Research and Tools for Decentralized Systems from WERF and the DWRC

Jeff Moeller, P.E., WERF

EPA Decentralized MOU Partnership
Web Seminar
September 18, 2012

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Water Environment Research Foundation
Collaboration. Innovation. Results.

Introduction

- Rural communities, suburbs, and cities are looking for ways to meet water, wastewater, and stormwater needs
- Decentralized systems can be an affordable, sustainable solution
- Can be used with centralized systems for optimization

Introduction




- $16 million in research available on decentralized systems
  - Decision-making tools
  - Design
  - Management options
  - Much more…
- Research program is a joint effort between the WERF and the Decentralized Water Resources Collaborative (DWRC) with funding from U.S. EPA

Decentralized Water Resources Collaborative

WERF
Water Environment Research Foundation
Collaboration. Innovation. Results.

CIDWT

Coalition for Alternative Wastewater Treatment

EPRI ELECTRIC POWER RESEARCH INSTITUTE

National Rural Electric Cooperative Association
A Touchstone Energy® Cooperative

NOWRA

Introduction




DWRC History:

- Phase 1: 1997-2003
  - Administered by Washington U. in St. Louis
  - 30+ projects, $8 mill.

- Phase 2: 2003-2010
  - Administered by WERF
  - 40+ projects, $8 mill.

Agenda




1. Program Scope
2. Research Highlights
3. Outreach

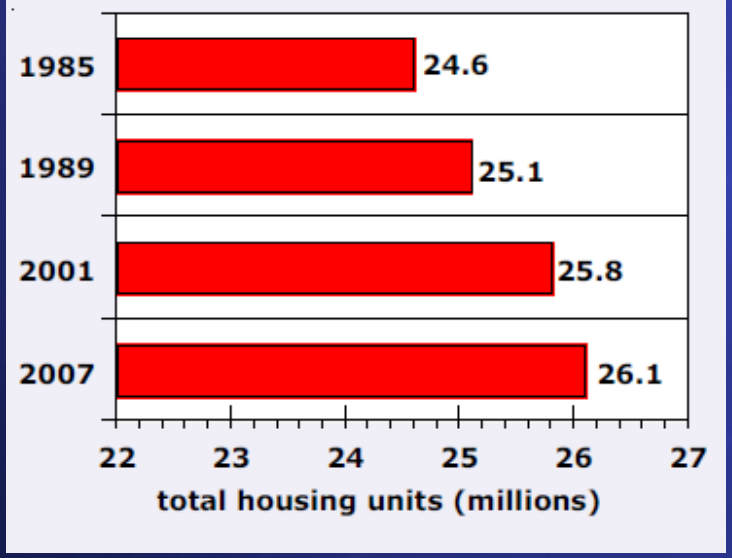
Questions/Discussion

Program Scope

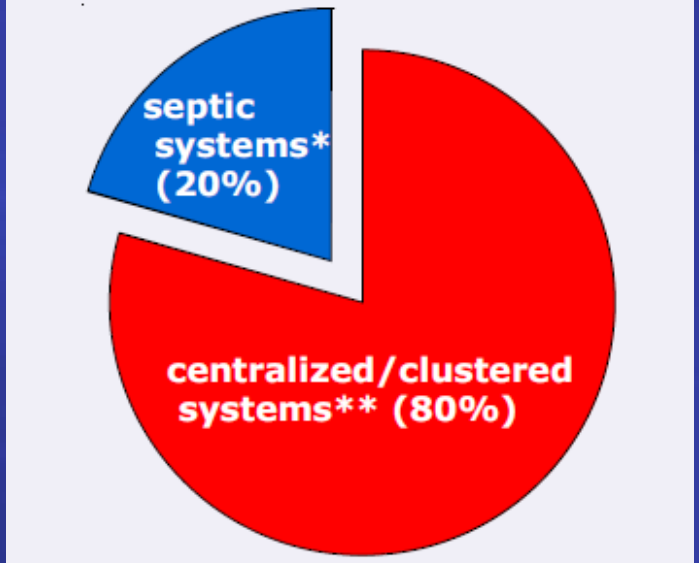
1. Septic / Onsite Systems

Source: NDWRCDP

Total housing units served by septic systems



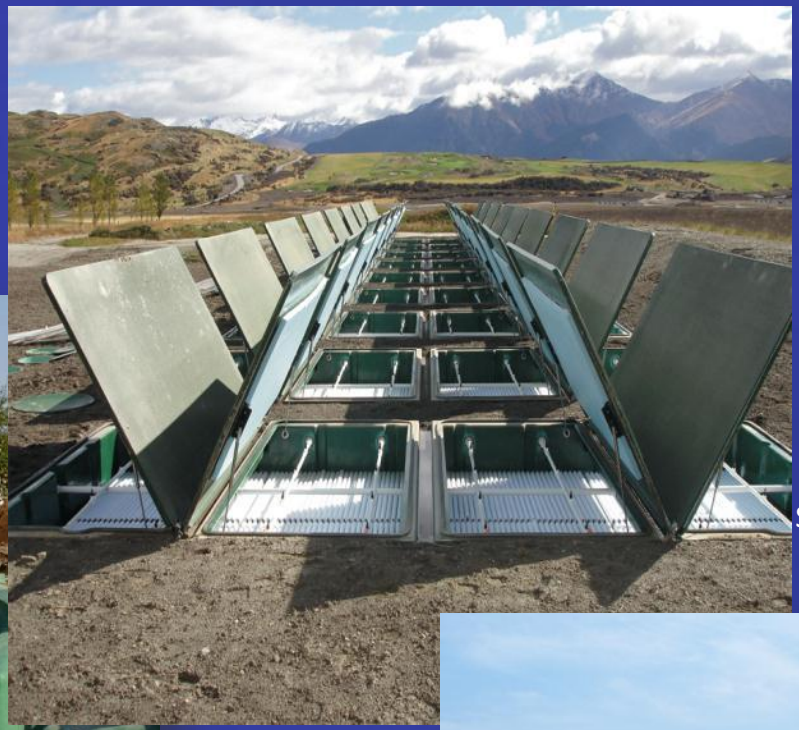
Total housing units served by septic and centralized/ clustered systems



Source: US EPA

Program Scope

2. Small Community and Cluster Systems



Source: Orenco Systems

Source: Premier Tech Aqua, Ecoflo Cluster

Source:
Loudon County

Program Scope

3. Urban and Suburban Applications

Source: Sidwell Friends

Source:
Ed Clerico, Alliance Environmental

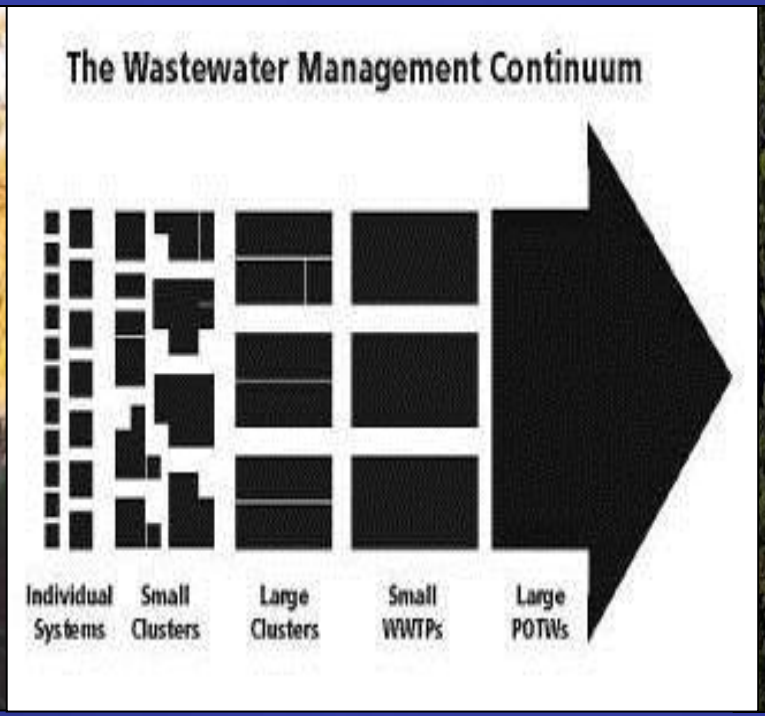
Source:
Terence Kerns, theEcoVillage.com.au

Program Scope

4. LID / Green Infrastructure for Stormwater

Source: Barr Engineering Company and the City of Burnsville, MN

Program Scope

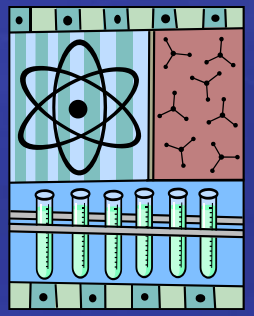


Source: Vic D'Amato, Tetra Tech

Program Scope

Focus Areas:

- WERF → Environmental Science & Engineering

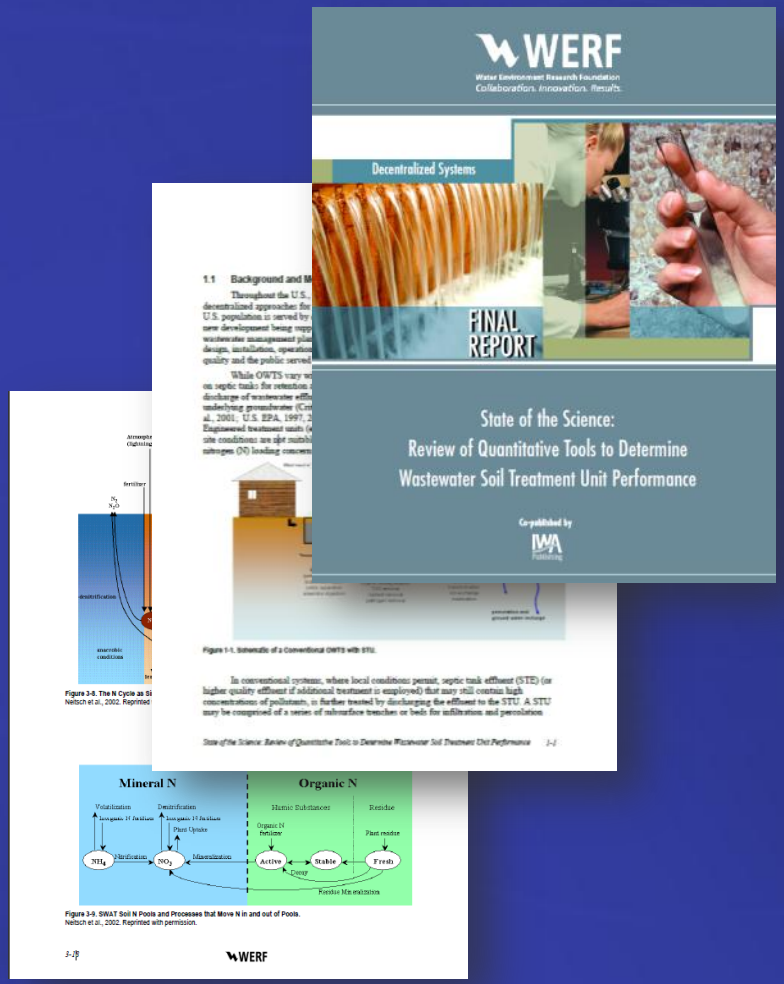


- CAWT
- EPRI
- NRECA → Management, Economics, & Policy

- CIDWT
- NOWRA → Training and Education

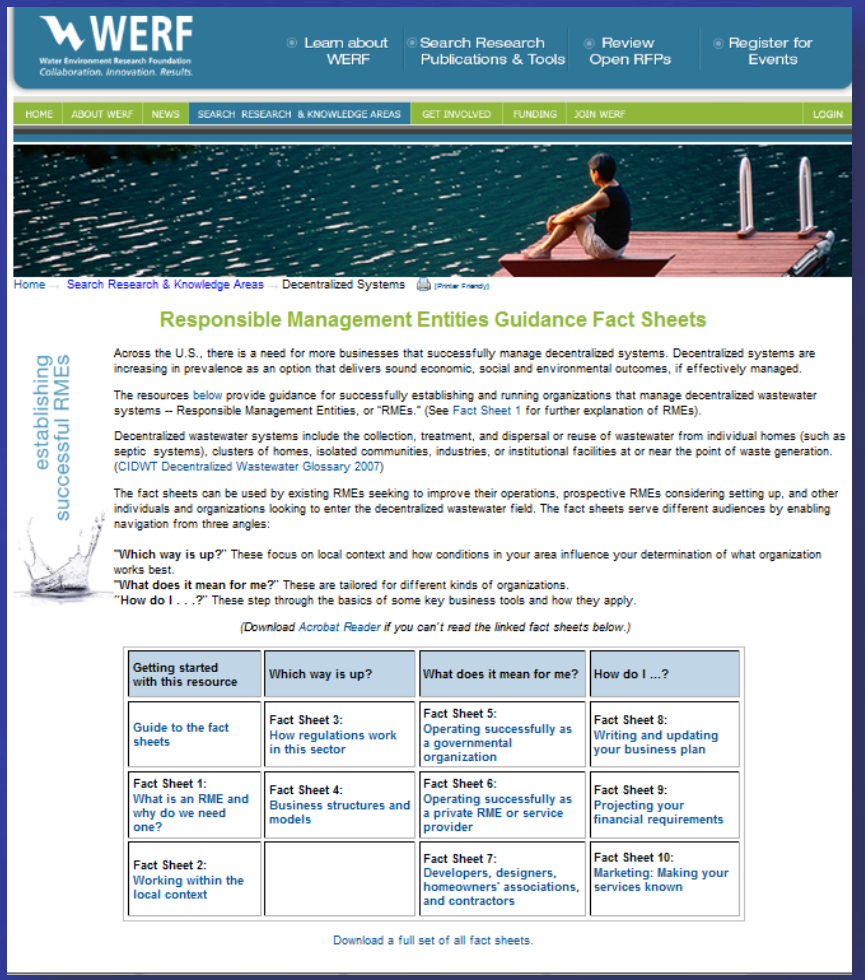
Research Highlights

- Environmental Science and Engineering
  - *Quantitative Tools to Determine the Expected Performance of Wastewater Soil Treatment Units*
  - *Evaluation of Greenhouse Gas Emissions from Septic Systems*
  - *Influent Constituent Characteristics of the Modern Waste Stream from Single Sources*



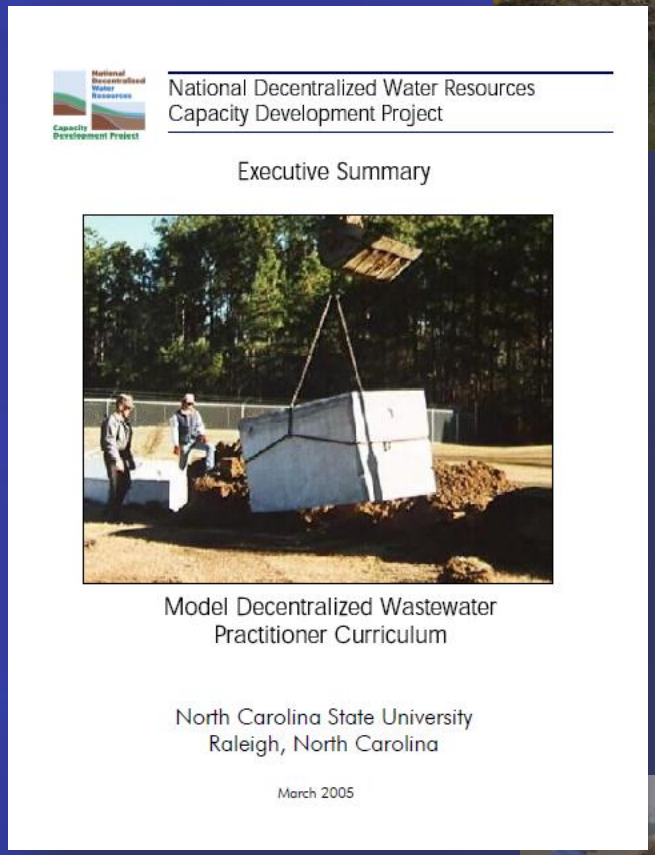
Research Highlights

- Management, Economics, and Policy
  - *Business Attributes of Successful Responsible Management Entities*
  - *International Issues and Innovations in Integrated and Decentralized Water Resource Infrastructure*
  - *Overcoming Barriers to Evaluation and Use of Decentralized Wastewater Technologies and Management*



Research Highlights

- Training and Education
  - *Educational Curriculum for Onsite/Decentralized Wastewater Treatment*
  - *Installer Training Program*
  - *Decentralized Wastewater Treatment O&M Service Provider Training Program*
  - *Decentralized Wastewater Glossary*



Research Highlights




Highlights From Select Projects

RMEs

Guidance for Establishing Successful Responsible Management Entities

- Professional management ensures performance and reliability of decentralized systems
- Responsible management entities (RMEs) are a successful management model
- A website was created to provide all the resources needed to establish an RME

www.werf.org/RME

RMEs




Getting started with this resource	Which way is up?	What does it mean for me?	How do I ...?
Guide to the fact sheets	**Fact Sheet 3:** How regulations work in this sector	**Fact Sheet 5:** Operating successfully as a governmental organization	**Fact Sheet 8:** Writing and updating your business plan
Fact Sheet 1: What is an RME and why do we need one?	**Fact Sheet 4:** Business structures and models	**Fact Sheet 6:** Operating successfully as a private RME or service provider	**Fact Sheet 9:** Projecting your financial requirements
Fact Sheet 2: Working within the local context		**Fact Sheet 7:** Developers, designers, homeowners' associations, and contractors	**Fact Sheet 10:** Marketing: Making your services known

Download a full set of all fact sheets.

RME Website Screenshot

Performance & Cost

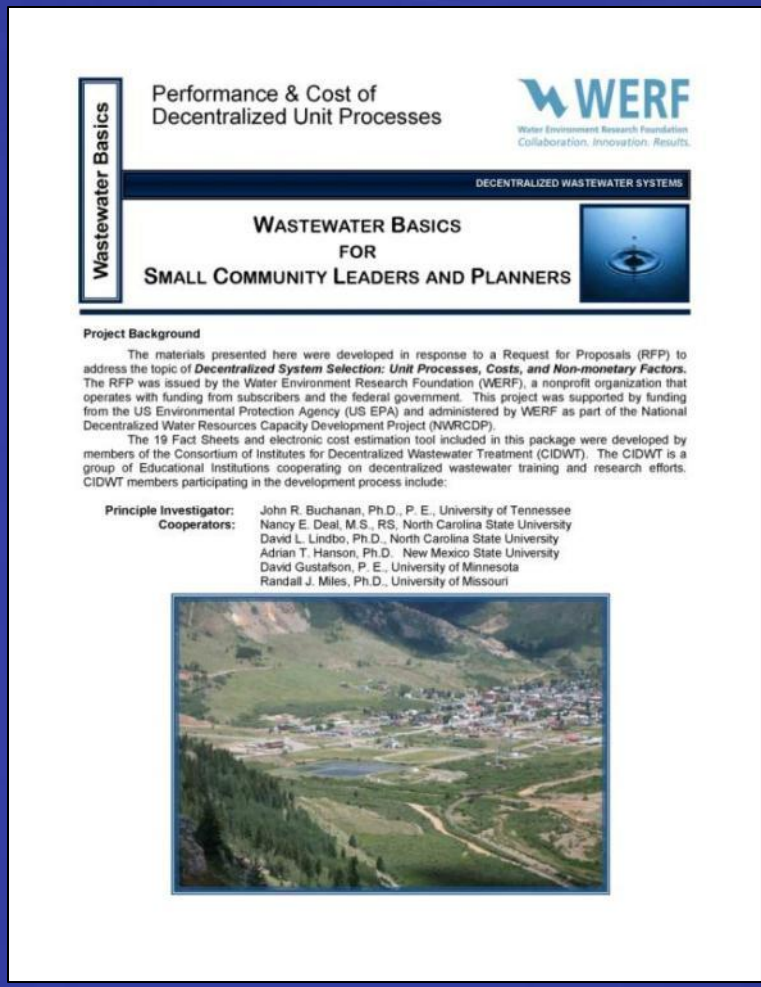



Performance and Costs of Decentralized Systems

- Provides basic wastewater management information to planners and decision-makers in very small communities
  - Mayor Smith

Products:

- Factbook
  - Wastewater Basics for Small Communities
- Factsheets
  - Collection systems (4)
  - Treatment systems (8)
  - Dispersal/disposal systems (7)
- Spreadsheet
  - Economic model of wastewater options



Wastewater Basics

Performance & Cost of Decentralized Unit Processes

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DECENTRALIZED WASTEWATER SYSTEMS

WASTEWATER BASICS FOR SMALL COMMUNITY LEADERS AND PLANNERS

Project Background

The materials presented here were developed in response to a Request for Proposals (RFP) to address the topic of ***Decentralized System Selection: Unit Processes, Costs, and Non-monetary Factors.*** The RFP was issued by the Water Environment Research Foundation (WERF), a nonprofit organization that operates with funding from subscribers and the federal government. This project was supported by funding from the US Environmental Protection Agency (US EPA) and administered by WERF as part of the National Decentralized Water Resources Capacity Development Project (NWRCDP).

The 19 Fact Sheets and electronic cost estimation tool included in this package were developed by members of the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT). The CIDWT is a group of Educational Institutions cooperating on decentralized wastewater training and research efforts. CIDWT members participating in the development process include:

Principle Investigator: John R. Buchanan, Ph.D., P. E., University of Tennessee
Cooperators: Nancy E. Deal, M.S., RS, North Carolina State University
David L. Lindbo, Ph.D., North Carolina State University
Adrian T. Hanson, Ph.D. New Mexico State University
David Gustafson, P. E., University of Minnesota
Randall J. Miles, Ph.D., University of Missouri

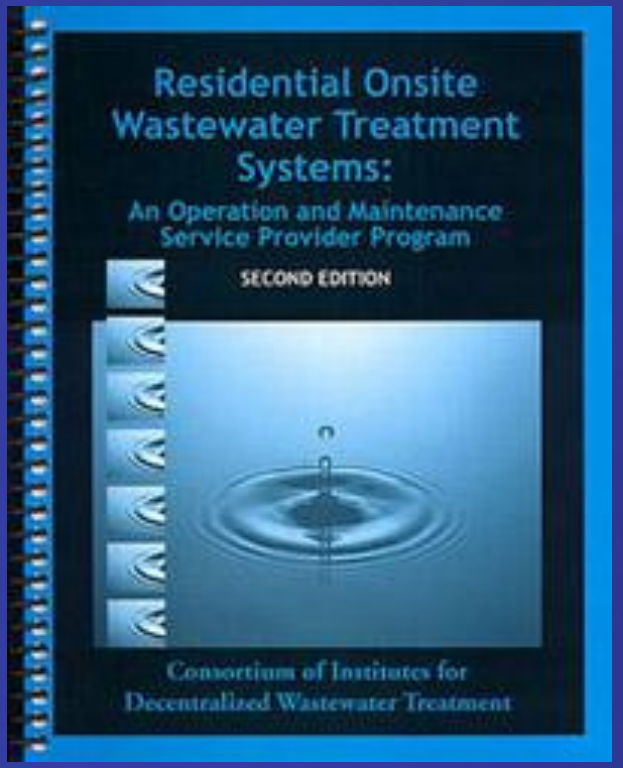
www.werf.org/decentralizedcost

Collection Fact Sheets	Treatment Fact Sheets	Dispersal Fact Sheets	Cost Tool
C1: Gravity Sewer Systems	T1: Liquid-Solid Separation	D1: Gravity Distribution	User's Guide
C2: Pressure Sewer Systems	T2: Suspended Growth Aerobic Treatment	D2: Low Pressure Distribution	Wastewater Planning Model, Version 1.0
C3: Effluent Sewer Systems	T3: Fixed Growth Aerobic Treatment	D3: Drip Distribution	
C4: Vacuum sewer Systems	T4: Constructed Wetland Systems	D4: Spray Distribution	
	T5: Lagoons	D5: Evapotranspiration System	
	T6: Nutrient Reduction	D6: Surface Water Discharge	
	T7: Disinfection	D7: Wastewater Reuse	
	T8: Residuals Management		

O&M

Decentralized Wastewater Treatment O&M Service Provider Training Program

- Benefits
  - Addressed the critical need for education and training for practitioners who provide O&M for onsite wastewater treatment systems
  - Provided training materials for developing a base level of knowledge of O&M service provider practitioners
  - Established a national basis for the best practices among O&M service providers



www.onsiteconsortium.org

Urban/Suburban

When to Consider Distributed Systems in an Urban and Suburban Context

- Analyzed 20 case studies in U.S. and Australia where decentralized /distributed systems are being used in areas where traditional approach would be centralized
- Study critical path details and decision processes for how these projects were planned and implemented
- Products:
  - Case studies and white papers
  - Decentralized Wastewater Stakeholder Model (Excel)

www.werf.org/distributedwater

Photo credits: reprinted with permission from Piperton, Tennessee.

Urban/Suburban




- Green Buildings and Sustainable Sites
  - Integration into buildings and landscapes
  - Resource conservation, recovery and reuse within facilities
  - Education and recreation
- Independent Communities
  - Maintain fiscal control
  - Preserve community character
  - Underserved communities
- Utility Optimization
  - Managed distributed systems
  - Sewer mining
  - Satellite reuse

Case Studies Listed by Type
Green Building/Sustainable Sites (GB)
Battery Park City, New York City (UO)
Couran Cove Island Resort, Queensland, Australia (IC)
Currumbin Ecovillage, Queensland, Australia (IC)
Dockside Green, Victoria, British Columbia, Canada (UO)
Philip Merrill Center, Annapolis, Maryland
Sidwell Friends School, Washington, D.C.
Workplace6 Recycled Water Factory, Sydney, Australia (UO)
Independent Communities (IC)
Bethel Heights, Arkansas
Gillette Stadium, Foxborough, Massachusetts (GB)
Lake Elmo, Minnesota
Piperton, Tennessee
Warren, Vermont
Weston Solar Aquatics, Weston, Massachusetts (GB)
Wickford Village, Rhode Island
Utility Optimization (UO)
LOTT Alliance, Lacey, Olympia, and Tumwater, Washington
Loudoun Water, Loudoun County, Virginia (IC)
Mobile Area Water and Sewer System, Mobile, Alabama
Pennant Hills Golf Club, Sydney, Australia
Sand Creek, Aurora, Colorado
University of North Carolina at Chapel Hill, North Carolina (GB)

Dockside Green, Victoria, B.C.

- Water-centric brownfield redevelopment based on integrated resource management
- *Fit-for-purpose*, reclaimed water supply (augmented by rainwater)
  - Toilet flushing, landscape irrigation, green roof watering, and natural stream/pond
- Stream/pond complex provides residential access, enhancing unit value, ecological function and biodiversity
- On site press for sludge dewatering to produce feedstock for co-located gasification plant
  - Single operations company = reduced staffing, maintenance and commissioning, and travel, reducing impact

Courtesy: Dockside Green and Aqua Tex Scientific

Sydney Water - Pennant Hills Golf Club




- Privately-driven sewer mining project
- Conveyance costs associated with more traditional centralized reuse systems often render satellite users uneconomic
- MBR treatment system produces 172,000 gallons of high quality water per day
- Treated water is used to irrigate the 22 hectares (55 acres) of greens, tees and fairways.




Decentralized Wastewater Stakeholders Decision Model




Economic

Maximize Economic Value

Minimize Capital Costs
- Planning and Design
- Land
- Phasing
- Existing Treatment
- Existing Collection
- Financing

Minimize Operating Costs
- Financing Cost
- Labor
- Power
- Byproducts
- Other

Meet Community Economic Needs
- Availability
- Adaptability
- Externalities

Environmental

Optimize Environmental Benefit

Water Quality
- Avoidance
- Removal

Water Quantity
- Water Balance
- Sustain Flow

Natural Environment
- Biodiversity
- Disturbance
- Global Warming

Societal

Fulfill Community Objectives

Quality of Life
- Health
- Outdoor Environment
- Built Environment

Stability
- Dependable
- Resilient
- Safe

Equitability
- Serves All Equally
- Charges Everyone Fairly

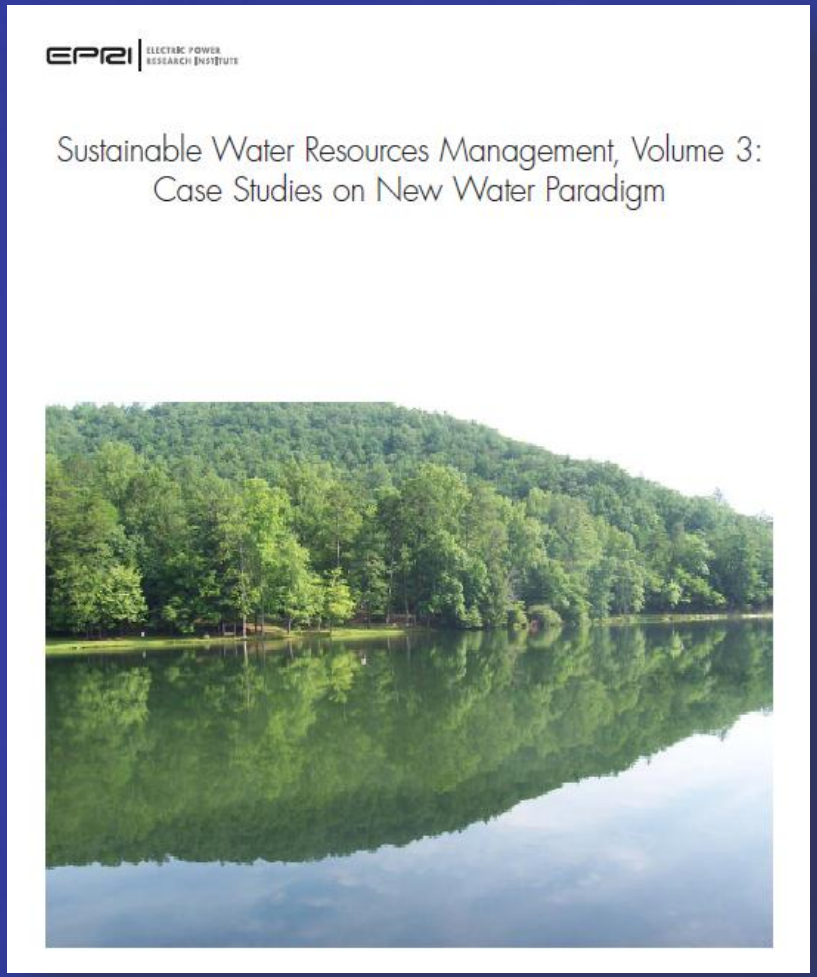
New Water Paradigm




Case Studies on
New Water Paradigm

- Creates a platform for communities to overcome challenges through operating under key sustainability principles and practices.

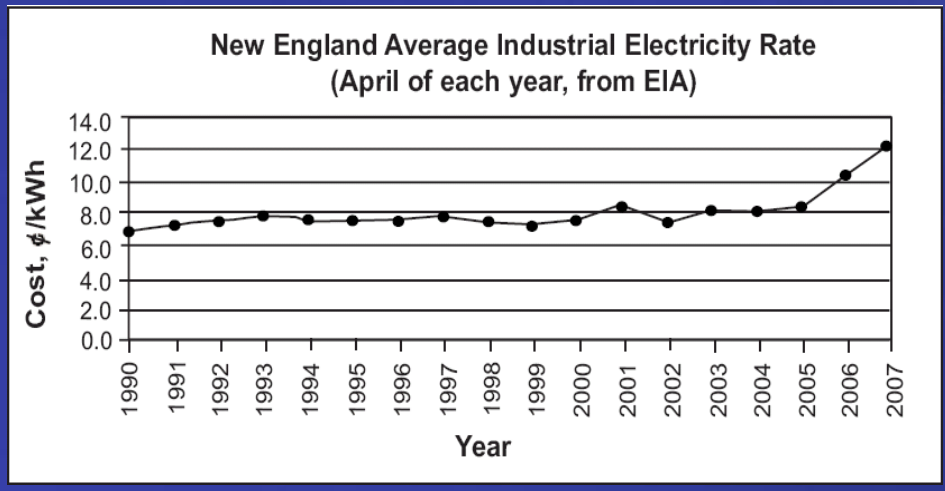
- Uses examples from 2 case study communities (Tucson/Pima County, Arizona and Northern Kentucky) to offer real world context.

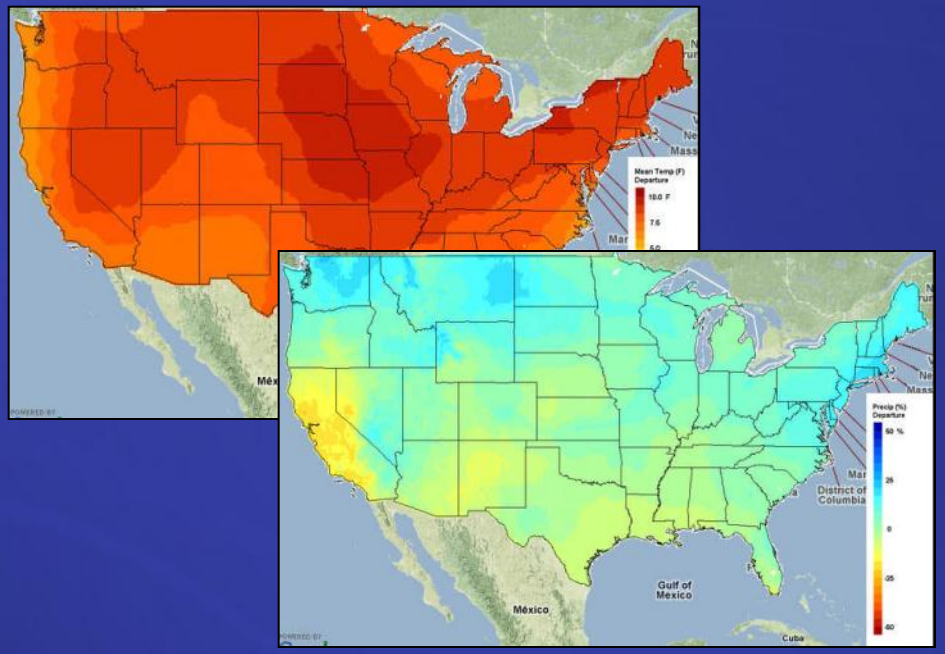


New Water Paradigm

21st Century challenges

- Increasing and variable energy costs
- Climate change
- Increased drought frequency and intensity
- Limited fresh water supplies
- Water quality impairment
- Ecosystem health and natural service deterioration
- Aging Infrastructure





New Water Paradigm

Aerial view of a typical wastewater treatment plant

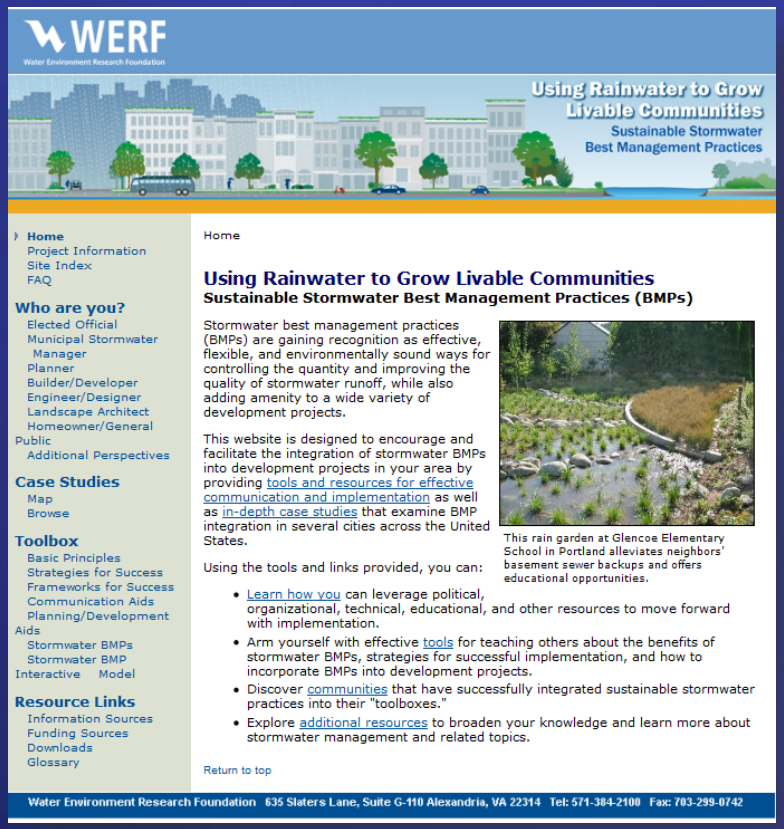
Old paradigm

- *–Highly specialized*
- *–Centralized*
- *–Segregated*
- *–Linear*
- *–Extractive*
- *–Inflexible*

New paradigm

- *–Multifunctional*
- *–Decentralized*
- *–Integrated*
- *–Systemic*
- *–Restorative*
- *–Adaptive*

Stormwater



www.werf.org/livablecommunities

Using Rainwater to Grow Livable Communities

- Stormwater BMPs are an effective ways to address stormwater runoff
- A website encourages and facilitates integration of BMPs into development
- Tools and resources for effective communication and implementation

Case Studies

We chose some of the best, but there are many more—with new examples every day.

Chicago, Illinois

Becoming the "Greenest City in America"

Stormwater

Philadelphia, Pennsylvania

Neighborhood Transformation Initiative

Before: Vacant lot before greening (Source for both: Pennsylvania Horticultural Society)

After: Vacant lot was regraded to capture stormwater and planted with trees, shrubs, and grass

Stormwater




Kansas City, MO

- 10,000 rain gardens
- CSO mitigation planning
- Stormwater management
- Green space
- Revitalization projects

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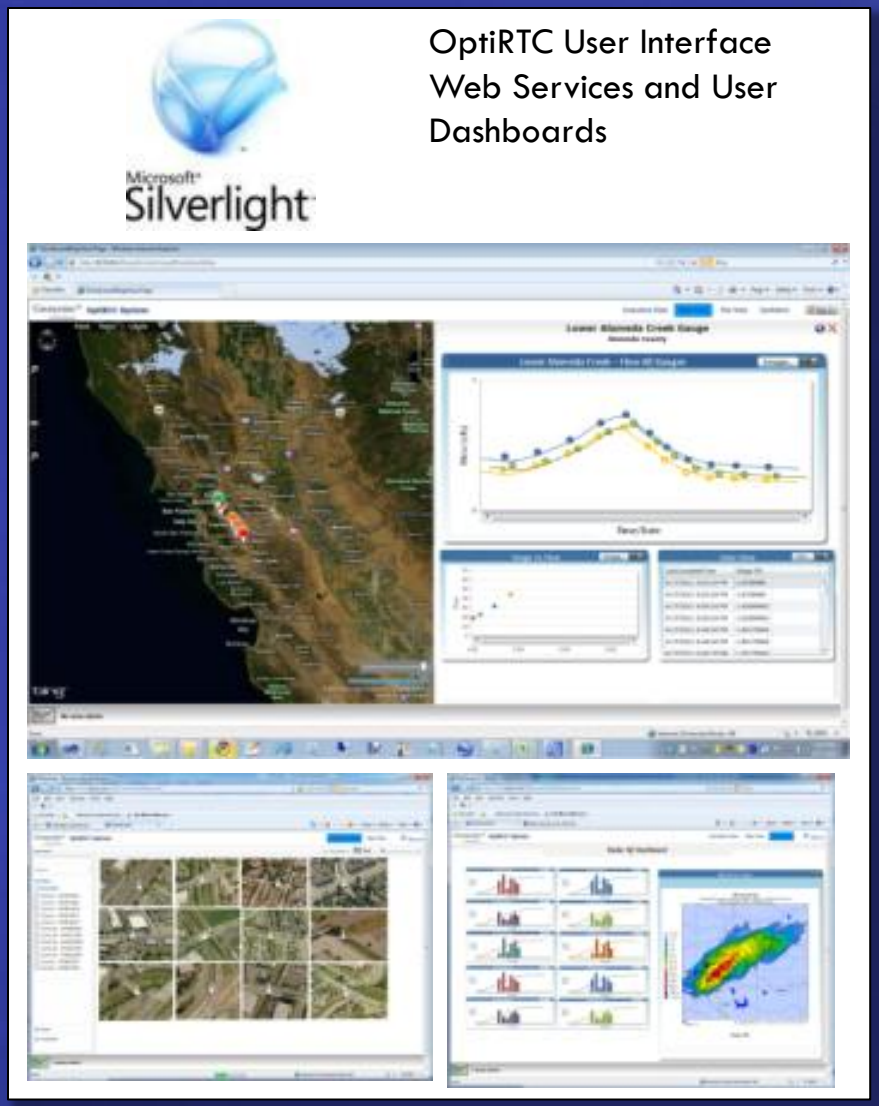
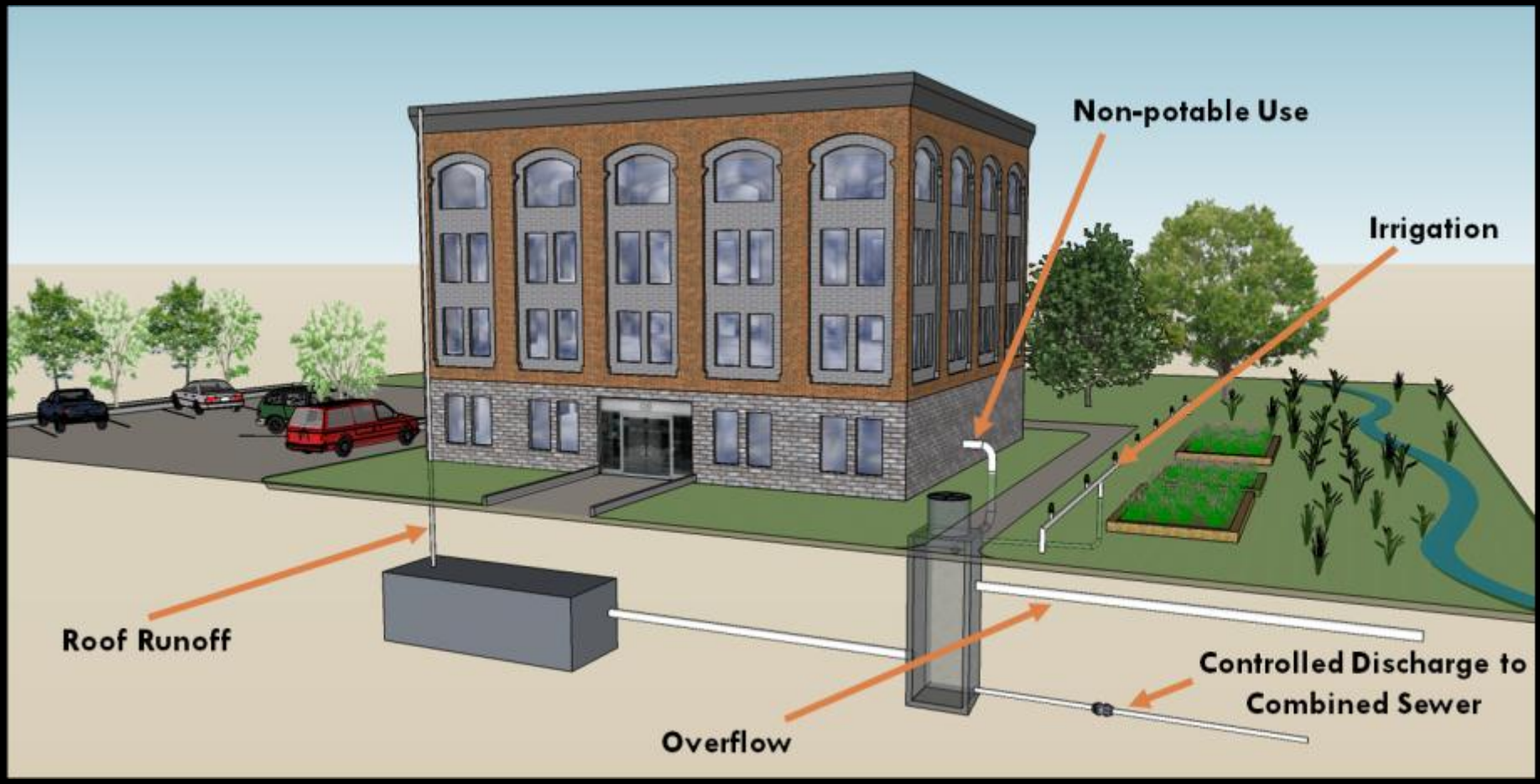
Green Infrastructure

Transforming Our Cities: High Performance Green Infrastructure (ongoing)

- Smart BMPs
- Highly distributed real time control of GI

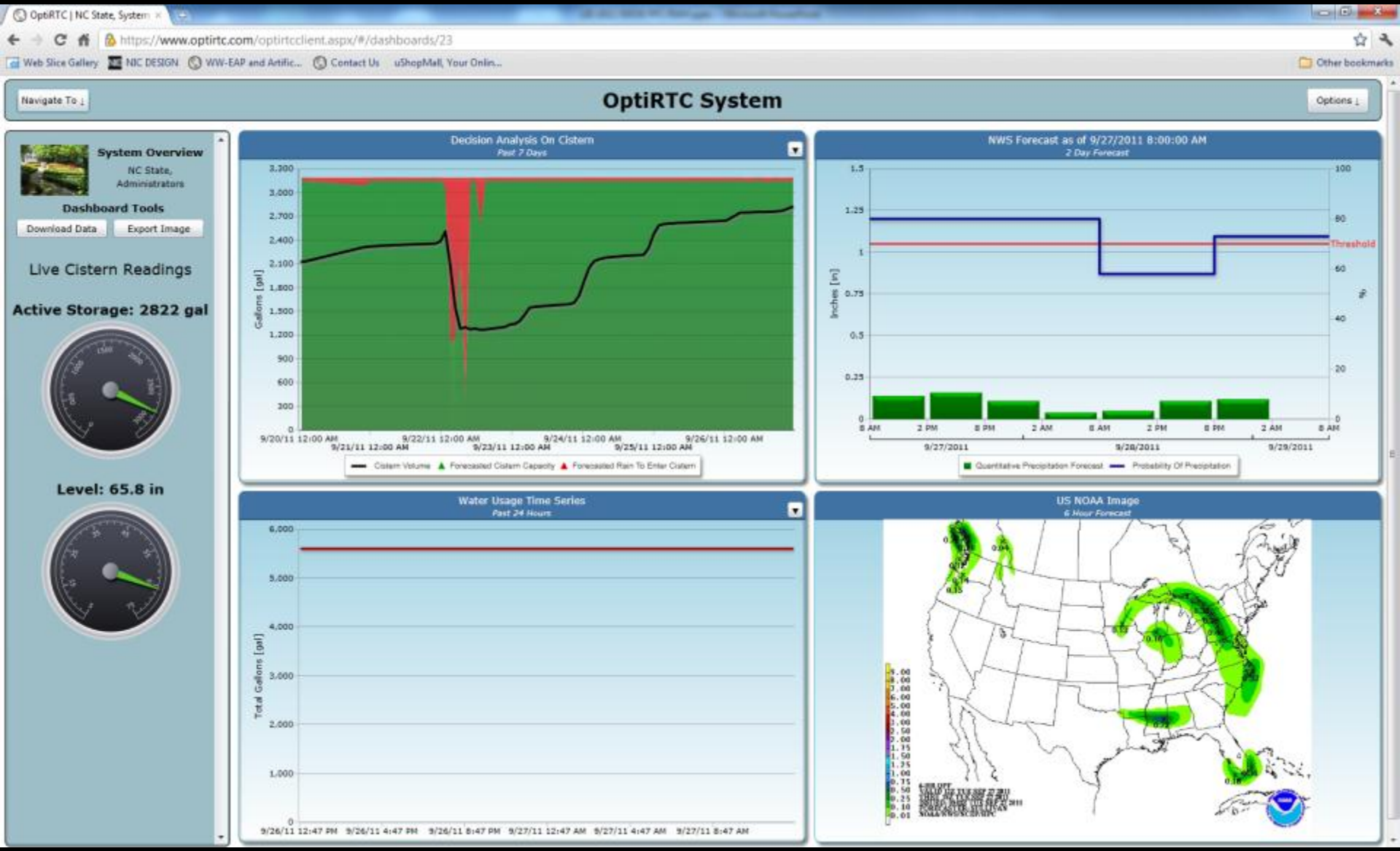


Pilot Technology: Advanced Rainwater Harvesting

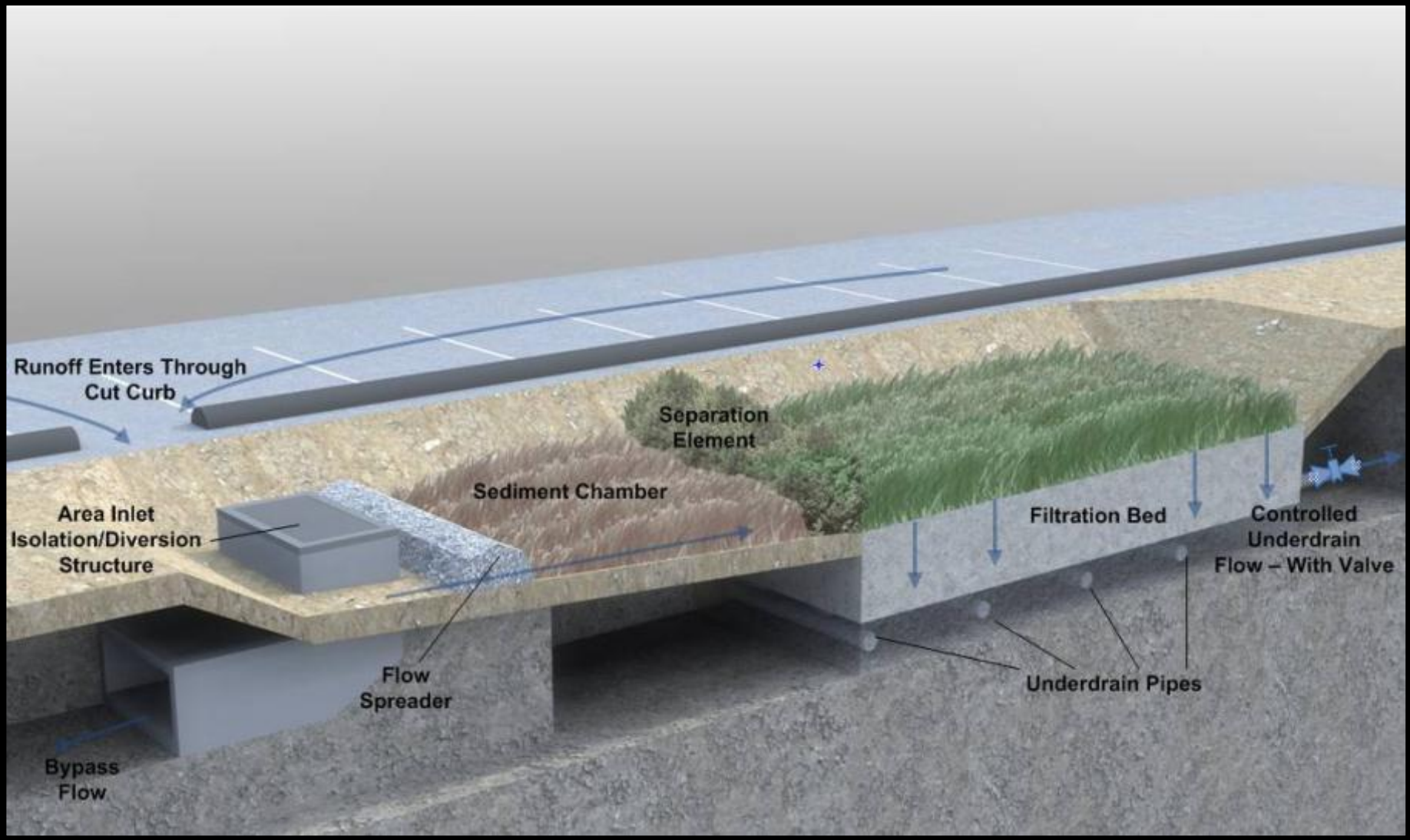


Simplest Definition: Drain storage in advance of predicted rainfall or other trigger

User Experience: Task Specific User Dashboards



Pilot Technology:
Controlled Under Drain Bioretention



Rainwater / Graywater

New Reports

- Stormwater Non-Potable Beneficial Uses and Effects on Urban Infrastructure (2012)
- Guidance Manual for the Separation of Graywater from Blackwater (2011)
- Long-term Study on Landscape Irrigation Using Household Graywater – Experimental Study (Oct 2012)

Integrated Water

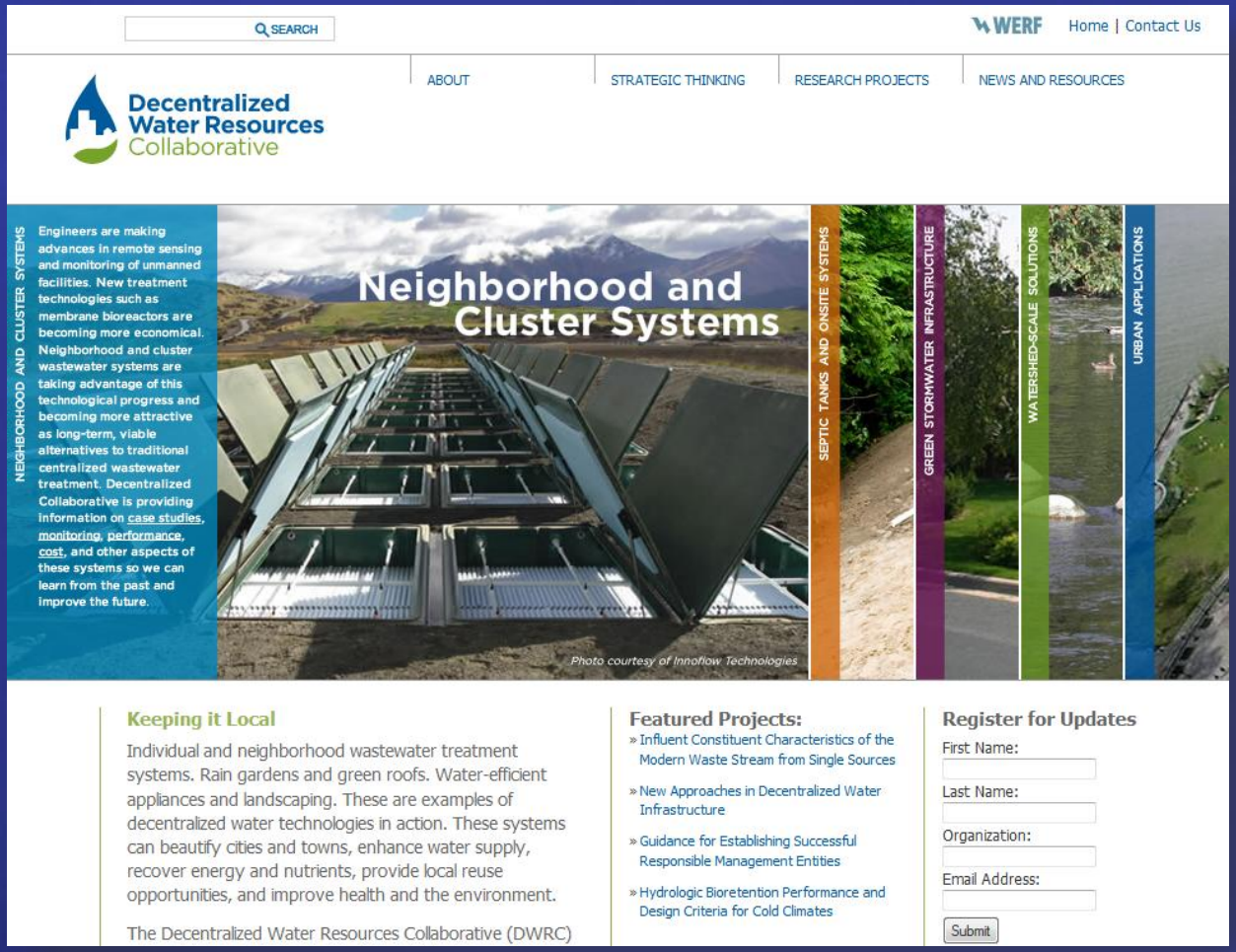
New Projects

- One Water Management Network (in cooperation with US Water Alliance)

- Institutional Approaches for Green Infrastructure and Integrated Water Management Success – RFP Coming Soon

Outreach



Award Winning Website:

www.decentralizedwater.org

Outreach




Quick Guide

Quick Guide to Research and Products from the Decentralized Water Resources Collaborative (DWRC)

Key to Product Audience:

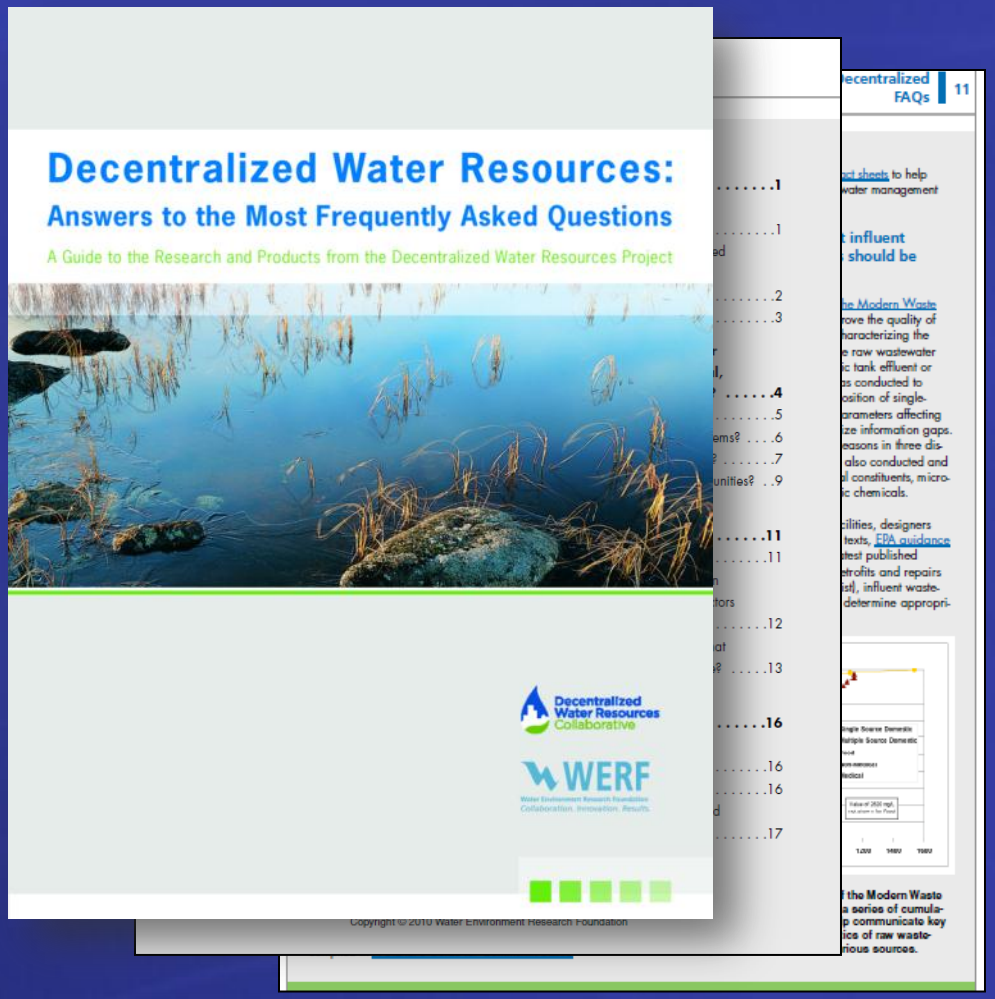
- Engineers/Designers
- Scientists/Researchers/Academics
- Regulators/Elected Officials/NGOs
- Utility Managers/Service Providers/Responsible Management Entities (RMEs)
- Developers
- Planners/Resource Managers
- Vendors/Suppliers/Installers

Product Title	Description	Year	Project #	Audience	Tags
ENVIRONMENTAL SCIENCE AND ENGINEERING					
Evaluation of GHG Emissions from Septic Systems	Evaluates data and info rmation on methane and other greenhouse gases from septic systems for more accurate GHG inventories.	2010	DEC1R09		onsite systems, energy and climate change, sustainability, unit processes, planning
Non-Traditional Indicators of System Performance	Describes technologies that can be used in the decentralized field to get relevant real-time info rmation about treatment system performance and water quality.	2010	DEC2R06		emerging applications, regulatory, monitoring, system management, operation and maintenance
Performance and Costs for Decentralized Unit Processes	Provides guidance on the performance of decentralized unit processes and templates for user-directed cost determination.	2010	DEC2R08		unit processes, system costs, performance, decision-making, operation and maintenance
Performance Effects of Water Softener Brine on Onsite Systems: Workshop	Defines research needs to evaluate if there are negative effects to onsite systems from water softener brine, and if so, what can be done to mitigate the problem.	2010	DEC2W09		onsite systems, design, soil treatment unit, unit processes, performance, operations and maintenance, wastewater characteristics
Long-Term Study on Landscape Irrigation Using Household Graywater: Experimental Study (Phase 2)	Provides quantitative data and information to better understand the fate and occurrence of graywater chemical constituents and pathogens and their potential impacts on soil and groundwater quality.	2010	06CTS1C0		water reuse, emerging contaminants, soil treatment unit, wastewater characteristics

The quick guide provides a snapshot of every product available from the DWRC, including links to tools and reports.

Outreach

Frequently Asked Questions (FAQ) Guide



The FAQ serves as a guide to the Research and Products from the DWRC, including links.

Outreach

Federal Agency and NGO Briefings

- *Smart, Clean & Green: 21st Century Sustainable Water Infrastructure*
- *Integration: A New Framework and Strategy for Water Management in Cities and Towns*

Outreach

Additional Outreach Efforts

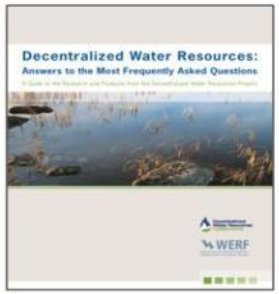
- Educational Video
- Promotional Brochures, Flyers
- PowerPoint Presentation Templates
- Brochure for Centralized Agencies
- Dedicated Outreach Web Page
- Journal, Magazine Articles
- Workshops, Presentations, and Webinars

Research and Products from the

Decentralized Water Resources Collaborative

Decentralized systems offer an affordable, sustainable solution for the treatment of wastewater. Nearly $16 million in research products are available from DWRC and the Water Environment Research Foundation on decentralized water and wastewater treatment. For help navigating this wealth of information, go to www.werf.org/decentralizedwater and access the resources below:

A short video tour introduces users to decentralized systems and provides a quick tour of how to access available research.



A Frequently Asked Questions guide highlights key issues and organizes topics by categories for quicker navigation to resources.

The DWRC Web site at www.decentralizedwater.org provides access to all 70+ products.

Decentralized Water Resources Collaborative

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www.werf.org/decentralizedoutreach

Conclusion

Questions and Discussion

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  www.werf.org/decentralized