EPA/600/R-08/073
May 2008

Summary Report of the NSF/EPA WATERS Network Workshop

April 30 - May 1, 2008

NSF/EPA WATERS Network Workshop

May 1, 2008

The WATERS Network Project Workshop

Day 2 Workshop Agenda

- **Overview of proposed EPA/NSF partnership**
- **Charge to the breakout groups**
- **Breakout group sessions (five in parallel)**
  - **Field operations—Field-Based Studies on Ecosystem Restoration and Enhancement of Ecosystem Services**
  - **T&E Facility Systems and Processes for Water, Wastewater, and Storm Water**
  - **Streams and Watersheds**
  - **Synthesis and Modeling**
  - **Institutions and Decision Making**
- **Lunch**
- **Reports from the breakout groups**
- **Discussion and wrap-up**

Recap: Workshop Background

- **EPA/NRMRL and NSF are exploring the possibility of a partnership related to WN**

- **In principle, NSF/EPA partnership projects might serve as new WN Test Beds**

  For WN, this would have the benefit of building on EPA's existing facilities and capabilities

  For EPA, the benefit might be enhancement of already existing facilities and capabilities

Recap: Potential guidelines for research projects funded through the NSF/EPA partnership:

- **Research would be performed at EPA sites**
- **Research teams would be composed of university researchers and students teamed with EPA researchers at EPA sites**
- **University researchers and students would be supported by NSF grants (up to $300K per grant)**
- **To request grant funding, university PIs would submit a proposal to NSF in response to a solicitation that might be posted by NSF (after concurrence by EPA), perhaps in 2009**
- **Each proposal from a university PI should include a letter from an EPA partner stating the intention to collaborate**

Special EPA Project Features

- Lab Instrumentation QA/QC Plan
- Sampling & Analysis Plan
- Health & Safety Plan
- RCRA/OSHA/TSDF Permits
- Facility Access
- Design of Research Plan
- Unique Scientific Expertise

Funding Options

- **Third Party Agreements (Private to Private)**
  - **Advantages:** Recipient has full control of funds, intellectual property, and FOIA protection
  - **Disadvantages:** Recipient must write (and pay for) all QA, Safety, etc. plans, provide entire project management oversight, and contract directly with facility for fixed and variable costs. Limited EPA involvement

Funding Options (cont.)

- **Cooperative Research & Development Agreements (CRADAs) (Public/Private)**
  - **Advantages:** Multiple partners possible. Recipient maintains research management, but EPA assumes facility oversight and is able to provide in-kind services directly. Patent & ROI process access.
  - **Disadvantages:** Funds “taken off the top” from project for facility costs. Co-ownership of intellectual property.

Funding Options (cont.)

- **InterAgency Agreements (Public to Public)**
  - **Advantages:** All contractor interaction and project management handled by EPA.
  - **Disadvantages**: Project funds go directly to EPA

Breakout Sessions: Logistics

Anticipated Breakout Group Outputs

- **Feedback from the academic community on the value of the proposed NSF/EPA partnership to academic research and education**
- **Outlines of example hypothetical partnership projects**
- **From the viewpoint of the academic community, some indications of issues, if any, that might arise in the partnership, relative to academic community participation**

Anticipated Outputs

- Feedback on the value of the proposed partnership to academic research and education
- Outlines of example hypothetical partnership projects
- From the viewpoint of academic community, some indications of issues, if any, that might arise in the partnership, relative to academic community participation

Charges

- Given the EPA facilities and resident expertise, how can the NSF WN benefit from a partnership
- Given the NSF WN objectives & EPA program mission, stretch your imagination for new broadly defined research ideas
- Given that the missions and operating principles of the two agencies are not identical, what issues could possibly appear as barriers to partnership, and prescribe ways of overcoming them

Breakout Group Sessions

- ✓ **Field Operations – Field-based studies on ecosystem restoration and enhancement of ecosystem services**
- ✓ **T&E Facility Systems and Processes for water, wastewater, and storm water**
- ✓ **Stream and Watersheds**
- ✓ **Synthesis and modeling**
- ✓ **Institutions and Decision Making**

Breakout Session Participants

Breakout Session #1 Field Studies, Ecosystem Restoration, and Enhancement of Eco Services	**Breakout Session #2** Technical Evaluation Facility	**Breakout Session #3** Streams and Watersheds	**Breakout Session #4** Modeling and Synthesis	**Breakout Session #5** Institutions and Decision Making
Francis de los Reyes Erich Emery Ken Forshay Steven Loheide Paul Mayer Craig Patterson Bob Puls Dave Soballe Alan Vicory Linda Weavers	Michael Aitken Nicholas Ashbolt Scott Belanger Paul Bishop Michael Borst Amy Childress Nick Clesceri Chuck Haas Roy Haught Ray Hozalski Chris Impelliteri Chip Kilduff Dan Murray John Novak Dan Oerther Ian Pepper Joan Rose Mike Royer David Sedlak Jeanne VanBriesen Matt Whiles	Joel Allen Patrick Brezonik Dan Giammar Cindy Lee Clark Liu Chris Nietch Joe Schubauer-Berigan Mike Stenstrom	Bill Ball Scott Dyer Herbert Fredrickson Peter Goodwin Ferdi Hellweger Barbara Minsker Bill Schultz Jim Shortle Bruce Wilson	John Braden Annette Gatchett Pat Gober Matt Heberling Sandra Schneider Daniel Woltering

Breakout Sessions: Results

Field Operations Summary Presentation

Feedback on Value

- EPA:
  - Values the complementary nature of academic work, projects to improve value and scope of research programs
  - Synergy could improve results and implementation into practice
  - NSF involvement improves program recognition, value insure continuity of programs
- Academic:
  - Established sites with baseline data, historic data
  - More people (expertise), more project capacity
  - Network of interdisciplinary scientists
  - Field equipment to instrument, sample sites
  - Long-term monitoring important to see ‘benefits of restoration, management actions’ at field scale, keep connection to site
  - Access to larger scale perspectives on field research (e.g. Gulf Hypoxia, Biofuels)
  - Students are temporary, projects continue, have continuity for academics, build on prior work
  - Truthing bench to field

Hypothetical Partnerships, Projects, Research Ideas

- Area/Scale – Research to inform how to extrapolate results from small to larger scales; also temporal scales
- What processes, influences are emergent or present at larger scales
- Remote monitoring, control, data processing of watershed data
- Improvements in monitoring technology, data management
- More specific projects (e.g. Baltimore, Oregon): N transformations, interactions which occur between different stream reaches, do we have to restore all unstable stream banks to restore watershed? – bang for the buck question
- Where to put BMPs? How do we sequence remedial actions?
- Relation of treatability to end goal (stormwater, wastewater)
- Optimization, prioritization of monitoring
  - Modeling helps here

Barriers or Issues Inhibiting Partnerships

- Communication, education
  - More info on what EPA is doing, interest, current activities
  - GWERD 1 pagers, Professional ‘personnels’, identification of needed expertise
  - Team (Willamette) calls
- EPA project/program commitment – risk for NSF grantees if program cancelled (see benefits to EPA)
- Competition between universities – existing relationships
  - NSF role seen as a benefit here to address this concern

Barriers or Issues Inhibiting Partnerships Cont.

- Understanding different publication goals between Universities and EPA
  - Sense that it is same re: journal articles
- Funding for 'planning' to promote partnerships
- Student housing at remote locations
- Publication review process
  - ORD clearance process
- Intellectual property ownership
  - Mixed reaction here – sense that it is similar for both EPA & Universities (e.g. GWERD policy)

T & E Facility Summary Presentation

Overarching Points

- WN needs to incorporate a stronger urban/engineered process orientation
- EPA needs stronger science and engineering support for infrastructure program
- How long term ownership and support of NSF expanded EPA capability would be assured?

Given the EPA facilities and resident expertise, how can the NSF WN benefit from a partnership?

- Could help WN become resensitized to issues of urban water management (and necessary science)
- Expertise in life cycle assessment, risk analysis, infrastructure
- Unique facilities - which would need to be at order of magnitude better capability

How can EPA benefit from such a partnership?

- Fundamental science of recycled water (engineering options, risk)
- Bringing larger scope of expertise (e.g., hydrology, civil engineering infrastructure) to bear on problems
- Anticipate future contaminants and waste sources of concern and emerging options for treatment. Perhaps more realistic to devise mechanisms whereby these emerging aspects can be elucidated
- Demonstrating “transportability” of current tools, techniques, expertise in other venues
- Understanding of how different (treatment and analysis) methods may compare
- Access to expertise in areas that may not be of highest priority to EPA, but are needed to solve particular problems
- Perception (on the part of some EPA folks) that this would be of a reduced burden for peer review than via the EPA cooperative agreement approach

Given the NSF WN objectives and EPA program mission, stretch your imagination for new broadly defined research ideas:

- A virtual urban test bed looking at innovative water and waste (e.g., urine separating toilets) management strategies and impact on energy and materials flows. Needs to be coupled with physical realization to test concepts. Transitions issues need to be addressed.
- Development of treatment & conveyance systems that can deliberately be tested to failure
- Investigation of system response to variability (and controls for such variability)

Given that the missions and operating principles of the two agencies are not identical, what issues could possibly appear as a barrier to the partnership and prescribe ways of overcoming them:

- Issue of being restricted to a single feed (at T&E) – but in the past, units have been taken off site in order to test different feeds. Also ability to alter water quality parameters exists.
- Limited capacity and accessibility
- Money flow, size of grants, IP issues, student housing, travel
- Would typical NSF reviewers fairly judge this type of work?

Feedback on the value of the proposed partnership to academic research and education:

- Unique aspects of T&E – distribution system; Edison facility, stream facility. Much else could be found at other locations.
- Comparing novel technologies to conventional on the same conditions would be useful to technology advancement
- Use of particular chemicals of concern in tests
- Uncertain if the facilities all represent an order of magnitude greater than what might be doable at individual institutions
- Some potential opportunities to perform “translational” research (theory -> practice)

Outlines of example hypothetical partnership projects:

- Migration of lab expertise (e.g., water biosensor work) to work outside of the laboratories.
- Use of samples generated by EPA for value added follow on work (e.g., sludge, microbial diversity)
- How to translate failure research to guidance for maintenance planning (NSF Criteria 2)

From the viewpoint of academic community, some indications of issues, if any, that might arise in the partnership relative to academic community participation:

- Not clear whether $300 K would permit meaningful graduate student involvement at a remote site.
- Need to be clear that there is not a problem with international students
- Having EPA personnel write a letter could serve as a “gatekeeper” to academics submitting a proposal to NSF in the envisioned program. At what level in EPA should level of support be required.
- Need to develop a mechanism for researchers to find out whom to contact at EPA.
- Need to define what the minimum time was that students would need to spend physically at EPA and to determine if that was compatible with typical university requirements. (But it may be possible to do some collaborations via remote interactions).
- NSF grants may need to pay for marginal time needed for on site contract personnel.
- Would collection of samples taken from EPA facilities for analysis back at universities be a sufficient level of collaboration to fall under this program?

From the viewpoint of EPA, some indications of issues, if any, that might arise in the partnership relative to academic community participation:

- Potential limitation of resource availability. How to fairly deal with competing proposals?
- A preliminary step would likely be needed in order to reduce time for EPA personnel to determine suitability for collaboration (liability/commitment issues?).
- EPA management needs to realize that the collaborations will require formal time commitments from the EPA staff.
- Defining types and mechanisms of in-kind support for collaboration

Streams and Watersheds Summary Presentation

The WATERS Network Project Workshop

Participants: Chris Nietch, Pat Brezonik, co-chairs
Joel Allen, Joe Schubauer-Berigan (EPA), Clark Liu (NSF),
Dan Giammar, Cindy Lee, Mike Stenstrom

I. Benefits of partnership to NSF/academic community and to EPA

1. Facilities like the streams are just not available at any universities
   intellectual benefits

2. Leveraging resources, which is critical in multi-disciplinary studies
   like watershed research

3. Having both the experimental streams and the watershed are a great opportunity
   for translating mechanistic studies to field level

4. Benefits to students in collaborating with EPA researchers as well
   as academic researchers

5. Benefit to EPA in getting the intellectual stimulation in being involved
   with leading academic researchers—something that is difficult to get from contractors

I. Benefits of partnership to NSF/academic community and to EPA cont.

6. Less money that has to change hands, the simpler things can be

7. Facilities will allow verification of model results

8. But should think about expansion of facilities

9. The partnership could serve as a model in developing partnerships with other agencies/data management database methods

10. Accessing rest of network as a benefit to EPA researchers

11. Partnership will provide concrete steps in developing true cross-agency collaborations to address larger national issues

12. Ability to include biological (wq/ecosystem quality) measurements in watershed studies is a big advantage—hydrologists and water quality engineers typically do not include these kinds of measurements

13. Collaboration between EPA's engineering lab and NSF's engineering directorate will lead to cross-fertilization of ideas and approaches

II. Examples of hypothetical projects

1. Watershed boot camp or summer internship program

2. Near-term projects:

   (A) Bio-vector contaminant transport mechanisms in watersheds.

   (B) Application of East Fork data to hydrologic models across the scales of the East Fork and comparison of accuracy of various existing models.

   (C) Linking hydrologic model to ecological services.

   (D) Linking fate and transport of emerging contaminants from the experimental stream scale to the (~500 mi^2) watershed scale.

   (E) Evaluating new BMPs having natural system components in terms of fate and transport of stressor at the large watershed scale.

   (F) Use of East fork data for testing and calibration of new GIS-based (e.g., BASINS-oriented) modeling tools.

II. Examples of hypothetical projects cont.

2. Near-term projects cont.:

(G) Development of digital watershed (in HIS) for East Fork

(H) IT mechanisms for cybercollaboration using the East Fork site

(I) Use of East Fork sites to test various new hydrologic and chemical sensors

(J) Application environmental engineering reactor-based modeling approaches to East Fork watershed modeling

(H) Use of indicator species (biological and chemical) to understand water and contaminant source contributions under different hydrologic regimes.

III. Challenges/stumbling blocks

1. Publication review process may be more cumbersome—if EPA needs to do an extensive policy review

2. How can QAPP and HASP process be streamlined?

3. Data reports; EPA technical report as a requirement of a partnership project? Issues of data ownership need to be resolved up front.

4. FOIA issues? We don't think this will be a major/common problem.

5. Student housing at EPA research facilities—on short term (for test-bed projects, may need to be done by academic PI); on long term, it would be good if local arrangements were made by an EPA contractor or by EPA with UC.

6. Security issues regarding foreign nationals are thought to be minor.

7. Space issues for student and perhaps faculty collaborators.

8. Time requirements for EPA researchers to advise students, but this is not likely to be a problem.

9. How do we set up a mechanism for writing proposals collaboratively between academic researchers and EPA researchers that will work for both sides (e.g., in terms of timing of commitments)?

10. Academics want/need assurance that their project, if selected, will be allowed to go to completion

Modeling and Synthesis Summary Presentation

Breakout Members

- Peter Goodwin, U of Idaho, fluid mechanics
- Barbara Minsker, U of Illinois, environ and water resources systems analysis
- Herbert Fredrickson, EPA NRMRL, microbial biogeochemistry
- Bill Shorts, NSF Fluid Mechanics program officer, desalination
- Bill Ball, John Hopkins U, environ engineering
- Jim Shortle, Penn State U, economics
- Bruce Wilson, U of Minnesota, impaired waters, erosion and BMPs
- Scott Dyer, Procter & Gamble, ecotoxicology, eco-epidemiology (impacts of chemicals on environment & humans)
- Ferdi Hellweger, Northeastern U, surface water modeling, microbial agent-based modeling

Research Ideas: Agency Perspectives

- Herbert's EPA perspective from ORD/regions meeting in Washington recently:
  - Ongoing process, no consensus yet on how EPA should engage in integrated watershed management
  - How to target which parts of a watershed to start working on to fix problems (e.g., Gulf of Mexico hypoxia)
  - How to prevent greenfields from getting further impaired
  - How to make faster progress on brownfields so that greenfields aren't getting impaired so quickly
  - Making decisions today on land use that will affect outcomes for generations – need available modeling tools today
    - Have fairly good hydrological models, but trying to get ecological data from retrofitted hydrological models. How can ecological models be integrated in to hydrological models? Scalability and data density are major barriers to doing that.
    - If NSF can fund studies on high-density, high quality watersheds to improve models, would be great benefit. Then need to look at how to use those models to make land use decisions.

Research Ideas: Agency Perspectives cont.

- Bill's buzz words at NSF
  - Sustainability – water quality, usage, energy, funding
  - CI – Cyber-enabled Discovery and Innovation (data, virtual organizations, computational thinking)
    - A few in FY08 competition related to WN
    - WQ2EAT will have massive data needs
  - Complexity – multi-scale, multi-physics, transdisciplinarity – includes human interactions & social science
  - Nano – part of multi-scale? Sensor development?
  - Transformative – mandate; data collection good but not sufficient
  - Sensors – WN has research needs, how to make connection with CENS, new research?
    - Biological indicators
    - Pathogens

Research Ideas

- EPA ORD not focusing on social science research & model development. This program could be good way to focus on integrated research
  - Have reverse auction rain garden & barrel market program in watershed nearby, but not in experimental watershed we saw – could be started in experimental watershed to look at human-natural interactions
  - Prediction, prioritization of options, benefits (e.g., ecosystem services) require understanding human impacts & their integration with natural systems

Research Ideas cont.

- Need appropriate suites of models that interact with hydrologic/engineering models. E.g.:
  - Geospatial land use modeling, including economics (ag, urban), social issues (e.g., 70% of OH farms owned by elderly widows & leased annually), & large-scale impacts of land use changes
  - Water demand modeling
  - Policy response modeling – e.g., effects of water or air quality trading on watershed, ethanol subsidies
    - Mismatch between policy & water prediction scales, need more spatially explicit models
      - » E.g., can occur in small areas where information on water quality is poor (e.g., HSPF models meant for large-scale forecasts) –
- Dynamic feedbacks between natural and human systems
- May not need to understand water quality & quantity everywhere to make good decisions
  - Need information to prioritize

Research Ideas cont.

- Cyberinfrastructure tools developed at NSF could benefit EPA and NSF researchers:
  - Tools: CUAHSI observations data model (ODM), data services, workflow tools, digital watersheds, virtual observatories, modeling frameworks
  - Modeling frameworks need to support testing one model vs another
  - Hypothesis testing & data mining on broader datasets, easy access to those datasets
    - Large quantity of operational data enhances research
    - Research data enhances operations and management

Research Ideas cont.

- Basic science in aquatic ecology, taxonomy (identified to species level), physiology (endocrine disruption, pharmaceuticals) needed to understand status of ecology
  - Decisions based on indices of aggregation that we don't know much about
  - Need better models of organism occurrence, response, feedbacks with environment
    - Including extrapolation to watershed scales
  - Stream facility allows isolation of factors, then testing in watershed in parallel experiments
- Smart speciation system - capture expert knowledge (e.g., need to count particular parts of body) and automate identification of species
  - Stream facility data used to train expert system
  - Stream camera and expert system, expert feedback to continue to train system over time

Research Ideas cont.

- How to use bioindicators as sensors of stream health at watershed scale, e.g.:
  - Nitrate/nitrogen measurements
  - Clam opening
- Food web models, stream ecosystem models could be created from database related to aquatic systems and models
- Identifying optimal management and sampling strategies (including adaptive), using experimental watershed as case study
  - Using integrated models and advanced optimization tools
  - Including human decision makers in optimization process
- Use EPA data to explore better integration of models and data
  - Data assimilation
  - Interpolation approaches that include models
  - Integrating multiple types of data at different scales, including legacy data

Research Ideas cont.

- Developing and testing solutions for rural water supply and sanitation
  - Model-based performance
- EPA urban village , stream facility could help identify response functions for models, scale up process results to large scale
- Performance and prioritization models for stream restoration – EPA expertise and database

Low-Hanging Fruit Research Ideas

- Include EPA facilities in Phase 2 WNPO proposal
  - Stream/watershed experimental facility for:
    - Nested watershed design (need data & model access)
    - How to integrate hydrology and ecology at multiple spaces – include NEON?
    - Impacts of variable and reduced flows
  - T&E facility
    - Design WN pilot and mobile treatment facilities (need data access)
  - Chesapeake Bay Program Office
  - Green Infrastructure Facility
    - Design experimental village/BMP facility (need data access)
    - Feasibility of adding wastewater to Green Infrastructure Facility to study integrated stormwater/wastewater management & treatment
- Evaluate stormwater model using Green Infrastructure Facility data (Bruce Wilson)

Value of EPA/NSF Partnership

- NSF doesn't have specific mission, so can operate as external force to bring agencies together
  - Ensure that state of science & information transfer is state of art
  - Support development of standards/protocols for data & model synthesis
- Problem-based research brings disciplines together
- Unique facilities, expertise, and datasets will benefit NSF researchers
  - EPA has long-term data streams
- EPA can help disseminate research results, identify new problem-driven research needs

Issues/Barriers

- Grad students
  - International students allowed at facilities?
  - Temporary housing?
- Is there a conflict between EPA's immediate needs and NSF's long-term research timeframe?
- Who pays for and maintains databases and tools?
  - Need long-term commitment that includes all data types (Fed, state, local, researcher)
  - Sign of commitment needed for people to spend time on it.
- Need to create and adopt standards/protocols
  - Emerging Federation of Environmental Observatory Networks (FEON) may be mechanism
  - If protocols change, will it affect value of historical datastreams? Will people be willing to adopt standards?

Issues/Barriers cont.

- Funding issues
  - Are agencies putting their money where their mouth is on synthesis? E.g., most NSF budgets are allocated along disciplinary lines.
  - Synthesis projects require engagement of multiple disciplines & may require larger budgets than typical projects - $300K may not be enough.
  - Should there be a special solicitation at NSF just for researchers using EPA facilities? Counter arguments:
    - If there is interest, researchers could submit to unsolicited program.
    - Prototyping and fostering of partnerships needed for WN is important.

Institutions & Decision-Making Summary Presentation

Defining Institutions & Decision-Making

- Interface between science and policies
- Interface between information and behaviors (constructive & reactive)
- Stakeholder interactions, social networks, and agency
- Domain of psychologists, sociologists, anthropologists, economists, geographers

Value of Proposed Partnership

- Develop best practices (effective policies, procedures)
  - Managing water quality/quantity
  - Putting science into action
  - Positively informing/influencing behavior
  - Community engagement
  - Setting priorities
- Advance basic social science knowledge
- Integrate social science knowledge and modeling into water science
- Strengthen social dimensions of EPA natural science infrastructure
- Expanded opportunities for data collection

Prospective Outcomes

- Understand decision making networks for water supply, quality, reuse
- Improve information/communication with decision makers (individual & community)
- More systematic collection & organization of data on water-related social phenomena
- Capacity to answer new, integrative research questions about human/water interactions
- Enhance public understanding, awareness, involvement

Ideas for Collaboration

- Decision-making research infrastructure (visualization, perceptions, attitudes, responses to institutions)
- Social data coupled to hydrologic information system
- Mapping information/interaction networks (e.g., scientist/stakeholder/community interactions)
- Development of national survey instrument for repeated application (ref. national surveys on income dynamics, voting, etc.)

Short/Intermediate Term Opportunities

- Pilot development of national survey on water perceptions and use
- Mapping and analysis of science-policy network of EPA labs and stakeholders
- Identify social data sets for HIS (workshop at IISRM meeting – June 11)

Barriers/Solutions

- Federal requirements for collection of survey data
- Agency PI co-authorship of studies related to surveys conducted by grantees
- Understanding institutions as “infrastructure”
- Harmonizing basic and mission-driven research
- Articulating “basic” contributions of water-oriented social science research
- Difficulty of involving stakeholders in research design impedes transferability

Next Steps:

- Work toward a Memorandum of Understanding between NSF and EPA
- Coordinate the financial aspects of the NSF/EPA partnership
- Draft a Solicitation and Management Plan

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- WATERS Network - http://www.watersnet.org/
- Association of Environmental Engineering and Science Professors (AEESP) - http://www.aeesp.org/
- Consortium of Universities for Advancement of Hydrologic Science (CUAHSI) - http://www.cuahsi.org/
- U.S. EPA National Risk Management Research Laboratory (NRMRL) - http://www.epa.gov/nrmrl/index.html