State of the Waters
Clean Water Challenges and Solutions in the Twin Cities

Thursday, October 20th, 2016
7 pm – 8:30 pm

Hosted by:

#StateoftheWaters2016
#SotW2016

Sponsored by:

LAND O’LAKES, INC.
FRESHWATER SOCIETY
Ramsey Conservation District
Agenda

• 7:00 – Welcome
  Margaret Behrens, Vice Chair of the Ramsey Conservation District & President of the Ramsey County League of Local Governments

• 7:05 – Introduction
  Dr. Anna Henderson, Water Advisor to the Office of Governor Mark Dayton

• 7:15 – The Past, the Present, and the Possible: Water in (and under) Ramsey County
  Steve Woods, Executive Director at Freshwater Society

• 7:45 – Snapshots of Waters in Ramsey County and Prize Drawings

• 8:00 – Climate Adaptation and Threats to Water Resources
  Bryan Baker, Lead Principal Investigator for Inland Climate Hydrology at US Army Corp of Engineers

• 8:25 – Final Questions and Wrap-Up
• 8:30 – Adjourn
Water Bar
Visit our friendly water bar!
Hosted by Ramsey Conservation Staff Joe Lochner & Brian Olsen

Taste water samples from:

**St. Cloud** – Surface water source

**St. Paul** – Surface water source

**Shoreview** – Groundwater source Prairie du Chien-Jordan Aquifer

**White Bear Lake** – Groundwater source Jordan and Prairie du Chien-Jordan Aquifers

**Minneapolis** – Surface water source

**Did you know?** Approximately 80% of the population of Ramsey County relies on surface water for their drinking water
Opening Introduction to the Year of Water Action
Anna Henderson
Water Advisor for the Office of Governor Mark Dayton
The Past, the Present, and the Possible: Water in (and under) Ramsey County
Steve Woods
Executive Director at FRESHWATER SOCIETY
The past, the present, and the possible: Water in (and under) Ramsey County
Why time and setting matter
13,000 years of Ramsey County water:

First, get a glacier...
The majority of Minnesota’s present-day topography was formed from 25,000-10,000 years ago when most of Minnesota was covered by glacial ice. Subsequent movements of ice scoured the landscape and redistributed soils and gravel, leaving behind lakes, wetlands, and rivers.

The land elevations in Minnesota are highest in the northeast Arrowhead region and range from 602 feet at the shores of Lake Superior to 2,301 feet at Eagle Mountain, northwest of Grand Marais. A broad, lowland valley extends from the east-central region of Minnesota westerly and southerly to South and North Dakota and then to Canada. It includes the large drainage areas of the Red River of the North, as well as the Mississippi, St. Croix, and Minnesota rivers.

The southwestern and southeastern corners of the state represent the southern limits of recent glacial ice advances. The high-elevation area of the southwest was formed by glacial drift piled upon deep bedrock. The southeastern corner of Minnesota, also known as the “driftless area,” has rolling hills and limestone bluffs.
13,000 years ago

SW: puddled, little local flow
GW: tanked up
DW: NA
Use: mix of IA, SD, WI, & Ont
150 years ago

Gov. Ramsey said if we drained the dimples we would have productive lands and less disease.
There was precedent:

Thus saith the Lord:

“Fill this valley with ditches.”

(II Kings 3:16)

(New International Version)
2 ways to improve your farm with DYNAMITE

—the easy, quick, low-cost way to clear your farm of stumps and boulders...to provide better drainage
• Altered Hydrology
150 years ago (just five generations)

SW: ditching and draining!
GW: mostly untapped
DW: typhoid and visionaries
Use: 1st wave of change & UM
Weir, Fourth Street South, Outlet, Minneapolis
Average discharge, 1,570,000 gallons per 24 hours
60 years ago (my parents)

SW: more of it, dead river, and green lakes
GW: showing slow declines
DW: post-WWII mess spreads
Use: suburbia explodes
Apparently we have limits

“Dilution is the solution to pollution” until it isn’t…
Federal Clean Water Act
1972

“...to restore and maintain the chemical, physical and biological integrity of the nations waters”
1970s - needed data
1990s - needed knowledge
2010s - need action
So How Are Cities Doing?

Met. Council Metro Plant
Phosphorus discharge
30 years ago

SW: mandated watersheds
GW: turned off once thru AC
DW: national regs & cleanups
Use: building out “right”
Do you know how much Turtle Lake’s clarity has changed in 30 years?
Secchi Disk, Lake Josephine

Year

Secchi Depth (m)

State Standard

Lake Phalen Secchi Transparency 1981-14

Year


Depth (meters)
Turtle’s back

Recorded Water Levels
2006-10-18 to 2016-10-18

Water Level (ft.)

WBL is rallying
Now

SW: trending the right way
GW: mostly the right way
DW: tested and reported
Groundwater!

A Netflix Original Series
Our 2016 report
Groundwater levels near the City of Shoreview show a long-term increase as recharge is greater than use.
Future challenges

SW: water stewards!
GW: reduce the waste
DW: ag runoff (Des Moines)
Post 2034
Urban Runoff

Master Water Steward
Community Leadership for Clean Water
• Rain gardens, buffers
• Keep rain where it falls
• Zillion little decisions
Annual Road Salt Symposium

NaCl
So how are things outside the cities?
Installing drain tile
Total Phosphorus

- Cropland/pasture runoff – 26.4%
- Atmospheric deposition – 13.1%
- Commercial/Industrial process water – 12.0%
- Human waste – 10.9%
- Stream bank erosion – 11.1%
Total Nitrogen

- **Cropland groundwater**: 30%
- **Cropland tile drainage**: 37%
- **Urban Stormwater**: 1%
- **Forests**: 7%
- **Atmos.**: 9%
- **Point sources**: 9%
- **Septic**: 2%
- **Feedlot runoff**: <1%
- **Cropland runoff**: 5%
- **Point sources**: 9%

**Watershed Pollutant Load Monitoring Network**

*Total Nitrogen Yield*

By Monitoring Site Watershed

Average: 2007 - 2011

- **Total Nitrogen Yield (lbs/acre)**
  - No Data Available
  - 0 - 2.97 lbs/acre
  - 2.98 - 4.57 lbs/acre
  - 4.58 - 9.71 lbs/acre
  - 9.72 - 21.93 lbs/acre
  - 21.94+ lbs/acre

- **Major Basins**
- **Mainstream Rivers**

*Minnesota Pollution Control Agency*  
Watershed Pollutant Load Monitoring Network

*Includes inputs from all upstream watersheds*
Aggressive Prep
Buffer needed
The Constitutional Amendment

33% Habitat
33% Water
14.25% Parks
19.75% Arts & Culture
FRESHWATER SOCIETY

Support an organization you trust
freshwater.org
Snapshots of Ramsey County Waters
Ramsey County Lake Sampling

- 30 Lakes
- 8 Samples per summer

<table>
<thead>
<tr>
<th>Grade</th>
<th>Total Phosphorus (µg/L)</th>
<th>Chlorophyll-a (µg/L)</th>
<th>Secchi Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt;23</td>
<td>&lt;10</td>
<td>&gt;3</td>
</tr>
<tr>
<td>B</td>
<td>23-32</td>
<td>10-20</td>
<td>2.2-3.0</td>
</tr>
<tr>
<td>C</td>
<td>32-68</td>
<td>20-48</td>
<td>1.2-2.2</td>
</tr>
<tr>
<td>D</td>
<td>68-152</td>
<td>48-77</td>
<td>0.7-1.2</td>
</tr>
<tr>
<td>E</td>
<td>&gt;152</td>
<td>&gt;77</td>
<td>&lt;0.7</td>
</tr>
</tbody>
</table>

(ug/L) is an abbreviation for microgram per liter

Metropolitan Council Lake Grading System

Lake Grade, 2015

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>McCarrons</td>
<td>Beaver</td>
<td>Bennett</td>
<td>Como</td>
</tr>
<tr>
<td>Wabasso</td>
<td>Loeb</td>
<td>Island</td>
<td>Valentine</td>
</tr>
<tr>
<td>Snail</td>
<td>Owasso</td>
<td>Long</td>
<td>Wakefield</td>
</tr>
<tr>
<td>Turtle</td>
<td>Twin</td>
<td>Crosby</td>
<td></td>
</tr>
<tr>
<td>Johanna</td>
<td>Josephine</td>
<td>Little Crosby</td>
<td></td>
</tr>
<tr>
<td>White Bear</td>
<td>Silver (Col.H)</td>
<td>Silver (N St P.)</td>
<td></td>
</tr>
<tr>
<td>Otter</td>
<td>Bald Eagle</td>
<td>Keller</td>
<td></td>
</tr>
<tr>
<td>Phalen</td>
<td>Gervais</td>
<td>Kohlman</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Round</td>
<td></td>
</tr>
</tbody>
</table>
### Change from 2013-2015

<table>
<thead>
<tr>
<th>Improvement</th>
<th>Decline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bald Eagle</td>
<td>Valentine</td>
</tr>
<tr>
<td>Silver (Col.H)</td>
<td>Island</td>
</tr>
<tr>
<td>Silver (N St P.)</td>
<td>Wakefield</td>
</tr>
<tr>
<td>Johanna</td>
<td>Loeb</td>
</tr>
<tr>
<td>Owasso</td>
<td>Little Crosby</td>
</tr>
<tr>
<td>Phalen</td>
<td></td>
</tr>
<tr>
<td>Kohlman</td>
<td></td>
</tr>
<tr>
<td>Gervais</td>
<td></td>
</tr>
<tr>
<td>Bennett</td>
<td></td>
</tr>
</tbody>
</table>

#### Lake Water Quality Change 2013-2015

- **Decline**: Orange
- **Improve**: Blue
- **Same**: Green

Data gathered by Ramsey County.
Impairments

- Aquatic Life - (ie, dissolved Oxygen)
- Aquatic Consumption – (ie, Mercury in Fish tissue)
- Aquatic Recreation – (ie, nutrients/eutrophication)

Changes

- 2016 Draft Impairment List
- Delistings
- Slow Process – dependent on data
Community Partners Grants
Ramsey County AIS Surveying

Aquatic Invasive Species (AIS)

• Organisms that live in water and invade ecosystems beyond their natural range

• Presence of AIS may harm native ecosystems as well as commercial, agricultural, and recreational activities dependent on these ecosystems (US Fish & Wildlife Service)

AIS Infestations in Ramsey County

**Plants**
- Curly Leaf Pondweed
- Purple Loosestrife
- Eurasian Watermilfoil
- Flowering Rush

**Animals**
- Zebra Mussel
- Bighead Carp
- Grass Carp
- Silver Carp

Invasive Species
- Curly-leaf Pondweed
- Purple Loosestrife
- Bighead Carp
- Grass Carp
- Silver Carp
- Eurasian Watermilfoil
- Flowering Rush
- Zebra Mussel

Infested Waters of Ramsey County

Data Source: DNR, Dec 2015
*Curlyleaf Pondweed & Purple loosestrife are from 2010 list*
Prize Drawings
Prizes Provided By:

LAND O’LAKES, INC.
FRESHWATER SOCIETY
Climate Adaptation and Threats to Water Resources

Bryan Baker

Lead Principal Investigator for Inland Climate Hydrology at US Army Corps of Engineers
Update on USACE Climate Preparedness and Resilience Activities

Bryan Baker, PE
Climate Preparedness and Resilience Community of Practice

State of Waters
20 October 2016
Bottom Line Up Front (BLUF) on Activities

- Climate communication
- Reports and other resources
- Vulnerability assessments
- Existing tools
- New tools
- Emerging areas of emphasis

http://www.corpsclimate.us/adaptationpolicy.cfm
Executive Order 13653
“Preparing the US for the Impacts of Climate Change”

- USACE is one of 30 named agencies in new **Council on Climate Preparedness and Resilience**, 
- EO 13653 requires agencies to build on recent progress and pursue new strategies to improve the Nation’s climate preparedness and resilience, promoting:
  - Engaged and strong partnerships and information sharing at all levels of government
  - Risk-informed decision-making and the tools to facilitate it
  - Adaptive learning, in which experiences serve as opportunities to inform and adjust future actions
  - Preparedness planning
Water: Renewable or Exhaustible?

Exhaustible
- All Water on Earth: 7,972 Mi
- Fresh Groundwater: 864 Mi

Renewable
- All Rivers: 42 Mi
- Fresh Groundwater: 10 Mi

Figure from George Annondale – Golden Associates
Climate Change is Inextricably Tied to Water

- Tornadoes
- Hurricanes
- Severe Droughts
- Extreme Precipitation Events
- Coastal Flooding
- Heat Waves
- Wildfire
- Post-Fire Flood/Debris

IMAGES:
- Tornadoes: Limited evidence
- Hurricanes: Limited evidence
- Severe Droughts: Strong evidence
- Extreme Precipitation Events: Strong evidence
- Coastal Flooding: Strongest evidence
- Heat Waves: Strongest evidence
- Wildfire: Strongest evidence
- Post-Fire Flood/Debris: Strongest evidence
Communicating About Interconnections and Interactions

Cochiti Canyon Flood
Dixon's Apple Orchard
August 22, 2011
Basis for Hydrologic Assessments: Interagency Archive of Climate and Hydrology Data

- Fact sheet describes information contained in the archive, which is continuously updated.
- USACE staff have access to the archive data through CorpsMap’s Oracle database and the various tools, portals, and vulnerability assessments.

http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpsInterface.html
Regional literature syntheses for 21 Water Resources Regions provide a context for
- Observed (historical trends)
- Projected (future trends)
- Snapshot

http://www.corpsclimate.us/rccciareport.cfm
Watershed Vulnerability Assessment: Summary for 4-digit HUCs in Mississippi Valley Division, FRM

Summary of HUC Results

<table>
<thead>
<tr>
<th>Business Line</th>
<th>Climate Data Source</th>
<th>Integrated Analysis Type</th>
<th>Threshold</th>
<th>ORness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood Risk Reduction</td>
<td>CMIP-5 (2014)</td>
<td>EACH</td>
<td>20%</td>
<td>0.70</td>
</tr>
</tbody>
</table>

Illustrative only
Progress: Hydrologic Nonstationarity

From this......

To this......

Science Tool
Projected Climate Hydrology

And from this.....

To this.....

Illustrative only
From Drought to Flood: Engineering for Climate Change

- **Context:**
  - What does it mean to go from drought to flood?
  - Why do I – and my agency – care about this?

- **Climate Change**
  - How do we plan and prepare for highly variable conditions in the future?
From Drought

U.S. Drought Monitor

May 19, 2015
(Released Thursday, May 21, 2015)
Valid 7 a.m. EST

Drought Impact Types
- Delinates dominant impacts
- S = Short-term, typically less than 6 months (e.g., agriculture, grasslands)
- L = Long-term, typically greater than 6 months (e.g., hydrology, cities)

Intensity:
- D1 = Abnormally Dry
- D2 = Moderate Drought
- D3 = Severe Drought
- D4 = Exceptional Drought

This Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for recent statements.

http://droughtmonitor.unl.edu/
All Droughts End in Flood

Across the Texas Region

- Record rainfall in May/June:
  - 14.4 inches in OK,
  - 8.8 inches in TX.
- Biggest flood in 70 years
- 51 flood control lakes in flood pool
- 20 flood control lakes > flood pool

- More than $13 billion in damages prevented by these projects

Utilizing > 50% Flood Control Storage: 37 projects
Utilizing > 100% Flood Control Storage: 11 projects

Cumulative rainfall 20-27 May

Heavy Precipitation May-June 2015 Ended Multiyear Drought
Connection Between Drought and Flood in Water Resources Management

The amount of water being stored in the reservoir is at or below the USACE authorized level.

Heavy precipitation occurs. There is enough storage in the reservoir to deal with the additional inflow.

The inflow from the heavy precipitation is able to be released slowly, reducing the risk of flooding to communities downstream as planned.

The amount of water being stored in the reservoir in the event of drought is higher than the USACE authorized level.

Heavy precipitation occurs, but because of the high initial pool level, there is not enough storage to handle the extra water. The reservoir is at risk for overtopping.

The inflow from the heavy precipitation needs to be released quickly to prevent overtopping, potentially flooding communities downstream.
Observed Precipitation Trends

Precipitation Change: 1900-2012

Observed Change in Very Heavy (Top 1%) Precipitation: 1958-2012

Source: Karl et al., 2009, in National Climate Assessment, 2014.
Projected Climate Change

- National Climate Assessment:
  - Heavy downpours
    - Increasing nationally, especially over the last three to five decades
    - Largest increases are in the Midwest and Northeast.
    - Heavy precipitation increasing in a manner consistent with model projections
  - Increases in the frequency and intensity of extreme precipitation events are projected for all U.S. regions
  - Heat waves everywhere are projected to become more intense, and cold waves less intense everywhere.
Projected Precipitation Extremes

RCP 2.6 – Rapid Emissions Reductions

Annual Maximum Precipitation

Changes in Consecutive Dry Days

Change (%)

Change (%)

-40 -30 -20 -10 0 10 20 30 40

-40 -30 -20 -10 0 10 20 30 40
Projected Precipitation Extremes

RCP 8.5 – Continued Emission Increases

Annual Maximum Precipitation

Changes in Consecutive Dry Days

Change (%)

Change (%)

-40 -30 -20 -10 0 10 20 30 40

-40 -30 -20 -10 0 10 20 30 40
Projected Precipitation

Figure 2.19. Maps show the increase in frequency of extreme daily precipitation events (a daily amount that now occurs once in 20 years) by the later part of this century (2081-2100) compared to the later part of last century (1981-2000). Such extreme events are projected to occur more frequently everywhere in the United States. Under the rapid emissions reduction scenario (RCP 2.6), these events would occur nearly twice as often. For the scenario assuming continued increases in emissions (RCP 8.5), these events would occur up to five times as often. (Figure source: NOAA NCDC / CICS-NC).
Projected Precipitation

Rapid Emissions Reductions (RCP 2.6)

Winter
Spring
Summer
Fall

Continued Emissions Increases (RCP 8.5)

Winter
Spring
Summer
Fall

Precipitation Change (%)
-30 -20 -10 0 10 20 30

Climate Change Impacts to Reservoirs – Flood Risk Management (FRM)

- All USACE reservoirs provide FRM
- FRM requires empty space – all other purposes require water – the perpetual conflict
- The ability to maintain or increase risk reduction may result in decreased ability to maintain other purposes
- Changes in flood magnitude and frequency may require poll reallocation to meet project purposes

Figure 2.21 Trends in Flood Magnitude – NCA#3
Change The Way You View The World

Technically, the glass is always full.....

Air

Water
Every Challenge Holds Opportunity

- Climate change offers the opportunity to look at existing problems in a new way, encouraging a system approach and freeing us from conventional wisdom.
- Emerging market: EBI 2014 report IDs ~$2B global market in 2013, poised to increase substantially after 2020 – there is a business case for adaptation.
Adaptation Questions

- Why
  - Adaptation is needed to manage unavoidable impacts of ...
    - Nuisance flooding
    - Increased water temperatures
- What
  - What is at stake? What are the drivers?
- When
  - It is about bringing more informed to ask the right questions
- Who
  - Everyone
- How
  - Examples Next Slide
Upcoming Conservation Events

Hometown Habitat Film Screening
   Roseville Library, October 27th, 2016, 7:00pm

Climate Connections: Climate + Culture
   Rondo Library, November 16th, 2016, Noon

Ramsey County League of Local Governments
Annual Meeting and Program: Election Recap with David Schultz
   Guldens Banquet & Event Center, December 8th, 2016, 6:00pm

Climate Connections: Climate + Water
   The Water Bar, December 16th, 2016, Noon