ASCE Committee Report on Our Systemic Flood Problems

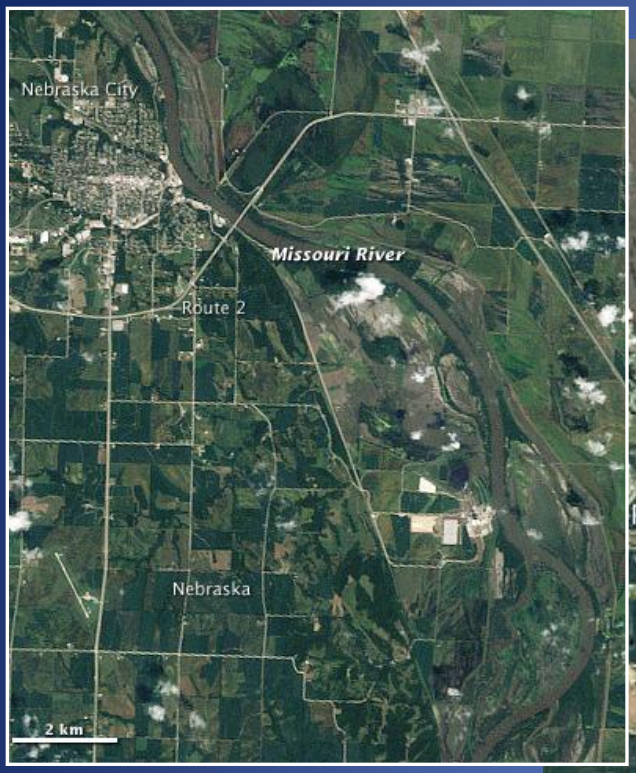
Presenter: David Fowler CFM, Senior Project Manager,
Milwaukee Metropolitan Sewerage District

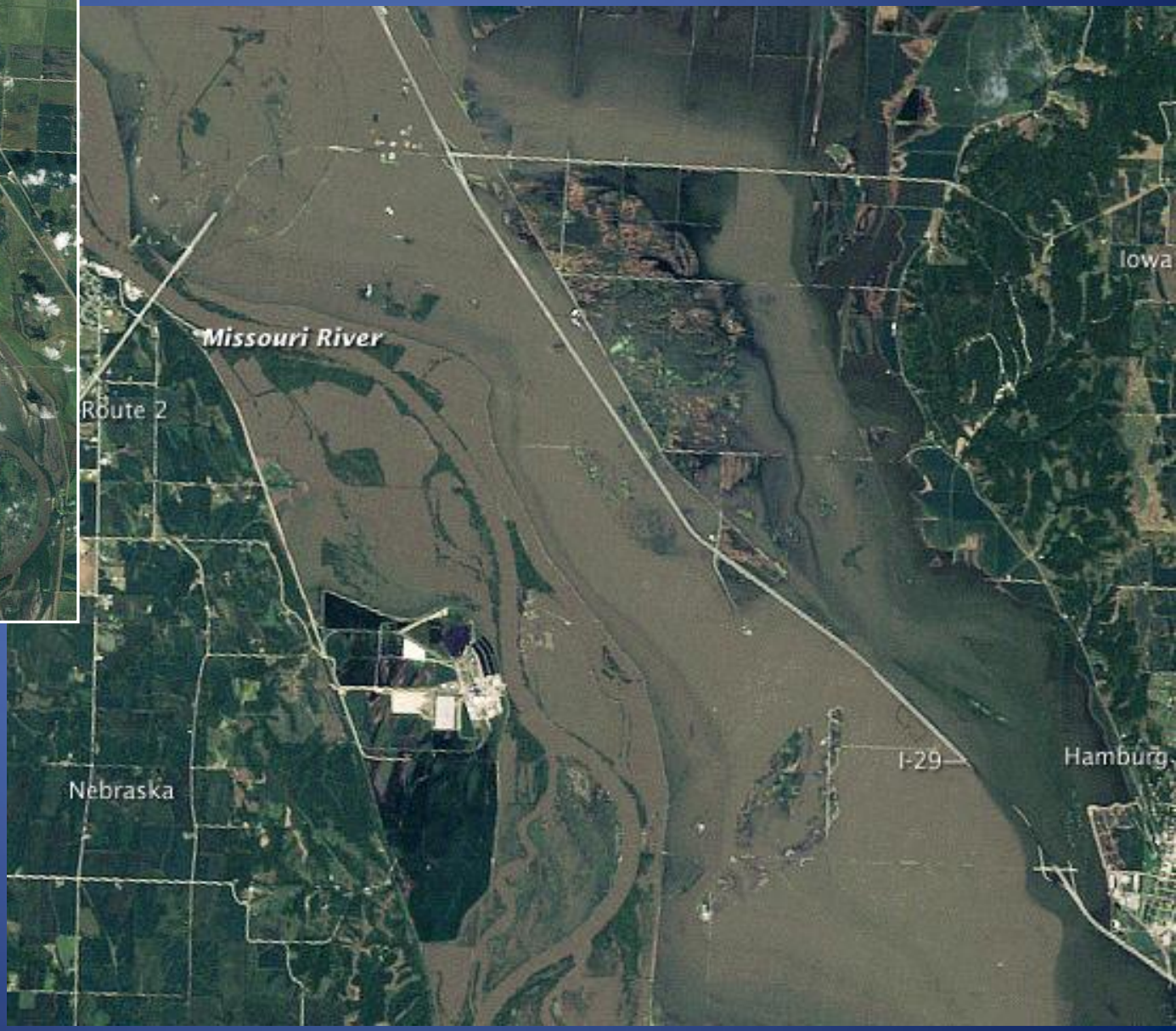
mmsd
Preserving The Environment •
Improving Water Quality

Great Midwest Flood 1993

Hurricane Katrina 2005

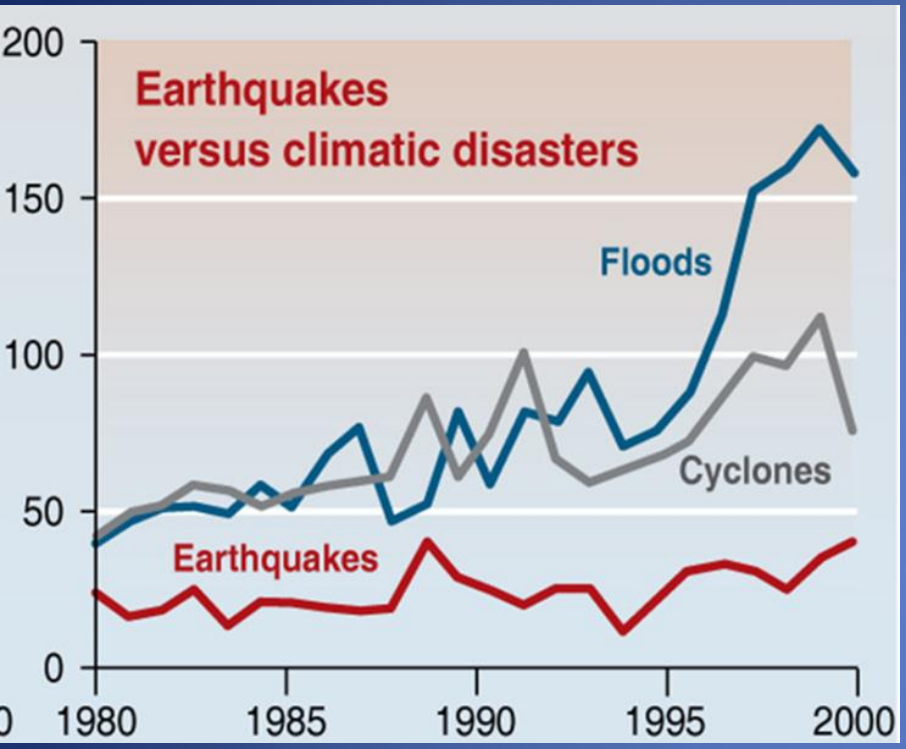
Missouri River Flooding 2011





Cartoon by Chris Britt/SJ-R

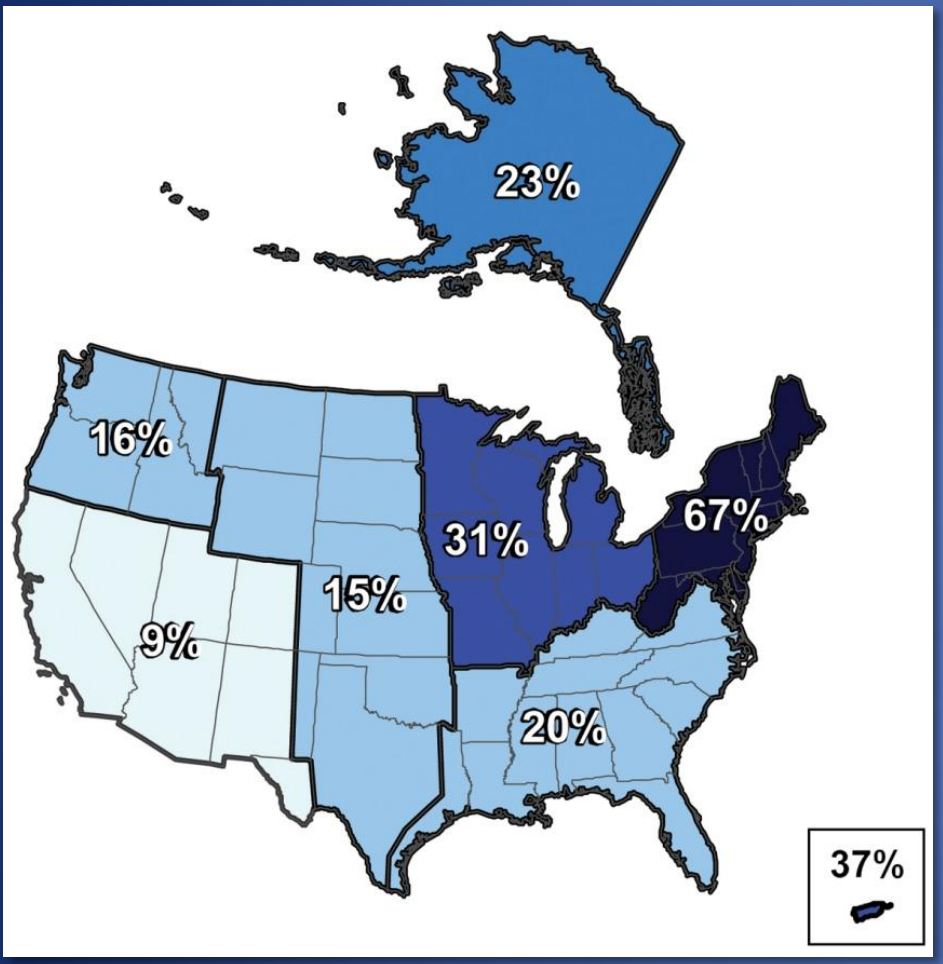
Flooding Demographics



San Joaquin County, California, 2010

- Flooding is #1 natural hazard (Loss of life and property damage)
- ~17 % of urban land in 100-year flood zone.
- UMRB loss of 65 m acres of wetlands = size of Illinois.
- $7.4 m in added flood damage per acre lost of wetlands (Brody, TX)
- FEMA predicts 100-year floods will grow by 40 to 45% over the next 90 years

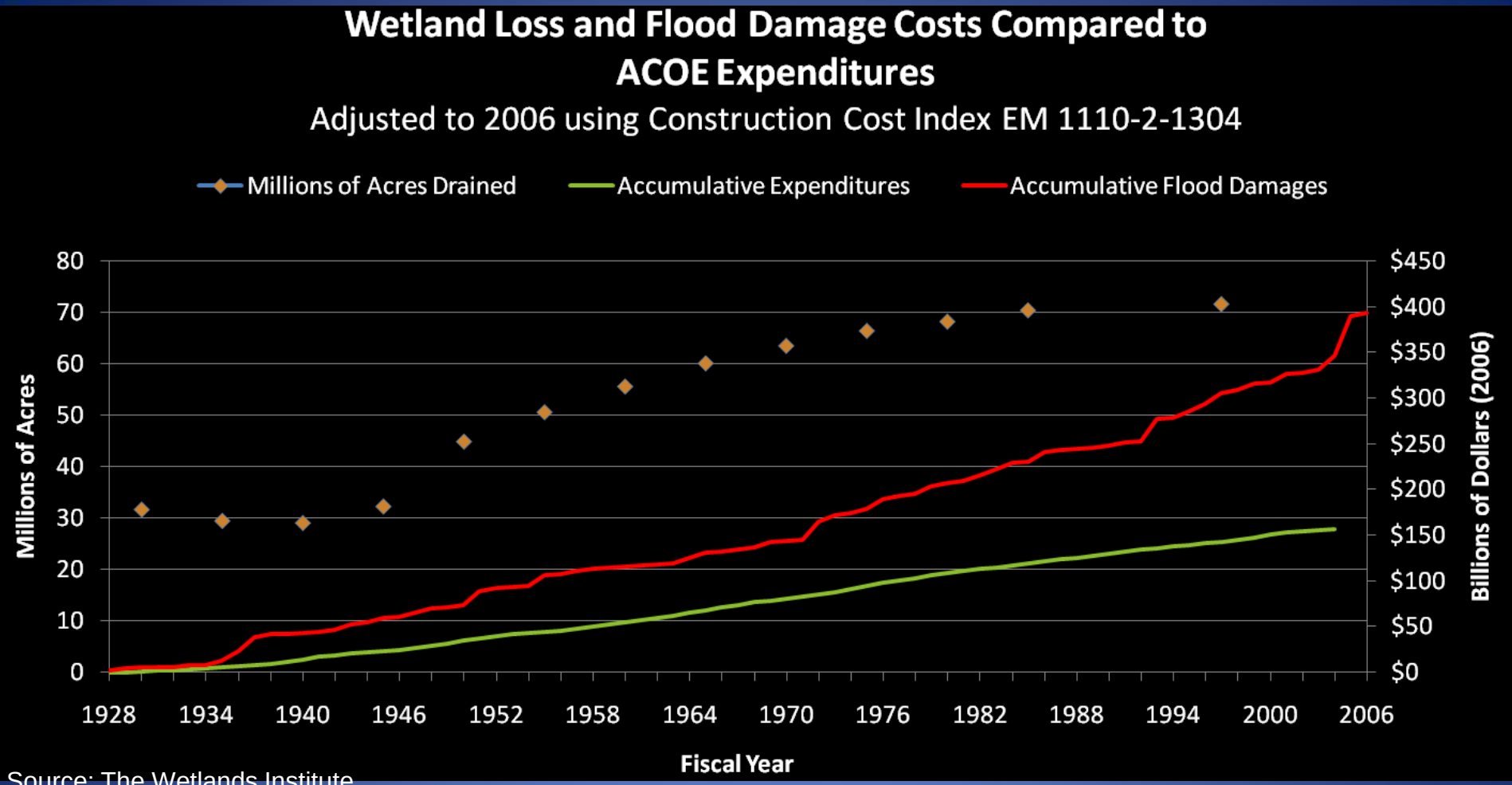
Changing Climate



Increase in intensity of precipitation from 1958-2007

(USGCRP Global Change Impacts in U.S. 2009 , updated from Groisman et al.)

- **Past century, overall precipitation up 7%**
- **heaviest downpours increased 20% over last 50 years**
- **1st 6 months of 2011, record breaking floods snowstorms, droughts and wildfires**
- **Increased Drought & Wildfires**
- **Future = volatility & uncertainty**



Source: The Wetlands Institute

- Average flood damages $10 billion per year.
- In 2011 there were 58 Federal flood disaster declarations, covering 33 different states.
- Flood damages were over $8 billion and caused 113 deaths, both exceeded the 30 – year averages ($7.82 Billion in flood damages and 94 deaths per year).

Task Committee on Flood Safety Policies and Practices

Getting Engineers Involved in the Solution is a big deal

Stop Building the Right Things in the Wrong Places

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Call to Action

- Mississippi 1993, $20 Billion
- Katrina 2005, $100 Billion
- Ike 2008, $40 Billion
- Mississippi 2011, $10 Billion
- Irene 2011, $25 Billion
- Sandy 2012, >$80 Billion
- NFIP > 20 Billion Deficit

Current National Flood Risk Policy

- **Promotes construction in risk areas**
- **Ignores changing conditions**
- **Many FIRMs that are old, inaccurate, or nonexistent (unmapped areas)**
- **Undervalues natural resources and floodplain functions**
- **Transfer of who pays for Risk**
- **Cycle of Disaster, Disaster Assistance, rebuild, Disaster**

The Problem

- Have lessons been learned, or merely observed?
- Have lessons been incorporated into public policy?
- Have lessons influenced engineering practice?
- If we know what we need to do, why aren't we doing it?

The Problem (Cont.)

- No National (Not Federal) Vision on how to reduce flood risk
- Lack of good data or sound analysis on what the potential risk is.
- The nation's flood infrastructure (dams and levees) is in marginal or near failing condition?
- Climate change and population growth will further increase flood risk.
- The greatest task is to reverse many decades of past decisions that created these issues

ASCE Hurricane Katrina Review (2007)

- Keep safety at the forefront of public priorities
- Quantify the risks
- Communicate the risks to the public and decide how much risk is acceptable
- Re-think the whole system (Land use, Flood Management Policy + NFIP),
- Put someone in charge
- Improve interagency coordination
- Upgrade engineering design standards
- Place safety first

Challenges

- How do we manage flood risk with least harm to natural resources?
- How do we avoid the cycle of loss-and-repair?
- How do we allocate costs fairly?
- How do we account for a growing population and climate change?
- How do we achieve sustainability?

Committee Charge

- Investigate whether the lessons learned from failures during Hurricane Katrina and other flood disasters have been incorporated in the planning, design, construction and management of engineering water resource projects for the future
- Provide a basis for influencing needed change in public policy and engineering practice related to flood safety and flood management.

Committee Members

- Robert Traver, Chair, Ph.D., P.E., DWRE, M.ASCE*
- Christine Andersen, P.E., M.ASCE*
- Billy Edge, Ph.D., P.E., D.CE, Dist.M.ASCE*
- David Fowler, CFM, P.E., M.EWRI
- Gerald Galloway, Jr., Ph.D., P.E., D.CE, Dist.M.ASCE
- Robert Gilbert, Ph.D., P.E., D.GE, M.ASCE*
- Carol Haddock, P.E., M.ASCE, Former ASCE Congressional Fellow
- L. Edward Link, Ph.D., HG, M.ASCE, IPET Chair**
- John Moyle, P.E., M.ASCE
- Lawrence Roth, P.E., D.GE, F.ASCE*
- P. Kay Whitlock, P.E., D.WRE, F.ASCE
- Jessica Ludy, M.EWRI (Non-voting member

ASCE Staff

- John Durrant, P.E., M.ASCE*
- Mike Charles, Aff.M.ASCE
- Barbara Whitten, A.M.ASCE

*Members of the Hurricane Katrina External Review Panel

**Hurricane Katrina Interagency Performance Evaluation Task Force (IPET)

Committee Work Plan

- Reviewed past recommendations and findings from several published reports
- Developed and implemented an extensive questionnaire to understand progress made and challenges ahead
- Identified 11 flood prone areas in the US and abroad as study areas
- Interviewed local experts in these areas
- Identified compelling topics in flood safety
- Hosted a Summit entitled “Building a Framework for Flood Risk Management; Goals, Roles and Responsibilities, Resources and Systems.
- Prepared Final Report

Summit on Building a Framework for Flood Risk Management

- What are our National Overarching Goals?
- What are the Roles and Responsibilities
  - For each level of government (local, state, federal)
  - Individuals and Property Owners
- What Resources are Needed?
- What Approaches are Needed?

Findings of Summit

- Flood safety continues to receive scant attention
- No common vision of how the nation should organize and coordinate to deal with flooding
- No sound analysis of the potential risk to the nation from flooding
- Flood infrastructure, primarily dams and levees, remains in near-failing condition with no plan to improve conditions
- Climate change and population growth will further stress this already difficult situation
- Limited progress has been made but more must be done
- Not enough emphasis on Non-Structural Sustainable Flood Management

Goals

- Look for opportunities to avoid development in high risk locations and include true cost/benefit for the extent and location of built resources that are needed
- Where risks exist in developed areas, ensure that communities are prepared to properly respond to emergencies to mitigate risk to life safety
- Preserve the basic natural resources that maintain social and environmental needs
- Determine new economic models and markets for our natural resources that include flood risk reduction

What resources are available, and how are the resources applied?

- Phases
  - Pre-disaster preparation—roles and responsibilities clearly defined
  - Disaster response—coordination of resources to enable efficient and effective operation
  - Post-disaster response—balance consideration of alternatives with immediate efforts to rebuild
- How do we avoid misapplication of resources?

Identified Resources

- Natural—environmental resources that are critical for sustainable ecosystems (eco services)
- Built—man-made flood reduction systems that support developed areas and land uses
- Individual—personal involvement
- Community—policy direction to achieve common goals
- Financial—capital resources to implement strategies

Implementing flood risk management requires:

1. A common definition of flood risk and a consistent means of assessing risk.
2. Effective collaboration, clear communications, and well-defined roles at all levels of government, the private sector, and the public.
3. Balanced consideration of structural and non-structural measures for sustainable resilient infrastructure.
4. Basing land use decisions on sustainable flood risk management principles
5. Establishing of long-term, reliable funding mechanisms for flood risk reduction at the federal, state and local level.
6. Adapting flood risk management strategies to meet changing conditions.

National Goals

1. What are we trying to achieve for life safety and economic risk?
2. How much of our expenditures and efforts to mitigate risk should be associated with preventative versus restorative measures?
3. How do we encourage effective risk management and discourage ineffective risk management?

Committee Findings

Recommendations

1. President and Congress need to address the infrastructure maintenance
   - Shared federal/state/local funding
   - National infrastructure bank
   - Local Funding mechanisms (similar to America Fast Forward Bonds)
   - Water infrastructure Finance and Innovation Act (pilot flood focused version)
   - ASCE needs to work with President and Congress to develop funding strategy
   - Identify of “full funding” for approved water projects

Recommendations (Cont.)

2. FIFMTF working with states should develop 21st Century unified national program for flood management.
3. Congress should provide funding to conduct the national flood vulnerability study stipulated in the 2007 WRDA Act.
4. At all levels of government balance non-structural and structural flood mitigation
5. In planning mitigation consider both long-term and short term impacts (climate change, population, and infrastructure renewal)

Recommendations (Cont.)

6. CEQ should develop guidelines to support implementation of federal principles and requirements that include public safety and ecosystem values equally in decision making. Provide incentives and create a framework that relates ecosystem benefits to other types of benefits.
7. FEMA, NOAA, USACOE , and USGS, should support the development of a coalition of nongovernment organizations to carry out a coordinated communication campaign concerning flood risk and actions to deal with the risk.

Sustainable Flood Risk Management Provides:

1. Effective and sustainable management of risks posed by floods to life safety, human health, economic activity, cultural heritage, and the environment.
2. Collaborative risk sharing and risk management at all levels of government and by all stakeholders.
3. Risk Informed policies and funding prioritization
4. Incorporate the use of natural processes to mitigate the consequences of flooding.

Future Actions

- Strengthen the Ties between the ASFPM and ASCE)
- Build on the ASCE National Flood Policy Recommendation Report
- Work on building on sustainable flood management engineering practices at the grass roots
- Get engineers to build great things in the right places (my opinion only)

Reasons for Optimism

Reasons for Optimism

- Structures in the SFHA < $250,000 will qualify for acquisition funding without a BCA Calculation
- Ecosystem Services Valuation was used in making this change (Dave Baxter, Earth Economics)
- Puts Acquisition on a level playing field for funding with Structural alternatives (i.e.: Levees)
- Working to get FEMA and ACOE to use ECO Services in BCA for structural project funding (loss of ECO Services would be a negative)
- Sustainable flood management like “Make Room for the River” is gaining momentum nation wide

Make Room for the River (RvR) began as idea in 1986, gained momentum in 1990s, US projects as inspiration

Netherlands Embassy

Time for Tough Questions:

"The rising waters of the Mississippi are about to test human judgment and engineering anew" John M. Barry, WSJ, 4/30/11

- **Do we have an over reliance on structural approaches (dams, levees, etc.)?**
- **Are we incentivizing flood risk?**
- **What should the federal role be in reducing the nation's flood risk?**
- **Will the upcoming policy opportunities provide the reforms that are so badly needed?**

"…floods will occasionally come which must be allowed to spread"

- William Hammond Hall, engineer 1800

New Approach for Flood Management

Make Room for Rivers to safely accommodate floods.

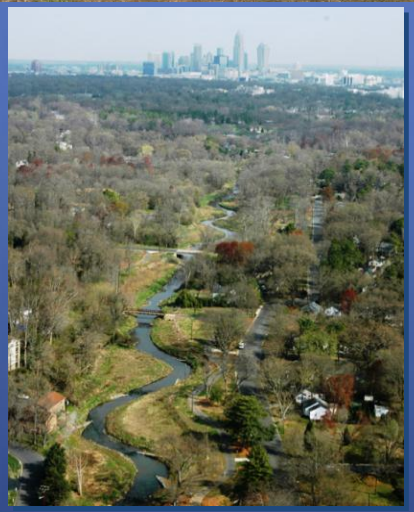
Grey Strategy

- Large, expensive projects
- Economies of scale
- Proven performance
- Exposure to failures, energy markets
- Long design and construction time
- End of pipe technology bears brunt of Climate Change

Green Strategy

- Smaller, inexpensive projects
- Network requires numerous projects
- Proven on demonstration level
- Low energy inputs reduce exposure to market fluctuations
- Shorter design and construction time
- Resilient to impacts of climate change
- Allows for adaptation and flexibility

Reconnecting the River…



- **Protect**: Floodplain acquisition through buyouts and relocations to restore beneficial functions of floodplains, establish greenways, parks, recreational space.

Restore: Setting levees back, retiring sensitive agricultural lands, and restoring riparian vegetation increases storage.

- **Replicate**: Implementing green infrastructure and working with nature reduces flood flows and enhance water quality.

Naturally Functioning Floodplains:

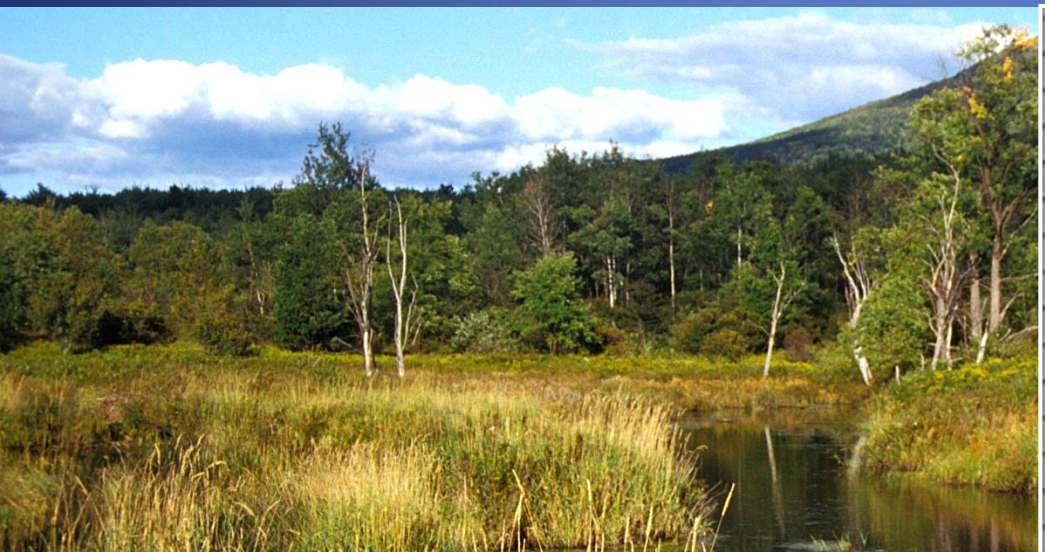
PEOPLE

- ✓ Reliable water supplies
- ✓ Protection of health
- ✓ Safety from storms and failing infrastructure
- ✓ Quality of life – recreation, aesthetics, quiet solace
- ✓ Economic security
- ✓ Community stability

ECOSYSTEMS

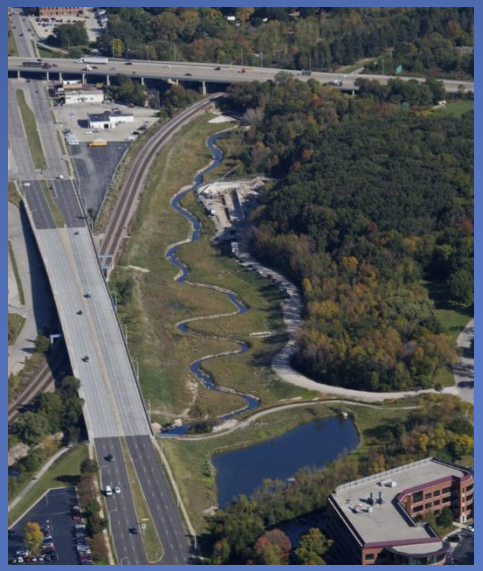
- ✓ Diversity of habitats
- ✓ Diversity of species
- ✓ Migratory corridors
- ✓ Refuge from disturbances
- ✓ Natural, dynamic flows trigger reproductive cues
- ✓ Protection of species health – especially from toxics

Despite representing <2% of Earth's land surface area, floodplains are 2nd to estuaries in the value to society providing ~25% of all terrestrial ecosystem service benefits.



Areas of Progress Sustainable Green Flood Management (Make Room for the River)

Boulder, CO
Milwaukee, WI
Charlotte, NC
Otter Creek, VE
Portland, OR
Denver, CO
Napa, CA
Ottawa, IL
Pierce County, OR
Sacramento, CA
New Madrid Floodway



MMSD's 2035 Vision

(http://v3.mmsd.com/NewsDetails.aspx)

Integrated Watershed Management Goals:

Zero sanitary sewer overflows

Zero combined sewer overflows

Zero homes in the 100 year floodplain

Acquire an additional 10,000 acres of river buffers through Greenseams®
Use green infrastructure to capture the first 0.5 inch of rainfall

Harvest the first 0.25 gallon per square foot of area of rainfall

Energy Efficiency and Climate Mitigation & Adaptation Goals:

Meet 100% of MMSD's energy needs with renewable energy sources

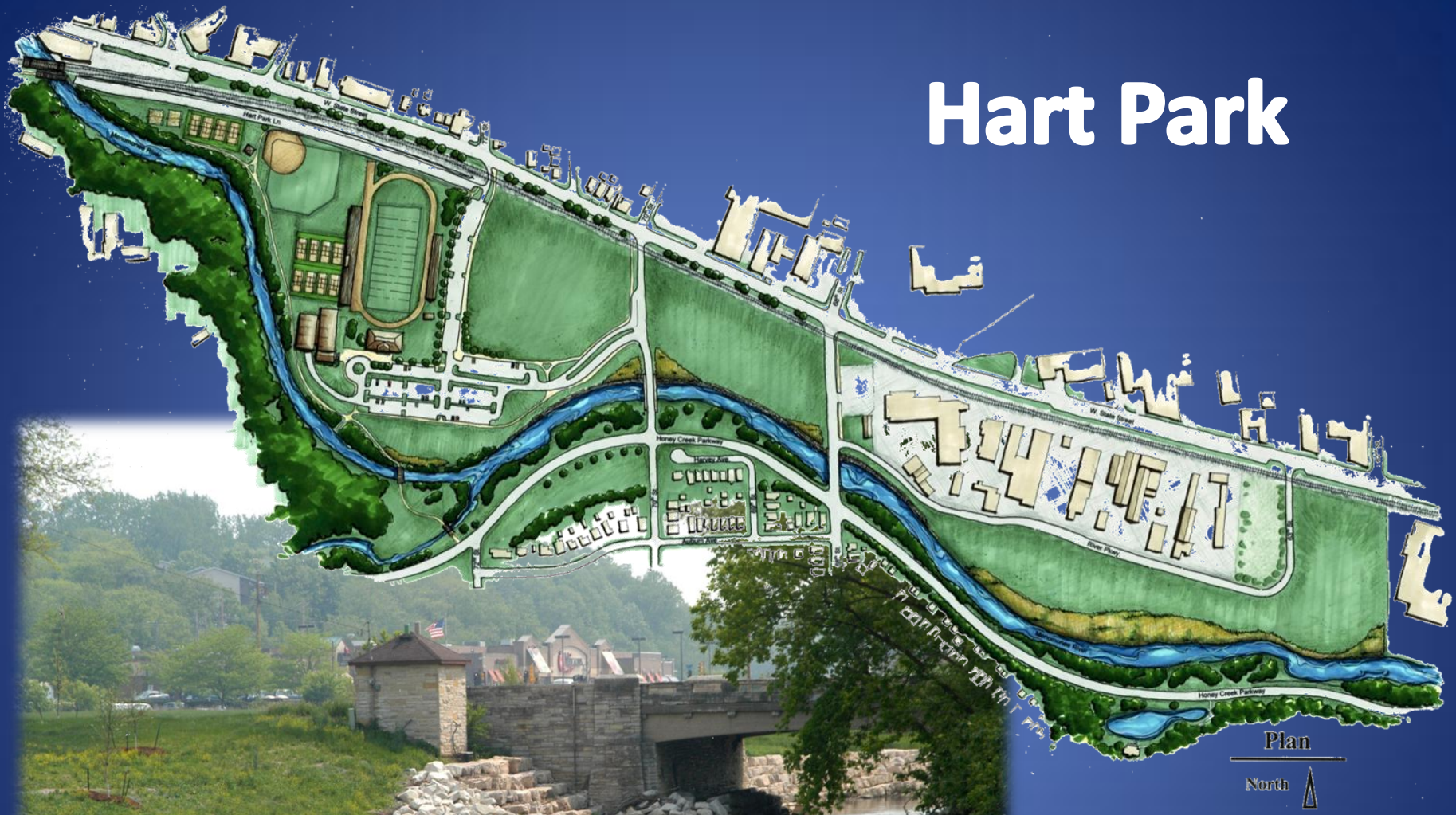
Meet 80% of MMSD's energy needs with internal, renewable sources

Use the Greenseams® Program to provide for 30% sequestration of MMSD's carbon footprint

Reduce MMSD's carbon footprint by 90% from its 2005 baseline

Valley Park Project

Hart Park


W. State Street
Hart Park Ln.
Honey Creek Parkway
Honey Ave.
River Pkwy.
Honey Creek Parkway
Plan
North

County Grounds

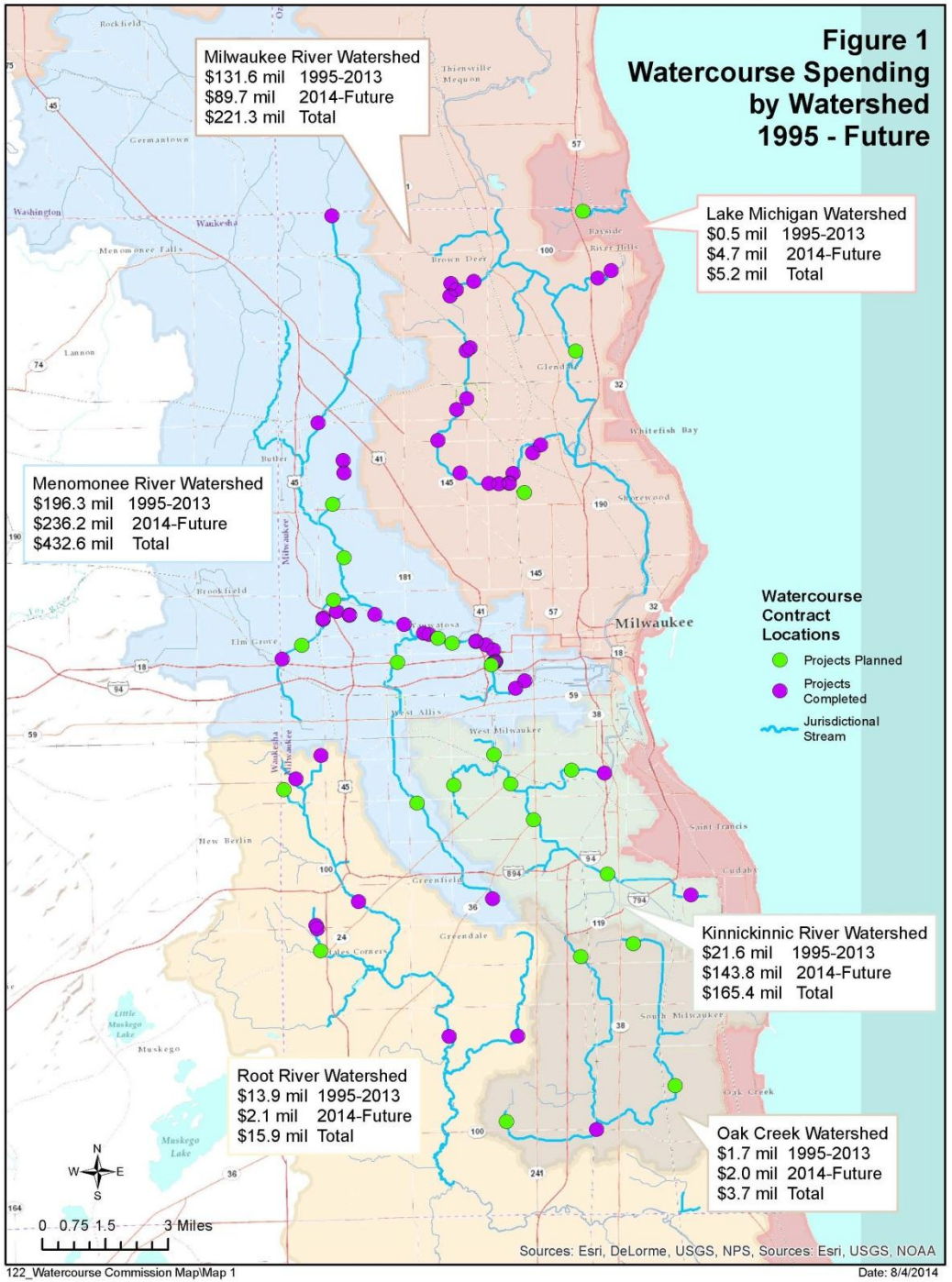
Kinnickinnic Concrete Removal

Menomonee River Concrete Removal


Greenseams®
2,660
Acres

Watercourse Spending

Milwaukee River	$221.3 M
Lake Michigan	$ 5.2 M
Menomonee River	$432.6 M
Root River	$ 15.9 M
Kinnickinnic River	$165.4 M
Oak Creek	$ 3.7 M



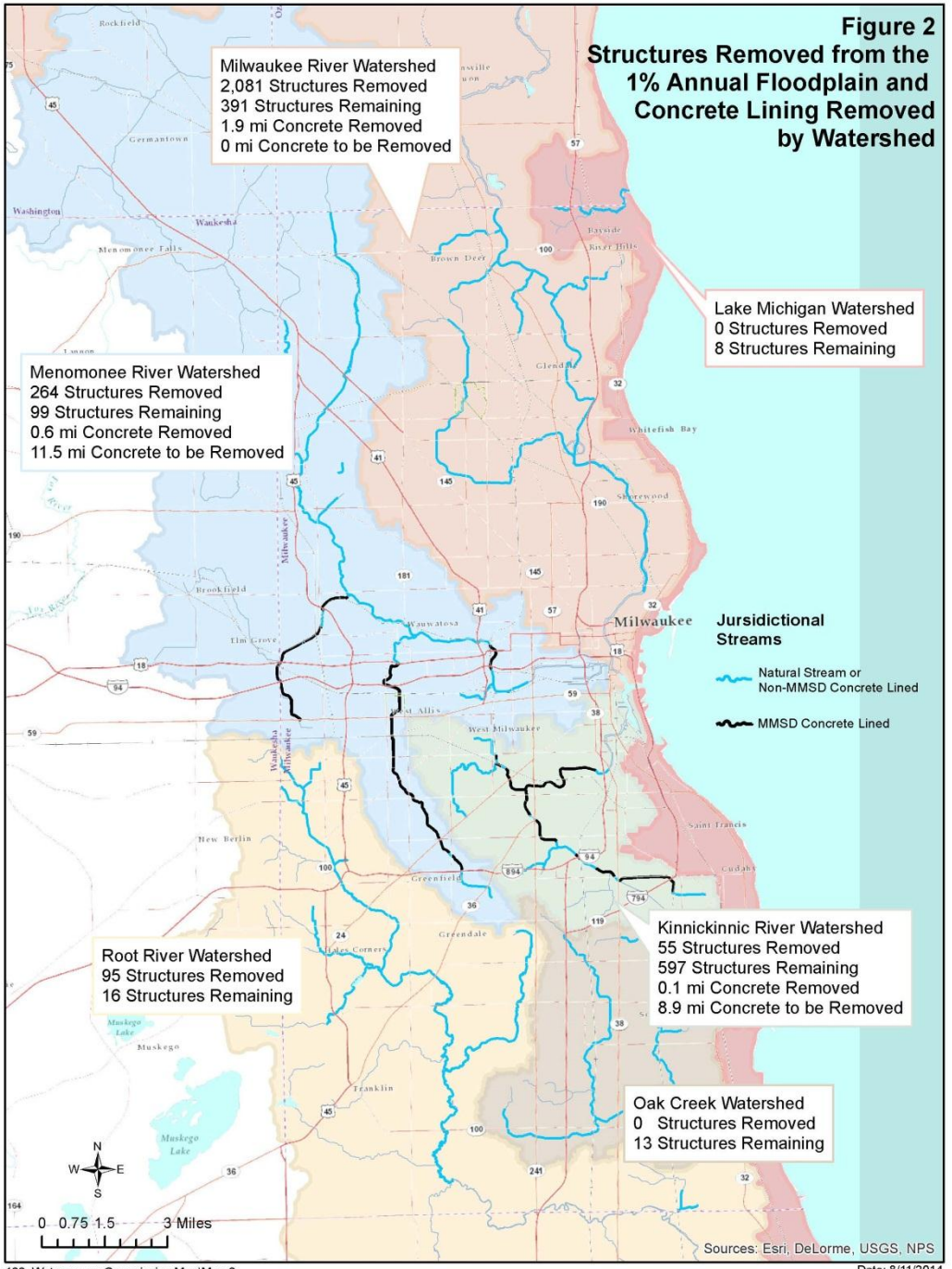
Impacts of our Work

Homes in Floodplain Removed/Remaining

Milwaukee River	2,081/391
Lake Michigan	0/8
Menomonee River	264/99
Root River	95/16
Kinnickinnic River	55/597
Oak Creek	0/13

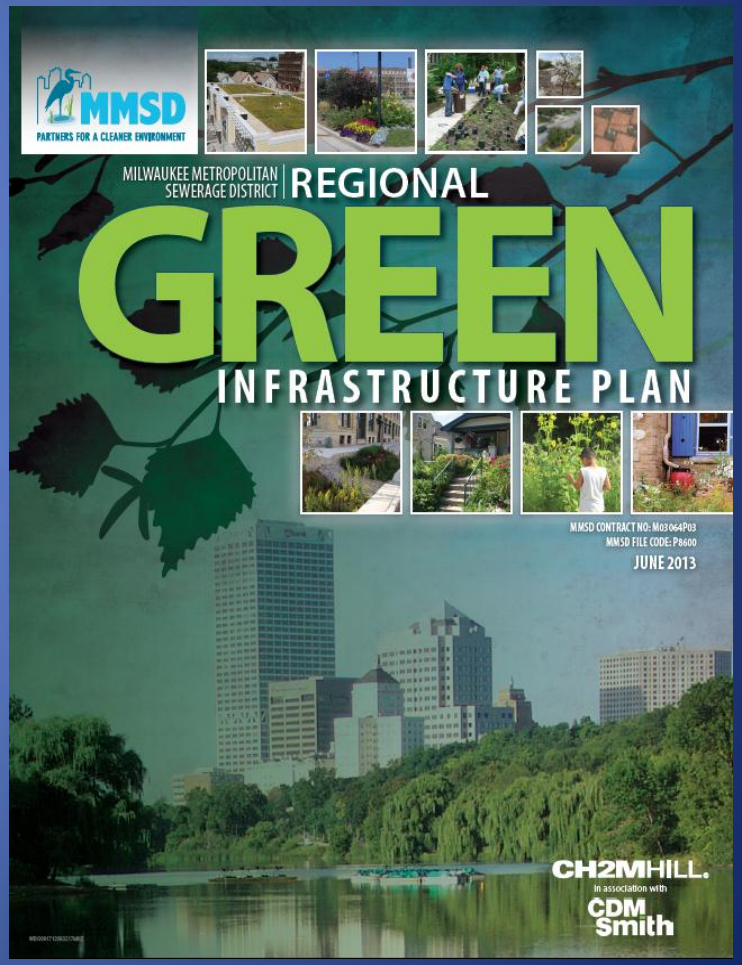
Miles of Concrete Removed/Remaining

Milwaukee River	1.9/0
Lake Michigan	0/0
Menomonee River	0.6/11.5
Root River	0/0
Kinnickinnic River	0.1/8.9
Oak Creek	0/0



MMSD's Regional Green Infrastructure Plan

- Meet new discharge permit requirement
- Capture the first 0.5" that falls on impervious surfaces or an additional 740 MG
- Prioritize green infrastructure projects



MMSD
PARTNERS FOR A CLEANER ENVIRONMENT

Milwaukee Metropolitan Sewerage District


FRESH COAST 740
MILWAUKEE, WISCONSIN

What is Green Infrastructure

10 GREEN INFRASTRUCTURE DEFINITIONS

Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. At the largest scale, the preservation and restoration of natural landscape features (such as forests, floodplains and wetlands) are critical components of green stormwater infrastructure. By protecting these ecologically sensitive areas, communities can improve water quality while providing wildlife habitat and opportunities for outdoor recreation. On a smaller scale, green infrastructure practices include strategies such as rain gardens, porous pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting for non-potable uses such as toilet flushing and landscape irrigation.

GREENWAYS

Greenways

RAIN GARDENS

Rain Gardens

BIO-SWALES

Bioswales

POROUS PAVEMENT

Porous Pavement

WETLANDS

Wetlands

STORMWATER TREES

Stormwater Trees

NATIVE LANDSCAPING

Native Landscaping

RAINWATER CATCHMENT

Rainwater Catchment

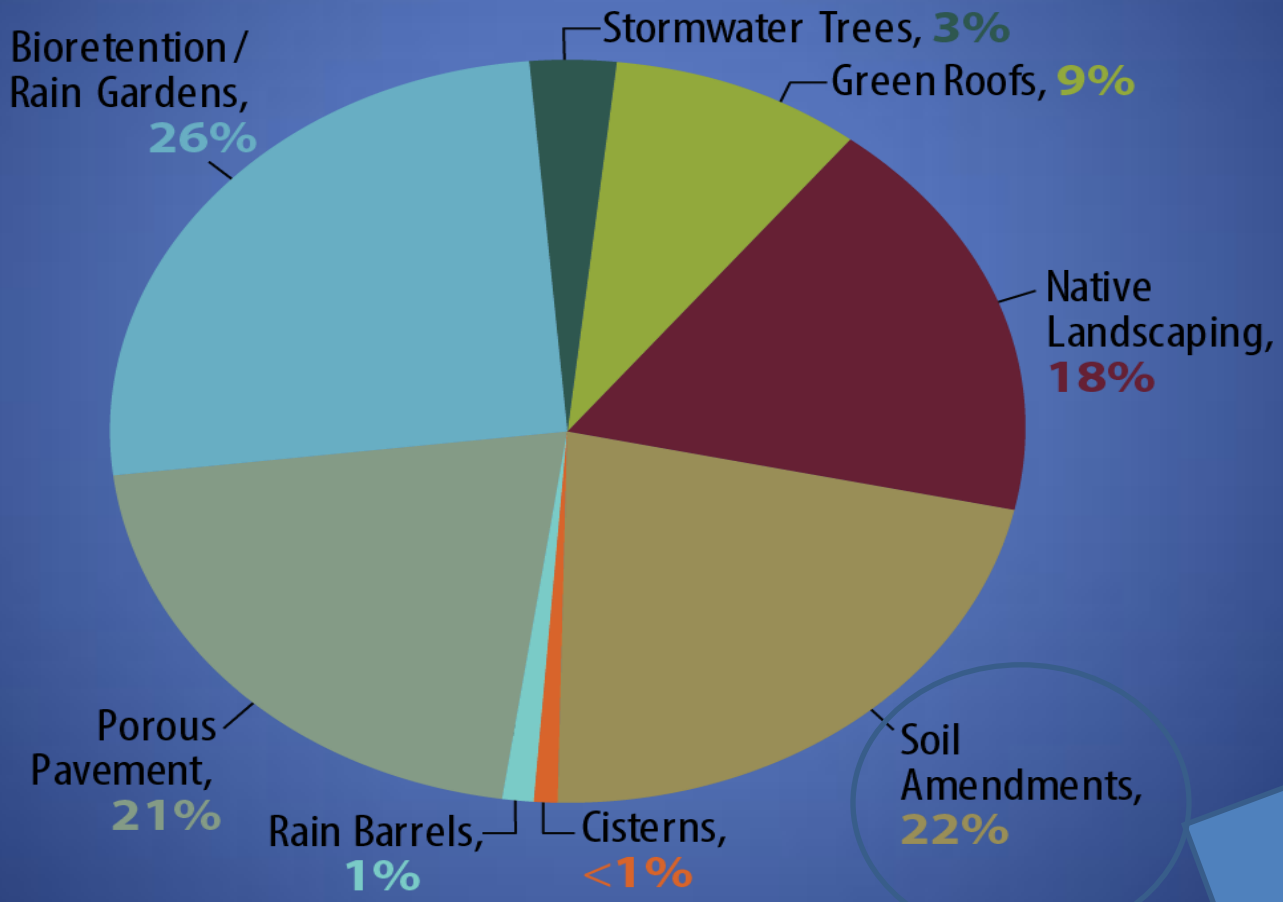
GREEN ROOFS

Green Roofs

GREEN ALLEYS, STREETS AND PARKING LOTS

Green Streets, Alleys, Parking

The Mix of Green



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LAKE MICHIGAN

Rain Gardens

INITIATIVE

29,300 Plants Sold Since 2006

PSWM Rain barrels

More than

18,000

SOLD

Since 2002


Green Roofs
+10 acres
since 2003

Benefits at full implementation

Economic	
Green job opportunities	633 O&M; 161 construction jobs
Reduced infrastructure costs in the CSSA	$221.8 million compared to cost of GI in CSSA of $179.5 Million
Reduced pumping and treatment costs	Reduction in the need for deep tunnel pumping and associated treatment: $1.3 million/year
Increased property values	Increase in property values due to aesthetic improvements from GI: Residential: $447.8 million Commercial: $238.2 million Industrial: $ 19.9 million Total: $705.9 million

Benefits at full implementation

Social	
Improved quality of life and aesthetics	Recreational Area Increase: 275 acres Reduced Crime & Social Program Costs
Improved green space/recreational areas	Native landscaping: 8,600 acres Bio-retention/rain gardens: 670 acres Number of trees: 738,000

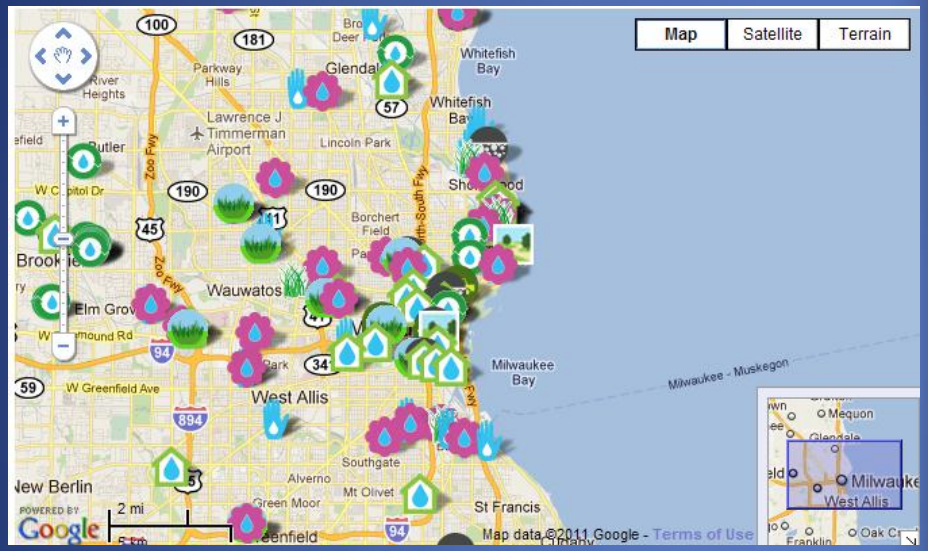
Benefits at full implementation

Environmental	
Captured stormwater runoff	740 MG new GI storage
Reduced pollutant loadings	Total suspended solids: 15.1 million pounds/year Total Phosphorus: 54,400 pounds/year
Carbon reduction	CO_2 sequestered plus emissions avoided due to GI-related energy savings: 73,000 tons/year Reduction costs due to effects on human health, property damages from increased flood risk, etc. $1.4 million/year

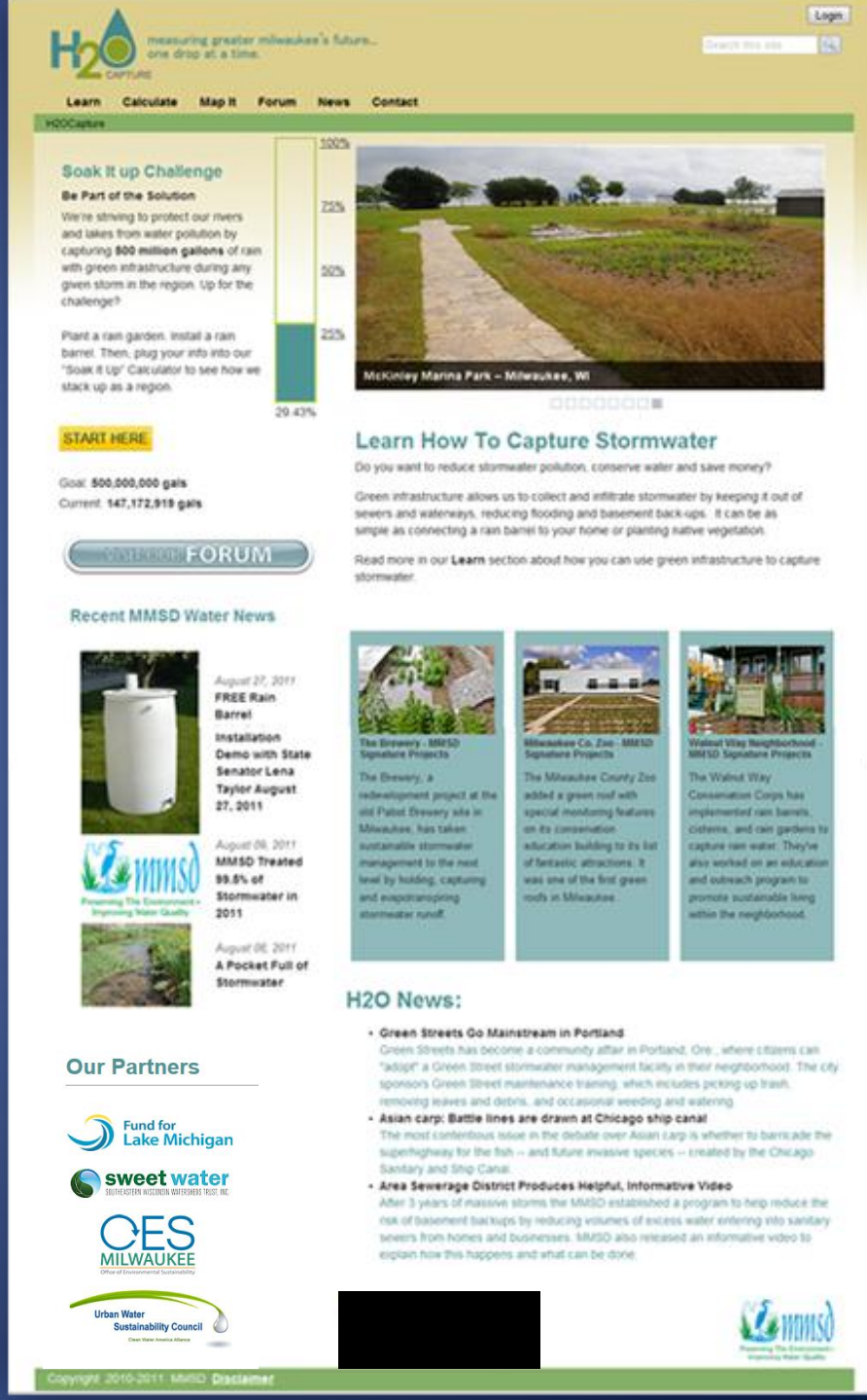
Benefits at full implementation

Environmental	
Reduced energy use for cooling	Due to the insulating properties of green roofs and tree shading: 16.5 million kWh/year Associated cost savings: $1.5 to $2.1 million
Improved air quality	Criteria air pollutants removed by trees plus emissions avoided due to GI-related energy savings: CO: 8 tons/year NO_2: 103 tons/year Ozone: 403 tons/year PM_{10}: 190 tons/year SO_2: 113 tons/year Human health benefit costs from NO_2 and SO_2 reductions: $6.4 million/year

Public Education



[www.mmsd.com and www.freshcoast740.com](http://www.mmsd.com)




Oh, crap! Was that TODAY?
REGAN


Questions?