Lower Santa Cruz River Basin Study:

Study Review and Introduction to Supply-Demand Scenario Combinations

Eve Halper,
Water Resources Planner
Bureau of Reclamation
Stakeholder Advisors Meeting #2
February 26, 2018
Lower Santa Cruz River (LSCR) Basin Study Summary

- Addresses the impacts of changing climate, population and other factors on water use through 2060
- Focuses on spatial distribution of water resources in the Tucson basin (Tucson Active Management Area)
- Includes analysis of environment (riparian areas)
- Employs a scenario approach to explore range of futures (with and without adaptation measures)
- Uses multiple climate projections as input to groundwater and surface water models
- Incorporates Input from Public and Stakeholder Advisors
LSCR Basin Study Objectives

1) Identify Where Physical Water Resources are Needed to Mitigate Supply-Demand Imbalances

2) Develop Adaptation Strategies to Improve Water Reliability for Municipal, Industrial, Agricultural and Environmental Sectors
Cost-Share Partners

- Southern Arizona Water Users Association
- Arizona Department of Water Resources
- Central Arizona Water Conservation District
- Pima Association of Governments
- Cortaro-Marana Irrigation District – Cortaro Water Users Association
- The University of Arizona

Project Team
Other organizations with participating staff include:

- Tohono O’odham Nation
- Pascua Yaqui Tribe
- ASARCO
- Freeport McMoran
- Vail Water
- Tucson Electric Power
- Pima County Flood Control District
- Sonoran Institute
- AZ Land and Water Trust
- Watershed Management Group
- Community Water Coalition
- Coalition for Sonoran Desert Protection
- Sky Island Alliance
- Tucson Audubon Society
- The Nature Conservancy
- American Rivers
Key Terms

• **Scenario** – set of assumptions used to help understand potential future conditions

• **Risk** - threats to life, health and safety, the environment, economic well-being, and other things of value

• **Adaptation** - Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects

Public Involvement: Key Part of Process

All Reclamation Basin Studies must have four required elements

Step 1: Project future supply & demand imbalances (without adaptation measures)
Step 2: Evaluate risks to infrastructure and other systems
Step 3: Develop and investigate adaptation strategies (structural and non-structural)
Step 4: Perform trade-off analysis of strategies
Simplified Modeling Overview

**Climate Driving Forces**
(Precipitation, Temperature)

GLOBAL CLIMATE MODELS

SURFACE HYDROLOGY MODEL

Tucson AMA Groundwater Model

**Socio-Economic Driving Forces**
(Demographics, Economics, Technological, Regulatory)

CAP SERVICE AREA MODEL

GLOBAL CLIMATE MODELS

SURFACE HYDROLOGY MODEL

Tucson AMA Groundwater Model
CAP Service Area Model (CAP: SAM)

- All Major Water Using Entities
  - 80 Municipal Providers
  - 23 Irrigation Districts
  - 12 Tribes and Districts
  - 20+ other user categories (CAGRD, AWBA, Industrial users, etc.)
- 16 Water Supply Types
  - Includes Surface Water, Effluent, CAP, LTSC, Groundwater, Recovered Water, etc.
  - Incorporates shortage scenarios from Colorado River Simulation model (CRSS)

Models municipal, agricultural and industrial demands and supplies used to meet them

Projects service providers total:

- Recharge and delivery of CAP and effluent
- Groundwater pumping
- Agricultural and incidental recharge
### Demand Scenario Summary

<table>
<thead>
<tr>
<th>Demand Scenario</th>
<th>Demand Scenario 1 Baseline</th>
<th>Demand Scenario 2 Slow Compact Growth</th>
<th>Demand Scenario 3 Slow Outward Growth</th>
<th>Demand Scenario 4 Rapid Outward Growth</th>
<th>Demand Scenario 5 Rapid Outward Growth Plus Mining and no Replenishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand Scenario 1</td>
<td>Low growth series: condensed growth pattern, no additional mines, no overdraft in Green Valley</td>
<td>Medium growth series: outward growth pattern, new mine development, replenish Green Valley</td>
<td>High growth series: outward growth pattern, new mine development, replenish Green Valley</td>
<td>High growth series: outward growth pattern, mining growth, no replenishment in Green Valley</td>
<td></td>
</tr>
<tr>
<td>Municipal Demand: Population Growth Rate</td>
<td>Medium</td>
<td>Low Series</td>
<td>Medium Series</td>
<td>High Series</td>
<td>High Series</td>
</tr>
<tr>
<td>Municipal Demand: Infill vs. Outward Growth</td>
<td>Baseline</td>
<td>In-Fill/Redevelopment</td>
<td>Slow Outward</td>
<td>Rapid Outward</td>
<td>Rapid Outward</td>
</tr>
<tr>
<td>Municipal Demand: Gallons Per Household Unit Per Day</td>
<td>Decline as expected</td>
<td>Decline faster than expected</td>
<td>Decline as expected</td>
<td>No change in current GPHUD</td>
<td>No change in current GPHUD</td>
</tr>
<tr>
<td>Municipal Demand: Additional recharge</td>
<td>per current CAP-SAM assumptions</td>
<td>Year 2020</td>
<td>Year 2030</td>
<td>Year 2030</td>
<td>Never</td>
</tr>
<tr>
<td>Municipal Demand: Develop Ag Land or Undeveloped Land</td>
<td>Baseline</td>
<td>Low GPHUD development tends to replace high water use ag land.</td>
<td>CAP-SAM Baseline</td>
<td>Higher GPHUD development occurs on undeveloped land before replacing agriculture</td>
<td>Higher GPHUD development occurs on undeveloped land before replacing agriculture</td>
</tr>
<tr>
<td>Agricultural Demand: Consumptive Use (CU) Crop</td>
<td>Baseline</td>
<td>Some ag areas convert to low CU crops</td>
<td>No change in CU crops</td>
<td>Some ag areas convert to higher CU crops</td>
<td>Some ag areas convert to higher CU crops</td>
</tr>
<tr>
<td>Agricultural Demand: Groundwater Savings Projects</td>
<td>per current CAP-SAM assumptions</td>
<td>Highest savings start 2018</td>
<td>Highest savings start in 2018</td>
<td>Half of highest savings start in 2025</td>
<td>No savings</td>
</tr>
<tr>
<td>Industrial Demand: Manufacturing</td>
<td>Baseline</td>
<td>Slow economic growth and/or greatly improved water use efficiency</td>
<td>Moderate economic growth within existing water service areas, expected improvements in efficiency</td>
<td>Rapid economic growth that depends on groundwater, minimal improvements in efficiency</td>
<td>Rapid economic growth that depends on groundwater, minimal improvements in efficiency</td>
</tr>
<tr>
<td>Industrial Demand: Mining</td>
<td>Baseline</td>
<td>No new mines</td>
<td>New mine in 2020-2030</td>
<td>New mine in 2020-2030, Existing mines expand</td>
<td>New mine in 2020, Existing mines expand</td>
</tr>
<tr>
<td>Environment's Demand: Riparian Evapotranspiration</td>
<td>Baseline</td>
<td>Changes with climate and availability of surface water and shallow groundwater</td>
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</tr>
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### Draft Demand Matrix

(for input into CAP:SAM)
Representative Concentration Pathways (RCPs)

- Used to compare results of global climate models
- Climate model projections available for RCP 4.5 and RCP 8.5
- RCP 4.5 – “Best Case / Lower Risk”
- RCP 8.5 – “Worse Case / Higher Risk”

Scenarios Focus on Risk

“Best Case”
Lower Emissions Future
(RCP 4.5)

Lower Risk

“Worse Case”
Higher Emissions Future
(RCP 8.5)

Higher Risk

“Base Case”
Without Climate Change
(For Comparison Purposes)
## Proposed Supply-Demand Scenario Combinations

<table>
<thead>
<tr>
<th>Supply</th>
<th>Demand</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Worse Case&quot; (Higher Emissions Future - RCP 8.5)</td>
<td>&quot;Worse Case&quot; (Higher Emissions Future - RCP 8.5)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>&quot;Best Case&quot; (Lower Emissions Future - RCP 4.5)</td>
<td>&quot;Best Case&quot; (Lower Emissions Future - RCP 4.5)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Base Case&quot; (Current Climate)</td>
<td>&quot;Base Case&quot; (Current Climate)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline Growth</td>
<td>Slow Compact Growth</td>
<td>Slow Outward Growth</td>
<td>Rapid Outward Growth</td>
<td>Rapid Outward Growth, No Replenishment of Future Mine Pumping</td>
<td></td>
</tr>
</tbody>
</table>
What we are going to discuss today?

1. Do the scenario combinations selected do a good job of describing the range of risk?
2. Should any scenario combinations be deleted?
3. Should any scenario combinations be added?
GUIDED DISCUSSION OF CLIMATE – CAP:SAM DEMAND MATRIX
Next Steps:

Step 1: Project future supply & demand imbalances (without adaptation measures) (TODAY)

Step 2: Evaluate risks to infrastructure and other systems

Step 3: Develop and investigate adaptation strategies (structural and non-structural)

Step 4: Input: Trade-off Analysis

Input: scenarios and assumptions

Input: Adaptation Strategies
GUIDED DISCUSSION OF OBJECTIVES FOR ADAPTATION STRATEGIES (IF TIME ALLOWS)
Thank you for participating!
### Proposed Supply-Demand Scenario Combinations

<table>
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<tr>
<th>Climate Scenario</th>
<th>CAP Service Area Model Demand Scenario</th>
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</table>
| "Worse Case" (Higher Emissions Future - RCP 8.5) | "Worse Case"            
(Higher Emissions 
Future - RCP 8.5) X X X X |
| "Best Case" (Lower Emissions Future - RCP 4.5) | X |
| "Base Case" (Current Climate) | X |
| Baseline Growth | Slow Compact Growth |
| Slow Outward Growth | Rapid Outward Growth |
| Rapid Outward Growth, No Replenishment of Future Mine Pumping |