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Proceeding of the Collaborative Science and Technology Network for Sustainability Workshop

APRIL 22 – 23, 2008
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Office of Research and Development
National Center for Environmental Research

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Summary

Energy, Water, and Land Use: A Framework for Incorporating Science Into Sustainable Regional Planning

Richard Taupier, Erin D.Baker, Sarah M. Dorner, and Catherine Miller
University of Massachusetts, Amherst, MA

Objective: The long-term project objective is to advance efforts to achieve local, regional, and global sustainability in the Pioneer Valley region of western Massachusetts and to serve as a model that can be applied in other regions of the country. To plan for sustainable growth in the region, we will work with the 43 communities in the Pioneer Valley to incorporate sustainability considerations and scientific information into land use and infrastructure decisions, taking into account scientific uncertainty. The specific objectives of this study are to make the concept of sustainability easy to understand and act on by involving stakeholders and the general public in a facilitated process to both define Pioneer Valley specific indicators of sustainability and identify specific and targeted actions to achieve sustainability. The communication regarding sustainability between interested parties in the Pioneer Valley will be enhanced, and a vehicle for incorporating scientific information into regional and community-based decision making will be provided.

Approach: To work toward these objectives, we will: (1) build on current connections at the University of Massachusetts, Amherst, and the Pioneer Valley Planning Commission to develop a network of decision makers and scientists; (2) develop and implement a framework to assist the region and communities to develop metrics of sustainability; (3) employ these metrics in a scientifically sound model that relates electricity generation decisions to sustainability metrics; and (4) build on this model to develop a Web-based decision support tool for local decision makers to use. We will focus in particular on the impacts of electricity generation choices on land use, air and water pollution, and greenhouse gas emissions and will incorporate the role of climate change in influencing these impacts. The projects will be grounded in the Pioneer Valley but will provide models and tools for other regions to build on. We envision this project as part of a larger project, in which a wide variety of integrated models will be developed that consider decisions on water, transportation, and land use more generally.

Expected Results: Project outputs will include: (1) the sustainability network and associated Web pages; (2) sustainability indicators and associated maps representing the current values of the metrics; (3) an integrated assessment model of the impacts of electricity generation alternatives on a number of attributes as defined by the metrics; and (4) the Web-based interactive decision tool. The expected outcomes of this project will be improved communication among stakeholders and between stakeholders and scientists; and improved decisions in terms of decision makers understanding the connection between choosing an alternative and the likely impacts of that alternative. Given that the Pioneer Valley has a demonstrated interest in environmental issues, sustainability, and environmental justice, we expect that having the tools and information to make better decisions will lead toward more sustainable decisions overall.

Building Sustainability Indicators To Assess the Physical, Social, and Economic Values of Greening Cities: A Study of the Million Trees Initiative in Los Angeles, CA

Jean-Daniel Saphores[1], Diane Pataki[1], Stephanie Pincetl[2], and Sassan Saatchi [2]
[1]Department of Civil and Environmental Engineering, University of California, Irvine, CA;
[2]Institute of the Environment, University of California, Los Angeles, CA

At a time of increasing concerns for urban sustainability, what are the physical, social, and economic values of urban forests in semi-arid climates where many of the world's fastest growing cities are located? Although urban forests are increasingly popular to improve environmental quality, little is known about their impacts on greenhouse gas emissions, local air quality, and local temperatures in relation to the urban heat island effect. We also want to understand how complex systems involving urban ecosystems, social organizations, and individuals learn and change when provided with scientific information on urban forests, and how this influences the implementation of sustainability at the regional level.

Objective: The goal of this research project is to build sustainability indicators for urban forests, quantify the value of urban forest, and shed light on the social dynamics of implementing sustainability in large urban areas.

Approach: The Million Trees Initiative in Los Angeles, CA, will be studied using an integrated systems approach that combines biology, earth system science, remote sensing, geography, and economics. We will perform the following tasks: (1) using remote sensing, map vegetation and its leaf area index (LAI) throughout Los Angeles over time; (2) conduct *in situ* measurements of urban tree function, and overlay meteorological data and concentrations of EPA criteria pollutants; (3) integrate these data with housing and key urban characteristics in a geographic information system (GIS) database; (4) perform hedonic studies to quantify the impacts of urban forests on the housing market; (5) define and calculate sustainability indicators for various neighborhoods, in cooperation with city agencies, non-governmental organizations, and the public; (6) observe how these parties use this information and implement sustainability; and (7) document and disseminate our findings.

Expected Results: This project will generate sustainability indicators to assess the physical, social, and economic values of urban forests. It will increase our physical knowledge of urban forests and evaluate their economic impacts on the housing market, allowing us to validate the popular iTree models, STRATUM and UFORE. Moreover, we will build a GIS tool that will be forward-looking and preventive in the practice of sustainability to monitor the impacts of urban forests in Los Angeles. Results from this project also will increase our understanding of how different parties learn and collaborate to implement aspects of urban sustainability. The results will be disseminated through scientific papers, workshops, and the Internet.

This innovative regional project combines biology, earth system science, remote sensing, geography and economics to inform decision makers about the potential benefits of urban forests and how it can contributes to regional sustainability.

Promoting Sustainable Pollutant Control Policies Through Consideration of Social and Biological Indicators: An Application to Mercury Control in New England

Mark E. Borsuk, Richard B. Howarth, Andrew A. King, and Darren J. Ranco
Dartmouth College, Hanover, NH

Objectives: The following objectives for the proposed research project are to: (1) identify meaningful biological and social indicators of sustainability that can be linked with mercury control policies using available knowledge and data; (2) determine whether the establishment of an explicit connection between mercury policy and biological and social indicators will increase the motivation for individual and organizational stakeholders to act in ways that promote ecological, economic, and social sustainability; and (3) assess whether the monitoring and reporting of biological and social indicators is likely to improve resilience in the human-environment system by improving stakeholder perception of ecological change, enhancing learning, and facilitating the process of adaptive management over time.

Approach: The objectives of this study will be pursued by our multidisciplinary team using a combination of economic and social scientific theory, environmental and ecological modeling, behavioral experiments, and stakeholder interviews. A particular focus of this project will be on identifying indicators that are meaningful to traditionally underrepresented or at-risk fractions of the American population, including rural Native American and urban African American communities, who may have unique livelihoods, cultural traditions, and exposure situations.

Expected Results: The hypothesis of this project is that explicitly connecting biological and social indicators to mercury management policies will forge a critical link in the feedback chain necessary to promote sustainability. This expectation arises for two reasons related to psychological framing. First, an explicit link between pollutant controls and measurable indicators will frame the sustainability issue in terms of "property rights." Second, well-designed indicators are more easily remembered and processed, and may link more easily to personal aspirations. There is evidence to suggest that both effects are likely to motivate individual and organizational stakeholders to act in ways that promote sustainability. We anticipate that the results of this project will be used to design regulatory frameworks that ensure environmental protection while exploiting economic efficiencies and addressing social justice concerns.

Testing Sustainable Building Materials and Practices During Gulf Coast Reconstruction

Jack Geibig[1], Bill Walsh[2], and Catherine Wilt[1]
[1]Center for Clean Products and Clean Technologies, University of Tennessee, Knoxville, TN;
[2]Healthy Building Network, Washington, DC

Objectives: In collaboration with architects and national green building experts, the University of Tennessee's Center for Clean Products and Clean Technologies and the Healthy Building Network, will develop a list of environmentally preferred building materials and products for the building of modular and prefabricated housing. Materials will be evaluated using a set of environmental and health-based criteria to be developed by a small group of materials and building experts. Criteria will stress a precautionary type of approach. The materials list will then be used by at least one manufacturer to develop, manufacture, and build onsite one or more demonstration homes. Data will be collected on the types and quantities of materials used in the traditional and green modular housing units, as well as all manufacturing and installation processes. An environmental assessment will be conducted comparing the life-cycle environmental footprint of the traditional house with that of the newly designed and constructed house made of sustainable and more environmentally benign building materials. Projected environmental benefits associated with the full-scale production of the green building will be estimated.

Metropolitan Accessibility and Transportation Sustainability: Comparative Indicators for Policy Reform

Jonathan Levine[1], Joe Grengs[1], Qing Shen[2], Carl Simon[1], and Susan Zielinski[1]
[1]University of Michigan, Ann Arbor, MI; [2]University of Maryland, College Park, MD

Objective: Transportation policy—a prime shaper of the built environment in metropolitan areas—has historically been guided by the idea of ensuring and improving mobility. However, it is accessibility—the capacity to reach destinations—that is the service people seek in a transportation system. We argue that sustainability in transportation and the built environment is furthered by a policy shift from mobility to accessibility as an overarching evaluative framework. This research project will support such a shift by developing and estimating, for the first time, measures of accessibility that will enable a meaningful comparison between multiple metropolitan areas of the United States. An outcome of this study will be a new method—in the form of indicators that can be analyzed both within and between regions—by which to gauge the progress of policy on infrastructure and the built environment toward sustainability.

Approach: This project will develop multiple measures of accessibility for 12-20 mid- to large-sized metropolitan regions. The concept of accessibility incorporates dimensions of environment, economy, and equity, and these dimensions are simultaneously present in the indicators that are being proposed. To inform land-use and transportation planning at the level of the metropolitan region, this study will seek to explain factors underpinning the differences in accessibility observed among the selected regions. It will explore the connection between accessibility and characteristics of the built environment in metropolitan regions, and develop several measures of urban form and transportation provision. These measures will be analyzed as inputs determining accessibility and sustainability outcomes.

Expected Results: Ultimately, we seek to accomplish for accessibility that which the Texas Transportation Institute's well-known Urban Mobility Study does for mobility: affect the terms of the debate and establish a measurable basis for policymaking at the metropolitan and intermetropolitan scale. The keen interest of EPA in communities and the built environment represents a significant opportunity to inject accessibility and hence, sustainability principles into transportation decision-making. The move within transportation circles toward accessibility-based transportation planning can be encouraged and accelerated with input from EPA.

Mapping Regional Development for Smart Growth Planning To Minimize Degradation of Water Quality and Enhance Green Infrastructure

Donald Katnik and Steve Walker
Maine Department of Inland Fisheries and Wildlife, Bangor, ME

Objective: Unplanned development threatens water quality and other environmental goods by degrading ecosystems. State agencies and towns evaluate permits for negative effects on water quality, but this case-by-case approach does not address cumulative impacts of urban sprawl. *Beginning with Habitat*, a collaborative public-private partnership, was initiated by the State of Maine to provide local planners with maps and information on riparian habitats, water resources, high value plant and animal habitats, and undeveloped blocks to guide smart growth and enhance green infrastructure. Tracking development is critical for *Beginning with Habitat*. Local planners and land trusts lack the regional, long-term perspective that a map of cumulative development could provide. Further, this information could be used to assess whether communities have used *Beginning with Habitat* information to successfully guide growth away from important habitats and to protect water resources. The objective of this research project is to use geospatial data to map development and provide that information to towns and land trusts to assist with smart-growth planning.

Approach: Maine has impervious surface data derived from 2004 satellite imagery that will combined with road centerlines, utility connections, and buildings digitized from high-resolution orthoimagery to create a baseline map of development for 2004. The second phase will use change-detection analysis to identify areas of residential or commercial growth between 2004 and 2008. New impervious surface data will be acquired for those high-growth areas and supplemented by field visits, new utility connections, and new road locations to map development for 2008. The development maps and accompanying information on urban sprawl and smart-growth planning will be provided to towns and land trusts through *Beginning with Habitat*.

Expected Results: The primary results of this study will be a 2004 baseline map of development and a 2008 map of new development, which will be incorporated into the *Beginning with Habitat* information package and distributed to local planners and land trusts. Short-term success will be measured by use of the development data in town comprehensive plans and zoning ordinances. Long-term success will be measured by less development and more conservation acquisitions in areas that have the most impact on important habitats and water resources. These outcomes will meet *Beginning with Habitat's* goal of conserving Maine's existing natural resources and open spaces and the stated objective of this project by protecting water quality and enhancing green infrastructure.

Reality Check Plus: Envisioning a Sustainable Maryland

Gerrit Knaap, Glenn E. Moglen, and Matthias Ruth
National Center for Smart Growth Research and Education, University of Maryland, College Park, MD

Objective: There is widespread consensus—based on a growing body of academic research—that how we design and construct cities has a significant impact on the natural environment. The types of natural systems affected are wide ranging and include effects on plant and animal habitat, hydrological cycles, air and water quality, and global climate. How to minimize these adverse impacts through sound land use policy, however, remains underexplored. This research project explores alternative development scenarios for the State of Maryland and provides estimates of how land development can affect energy consumption and surface water quality.

Approach: This interdisciplinary project builds on a large, recently completed public participation exercise in which Maryland residents placed LEGO® blocks on a map as a means of expressing a preferred future development scenario. This development scenario will be compared with existing conditions, an extension of current development trends, and two yet-to-be developed scenarios to identify impacts on a variety of development indicators. Work under this grant will focus on two specific areas: (1) energy consumption, and (2) surface water quality. Water quality impacts of alternative development scenarios will be estimated using a geographic information system-based model that yields estimates of nitrogen, phosphorus, and sediment loadings into stream segments throughout the state. Impacts on energy consumption will be estimated using statistical models that capture interactions among urban development patterns, local climate change, and energy consumption.

Expected Results: The results are expected to reveal significant differences in estimates of water quality degradation and energy consumption by development scenario. More compact growth, for example, will lead to fewer acres with impervious surfaces and thus higher water quality in most Maryland streams. More compact growth also will lead to smaller houses and denser development patterns, which may result in higher residential energy use for heat but, perhaps due to heat island effects, lower energy use for cooling. These two sustainability indicators, combined with other social and economic indicators, can lead to better informed decisions regarding land policy and infrastructure investments.

Sustainable Lake Management in Maine's Changing Landscape

Kathleen P. Bell, Jessica Leahy, Stephen Sader, Peter Vaux, Katherine Webster, and Jeremy Wilson
University of Maine, Orono, ME

This research project focuses on the development of sustainable lake management strategies in Maine's changing landscape. By providing mechanisms to track and anticipate new residential development and to delineate the impacts of such development on lake ecosystems and their service flows, the proposed research advances scientific understanding and fills significant information gaps. By demonstrating how such information and spatial modeling tools may be used to consider alternative futures, this study also allows for proactive, collaborative management strategies to sustain the quality and enjoyment of Maine lakes.

Objectives: Four objectives have been established to support sustainable lake management: (1) create base line spatial databases of residential development and lake characteristics; (2) develop a spatial economic model of residential development to determine the role of various factors in influencing the spatial distribution of residential development; (3) develop a spatial risk assessment tool to examine the vulnerability of specific lake characteristics to new residential development; and (4) create a practical planning tool using modeling-based alternative futures scenarios to support lake management, land-use planning, and economic development decisions.

Approach: By combining ecological, economic, silvicultural, recreation, and remote-sensing expertise, a collaborative, multidisciplinary approach is advanced to address this project's research objectives. By integrating spatial models of residential development with spatial models describing ecological and social lake characteristics, practical planning tools will be designed to assess the impacts of future residential development on the sustainability of Maine's lakes. This project's communication tasks will be enhanced by input from project collaborators and a set of community-based pilot studies.

Expected Results: This study's outputs include baseline GIS databases, spatial modeling tools, an alternative futures tool, and community involvement in lake management. All outputs are designed to support ecologically sensitive land management and development and to sustain water resources to ensure quality and availability for desired uses.

Partnership for Industrial Ecology in Central Ohio

Joseph Fiksel[1], Bhavik R. Bakshi[1], and Mike Long[2]
[1]Ohio State University, Columbus, OH; [2]Solid Waste Authority of Central Ohio (SWACO), Grove City, OH

Objectives: Despite its promise, industrial ecology (IE) is practiced only sporadically in the United States and has not been pursued consistently at a regional scale. Aside from technical and economic challenges, an important barrier is behavioral inertia among industrial firms and consumers. To overcome these challenges, the Partnership for Industrial Ecology in Central Ohio (PIECO) was launched as a collaboration between The Ohio State University, the Solid Waste Authority of Central Ohio, and several regional partners. PIECO's mission is to promote a systems approach based on sound science and informed decision-making. This research project will support this mission by pursuing the following objectives: (1) develop a systems-level model of resource flows and interdependencies in Central Ohio; (2) implement decision tools for evaluating costs and benefits of innovative IE opportunities; and (3) promote acceptance of IE innovations by regional businesses, citizens, and public agencies.

Approach: This research project will develop and apply an Industrial Ecosystem Toolkit to explore innovative IE policies and technologies. A network model of resource flows will be constructed using material flow analysis and economic input-output methods. Within this framework, potential IE innovations proposed by PIECO partners will be evaluated, using tools such as thermodynamic life-cycle assessment, impact assessment, systems dynamics, and multi-objective cost-benefit analysis. Results will be disseminated to regional stakeholders through a variety of channels, including Web sites, educational materials, and public meetings. SWACO will take the lead in seeking investments and capital approval for selected innovations. The Toolkit will be made broadly available for application to other regions.

Expected Results: PIECO's application of the above tools will support the promulgation and adoption of IE practices in Central Ohio, yielding both environmental and economic gains. Our target is a 15 percent reduction in waste disposal to landfill by 2012, equivalent to avoiding approximately 150,000 tons per year, coupled with a 15 percent increase in resource productivity. More broadly, we anticipate that dissemination of these results to other regions will help to: (1) advance both theory and practice of IE by demonstrating a pragmatic systems approach; (2) provide useful decision tools, data, and indicators for quantifying the benefits of IE; and (3) establish a model for public-private collaboration in other U.S. communities and regions.

Protection of Critical Source Areas for Achieving Long-Term Sustainability of Water Resources

Zeyuan Qiu[1], Dan Van Abs[2], Christine Hall[3], and Grace Messinger[4]
[1]New Jersey Institute of Technology, Newark, NJ; [2]New Jersey Water Supply Authority, Raritan, NJ; [3]Natural Resources Conservation Service, Washington, DC; [4]North Jersey Resource Conservation and Development Council, Clinton, NJ

Urban development and urban sprawl are among the most pressing issues in the United States as well as in New Jersey. Urban development and sprawl impose immediate threats to sustainability of water resources. Although land use decisions are critical to achieve long-term sustainability of water resources, not every part of landscapes is equally important. Municipalities play a key role in local land use decision making.

Objective: The objective of this research project is to protect/preserve critical source areas at the municipal level for achieving the long-term sustainability of water resources through community-based land use planning and ordinances.

Approach: To support the objective, this project will: (1) establish and maintain an effective network of scientists and agency personnel for protecting the critical source areas at the municipal level; (2) identify the critical source areas for protection by applying the variable source area hydrology modeling techniques in Rockaway Creek watershed, Hunterdon County, New Jersey; (3) review the existing municipal land use plan, zoning, and ordinances, and develop land use plans, ordinances, and best management practices that are adoptable by municipalities to protect the critical source areas in local communities in the selected watershed; and (4) design and implement a set of education and outreach programs that help municipalities adopt the proposed land use plans and ordinances to protect critical source areas in their communities based on social and economic analyses.

Expected Results: The expected results include: (1) connecting hydrological science and technology to feasible water resource protection actions; (2) going beyond the education to stakeholders and focusing on the actions related to land use planning and decisions at the municipal levels; (3) coordinating various federal and state programs for achieving locally identified water resource management objectives; and (4) developing a series of land use planning tools and protocols that are transferable to other communities.

Appendices

U.S. Environmental Protection Agency
Collaborative Science and Technology Network for Sustainability (CNS)
Grantees Workshop
in Concert With the P3 (People, Prosperity and the Planet)
National Sustainable Design Expo

April 22 - 23, 2008
Grand Hyatt Washington
Washington, DC

AGENDA

Tuesday, April 22, 2008

7:00 a.m. – 8:00 a.m.	**Registration**
8:00 a.m. – 8:05 a.m.	**Welcome** Leanne Nurse, U.S. Environmental Protection Agency (EPA), Office of Research and Development (ORD), National Center for Environmental Research (NCER)
8:05 a.m. – 8:15 a.m.	**Opening Remarks** William H. Sanders III, EPA, ORD, Director, NCER
8:15 a.m. – 10:15 a.m.	**CNS Project Briefs** (10 minutes per project)
	Energy, Water, and Land Use: A Framework for Incorporating Science Into Sustainable Regional Planning *Richard Taupier, University of Massachusetts*
	Building Sustainability Indicators To Assess the Physical, Social, and Economic Values of Greening Cities—A Study of the Million Trees Initiatives in Los Angeles, CA *Jean-Daniel Saphores, University of California at Irvine*
	Promoting Sustainable Pollutant Control Policies Through Consideration of Social and Biological Indicators: An Application to Mercury Control in New England *Mark Borsuk, Dartmouth College*
	Testing Sustainable Building Materials and Practices During Gulf Coast Reconstruction *Jack Geibig, University of Tennessee*
	Metropolitan Accessibility and Transportation Sustainability: Comparative Indicators for Policy Reform *Jonathan Levine, University of Michigan*

Tuesday, April 22, 2008 (continued)

CNS Project Briefs, continued

Mapping Regional Development for Smart Growth Planning To Minimize Degradation of Water Quality and Enhance Green Infrastructure
Donald Katnik, Maine Department of Inland Fisheries and Wildlife

Reality Check Plus: Envisioning a Sustainable Maryland
Jason Sartori, University of Maryland
Glenn Moglen, University of Maryland

Sustainable Lake Management in Maine's Changing Landscape
Kathleen Bell, University of Maine

Partnership for Industrial Ecology in Central Ohio
Joseph Fiksel, Ohio State University

Grant Protection of Critical Source Areas for Achieving Long-Term Sustainability of Water Resources
Zeyuan Qiu, New Jersey Institute of Technology

10:15 a.m. – 1:00 p.m. **CNS Grantees' Visit P3 Expo and Lunch** (on your own)

For more information on the P3 Expo, please visit:
http://es.epa.gov/ncer/p3/expo/index.html

Interagency Panels (at the Grand Hyatt Washington)

1:00 p.m. – 1:05 p.m. **Welcome to Panel Discussions**
Diana Bauer, EPA, ORD, NCER

1:05 p.m. – 2:15 p.m. ***Energy and Materials***
Grecia Matos, U.S. Geological Survey
Joseph Fiksel, Ohio State University, Co-Director, Center for Resilience (CNS grantee)
Laura Draucker, EPA, ORD, National Risk Management Research Laboratory

- What types of models and metrics are most useful to understand materials and energy sustainability at a regional scale in transportation, energy supply, the industrial sector, and the built environment?
- How can these analyses inform development patterns or economic activity?
- How do regional scale decisions regarding energy and materials relate to larger scale effects?

Tuesday, April 22, 2008 (continued)

Interagency Panels, continued

2:15 p.m. – 3:30 p.m.

Water, Urban Forests, and Land Use

Heather Whitlow, Casey Trees
Hannah Campbell, National Oceanic and Atmospheric Administration, Regional Integrated Sciences and Assessments Program
Zeyuan Qiu, New Jersey Institute of Technology (CNS Grantee)
John Lyon, EPA, ORD, Office of the Science Advisor

- At the regional scale, how can water management be informed by development patterns; how can development decisions be informed by water management needs; and how can both take into account uncertain changes beyond local and regional control such as climate change?
- How do urban forests and other ecosystems located in densely developed areas affect greenhouse gas emissions, air quality, local water quality, local temperatures, etc., and how is this measured?
- How can this knowledge and information best inform economically sound land use planning at a regional scale?

3:30 p.m. – 4:45 p.m.

Getting to Shared Information (Distributed Decision Making)

Stuart Schwartz, University of Maryland (former CNS Grantee)
Richard Taupier, University of Massachusetts – Amherst, The Environmental Institute, Associate Director, International Research (CNS grantee)
Britta Bierwagen, EPA, ORD, National Center for Environmental Assessment (NCEA)
Steve Young, EPA, Office of Environmental Information

- What are some approaches to make the concept of sustainability easy to understand and compelling to act on across a diverse population?
- What is the role of geographic information, material flow data, and other data and models?
- When and how does scientific understanding best interface with a collaborative process to inform creative and effective solutions?

6:30 p.m. – 8:00 p.m.

CNS Grantees' Opportunity to Attend the P3 Awards Ceremony
For more information on the P3 Expo, please visit:
http://es.epa.gov/ncer/p3/expo/index.html

Wednesday, April 23, 2008

9:00 a.m. – 12:30 p.m. **CNS Grantees Meet With EPA Program Offices**
(P3 teams are welcome to attend at EPA offices.)

EPA program offices host individual interactive conversations with CNS grantees and other federal, state, and local sustainability leaders. Grantees will briefly review their project goals and findings to date. This also will be an opportunity to provide input and suggestions to the projects and identify opportunities for future collaboration and exchange.

- CNS Grantee: *Energy, Water, and Land Use: A Framework for Incorporating Science Into Sustainable Regional Planning*
  Richard Taupier, University of Massachusetts
  EPA Host: Bernice L. Smith, EPA, ORD
  9:00 a.m. – 10:30 a.m., Woodie's Building,
  1025 F Street, NW, Room 3127, 3rd Floor,
  South Conference Room

- CNS Grantee: *Building Sustainability Indicators To Assess the Physical, Social, and Economic Values of Greening Cities—A Study of the Million Trees Initiatives in Los Angeles, CA*
  Jean-Daniel Saphores, University of California at Irvine
  EPA Host: Anne Sergeant, EPA, ORD
  9:00 a.m. – 10:30 a.m., Woodie's Building,
  1025 F Street, NW, Room 3306, 3rd Floor,
  East Conference Room

- CNS Grantee: *Promoting Sustainable Pollutant Control Policies Through Consideration of Social and Biological Indicators: An Application to Mercury Control in New England*
  Mark Borsuk, Dartmouth College
  EPA Host: Pasky Pascual, EPA, ORD
  10:30 a.m. – 12:00 p.m., Woodie's Building,
  1025 F Street, NW, Room 3127, 3rd Floor,
  South Conference Room

- CNS Grantee: *Testing Sustainable Building Materials and Practices During Gulf Coast Reconstruction*
  Jack Geibig, University of Tennessee
  EPA Host: Dale Manty, EPA, ORD
  10:30 a.m. –12:30 p.m. – Ronald Reagan Building,
  1300 Pennsylvania Avenue, NW, "Fishbowl"
  Conference Room

CNS Grantees Meet With EPA Program Offices, continued

- CNS Grantee: *Metropolitan Accessibility and Transportation Sustainability: Comparative Indicators for Policy Reform*
  Jonathan Levine, University of Michigan
  EPA Host: Kevin Nelson, EPA, Office of Policy, Economics and Innovation
  10:30 a.m. – 12:00 p.m., EPA East,
  1201 Constitution Avenue NW, Room 2379

- CNS Grantee: *Mapping Regional Development for Smart Growth Planning To Minimize Degradation of Water Quality and Enhance Green Infrastructure*
  Donald Katnik, Maine Department of Inland Fisheries and Wildlife
  EPA Host: Laura Gabanski, EPA, Office of Water
  10:30 a.m. – 12:00 p.m., EPA West,
  1301 Constitution Avenue, NW, Room 7201

- CNS Grantee: *Reality Check Plus: Envisioning a Sustainable Maryland*
  Matthias Ruth, University of Maryland
  EPA Host: Carlton Eley, EPA, Office of Policy, Economics and Innovation
  9:00 a.m. – 10:30 a.m., EPA East,
  1201 Constitution Avenue, NW, Room 2379

- CNS Grantee: *Sustainable Lake Management in Maine's Changing Landscape*
  Kathleen Bell, University of Maine
  EPA Host: Robert Goo, EPA, Office of Water
  9:00 a.m. – 10:30 a.m., EPA West,
  1301 Constitution Avenue, NW, Room 7129

- CNS Grantee: *Partnership for Industrial Ecology in Central Ohio*
  Joseph Fiksel, Ohio State University
  EPA Host: Angela Leith, EPA, Office of Solid Waste and Emergency Response
  10:30 a.m. – 12:00 p.m., EPA West,
  1301 Constitution Avenue, NW, Room 4118

- CNS Grantee: *Grant Protection of Critical Source Areas for Achieving Long-Term Sustainability of Water Resources*
  Zeyuan Qiu, New Jersey Institute of Technology
  EPA Host: Angela Page, EPA, ORD
  10:30 a.m. – 12:00 p.m., Woodie's Building,
  1025 F ST NW, 3rd floor, Room 3306 East Conference Room

Wednesday, April 23, 2008 (continued)

12:30 p.m. – 2:00 p.m.	**CNS Group Lunch/Networking** (individually paid) Location: TBA
2:00 p.m.	**Adjournment**

U.S. Environmental Protection Agency
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National Sustainable Design Expo

April 22 - 23, 2008
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POST-MEETING PARTICIPANTS LIST

Beth Anderson
U.S. Environmental Protection Agency

Nelisa Ballosingh
University of the District of Columbia

Larry Bank
National Science Foundation

Diana Bauer
U.S. Environmental Protection Agency

Kathleen Bell
University of Maine

Joan Biermann
Accrew Business Growth Partners

Britta Bierwagen
U.S. Environmental Protection Agency

David Blockstein
National Council for Science and the Environment

Nicole Barone Callahan
Environmental Literacy Council

Richard Callan
U.S. Environmental Protection Agency

Hannah Campbell
National Oceanic and Atmospheric Administration

Tiao Chang
Ohio University

Edward Chu
U.S. Environmental Protection Agency

Alva Daniels
U.S. Environmental Protection Agency

Laura Draucker
U.S. Environmental Protection Agency

Joseph Fiksel
The Ohio State University

Amy Forrester
Sustainability: Science, Practice, and Policy

Leslie Friedlander
Department of Homeland Security

Laura Gabanski
U.S. Environmental Protection Agency

Jack Geibig
The University of Tennessee

Robert Hershey
Capital PC User Group

Barry Ikpe
Movement for the Survival of the Ogoni People

Jamal Kadri
U.S. Environmental Protection Agency

Dongjin Kang
American Planning Association

Donald Katnik
Maine Department of Inland Fisheries and Wildlife

Carrie Knowlton
ASPH Fellow
U.S. Environmental Protection Agency

Jonathan Levine
The University of Michigan

John Lyon
U.S. Environmental Protection Agency

Grecia Matos
U.S. Department of the Interior
U.S Geological Survey

Glenn Moglen
University of Maryland

Melinda Montgomery
University of the District of Columbia

Leanne Nurse
U.S. Environmental Protection Agency

Zeyuan Qiu
New Jersey Institute of Technology

William Sanders
U.S. Environmental Protection Agency

Jean-Daniel Saphores
University of California, Irvine

Jason Sartori
University of Maryland

Ryan Scherzinger
American Planning Association

Stuart Schwartz
University of Maryland, Baltimore County

Bernice Smith
U.S. Environmental Protection Agency

Jelena Srebric
The Pennsylvania State University

Zahava Stroud
Hollywood News

Rick Taupier
University of Massachusetts at Amherst

Bessie Taylor
U.S. Environmental Protection Agency

Rama Mohana Turaga
Dartmouth College

Claudia Walters
U.S. Environmental Protection Agency

Heather Whitlow
Casey Trees

Catherine Wilt
University of Tennessee

Steve Young
U.S. Environmental Protection Agency

José Zambrana
U.S. Environmental Protection Agency

Contractor Support

Maria Smith
The Scientific Consulting Group, Inc.

Darlene Summers
The Scientific Consulting Group, Inc.

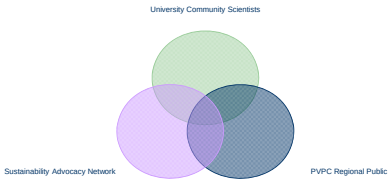
Energy, Water, and Land Use: A Framework for Incorporating Science into Sustainable Regional Planning

University of Massachusetts at Amherst and the Pioneer Valley Planning Commission
Rick Taupier,
Erin Baker and Catherine Miller, PIs

Contributions to Regional Sustainability

Formalization a of Network of Regional Sustainability Advocates
Selection of Sustainability Indicators to Define and Track Progress
Use of Media Tools to Engage Public and Encourage Action
Design of an On-line Decision Support Tool
Extension of DS Tool for Other Uses

Partnership Structure



Project Task Flow

Convene Sustainability Network Group
Select Indicators to Aid Decision Making
Develop Web Tools and Public Media Campaign
Select Metrics for Decision Support
Design Decision Support Tool for Energy Choices
Provide and Promote Access to DS Tools
Apply to Additional Decision

Lessons so Far

Difficulty of Multidisciplinary Agreement

Independence of Sustainability Advocates

Importance of Local Applicability

Difficulties of Selecting and Applying Indicators

The Big Questions

How do we make issues of local, regional and global sustainability important and actionable for residents in a wealthy post-industrial society?

How do we organize information so that consumers understand the effects of their choices?

Building sustainability indicators to assess the physical, social, & economic values of greening cities

A study of the million trees initiatives in Los Angeles, CA

Jean-Daniel Saphores[a], Diane Pataki[a], Stephanie Pincetl[b], and Sassan Saatchi[b]

[a]: University of California, Irvine;
[b]: University of California, Los Angeles

Link with Sustainability

Our goal:

- To build sustainability indicators for semi-arid urban forests and shed light on the social dynamics of implementing sustainability in large urban areas, with an application to Los Angeles.

Key questions for our project:

- What are the *physical, social, and economic values of urban forests in semi-arid climates*?
- What are the impacts of urban forests on *greenhouse gas emissions, local air quality, and local temperatures* in relation to the urban heat island effect?
- How do complex systems involving urban ecosystems, social organizations and individuals change when provided with scientific information on urban forests?

Project Overview

1. Using remote sensing, map vegetation and its leaf area index throughout LA ,over time;
2. In-situ measures of urban tree function; overlay meteorological data and conc. of EPA criteria pollutants;
3. Hedonic studies to quantify the impacts of urban forests on the housing market;
4. Build sustainability indicators for various neighborhoods, jointly with LA agencies, NGOs, and the public;
5. Integrate biological, meteorological, socio-economic, & demographic data in a GIS database;
6. Observe how LA/NGOs/the public use this information and implement sustainability;

Current and Potential Partners

Current Partners

- City of Los Angeles, Environmental Affairs
- City of Los Angeles, Department of Public Works
- City of Santa Monica
- Metropolitan Transit Authority
- US Forest Service
- North East Trees
- Livable Places
- Global Green

Potential Partners

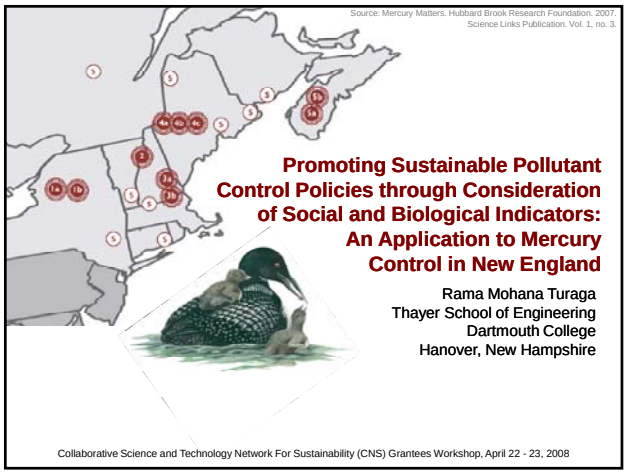
- City of Los Angeles, Department of Water & Power
- City of Seattle?

Lessons Learned thus Far

- Tensions between sustainability and political realities: creating disaggregated sustainability indicators may pit one part of the city against another…
- Difficulty of findings good sites for installing a tower with instruments to measure air quality in an urban area.
- There are lots of data: we just need to look in the right places…

Our Goals for this Meeting

1. Meet people with experience in managing urban forests
2. Share experiences about starting a process for creating sustainability indicators.
3. More generally, meet other grantees and get an overview of cutting edge sustainability work.



Promoting Sustainable Pollutant Control Policies through Consideration of Social and Biological Indicators: An Application to Mercury Control in New England

Rama Mohana Turaga
Thayer School of Engineering
Dartmouth College
Hanover, New Hampshire

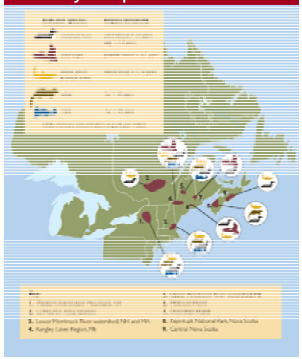
Key Contributions to Sustainability:

→ Conceptually-supported indicators that represent both *process* and *outcome* for both *social* and *biological objectives* for a sustainable mercury policy in New England.

→ Experimental tests of the hypothesis that an appropriate choice of indicators will fundamentally change the dynamics of stakeholder participation and regulatory enforcement and assessment in ways that promote sustainability.

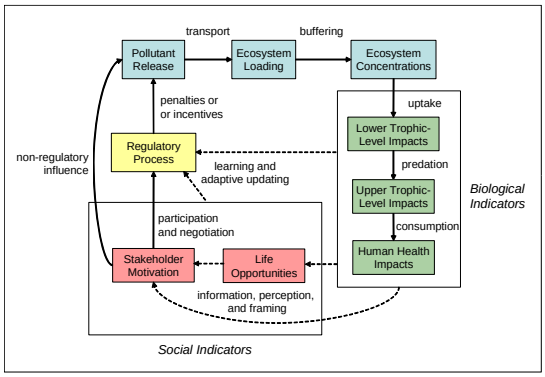
→ The development and demonstration of an integrative model to simulate mercury control policy options in New England to predict how they fare with regard to the regional sustainability indicators developed.

Mercury Hotspots in the Northeast



Source: Mercury Connections. 2005. BioDiversity Research Institute. Gorham, ME.

System Schematic



Project Partners

Investigators:

Mark Borsuk, Engineering, Dartmouth – Integrated Modeling
Richard Howarth, Environmental Economist, Dartmouth - Sustainability Indicators and Economics
Andrew King, Business Policy and Strategy, Harvard/Dartmouth – Experimental Games
Darren Ranco, Native American Studies, Dartmouth – Stakeholder Interviews
Rama Mohana Turaga, Research Associate, Dartmouth – Modeling and Stakeholder Analysis

Collaborators:

MERGANSER Team: Alison C. Simcox, EPA Region 1
John M. Johnston, EPA ORD, Athens

- US EPA: Alan VanArsdale, Dwight Atkinson, Tom Braverman, Ruth Chemery, Glynis Lough, Diane Nacci, Randy Waite, Jeri Weiss
- USGS: Keith Robinson, Richard Moore, Richard Smith
- Biodiversity Research Institute (BRI): David Evers
- Ecosystems Research Group, Ltd.: Eric Miller
- VT Agency of Natural Resources (VT ANR): Neil Kamman
- Clean Air Association of the Northeast States (NESCAUM): John Graham
- NE Interstate Water Pollution Control Commission (NEIWPCC): Susannah King

New England Environmental Justice Groups:

- Penobscot Indian Nation of Maine
- Alternatives for Community and Environment (ACE) of Boston

Work on Four Main Tasks

→ **Sustainability Concepts:** Literature review on prevailing definitions
  • Inter- and intra-generational equality of opportunity

→ **Sustainability Indicators:** Literature review with the aim of identifying existing frameworks and gaps that can be addressed by our project
  • Top-down vs. bottom-up approaches
  • Importance of scale and salience

→ **Mercury**: Review of exposure pathways, human health and ecological impacts, and regulatory framework
  • Current regulations focus on human health endpoints only; no provision for protection of ecosystem health, wildlife, or life opportunities
  • Our review of public comments on the Clean Air Mercury Rule (CAMR) has revealed a surprising level of participation from Native American tribes.

→ **Models and Data**: SERAFM, MERGANSER, NERC, GIS data

Interesting Recent Developments

→ A new category (5m) for waters listed as impaired by atmospheric mercury under Clean Water Act Section 303(d) was introduced in March 2007, acknowledging the transboundary challenges involved in mercury control.

→ New England has taken the lead in addressing mercury pollution through a coordinated regional TMDL, recently approved by EPA.

→ In February 2008, a federal appeals court rejected CAMR on the basis of the regulatory approach followed by EPA.

Goals for This Meeting

- → Discuss with other participants concepts of sustainability and criteria for selecting appropriate indicators at the regional scale
- → Learn more about previous stakeholder elicitation or analysis efforts related to mercury or other contaminants
- → Connect with human health scientists to identify predictable indicators of human health impacts of mercury
- → Understand what policy options the EPA is considering in response to the court ruling against CAMR
- → Share experiences with other grantees regarding the challenges of interdisciplinary research projects

Sustainable Building Materials and Practices during Gulf Coast Reconstruction

NCER CNS Mtg.- Wash D.C.
April 22, 2008

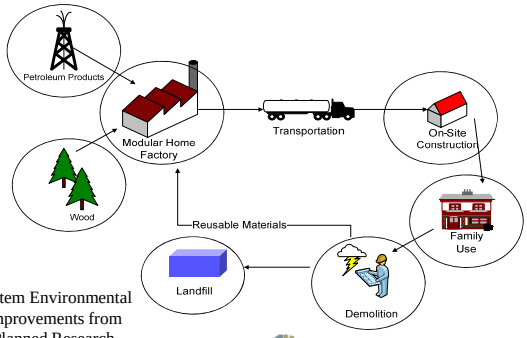
Sustainable Future

- Applies life-cycle thinking and a precautionary approach to the immediate housing needs of the Gulf Coast.
- Provide life-cycle materials data/resources to promote the construction of future sustainable housing in the residential sector.
- Improve the health, safety, and livelihood of Gulfport residents through access to environmentally improved, affordable housing.

Project Partners/Roles

- Center for Clean Products- UT
  - Evaluate materials use and identify environmentally preferable bldg materials
  - Conduct life-cycle analysis of benefits of green material use
- Healthy Building Network
  - Design and construction of demonstration home
  - Community development and organization
- Unity Homes / Clayton Homes
  - Unity Homes builder of demonstration green homes
  - Clayton providing data on materials use in mod homes

Building Materials Life Cycle



System Environmental Improvements from Planned Research

Lesson Learned To-Date

- Establishing criteria for evaluating building materials a complex and complicated task
  - Consensus lacking on key issues
  - Lack of data in marketplace
  - Assemblies complicate analysis
- Material use distributed across the supply chain
- Limited availability of preferable materials at affordable cost
- Trend in market toward upscale homes and permanent communities

Goals for the Meeting

- How our project dovetails with other EPA efforts in the green building arena
- Possible connections with FEMA efforts in the gulf coast region.
- Identify upcoming opportunities to partner or participate with on-going efforts or forums
- Identify experts or resources in key areas of compatible research

Metropolitan Accessibility and Transportation Sustainability:
Comparative Indicators for Policy Reform

University of Michigan
University of Maryland

Promote Sustainability: *Meet needs of present without compromising ability of future generations to meet their needs*

- Reduce (fulfillment of) needs
- Reduce impact of need fulfillment
- Redefine needs

Redefining needs in Transportation Policy

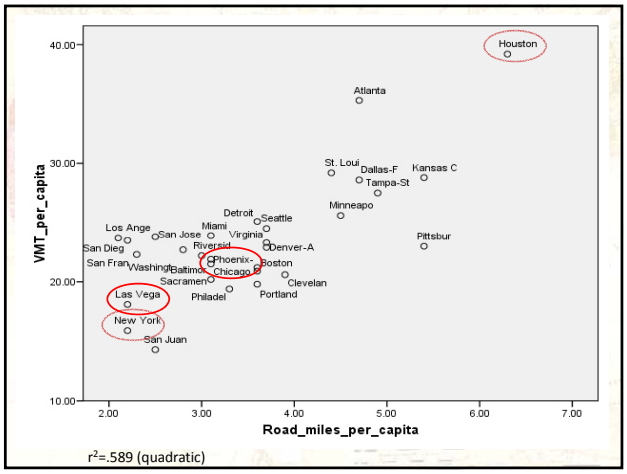
Traditional Mobility-Based Definition

- Mobility
  - Capacity Expansion
  - Land-Use Planning
  - Travel Demand Management

Alternative Accessibility-Based Definition

- Accessibility
  - Mobility
  - Proximity
  - Remote Connectivity

Eric Britton	Founder and Director, EcoPlan International and The Commons
Mary Crass	Senior Policy Analyst, Urban, Environment, and Accessibility Issues, European Conference of Ministers of Transport (ECMT of the OECD)
Charlotte Kahn	Executive Director, Boston Indicators Project
William Klein	Director of Research, American Planning Association
Xuan Liu	Data Center Director, Southeast Michigan Council of Governments
William Lyons	Senior Project Manager, Volpe National Transportation Systems Center
Alex Marshall	Senior Fellow, Regional Plan Association, New York
Eric Miller	Bahen/Tanenbaum Professor, Department of Civil Engineering, University of Toronto
Harriett Tregoning	Executive Director, Smart Growth Leadership Institute
SMART	Sustainable Mobility and Accessibility Research and Transformation, The University of Michigan



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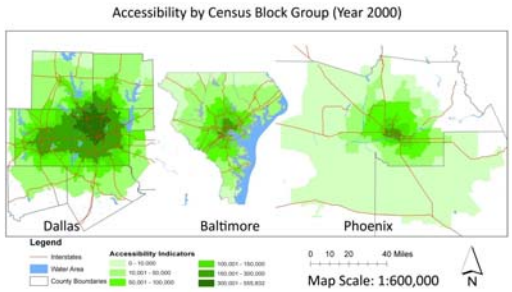
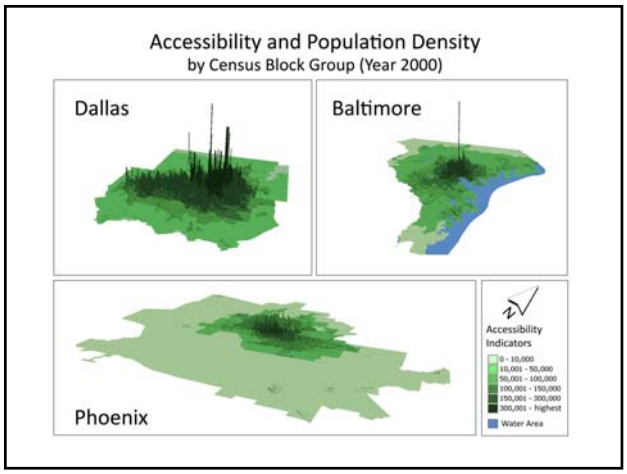
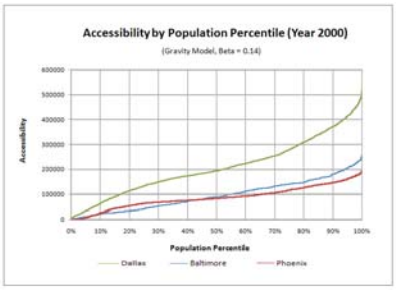
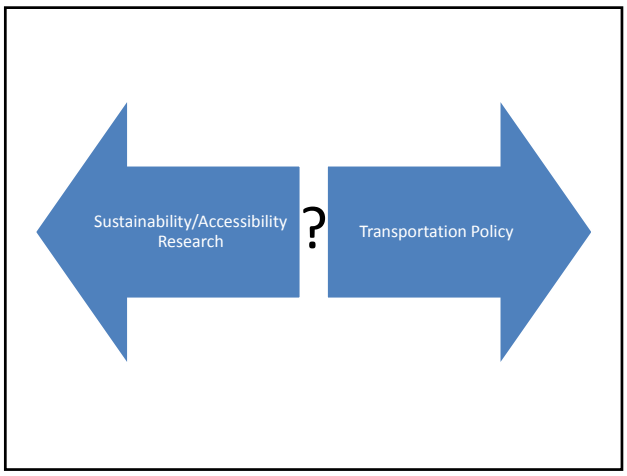
Job Accessibility by Car
Dallas, Baltimore, and Phoenix





Distribution of Job Accessibility by Car, Dallas, Baltimore, and Phoenix





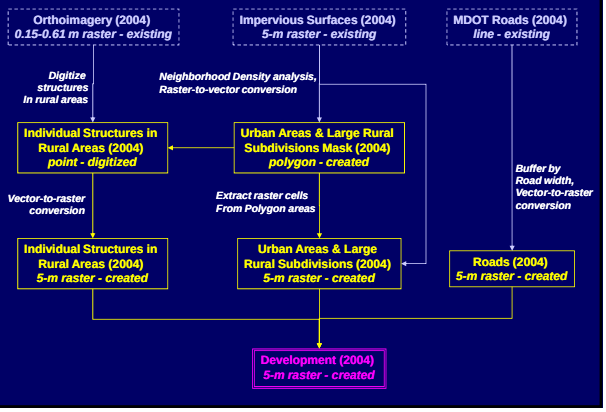
Mapping Regional Development for Smart Growth Planning to Minimize Degradation of Water Quality and to Enhance Green Infrastructure

Don Katnik, Maine Dept. of Inland Fisheries & Wildlife
Steve Walker, Maine Dept. of Inland Fisheries & Wildlife
Elizabeth Hertz, Maine State Planning Office

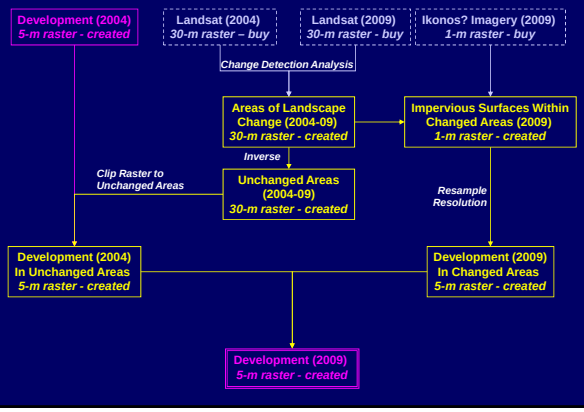
How This Project Supports Sustainability

- **Riparian areas and water resources are a critical natural resource for long-term sustainability of natural ecosystems**
- ***Beginning with Habitat*** **provides maps of natural resource data to municipalities & land trusts to encourage Smart Growth development and landscape planning to conserve habitat and open space**
- **The current maps only shows half of the picture: what areas are most valuable to conserve, but NOT what areas are under the most threat from recent development**
- **Showing planners the landscape pattern of growth that their current ordinances & policies is creating will help guide smarter growth**
- **Smarter growth will lead to better conservation of natural resources**

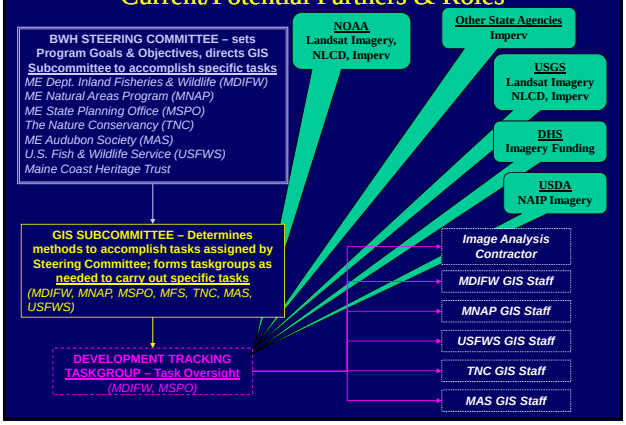
Systems Overview – 2004 Development



Systems Overview – 2009 Development



Current/Potential Partners & Roles



Findings & Lessons Learned So Far

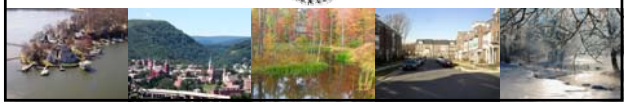
- **Considerable interest in acquiring the data (when completed)**
- **High risk of Repetitive Motion Injury when digitizing**
- **Stylus/tablet works much better than mouse for digitizing**
- **Coordinating multiple digitizers is time-consuming and complex**
- **Free NAIP imagery may eliminate need for digitizing**

Questions/Contacts For This Meeting

- **USGS/NOAA – collaboration on NLCD/Impervious mapping 5-year cycle for updates**
- **DHS – potential funding for imagery acquisition**
- **USDA – future "gifts" of NAIP imagery**
- **Single source contracts?**
- **Direct billing for large contracts?**

Blueprint for the Future of Maryland

National Center for Smart Growth Research and Education



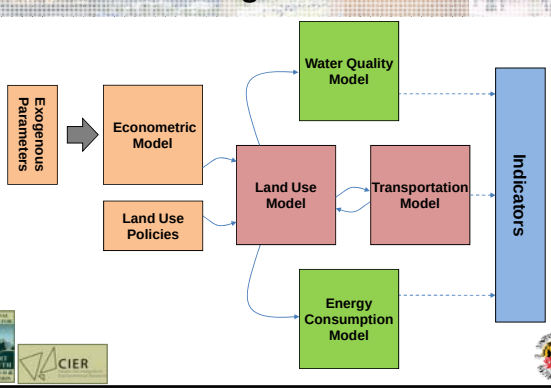
Project Partners

Partner	Role
1000 Friends of Maryland	Reality Check *Plus* leadership
Urban Land Institute	Reality Check *Plus* leadership
More than 140 organizations, businesses and foundations	Reality Check *Plus* support
Nearly 850 Maryland residents	Reality Check *Plus* participants
Partnership for Land Use Success	Outreach and implementation
Scenario Advisory Group members	Scenario development
Maryland Department of Planning	Project support and data
State Highway Administration	Statewide transportation model
INFORUM	Econometric model
PB PlaceMaking	Project support

Supporting Sustainability

- Creating and evaluating the impacts of several growth scenarios
- Evaluating policy implications
- Incorporating energy and stream quality impacts
- Analysis includes typical indicators – transportation, land use, infrastructure, and economic

Modeling Framework



Lessons Learned Thus Far

Water Quality Modeling

- Future development leads to mixed changes (positive and negative) at the county level depending on source land use converted
- Land use change effect is small (1/10th) relative to reductions that can be realized through BMP implementation

Energy Consumption Modeling

- Local climate and dispersion of the population within and across counties have notable impacts on residential electricity consumption
- A 1% increase in population dispersion leads to a 1.29% increase in per capita energy use (assuming everything else equal)

Challenges

- How do we resolve differences in the spatial and temporal resolution of land use, water, energy and climate information?
- How do we reconcile multi-dimensional social, economic and environmental criteria for land use planning and policy making?
- How would the water quality findings vary if the perspective changed from "loadings as delivered to the nearest stream" to "loadings as delivered to the Chesapeake Bay?"
- What is the most appropriate way to weight (value) the different components of runoff to recognize the differences of land use conversion from ag to urban, with respect to water quantity and other pollutants?
- The tributary strategy (TS) findings suggest that we can mitigate ourselves out of the negative consequences of both agricultural and urban land uses. Is this realistic? Are the pollutant removal efficiencies accurate? Does the TS analysis paint an overly-optimistic picture of what BMPs can accomplish?

Sustainable Lake Management in Maine's Changing Landscape

Kathleen P. Bell*, Jessica Leahy**, Stephen Sader**,
Peter Vaux***, Katherine Webster****, and Jeremy Wilson**

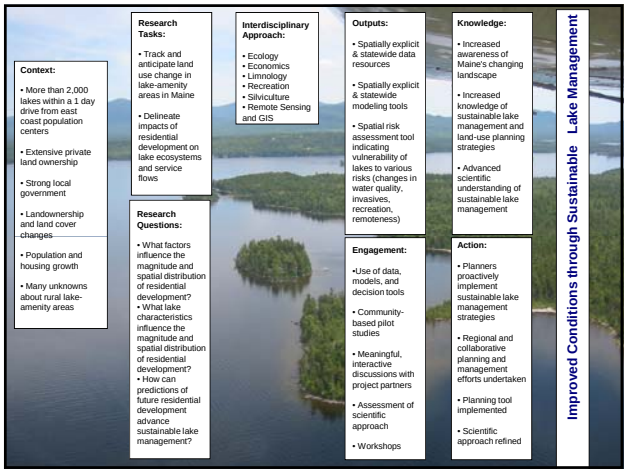
*School of Economics
**School of Forest Resources
***Senator George J. Mitchell Center for Environmental and Watershed Research
****School of Biology and Ecology

April 22, 2008
CNS Grantee Workshop
Washington, DC

THE UNIVERSITY OF MAINE

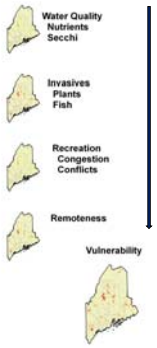
Knowledge to Action: mobilizing science and technology for sustainability (Cash et al. 2003)

- **Applied to Sustainable Lake Management**
  - managing boundaries between knowledge and action
    - fostering meaningful interactions among scientists, policy-makers, communities, NGOs, businesses, and citizens
    - changing scientific approach to be inclusive, reflective, and adaptive
  - enhancing salience, credibility, and legitimacy of information produced
    - generating information on residential development patterns and the interactions among these patterns and lake service flows
    - evaluating alternative mechanisms to communicate this information
    - assessing impacts of this information on lake management activities and lake conditions

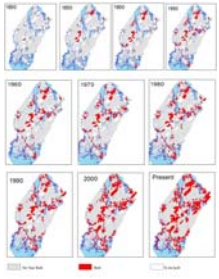


State scale

Development pressure



Community-based pilot studies



Project Partners - collaborators

- **Current**
  - State agencies - Maine Department of Environmental Protection; Maine Department of Inland Fisheries and Wildlife; Maine Department of Conservation; Maine State Planning Office; Land Use Regulation Commission; Maine Office of GIS
  - NGOs - Volunteer Lake Monitoring Program, Congress of Lake Associations
  - Research and communication organizations - Senator George J. Mitchell Center for Environmental and Watershed Research; Maine Cooperative Extension
- **Future**
  - Mix of partners in 8 pilot communities (local governments, lake associations, citizens, private businesses)
  - NGOs- TNC, MLTN, SWOAM, CENTRO
  - US EPA Region 1
  - Research network (University of Wisconsin Madison, Ohio State University, University of Maine ESI)

Lessons learned thus far

- Data on residential development is sparse
  - successful interaction with other Maine CNS Grantee
  - potential collaboration with VLMP for citizen science collection of data
- Lake database has an eager audience
  - integrating data from various agencies and groups
    - adding more social science data to PEARL
- Interest of partners is strong
  - widespread support by state agency staff
  - complementing cooperative extension lake education
  - ongoing state-wide debate (Moosehead Lake Proposal)

Workshop Feedback

- Improving knowledge to action
  - appropriate balance between complex modeling and effective decision support tools
  - effective collaboration with project partners
  - effective communication with local groups
  - successes and failures of similar projects in other regions
  - sustainability of a dynamic resource
- Fundamental challenge
  - "smart" growth in rural, amenity regions

Development of a Software Toolkit to Support Industrial Ecology Networks

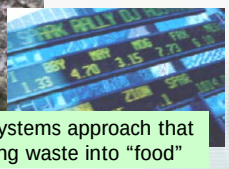
Joseph Fiksel

Executive Director
Center for Resilience
College of Engineering
The Ohio State University

Resilience.OSU.edu

OSU Industrial Ecology Project

Waste = Food
= Value
= Profit



Industrial ecology is a process systems approach that mimics natural cycles, converting waste into "food"

Project Objectives

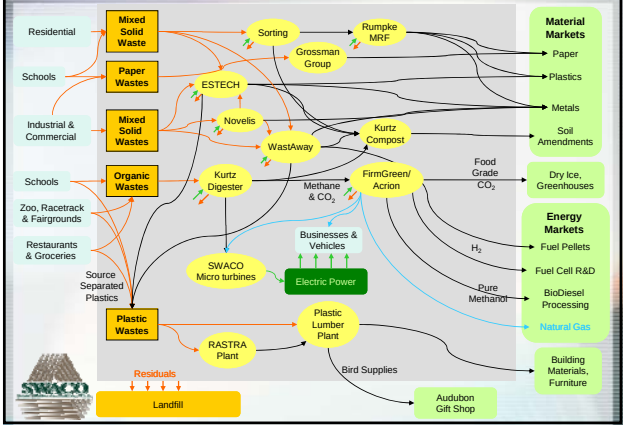
- **Develop a systems-level model of resource flows and interdependencies in Central Ohio**
  - **Existing Eco-Flow™ model developed for SWACO provides basic software prototype**
- **Implement decision tools for evaluating costs and benefits of innovative IE opportunities.**
  - **Industrial Ecosystem Toolkit will incorporate material flow analysis, economic input-output, life cycle analysis, and system dynamics methods**
- **Promote acceptance of IE innovations by regional businesses, citizens, public agencies**
  - **15% reduction in waste disposal to landfill by 2012, =150,000 tons/yr converted to value streams**

Current and Potential Partners

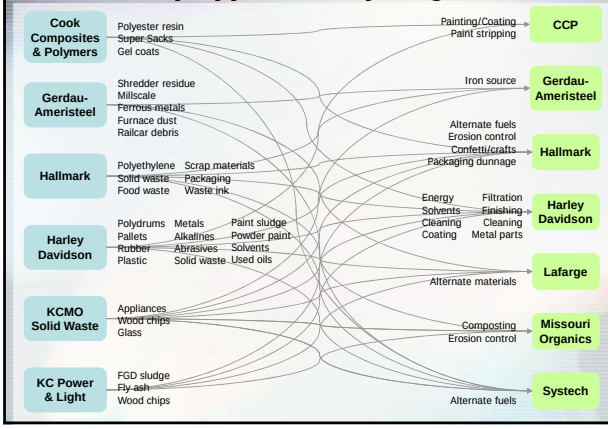
- **EPA awarded OSU a grant for an Industrial Ecosystem toolkit, linking an existing tool (Eco-Flow™) with LCA and other tools, to help significantly reduce solid waste in Ohio**
- **Bridging the Gap is applying the tools to the Kansas City Byproduct Synergy Network (Hallmark, Harley-Davidson, Lafarge, etc.)**
- **OSU is working with the U.S. Business Council for Sustainable Development to develop similar industrial networks in Ohio and encourage systems thinking**

Bridging The Gap · USBCSD · SWACO · OhioEPA · Millennium Inorganics

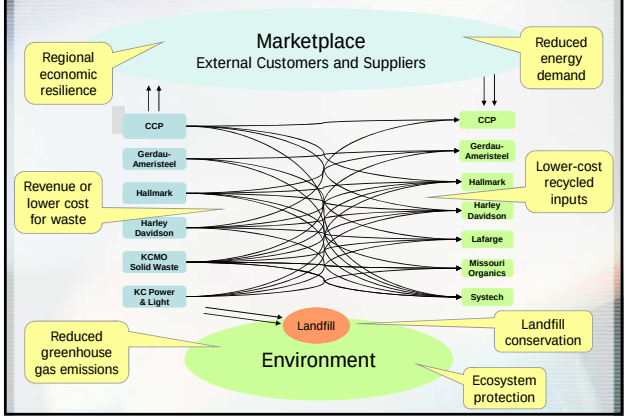
Central Ohio Resource Transformation Center



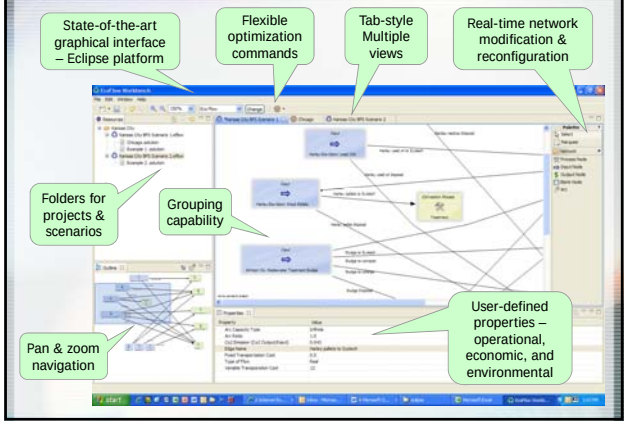
Kansas City Byproduct Synergies



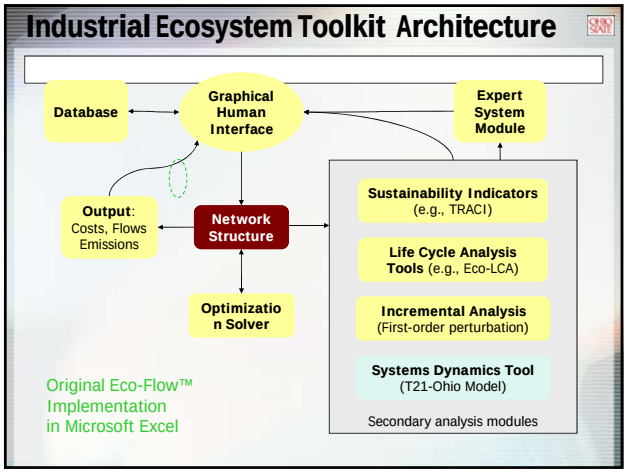
Industrial Ecology Enhances Sustainability



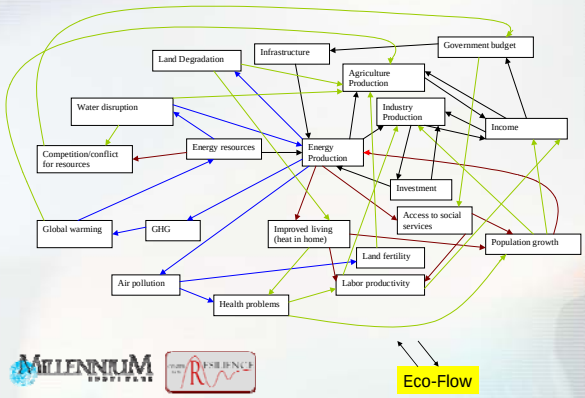
Principal Eco-Flow™ v0.1 Features



Industrial Ecosystem Toolkit Architecture



The T21-Ohio Model



Findings and Lessons Learned

- Giving companies access to tools that help to visualize, quantify, and optimize material flows can help them discover opportunities and build confidence in industrial ecology
- The applicability of network analysis tools ranges from specific facility partnerships to broad, regional-scale modeling
- Preliminary results for Kansas City suggest that up to $15 million per year of savings are possible, with the benefits evenly divided
- As expected, environmental and financial benefits are closely correlated

Questions to be Explored

- **For an individual company**
  - How can we maximize profit by exploiting available byproduct synergies?
  - What are the total environmental benefits associated with these synergies?
- **For a collective regional network**
  - What is the maximum amount of solid waste that can be diverted from landfills?
  - What reductions in greenhouse gases or other emissions can thus be achieved?
  - How might new technologies benefit the region economically and environmentally?

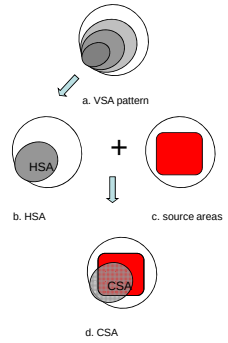
Protection of Critical Source Areas for Achieving Long-term Sustainability of Water Resources in Rockaway Creek Watershed

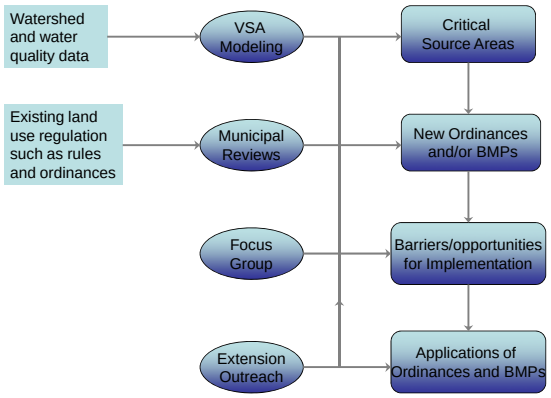
Zeyuan Qiu, Christine Hall, Kathy Hale
Donna Drewes and Grace Messinger

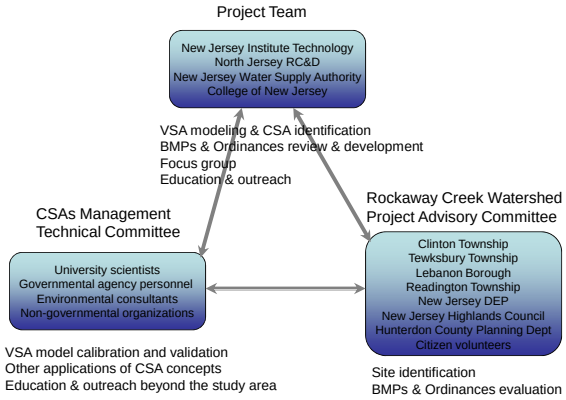
April 22, 2008

Support Long-term Sustainability of Water Resources by Properly Managing Land Uses

- Promote a set of new concepts such as variable source areas (VSAs), hydrologically sensitive areas (HSAs), critical source areas (CSAs) for land use planning and management
- Develop a set of tools to identify VSAs, HSAs and CSAs for municipal uses in their land use planning and management
- Develop a set of land use-based model ordinances and best management practices (BMPs) to protect CSAs
- Evaluate the technical, social, economic and institutional barriers to implement those ordinances and BMPs







Surprising Findings or Lessons

- Overwhelming interests in the concept and ideas of managing CSAs for improving water quality
- Strong demands on VSA model validation and calibration
- Complexity of land use planning and management at the municipal level
- Potential for other applications of CSA concept

- Questions
  - What are the expected outputs and/outcome from EPA perspective?
- Contacts
  - EPA experiences on developing land use-based model ordinances
  - USDA ERS group on water quality and land use management led by Dr. Marc Ribaudo
  - Any other EPA contacts who may be interested in the project methodology and results.

Panel: Getting to Shared Information (Distributed Decision- Making)

Collaborative Science and Technology Network for Sustainability Grantees Workshop

April 22, 2008 – Earth Day

Steve Young
US EPA Office of Environmental Information

Visualizing Earth as a System We Need to Sustain

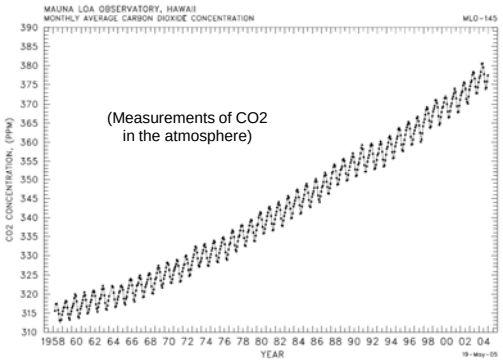
Earth as seen from lunar orbit, Apollo 8, December 24, 1968. NASA.

2

The International Space Station, NASA

3

The Keeling Curve



(Measurements of CO2 in the atmosphere)

Source: cdiac.ornl.gov

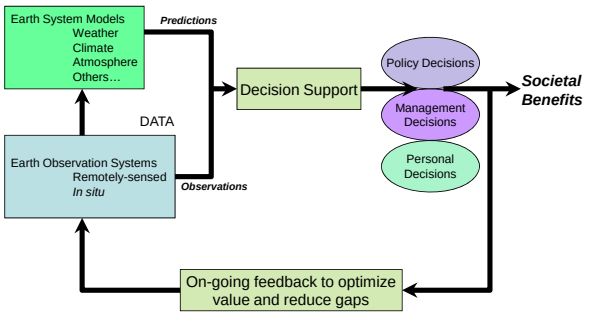
4

Lights at Night from Space – Energy Waste?

Source: NOAA.gov

5

Global Earth Observation System of Systems (GEOSS) Model



Linking Earth Observations to Societal Benefits (IEOS Strategic Plan, p. 17 Figure1)

7

Flows

- Material flows – yes
- Don't forget water ("virtual water")
- Address energy
- Look for ways to integrate with economic data
- Address ecosystem service levels

8

The Promise of "Web 2.0"

- Wikis – such as Wikipedia, Encyclopedia of Earth – collaborative knowledge
- Social networks like Facebook and MySpace
- Video and images – YouTube and Flikr
- Tagging and related tools deli.cio.us, etc
- New-generation geospatial software such as Google Earth, Google Maps, Microsoft Virtual Earth, etc.
- Web-based collaboration software e.g. Google Sites

9

Final Thoughts

- Apply systems thinking and modeling
- Provide capabilities to simulate alternatives, explore scenarios
- Practice adaptive management to refine initial decisions based on early outcomes and adjust to the unexpected

10

Contacts and References

Steve Young
Young.steve@epa.gov

usgeo.gov
epa.gov/geoss
maps.google.com
earth.google.com
http://www.microsoft.com/virtualearth/

11

Park entrance road
Foot only entrance to park meadow area
Meadow area
Picnic area
Historic Moses Ball spring
Foot only entrance to park
Great Horned Owl enclosure
Long Branch Nature Center building entrance
Amphitheater fire pit
Long Branch Nature Center information
Kiosk/bulletin board
Amphitheater
Unofficial sledding hill - top
Placemark 34
Poplar Pond
Access road bridge over Salamander Run
Placemark 35
Medical Offices parking garage entrance
Closed foot bridge
Long Branch Nature Center sign
Access road entrance
Google

U.S. Environmental Protection Agency
Collaborative Science and Technology Network for Sustainability Grantees Workshop

Grand Hyatt Washington
1000 H Street, NW
Washington, DC
April 22 - 23, 2008

Executive Summary

INTRODUCTION AND OVERVIEW

The U.S. Environmental Protection Agency's (EPA) Collaborative Science and Technology Network for Sustainability (CNS) Grantees Workshop was held April 22 - 23, 2008, in Washington, DC. The workshop provided an opportunity to share and discuss the research of the 2006 CNS grantees on scientific or engineering approaches to sustainability. The CNS program enables citizens from all sectors—local governments, nonprofits, and universities—to work together on practical projects for communities and states to achieve the economic and environmental benefits of green building and smart growth. Examples of CNS projects are tools to predict the impact of housing development on nearby lakes and streams, and methods for urban planners to build sustainability into land development and transportation in cities. Approximately 45 people attended the meeting.

APRIL 22, 2008

Welcome and Opening Remarks
Leanne Nurse, U.S. EPA, Office of Research and Development (ORD), National Center for Environmental Research (NCER)

Ms. Nurse welcomed the attendees to the workshop and said that she looked forward to 2 days of productive dialogue and learning. She explained the meeting schedule: on Tuesday morning, brief descriptions of the projects (Project Briefs) will be presented by grantees who received funding from the FY 2006 allocations, followed by inter-agency panels during the afternoon. Individual project meetings will be held with EPA Program Offices on Wednesday morning. She expressed appreciation for the opportunity to work with the grantees and invited the meeting participants to visit the EPA People, Prosperity and Planet (P3) Design Expo that was being conducted on the National Mall. Ms. Nurse introduced Dr. William Sanders, Director, National Center for Environmental Research (NCER), who also serves as the executive champion for EPA's green building initiative.

Opening Remarks
William H. Sanders III, EPA, ORD, Director, NCER

Dr. Sanders welcomed participants to Washington, DC, and encouraged them to take advantage of the good weather to visit the P3 Expo on the Mall. He asked attendees to introduce themselves. This meeting on sustainability research was scheduled to coincide with the 38th annual celebration of Earth Day. As one of the greatest challenges facing the world, sustainability is the key to the future of environmental protection. Federal, state, and local governments, along with private industry, now think more holistically

about how to attain sustainability, particularly the translation of science to inform practical action. Dr. Sanders shared a quotation from EPA Administrator Stephen L. Johnson, who said, "We have the responsibility to sustain, if not enhance, our national environment and our nation's economy for future generations."

The CNS program is part of a larger effort within EPA to grapple with the challenges of sustainability and to find workable solutions on a regional scale. It is an informative, interdisciplinary approach to environmental science and engineering to think across traditional media and sector divisions. EPA can reduce the gap between science and avocation through ongoing feedback and input from users as models and tools are being developed in its grant-supported projects. EPA's sustainability research strategy, published in 2007, describes its vision.

Green design, engineering, chemistry, and buildings, as well as a smart growth philosophy can help avoid environmental problems. The momentum in the concept of green buildings is growing. About 7 years ago, Dr. Sanders was involved in the construction of a green building. Recently, he led the design of a green town hall in his community; this is the second building in the State of Maryland to achieve the Leadership in Energy and Environmental Design (LEED)-platinum certification from the U.S. Green Building Council. He noted that it is much easier today to find green materials and to identify contractors who understand the concept of green than 7 years earlier. On the previous day, the EPA Administrator revealed a new approach to green buildings that will help the Agency facilitate the mainstream adoption of green building practices. Dr. Sanders closed with a quotation from the founder of Earth Day, former Governor of Wisconsin, Gaylord Nelson: "The ultimate test of man's conscience may be his willingness to sacrifice something today for future generations whose words of thanks will not be heard."

CNS PROJECT BRIEFS

Energy, Water, and Land Use: A Framework for Incorporating Science Into Sustainable Regional Planning

Richard Taupier, University of Massachusetts

Dr. Taupier's research project is composed of three existing projects that formed a network of regional sustainability advocates to contribute to regional sustainability in western Massachusetts. They are called "advocates" because many sustainable experts do not hold decisionmaking positions. The project is focused on the selection of sustainability indicators to define and track progress and the use of media tools to engage the public and encourage action. The design of an online decision support tool and the extension of such a tool for other uses also are important project activities. Numerous organizations are represented in the partnership through the sustainability advocacy network with approximately 25 specialists, University community scientists, the Pioneer Valley Planning Commission (PVPC), and the public community across the region. The project is working to select indicators to aid decisionmaking processes and to develop Web tools and a public media campaign. Other activities include the selection of metrics for decision support, design of the decision support tool for energy choices, provision of access to design support tools, and their application to additional decisions. Project lessons include the difficulty of a multidisciplinary agreement, the independence of sustainability advocates, the importance of local applicability, and difficulties of selecting and applying indicators.

Building Sustainability Indicators To Assess the Physical, Social, and Economic Values of Greening Cities—A Study of the Million Trees Initiatives in Los Angeles, CA

Jean-Daniel Saphores, University of California at Irvine

Dr. Saphores' research project is building sustainability indicators for semi-arid urban forests and researching the social dynamics of implementing sustainability in large urban areas, particularly Los

Angeles. It is focused on the physical, social, and economic values of urban forests in semi-arid climates, as well as the impacts of urban forests on greenhouse gas emissions, local air quality, and local temperatures in relation to the urban heat island effect. Another important issue is the ways in which complex systems involving urban ecosystems, social organizations, and individuals change when provided with scientific information on urban forests. The project uses remote sensing to map vegetation and its leaf area index throughout Los Angeles over time. Other activities include *in situ* measures of urban tree function that are layered with meteorological data, hedonic studies to quantify the impacts of urban forests on the housing market, and the establishment of sustainability indicators for various neighborhoods, jointly with Los Angeles agencies, nongovernmental organizations (NGOs), and the public. The project will integrate biological, meteorological, socioeconomic, and demographic data into a geographic information system (GIS) database, and will observe how Los Angeles and the public use this information and implement sustainability. Current partners include municipalities, including the City of Los Angeles, as well as the Los Angeles Metropolitan Transit Authority, the U.S. Forest Service, and NGOs. Lessons that have been learned thus far include the recognition that tensions can arise between sustainability and political realities, particularly the creation of disaggregated sustainability indicators that may pit one part of the city against another. Other lessons include the difficulty of finding good sites for installing a tower with instruments to measure air quality in an urban area and the capturing of data.

Promoting Sustainable Pollutant Control Policies Through Consideration of Social and Biological Indicators: An Application to Mercury Control in New England
Mark Borsuk, Dartmouth College

Dr. Rama Mohana Turaga, an investigator on the project, presented this research project for Dr. Borsuk, who was unable to attend the meeting. The project is working to identify social and biological indicators of sustainability that are linked with the mercury policy in New England, use this connection to motivate individuals and organizations, and assess whether the monitoring and reporting of these indicators will improve resilience in the human-environment system through improved perception of ecological change, enhanced learning, and greater adoption of adaptive management. Partners include investigators; collaborators, such as the Mercury Geo-spatial Assessments for the New England Region (MERGANSER) team, EPA, and U.S. Geological Survey (USGS); and New England Environmental Justice Groups. The project's primary tasks encompass sustainability concepts, such as a literature review on prevailing definitions and inter- and intra-generational equality of opportunity; and sustainability indicators, which involves a literature review with the aim of identifying existing frameworks and gaps that can be addressed by the project and considers the merits of various approaches and the importance of scale and salience. Another activity addresses mercury through the review of exposure pathways, human health and ecological impacts, and regulatory framework. The review of public comments on the Clean Air Mercury Rule (CAMR) has revealed a surprising level of participation from Native American tribes. The project also works on models and data, particularly the Spreadsheet-based Ecological Risk Assessment for the Fate of Mercury (SERAFM), MERGANSER, North American Electric Reliability Corporation (NERC), and GIS data. Recent developments include the introduction of a new category (5m) for waters listed as impaired by atmospheric mercury under the Clean Water Act Section 303(d) in March 2007, acknowledging transboundary challenges involved in mercury control, and New England's leadership role in addressing mercury pollution through a coordinated regional total maximum daily load (TMDL), which EPA recently approved. Additionally, in February 2008, a federal appeals court rejected CAMR on the basis of the regulatory approach followed by EPA.

Testing Sustainable Building Materials and Practices During Gulf Coast Reconstruction
Jack Geibig, University of Tennessee

Dr. Geibig's research project promotes a sustainable future through the application of life-cycle thinking and a precautionary approach to the immediate housing needs of the Gulf Coast following the destruction

caused by Hurricane Katrina in 2005 and through the provision of life-cycle materials data/resources. It also works to improve the health, safety, and livelihood of current and future Gulfport residents through access to environmentally improved, affordable housing. The three project partners include: (1) the University of Tennessee's Center for Clean Products, which evaluates materials use and identifies environmentally preferable building materials, along with conducting life-cycle analysis of the benefits of green material use; (2) the Healthy Building Network, which designed and constructed a demonstration home and has supported community development and the involvement of many organizations; and (3) Unity Homes/Clayton Homes, which helps build demonstration green homes (Unity Homes) and provides data on materials used in modular housing (Clayton Homes). This project will impact the life cycle of building materials, including wood, petroleum products, modular home factories, onsite construction, and family use. Materials from demolished buildings will be recycled as much as possible. The project is engaging material users in the reusable process for high-value materials that might otherwise end up in landfills. Current lessons include that the establishment of criteria for evaluating building materials is a complex task because of the lack of consensus on key issues, the absence of data in the marketplace, and the complication of assemblies on analysis. Additionally, material use is distributed across the supply chain, and there is a limited availability of preferable materials at an affordable cost; the market is trending toward upscale homes and permanent communities.

Metropolitan Accessibility and Transportation Sustainability: Comparative Indicators for Policy Reform
Jonathan Levine, University of Michigan

Dr. Levine's research project is developing multiple means of accessibility for mid- to large-sized metropolitan regions based on the premise that accessibility, not mobility, promotes sustainability. Transportation policy traditionally has been grounded on a mobility-based definition; if it is accepted, however, that people move to reach destinations and not for the sake of movement, then the goal of transportation is access. Different means to accessibility include mobility, proximity, and remote connectivity. The project will develop multiple measures of accessibility for 12 to 20 or more mid- to large-sized metropolitan regions, as well as explore the connection between accessibility and characteristics of the built environment in these areas. The project developed a set of accessibility indicators drawing from approximately 30 metropolitan areas. Preliminary analyses have revealed several surprises, including that drivers in Las Vegas average the same number of road miles per capita as those in New York City. Other analyses are targeting job accessibility by car and comparing accessibility with population density, such as in Baltimore, Dallas, and Phoenix. Findings from these analyses should help inform land-use and transportation planning at the level of the metropolitan region.

Mapping Regional Development for Smart Growth Planning To Minimize Degradation of Water Quality and Enhance Green Infrastructure
Donald Katnik, Maine Department of Inland Fisheries and Wildlife

Dr. Katnik's research project supports sustainability because riparian areas and water resources are a critical natural resource for natural ecosystems and smarter growth will lead to better conservation of natural resources. It involves the use of a 2004 baseline map of development and a map of new development, which will be incorporated into the *Beginning with Habitat* information package that is distributed to local planners and land trusts. The maps of natural resource data can be used to conserve habitat and open space, whereas current maps do not show the areas that are under the most threat from recent development. The maps will show planners the landscape pattern of growth that their current ordinances and policies are creating and thus help guide smarter growth over the course of 5 years. New imagery will be obtained, and collaborations can help reduce costs. Current and potential partners encompass all interested stakeholders, including those in the imagery acquisition business as well as digitizing staff. The project's lessons to date include that there is considerable interest in acquiring the

complete data and that free imagery from the National Agriculture Imagery Program (NAIP) may eliminate the need for digitizing. The act of digitizing poses a high risk of repetitive motion injury, and the stylus or tablet has been found to work better than mouse in this process. In addition, coordinating multiple digitizers is a time-consuming and complex process.

Reality Check Plus: Envisioning a Sustainable Maryland
Jason Sartori, University of Maryland
Glenn Moglen, University of Maryland

Drs. Sartori and Moglen's research project is focused on minimizing the adverse effects of the design and construction of cities in Maryland on the natural environment. The project aims to support sustainability by creating and evaluating the impacts of several growth scenarios, evaluating policy implications, and incorporating energy and stream quality impacts. The analysis includes transportation, land use, infrastructure, and economic indicators. The project has numerous partners from the individual, community, organization, and state levels. The modeling framework includes land-use models, trends, and policies. In terms of water quality modeling, the project has recognized that future development leads to mixed changes (positive and negative) at the county level depending on the amount of source land-use converted. Another lesson learned is that the effect of land-use change is small (1/10th) relative to reductions that can be realized through the implementation of best management practices. The program faces numerous challenges, including the integration of data from different sources and resolutions; the variance of water quality findings, such as how weight or value runoff components decide which pollutants to address; and the realistic findings from the tributary strategy, which suggest that the negative consequences of both agricultural and urban land uses can be mitigated.

Sustainable Lake Management in Maine's Changing Landscape
Kathleen Bell, University of Maine

Dr. Bell's research project focuses on the development of sustainable lake management strategies in Maine's changing landscape, with an emphasis on mobilizing science and technology to achieve sustainability. This includes managing boundaries between knowledge and action through meaningful interactions among stakeholders and changing the scientific approach to be inclusive, reflective, and adaptive, as well as enhancing the salience, credibility, and legitimacy of information produced. Because more than 2,000 lakes are located within a 1-day drive from East Coast population centers and approximately 95 percent of Maine's lakes are held in private ownership, managing growth within the state is becoming more important to the ecology of Maine's water bodies. The project is using an interdisciplinary approach involving ecological, economical, silvicultural, recreational, and remote-sensing expertise. On a state scale, work has begun to determine Maine's vulnerability to development pressures on the lakes, such as human recreation, as well as to capture data on water quality nutrients, invasive plants and fish, and issues related to the remoteness of lakes. Additionally, eight community-based pilot studies are underway. Current project partners include state agencies, NGOs, and research and communication organizations. Lessons that have been learned thus far are that data on residential development is sparse, the lake database has an eager audience, and the interest of partners is strong.

Partnership for Industrial Ecology in Central Ohio
Joseph Fiksel, Ohio State University

Dr. Fiksel explained that industrial ecology has not been pursued consistently at a regional scale, and that this research project is focused on developing and applying an industrial ecosystem toolkit to explore innovative policies and technologies that enhance sustainability in Central Ohio and, perhaps, can be used elsewhere in the United States. The toolkit will link the Eco-Flow™ tool with the life-cycle assessment (LCA) and other tools, to help significantly reduce solid waste in Ohio. Additionally, Bridging the Gap, a

nonprofit environmental organization, is applying the tools to the Kansas City Byproduct Synergy Network (e.g., Hallmark, Harley-Davidson, and Lafarge). The Ohio State University also is working with the U.S. Business Council for Sustainable Development to develop similar industrial networks in Ohio and encourage systems thinking. The project has found that giving companies access to tools that help to visualize, quantify, and optimize material flows can help them discover opportunities and build confidence in industrial ecology. In addition, the applicability of network analysis tools ranges from specific facility partnerships to broad, regional-scale modeling. Preliminary results for Kansas City suggest that up to $15 million per year of savings are possible, with the benefits evenly divided. The project also confirmed that environmental and financial benefits are closely correlated.

Grant Protection of Critical Source Areas for Achieving Long-Term Sustainability of Water Resources
Zeyuan Qiu, New Jersey Institute of Technology

Dr. Qiu's research project supports the long-term sustainability of water resources by properly managing land uses, particularly through the protection of critical source areas and attention to changes in soil moisture. The project applies the variable source area hydrology modeling techniques in the Rockaway Creek watershed in New Jersey. It is promoting these concepts and developing a set of tools for land-use planning and management, developing a set of land use-based model ordinances and best management practices to protect these areas, and evaluating the technical, social, economic, and institutional barriers to implement those ordinances and practices. Project stakeholders include the New Jersey Institute of Technology, North Jersey Resource Conservation and Development Council, New Jersey Water Supply Authority, and the College of New Jersey, as well as state and local governments, academia, water organizations, and other NGOs. There has been an overwhelming interest in the concept and ideas of managing critical source areas for improving water quality, as well as strong demands for the validation and calibration of variable source areas models. Other lessons learned are that land-use planning and management is complex at the municipal level, and that there is potential for other applications of the critical source areas concept.

INTERAGENCY PANELS

Welcome to Panel Discussions
Diana Bauer, EPA, ORD, NCER

Dr. Bauer welcomed the panelists. She noted that each panel was composed of individuals who represented diverse academic backgrounds and organizations, which should encourage interesting discussions. She explained that each panelist would speak for 10 minutes, and a general discussion and question-and-answer session would follow the final presentation of each panel.

PANEL 1: ENERGY, MATERIALS, AND CLIMATE CHANGE

Panel Members:
Grecia Matos, U.S. Geological Survey (USGS)
Joseph Fiksel, Ohio State University, Co-Director, Center for Resilience (CNS grantee)
Laura Draucker, EPA, ORD, National Risk Management Research Laboratory (NRMRL)
Edward Chu, EPA, Office of Solid Waste and Emergency Response

Dr. Matos described the USGS' work in minerals and materials in terms of science in a changing world, particularly the future supply of minerals. There is a growing global awareness that, because materials are vital to the economy and the expanding global population, material efficiency and productivity are needed to meet production and consumption levels. Increased recycling and processing technology will continue, as expanding populations demand increased infrastructure; this critical requirement is second only to

security. To help minimize the environmental and economic implications of materials use, it is important to understand the social dimensions involved and provide a framework for future requirements. The USGS is tracking materials and materials flow, including the extraction and processing of materials, and developing a comprehensive database to capture production and consumption levels. The collection of information on the consumption and industrial use also has helped the USGS to develop a comprehensive approach to minerals and mineral flow. The materials flow approach is a way to encourage innovation and avoid negative impacts; waste flow also is an important consideration in the framework. Access to the data will be important, as the current level of data is inadequate to track the quantity of post-consumer waste or the importation of minerals and materials.

Dr. Fiksel said that many problems facing current and future generations were apparent 20 years earlier. The models and metrics used historically are based on the linear approach of a reductionist model and are inadequate: the process of identification, analysis, and control does not work in a world that is turbulent, uncertain, and tremendously interdependent. Modelers now face an immense challenge in developing and working with multiple macro and micro models. Because not all necessary elements can be included in a single model, it is necessary to develop models that are compatible. The science for an entire set of tools to handle this work is in its infancy. Dr. Fiksel mentioned that his research is conducted in the Center of Resilience; he suggested that the word "resilience" is preferable to "sustainability" because systems are competing for resources in a dynamic world. Two categories of metrics that need to be considered are: (1) releases and fluxes of industrial waste into the environment; and (2) true footprint metrics that focus on ecological integrity, such as the accumulation of contaminants in soil or water. It is difficult to garner stakeholders' consensus on one specific metric. One approach to the issue might be to develop a tool that maps the national consumption of nature services and products. An even greater challenge in models and metrics resides at the policy level and the dialogue among different policy regimes because of the inertia and boundaries present in the legislative mechanism. A genuine integrated policy model is needed.

Dr. Draucker said that her group's research in EPA's NRMRL is focused on energy. Markel energy models have been used to predict least cost out to 2050, as well as to track energy use and the technology used, both from the national scale and a regional scale covering nine areas of the United States; the national study has been completed and the regional study is undergoing peer review. The regional model is looking at ecological programs under multiple scenarios to project future land use. Other EPA groups use the Markel model to obtain different outputs for other sectors. Dr. Draucker described costs from the technological perspective, including tipping points of energy, such as hydrogen cars. Energy efficiency has improved in certain sectors, such as industry, but has further to go in others. In the production of corn ethanol, for instance, the factory model involves the transportation of corn to the plant and then to the user or consumer; the factories that produce the ethanol, however, run on coal. EPA uses the Markel model to track water, and the model could be useful for the projects that were presented earlier, including those with sociology data (e.g., hurdles to adopt technology); researchers who want to track materials, however, should use the "Markel Matters" model.

Dr. Chu recalled that he once met Sir Nicholas Stern of the *Stern Review on the Economics of Climate Change*, who pointed out that sustainability revolves around the consumption of goods and services and, thus, is an economics issue. Resources have a direct impact on the environment, and the conservation of resources and efficient use of land and materials, such as through waste management and recycling, both have a direct impact on energy consumption and the production of greenhouse gas. During the past 5 years, increases in energy prices, not governmental policies, have resulted in increased recycling and re-use and better management of materials, and this likely will increase as the awareness of greenhouse gases and carbon issues continues to grow. There are two options to address the intensive energy use by clean-up technologies: move to a renewable source or change the remedy. With reduction strategies now being discussed in terms of greenhouse gas, and mitigation technologies advocating more natural attenuation, the idea of optimizing and selecting remedies is becoming important. EPA is encouraging the

use or reuse of land managed by the federal and state governments for renewable energy generation, including concentrated solar-generated potential. Partnerships across EPA regions also are promoting more renewable energy, and EPA is preparing fact sheets by state so that citizens can understand renewable potential and the energy incentives that are available. In the sequestration arena, EPA is studying soil restoration through the use of biosolids and soil amendments in acid mine drainage sites; significant amounts of tonnage of carbon are being captured per acre and initial studies are determining whether a protocol can be developed for management, monitoring, and measurements. EPA believes that any reuse of previously contaminated land is sustainable; modeling efforts, however, caution that most people do not perceive this as a long-term solution. Additionally, much of EPA's analysis is being conducted by sector rather than via multimedia and cross sector; EPA is shifting the way it is thinking about materials and greenhouse gas to develop better policy solutions.

Discussion

In response to a comment by Dr. Fiksel that residential energy use accounts for 95 percent of use as end-user consumption drives the economy, Dr. Chu explained that his office's research does not include indirect emissions and calculations.

Dr. Bell asked Dr. Draucker to elaborate on the scale of the Markel model and identify key inputs. Dr. Draucker replied that the scale is national with movement toward a regional scale. The inputs vary by sector, such as vehicles, miles travelled, and classes and types of vehicles for the transportation sector. On the industrial side, inputs for a boiler would include the fuel burn rate, efficiency, retirement rate, and cost. The model uses these criteria to select the technology; emissions are not a criterion. Dr. Fiksel noted that in Markel models, the future demand, such as for education, comes from outside the model, which supports the idea that many models and feedback loops are needed. Dr. Draucker agreed.

Dr. Bell asked whether targeting consumers could be more effective than focusing on integrated policy discussions or the market itself. Dr. Fiksel replied that consumers have limited opportunities and grassroots movements toward change are insufficient because consumers are too complacent; significant radical changes must be produced by government policy directed at the producing sector as well as to the communications campaign to motivate and justify the change. One participant said that American society is driven more by supply than demand and asked how the cycle of offering consumers a limited set of choices and then decrying looming problems could be addressed. Dr. Fiksel commented that people appear to be locked into a lifestyle that will be difficult to change. Dr. Chu said that, in the public goods arena, many practices, such as the use of seatbelts, are not adopted until they are regulated. Dr. Geibig offered a different conclusion in that the government should act as the savior; he said that "big box" retailers and individuals in corporations exercise a much greater influence through the power of their purchasing or specifications that can drive a major change through the entire supply chain. Ms. Joan Biermann, Accrew Business Growth Partners, related the topic to the importance of education and communication of ideas at the government, business, and individual levels; she said that programs could be based on a 1–3 year timeframe, which most households and children would more likely embrace. Dr. Saphores stated that education will not be effective without incentives. Dr. Fiksel expressed the belief that traditional regulatory mechanisms will not move the industry adequately because competition requires companies to not deviate too much from the norm; the radical changes needed require the collective action of a private-public coalition, the government's political will, and agreement of industry to embrace this collective consideration. Dr. Chu said that government action includes providing information and that researchers have a role in this work. Dr. Levine noted that, in the issue of individual versus government action, it may be that already existing government action impedes environmentally friendly solutions, and he pointed to many alternative transportation possibilities that regulations in various levels discourage or do not allow.

Dr. Levine commented that geography determinism is not a factor in smart growth. In comparison with Europe, the United States has a much lower population density. However, the densest country in Europe is the Netherlands, and the densest U.S. state is New Jersey; the Netherlands is an example of smart growth, whereas New Jersey is wall-to-wall sprawl.

Dr. Chu said that more could be done, such as increasing recycling to 70 percent and persuading citizens to consider efficient use of resources. Dr. Saphores suggested that environmentally friendly packaging would be more efficient, and a participant noted that Wal-Mart voluntarily has changed its packaging. Dr. Bauer said that some government policies that are aimed toward good consequences have side effects that discourage a better use of resources.

Dr. Catherine Wilt, University of Tennessee, Center for Clean Products, said that during a recent meeting with representatives from the European Union's (EU) Science and Technology Directorate, one attendee suggested that Americans are genetically predisposed to take risk, as the founders of the nation were the Europeans who were willing to take risks. She added that the government has an important role to play in policy change, and the greatest challenge is to move from the current level of environmental science policy to solve some of the multisectoral, multimedia, and multigenerational problems. Dr. Fiksel stated that he has witnessed increases in political will at the state level, interest in experiments across agency alliances, and dialogue between and building of multisector coalitions. Dr. Chu said that there are many opinions on the possible outcome of the energy situation; energy discussions in EPA's Region 8, for instance, center around how energy production and coal reserves fit into the impact of the environment and energy future.

PANEL 2: WATER, URBAN FORESTS, AND LAND USE

Panel Members:
Heather Whitlow, Casey Trees
Hannah Campbell, National Oceanic and Atmospheric Administration (NOAA), Regional Integrated Sciences and Assessments Program
Zeyuan Qiu, New Jersey Institute of Technology (CNS Grantee)
John Lyon, EPA, ORD, Office of the Science Advisor

Ms. Whitlow described the work of Casey Trees, a local, nonprofit organization focused on restoring and enhancing the tree canopy in Washington, DC, through tree planting, urban forestry, and community forestry programs. The organization includes a strong education plan that works both with high schools and adult education, as well as an internship program that includes careers in tree care and maintenance. Casey Trees has a large GIS shop to maintain tree inventory of public lands and also relies on satellite imagery to cover the private land canopy. Ms. Whitlow leads the Planning and Design Division, which recently was formed to impact the tremendous amount of development and redevelopment that is occurring in the city. Casey Trees' work with maintaining and renovating streetscapes requires extensive interfacing with agencies, organizations, and communities, as well as modelers, planners, and other partners. Specific projects include the planting of trees in rain gardens as demonstration projects for parking lots and schools throughout the city, and work with modelers to include trees in models to determine the effect of vegetative canopies. Other work includes involvement with city planning and zoning codes to ensure that tree-friendly policies are written into documents, particularly in water quality policies. Planning and outreach efforts encompass one watershed per season to determine impact and measurable results.

Dr. Campbell explained that NOAA's Climate Program Office supports competitive grant programs, Regional Integrated Sciences and Assessments (RISA) and Southeast Aquatic Resources Partnership (SARP), which interpret the human dimension of sustainability for decisionmakers and sectors. The 3-

and 5-year lengths of the projects allow for the development of partnerships to help with the work. An important premise for both programs is that government action can provide useful information. The RISA program covers eight regions across the United States through 5-year projects that study how climate information can be used, particularly with uncertain climate changes. The SARP program supports 3-year projects that focus on water, urban, and coastal issues. Research projects include: the analysis and interpretation of various models studying the Colorado river flow; an application program of the California Energy Commission to provide climate information to and connect with stakeholders; and the Climate Impacts Group's preparation of the *Guidebook: Preparing for Change* to help stakeholders in sewage and forestry industries in King County, Washington, to incorporate data and models as part of their sustainability process. Many other agencies and organizations are interested in supporting similar research.

Dr. Qiu said that his work entails the integration of economics models with water use data and GIS to target practical, local water quality, and groundwater issues in a cost-effective manner. The data from the models can be used to provide inputs that complement existing water regulations, and it can be combined with practical, social, and economic information to effect behavior change. Dr. Qiu described two projects that used models to provide an economic framework to evaluate adaptive behavior. One project combined the modeling framework with an economic model to evaluate farmers' adaptive management practices to climate change in Montana in terms of water quality and economic return and risk. The other project studied ways to improve the water quality of a watershed in New Jersey, and monitor its changes, through assessments and evaluation of different practices; it considered how to promote better management by using basic hydrological theory, combining models, and re-evaluating the TMDL, as different elements have different contributions on the load.

Dr. Lyon said that the problems at hand are typical issues faced by many disciplines in that much of it is trying to provide decisionmakers with information from many disciplines. This requires a collaborative and synergistic process. The U.S. Group on Earth Observations (US GEO) is one example of a successful, multinational collaboration. It was formed because complex computations required good onsite data and data management. In US GEO, information on stream gauges, local weather, and other climate data is collected with the consensus of all stakeholders, including developed and developing countries, on the premise that more can be done when onsite information is available. Contributions from governments, interagency organizations, NGOs, and academia can be used to predict current climate states. Because of the 2006 tsunami disaster in Indonesia, the United States developed a tsunami prediction system. Shortly after the tsunami, all levels and types of data that could be used to predict hazards were made available on the Internet. Dr. Lyon encouraged organizations and researchers to continue their innovative studies and other work.

Discussion

Dr. Moglen expressed his frustration as a hydrologist regarding the limited attention paid to water during the land development process. Dr. Lyon commented that approximately 5,000 plants treat the drinking water supply in the United States, many using their unique processes; in land-use development, water is an afterthought because citizens have never paid for it. He said that EPA allocated funds in its 2009 budget for a water census project called Water for the Americas to obtain data about some of these issues. Dr. Qiu stated that the New Jersey highlands are regulated through the Water Quality Protection Act; many local rules govern water quality, ranging from groundwater to greening issues, but they are not imposed at the state level. Dr. Laura Gabanski, EPA, Office of Water, said that her office funded a project managed by the Water and Environmental Research Foundation to develop a regional framework for sustainable water management; the research found that little data on water quantity existed and that in areas prone to drought, such as Denver, people tend to react to crises but revert to short-term management approaches once a crisis has passed. Ms. Whitlow said that the Washington, DC, metropolitan area is

aware of the tensions between density and economic growth versus tree canopy and sustainability. Smart conservation planning, which advocates the planning of what is to be conserved before other plans are developed, is important. Dr. Campbell said that extreme conditions lead people to react. National Integrative Drought Information Assistance (NIDIA) is reaching out to water, forest, and fire communities to push for longer term changes that promote sustainability and other environmental issues.

Dr. Steve Young, EPA, Office of Environmental Information, asked about the ecosystem services or components of the urban forest. Ms. Whitlock responded that Casey Trees is looking at carbon and water quality issues. In 2004, a plot sample survey used a U4 model to plot all vegetative and species information to project the function of the entire canopy for the region, and it yielded good data about air quality, carbon, temperature, and economic value; these data were helpful in the acceptance of tree canopy as an emerging criteria. The U4 hydro model considers tree canopy and storage in relation to water quality.

In response to a question posed by Dr. Bauer regarding the options for relating ecological conditions to economic activity, Dr. Qiu said that environmental economists can collaborate to quantify how ecosystems provide value, and they can help decisionmakers overcome deficits. Another participant added that assessment of natural resources damages offers significant contributions to an environmental economy. Dr. Sartori said that different methods can be used to determine the impact on the environment; one way is to develop a link between trees and several impacts. Dr. Bell encouraged collaboration with researchers in many other disciplines, such as wildlife economists and social scientists. Dr. Geibig mentioned the importance of metrics and indicators in the process. Dr. Campbell suggested that future projects should address how to evaluate efficacy, and determine and measure benefits and the impact on decisions.

Dr. Bauer noted that complex models can have unexpected inaccuracies and asked how researchers model. Dr. Lyon replied that investigators try to define the hypothesis well, recognizing the complexity involved, and work to answer the question without "over modeling." Dr. Fiksel referenced a quotation that all models are wrong, but some are useful. Dr. Campbell said that researchers should be honest in their communications about the models that they used, including those models that do not predict properly.

PANEL 3: GETTING TO SHARED INFORMATION (DISTRIBUTED DECISION MAKING)

Panel Members:
Stuart Schwartz, University of Maryland (former CNS Grantee)
Richard Taupier, University of Massachusetts–Amherst, The Environmental Institute, Associate Director, International Research (CNS Grantee)
Britta Bierwagen, EPA, ORD, National Center for Environmental Assessment (NCEA)
Steve Young, EPA, Office of Environmental Information

Dr. Schwartz, a 2004 CNS grantee, said that the challenge for sustainability is that sustainability is filled with common knowledge. The dialogue should shift from quantitative to qualitative considerations, showing partners where they can fit in and persuading others that sustainability is a better way of doing business. An example of sustainability as a good practice is the work by Dr. Schwartz and several partners, who were then at Cleveland State University in Ohio, to persuade campus administrators and architects to use LEED-certified construction during the renovation of a section of the campus. The architects later decided to use material other than pervious concrete in the parking lot. Dr. Schwartz's group obtained permission to pave with pervious concrete in a small area as a pilot test; the architects were duly impressed with how the concrete held up during the winter, and they changed the paving material to pervious concrete. From this experience, Dr. Schwartz realized the importance of having good

partners and demonstrating the performance to be able to move to qualitative issues—the role of data and models is essential but not sufficient. Complex models affect the way decisions are made, but decision heuristics exclude *a priori* a vast number of possible solutions. Dr. Schwartz described the failed experience of the "Potomac Point Source Bubble," in which the sewage treatment plants decided to handle the reduction of nutrient flow from their plants into the river, EPA and Congress approved of the plan, but the plants did not carry out the program. The question of separability in complexity also is important. Work on the Euclid Creek in northeast Ohio demonstrated the utility of changing the decision framework. Because Ohio has home rule, negotiations were required with 11 municipalities, who each felt another municipality should burden the cost of the work. Once they agreed on a cost-equitable allocation, they were able to find the most effective solution. The complexity of systems creates opportunities to find clever, innovative solutions if one can take advantage of the complexities.

Dr. Taupier worked in the early 1980s and 1990s in the Massachusetts state government as the chief information officer and dealt with the state's environmental assessments and GIS work. Approximately $40 M was appropriated for the GIS program, but even today this investment has had only some effect. Sustainability falls into the class of problems for which there are no solutions. Data need to be translated into information that is useful for decisionmakers. The State of Massachusetts, for instance, disseminated its data to 351 local municipalities, of which very few paid attention to the data. It is hard to be persuasive when the government sets a poor example. The U.S. community and the international world are aware that the U.S. government often uses an anti-rational decisionmaking process. Dr. Taupier observed that information should be targeted to help people make specific decisions that will have the least impact on the environment. Routine decisions of local government and citizens can be influenced, including in building and maintaining infrastructure through the promotion of green buildings. The increase of the recycling rate to 70 percent would result in a significant reduction of carbon. Additionally, households could be better educated on which type of automobile to purchase.

Dr. Bierwagen explained that her office looks at land use and climate change effects on various endpoints, such as water quality, from the adaptive perspective using the Integrated Climate and Land Use Scenarios (ICLUS) model. ICLUS is a GIS-based model that originally was developed to assist a broad range of EPA users to achieve more consistent results; previously, EPA researchers had to reproduce demographically based land-use models for each study. The model has produced five scenarios that serve as benchmarks and allow the customization of information to meet specific needs. Moreover, if assumptions are consistent, information can be disseminated to diverse audiences. Regarding the future and the policies needed, it is important to integrate the concept of sustainability into decisions. The model could be used for smart growth planning as the intensity of densities within the model can be adapted. Other considerations for the future include the provision of useful information and the engagement of stakeholders early in processes to encourage feedback.

Dr. Young discussed the accessibility of mapping tools and other technologies to the broader community; he recalled that at one time, only very few people could use GIS, which now is a widely used tool. Photographs taken from space of the Earth and International Space Station were important to visualizing the Earth as a system that should be sustained. Both the Keeling Curve, which measured CO_2 levels, and U.S. lights at night seen from space drive home issues of the ozone hole and energy waste. One technology, the Global Earth Observation System of Systems (GEOSS) model, links Earth observations to societal benefits through decisions made at multiple levels. In addition, "Web 2.0" offers promises of improvements in imaging, tagging, geospatial software, and collaboration software. Dr. Young suggested that the sustainability industry and decisionmakers apply systems thinking and modeling, provide the capability to simulate and explore alternative scenarios, and practice adaptive management to refine decisions based on early outcomes and the unexpected.

Discussion

Dr. Levine emphasized the importance of sharing information. Many levels of government, especially local and metropolitan levels, however, are not interested in sharing information. One option to address this is to make open information (i.e., free, documented, and available via the Internet) a condition of federal grants to states or municipalities.

Dr. Young noted that EPA has begun a national dialogue on access to environmental information (www.epa.gov/nationaldialogue/), and the public is invited to provide input on the topic.

Dr. Young said that more attention should be paid to states and organizations that are making progress as a way of encouraging others; for example, the "Virtual Alabama" initiative, which was started because of the damage caused by Hurricane Katrina, is converting previously unavailable statewide data into a Google environment to assist with primary emergency future response. He also called attention to EPA's National Environmental Information Exchange Network (NEIEN), which aims to improve EPA information flows, particularly with states and native tribes. Dr. Katnik cautioned that any requirements to make information available should be accompanied with the appropriate resources for the proper infrastructure. He said that when the State of Maine began making data accessible on the Internet, a hacker went through the state system into files of the U.S. Department of Justice.

Dr. Bell said that the lack of sharing of information across municipal boundaries in Maine is notable and asked Dr. Taupier about his experience in Massachusetts in overcoming that barrier and the possibility of other successful approaches. Dr. Taupier indicated that one of the most effective approaches involves incentives. He observed that the culture about information and information access varies by state and that privacy is a big issue in Maine. Additionally, the cost of making information available can be an issue. Many local municipalities restrict access to information by making it expensive and time consuming. In Massachusetts, an aggressive policy was adopted that information is a public good and in the public domain, and that units of government do not have the right to restrict access to it. Because local governments have numerous other fiscal issues, this work likely would not be funded unless state governments created incentives for it.

Dr. Bierwagen said that the climate change issue is galvanizing certain communities to share more information. Although climate change issues concern a large region, impact and adaptation are local. A state bioassessment project that has generated significant interest across states to look at ways to detect climate change has provided an impetus to share information and determine how consistent methods used in individual states provide uniformity about quality and other factors.

ADJOURNMENT

Dr. Bauer thanked the presenters, panels, and attendees for their participation. She adjourned the meeting at 5:00 p.m.