San Juan Basin

Watershed Size:
16,000 mi² (42,000 km²)
Water Users Face Drought-Related Challenges

- Recent drought in San Juan Basin drove Navajo Reservoir to lowest level ever
- Endangered species in the San Juan River will likely reduce the reliability of water supply
- San Juan Generating Station uses 22,000 acre feet/year of San Juan River water
- Agricultural, Industrial and Municipal demands

SUPPLY

DEMAND

What/Who is ZeroNet?

- Initial partnership: between LANL, EPRI, and PNM
- Established in multi-sector stakeholder meeting
- Main goal: to meet new power generation needs with Zero Net new freshwater withdrawals by 2010
- DOE funding started in Spring of 2004
- Current partnership: LANL, EPRI, PNM, Systech, SNL, UNM, NETL
ZeroNet Decision Tools
Understand and integrate parts of complicated problems
to better predict outcomes of decisions

Stakeholder Input and Watershed Data

Geographic Information System (GIS)

ZeroNet Knowledge Base
San Juan Data Scenario Library

Watershed Tools (WARMF)

lead: LANL, Paul Rich

Quick Scenario Tool

lead: LANL/UNM, Mary Ewers

Watershed Tools

WARMF
Watershed Analysis Risk Management Framework

• Physically based:
  - meteorology, topography, land use, diversions, point sources…

• Simulates stream flow and water quality

• Helps address "What If?" scenarios

• Results linked with quick scenario model and knowledge base
WARMF Credentials

- Applied to over 16 watersheds
  - Hydrology, water quality, TMDLs, watershed planning
- 4 USEPA-Guided Peer Reviews
- Available as a Public Domain Tool via USEPA
  - Compatible with EPA BASINS

Hydrologic Model Calibration
Animas River above Farmington Glade

- Wet Year
  - $R^2 = 0.9738$
- Normal Year
  - $R^2 = 0.9772$
- Dry Year
  - $R^2 = 0.8853$
### Drought vs. Recovery Scenarios

#### Navajo Reservoir

<table>
<thead>
<tr>
<th>Elevation (m)</th>
<th>Sep-97</th>
<th>Sep-99</th>
<th>Sep-01</th>
<th>Sep-03</th>
<th>Sep-05</th>
<th>Sep-07</th>
<th>Sep-09</th>
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**Minimum Elevation Target**
- **Drought**
- **Continued Drought with 5000 acre-ft Produced Water & SS**
- **Continued Drought with Shortage Sharing**
- **Continued Drought 2000-2004 Met data**

**Recovery 1991-1995**

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*Using the 2003 Shortage Sharing values
Scenario Generation with ZeroNet Module

**Climate / Drought Scenarios**

*Examine impact of drought and temperature increase on water supply*

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Temp Increase (°C)</th>
<th>Drought Length (yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3T0</td>
<td>+0</td>
<td>3</td>
</tr>
<tr>
<td>D3T1</td>
<td>+1</td>
<td>3</td>
</tr>
<tr>
<td>D3T2</td>
<td>+2</td>
<td>3</td>
</tr>
<tr>
<td>D5T0</td>
<td>+0</td>
<td>5</td>
</tr>
<tr>
<td>D5T1</td>
<td>+1</td>
<td>5</td>
</tr>
<tr>
<td>D5T2</td>
<td>+2</td>
<td>5</td>
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</table>

- 6 Scenarios
- Sampling random pattern of drought years
- 50 iterations per scenario (for convergence)
Navajo Reservoir Elevation - 3 Year Drought

- Normal:
- Dry:
- Normal/Wet:

Navajo Reservoir Elevation - 5 Year Drought

- Normal:
- Dry:
- Normal/Wet:
### Reservoir Adjustment Summary

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>% Reduction</th>
<th>Volume Held (AF)</th>
<th>Volume Held (AF/yr)</th>
<th># of Years</th>
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</thead>
<tbody>
<tr>
<td>D3T0</td>
<td>18</td>
<td>86,786</td>
<td>86,786</td>
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<td>65</td>
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<td>D3T2</td>
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<td>D5T2</td>
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<td>1,358,127</td>
<td>339,532</td>
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</tbody>
</table>

- To meet minimum elevation criteria, reservoir release had to be reduced for all scenarios
- Both temperature and drought have significant impacts
- Holding back water in reservoir creates more critical conditions downstream

### Impact of Reservoir Adjustment

**No Adjustment:**
- Reservoir violates minimum elevation
- SJ River meets minimum flow requirement

**With Adjustment:**
- Reservoir meets minimum elevation
- Most of SJ River violates minimum flow requirement
Shortage / Pass Through Charts:
*Increased Shortage with Higher Temperature and Longer Drought*

**Shortage Summary**

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>San Juan</th>
<th>Animas</th>
<th>La Plata</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>D3T0</td>
<td>63</td>
<td>203</td>
<td>217,174</td>
<td>217,440</td>
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<tr>
<td>D3T1</td>
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<td>332,907</td>
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<td>313,935</td>
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<td>598</td>
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<tr>
<td>D5T1</td>
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<td>14,405</td>
<td>380,009</td>
<td>489,722</td>
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<tr>
<td>D5T2</td>
<td>195,881</td>
<td>52,401</td>
<td>411,060</td>
<td>659,342</td>
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</tbody>
</table>

- Increased Shortage with higher temperature and longer drought
- La Plata always in shortage
- Shortages most significant below Farmington
Summary

- ZeroNet DSS – Set of useful tools
  - Integrate critical water supply and demand information
  - Assist water owners and managers with planning drought and climate change
- Prototype distributed to the stakeholders of the San Juan Basin
- Future Work
  - Tighter integration of DSS tools
  - Continued work in San Juan Basin
  - Application to other watersheds