2013 SEA GRANT CLIMATE NETWORK CONFERENCE

Managing Drought Risks in the Chicago Metro Region

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Droughts?
In urban areas, droughts treated as water supply reliability issue: water system capacity overbuilt based on historical worst drought of record

Can extrapolate from rates and severities of past droughts, but the region’s future drought risks likely to be different than its historical record because of climate change
Droughts and Urban Water Supply (con’t)

- But often high uncertainty in modeling future precipitation trends — e.g., by 2050, Illinois State Water Survey’s models forecast that:
  
  **Precipitation will increase by 5%** and temperatures will rise by 2° F in region (Hadley GCM)

  **OR**

  **Precipitation will decrease by 3%** and temperatures will rise by 6° F in region (Japan GCM)

## Climate Change and Water Use Forecasts in CMAP’s 2050 Plan

<table>
<thead>
<tr>
<th>Weather scenario</th>
<th>2005 use (mgd)</th>
<th>Use in 2050 (mgd)</th>
<th>2005-2050 change (mgd)</th>
<th>Change from CT in 2050 (+/-%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT scenario</td>
<td>1,428</td>
<td>1,958</td>
<td>530</td>
<td>—</td>
</tr>
<tr>
<td>+6°F temp.</td>
<td>1,428</td>
<td>2,136</td>
<td>708</td>
<td>+9</td>
</tr>
<tr>
<td>+2.5&quot; precip.</td>
<td>1,428</td>
<td>1,929</td>
<td>501</td>
<td>-1</td>
</tr>
<tr>
<td>-3.5&quot; precip.</td>
<td>1,428</td>
<td>2,007</td>
<td>579</td>
<td>+2</td>
</tr>
<tr>
<td>+6°F and +2.5&quot; precip.</td>
<td>1,428</td>
<td>2,105</td>
<td>677</td>
<td>+7</td>
</tr>
<tr>
<td>+6°F and -3.5&quot; precip.</td>
<td>1,428</td>
<td>2,188</td>
<td>760</td>
<td>+12</td>
</tr>
</tbody>
</table>

Source: Dziegielewski and Chowdhury, 2008
Adaptive Management

- Infrastructure is very expensive to build, so need a management strategy that best addresses the uncertainties of accurately forecasting climate change impacts.

- Best practices (AWWA/National Drought Mitigation Center/State Drought Plans) use an adaptive management framework – the more severe the drought, the more stringent the water management and conservation measures employed.
Drought Planning Protocols

- Drought management programs staged according to indicators of drought severity:
  - Palmer Index (soil moisture)
  - Decline from normal average precipitation levels
  - Decline in surface– or ground–water levels
  - Reservoir capacity

- Depending on the drought severity stage, interventions range from public information, to demand restrictions, to bans on non–essential water uses
Water Supplies in NE Illinois

- Lake Michigan 77%
- Ground water 18%
- Inland rivers 5%

Other Water Supply Resources

- **Ground-water:**
  - About half the region’s population uses the deep (Cambrian–Ordovician) aquifer system, which is being mined beyond its sustainable yield.
  - Deeper wells & advanced treatment needed as water levels and ambient water quality keep declining in the western and southern suburbs.

- **Surface-water:** Fox and Kankakee Rivers supply only 5% of region’s residents.
Regulatory Strategies: Lake Michigan and Deep Aquifers

- Lake Michigan and deep aquifers are relatively immune to drought impacts
  - Corresponds to ~85% of region’s 9M population
  - 7.65M people won’t be affected much by droughts
  - Lake Michigan service area mostly already built out

- Region’s population estimated to reach ~12.1M by 2050 – issue one of finding enough water to meet the metro region’s projected needs

- Problem is that these two secure sources are essentially already fully used (and, with respect to the deep aquifers, over-used)
Most communities at risk are those depending on surface-water and shallow ground-water for their drinking water sources (~1.35 M people)

These sources will become most stressed in the most rapidly growing areas of the region
- Drought and growing use can reduce quantities available for water supply purposes
- Vulnerable to water pollution (> treatment costs)
Drought Policies


- Water conservation would allow the Lake Michigan service area to be expanded.

- Drought policies comprise only two out of 265 pages in CMAP’s water supply plan (but 2005 drought – 3rd highest on record – raised water consumption by only 8% in Illinois).
## Water Conservation Policies

<table>
<thead>
<tr>
<th>Conservation Measures</th>
<th>Low Conservation (MGD)</th>
<th>High Conservation (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Efficiency Toilets</td>
<td>15.0</td>
<td>74.8</td>
</tr>
<tr>
<td>Water Waste Prohibition</td>
<td>12.1</td>
<td>60.3</td>
</tr>
<tr>
<td>Metering</td>
<td>30.3</td>
<td>31.5</td>
</tr>
<tr>
<td>Leaks and Audit Repair</td>
<td>5.9</td>
<td>29.7</td>
</tr>
<tr>
<td>Residential Plumbing Retrofits</td>
<td>5.2</td>
<td>26.0</td>
</tr>
<tr>
<td>Commercial/Industrial</td>
<td>5.0</td>
<td>25.2</td>
</tr>
<tr>
<td>High-Efficiency Clothes Washers</td>
<td>3.2</td>
<td>16.1</td>
</tr>
<tr>
<td>Large Landscape</td>
<td>1.0</td>
<td>5.1</td>
</tr>
<tr>
<td>Residential Water Survey</td>
<td>0.1</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>All Measures - Total</strong></td>
<td><strong>77.9</strong></td>
<td><strong>269.5</strong></td>
</tr>
</tbody>
</table>

Source: The Chicago Metropolitan Agency for Planning
Other Regulatory Options

- Reallocating the Lake Michigan diversion can, in theory, increase Great Lakes domestic water supply by ~30%
  - By reallocating the stormwater runoff component of the diversion to drinking water, can increase availability of Lake Michigan water by 27.7%
  - If close Chicago Area Waterway System (for AIS control, e.g.), can also reallocate navigational and lockage use, increasing Lake Michigan supply by an additional 2.4%
Use of Lake Michigan Water

Illinois Diversion of Lake Michigan – 2005

- Leakage: 0.9%
- Discretionary: 9.2%
- Runoff: 27.7%
- Domestic: 59.8%
- Nav. Make Up: 0.8%
- Lockage: 1.6%


Source: CMAP, 2050 Regional Water Supply/Demand Plan (2010)
Municipalities won’t interconnect their water systems without first getting state water allocation permits (and unlikely to assume bond obligations for low-probability drought events)

State unlikely to allow “temporary” new water allocation permits, even on emergency basis, during droughts (OWR issues 40-year permits)

No incentives for conjunctive use – prohibited by law within Lake Michigan service area
Water Pricing Approaches

- In theory, can create promote water conservation by simply making water more expensive

- But water is a relatively inelastic good: price elasticity of demand is 0.15 in NE Illinois (i.e., increasing price by 10% would reduce demand by only 1.5%)

- Could use “Full Cost Pricing” to take into account not only the costs of supplying water from a specific source but also the lost opportunity and environmental costs of doing so (and Illinois OWR proposing this as a municipal requirement in its new draft Lake Michigan allocation permit rules)
Full Cost Pricing

Source: M. Schneemann, *Full Cost Water Pricing Guidebook* (CMAP/IISG 2012)