Implementing Robust Decision Making in Metropolitan’s IRP

Brandon Goshi
Metropolitan Water District
August 8-9, 2018
Overview

- Metropolitan and its scope of planning
- Review of uncertainty planning for MWD
- Metropolitan’s Robust Decision Making Framework
- Key findings from 2012 RDM analysis
- Re-tooling RDM with the 2015 IRP Update
Metropolitan Water District

Water Wholesaler
26 Members Agencies
19 Million People
5,200 Square Miles
~4 MAF Annual Demand

- ½ Imported Supplies
- ½ Local Supplies
The Retail/Wholesale Water Supply Relationship

Water Supplies

IEUA (Wholesale)

Chino Hills (Retail)

Metropolitan (Wholesale)
Metropolitan's Imported Water Supply
Metropolitan’s Integrated Water Resources Strategy (IRP)

- Invest in a diversified supply mix
  - Stabilize imported supplies
  - Meet new demands with local resources and conservation
Review of Uncertainty
There are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know.

~Donald Rumsfeld
Known Knowns

- Official Demographic projections
- Project parameters (online dates, capacity)
- Project yields
- Historical weather outcomes
- Other
Known Unknowns

- Project yield loss/reductions
- Changes in project parameters
- Regulatory changes
- Shifts in demographics
- Economic boom and bust cycles
- Climate change
I don’t know what these are and neither do you, because that’s the whole point of unknown unknowns!
Overview of the IRP Robust Decision Making Process
The 2010 IRP Strategy
3 Components for Adapting to Change

Component 1: Core Resource Strategy

Component 2: Supply Buffer

Component 3: Foundational Actions

Reliability Under Planned Conditions (e.g. Historical weather)

Adapt to Shorter-Term Uncertainty (Outside of planned conditions)

Preparation for Long-Term Change (Climate Change, Supply Loss, Demands)
Local Supply Surveys -> CRA Forecast CRSS
Conservation Savings -> Demand Forecast Sales Model
Retail Demands MWD-MAIN -> SWP Forecast CALSIM II

Metropolitan’s Resource Portfolio -> Resource Analysis IRPSIM
IRPSIM Summary

Inputs
- 30 Supply Sources and Programs
- 10 Demand Categories
- 20 Storage and Transfer Programs
- 1000+ Supporting Variables
- 24 Operational Stages

Outputs
- 50 Year Simulation
- 83 Hydrologic Traces

50 Years x 83 Traces x 1000 Variables x 24 Stages
≈ 100 Million Calculations

Simulation Run Time... 8 seconds!
Incorporating Uncertainty
Using an Existing Model Framework

Local Supplies
- Climate
- Yields
- Timing

Conservation
- Yields
- Timing

Retail Demands
- Demographics
- Climate

CRA Forecast
- Climate

SWP Forecast
- Climate
- Delta Fix
- Timing

IRPSIM Resource Analysis

Metropolitan’s Resource Portfolio
## Defining Future Uncertainties

### The Experimental Design

<table>
<thead>
<tr>
<th>Factor</th>
<th>Range of Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic Changes</td>
<td>4 Scenarios: Balanced Growth, Baseline Growth, Periurban Growth, High Growth</td>
</tr>
<tr>
<td>Climate Conditions</td>
<td>12 Climate Scenarios: 6 GCMs x 2 Emissions Scenarios used by IPCC</td>
</tr>
<tr>
<td>Bay-Delta Conditions</td>
<td>3 Scenarios: No Delta Fix, Partial Delta Fix, Full Delta Fix</td>
</tr>
<tr>
<td>Local Resource Yields</td>
<td>±20% Variation in Groundwater, Recycling, Groundwater Recovery, Conservation</td>
</tr>
<tr>
<td>Project Implementation Timing</td>
<td>Delays: 0-10 years Desalination &amp; Recycling, 0-20 years Conservation, 0-30 years Delta Fix</td>
</tr>
</tbody>
</table>
Analyzed +6,900 combinations of uncertainty
Used “scenario discovery” to identify where IRP Resource Mix failed:
  - Net Balance
  - Total Storage
Used statistical methods to determined common areas of vulnerability
1. Configure IRPSIM with the IRP “Core Resources Strategy and Buffer”
2. Evaluate “Core Resources Strategy and Buffer” across Experimental Design
3. Identify when failure occurs based on specified markers/thresholds
4. Identify uncertainties that led to failure
5. Develop “signposts” for monitoring data related to the sources of uncertainty
Key Findings from RDM
The 2010 IRP approach is vulnerable when two or more uncertainties turn out unfavorably.

Example: High inland growth with hot/dry climate

Key uncertainties to “signpost” and monitor:

- Future Delta conditions
- Demographic trends
- Groundwater yields
- Climate Conditions
Signposts for Monitoring

Demographics
- Growth Rates
- Areas of Growth
- Housing Type Trends
- Density Trends
- Employment

Bay-Delta
- Environmental Impacts
- Ecosystem Restoration
- New and Improved Facilities
- Operations

Local Supplies
- GW Adjudications
- Water Quality Impacts
- Regulations
- New Projects/Timing
- Reduced Yields

Climate Change
- Precipitation Trends
- Temperature Trends
- Global Modeling results
- Downscaling improvement
Retooling for the 2015 IRP Update
Metropolitan’s Board approved updated 2015 IRP in January 2016

IRP Update and planning targets included new(est) information and forecasts on:
- Demographics/Demand
- Local resources development
- Bay-Delta outlook

Next step with RDM: Evaluate updated ranges and information
2015 IRP Update Targets

Conservation
- Pursue savings in outdoor water use (MWELO equivalent)
- Continue device-based approaches in support of target
- Ensure consistency with 20x2020 goals

Local Resources
- Ensure that total local supply production target of 2.43 MAF in 2040 is reached
- Recognize risks and potentially develop additional supplies

State Water Project
- Manage flow and export regulations through collaborative science-based approaches
- Pursue a long-term Delta solution through WaterFix/EcoRestore

Colorado River Aqueduct
- Develop sufficient programs to ensure 900 TAF of diversions
- Maintain flexible programs to ensure access to 1.2 MAF of diversions in dry-years
### Re-Defining Future Uncertainties

#### Factors and Ranges

<table>
<thead>
<tr>
<th>Factor</th>
<th>Range of Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic Changes</td>
<td>4 New Scenarios: Baseline, Balanced Growth, Peri-Urban Growth, High Growth</td>
</tr>
<tr>
<td>Climate Conditions</td>
<td>12 Climate Scenarios: Used to inform a range of <em>Delta Method</em> climate scenarios and map results</td>
</tr>
<tr>
<td>Bay-Delta Conditions</td>
<td>2 Scenarios: No California WaterFix, Full California WaterFix</td>
</tr>
<tr>
<td>Local Resource Yields</td>
<td>±20% Variation in Groundwater, Recycling, Groundwater Recovery, Conservation</td>
</tr>
<tr>
<td>Project Implementation Timing</td>
<td>Delays: 0-10 years Desalination &amp; Recycling, 0-20 years Conservation, 0-30 years Delta Fix</td>
</tr>
</tbody>
</table>
Summary of Implementing RDM

- RDM developed by RAND Corporation
- Supports adaptive decision-making incorporating data, modeling, and analytics
- Evaluates many planning scenarios against a wide range of uncertain future conditions
- Identifies why scenarios fail to meet planning goals
- Identifies signposts and monitoring criteria for adaptive management and practical implementation