Sustainability of Source-Water Supply, Rochester

John Greer, PG - Barr Engineering Co.
Todd Osweiler – Rochester Public Utilities
Overview

- RPU’s Water System
- Future Water Demands
- Water Source Sustainability
- Groundwater Modeling
- Potential Alternative Water Sources
- Stakeholder Communication
Rochester’s Water System

- Rochester population ~ 115,000
- Approximately 40,400 water customers
- Appropriation limit 5.7 billion gallons/year
- 10 pressure zones
- 20 water storage facilities
  - Storage capacity = 16.95 million gallons
Rochester’s Water System

- 31 active water supply wells
- Pumping from 5 aquifers:
  - Shakopee (6)
  - Jordan (31)
  - Tunnel City (9)
  - Wonewoc (9)
  - Mt. Simon (1)
Historical Annual Water Pumpage and Permitted Appropriations (1980-2018)

- DNR Permitted Appropriation
- Historical Annual Water Pumpage
- Population


Population: 0, 20,000, 40,000, 60,000, 80,000, 100,000, 120,000, 140,000

Annual Water Pumpage, Million Gallions: 0.0, 1,000.0, 2,000.0, 3,000.0, 4,000.0, 5,000.0, 6,000.0, 7,000.0

Rochester’s Water System
Rochester’s Water System
Mayo Destination Medical Center (DMC)

- Largest economic development initiative in Minnesota’s history
- $5 billion in private development
- $585 million in public infrastructure (State, County, City)
- Projected growth by 2040 as a result of DMC
  - Population increase ~40% (115,000 to 165,000)
  - 50,000 new jobs
- Larger population = greater water demand
Water Demand Projections

Rochester Projected Growth (2019-2040)

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Average Daily Demand (MGD)</th>
<th>Maximum Daily Demand (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>119,100</td>
<td>13.1</td>
<td>28.17</td>
</tr>
<tr>
<td>2020</td>
<td>121,000</td>
<td>13.31</td>
<td>28.62</td>
</tr>
<tr>
<td>2021</td>
<td>123,200</td>
<td>13.55</td>
<td>29.14</td>
</tr>
<tr>
<td>2022</td>
<td>125,400</td>
<td>13.79</td>
<td>29.66</td>
</tr>
<tr>
<td>2023</td>
<td>127,600</td>
<td>14.04</td>
<td>30.18</td>
</tr>
<tr>
<td>2024</td>
<td>129,800</td>
<td>14.29</td>
<td>30.7</td>
</tr>
<tr>
<td>2025</td>
<td>132,000</td>
<td>14.52</td>
<td>31.22</td>
</tr>
<tr>
<td>2030</td>
<td>143,000</td>
<td>15.73</td>
<td>33.82</td>
</tr>
<tr>
<td>2040</td>
<td>165,000</td>
<td>18.15</td>
<td>39.02</td>
</tr>
</tbody>
</table>
RPU has a robust water conservation program
RPU has been investigating their groundwater source for 30 years
- Partnering with MGS/USGS/DNR/MDH
- Total expenditures to day >$1.5 million
Still, the question remains:

Can the aquifers sustainably meet future water demand?
Water Source Sustainability

- Water source sustainability study started in late 2013 and is ongoing
  - Groundwater modeling
  - Identification and closing of data gaps
  - Calcareous fen evaluations
  - Preliminary evaluation of alternative sources
  - Periodic coordination meetings with DNR staff
- Future work
  - Assessment of deeper aquifers
  - Evaluation of potential water re-use options
  - Optimization of pumping
Water Source Sustainability: Groundwater Use

- Proposed use:
  - No adverse effect on the aquifer’s ability to supply the needs of future generations
  - No harm to ecosystems
  - No degradation of water quality
  - No reduction of water levels such that existing wells can no longer access water
- Potential for ecosystem impacts
Ecosystem includes:
- Rivers and streams
- Calcareous fens (13)
- Trout streams

Groundwater modeling being used to evaluate potential impacts of future pumping on the ecosystem

RPU has regular meetings with DNR staff to discuss the evaluation
Groundwater Modeling

- Preliminary model available 2014
- Two rounds of model improvement have been completed
  - Model domain and BCs
  - Addition of model layers
  - Decorah edge enhanced recharge
  - Improved capability to evaluate land use changes
  - Steady state & transient calibration
Groundwater Modeling

- Future demand modeled in steady state scenarios (w/ uncertainty analysis)
- 2007 – 2013 averages used as the baseline
- Up to 18 additional wells
  - New wells assumed to be in Jordan
  - Modeled pumping rates based on ultimate demand projection of 28.2 MGD (developed in 2010)
    - Average day demand of 12.1 MGD for 2014 – 2018
Groundwater Modeling

- Model used to evaluate potential impact of future pumping:
  - Water table drawdown at calcareous fens
  - Baseflow reduction in streams
  - Drawdown in pumped aquifers
Groundwater Modeling

High Forest 15 Fen

Pumping Condition with Additional Well Number

Key:
- base simulation
- mean
- median

Distribution of results
Groundwater Modeling

Silver Creek at Confluence with South Fork Zumbro River

Percent Change in Baseflow From Baseline Pumping Condition

Pumping Condition with Additional Well Number

Key

- base simulation
- mean
- median
Groundwater Modeling

Cascade Creek at Confluence with South Fork Zumbro River

Percent Change in Baseflow From Baseline Pumping Condition

Pumping Condition with Additional Well Number

Key:
- base simulation
- mean
- median

Distribution of results
Potential Alternative Water Sources

- Potential alternative sources:
  - Surface water
  - Stormwater reuse
  - Wastewater reuse
  - Aquifer storage and recovery
  - Move more pumping to deeper aquifers
## Potential Alternative Water Sources

### Preliminary evaluation criteria:
- Water quantity
- Drought resistance
- Water Quality/Treatment
- Reliability
- Regulatory burden
- Overall cost

### Potential uses
- Total replacement of GW
- Total replacement of Shakopee/Jordan
- Partial replacement of supply from existing wells
- Mitigation of ecosystem impacts
- Reduction of summer irrigation peak impacts
- ASR
### Table 9  Total replacement of potable groundwater supply

<table>
<thead>
<tr>
<th>Source</th>
<th>Water Quantity</th>
<th>Drought Resistance</th>
<th>Water Quality/Treatment</th>
<th>Reliability</th>
<th>Regulatory Burden</th>
<th>Overall Cost</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCW aquifer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mt Simon Aquifer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wastewater Reuse</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Surface Water</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2-3</td>
<td>11-12</td>
</tr>
<tr>
<td>Stormwater Reuse</td>
<td>1-3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>13-15</td>
</tr>
</tbody>
</table>

### Table 10  Total replacement of potable Shakopee/Jordan supply

<table>
<thead>
<tr>
<th>Source</th>
<th>Water Quantity</th>
<th>Drought Resistance</th>
<th>Water Quality/Treatment</th>
<th>Reliability</th>
<th>Regulatory Burden</th>
<th>Overall Cost</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCW aquifer</td>
<td>2</td>
<td>1</td>
<td>1-2</td>
<td>1</td>
<td>1</td>
<td>1-2</td>
<td>7-9</td>
</tr>
<tr>
<td>Mt Simon Aquifer</td>
<td>2</td>
<td>1</td>
<td>1-2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>8-9</td>
</tr>
<tr>
<td>Wastewater Reuse</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Surface Water</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Stormwater Reuse</td>
<td>1-3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>14-16</td>
</tr>
</tbody>
</table>
## Potential Alternative Water Sources

### Table 11 Partial replacement of potable supply

<table>
<thead>
<tr>
<th>Source</th>
<th>Water Quantity</th>
<th>Drought Resistance</th>
<th>Water Quality/Treatment</th>
<th>Reliability</th>
<th>Regulatory Burden</th>
<th>Overall Cost</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCW aquifer</td>
<td>1-2</td>
<td>1</td>
<td>1-2</td>
<td>1</td>
<td>1</td>
<td>1-2</td>
<td>6-9</td>
</tr>
<tr>
<td>Mt Simon Aquifer</td>
<td>1-2</td>
<td>1</td>
<td>1-2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>7-9</td>
</tr>
<tr>
<td>Wastewater Reuse</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>Surface Water</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Stormwater Reuse</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>14-16</td>
</tr>
</tbody>
</table>

### Table 12 Mitigation of impacts to natural resources

<table>
<thead>
<tr>
<th>Source</th>
<th>Water Quantity</th>
<th>Drought Resistance</th>
<th>Water Quality/Treatment</th>
<th>Reliability</th>
<th>Regulatory Burden</th>
<th>Overall Cost</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCW aquifer</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Mt Simon Aquifer</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Wastewater Reuse</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2-3</td>
<td>7-10</td>
</tr>
<tr>
<td>Surface Water</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Stormwater Reuse</td>
<td>2</td>
<td>3</td>
<td>2-3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>11-12</td>
</tr>
</tbody>
</table>
## Table 13: Reduction of the impact of summer irrigation peak

<table>
<thead>
<tr>
<th>Source</th>
<th>Water Quantity</th>
<th>Drought Resistance</th>
<th>Water Quality/Treatment</th>
<th>Reliability</th>
<th>Regulatory Burden</th>
<th>Overall Cost</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCW aquifer</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1-2</td>
<td>2</td>
<td>7-8</td>
</tr>
<tr>
<td>Mt Simon Aquifer</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1-2</td>
<td>3</td>
<td>9-10</td>
</tr>
<tr>
<td>Wastewater Reuse</td>
<td>1</td>
<td>1</td>
<td>2-3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>10-11</td>
</tr>
<tr>
<td>Surface Water</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Stormwater Reuse</td>
<td>1-2</td>
<td>2-3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>8-10</td>
</tr>
</tbody>
</table>

## Table 14: Aquifer storage and recovery

<table>
<thead>
<tr>
<th>Source</th>
<th>Water Quantity</th>
<th>Drought Resistance</th>
<th>Water Quality/Treatment</th>
<th>Reliability</th>
<th>Regulatory Burden</th>
<th>Overall Cost</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCW aquifer</td>
<td>1</td>
<td>1</td>
<td>1-2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>7-8</td>
</tr>
<tr>
<td>Mt Simon Aquifer</td>
<td>1</td>
<td>1</td>
<td>1-2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>8-9</td>
</tr>
<tr>
<td>Wastewater Reuse</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>Surface Water</td>
<td>1-2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>12-13</td>
</tr>
<tr>
<td>Stormwater Reuse</td>
<td>1-3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>14-16</td>
</tr>
</tbody>
</table>
Upcoming Work

- **2019** – Applying for a LCCMR grant to expand MW network
  - Currently 10 MW’s (DNR Contract) expanding to 17 MW’s
- **2019** – Completing RPU’s wellhead protection plan amendment
- **2019** – Continuing Evaluation of Alternative Sources
  - Water re-use options w/water reclamation plant
  - Assessment of deeper aquifers
- **2019** – Continue Coordination w/DNR Staff
- **2020** – Update water master plan
  - Future wells needed to meet demands
  - Optimization of pumping
Community Outreach and Stakeholder Engagement
Drinking Water Week

- Public Tours of Water Tower & Well
- Promotional Giveaways
  - Rain Barrels & Water Bottles
- Water Bottle Display in Lobby
RPU Partnering with local businesses

RPU Partnered with Graham Arena & Children’s Museum

- Installed Bottle Filler Drinking Fountains
- Reduced Waste, Save Money & Conserve Water

This bottle filler is provided by Rochester Public Utilities to promote the efficient use of water!
Tips from Tony - Water Bottles

Tips from Tony - Water Conservation & Backflow Testing
Summary

- Communication with Stakeholders:
  - Customer Communication
    - Presentations, social media, website, brochures
  - DNR Meetings
    - GW model, water sustainability activities, field monitoring
  - State & Local Agencies
    - MDH, MPCA, DNR, Olmsted County, SWCD
Questions

John Greer, PG - Barr Engineering Co.
Jgreer@barr.com
952-832-2691

Todd Osweiler - Rochester Public Utilities
Tosweiler@rpu.org
507-280-1589