#StateoftheWaters2016
#SotW2016

State of the Waters

Clean Water Challenges and Solutions in the Twin Cities

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

Sponsored by:

LAND O'LAKES, INC.
FRESHWATER SOCIETY

Hosted by:

Ramsey Conservation District
RAMSEY rcllg COUNTY LEAGUE OF LOCAL GOVERNMENTS

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

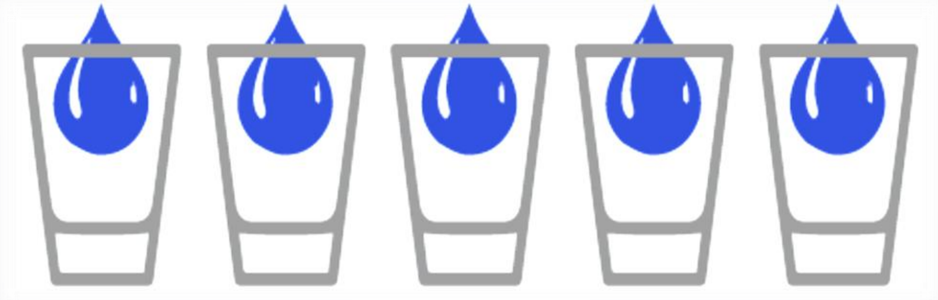
St. Paul – Surface water source

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

#WaterActionMN

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

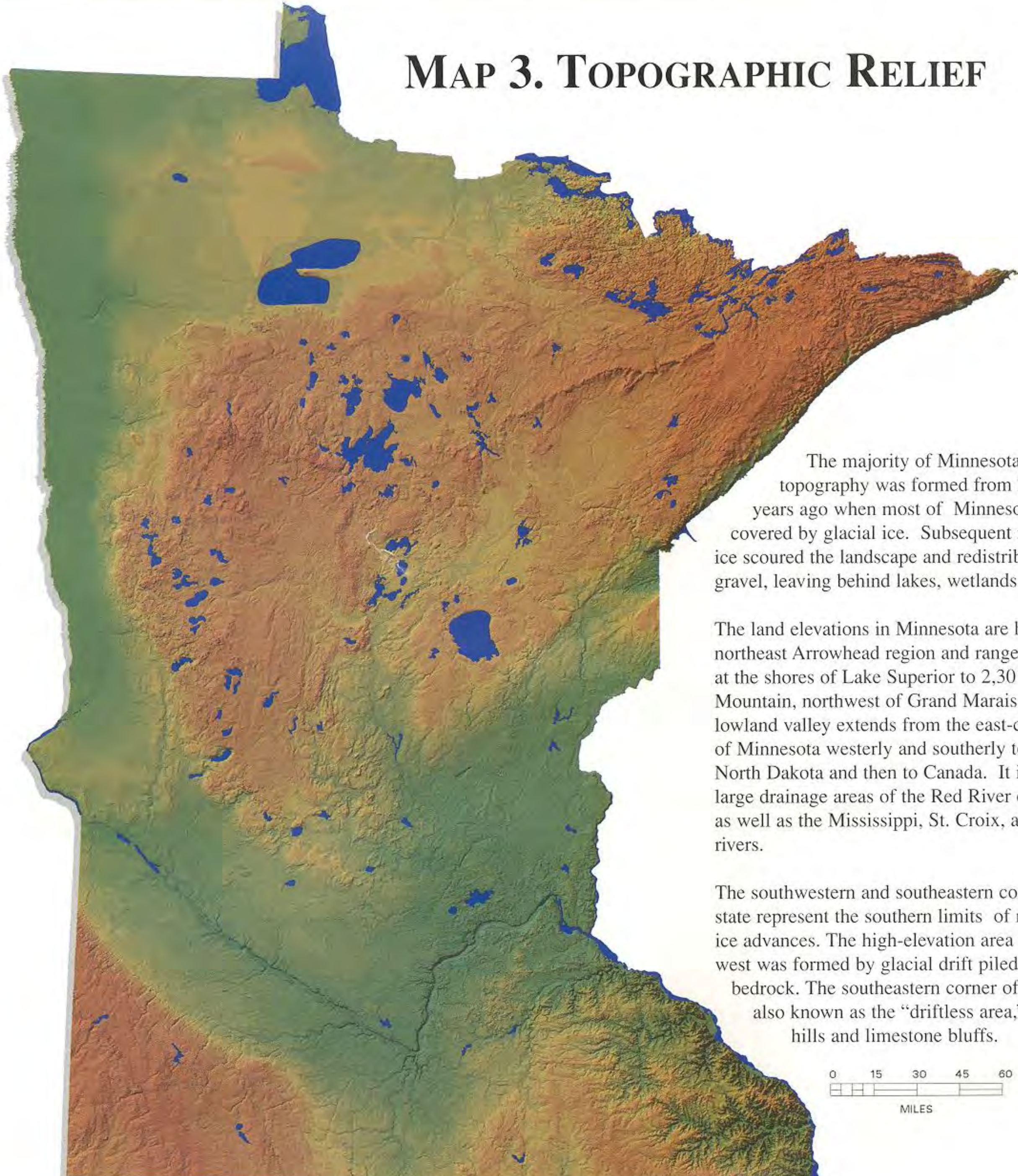
FRESHWATER SOCIETY

Why time and setting matter

13,000 years of Ramsey County water:

First, get a glacier…

Map 3. Topographic Relief



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)

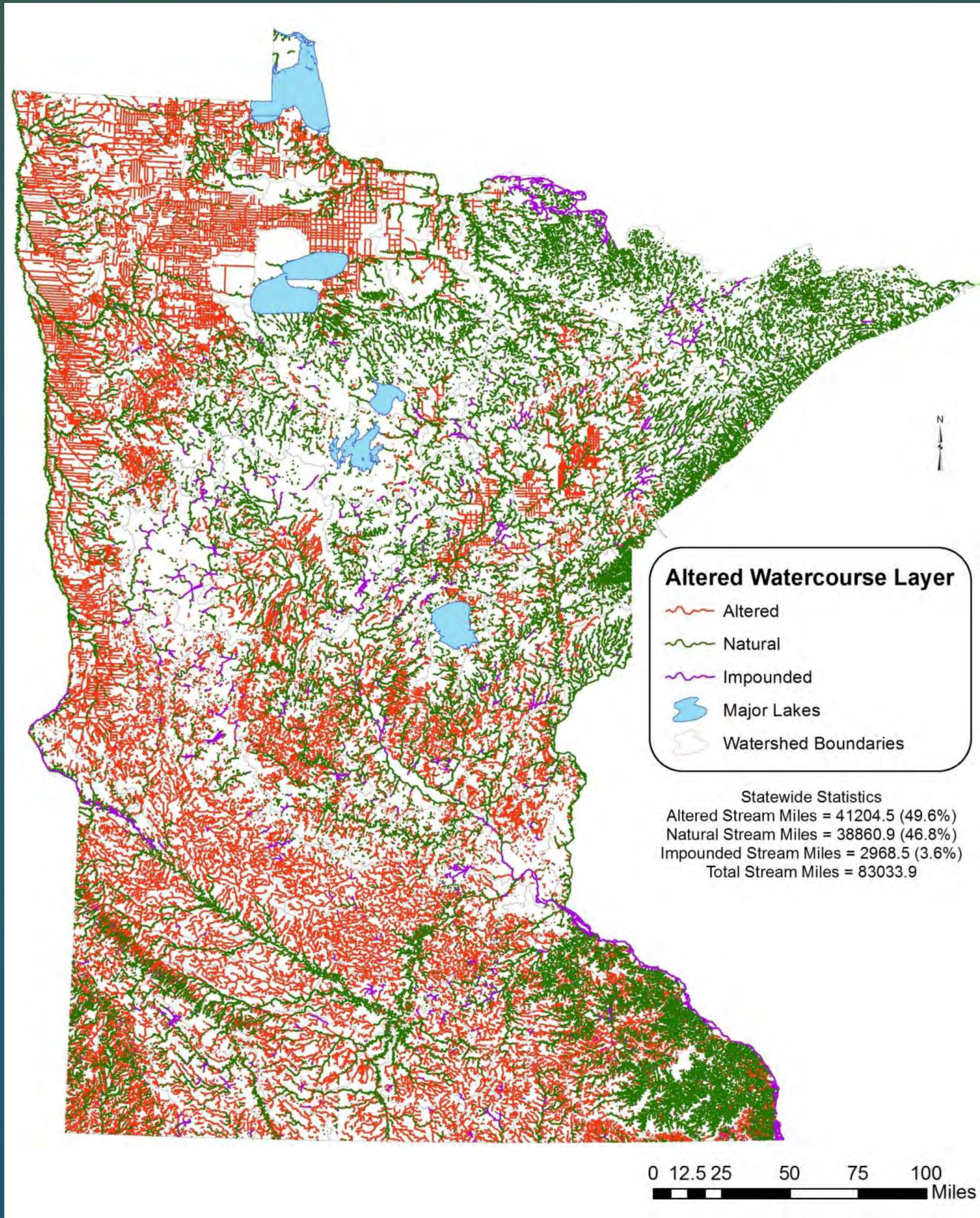
from the

BUREAU FARMER Aug. 1930

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

minimum, and average rates of flow

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

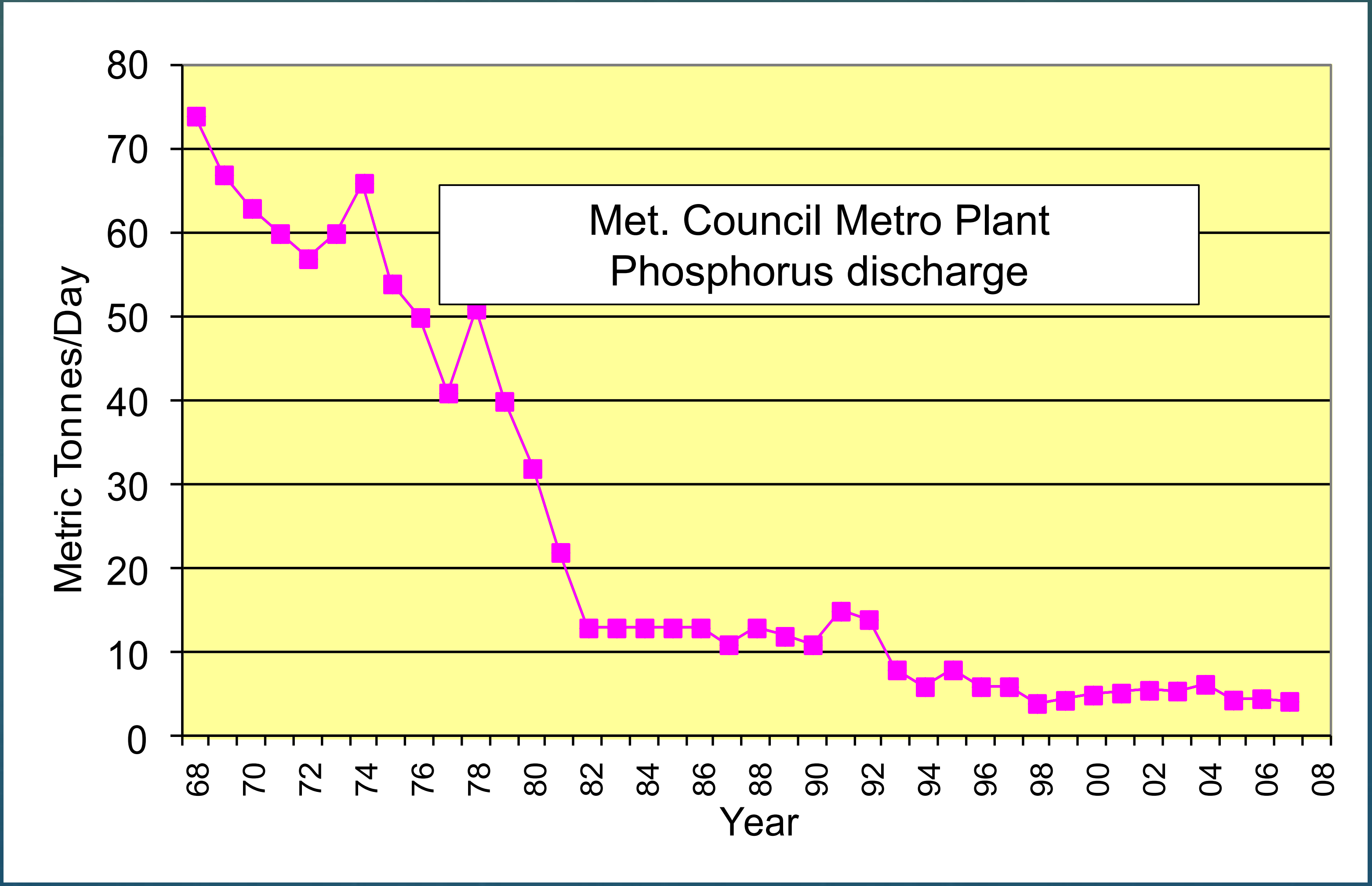
"…to restore and maintain the chemical, physical and biological integrity of the nations waters"

1970s - needed data

1990s - needed knowledge

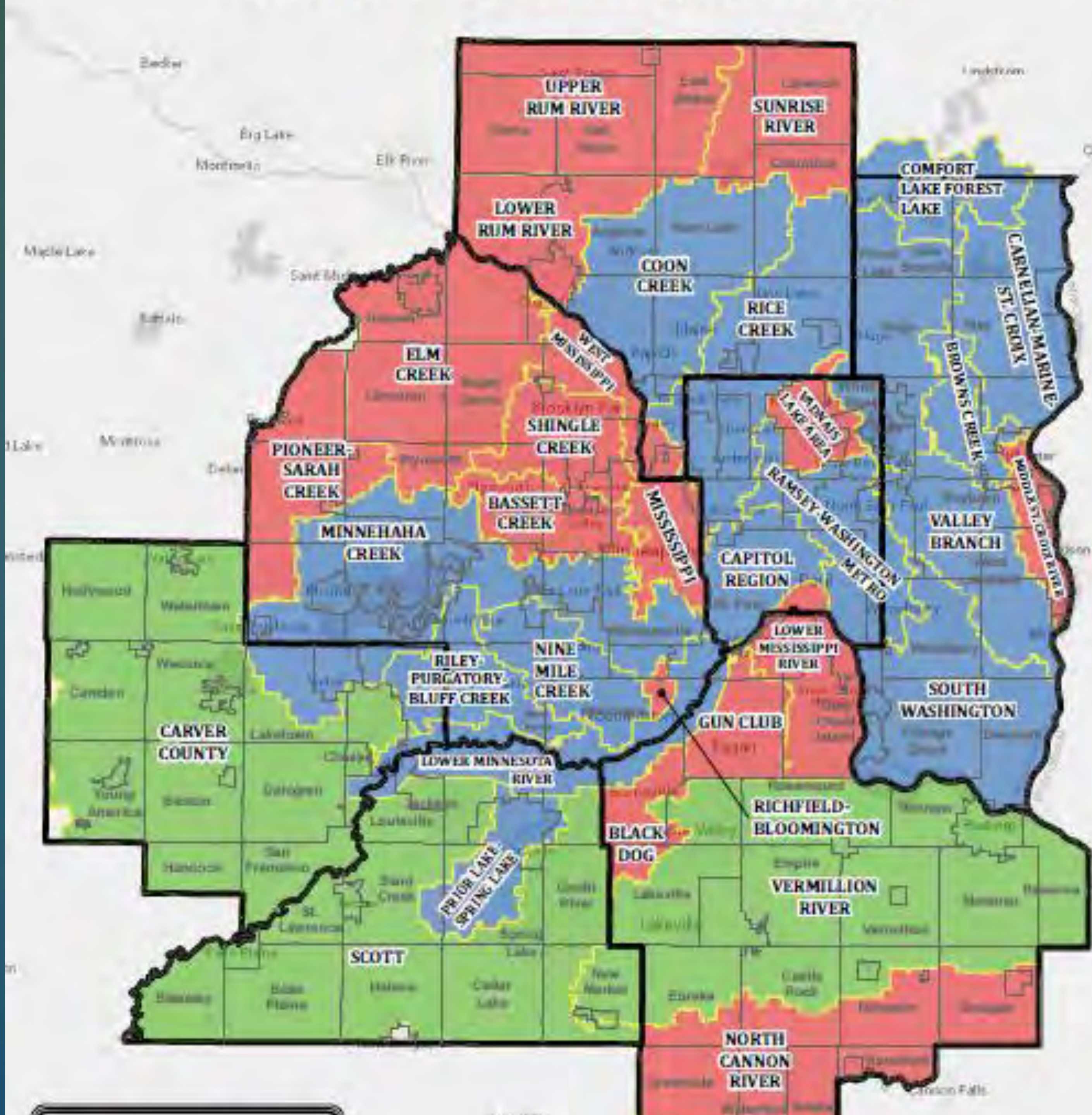
2010s - need action

So How Are Cities Doing?

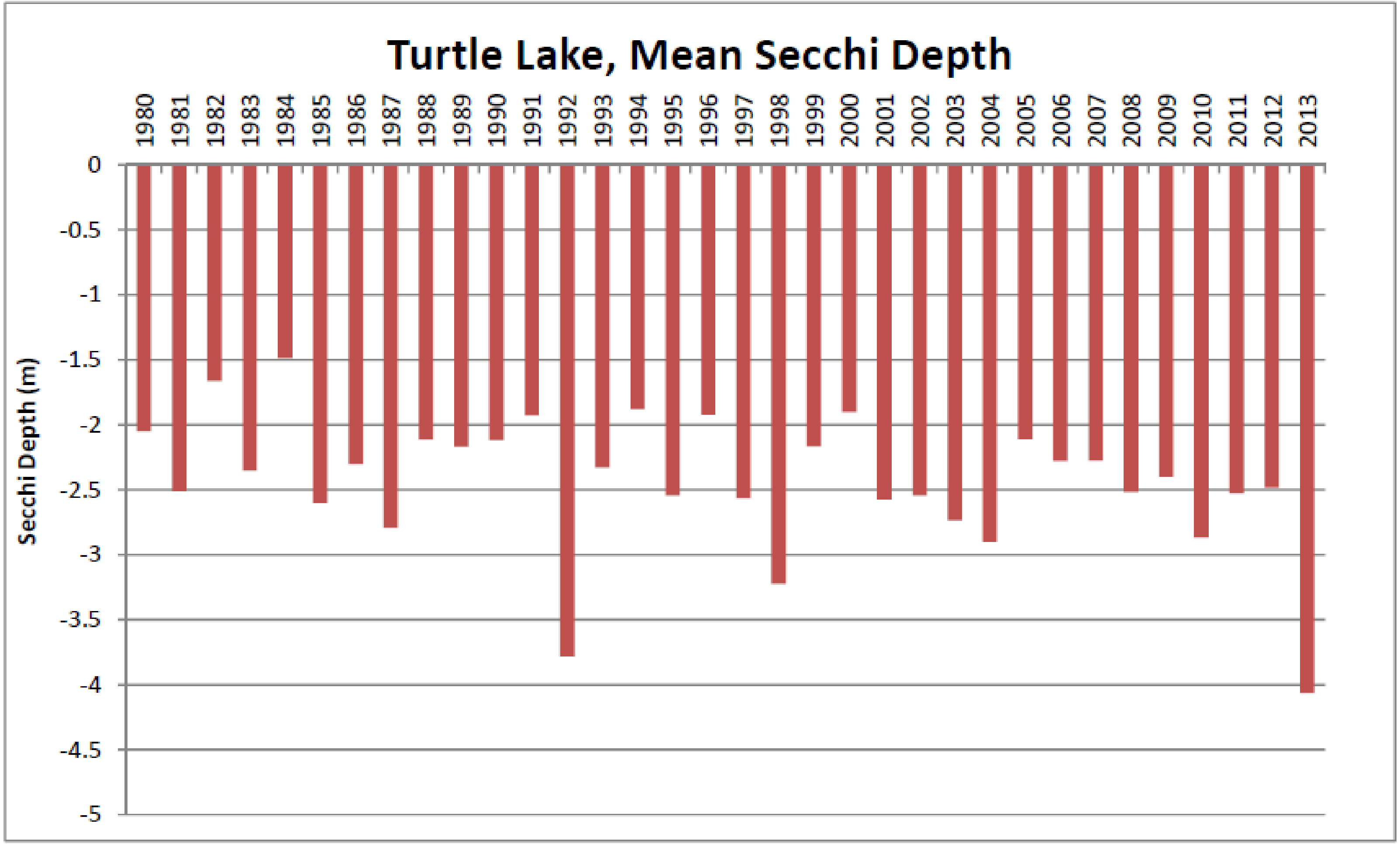


30 years ago

SW: mandated watersheds
GW: turned off once thru AC
DW: national regs & cleanups
Use: building out “right”


UPPER RUM RIVER
SUNRISE RIVER
LOWER RUM RIVER
COMFORT LAKE FOREST LAKE
COON CREEK
RICE CREEK
CARNELIAN-MARINE-ST. CROIX
BROWNS CREEK
WEST MISSISSIPPI
ELM CREEK
SHINGLE CREEK
VADNAIS LAKE AREA
PIONEER-SARAH CREEK
BASSETT CREEK
MISSISSIPPI
RAMSEY-WASHINGTON METRO
MIDDLE ST. CROIX RIVER
VALLEY BRANCH
MINNEHAHA CREEK
CAPITOL REGION
LOWER MISSISSIPPI RIVER
RILEY-PURGATORY-BLUFF CREEK
NINE MILE CREEK
SOUTH WASHINGTON
GUN CLUB
CARVER COUNTY
LOWER MINNESOTA RIVER
RICHFIELD-BLOOMINGTON
BLACK DOG
PRIOR LAKE SPRING LAKE
VERMILLION RIVER
SCOTT
NORTH CANNON RIVER

Do you know how much Turtle Lake's clarity has changed
in 30 years?


Turtle Lake, Mean Secchi Depth
Secchi Depth (m)
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
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1994
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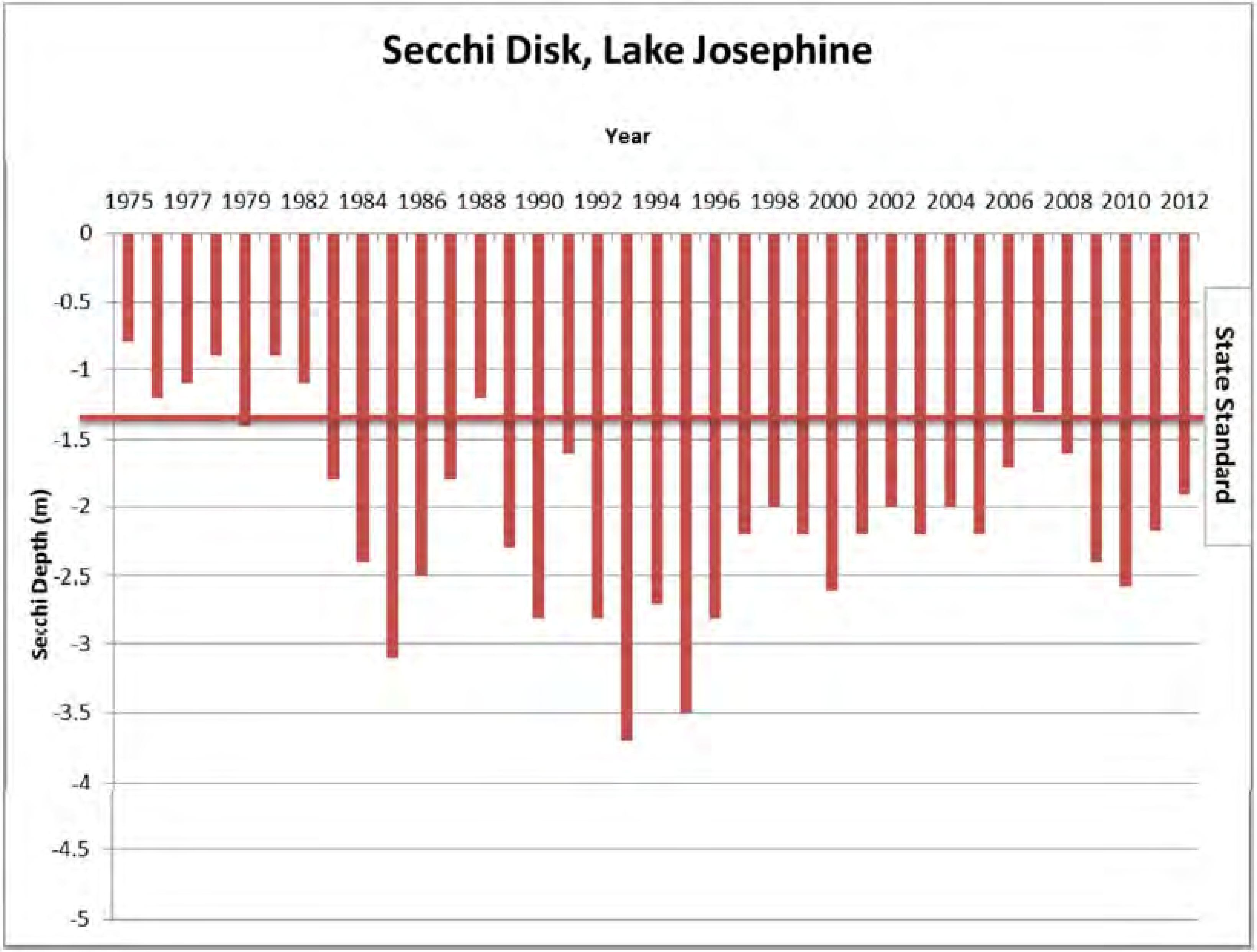
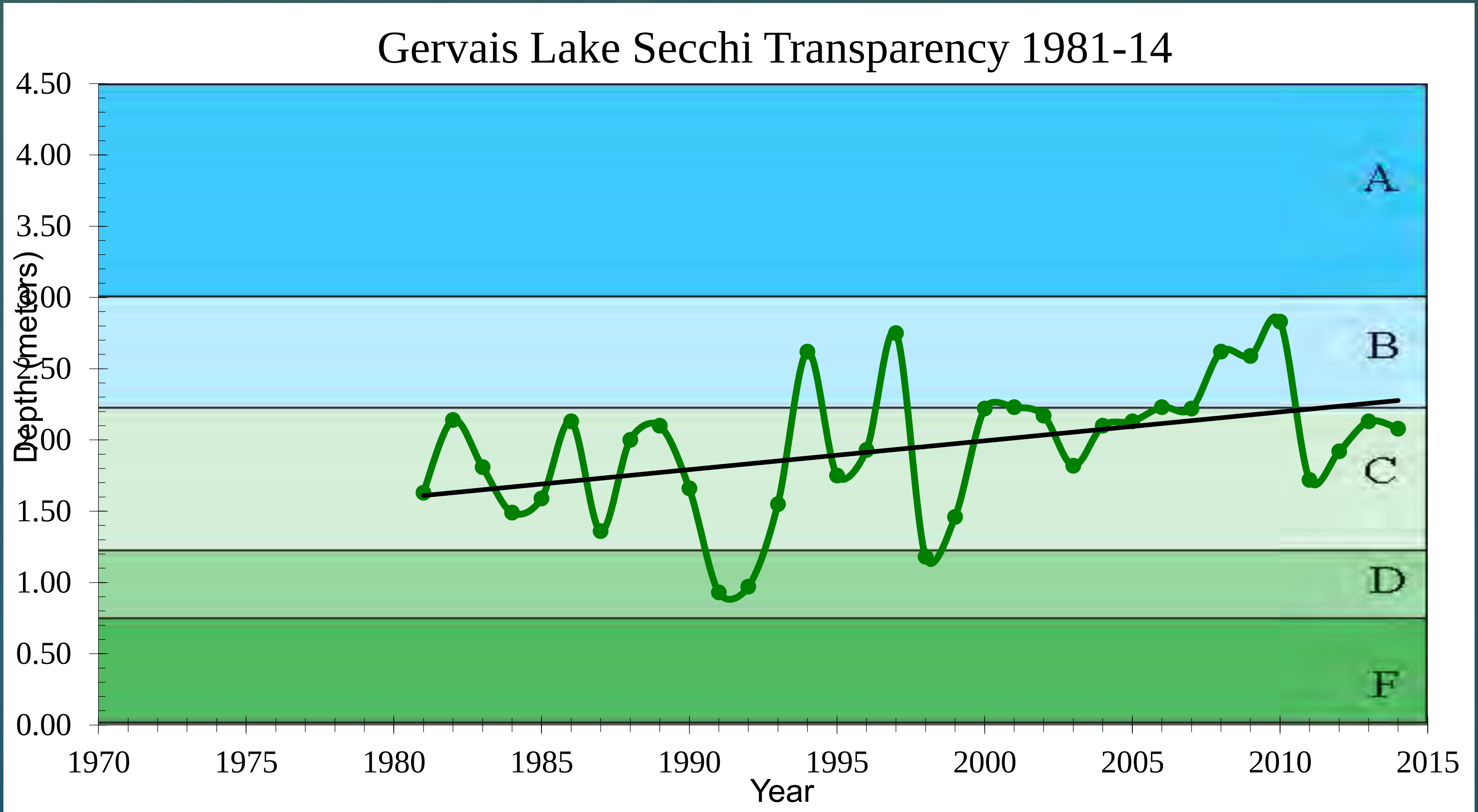
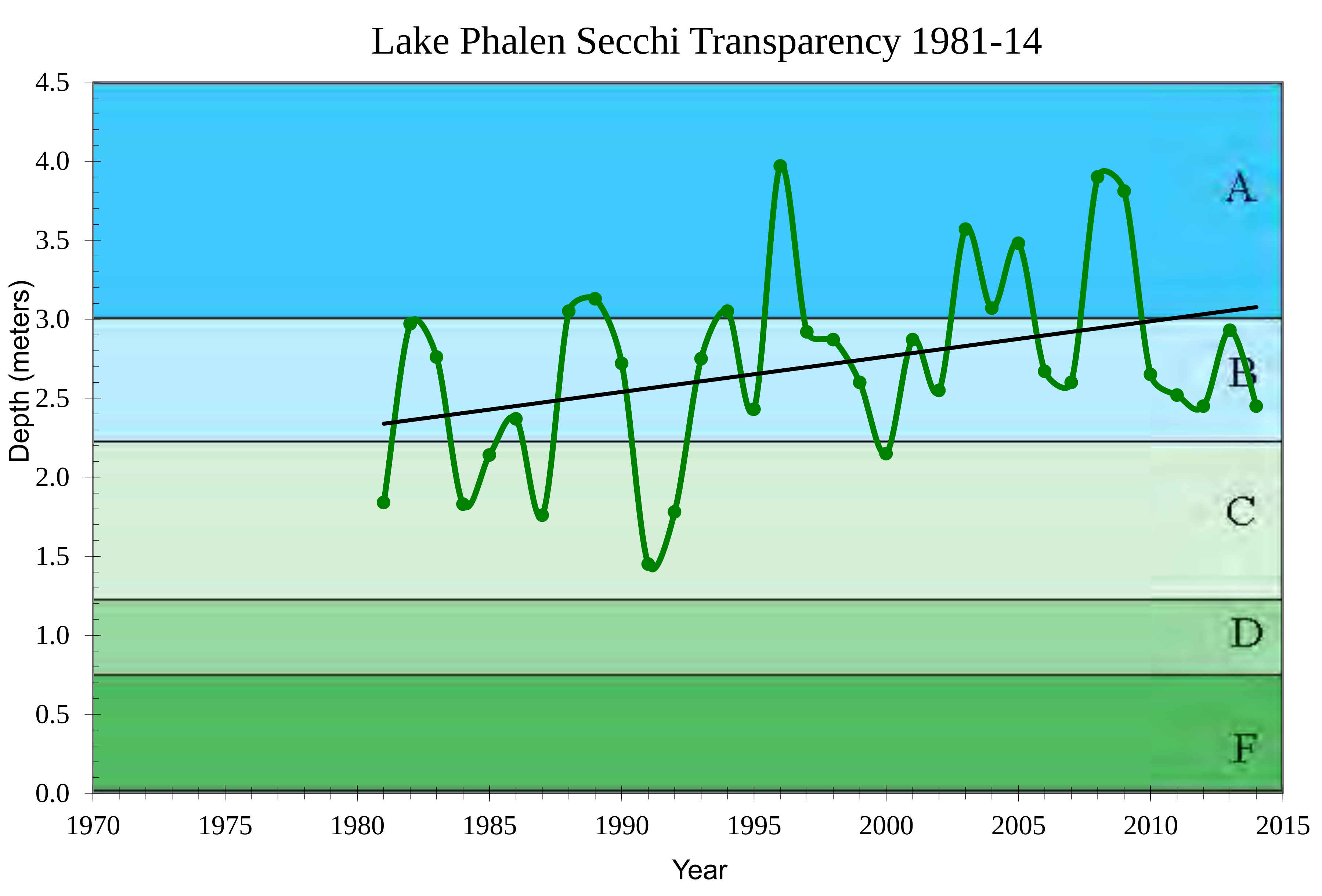
2008
2009
2010
2011
2012
2013

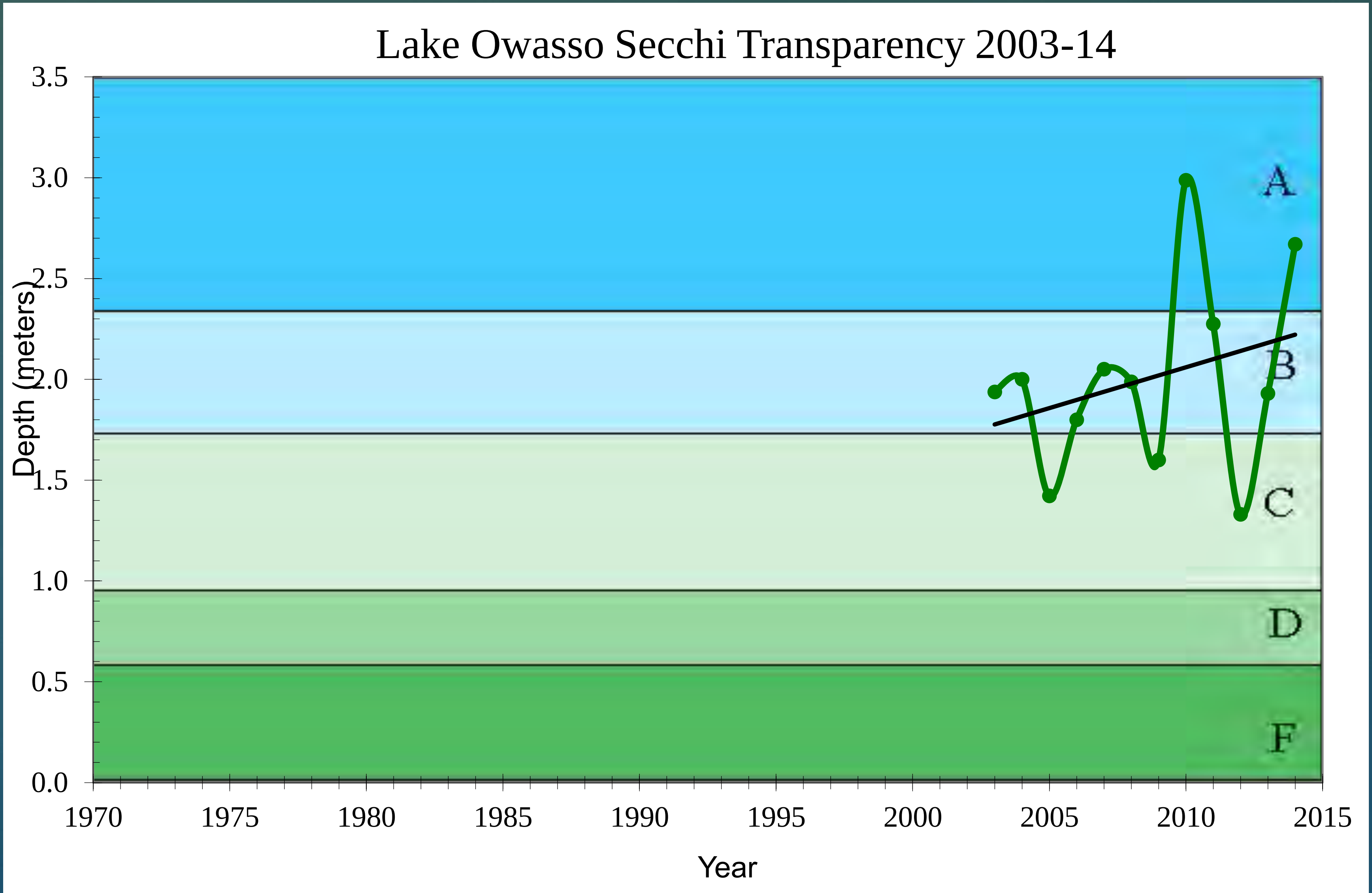


Secchi Disk, Lake Josephine
Year
1975 1977 1979 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
Secchi Depth (m)
State Standard

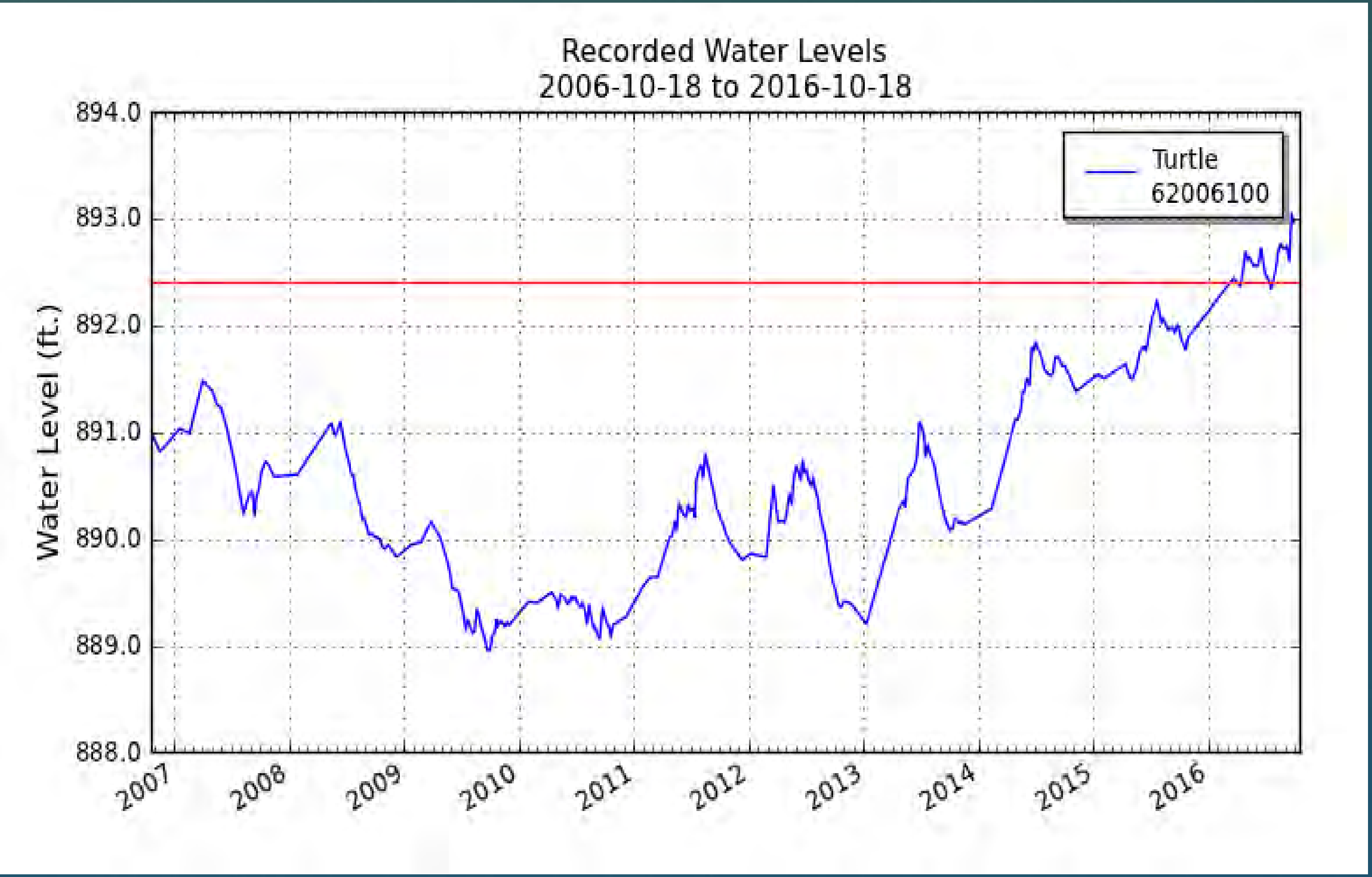


Gervais Lake Secchi Transparency 1981-14
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Depth (meters)
A
B
C
D
F
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year

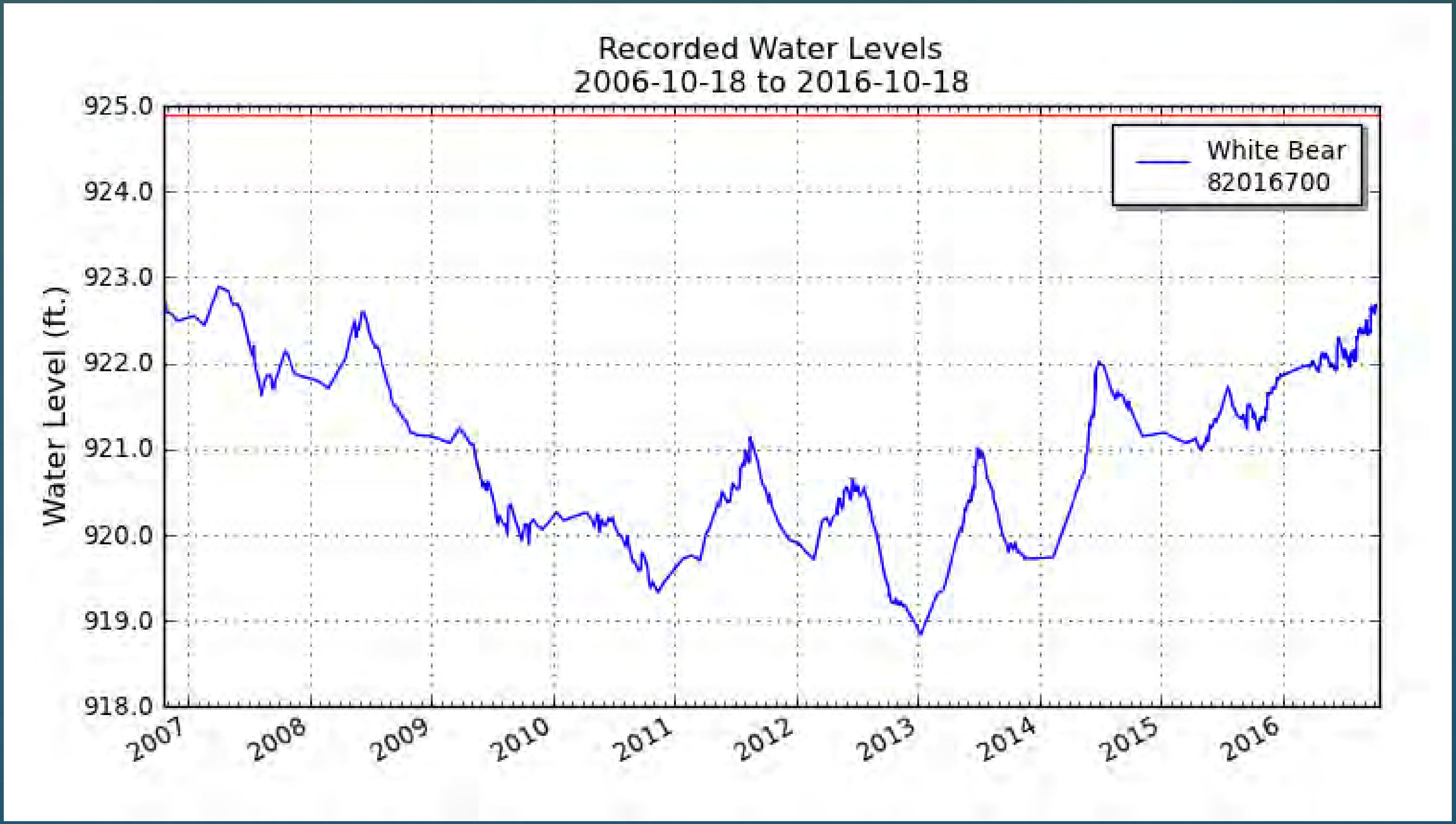

Lake Phalen Secchi Transparency 1981-14
Depth (meters)
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
A
B
C
D
F


Lake Owasso Secchi Transparency 2003-14
Depth (meters)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
A
B
C
D
F

Turtle's back



WBL is rallying



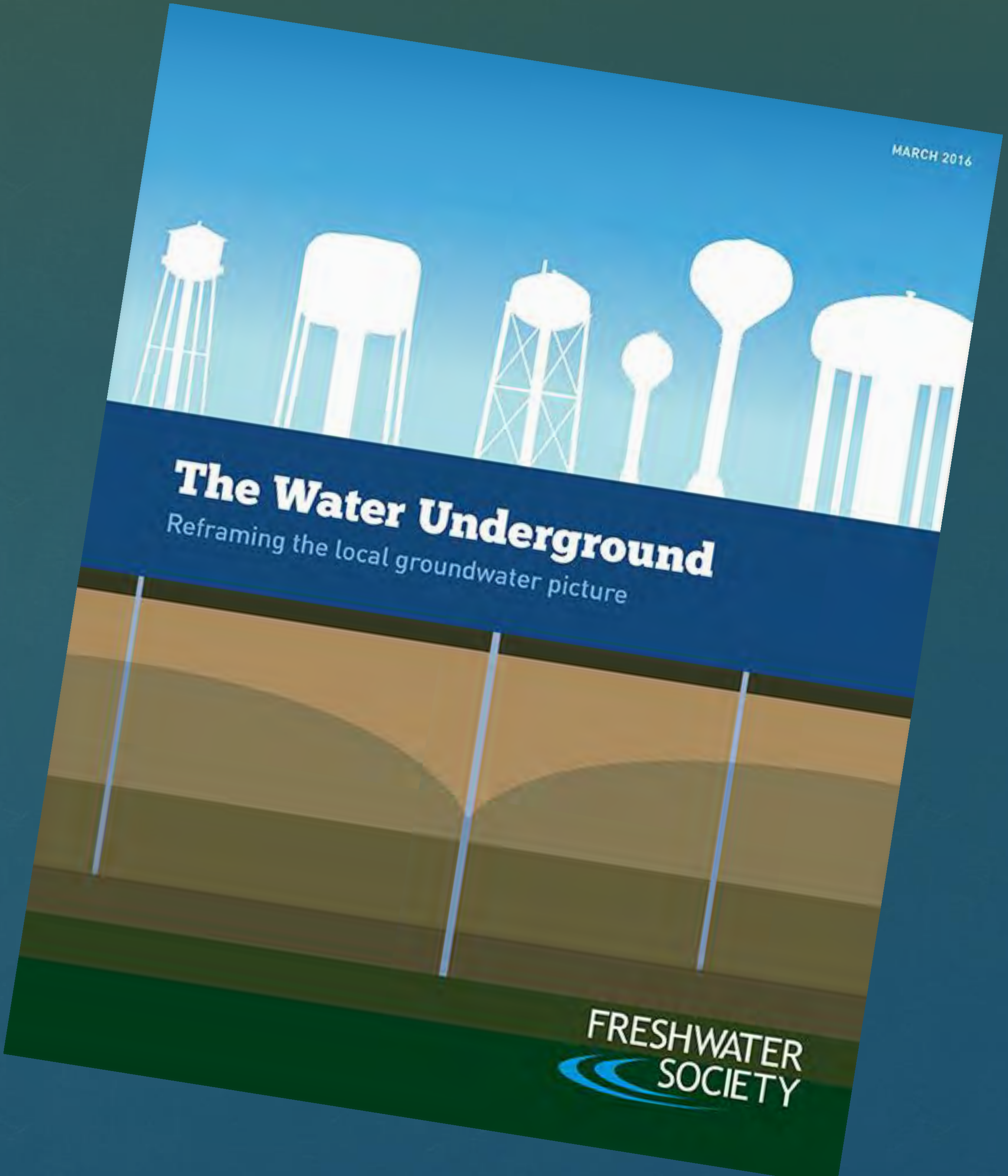
Now

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

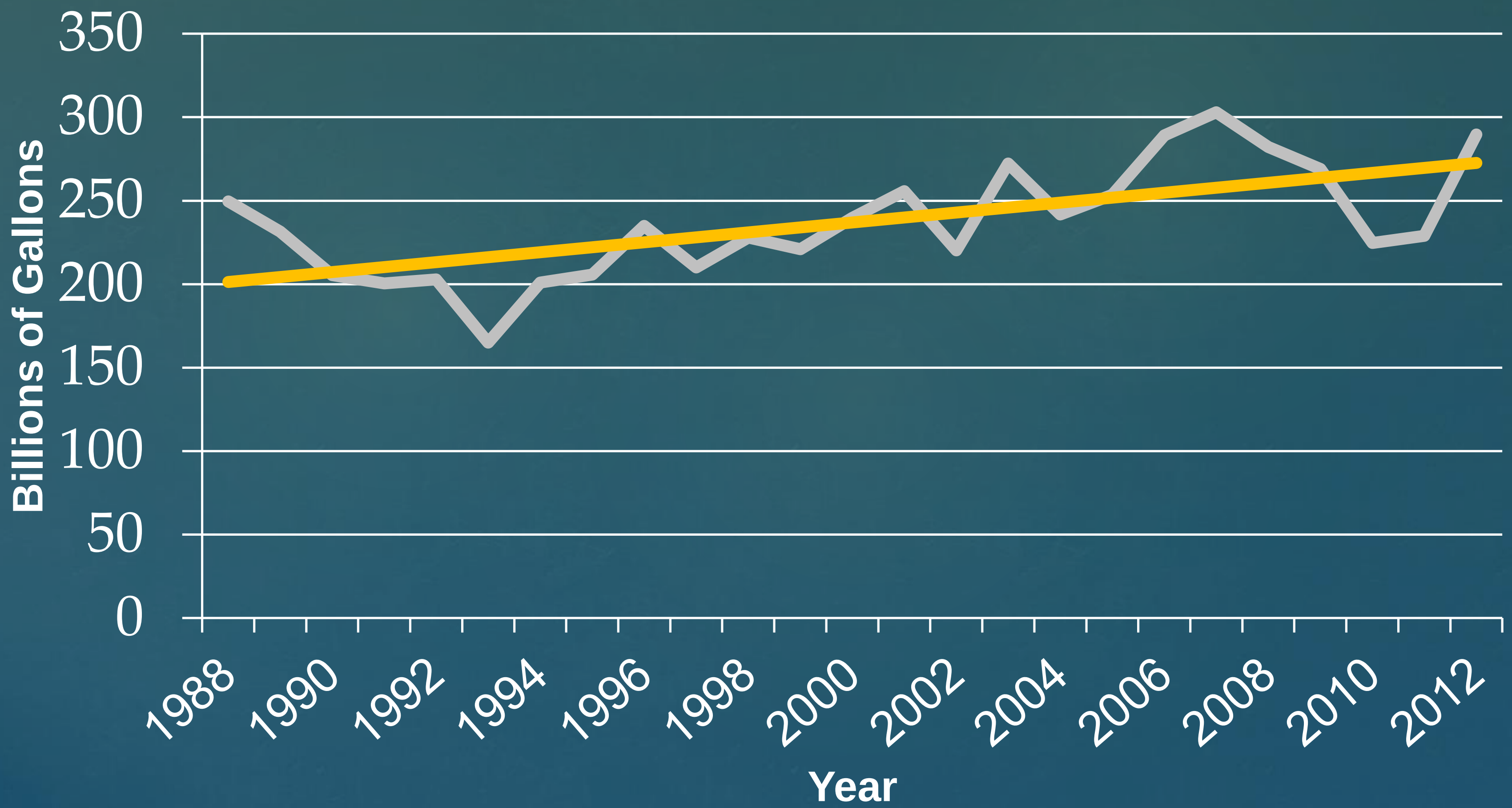
Groundwater!

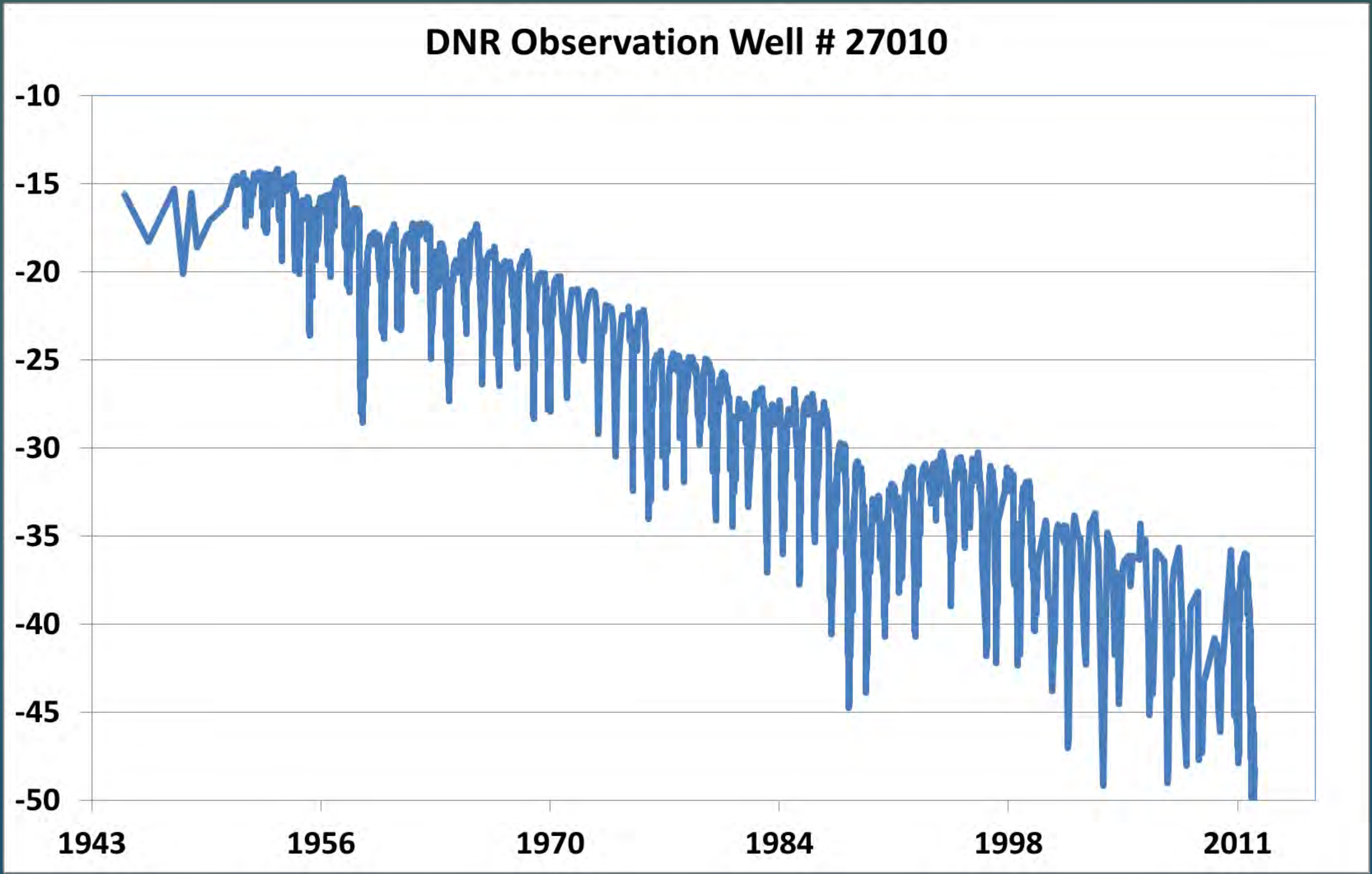
A Netflix Original Series

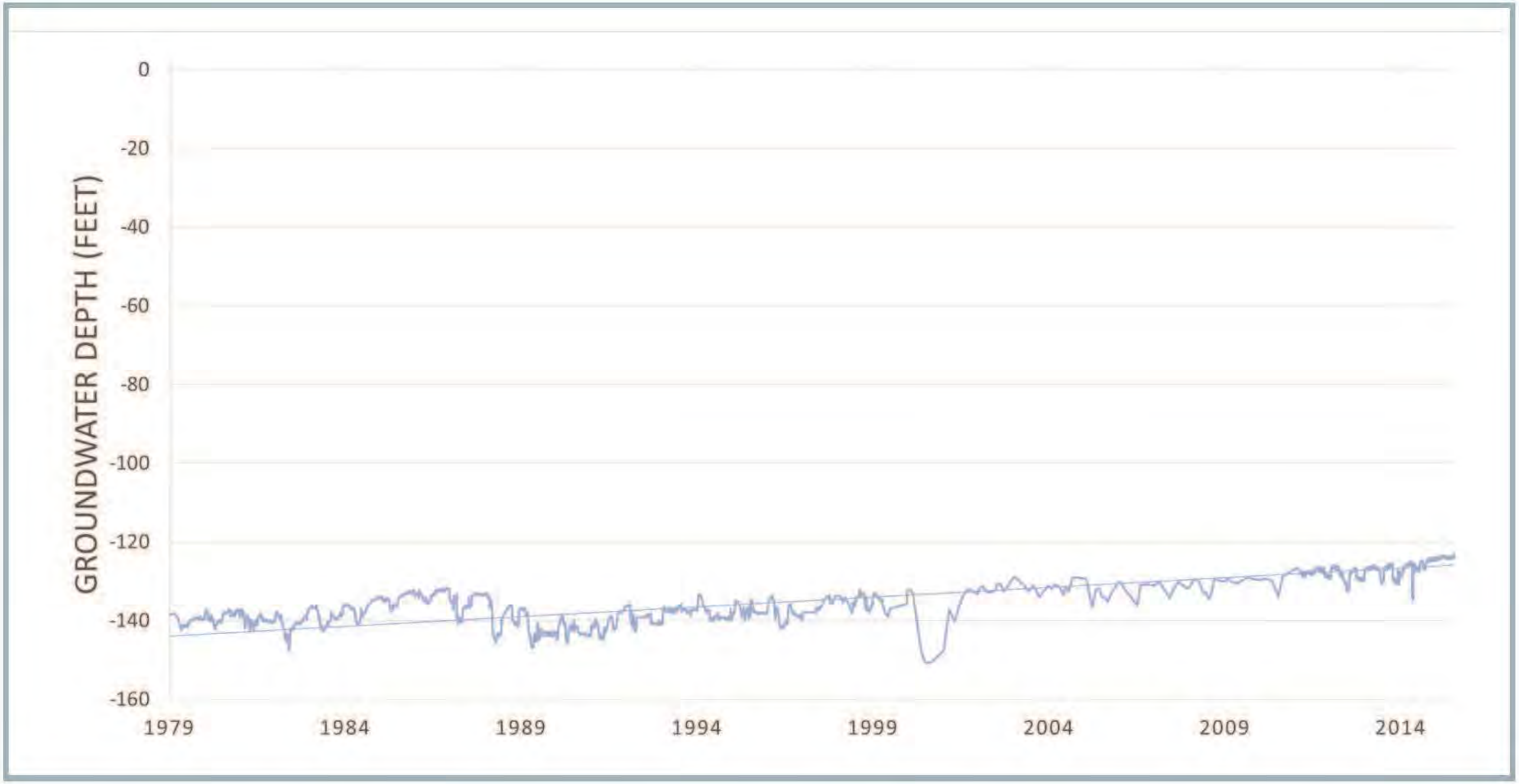
Our 2016 report



Annual Reported Groundwater Use




DNR Observation Well # 27010
-10
-15
-20
-25
-30
-35
-40
-45
-50
1943
1956
1970
1984
1998
2011



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

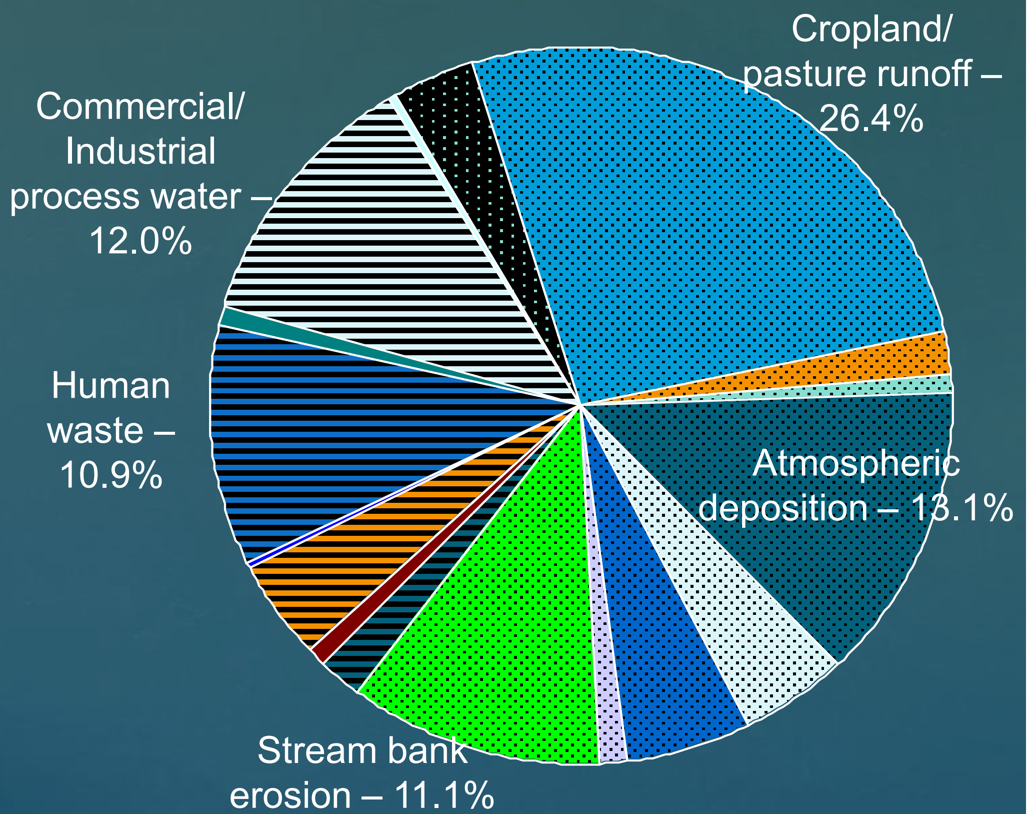

USGS

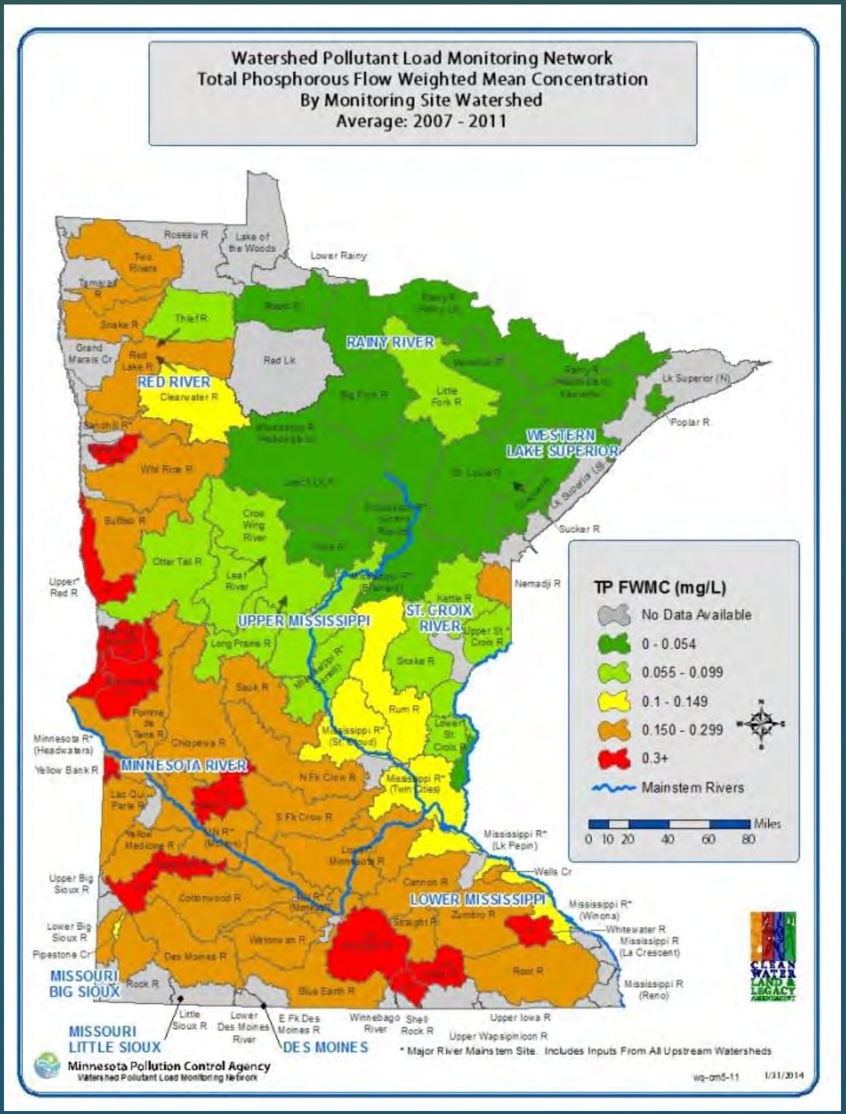
So how are things outside the cities ?

Drain Tile

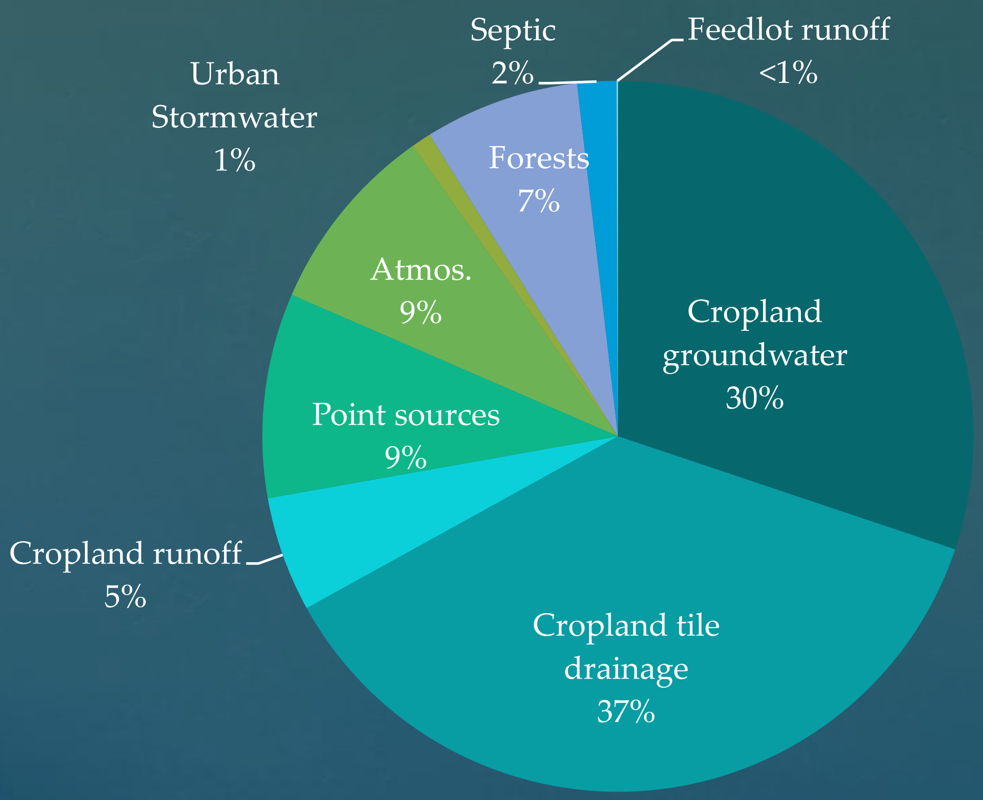
Installing drain tile

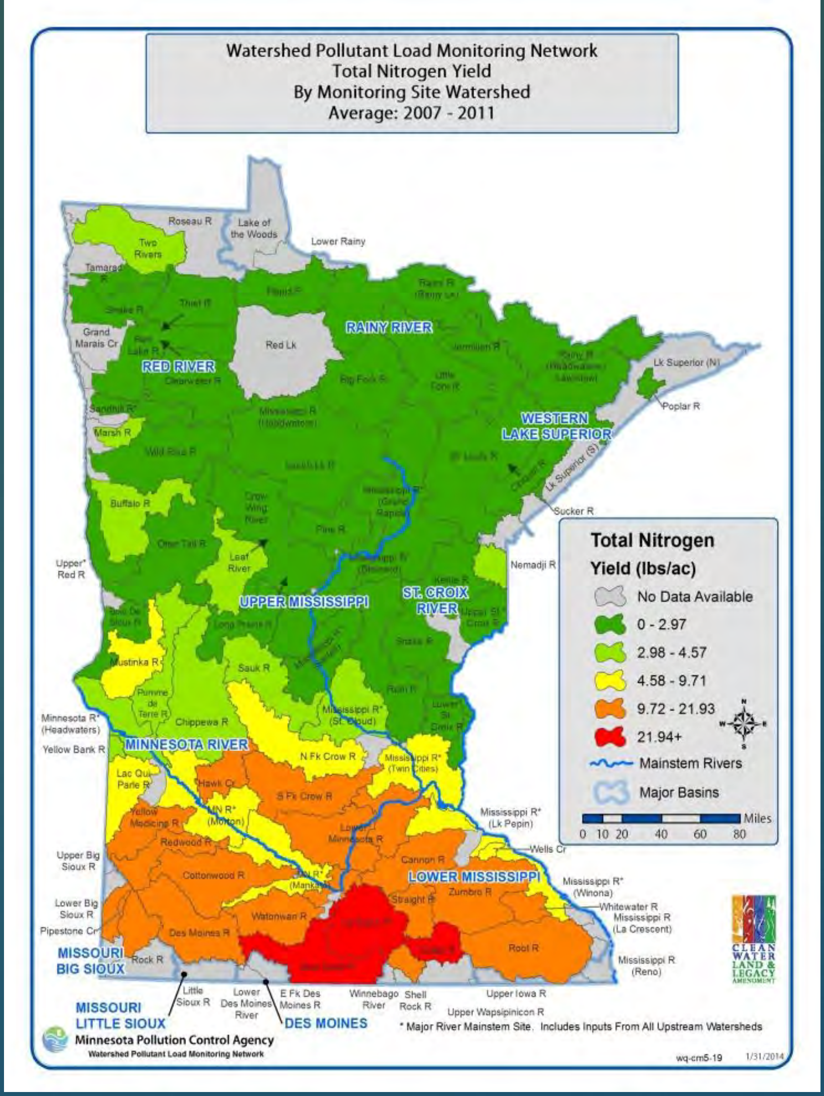
Total Phosphorus





Total Nitrogen





Aggressive Prep

Buffer needed

Buffer complete

The Constitutional Amendment

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

CLEAN WATER LAND & LEGACY AMENDMENT


FRESHWATER SOCIETY
Support an
organization you trust
freshwater.org

Snapshots of Ramsey County Waters

Ramsey County Lake Sampling

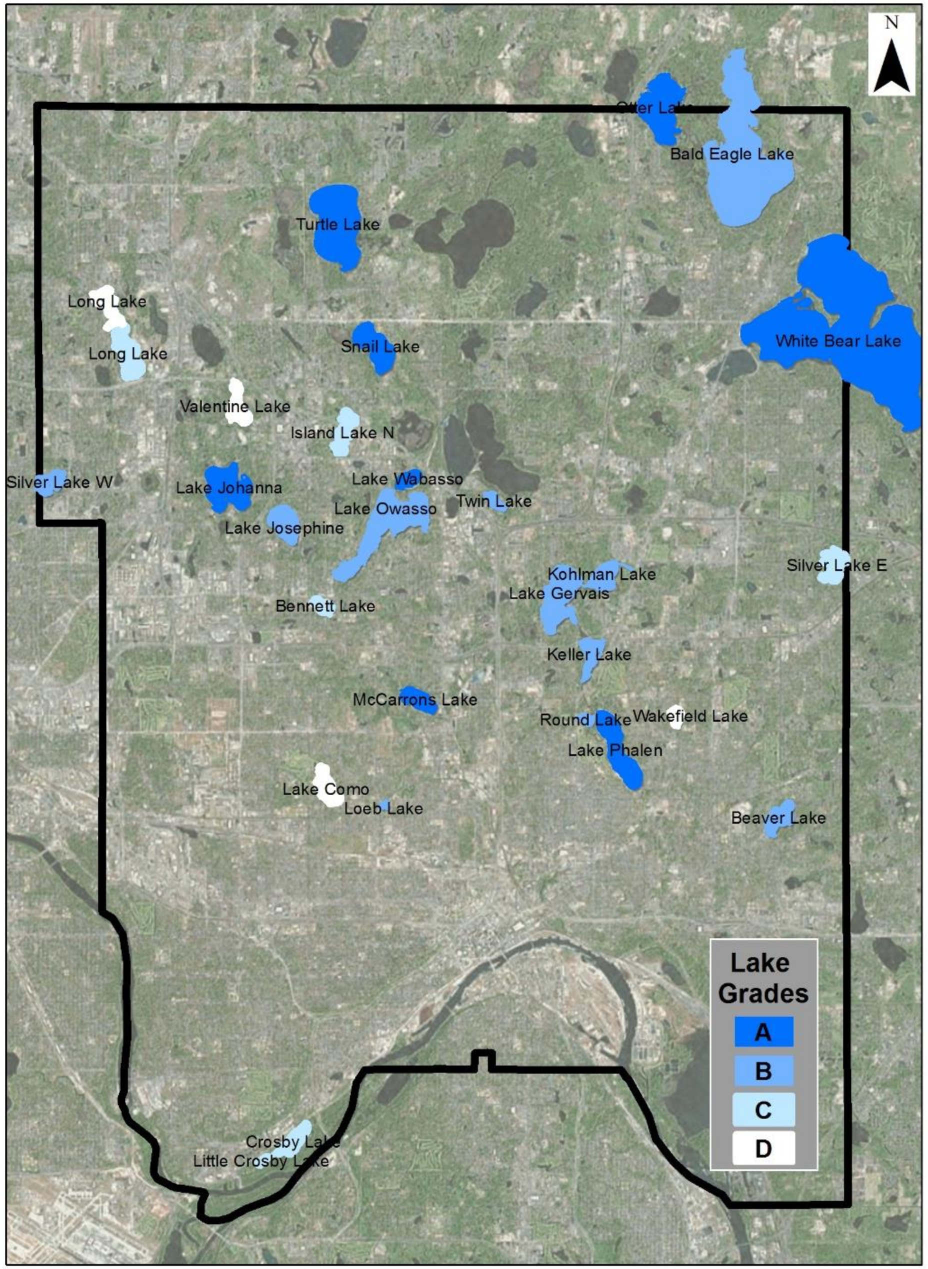
- 30 Lakes
- 8 Samples per summer

WATER QUALITY GRADING SYSTEM				
Grade	Total Phosphorus (ug/l)	Chlorophyll -a (ug/l)	Secchi Depth (m)	(ft)
A	<23	<10	>3	>9.8
B	23-32	10-20	2.2-3.0	7.2-9.8
C	32-68	20-48	1.2-2.2	3.9-7.2
D	68-152	48-77	0.7-1.2	2.3-3.9
F	>152	>77	<0.7	<2.3

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

Metropolitan Council Lake Grading System

Lake Grade, 2015			
A	B	C	D
McCarrons	Beaver	Bennett	Como
Wabasso	Loeb	Island	Valentine
Snail	Owasso	Long	Wakefield
Turtle	Twin	Crosby	
Johanna	Josephine	Little Crosby	
White Bear	Silver (Col.H)	Silver (N St P.)	
Otter	Bald Eagle		
Phalen	Keller		
	Gervais		
	Kohlman		
	Round		



2015 Lake Grades, Ramsey County, MN

Ramsey Conservation District

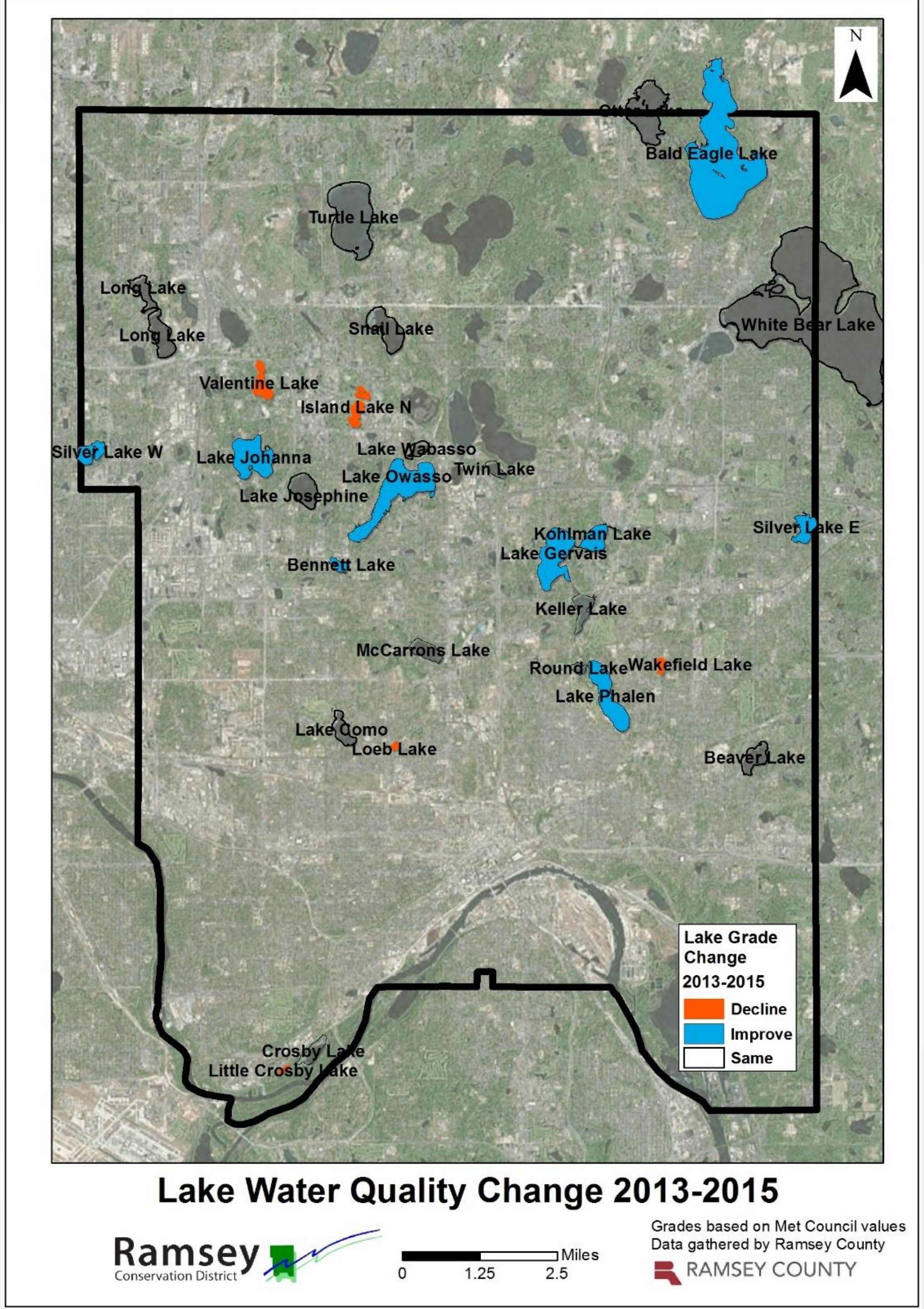
Miles 0 1.25 2.5

Grades based on Met Council values
Data gathered by Ramsey County

RAMSEY COUNTY

Overall Improvement

Change from 2013-2015	
Improvement	**Decline**
Bald Eagle	Valentine
Silver (Col.H)	Island
Silver (N St P.)	Wakefield
Johanna	Loeb
Owasso	Little Crosby
Phalen	
Kohlman	
Gervais	
Bennett	



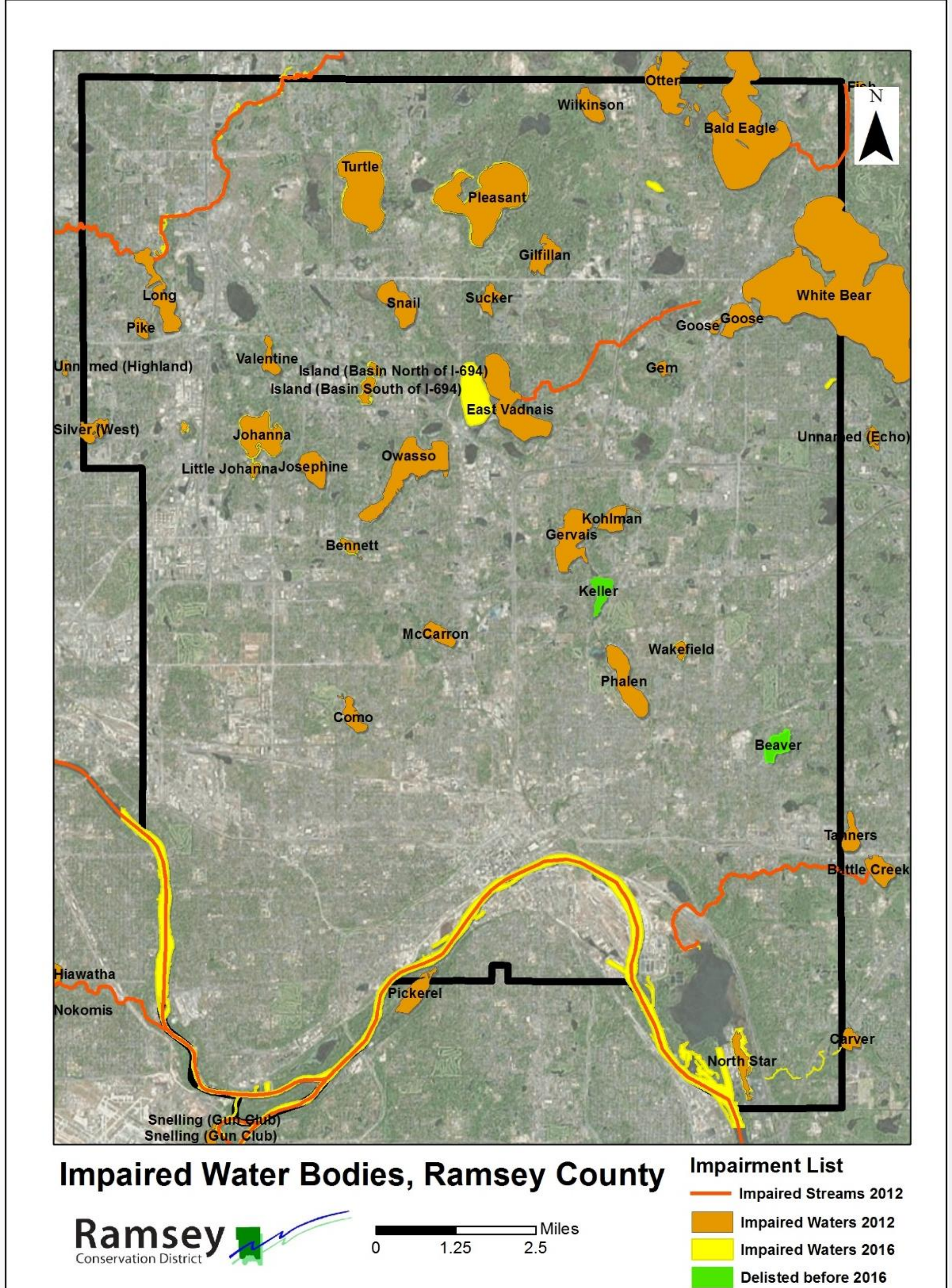
Impaired Waters, MPCA list

Impairments

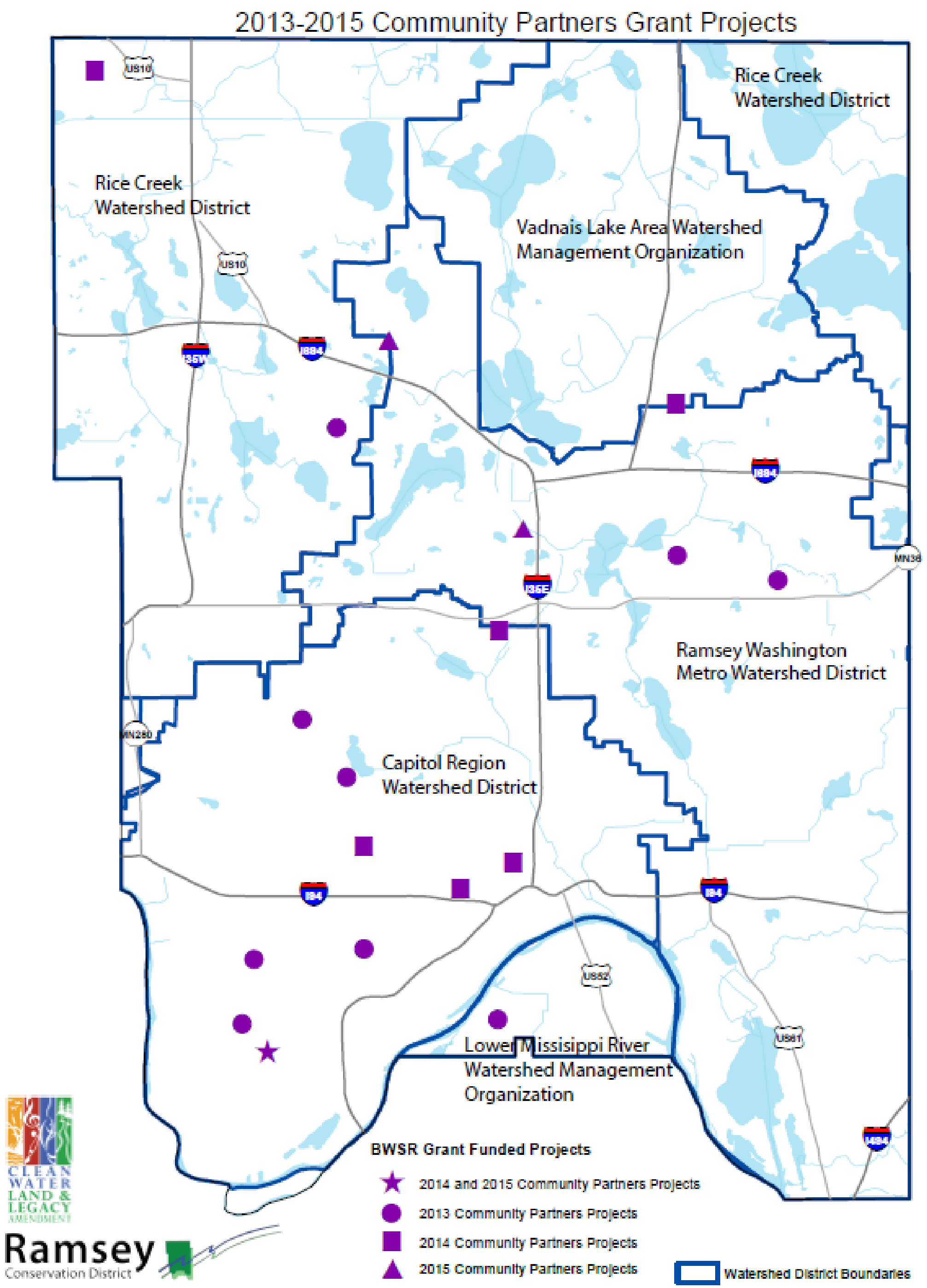
- Aquatic Life - (ie, dissolved Oxygen)
- Aquatic Consumption – (ie, Mercury in Fish tissue)
- Aquatic Recreation – (ie, nutrients/eutrophication)

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)

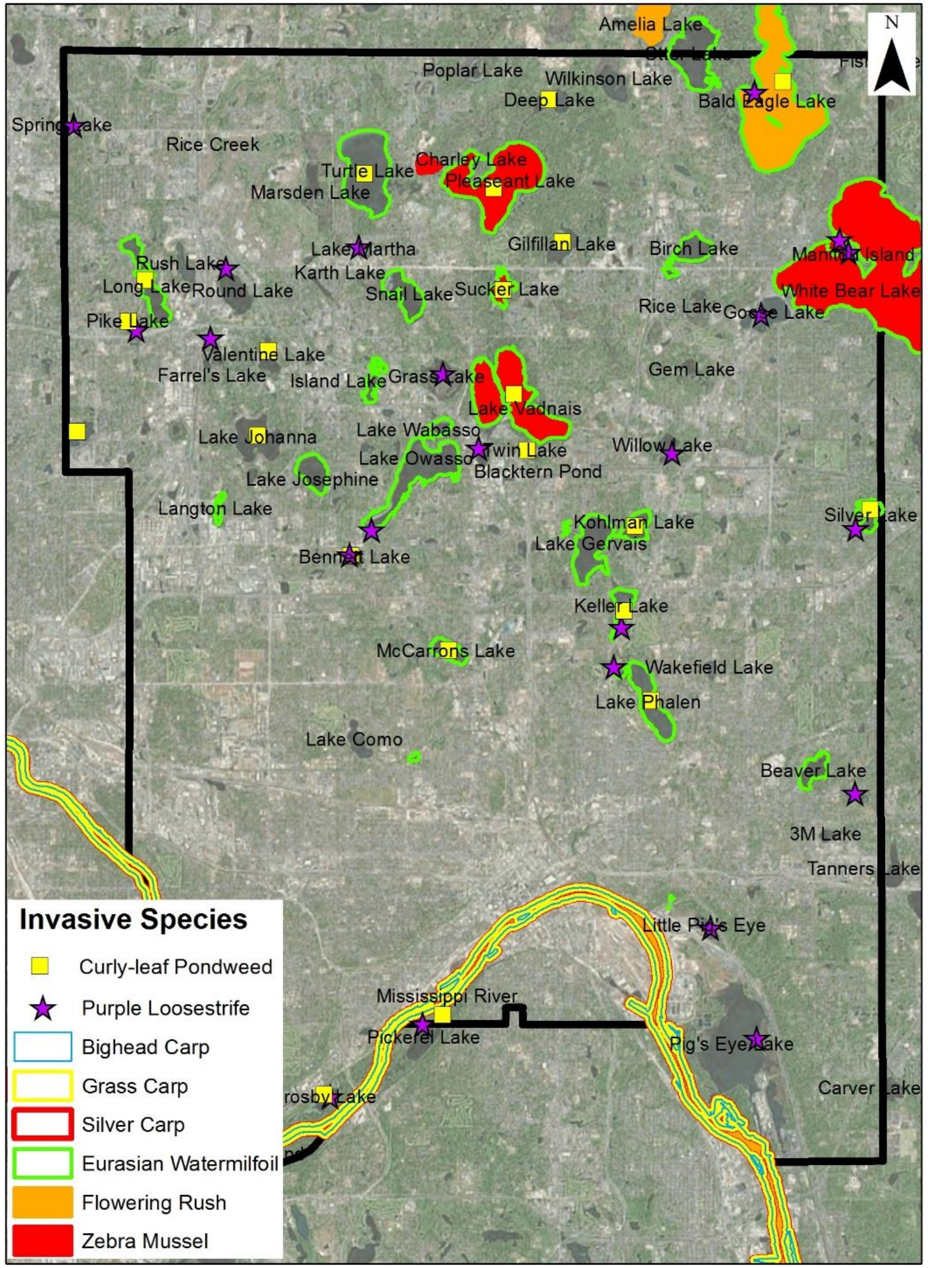
AIS Infestations in Ramsey County

Plants

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

Animals

- Zebra Mussel
- Bighead Carp
- Grass Carp
- Silver Carp



Infested Waters of Ramsey County

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

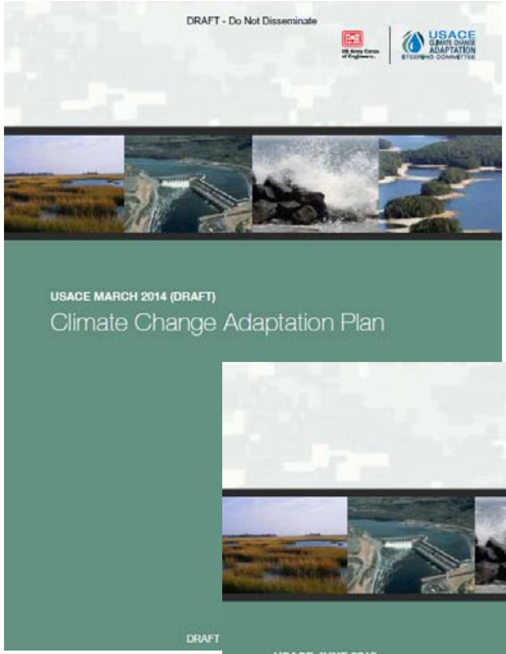
Bryan Baker, PE

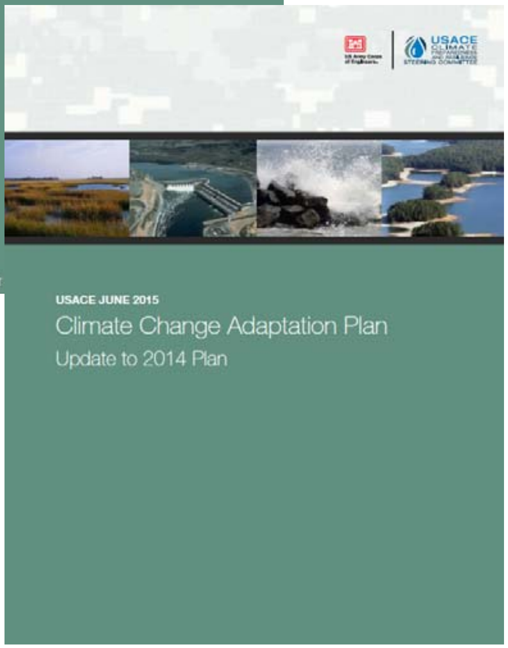
Climate Preparedness and Resilience Community of Practice

State of Waters
20 October 2016

Bottom Line Up Front (BLUF) on Activites

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





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

66819

Federal Register
Vol. 78, No. 215
Wednesday, November 6, 2013

Presidential Documents

Title 3—
The President

Executive Order 13653 of November 1, 2013

Preparing the United States for the Impacts of Climate Change

By the authority vested in me as President by the Constitution and the laws of the United States of America, and in order to prepare the Nation for the impacts of climate change by undertaking actions to enhance climate preparedness and resilience, it is hereby ordered as follows:

Section 1. *Policy.* The impacts of climate change—including an increase in prolonged periods of excessively high temperatures, more heavy downpours, an increase in wildfires, more severe droughts, permafrost thawing, ocean acidification, and sea-level rise—are already affecting communities, natural resources, ecosystems, economies, and public health across the Nation. These impacts are often most significant for communities that already face economic or health-related challenges, and for species and habitats that are already facing other pressures. Managing these risks requires deliberate preparation, close cooperation, and coordinated planning by the Federal Government, as well as by stakeholders, to facilitate Federal, State, local, tribal, private-sector, and nonprofit-sector efforts to improve climate preparedness and resilience; help safeguard our economy, infrastructure, environment, and natural resources; and provide for the continuity of executive department and agency (agency) operations, services, and programs.

A foundation for coordinated action on climate change preparedness and resilience across the Federal Government was established by Executive Order 13514 of October 5, 2009 (Federal Leadership in Environmental, Energy, and Economic Performance), and the Interagency Climate Change Adaptation Task Force led by the Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA). In addition, through the U.S. Global Change Research Program (USGCRP), established by section 103 of the Global Change Research Act of 1990 (15 U.S.C. 2933), and agency programs and activities, the Federal Government will continue to support scientific research, observational capabilities, and assessments necessary to improve our understanding of and response to climate change and its impacts on the Nation.

The Federal Government must build on recent progress and pursue new strategies to improve the Nation's preparedness and resilience. In doing so, agencies should promote: (1) engaged and strong partnerships and information sharing at all levels of government; (2) risk-informed decisionmaking and the tools to facilitate it; (3) adaptive learning, in which experiences serve as opportunities to inform and adjust future actions; and (4) preparedness planning.

Sec. 2. *Modernizing Federal Programs to Support Climate Resilient Investment.* (a) To support the efforts of regions, States, local communities, and tribes, all agencies, consistent with their missions and in coordination with the Council on Climate Preparedness and Resilience (Council) established in section 6 of this order, shall:

(i) identify and seek to remove or reform barriers that discourage investments or other actions to increase the Nation's resilience to climate change while ensuring continued protection of public health and the environment;

Water:
Renewable or Exhaustible?

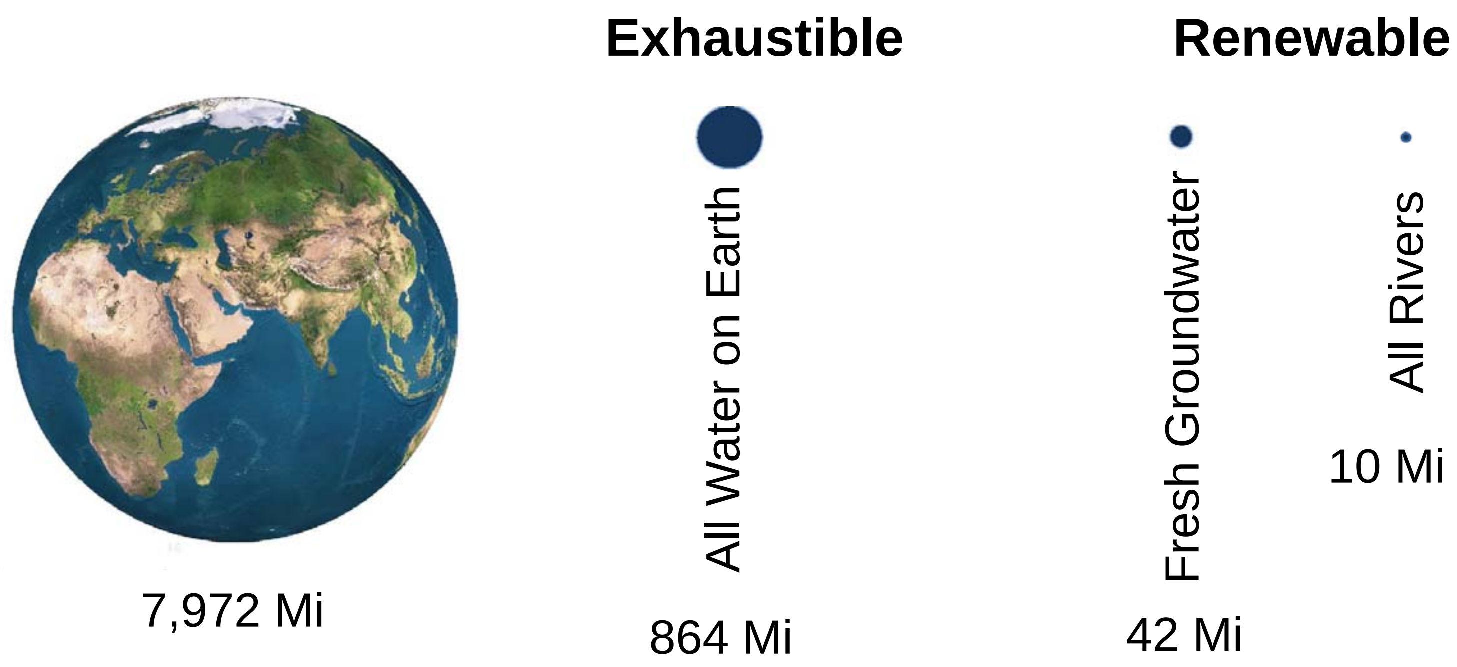
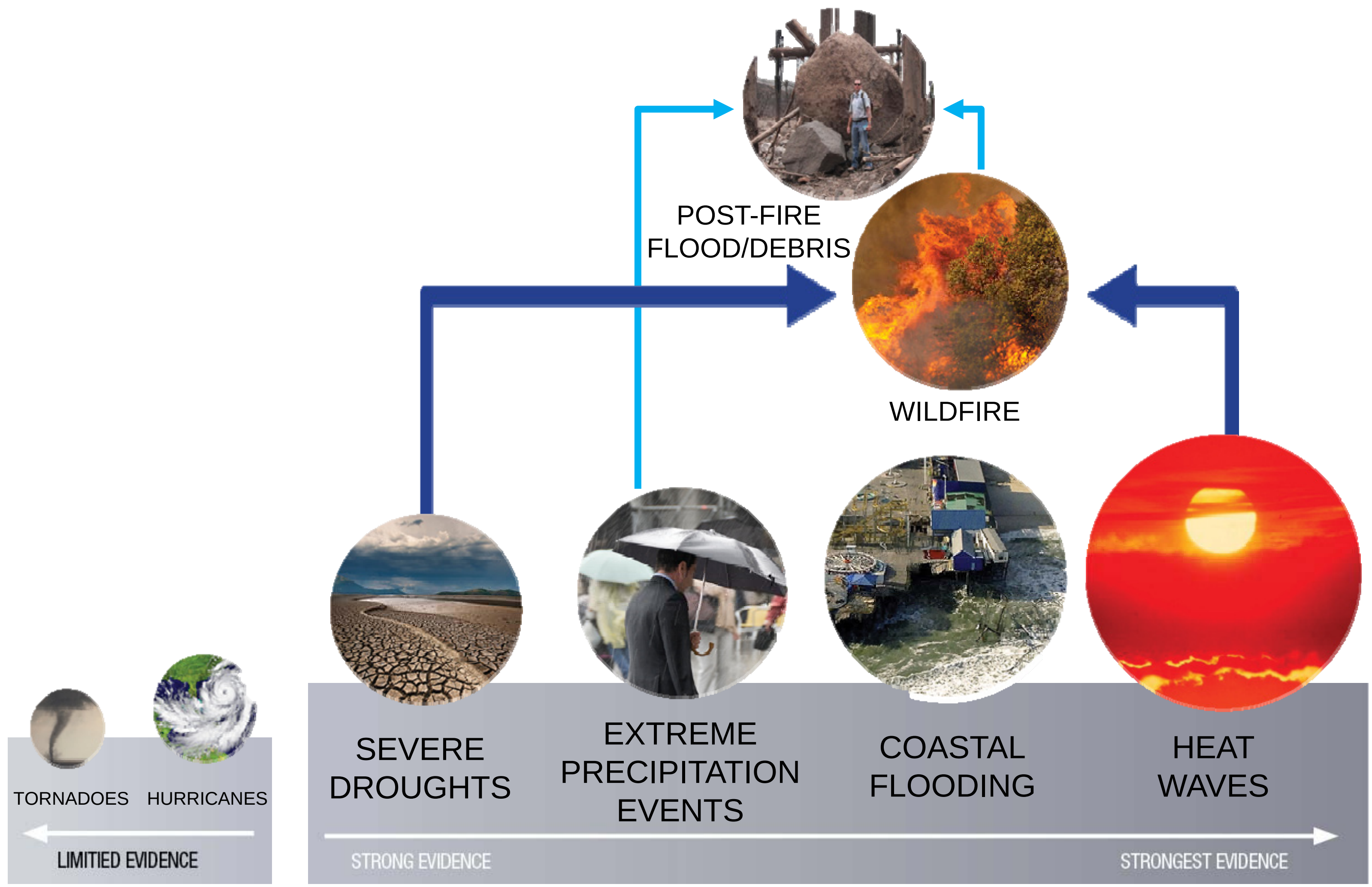


Figure from George Annondale – Golden Associates

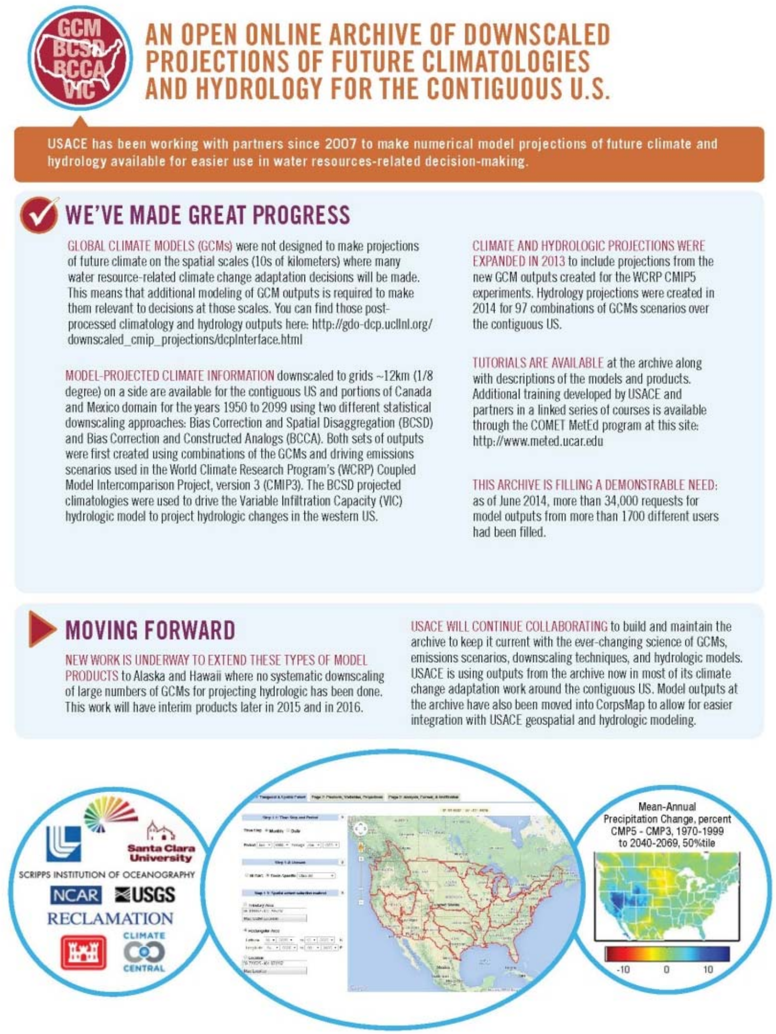
Climate Change is Inextricably Tied to Water



Communicating About Interconnections and Interactions

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


AN OPEN ONLINE ARCHIVE OF DOWNSCALED PROJECTIONS OF FUTURE CLIMATOLOGIES AND HYDROLOGY FOR THE CONTIGUOUS U.S.

USACE has been working with partners since 2007 to make numerical model projections of future climate and hydrology available for easier use in water resources-related decision-making.

WE'VE MADE GREAT PROGRESS

GLOBAL CLIMATE MODELS (GCMs) were not designed to make projections of future climate on the spatial scales (10s of kilometers) where many water resource-related climate change adaptation decisions will be made. This means that additional modeling of GCM outputs is required to make them relevant to decisions at those scales. You can find those post-processed climatology and hydrology outputs here: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html

MODEL-PROJECTED CLIMATE INFORMATION downscaled to grids ~12km (1/8 degree) on a side are available for the contiguous US and portions of Canada and Mexico domain for the years 1950 to 2099 using two different statistical downscaling approaches: Bias Correction and Spatial Disaggregation (BCSD) and Bias Correction and Constructed Analogs (BCCA). Both sets of outputs were first created using combinations of the GCMs and driving emissions scenarios used in the World Climate Research Program's (WCRP) Coupled Model Intercomparison Project, version 3 (CMIP3). The BCSD projected climatologies were used to drive the Variable Infiltration Capacity (VIC) hydrologic model to project hydrologic changes in the western US.

CLIMATE AND HYDROLOGIC PROJECTIONS WERE EXPANDED IN 2013 to include projections from the new GCM outputs created for the WCRP CMIP5 experiments. Hydrology projections were created in 2014 for 97 combinations of GCMs scenarios over the contiguous US.

TUTORIALS ARE AVAILABLE at the archive along with descriptions of the models and products. Additional training developed by USACE and partners in a linked series of courses is available through the COMET MetEd program at this site: http://www.meted.ucar.edu

THIS ARCHIVE IS FILLING A DEMONSTRABLE NEED: as of June 2014, more than 34,000 requests for model outputs from more than 1700 different users had been filled.

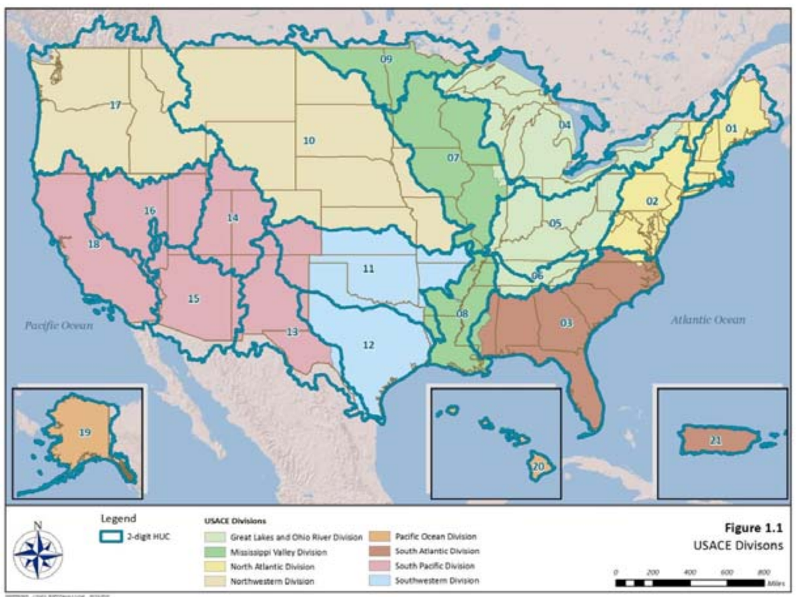
MOVING FORWARD

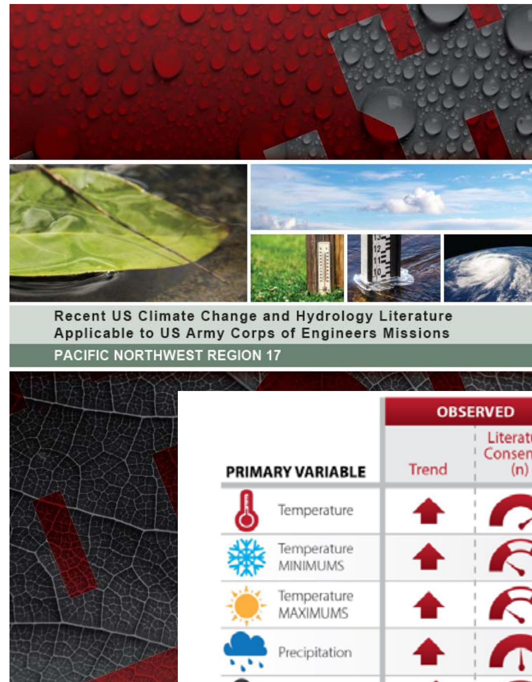
NEW WORK IS UNDERWAY TO EXTEND THESE TYPES OF MODEL PRODUCTS to Alaska and Hawaii where no systematic downscaling of large numbers of GCMs for projecting hydrologic has been done. This work will have interim products later in 2015 and in 2016.

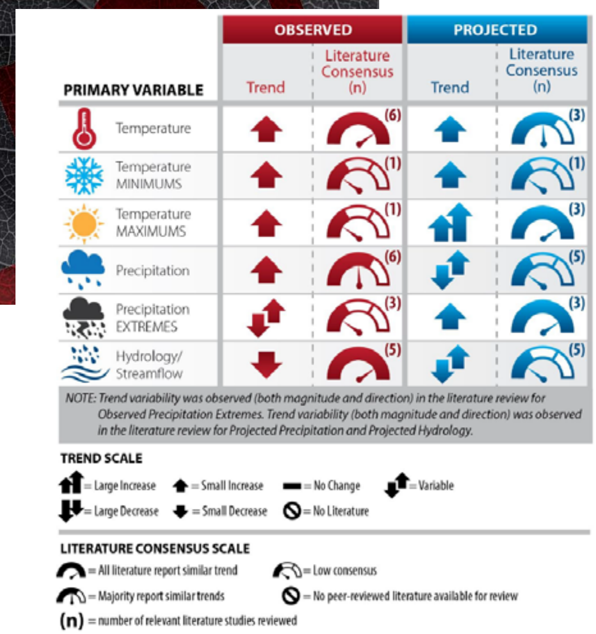
USACE WILL CONTINUE COLLABORATING to build and maintain the archive to keep it current with the ever-changing science of GCMs, emissions scenarios, downscaling techniques, and hydrologic models. USACE is using outputs from the archive now in most of its climate change adaptation work around the contiguous US. Model outputs at the archive have also been moved into CorpsMap to allow for easier integration with USACE geospatial and hydrologic modeling.

USACE Recent Publications – Regional Series

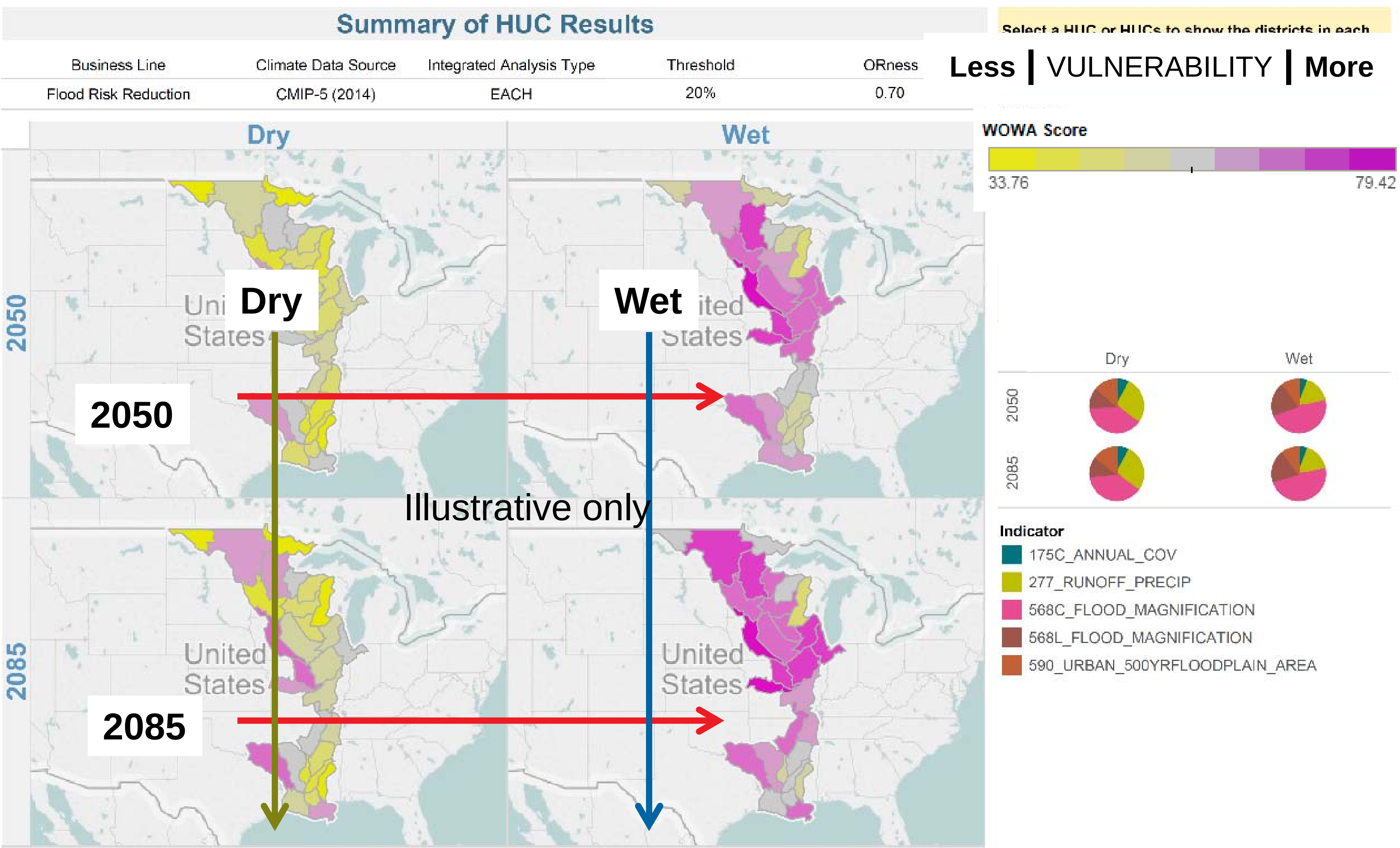
- Regional literature syntheses for 21 Water Resources Regions provide a context for
  - Observed (historical trends)
  - Projected (future trends)
  - Snapshot







Watershed Vulnerability Assessment: Summary for 4-digit HUCs in Mississippi Valley Division, FRM



Progress: Hydrologic Nonstationarity

From this…….


POLICYFORUM

CLIMATE CHANGE

Stationarity Is Dead: Whither Water Management?

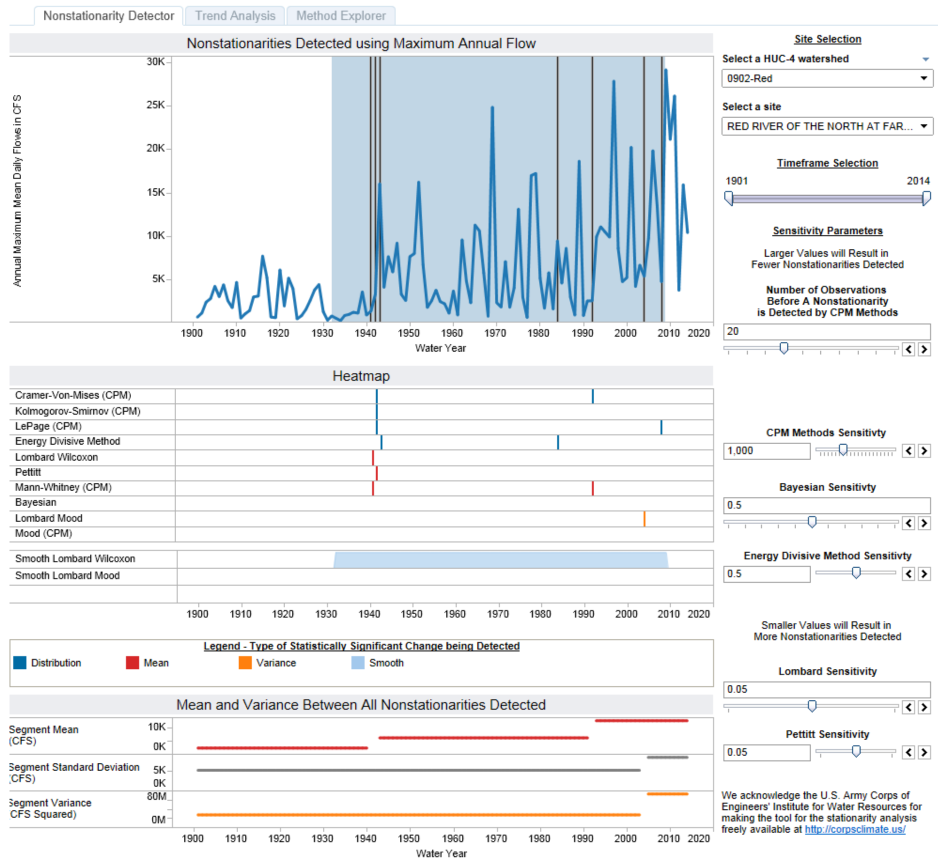
Climate change undermines a basic assumption that historically has facilitated management of water supplies, demands, and risks.

An uncertain future challenges water planners.

www.sciencemag.org SCIENCE VOL 319 1 FEBRUARY 2008 573

Science

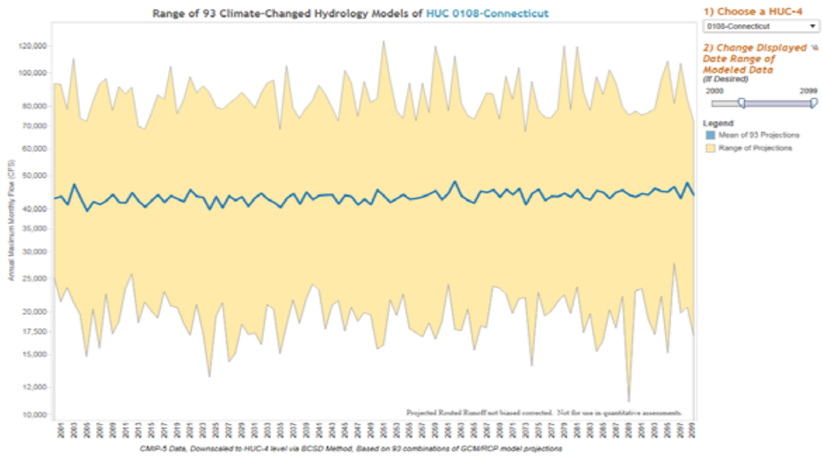
To this……



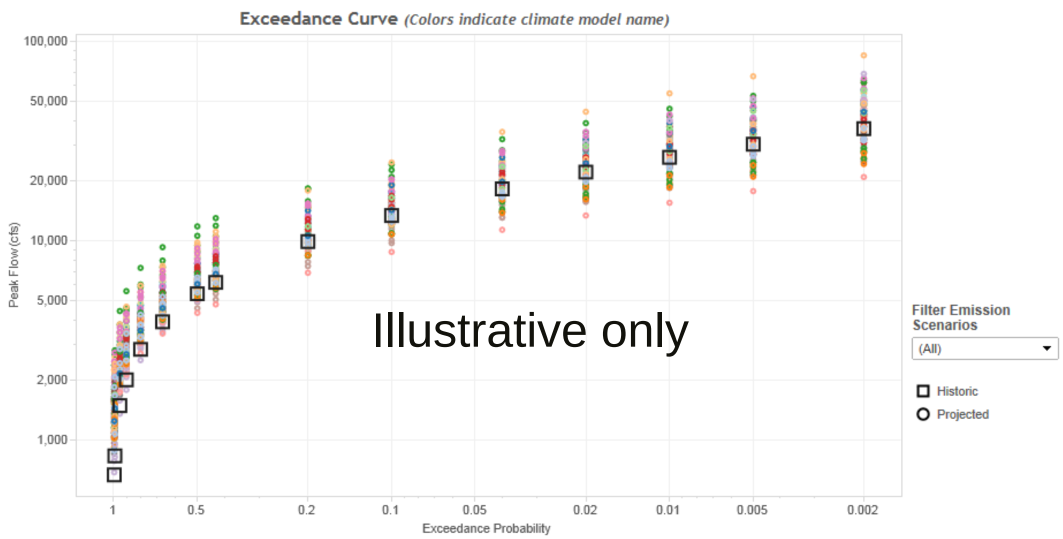
Tool

Projected Climate Hydrology

And from this…..



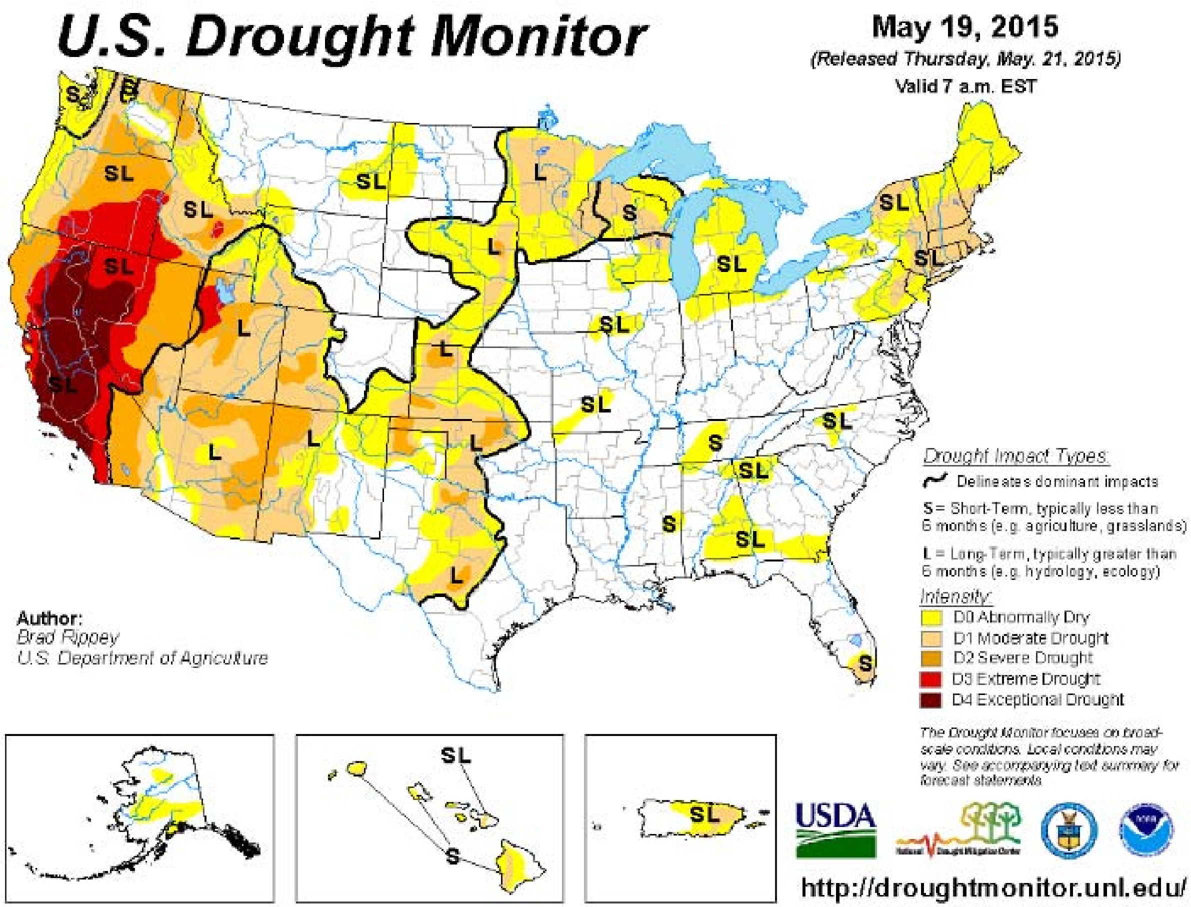
To this…..



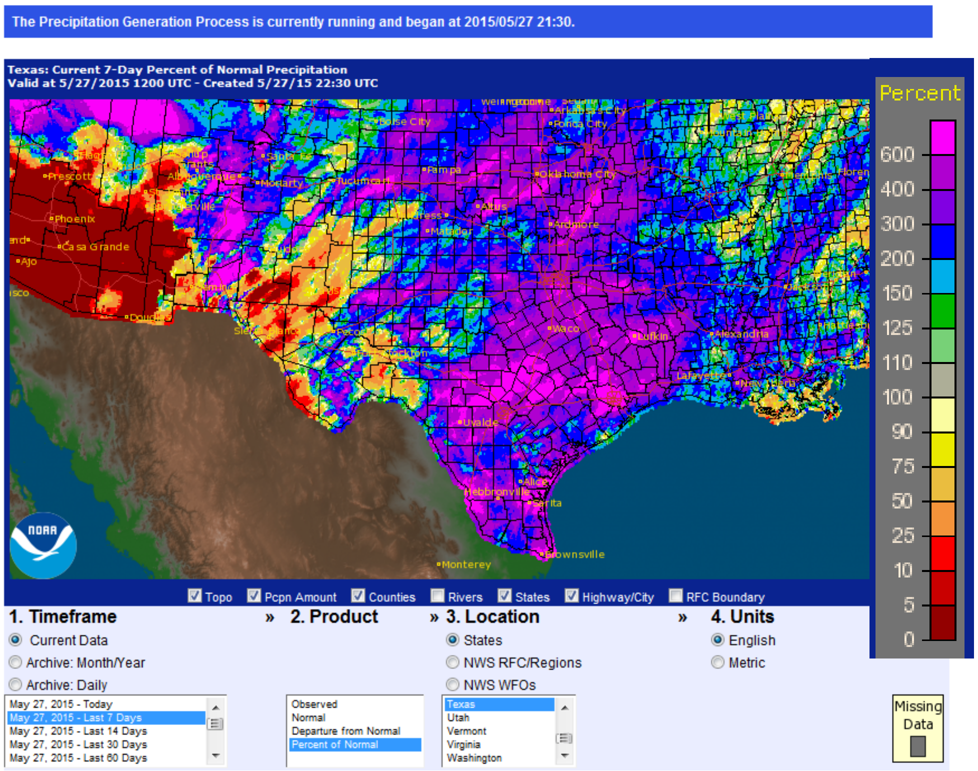
From Drought to Flood: Engineering for Climate Change

- 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



All Droughts End in Flood



<u>Across the Texas Region</u>

- 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

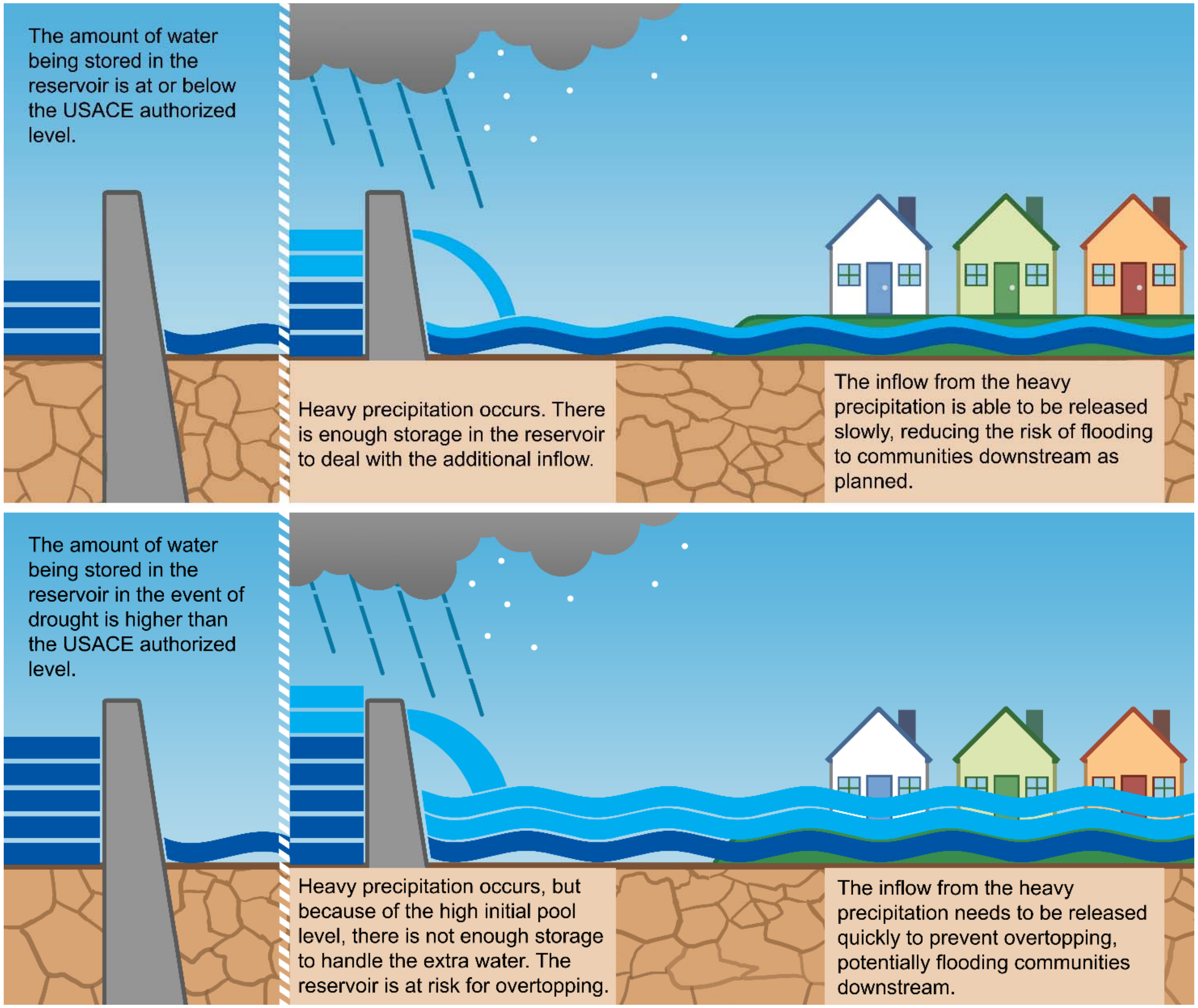
- More than $13 billion in damages prevented by these projects

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

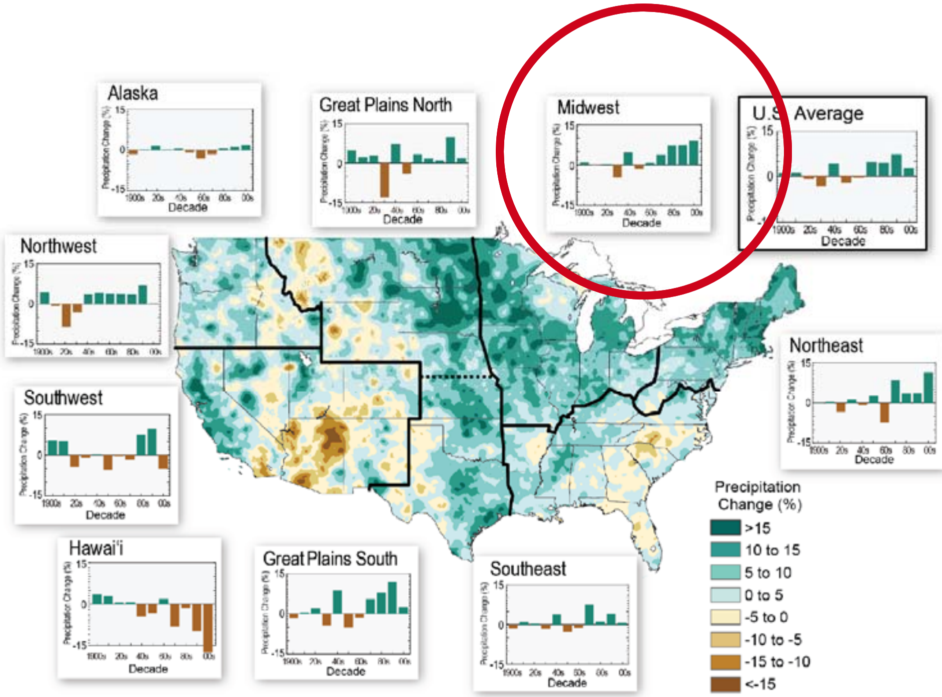
Cumulative rainfall 20-27 May

Heavy Precipitation May-June 2015 Ended Multiyear Drought

Connection Between Drought and Flood in Water Resources Management

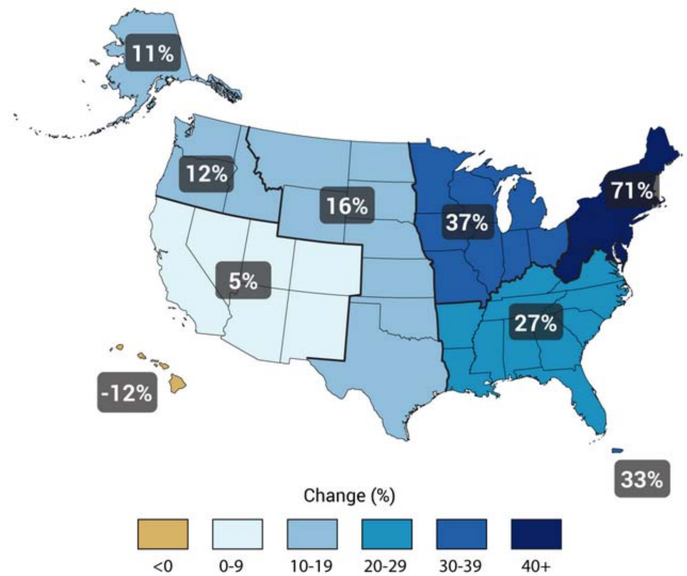


Observed Precipitation Trends



Precipitation Change: 1900-2012

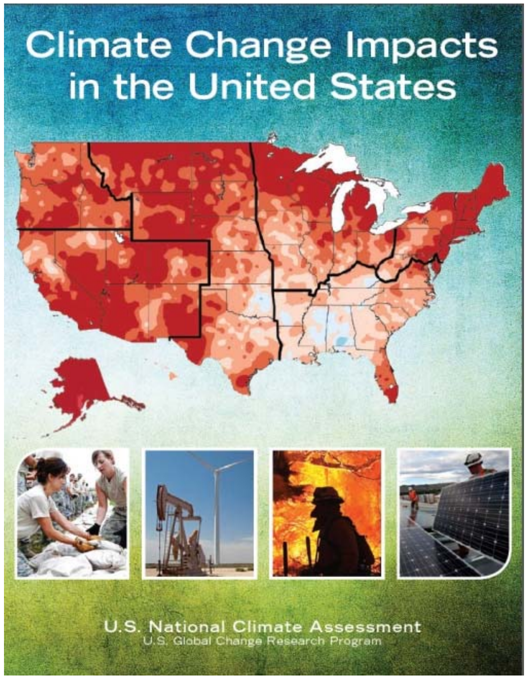
Observed Change in Very Heavy (Top 1%) Precipitation: 1958-2012



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

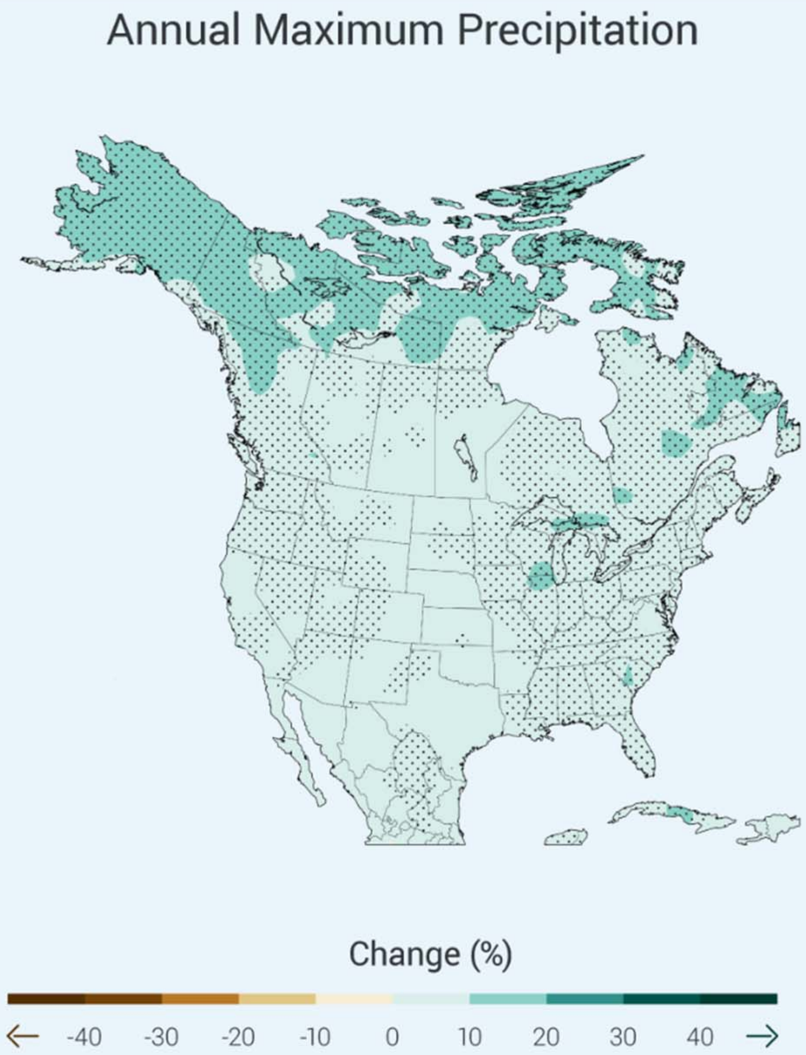
Projected Climate Change

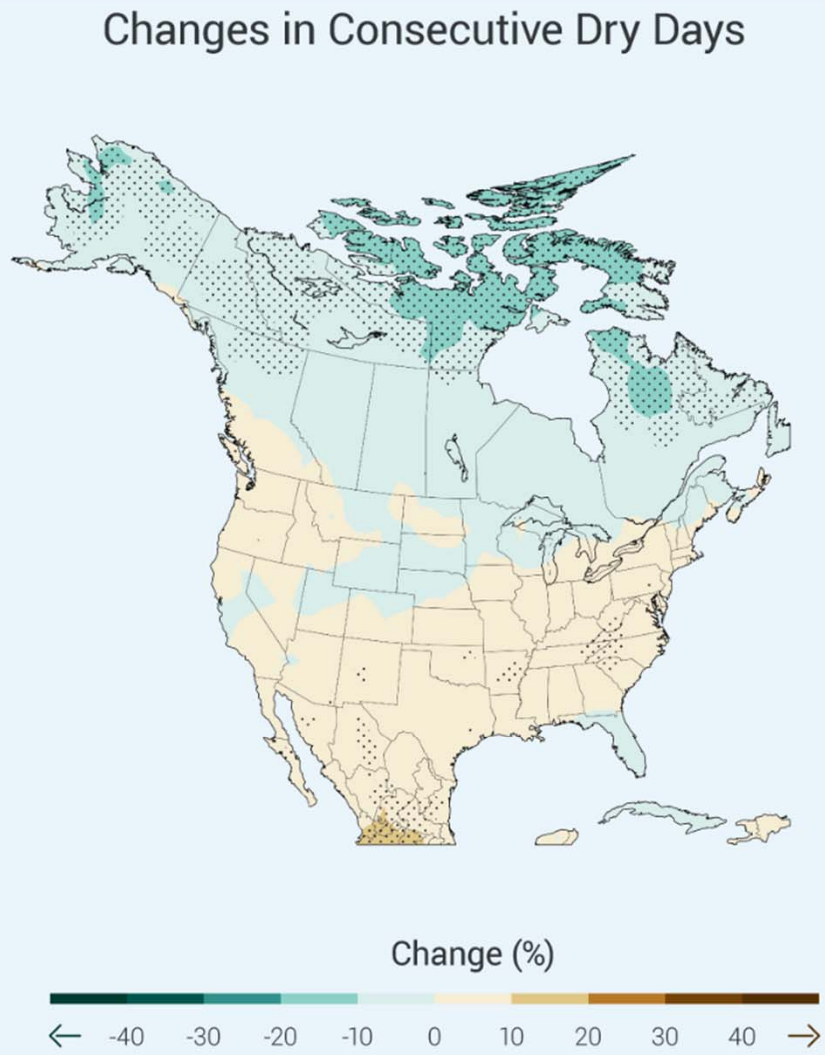
- National Climate Assessment:
  - Heavy downpours
    - Increasing nationally, especially over the last three to five decades
    - Largest increases are in the Midwest and Northeast.
    - Heavy precipitation increasing in a manner consistent with model projections
  - Increases in the frequency and 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

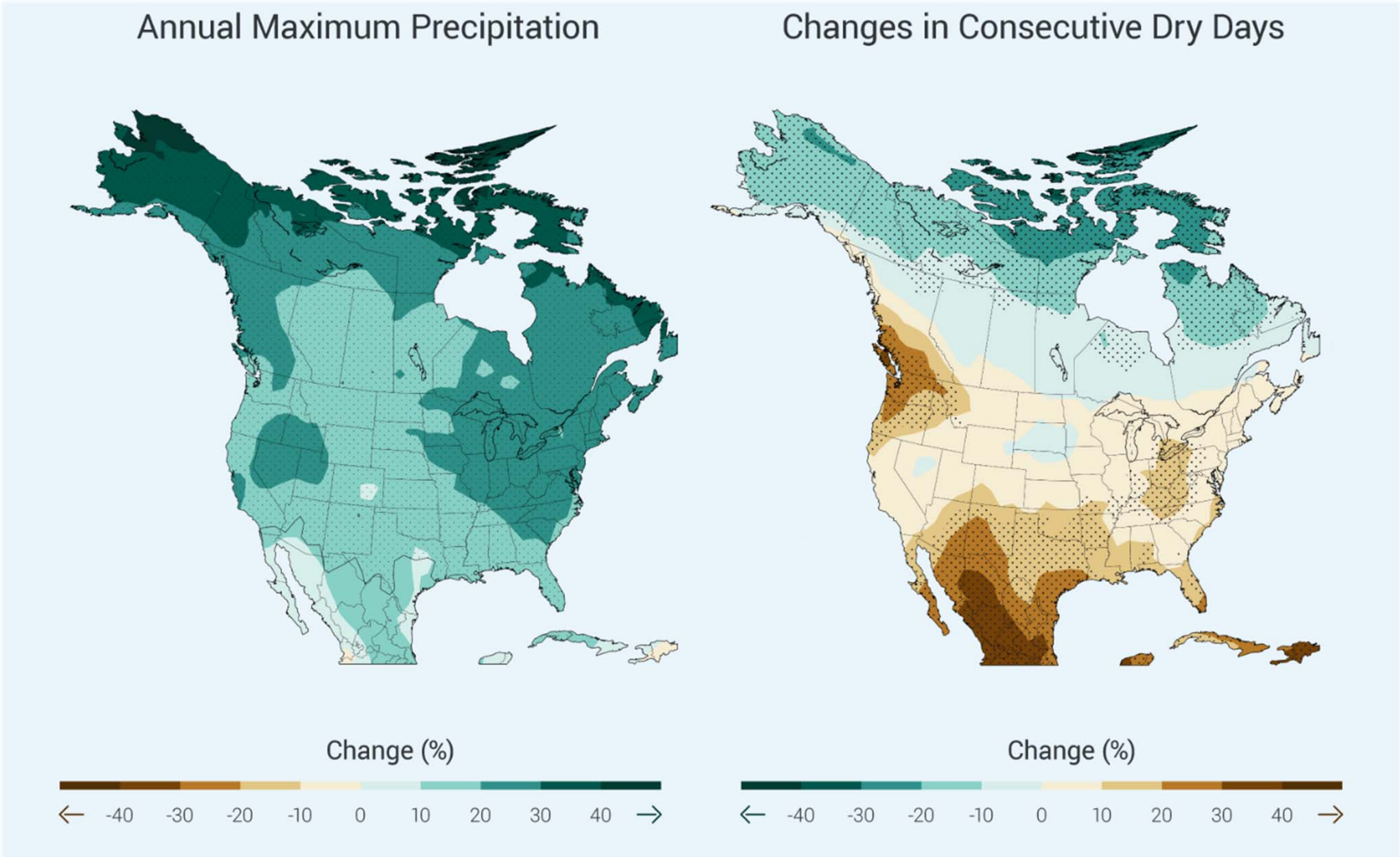
RCP 2.6 – Rapid Emissions Reductions





Projected Precipitation Extremes

RCP 8.5 – Continued Emission Increases



Projected Precipitation

Projected Change in Heavy Precipitation Events

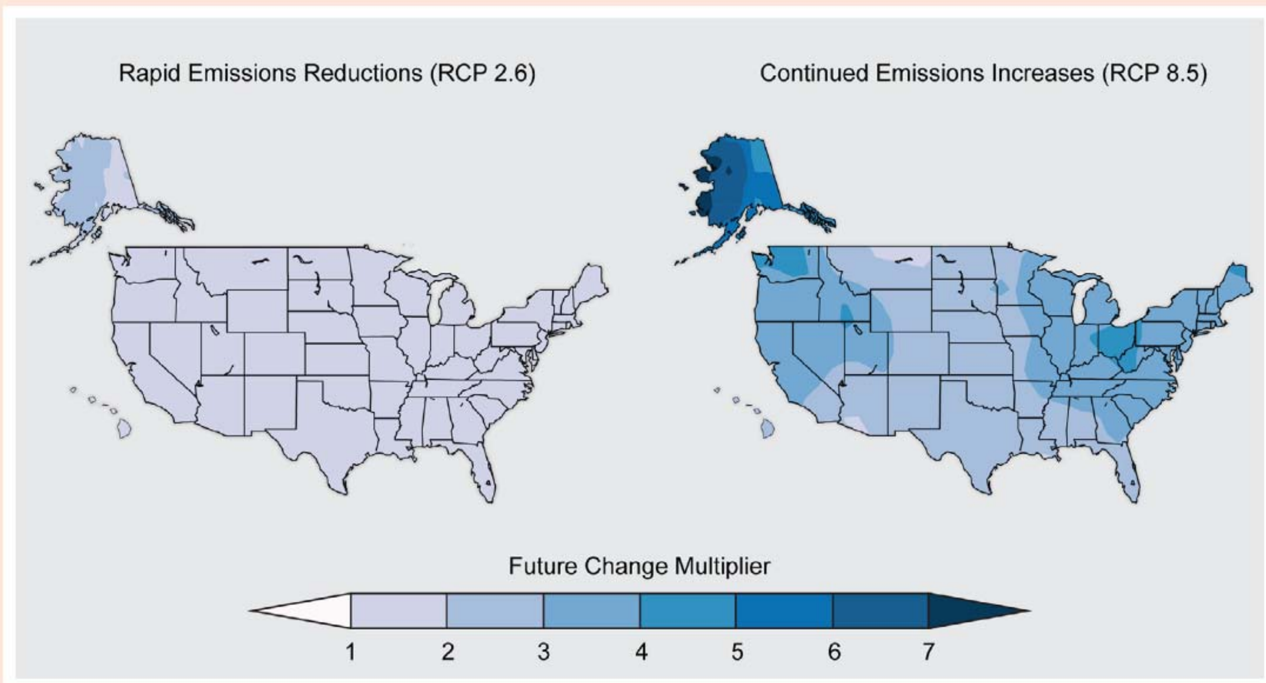
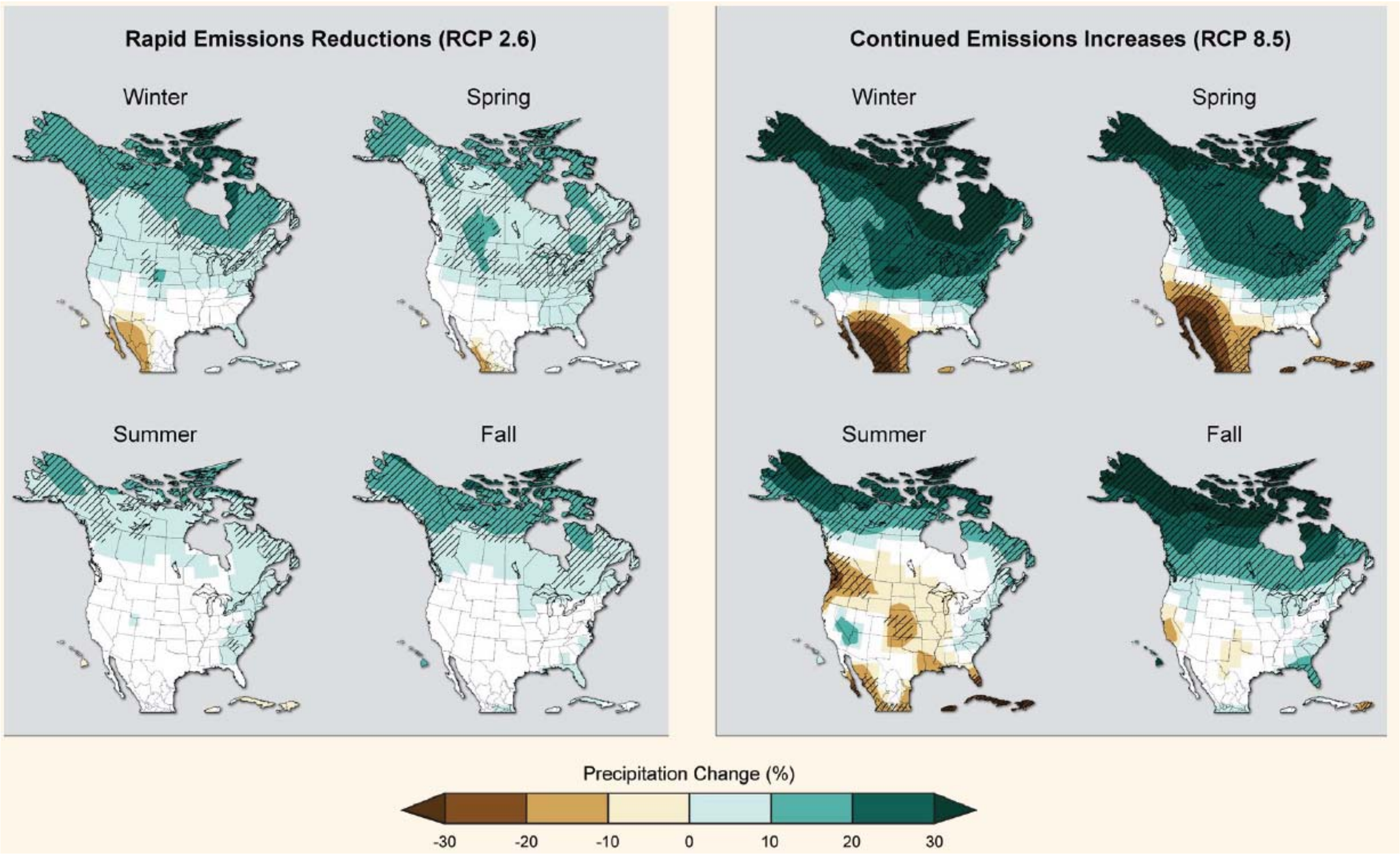


Figure 2.19. Maps show the increase in frequency of extreme daily precipitation events (a daily amount that now occurs once in 20 years) by the later part of this century (2081-2100) compared to the later part of last century (1981-2000). Such extreme events are projected to occur more frequently everywhere 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).

Source: National Climate Assessment, 2014.

Projected Precipitation



Source: National Climate Assessment, 2014.

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

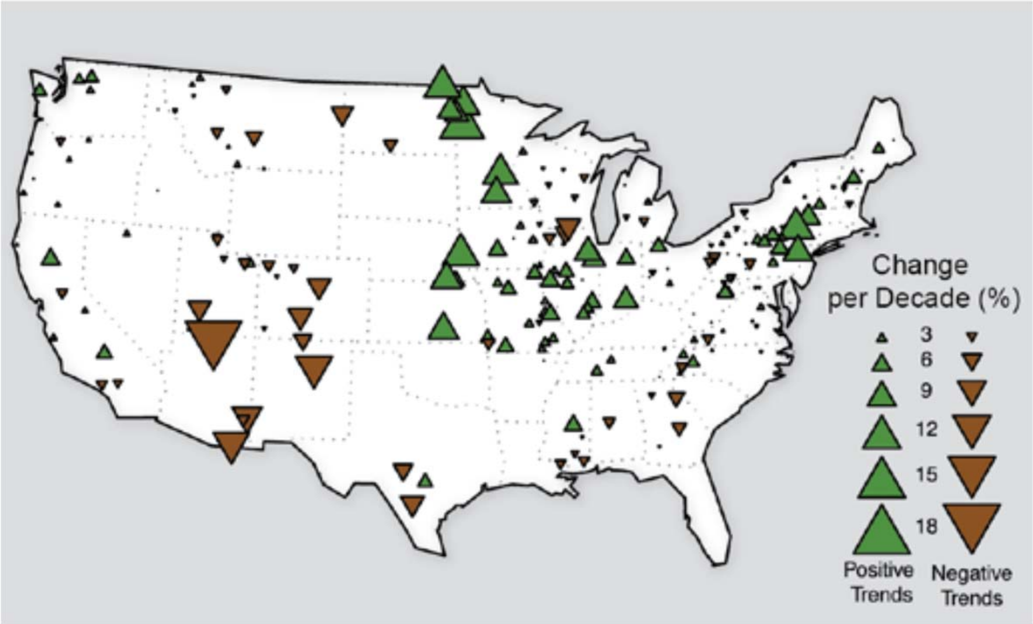


Figure 2.21 Trends in Flood Magnitude – NCA#3

Change The Way You View The World

Technically, the glass is always full…..

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

CLIMATE CHANGE BUSINESS JOURNAL®

A Climate Change Industry
Business Segment Review

EBI Report 4800:
Emerging Business Opportunities in the
Climate Change Adaptation Industry

Part of the
EBI Report 4000 Series on
The Climate Change Industry

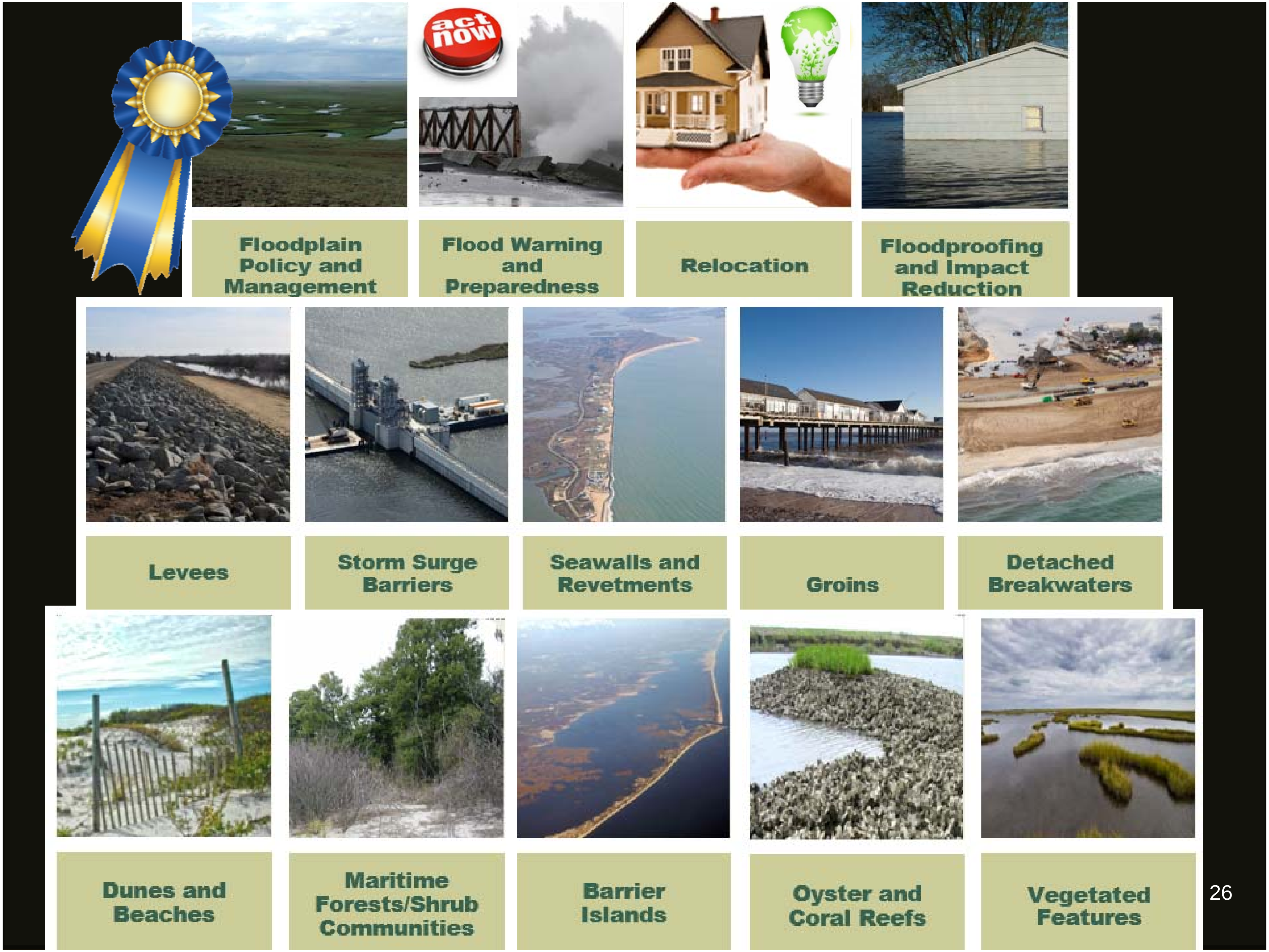
Summer 2014

A publication of
Environmental Business International, Inc.
4452 Park Blvd. #306
San Diego CA 92116
619-295-7685
www.ebionline.org

ENVIRONMENTAL BUSINESS INTERNATIONAL, INC.

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


Floodplain Policy and Management
Flood Warning and Preparedness
Relocation
Floodproofing and Impact Reduction
act now
Levees
Storm Surge Barriers
Seawalls and Revetments
Groins
Detached Breakwaters
Dunes and Beaches
Maritime Forests/Shrub Communities
Barrier Islands
Oyster and Coral Reefs
Vegetated Features

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