout this paper and will also be used during the IRP process.

- **Water Supply Reliability** – Consumers having access to and receiving water to meet their demands with no curtailment
- **Water Supply Reliability Goal** – A policy goal that sets the maximum frequency and depth of water supply curtailments that the region's water supply and demand management Resource Mix should provide
- **Scenario** – A singular view of the future under specified assumptions and outcomes
- **Scenario Planning** – A Decision Support Planning method that employs the use of multiple alternative futures described by Scenarios
- **Fundamental Outcomes** – For the purposes of supporting and informing high level IRP policy discussions, these are the general uncertainties whose outcomes have impact: Demand, Local Supply, Imported Supply
- **Drivers of Change** – Specific factors whose future values and outcomes are uncertain, but significantly impact future water supply reliability
- **Learning Scenario** – A detailed scenario that includes quantified outcomes of various Drivers of Change and can be used to inform the development of specific water resources and demand management actions and signposts

- **Resource Mix** – A resource and demand management development plan that describes the investments and policy approaches needed to meet water supply goals within a Scenario
- **Signposts** – Measurable indicators of the direction and trends of identified Drivers of Change through time
- **Robust Actions** – Water resource and demand management actions that are determined to be common to many/all future scenarios and whose implementation would not be better informed through signposts
- **Adaptation Actions** – Water resources and demand management actions that are specific to a smaller set of future scenarios and whose implementation would be better informed through signposts

Scenario Planning Method Description and Approach for IRP

Knowing that future water supplies and demands are unpredictable for a variety of reasons, how can Metropolitan best prepare Southern California for continued water resilience and sustainability? The 2020 IRP will address this question by adopting a Decision Support Planning method known as Scenario Planning. With Scenario Planning, multiple futures are envisioned and systematically explored. Scenarios are not forecasts or predictions; rather, they offer dynamic views of the future by exploring various trajectories of change that lead to a broadening range of plausible alternative futures.[1] Scenario Planning offers advantages over traditional deterministic forecasting through deliberative consideration of a wider range of potential outcomes, which in turn allow for more thorough understanding of potential challenges to water supply reliability. Such learning helps inform applicable potential policy direction suitable to meet those challenges. In short, Scenario Planning will provide the 2020 IRP to integrate highly uncertain and uncontrollable factors, such as climate change, into water resource decision making.

The overall concept of Scenario Planning is straightforward: Envision a scenario of the future. Identify a plan of solutions and policies that effectively deal with the outcomes within that future. Repeat with a series of multiple futures. Analyze the outcomes of the multiple futures to identify solutions and policies that are "robust" across a variety of futures. Understand the underlying drivers that lead to different futures.

The approach to using Scenario Planning for the 2020 IRP is being tailored to inform and support the goals of Metropolitan in the 2020 IRP Process. The approach will specifically help to inform:

- Policy discussion and direction
- Water resources investment needs
- Risks to future water supply reliability
- Development of an adaptive management strategy

[1] Mahmoud M., Liu Y., Hartmann H., Stewart S., Wagener T., Semmens D., Stewart R., Gupta H., Dominguez D., Dominguez F., Hulse D., Letcher R., Rashleigh B., Smith C., Street R., Ticehurst J., Twery M., van Delden H., Waldick R., White D., Winter L., "A formal framework for scenario development in support of environmental decision-making", *Environmental Modelling & Software*, vol. 24, 2009, p. 798-808. Available at https://www.researchgate.net/publication/220274818_A_formal_framework_for_scenario_development_in_support_of_environmental_decision-making

The Scenario Planning approach for the 2020 IRP can be described as a series of steps:

#	Step	What/Description	Who
1	Identify **Drivers of Change**	"What concerns you the most, what keeps you up at night?" These are the building blocks of developing **Learning Scenarios**	Stakeholders – Member Agencies and IRP Committee
2	Develop **Learning Scenarios**	Internally consistent scenarios with detailed and quantified information	Metropolitan Staff
3	Develop **Resource Mix** for each Learning Scenario	• Develop a **Resource Mix** to meet water supply reliability targets for each scenario • Assess outcomes of policy direction and decisions within each scenario • Develop comparable cost estimates for **Resource Mix**	Board discussion Metropolitan Staff
4	Develop **Adaptive Management Strategy**	Evaluate Resources Mixes to identify Robust Actions, Adaptation Actions and Signposts and incorporate into an Adaptive Management Strategy	Board discussion Metropolitan Staff

1. Identify Drivers of Change

There are a complex variety of specific underlying factors that impact water supply and demand. The outcomes of these factors can and will greatly affect the actual outcomes of the future water supply reliability. For example, residential water use, which comprises roughly 70 percent of total water demand in Southern California today, is highly uncertain in the future. This is because of the importance and uncertainty of underlying factors such as population, income levels, and the water use behaviors of the residential consumer. These underlying factors are "Drivers of Change", so named due to their uncertain but influential impact on the future.

Gathering input on the important Drivers of Change will be done through a stakeholder process involving the IRP Committee, the Member Agencies and other regional stakeholders. The IRP Committee and the Member Agencies will be engaged to provide input on "What concerns you the most, what keeps you up at night?" regarding potential uncertainties that affect future water supply reliability and policy. This is a key part of the Learning Scenario building process. The goal is to identify factors whose importance and uncertainty is large and significant so that the exploration of the uncertainty and their interaction with other factors will describe Learning Scenarios with futures that will cover a wide range of outcomes.

Following the stakeholder and Member Agency input, staff will collate and report on the drivers of change to the IRP Committee. The IRP Committee will be asked for additional input and discussion. Based on the input, staff will incorporate the most important and uncertain drivers of change into the development of Learning Scenarios.

2. Develop Learning Scenarios

The most important Drivers of Change will form the building blocks for the development of Learning Scenarios. Learning Scenarios will have detailed and quantified information and impacts of their underlying Drivers of Changes. Relationships between the Drivers of Change will be identified to ensure that the constructed Learning Scenarios are internally consistent and cover a wide range of possible futures.

The level of detail within the Learning Scenarios will allow for the identification of specific Resource Mixes and the analysis of the influence and outcomes policy options. The process of developing the Learning Scenarios will support the discussion and deliberation of policy questions. It will also help to inform the development of "Signposts," which are essentially indicators of the trends and direction of the "drivers of change" that will be used to inform adaptation actions in the future. Staff will employ the use of two Expert Panels in the areas of water demand and climate change to help inform the Learning Scenarios.

3. Develop a Resource Mix for Each Learning Scenario

The Learning Scenarios will portray alternative futures that differ based on various outcomes of the Drivers of Change. Each future will result in a different outcome for water supply and demand but do not offer solutions in and of themselves. Staff will quantify and analyze the Learning Scenarios to develop Resource Mixes utilizing policy discussion and direction. The result of this will be that each Learning Scenario will have:

- A Resource Mix to meet a water supply reliability goal with data on timing of resource actions
- Estimated cost information associated with the Resource Mix
- An assessment of the outcome of policy direction and decisions

4. Develop Adaptive Management Strategy

Each Learning Scenario will result in a Resource Mix with cost and policy outcomes. Quantifying and analyzing the findings across the various Learning Scenarios may reveal actions and outcomes that are common to many/all of the Learning scenarios. These Robust Actions can serve as the basis for a basic IRP implementation strategy of programs and policies that essentially provide value regardless of the outcome of the future.

Conversely, there will be actions and outcomes that may only provide value under the circumstances of one or few Learning Scenarios. These actions are Adaptation Actions, which should be considered for implementation when better information indicates an increased likelihood that they will be needed.

The circumstances under which an Adaptation Action would be needed in the future to augment the basic IRP implementation strategy are identified by analyzing the underlying Drivers of Change that caused the need for the action in a Learning Scenario. This forms the basis for Signposts. Signposts are measurable data and information that may give early indications as to the future direction of a Driver of Change. For example, if population and housing growth are Drivers of Change that indicate the future level of water demand, annual California Department of Finance population estimates

and county-level new housing construction permits may serve as Signposts that can be monitored over time to get a better idea of growth that is occurring.

Signpost monitoring and reporting would form the basis of an Adaptive Management Strategy that the Board could utilize over time to make better informed resource investments and policy direction.

Additional Considerations

There are several additional considerations that will need to be managed in the Scenario Planning approach for the 2020 IRP. These considerations mostly deal with the fact that Metropolitan is a large regional agency whose policies and implementation approaches may have an influence on how elements of the future unfold. It will be important that the approach clearly identifies drivers of change that are controllable or affected by Metropolitan's actions, and to ensure that drivers of change, policy decisions and implementation or adaptation actions are managed appropriately in the process. For example, retail agency-level compliance with the State's "Conservation as a Way of Life" legislation may be affected by the role that Metropolitan takes in researching, encouraging and incentivizing water use efficiency in the future.

An Example of Learning Scenario Development and Use

The following is an example of how the Learning Scenario development process works.
This assumes that the first two steps of the scenario process have taken place, where the first step helps to ensure we will address the right policy questions and the second step identifies significant Drivers of Change. Assume for this example that the stakeholder, Member Agency and IRP Committee input process identified the following important and uncertain Drivers of Change:

- Economic Growth
- Residential water use efficiency and behavior
- Climate Change - Increased temperatures/Decreased rain and snow
- Local agency development of local supplies
- Regulatory/Emerging Contaminants impact on groundwater supplies

Staff would analyze and evaluate these Drivers of Change and construct a Learning Scenario, which would be one of multiple scenarios that would be developed to get a wider view of a possible futures. The Learning Scenario would have a descriptive name and narrative that describes the conditions under which the future unfolds. In this example, the Learning Scenario is named and described as follows:

"Water Supply Challenges in a World of Awareness"

Southern California's economy thrives over the next 25 years, supporting job and income growth. Population and occupied housing rise. However, retail level water consumers have embraced and supported more efficient building standards and water use habits and devices. Housing stock is "smarter" and more vertical, with less housing density per square mile. There is higher self-investment in both indoor and outdoor water use efficiency, with less outdoor water

irrigation needs, which also leads to sustained lower per-capita water use. Despite the healthy economy, local supply production has been challenged due to impacts of contaminants on both existing groundwater and on the slower than expected progress on implementation of local supplies due to hesitancy to invest in local supplies in the face of continued losses. In addition, climate change is affecting supply and demand. Both local and imported supplies are challenged by climate change, with the impacts of increased temperatures and decreased/changed precipitation pattern while increasing temperatures and changes in rainfall put an increasing pressure on the remaining outdoor water use.

The scenario elements would be analyzed and quantified to determine what outcomes would occur for demand, local supply, imported supply and storage based on the conditions of the underlying Drivers of Change. Quantification and analysis, using models that estimate water demand, supply and water resource operations and use, would help to inform questions like:

- What level of total retail demands will there be over the next 25 years, with:
  - A healthy economy with a growing population, housing stock and job growth
  - Reduced per-capita use due to less landscape area and more efficient outdoor water use
  - Increased outdoor watering requirements from the higher temperatures of climate change
- What does local supply production look like over the next 25 years, with:
  - Losses of groundwater production due to emerging contaminants
  - Reduced local production from impacts of increased temperatures and changes in precipitation
  - Lower levels of new self-funded local production
- What is the water supply reliability of total supplies and storage in meeting total demand over the next 25 years with existing supplies and losses in supplies associated with this scenario?
- What would be a Metropolitan-directed Resource Mix of augmented supplies and demand management actions that would achieve the reliability goal?
- How do storage reserves, which provides supply resiliency in addition to water supply reliability, perform over the next 25 years with and without the implementation of a Resource Mix?
- What are the cost implications (capital, O&M, local agency/Metropolitan share, others) from the development path described by the Resource Mix?

Analysis and learning for this Learning Scenario, together with any number of other contrasting but plausible scenarios, helps to chart a common path of low-regret Robust Actions that may be resilient across a wide range of futures. As an example, there could be a Learning Scenario to explore an alternative future to the "Water Supply Challenges in a World of Awareness" above, with a name and narrative:

"Local Water Supply Thrives In a Lush Landscape"

Southern California's economy thrives over the next 25 years, supporting job and income growth. Population and occupied housing rise. However, while retail level water consumers have embraced and supported more efficient building standards and efficient indoor water use

habits and devices, the desire for outdoor landscaped areas has increased. Housing stock includes more irrigable area for turf and tree cover leading to higher per-capita water use. Local supply production has not been impacted significantly from regulation of contaminants on both existing groundwater and local agencies have been able to invest in new local supplies without regional incentives. Climate change is affecting both local and imported supplies with the impacts of increased temperatures and decreased/changed precipitation pattern while increasing temperatures and changes in rainfall put an increasing pressure on the remaining outdoor water use. Imported supplies from the State Water Project are additionally impacted by higher than expected sea level rise.

Compared to the first scenario, this scenario would likely have:

- Higher total demand due to outdoor irrigation and climate change impacts
- Higher local supply production from existing and new local supply projects
- Lower State Water Project supplies due to increased salinity levels from sea level rise

The Resource Mix required to meet the reliability goal under this second scenario would be different than under the first scenario. This is because the underlying conditions of some of the Drivers of Change are different, resulting in different supply and demand gaps in terms of timing and quantity.
For example, there would likely be a higher need for actions that maintain and increase local supplies in the first scenario because of groundwater losses and lower self-funded development of new local supplies. These actions would increase the cost of Metropolitan's investment in the development of the local supplies in that Resource Mix.

Comparing the actions to develop the appropriate Resource Mix for each scenario may reveal actions that will make sense to have in either scenario. For example, climate change is in both Learning Scenarios and so actions to protect existing resources from climate change impacts may be part of the Resource Mixes for each. These common actions would be considered Robust Actions that Metropolitan should strongly consider taking under any scenario.