

Ecosystem Services Research Program: Strategic Directions

Rick Linthurst, National Program Director
Iris Goodman, Deputy

Vision

A comprehensive theory and practice for quantifying ecosystem services so that their value and their relationship to human well-being, can be consistently incorporated into environmental decision making.

Goal

Transform the way decision makers understand and respond to environmental issues by making clear the ways in which our management choices affect the type, quality and sustainability of the services we receive from ecosystems.

Research Opportunities

Pollutant-Based Ecosystem Services Research

How does a regulated pollutant—nitrogen—affect, positively and negatively, the bundle of ecosystem services at multiple scales?

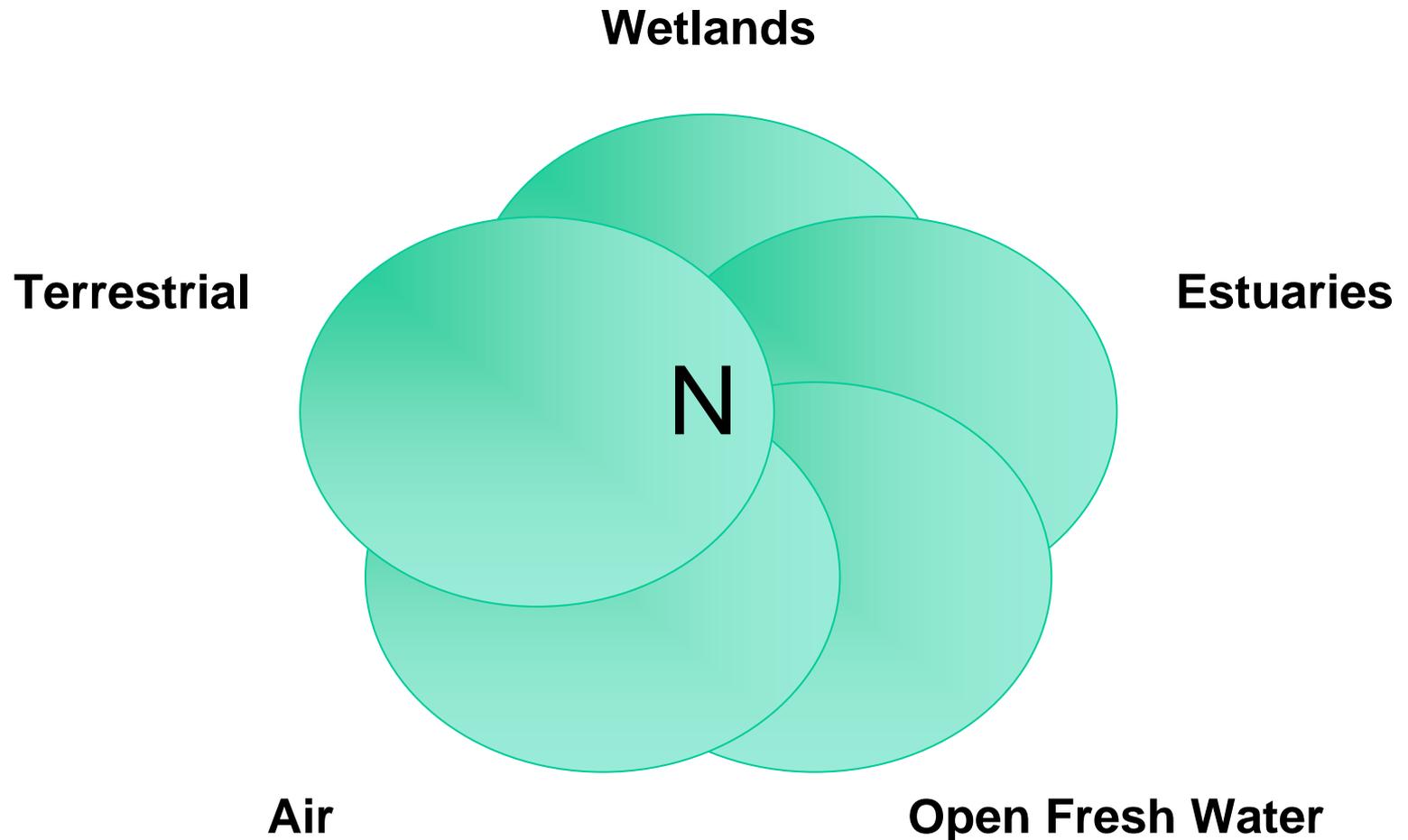
Ecosystem-Based Ecosystem Services Research

How does the bundle of ecosystem services provided by selected ecosystem types—wetlands and coral reefs—change under alternative management options at multiple scales?

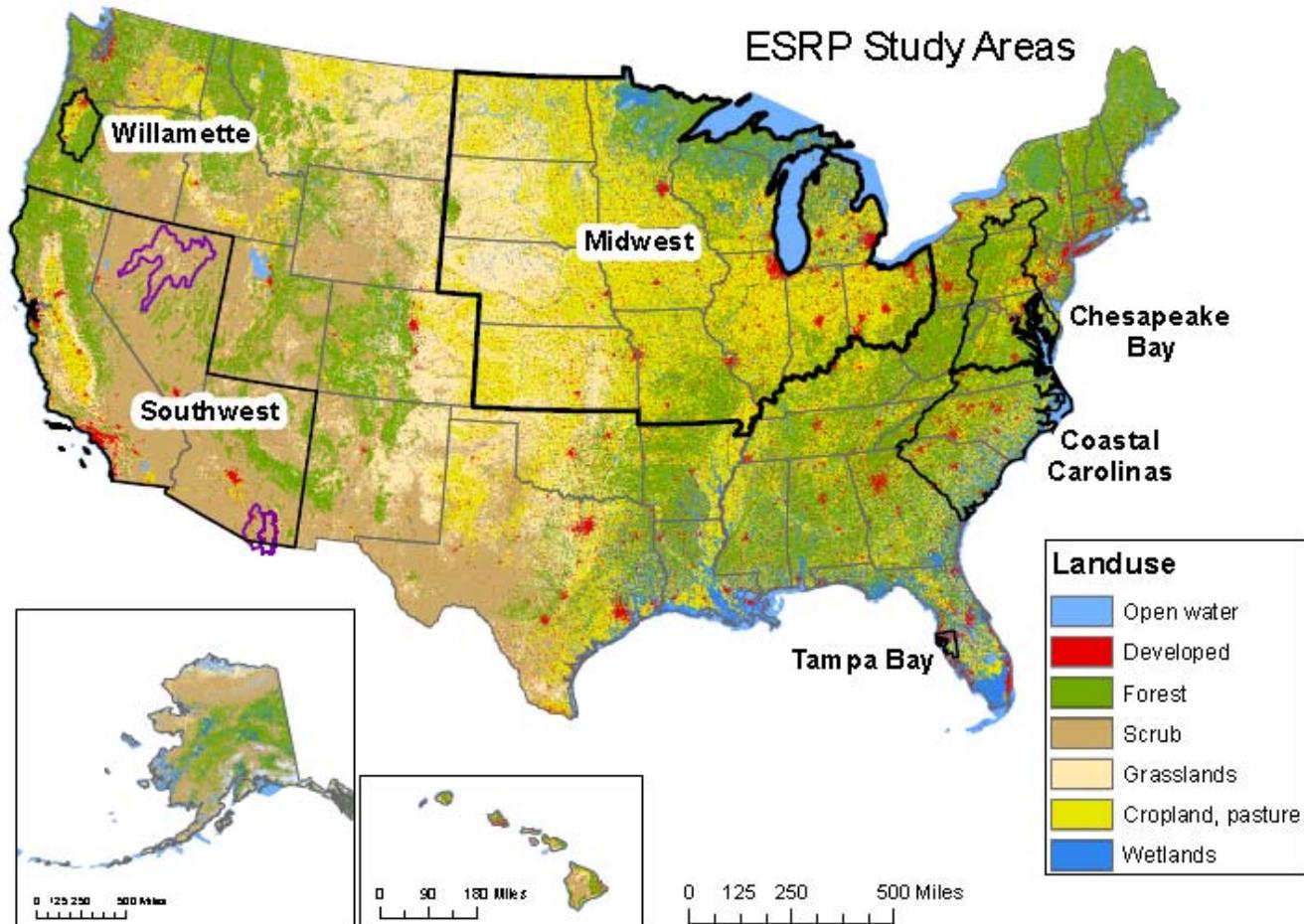
Place-Based Ecosystem Services Research

How does the bundle of ecosystem services for all ecosystems within an ecosystem district change under alternative management options?

Nitrogen is also being used as an integrator across the whole of the Program:
All components have an N element



Learning from studying places at multiple scales, with common testing across places, is a major part of the ESRP



Cross-Cutting Themes Advancing Science and Providing Support

- Landscape characterization and mapping
- Modeling
- Inventory and Monitoring

- Education and outreach
- Human health and well-being
- Valuation
- Decision Support

ESRP Organizational Matrix

Projects and Long term Goals →		LTG 3 Pollutant-Specific Studies: 6%	LTG 4 Ecosystem Specific Studies: 23%		LTG 5: Community Based Demonstration Projects: For National, Regional, State and Local Decisions: 28%					Theme Leads			
	Cross Program Themes and Research Objectives	Nitrogen (6%)	Wetlands (22%)	Coral Reefs (5%)	Willamette (11%)	Tampa Bay (4%)	Mid-West (4%)	Coastal Carolinas (8%)	Southwest (1%)				
Integration, Well-Being, Valuation, Decision Support, Outreach and Education LTG 1 9%	Ecosystem Services and Human Well-Being (3%)									Laura Jackson			
	Valuation of Ecosystem Services									Wayne Munns-- Consultation Committee			
	Decision Support (6%)									Ann Vega			
	Outreach & Education to				Budgetary Information ~\$71M ~272 In-house scientists and support staff					Open			
Inventory, Map, and Forecast Ecosystem Services at multiple scales LTG 2 31%	Landscape Characterization and Mapping (12%)												Anne Neale
	Inventory and Monitoring of Services (14%)												Mike McDonald
	Modeling (5%)									Tom Fontaine-- Consultation Committee			
Pollutant Specific Studies LTG 3	Nitrogen (6%)									Jana Compton			
Eco-system Specific Studies LTG 4	Wetlands (22%)									Janet Keough			
Project Area Leads	Rick Linthurst and Iris Goodman	Jana Compton	Janet Keough	Bill Fisher	David Hammer	Marc Russell	Randy Bruins/ Betsy Smith	Deborah Mangis	Nita Tallent-Halsell	Rick Linthurst and Iris Goodman			
Hal Walker: Place Based Coordinator													

Partnerships and proposals to build capacity for transdisciplinary research

- Announced establishment of public-private National Ecosystem Services Research Partnership
 - Received more than 160 expressions of interest from:
 - State resource agencies
 - Regional planning councils
 - Interdisciplinary research institutions
 - Professional ecological organizations
 - NGOs
 - Businesses
 - Federal agencies
 - Legal practitioners

- Meeting was held at National Geographic Society on October 1-2, 2009
 - Concluded NESRP was a value added organization
 - EPA provided modest support to a Partnership staff office at Duke University, Dr. Lydia Olander
 - Next steps being determined

Comments from July 2009 SAB (EPEC) Consultation

- The program focuses on research to understand the ways in which policy and management choices affect the type, quality, and magnitude of the goods and services ecosystems provide to sustain human well-being. As such, and because it is taking an integrated multidisciplinary approach to addressing multiple stressors acting within and across media, the research program has the potential, with appropriate support, to transform the way environmental decisions are made within and outside of EPA. Products of the research program should advance the practice of risk assessment by providing information for improved consideration of risks and benefits in environmental decision-making.
- As further discussed in the enclosed Committee member comments, ORD has been responsive to many of the SAB's previous recommendations. In particular, Committee members found that EPA has excelled in developing creative research partnerships with U.S. academic scientists and other federal agencies, and has begun to develop international partnerships. The partnership approach is crucial to the success of the research program. It is important that ORD focus on preserving these partnerships and making them even more effective.



WATER QUALITY RESEARCH PROGRAM

BUILDING A SCIENTIFIC FOUNDATION FOR SOUND ENVIRONMENTAL DECISIONS

www.epa.gov/ord

Water Quality Research Program: Strategic Directions

Charles Noss
National Program Director

Long-term Goal Structure

- The Clean Water Act provides the legislative mandate to restore and maintain the chemical, physical, and biological integrity of the nation's waters. To this end the LTGs are structured to:
 - inform the development and application of water quality criteria for protecting and restoring the biological, physical, and chemical integrity of U.S. waters;
 - provide tools and expertise to diagnose and predict the causes and sources of water quality impairment on a watershed management level; develop Total Maximum Daily Loads (TMDL); and select, apply, and evaluate the effectiveness of management measures; and
 - provide expertise, research, and tools to characterize, control, and manage sources of water quality impairment in U.S. waters.

Long-term Goals

- **LTG 1:** *The Office of Water, EPA Regions, States, and Tribes use ORD research and expertise to inform the development and application of water quality criteria for protecting and restoring the biological, physical, and chemical integrity of U.S. waters.*
- **LTG 2:** *The Office of Water, EPA, Regions, States, Tribes, and watershed managers use ORD research, tools, and expertise to diagnose and predict the causes of water quality impairment; develop TMDLs; and select, apply and evaluate the effectiveness of watershed management measures.*
- **LTG 3:** *The Office of Water, EPA Regions, States, Tribes, and communities, especially municipal utilities use ORD expertise, research, and tools to characterize, control and manage sources of water quality impairment in U.S. waters.*

LTG 1 Research Directions

- The focus of this LTG is to provide the approaches and methods needed to develop and apply protective criteria related to stressors (e.g. nutrients, pathogens, emerging contaminants) and stressor-induced habitat alterations in order to maintain designated uses for aquatic systems. Research themes are:
 - Aquatic life guidelines
 - Biological assessment approaches to biocriteria and Tiered Aquatic Life Uses
 - Nutrient criteria
 - Recreational water criteria for pathogens and pathogen indicators
 - Emerging contaminants

Examples of Anticipated Products

- Data to support the recognition of multiple exposure routes and the factors that control their significance in updating aquatic life guidelines, including aquatic dependent wildlife, and provisions of risk expressions that are useful in guiding management decisions.
- Develop comparative assessments of resource (estuary and wetland) vulnerabilities and sensitivities to nutrients, including increased understanding of system variability, between habitat sensitivities, and ecosystem responses along nutrient gradients.
- Develop approaches for identifying and categorizing which emerging contaminants (or classes) present potential risks to the environment or human health.
- Provide data, analyses, and tools to use to establish recreational water criteria for human pathogens and/or pathogen indicators.

LTG 2 Research Directions

- Watershed management research focuses on developing tools and processes to identify or measure:
 - Impaired and vulnerable resources,
 - Threats and causes of impairment for effective decision-making,
 - Ways to reduce impairment and vulnerability,
 - The effectiveness of implemented management measures, and
 - As these advances are made, technology transfer will be a priority effort to ensure users have access to information for successful implementation.

Examples of Anticipated Products

- Provide research and develop tools for assessing significant nexus and permanence of hydrologic connections in headwaters streams, adjacent wetlands, and isolated wetlands.
- Provide landscape analysis tools to identify locations for follow-up targeted ambient monitoring, assist in stressor and source identification, and to help evaluate effectiveness of management actions.
- Provide protocols for evaluating the restoration potential of watersheds.
- Support a Web-based approach to provide integration, access and feedback to the tools, data, and information resources needed to support federal, State, Tribal, and local watershed management decisions.

LTG 3 Research Directions

- Source control and management research addresses needs for point sources and nonpoint source control using best technological control and management practices. The research focuses on:
 - Aging Infrastructure,
 - POTW Management and Treatment, and
 - BMP Performance.

Examples of Anticipated Products

- Provide “State of the Technology” assessments and comprehensive information on the verification/demonstration of emerging and innovative inspection/condition assessment, rehabilitation, and replacement technologies for collection system infrastructure.
- Provide data and information on optimized strategies and on the effectiveness of new and/or innovative technologies for in plant peak flow management.
- Provide information on the performance, cost, and influencing factors to improve the selection, design, construction, and O&M of BMPs to address wet weather flows and diffuse sources, including CAFO management practices for controlling microorganism and nutrient releases.

Drinking Water Research Program: Strategic Directions



Audrey Levine
National Program Director

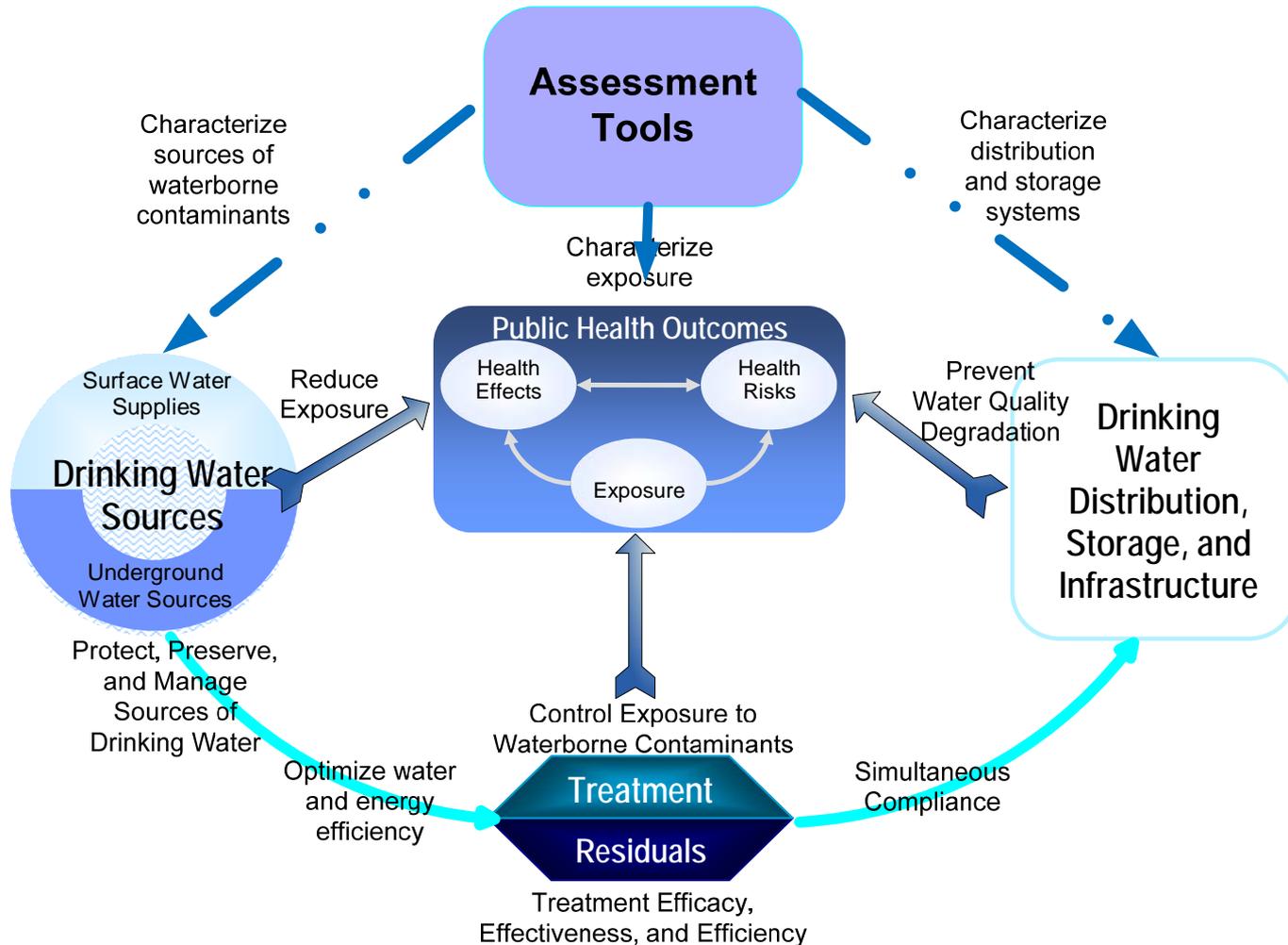
ORD's Drinking Water Research Program

▪ Long-term goals

- Characterize risks: chemical and microbial contaminants, infrastructure, water availability
- Manage risks: Source water protection, treatment, distribution and storage
- **Thematic areas—Relate to hydrologic cycle**
 - Assessment tools
 - Exposure/health effects
 - Source water/Water Resources
 - Treatment and residuals
 - Distribution and storage

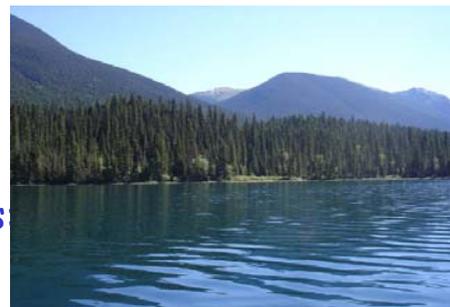


Interrelationships among Thematic Areas



Current and Emerging Research Drivers

- **Public health protection**
 - Are current approaches adequate under changing water quality, water availability, and water use patterns?
 - Role of water infrastructure: Current inventory
Migration towards alternative water delivery/collection/reuse systems
Green Infrastructure, Low Impact Development, Integration of centralized and decentralized systems
 - Prioritization of waterborne contaminants
(health end-points, exposure pathways, mixtures, cumulative risks, sensitive populations)
- **Water scarcity/availability**
 - Impacts of drought/intense storms/snowpack variability on water quality and availability
 - Integrated water management and role of water reuse on regulatory construct for protecting public health
 - Increased rates of evaporation and variability in water sources
(impacts on salinity, solubility, microbiology, pathogen diversity)
 - Nutrient and contaminant loadings:
Organic and inorganic disinfection byproduct precursors
- **Energy and economic impacts on treatment reliability**
 - Availability of chemicals (phosphates for corrosion control)
 - Energy needs to convey water (supply drinking water and collect wastewater)
 - Transportation costs—chemicals, residuals
 - Water-energy interdependencies--Carbon footprint of water and water footprint of energy production and delivery
 - Impacts of energy decisions on water quality and availability (e.g. biofuels, thermo-electric power generation, geologic sequestration, etc.)
 - Water economics—true costs of providing water, costs of waterborne disease outbreaks



2010 - 2014 Strategic Directions

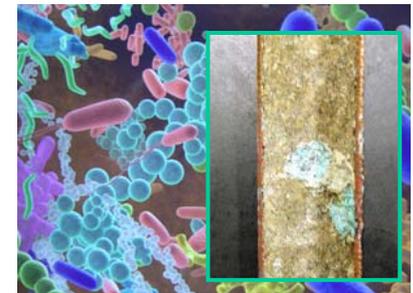
Long Term Goal 1

- **Exposure/Health Effects** —Health effects attributable to mixtures relevant to drinking water including DBPs, PPCPs, environmental and treatment “degradates”, microbial metabolites, oxidation/reduction byproducts; emerging contaminants—tools for prioritizing health effects research
- **Assessment tools** —Integrated approaches for monitoring drinking water sources, treatment systems, and distribution systems



Long Term Goal 2

- **Source Water Protection** —Underground injection control with an emphasis on geologic sequestration; aquifer storage and recovery; water availability and quality; water reuse
- **Treatment and Distribution Systems** —support for regulatory agenda including TCR, LCR, D/DBP, GWR, SWTR, 6-year review; support for Research and Information Collection Partnership (RICP), water infrastructure, Residuals management
- **Increased emphasis/visibility across thematic areas** — Water efficiency and water-energy nexus (includes source water protection, water reuse, water infrastructure, treatment and distribution systems); Environmental Justice



Major Accomplishments

- **Where we've been: Major recent program accomplishments**
 - Analytical methods for microbial pathogens and emerging chemical contaminants, arsenic bioavailability
 - Characterization of role of water quality (organic carbon, dissolved solids) in disinfection byproduct (DBP) formation and health effects (cancer and non-cancer) attributable to DBP mixtures (regulated and unregulated contaminants)
 - Treatment technologies for control of arsenic, particularly for small systems
 - Water distribution systems/infrastructure
- **Where we're going: Major program accomplishments anticipated in the near-term**
 - Biomarkers of exposure, Virulence Factor Activity Relationships (VFARs), analytical methods for sampling and analysis of multiple pathogens
 - Health effects: integration of screening tools, CCL3 high priority contaminants (strontium, molybdenum, nitrosamines, 1,1-dichloroethane)
 - Improved characterization of underground sources of drinking water—microbial risks, risk management, underground injection
 - Geologic sequestration of carbon dioxide: models, monitoring, geochemistry
 - Simultaneous compliance—lead and copper corrosion control; disinfectants and their byproducts, NPDWR
 - Water distribution systems—biofilms, solids accumulation, nitrification; integration/coordination with water infrastructure program
 - Water efficiency and water-energy nexus

Acronyms:

CCL: Contaminant Candidate List
DBP: Disinfection byproducts

GWR: Groundwater Rule
LCR: Lead and Copper Rule
NPDWR: National Primary Drinking Water Regulations
SWTR: Surface Water Treatment Rule

TCR: Total Coliform Rule
UCMR: Unregulated Contaminant Monitoring Rule
UIC: Underground Injection Control

Regulatory Research Drivers

Long Term Goal 1

Exposure/ Health Effects

- CCL3 and emerging contaminants
- 6-year review: lead, DBPs

Assessment tools

- Unregulated Contaminant Monitoring Rule (UCMR)
- CCL3 contaminants
- Distribution Systems
 - Lead and copper
 - Biofilms
 - Microbial indicators
 - Solids Accumulation
 - "Smart" monitoring

Long Term Goal 2

Source Water/Water Resources

- Surface water
 - Source Water Protection
 - Surface Water Treatment Rule (LT2)
- Underground sources of drinking water
 - Underground Injection Control (UIC),
 - Ground water Rule (GWR)

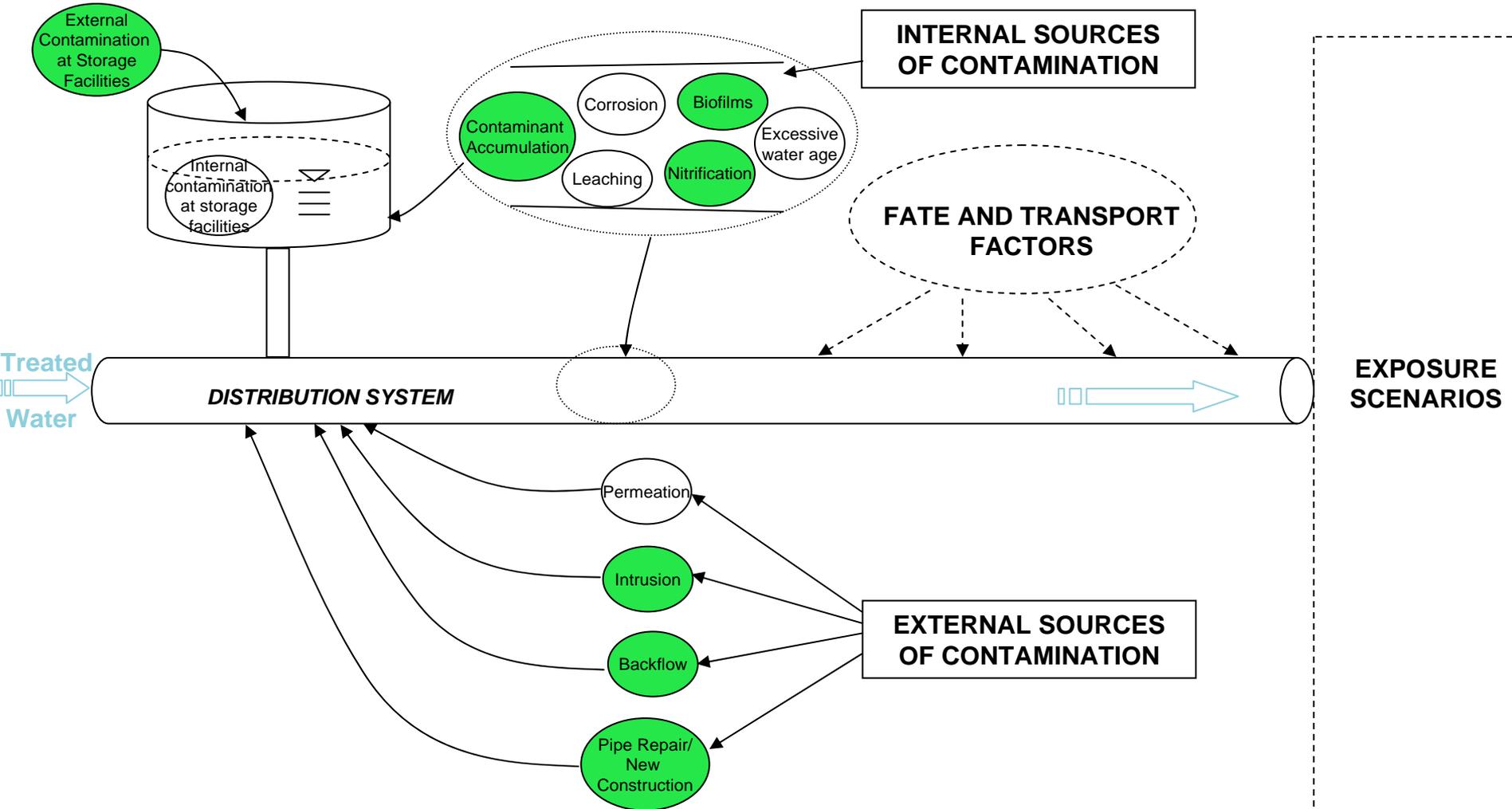
Treatment

- CCL3 contaminants
- Simultaneous Compliance
 - Corrosion control (LCR)
 - Disinfection byproducts (D/DBPs)
 - Nitrite/nitrate
 - Total Coliform Rule (TCR)

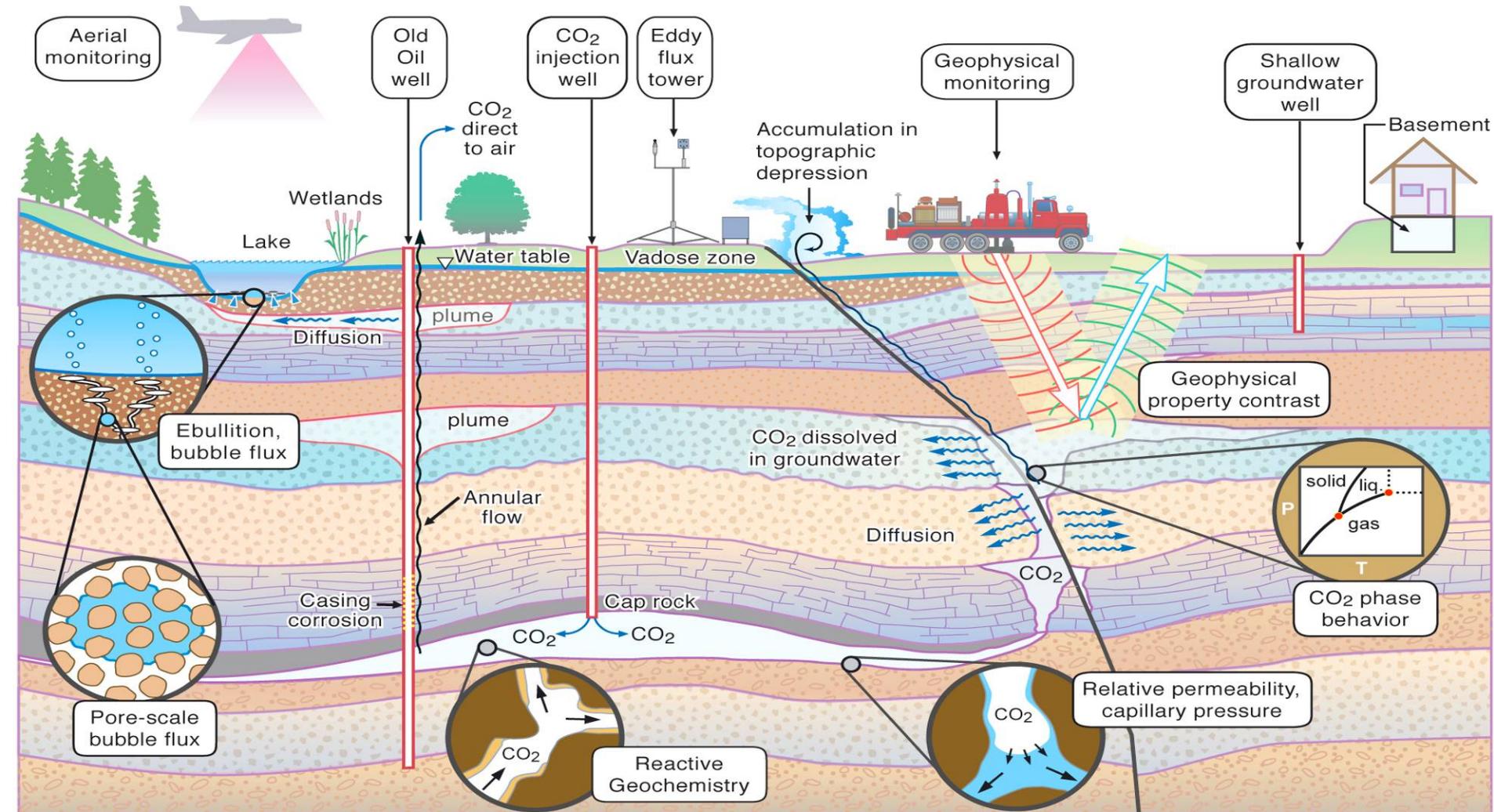
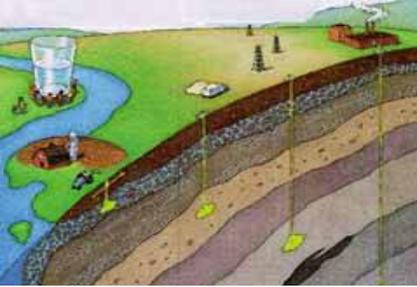
Distribution Systems

- Total Coliform Rule (TCR)
- Lead and Copper Rule (LCR)
- Disinfection Byproduct Rule (DBP)
- Surface Water Treatment Rule (LT2)
- Simultaneous Compliance

Distribution System/Infrastructure Research Focus



Overview of Geological Sequestration of CO₂



OW and Regional Near-Term Research Needs (2-4 years)

- Scientific support for strengthening the existing standards for regulated contaminants
- Occurrence, exposure, and health effects research to support regulatory determinations for chemical and microbial contaminants that are currently unregulated (e.g. CCL3 and other contaminants of concern)
- Modeling and monitoring support for the proposed revisions to the UIC
- Facilitating rule implementation through pilot-scale and full-scale demonstration projects
- Responding to regional issues related to simultaneous compliance, corrosion control, infrastructure, underground injection control, etc

OW and Regional Longer-Term Research Needs (3-10 years)

- Analytical methods to enable monitoring of emerging contaminants through future cycles of the UCMR
- Support for regulatory decisions pertaining to water distribution systems with an emphasis on cross-connection control, main repairs, storage, intrusion, biofilms, nitrification, and solids accumulation
- Scientific support for strengthening the microbial and disinfection by-product rules
- Research to support future regulatory determinations including analytical methods, health effects information for emerging contaminants, treatment efficacy, and simultaneous compliance challenges and opportunities
- Developing integrated approaches for protecting sources of drinking water and managing water quality through treatment, and distribution systems
- Developing tools for improving water infrastructure sustainability with an emphasis on corrosion control, biofilms, nitrification, and solids accumulation
- Continued support for integrating climate, energy, and water availability issues into approaches and safeguards for managing drinking water safety and sustainability