

U.S. Environmental Protection Agency

Office of Research and Development

Response to ERIS State Research Needs

**DISCLAIMER: Some of the research discussed in this document is in progress and has not been peer reviewed or formally disseminated by EPA. It does not represent and should not be construed to represent any Agency determination or policy.**

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# Introduction

Over the past few years EPA’s Office of Research and Development (ORD) has connected with the Environmental Council of States (ECOS)—the national association of state environmental agency leaders—and its research arm, the Environmental Research Institute of the States (ERIS), to share information on ORD’s scientific and technical capabilities and to solicit input on how ORD scientific products can be more useful to the states.

To that end, ORD has hosted ERIS Board members on three separate visits to EPA facilities in Research Triangle Park (Summer 2011), Cincinnati (August 2012) and Las Vegas (May 2013). They will also visit our Gulf Ecology Division in May of this year.

As part of these ongoing efforts, ERIS has provided a set of research needs they gathered at the ECOS Annual Meeting in September 2013 that are grouped into several broad topical areas.

This document is ORD’s response to the list of state research needs provided by ERIS. We have identified existing tools, methods or models on these topics, as well as other relevant work being done by ORD or the program offices in these areas. The appendix includes supplemental information and active research in these areas.

ORD values the collaboration with ERIS and our state partners. Our goal is to make our tools, models and research as useful and practical as possible to help the states do their important environmental work.

# Nutrients in Water

## Develop models for nutrient discharges from wastewater facilities similar to air models that are already in use to replace or augment monitoring.

Existing tools, methods or models:

* **AQUATOX**—AQUATOX is a simulation model for aquatic systems. AQUATOX predicts the fate of various pollutants, such as nutrients and organic chemicals, and their effects on the ecosystem, including fish, invertebrates and aquatic plants. This model is a valuable tool for ecologists, biologists, water quality modelers and anyone involved in performing ecological risk assessments for aquatic ecosystems.   
  [water.epa.gov/scitech/datait/models/aquatox](file:///C:\Users\lmatth02\AppData\Local\Microsoft\Windows\Temporary%20Internet%20Files\Content.Outlook\6XWZSS0Z\water.epa.gov\scitech\datait\models\aquatox)
* **Hydrological Simulation Program (HSPF)**—HSPF is a comprehensive watershed model that can be applied to rural and urban environments to simulate point and nonpoint runoff and pollutant loadings at a watershed scale. This model will be valuable to environmental scientists and biologists in performing water quantity and quality routing in stream reaches and lakes and in simulating sediment, nutrients, pathogens, dissolved oxygen, pesticides and other waterquality constituents. HSPF is programed in FORTRAN.

<http://www2.epa.gov/exposure-assessment-models/hspf>

Additionally, the HSPF Best Management Practice Web Toolkit builds hydraulic function tables (FTABLES) for the HSPF model. These FTABLES display the depth-area-volume-discharge relationships of engineered systems (e.g., sewer networks and best management practices) and natural systems such as river reach networks. Accurate representation of channel and sewer networks is important for modeling flow, fate and transport of water quality constituents. Therefore, the accuracy with which channel hydraulics are represented in HSPF has important implications forTotal Maximum Daily Load (TMDL) estimation. <http://www.epa.gov/athens/research/modeling/HSPFWebTools/>

* **Nutrient Control Design Manual**—This manual describes chemical and biological-based wastewater treatment systems and provides updated design guidance on nitrogen and phosphorus control at municipal wastewater treatment plants (WWTPs). <http://nepis.epa.gov/Adobe/PDF/P1008KTD.pdf>
* **Water Quality Analysis Simulation Program (WASP)**—WASP is a spatially and temporally dynamic, mechanistic modeling framework that simulates solids and contaminants in the surface water and the underlying sediment layers, with flexibility to handle different complexities of such systems as ponds, lakes, streams, rivers and estuaries. WASP has been widely applied in the development of TMDLs. EPA’s Office of Wastewater Management routinely uses this model to address nitrogen (N) and phosphorus (P) loadings. (The U.S. Geological Survey [USGS] uses its own SPARROW (SPAtially Referenced Regressions On Watershed Attributes model <https://water.usgs.gov/nawqa/sparrow/>). WASP is programmed in FORTRAN and uses a Windows interface for the user to input and construct the model. WASP also has its own postprocessor to view and plot output.   
  <http://epa.gov/athens/wwqtsc/html/wasp.html>
* **QUAL2K**—The QUAL2Kriver and stream water quality model is a simpler construct than WASP, with less spatial freedom. The model is usable for assessing TMDLs and point and nonpoint source loads.   
  <http://www.epa.gov/ATHENS/wwqtsc/html/qual2k.html>

Relevant work:

* **Nitrogen Roadmap**—This roadmap is a cross-media, integrated, multidisciplinary approach to sustainably managing nitrogen and co-pollutant loadings to air and water to reduce adverse impacts on the environment and human health. The Nitrogen and Co-Pollutant Research Roadmap will provide a framework for integrating and coordinating Agency research related to nitrogen and co-pollutants (e.g., phosphorus, sulfur, carbon). This long-term research planning effort will identify major focus areas, opportunities for integration across the Agency, and research gaps, as well as make recommendations for future research directions. Over the next year, we would like to get a better understanding of what tools, methods and models are of interest to states and develop a process for providing them in a timely fashion. Developer: Collaboration across EPA’s research and program offices (ORD, Office of Water [OW] and Office of Air and Radiation [OAR]) and Regions.
* **Target Opportunity**—ORD would like to engage with states as we develop the roadmap in the next year. What would be most helpful for states?
* **Causal Analysis/Diagnosis Decision Information System (**[**CADDIS**](http://www.epa.gov/caddis/)**)**—EPA’s CADDIS is an application to help scientists systematically evaluate the causes of harm to plants and animals in aquatic habitats. CADDIS provides basic information on eight common causes of biological impairment, including excess nutrients. The tool enables states to pinpoint causes of impairment and target remedial action.  
  [www.epa.gov/caddis/](http://www.epa.gov/caddis/)
* **Greening Combined Sewer Overflow (CSO) Plans**—This plan is intended to help communities develop and evaluate control alternatives that include green infrastructure (GI). It is designed to provide municipal officials and sewer authorities with tools to help quantify GI contributions to an overall CSO control plan.

This resource contains three major parts:

* + A general overview of the regulatory and policy context for incorporating GI into CSO control programs;
  + A description of how municipalities may develop and assess control alternatives that include GI; and
  + A brief demonstration of a **modeling tool** that can help quantify GI contributions to an overall CSO control plan.

This tool is intended for use by both policy-oriented and technical professionals working to incorporate GI practices into CSO Long-Term Control Plans.  
<http://water.epa.gov/infrastructure/greeninfrastructure/upload/Greening_CSO_Plans.PDF>

* **Nitrogen and Phosphorus Data Access Tool (NPDAT)**—This tool provides downloadable data layers and key information on the following:
  + The extent and magnitude of nitrogen and phosphorus pollution in our nation's waters;
  + Water quality problems or potential problems related to this pollution; and
  + Potential sources of these pollutants.

Where available, the data layers in this data access tool are national in scope. In some cases, data sets are available only in the Mississippi/Atchafalaya River Basin (e.g., USGS-estimated loadings of nitrogen and phosphorus pollution) or for a smaller area or region. The goal of the NPDAT is to support states, other partners, and stakeholders in their nitrogen and phosphorus analyses.   
<http://www2.epa.gov/nutrient-policy-data/nitrogen-and-phosphorus-pollution-data-access-tool>

* **Storm Water Management Model (SWMM)**—The EPA SWMM is a dynamic rainfall-runoff simulation model used for single-event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of subcatchment areas on which rain falls and runoff is generated. The routing portion of SWMM transports this runoff through a conveyance system of pipes, channels, storage/treatment devices, pumps and regulators. SWMM tracks the quantity and quality of runoff generated within each subcatchment, as well as the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps. SWMM also has the ability to impose user-supplied treatment functions at any point in the conveyance system. This feature could be used to represent nutrient removals at high-rate treatment devices placed near combined sewer system outfalls or through advanced treatment of sanitary sewer flows in centralized wastewater treatment plants. <http://www.epa.gov/athens/wwqtsc/html/swmm.html>
* **Technical Support for Numeric Nutrient Criteria Development**—EPA has developed a number of resources to help states with developing nutrient criteria. Available resources include the following:
  + A comprehensive framework (2011) to help states, territories and tribes address nitrogen and phosphorus pollution;
  + Technical guidance documents that describe the techniques for developing numeric criteria for nitrogen and phosphorus pollution for different water bodies;
  + Technical documents describing ecoregional criteria;
  + Online databases and clearinghouses; and
  + Data concerning impaired waters and TMDLs.

The goal of the framework is to assist in the development of numeric nitrogen and phosphorus criteria, which will help states, territories and tribes move toward adopting water quality standards for nitrogen and phosphorus.

<http://www2.epa.gov/nutrient-policy-data/technical-support-numeric-nutrient-criteria-development>

## Identify approaches for treating phosphorous in municipal or industrial wastewater, in nonpoint discharges or sediments.

Relevant work:

* **P Grand Challenge**—The P Grand Challenge is intended to find a lasting and cost-effective solution to the nonpoint source P problem. The P Grand Challenge is aimed at building a community working together to develop successful technologies while competing against each other in identical conditions. It is structured to incentivize, encourage and support the development of efficient and resilient solutions to P removal and recovery. The innovative removal technology has to be adaptive to the spatial and temporal variability (technology performing well at 25˚C in Florida, as well as in the Great Lakes at 2˚C). This is one of the major obstacles in developing a universal solution. Developers: EPA is partnering with the Everglades Foundation, which is launching a prize (P Grand Challenge) to identify an innovative solution to this problem. ***The Everglades challenges will be announced on Earth Day, and the challenge will be staged to run over the next two years.***

## Develop new technologies to assist in addressing phosphorous loadings to lakes, especially as related to algal blooms in Lake Erie.

Relevant work:

* **Integrated Assessment of Large Lakes and Reservoirs**—Part of the Coordinated Science and Monitoring Initiative of the Great Lakes Water Quality Agreement, the Assessment consists of a series of surveys taken along the coastlines of the Great Lakes. In each survey, *in situ* sensors were towed along the coast capturing real-time data on water quality and plankton. With this data, the Assessment will make connections between the condition of near-shore waters and adjacent watersheds. This approach has been applied at Lake Tahoe to address information and indicators that may be needed for Lake Tahoe’s near-shore TMDL. Some of the data from these surveys may be used by the states in Clean Water Act reporting. The outcome of the work has been that Region 5/Great Lakes National Program Office has now adopted the technology and approach in the annual monitoring surveys that it conducts in conjunction with other federal agencies and states on the Great Lakes.

Publication: <http://www.tandfonline.com/doi/abs/10.1080/14634988.2013.811381#.UzCkzfldXAQ>

DOI: 10.1080/14634988.2013.811381

* **Hydrological Simulation Program (HSPF)**—See description above.
* **Propagation of cyanobacteria and their toxins through drinking water treatment plants during a bloom event**—Seven drinking water treatment facilities on Lake Erie are being sampled for cyanobacteria, their toxins and bloom-associated water quality indicators. Samples are collected monthly, from May through November, at six to nine locations within each facility. The treatment facilities are distributed along the entire Ohio shore of the lake, and their raw water qualities range from mildly to highly bloom-impacted. Our results could be used to determine if it makes sense to include ‘stream daylighting’ as a GI approach eligible for funding under various programs. The state of Ohio is closely involved in this project. We are very interested in involving other states in this research area.

## Study the travel of nutrients to better understand if and how they travel from the upper Midwest to the Gulf of Mexico.

Relevant Work:

* **Nutrient Sensor Specifications and Requirements**—The White House Office of Science and Technology Policy has convened the U.S. Department of Agriculture (USDA), EPA, USGS and National Oceanic and Atmospheric Administration (NOAA) to work together and collaborate with industry and other organizations to have lower-cost nutrient sensors (for water and soil) on the market within three years. The work is being undertaken to fill significant gaps in our understanding of nutrients in soil, nutrient loadings and nutrient transport that current methods and monitoring do not adequately resolve. USDA and EPA are developing specifications and requirements for sensors that include cost, usability and interoperability, sensitivity, accuracy and precision.
* **Target Opportunity**: American University has taken the lead to bring together the federal agencies, Duke University, Environmental Defense Fund, Tulane University and the Everglades Foundation, as well as industry and manufacturers, and is reaching out to ECOS, states and other organizations to get their review and input on the specifications and requirements. A meeting with industry representatives is scheduled for June to discuss the opportunity in more detail.

## Develop and share Best Management Practices related to nutrient losses.

Relevant Work:

* **Hydraulic Monitoring in Restored and Native Oxbow Wetlands**—EPA, the Nature Conservancy, Iowa Soybeans Association, and the Iowa Department of Natural Resources together are monitoring restored and native oxbow wetlands, which provide nutrient load reduction from agricultural fields that drain to the Mississippi River basin. The studies are being conducted in the Mississippi River Basin Initiative (MRBI), which was established to address Gulf of Mexico hypoxia issues. Boone River, identified by the Nature Conservancy as a ‘top priority for aquatic conservation,’ has been selected for targeted nutrient removal.
* **Target Opportunity**: If other states involved in the MRBI are interested in oxbow wetlands for nutrient removal, it may be possible to include additional pilot projects in this effort. *Additional monitoring would require more funds than currently in the budget for this effort.*

# Cumulative Risk/Effects on Disadvantaged Communities *Environmental Justice and Title VI Issues*

## Develop methods or models to evaluate the overall harm from exposures to a mixture of pollutants that individually may not exceed a risk level of concern.

Existing tools, methods or models:

* **Guidance for Conducting Risk Assessment of Chemical Mixtures**—The Agency has published its science policy and provided procedural guidance for evaluating data on the health risks from exposures to chemical mixtures. The emphasis is on dose-response and risk characterization, with details on the principles and their applications. <http://www.epa.gov/raf/publications/guidelines-for-hra-chemical-mixtures.htm>
* **Framework for Cumulative Risk Assessment**—The Framework is the first step in a long-term effort to develop cumulative risk assessment guidance. Building on EPA’s growing experience with cumulative risk assessment, the Framework identifies the basic elements of the cumulative risk assessment process and provides a flexible structure for conducting and evaluating cumulative risk assessment, as well as for addressing scientific issues related to cumulative risk. Although this Framework report will serve as a foundation for developing future guidance, it is neither a procedural guide nor a regulatory requirement within EPA, and it is expected to evolve with experience. The Framework is not an attempt to lay out protocols to address all the risks or considerations that are needed to adequately inform community decisions. Rather, it is an information document, focused on describing various aspects of cumulative risk. <http://www.epa.gov/raf/publications/framework-cra.htm>

Relevant Work:

* **Human Exposure Models**—EPA scientists have developed a number of Stochastic Human Exposure and Dose Simulation (SHEDS) models and modules, which can simulate exposures to single and multiple chemicals over time for a population via multiple sources and pathways. SHEDS models have been used in a number of case studies and also by EPA for cumulative exposure assessments to support regulatory decisions. In addition, a simpler version of these models, SHEDS-Lite, is under development to reduce user burden and increase run speed for more rapid exposure assessment for consumer products and other compounds.
  + SHEDS Case Studies: <http://www.epa.gov/heasd/research/sheds/index.html>
  + SHEDS-Lite: <http://ehp.niehs.nih.gov/ehbasel13/p-1-08-13/>

## Develop a method to evaluate the social impacts from exposure to pollutants in light of current and future policies, including Environmental Justice and Title VI policies.

Our response examines health impacts to exposure to multiple pollutants more generally.

Existing tools, methods or models:

* **Decision Analysis for a Sustainable Environment, Economy and Society (DASEES)**—The DASEES project creates a formal framework so that the same common-sense decision-making principles that we use in our daily lives can be applied to more complex environmental issues. The last part of the DASEES acronym, “EES” acknowledges that this approach takes into account the *environmental*, *economic* and *societal* aspects of what have traditionally been defined as just environmental issues. DASEES has been applied in a number of case studies, including in Guánica Bay, Puerto Rico, where the community-derived overall objective was to improve the quality of life in the Guánica Bay watershed, defined as maximizing ecological integrity, maximizing economic benefits, maximizing social well-being, minimizing threats to human health, meeting political and legislative requirements and maximizing learning opportunities.
  + - Fact sheet: <http://nepis.epa.gov/Adobe/PDF/P100DSGE.pdf>
    - EPA website: <http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=238232>
    - Guánica Bay: <http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=236277>
* **Eco-Health Relationship Browser**—The Eco-Health Relationship Browser illustrates scientific evidence for linkages between human health (including such mental health concerns as aggression, stress and social relations) and ecosystem services, better understood as the benefits supplied by nature. This interactive tool provides information about several of our nation’s major ecosystems, the services they provide and how those services—or their degradation and loss—may affect people. <http://www.epa.gov/research/healthscience/browser/introduction.html>
* **Health Impact Assessment**—A Health Impact Assessment (HIA) is a decision-making tool that evaluates the public health impacts of projects, policies or plans in communities and aims to provide communities with information or advice that may influence their choices. An HIA can provide information to show what would positively impact health and what would negatively impact health. It applies community input and balances physical, human and environmental factors to community projects. There is a large body of knowledge about how to do HIAs. ORD has published a review of health impact assessments in the United States (<http://www.epa.gov/research/healthscience/health-review-hia.htm>) and is currently working with communities on two case studies (one involving an elementary school in Springfield, MA, and the other involving a city creek in Atlanta, GA). More information is available at <http://www.epa.gov/research/healthscience/health-impact-assessment.htm>

## Study the effectiveness of “additional outreach” under Title VI and Environmental Justice issues.

Existing tools, methods or models:

Existing tools and training resources for promoting community engagement are available through the Office of Solid Waste and Emergency Response’s Superfund public involvement program.

* **Superfund Community Involvement Toolkit (“CI toolkit”)**—The CI toolkit was designed to provide Superfund Regional site teams, community involvement staff and others with a practical, easy-to-use aid for designing and enhancing community involvement activities. The goal of this toolkit is to help users avoid some of the pitfalls common to the community involvement process. It enables them to quickly review and adapt a variety of community involvement tools to engage the community during all stages of the Superfund removal and remedial processes.

<http://www.epa.gov/superfund/community/toolkit.htm>

Relevant Work:

* EPA provides assistance to communities through a variety of technical assistance and training resources. These resources help communities participate in Superfund decisions at sites in their community. EPA provides information about community involvement resources, as well as links to other programs that may be useful to communities with Superfund sites.

<http://www.epa.gov/superfund/community/resources.htm>

## Conduct research on “cumulative effect” as opposed to “cumulative impacts” of environmental decisions on Environmental Justice populations.

Relevant Work:

* **EnviroAtlas**—EnviroAtlas is a one-stop shop, web-based decision-support tool that integrates geospatial data from a variety of sources to allow users to visualize and analyze how decisions impact ecosystem services. Communities are often faced with difficult decisions, such as trade-offs between enhancing transportation and residential or commercial development and maintaining local wetlands, urban green spaces or urban forests. The EnviroAtlas helps communities better understand the potential trade-offs and synergies of their decisions by providing data, maps and tools to analyze relationships between nature, people and the economy.

EnviroAtlas is designed for users from all levels of government, professionals, researchers, educators, and nongovernment organizations, as well as anyone with an interest in the benefits societies receive from the natural environment. Experience with Geographic Information Systems (GIS) or special GIS software is not needed, but using the interactive map does require a flash player.

* **Target Opportunity:** For more information and to access EnviroAtlas, go to <http://www.epa.gov/research/enviroatlas/>.
* **Community-Focused Exposure and Risk Screening Tool (C-FERST)**—CFERST is a tool for individual communities to take a deeper dive into their environmental health problems. It is a community mapping, information access and assessment tool designed to help assess risks in a community at a screening. This tool includes data and guidance to help identify and prioritize the numerous community environmental health issues to help inform decisions relevant to communities, including Environmental Justice (EJ) populations. This tool can complement EJ screening tools designed to identify EJ communities; C-FERST provides more information for a given community to learn more about their issues and potential solutions.

<http://www.epa.gov/heasd/c-ferst/index.html>

* **Target Opportunity:** A pilot version (beta) is available by using the above link. Go to Status of C-FERST and click on the link to obtain a username and password. This tool has gone through a peer review and we anticipate public release in September 2014.
* **Tribal-Focused Environmental Risk and Sustainability Tool (Tribal-FERST**)—Tribal-FERST is a web-based environmental decision support tool designed to provide tribes with the best available human health and ecological scientific information. It includes a tribal assessment roadmap developed in collaboration with tribal organizations, in addition to information as described for C-FERST

<http://www.epa.gov/heasd/research/tferst.html>

<http://epa.gov/ord/annualreport/2012/alaska.htm>

* **Target Opportunity:** A pilot version (beta) is available by using the link below. Look at the upper right-hand box and click on the link for pilot T-FERST. This tool has gone through a peer review and we anticipate public release in September 2014.

<http://www.epa.gov/research/healthscience/health-tferst.htm>

* **Eco-Health Browser**—See description above.
* **Environmental Quality Index (EQI)**—EQI estimates overall environmental quality at the county level across the United States, spanning the years 2000–2005. The database includes quality measures for air, water, land, built environment and sociodemographic environment. The goal is to understand how various environmental factors affect health in low-income, underrepresented minority and vulnerable populations, such as tribal and indigenous populations. The EQI offers a comprehensive measure of environmental quality for all counties in the United States and provides information on overall environmental exposures faced in a community. Because data were collected across the United States, the EQI is comparable across communities, allowing for areas with poor environmental quality to be identified.

The EQI is anticipated to be used in two primary ways: (1) as an indicator of ambient conditions/exposure in environmental health modeling and (2) as a covariate to adjust for ambient conditions in environmental models. However, other uses of the data are expected by different end users, such as nongovernmental organizations, academic institutions and local, county and state governments. An inventory outlining the available data for the five domains (air, water, land, built environment and sociodemographic environment) for locations is now publicly available for the years 2000–2005.   
<http://www.epa.gov/nheerl/eqi/>

By the end of September 2014, the calculated EQIs by county will be publicly available on the GeoPlatform along with a user guide, so communities can extract the variables used to calculate the EQI and use the information for their own study questions.

# Issues Related to Hydraulic Fracturing and Oil and Gas Development

## Help states characterize waste from hydraulic fracturing materials.

Relevant work:

* EPA is developing and publishing analytical chemistry measurement methods for detecting and quantifying concentrations of potential chemical constituents (analytes) in hydraulic fracturing flowback and produced water. Analytes of interest include alcohol ethoxylates, alkylphenol ethoxylates, acrylamide, various glycols, and gross alpha and beta radionuclides.

## Study air quality around oil and gas development to identify any pollution issues that need to be addressed.

The only hydraulic fracturing research EPA currently has underway is an assessment of the potential impact of hydraulic fracturing on drinking water resources. However, see the Appendix for oil and gas research focused on conventional operations, which can be relevant to hydraulic fracturing air quality issues.

## Research air quality and public impacts from open sand mining operations.

ORD is not doing any research in this area, and we are not aware of any work in EPA program offices on this topic. We are aware that the National Institute for Occupational Safety and Health (NIOSH) is conducting research on the potential occupational risks associated with sand mining operations and the mixing of sand with other hydraulic fracturing chemicals at unconventional oil and gas well pads.

# Mining Impacts

## Conduct research on how to prevent acid drainage from mining.

Relevant Work:

* **EPA Engineering and Ground Water Technical Support Centers**—EPA technical support centers offer short- and long-term assistance to Superfund and Resource Conservation and Recovery Act Corrective Action staff on such issues as control of acid mine drainage and assessment of impacts to groundwater. Services include field evaluation and demonstration of innovative technologies, verification of externally acquired data, development and testing of remediation management techniques, and on-call technical assistance.
* **Target Opportunity**: States can submit requests for technical support regarding acid mine drainage at a site through their EPA Regional Office.
* **Hard-Rock Mining Conference**—A National Conference on Mining-Influenced Waters is being held August 12–14, 2014, in Albuquerque, NM. The target audiences for this workshop are EPA program and regional offices, other federal agencies, consortiums,state and local governments, tribal nations, local communities, industry and other interested parties and decision-makers involved with the management, remediation and restoration of impacted hard-rock mining areas. Scientific information will be presented on current approaches to characterize, monitor and treat and/or remediate mining-related impacts on aquatic environments. Partners: Department of Energy (DOE), Department of Defense, EPA, and others.
* **Target Opportunity:** For more information about and to register for the upcoming conference, please go to <http://www.epa.gov/nrmrl/events/event08142014.html>

## Study the health impacts from sulfates from mining in drinking water.

ORD is not doing work in this area. Sulfate is included as one of the ions in our ecotox work. We are not aware of any work on the human health impacts from sulfates going onin other EPA program offices.

# Air Quality

## Develop models or methods to quantify the air quality improvements resulting from nontraditional control strategies, such as insulating houses, so that State Implementation Plan (SIP) credit can be provided for these efforts.

Existing tools, methods or models:

* **AVoided Emissions and geneRation Tool (AVERT)**—AVERT is a free tool that estimates the emissions benefits of energy efficiency and renewable energy (EE/RE) policies and programs. AVERT is designed to meet the needs of state air quality planners, energy offices, public utility commission staff and other stakeholders who are interested in knowing the emission impacts of energy efficiency, solar power and wind power. Nonexperts can easily use AVERT to evaluate county-level emissions displaced at electric power plants by EE/RE policies and programs. AVERT is designed to use public data, which is accessible and auditable.

<http://epa.gov/avert/> and <http://www.epa.gov/statelocalclimate/resources/avert/>

* **EE/RE Credit Guidance**—In 2012, OAR released a modified guidance document that provided more detail on various routes that a state/nonattainment area could pursue to claim credit for EE/RE measures.   
  <http://epa.gov/airquality/eere/pdfs/appendixC.pdf>

Relevant Work:

* ORD is studying the impact that barriers (sound walls) and vegetation have on pollutants traveling from highways toward nearby communities. Though this research is not in the context of SIP credit, it is important to note its relevance.

## Study how ozone level increases caused by unusual circumstances affect transport models and attainment decisions.

Existing tools, methods or models:

* **Community Multiscale Air Quality (CMAQ) model**—The CMAQ Model has been a powerful computational tool used by EPA and states for air quality management. The system simultaneously models multiple air pollutants—including ozone, particulate matter and a variety of air toxics—to help regulators determine the best air quality management scenarios for their communities, states and countries. CMAQ is used by the National Weather Service to produce daily U.S. forecasts for ozone air quality, as well as by states to assess implementation actions needed to attain National Ambient Air Quality Standards (NAAQS).

The CMAQ system includes emission, meteorology and chemical modeling components. Research continues in all of these areas to reduce uncertainties in model simulations. In addition to air quality research and regulation, the CMAQ system is also being developed to address interactions between air pollutant concentrations and climate forcing, through two-way coupling between CMAQ and the Weather Research and Forecast model. <http://www.epa.gov/AMD/Research/RIA/cmaq.html>

Relevant Work:

* ORD is currently expanding the spatial scale of CMAQ to a hemispheric scale. This will allow for improved modeling tools that can account for the intercontinental transport of air pollutants to the United States so that this uncontrollable portion of the pollutant burden can be accounted for.
* Research is under way to develop a comprehensive modeling framework that can represent the complex interactions between physical, chemical and dynamical processes at local to global scales. Three broad approaches for representing the impacts of hemispheric/global air pollution on regional air quality over the United States are being investigated: (1) linking regional CMAQ calculations with global chemistry-transport models; (2) extending the applicability of the CMAQ modeling system to the entire northern hemisphere; and (3) developing variable grid techniques (with high resolution in selected areas) to consistently link atmospheric processes from regional to global scales.
  + As ozone concentrations have decreased across the United States, long-range transport of ozone has become a larger contribution to ozone in the United States. OAR uses CMAQ when considering revisions to the NAAQS for ozone. In addition, states use CMAQ when developing SIPs to meet the NAAQS.
  + ORD has conducted research characterizing emissions from biological (biogenic) sources and has incorporated this information into predictive models. Recent models yield volatile organic compound data from vegetation and nitric oxide and carbon monoxide emissions from soils. Such information can assist states with rural and suburban areas to more cost effectively control ozone by accounting for the impact of biogenic emissions.

## Complete work needed to keep AP42 and similar sources updated and available.

Existing tools, methods or models:

* **SPECIATE ─** SPECIATE is EPA’s repository of volatile organic gas and particulate matter (PM) speciation profiles of air pollution sources. Among the many uses of speciation data, these emission source profiles are used to (1) create speciated emissions inventories for regional haze, fine particulate matter, and ozone air quality modeling; (2) estimate hazardous and air toxic emissions from total PM and total organic gases (TOGs) primary emissions; (3) provide input to chemical mass balance receptor models; and (4) verify profiles derived from ambient measurements using multivariate receptor models. This product continues to incorporate new profiles generated from research both within and outside the Agency. The release of SPECIATE Version 4.4 updates and expands SPECIATE data available to the public. It includes 5,728 profiles for PM, TOGs, and other gases.  
  <http://www.epa.gov/ttnchie1/software/speciate/>

Relevant Work:

* ORD has no ongoing research specifically to address AP42 infrastructure, communication tools or implementation.
* OAR is responsible for developing AP42 emissions factors. ORD contributes relevant emissions information that can be used in conjunction with other sources of emissions data to develop and update AP42 emission factors. EPA is developing an electronic reporting program to expedite the revision or development of emission factors and has begun incorporating requirements into our regulations that require affected sources to submit stack test data to EPA electronically. All submitted data and resulting emissions factors will ultimately be available in WebFIRE (<http://www.epa.gov/ttn/chief/webfire/index.html>) for review, retrieval and use by all stakeholders.

# Small Drinking Water and Wastewater Treatment Systems

## Develop alternative treatments for drinking water, especially for small systems, to help address issues with disinfection byproducts.

Existing tools, methods or models:

* **EPA’s Small Drinking Water Systems Annual Workshop**—This annual workshop offers in-depth training and information on various solutions and strategies for handling small systems problems and compliance challenges. The workshop is designed for state personnel responsible for technology permits related to drinking water regulations compliance and treatment. All states are invited to attend and are encouraged to continue dialogue with EPA throughout the year. By maintaining dialogue, EPA can focus efforts on the best, most helpful ways to get information to the states. The fall 2014 workshop link is pending final EPA approval before posting. The proceedings of the fall 2013 workshop can be found on the website of the Association of State Drinking Water Administrators (ASDWA). Partners: EPA and the ASDWA. <http://www.asdwa.org/index.cfm?fuseaction=page.viewpage&pageid=801>
* **New Cost Model for Drinking Water Treatment Plants**—The Safe Drinking Water Act Amendments of 1996, as well as a number of other statutes and executive orders, require that EPA estimate regulatory compliance costs as part of its rulemaking process. A new series of cost models has been designed for the purpose of estimating the national costs of drinking water regulations, although they can also be used at the individual site scale. The models were designed to be transparent and versatile. They are expected to be released on the EPA website in late March or early April. The models have not yet been used in support of any regulatory action to date, but will be for upcoming regulations. An introductory journal article on the model has been published and is available at the following website: <http://cfpub.epa.gov/si/si_public_record_report.cfm?dirEntryId=266096>

Relevant Work:

* **Drinking Water Treatability Database (TDB) ─** This database is a single-source tool that presents referenced information on the control of contaminants in drinking water. The TDB can be used to identify effective drinking water treatment processes, to assist regulators in best available technology and Contaminant Candidate List decisions, and to recognize research needs. The site currently contains 60 contaminants, but it will expand to include more than 200 regulated and unregulated contaminants and their contaminant properties. It also includes more than 25 treatment processes used by drinking water utilities. As the TDB expands, it will be one site, housing referenced information on the control of drinking water contaminants. In 2014, nitrate will be added to the TDB. <http://epa.gov/tdb>

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## Research and identify new and affordable technologies for small community wastewater treatment plants.

Existing tools, methods or models:

* **Guidelines for water reuse**—This manual provides comprehensive, up-to-date national guidance on water reuse regulations, as well as program planning in support of regulations and guidelines developed by states, tribes, and other authorities. <http://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf>
* **Process design manual for land treatment of municipal wastewater effluents**—This manual provides extensive information on the principles of biological nutrient removal and chemical phosphorus removal as the basis for design. A detailed description of technologies, both conventional and emerging, serves as a resource for state and local officials to aid in preliminary technology selection. Because most WWTPs in the United States are equipped with secondary treatment, the focus of this design manual is on retrofits to add nutrient removal to existing WWTPs, rather than on new treatment plant design, although guidance for greenfield design is presented.   
  <http://nepis.epa.gov/Adobe/PDF/P1008KTD.pdf>
* **Report on using a constructed wetland to treat greywater**—Results from the report of water quality measurements show that the constructed wetland substantially reduced organics, solids, nutrients, pathogens, and surfactants throughout the one-year sampling period. A comparison of the wetland effluent quality with state reclaimed water quality regulations indicated that effluent would typically meet reclaimed water quality standards for restricted irrigation reuse. However, treatment efficiencies decreased precipitously during winter months, producing an effluent likely unsuitable for unrestricted reuse. States and local authorities can use the results of this report, as well the underlying methods, to develop and monitor constructed wetland projects in their region.   
  <http://nepis.epa.gov/Adobe/PDF/P100FSPJ.pdf>
* **Water Infrastructure Database**—This database is used for helping utilities choose the best pipe rehabilitation, condition assessment, and pipe-location determining technologies for both wastewater conveyance systems and drinking water distribution systems. It includes primary information about individual renewal technologies’ cost and performance, case studies for their real-world applications, and the list of vendors, consultants and contractors available for a particular technology on a regional basis. The database allows utilities to input their experiences in these areas for the benefit of other utilities.   
  <http://waterid.org/>

# Greenhouse Gas Emissions Reductions

## Work with states to develop one or more scenarios that will produce an 80‑percent reduction in greenhouse gas emissions nationally, from a 2005 baseline, in 2050 or beyond.

Existing tools, methods or models:

* **Market Allocation Model (MARKAL) Technology Database**—Available to the public for use with the MARKAL energy system model, this framework allows exploration of regional (e.g., Census Divisions) and national strategies for achieving deep carbon dioxide (CO2) reductions. Because of the spatial resolution of the database, however, the results would not be state-specific, but instead would be indicative of cost-effective strategies that could be employed in each region of the country.   
  <http://www.epa.gov/nrmrl/appcd/climate_change/markal.htm>
* OAR’s OAP Climate Change Protection and Partnerships Division has been developing a number of tools, models and guidance documents to help state and local decision-makers address air quality, climate and energy issues in a coordinated fashion.<http://www.epa.gov/statelocalclimate/index.html>
* **Greenhouse Gases Mitigation Options Database (GMOD):**  **State Level Benefits**—EPA developed GMOD from information from industry, government research agencies and academia. GMOD is a decision support database and tool that is designed to provide information on mitigation technology performance, availability and applicability to support state and regional level activities and independent research. GMOD’s primary goal is to provide decision-makers with the information necessary to evaluate realistic technology choices on a comparable basis for engineering and economic analyses. The focus to date has been on the power-generation and cement-manufacturing sectors.   
  <http://www.epa.gov/air/caaac/pdfs/1_11_GMOD_CAAAC.pdf>

Relevant Work:

* **CO2 Reduction Strategies**—ORD has explored using the MARKAL model to develop deep CO2 reduction strategies. It should be noted that 50 percent of reduction strategies are quite challenging and require a major transformation of the energy system, requiring a near carbon-free electric sector.
* **Northeast States for Coordinated Air Use Management (NESCAUM)**—ORD has been involved with NESCAUM’s effort to develop a state-level version of MARKAL, New England-MARKAL (NE‑MARKAL). This effort began around 2002. NESCAUM now has a 12-state model, which includes the states in New England and the Mid-Atlantic. This model allows both state and regional policies to be examined. NESCAUM has used it to analyze the Regional Greenhouse Gas Initiative program and state policies that include energy efficiency and advanced vehicle programs. At least one state partner of NESCAUM, Maryland, has notified OAR that it intends to use NE‑MARKAL as part of its SIP efforts to demonstrate the efficacy of energy efficiency, renewable energy and fuel switching in achieving ambient air quality standards. <http://www.nescaum.org/topics/ne-markal-model>
* **Global Change Assessment Model (GCAM)**—OAR’s OAP has sponsored some work with GCAM, although we believe that the funding provided has been modest. GCAM is an integrated assessment tool for exploring consequences and responses to global change. A state-level version of this application is under development by Pacific Northwest National Lab. GCAM has been used in Intergovernmental Panel on Climate Change and other high-profile national and international greenhouse gas modeling exercises. Recent development efforts have added state-level resolution to improve climate vulnerability assessments and the development of mitigation and adaptation strategies.   
  <http://www.globalchange.umd.edu/models/gcam/>

# Specific Waste Issues

## Conduct studies and research related to the safe disposal and beneficial reuse of coal ash.

Existing tools, methods or models:

* **Leaching Environmental Assessment Framework (LEAF)**—LEAF methods more accurately predict pollutant release by accounting for the impact on leaching of differences in waste form and environmental conditions (e.g., pH levels and contact with liquids). LEAF data can be used in screening tools or in pollutant fate and transport assessments to account for site-specific factors, such as geometry of disposal units or construction projects using secondary materials and local or regional hydrology and precipitation. Using LEAF, material-specific leaching mechanisms and rates, pollutant dilution and attenuation in environmental transport are accounted for when developing tailored source terms for use in making materials management decisions.   
  <http://epa.gov/wastes/hazard/testmethods/sw846/new_meth.htm>
* **Methodology for Evaluating Encapsulated Beneficial Uses of Coal Combustion Residuals (CCR)** —EPA has developed and applied a methodology to evaluate the potential environmental impacts associated from fly ash used as a substitute for Portland cement in concrete and from fluid gas desulfurization (FGD) gypsum used as a replacement for mined gypsum in wallboard. EPA supports the continued use of fly ash and FGD gypsum in these encapsulated uses, because the evaluation releases from these CCR products are either comparable to those from analogous products or below relevant benchmarks. Data from the LEAF methods were relied upon in this evaluation to provide a more realistic characterization of the leaching behavior of intact concrete.   
  <http://www.epa.gov/epawaste/conserve/imr/ccps/benfuse.htm>

## Study the economics of control activities and cleanup efforts to evaluate the overall effect(s) of the use of pollution controls and environmental cleanup.

Existing tools, methods or models:

* **Municipal Solid Waste Decision Support Tool**—This tool can be used to identify and evaluate the cost and environmental aspects associated with specific or proposed waste management strategies or existing systems. This software tool is freely available and can be used to evaluate sustainable materials management for the municipal waste sector. It includes optimization capability to evaluate the economics, life-cycle environmental tradeoffs, and energy offsets. It

has been used in more than 150 studies to date. An updated version of the tool was released in March 2013 with an improved user interface, embedded tutorials and different reporting formats.   
<https://mswdst.rti.org/>

Relevant Work:

* **EPA’s *Handbook on the Benefits, Costs, and Impacts of Land Cleanup and Reuse***—This report summarizes the theory and methods economists use in developing benefit-cost analyses and measuring economic impacts applied to land cleanup and reuse scenarios. The report provides state and local authorities with materials to gain a basic understanding of the issues and questions that arise in conducting economic analyses, along with more technical information on how to structure and conduct an economic analysis of land cleanup and reuse sites and programs. The *Handbook* provides a window into recent research and identifies important questions that remain in the literature. <http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/LandHandbook.html>

## Work with states on green chemistry and toxic substances studies because there is not capacity for each state and the federal government to duplicate one another’s work.

Existing tools, methods or models:

EPA and state environmental agencies are working closely together on more sustainable chemistry and researching potentially toxic substances. To guide these efforts, EPA has asked the National Academies of Science (NAS) to develop a decision framework for industry and government to use when evaluating potentially safer substitute chemicals to ensure they minimize impacts on human health and the environment. All EPA chemical safety data and information are made publicly available (<http://www.epa.gov/research/mmtd/chemsafe.htm>), providing the latest science to help support more informed decisions, both nationally and at the state level. Below is a list of chemical safety online tools that EPA researchers are integrating to inform risk-based chemical evaluations:

* **Consumer Product Category Database**—Catalogs the use of more than 40,000 chemicals and their presence in different consumer products. <http://actor.epa.gov/actor/faces/CPCatLaunch.jsp;jsessionid=F6B18ABD1CBBFC38EC4F1BAC53367C20>
* **Aggregated Computational Toxicology Resource (ACToR)**—Online warehouse of publicly availably chemical toxicity data from more than 1,000 public sources on more than 500,000 environmental chemicals.   
  <http://actor.epa.gov/actor/faces/ACToRHome.jsp>
* **Interactive Chemical Safety for Sustainability dashboard**—Provides a portal for users to search and query high-throughput chemical screening data.   
  <http://actor.epa.gov/actor/faces/CSSDashboardLaunch.jsp>
* **Markov Chain Nest Productivity Model**—Integrates bird toxicity data with information on species life history and the timing of pesticide applications to estimate the relative impact of a pesticide-use scenario on the annual reproductive success of birds of interest.   
  <http://www.epa.gov/medatwrk/Prods_Pubs/mcnest.htm>
* **Übertool**—Ecological Risk Web Application for Pesticide Modeling: Provides environmental models used to evaluate ecosystem-level pesticide risks. <http://www.epa.gov/athens/research/ubertool.html>

Relevant Work:

* EPA’s chemical safety research leads the development of innovative science to support the safe, sustainable design and use of chemicals and materials required to promote human and environmental health, as well as to protect vulnerable species and populations. EPA’s chemical safety researchers have accelerated the pace of evaluating the thousands of chemicals used in products through the development of tools, such as the following:
  + **Toxicity Forecaster (ToxCast™)**—ToxCast is a multiyear effort launched in 2007 that uses automated chemical screening technologies (called “high-throughput screening assays”) to expose living cells or isolated proteins to chemicals.   
    <http://epa.gov/ncct/toxcast/>
  + **ExpoCast**—EPA evaluates the potential risks of the manufacture and use of thousands of chemicals. To assist with this evaluation, EPA scientists developed a rapid, automated (high-throughput) model using off-the-shelf technology that predicts exposures for thousands of chemicals. These predictions are being used to prioritize the order in which chemicals should be further evaluated. EPA refers to this research effort as ExpoCast.  
    <http://epa.gov/ncct/expocast/>
  + **Product Category Rule (PCR) Guideline Development Initiative**—EPA chemical safety researchers are working with partners to develop draft PCR guidelines, which help foster solutions for sustainable materials claims.  
    <http://www.pcrguidance.org/>
* EPA’s endocrine-disruption screening program has already started the scientific review process to begin using ToxCast and ExpoCast to prioritize the thousands of chemicals that need to be tested for potential endocrine-related activity.   
  Guidelines: <http://blog.epa.gov/epaconnect/2013/11/greening-federal-purchasing/>
* EPA’s chemical safety research planned for FY 2015 is putting a greater emphasis on determining how to incorporate the knowledge about the health impacts of existing chemicals into the design of safer chemicals and using sustainability analytics to develop models that can be used to anticipate detrimental impacts of chemicals to human health, ecosystems and the environment.
* The Office of Chemical Safety and Pollution Prevention (OCSPP) Pesticides Office will use tools and models to assess the ecological risks of pesticide use. For example, EPA researchers developed a model that estimates the potential impact of pesticide exposures on the reproductive success of bird populations.   
  <http://epa.gov/sciencematters/ecosystem/mcnest.htm>.
* OCSPP’s Toxics Office will link the Chemical Safety for Sustainability Dashboards to the Chemical Data Access Tool (CDAT). CDAT provides public access to all the chemical tests that companies (that are not confidential business information) have submitted to EPA for chemical registration. The Dashboards provide public access to rapid, automated chemical screening data on 1,800 chemicals. EPA ORD is working with OCSPP to link these two efforts together. An EPA YouTube video about the Dashboard is available at <http://youtu.be/OdDBwkKN4B8> and the CDAT tool is available at <http://java.epa.gov/oppt_chemical_search/>
* OCSPP, ORD and the European Chemicals Agency have a statement of intent to work together to share chemical safety research data and to share information about how chemicals are being managed for risk in the United States and in Europe.
* The National Science Foundation, universities, OCSPP, ORD and NAS are working together to determine ways to incorporate the knowledge about the health impacts of existing chemicals into the design of safer chemicals and are using sustainability analytics to develop models that can be used to anticipate detrimental impacts of chemicals on human health, ecosystems and the environment.

## Research how to deal with plastics in aquatic environments.

Relevant Work:

* **Trash-Free Waters (TFW) Program**—EPA’s OW developed TFW to help support and promote efforts to reduce trash loadings into U.S. water bodies. TFW regularly coordinates and communicates with other government bodies, such as NOAA, on respective projects addressing debris in aquatic environments.

<http://water.epa.gov/type/oceb/marinedebris/index.cfm>

* EPA is analyzing (1) the societal costs of trash in the aquatic environment and (2) the economic benefits of trash prevention and reduction, based on an inventory and assessment of *existing* studies of management costs, trash and debris impacts on local and state economies, and potential savings from innovative approaches (i.e., technologies, processes, programs) to trash prevention and reduction.  **States will be able to use the results of this economic study to provide an impetus for action if the economic benefits of trash prevention exceed the sum of reactive trash management plus other societal costs associated with trash in the environment.** EPA TFW will have the study available in May 2014.
* **NAS** **Discussion Forum: Microplastics in the Marine Environment and Potential Human Health Risks**—The forum will review and assess studies to date on the possible human health effects from the consumption of fish that have consumed microplastics. The group of experts will be asked to provide insights on the current scientific basis for determining potential changes in human health risk associated with this scenario. The current scientific findings presented by Dr. Richard Engler of EPA will provide a basis for discussion. EPA will use information from the discussion to inform decisions about future research, policies and programs. This information can be shared with states, potentially providing impetus for action if the connection to human health is made. The expert panel will be convened in April 2014. Proceedings will be widely shared, both internally and with interested external stakeholders like state agencies.

# Appendix: Supplemental Information and Active Research

**Nutrients in Water**

**Study the travel of nutrients to better understand if and how they travel from the upper Midwest to the Gulf of Mexico.**

* **Coastal Ocean Deoxygenation**—EPA researchers are developing new models of the northern Gulf of Mexico Dead Zone based on advancements in ecosystem modeling, high performance computing, and field and remote sensing based oceanographic investigations. The research and development activities will provide new insights and tools for understanding how changes in nutrient loads from the Mississippi River Basin in combination with potential climate change impacts may affect the extent and duration of hypoxia in the northern Gulf. These models are also being generalized for application to other systems outside the Gulf. The new models—the Gulf Ecosystem Model and the Gulf of Mexico Dissolved Oxygen Model—will be available in FY 2015. A product describing the nutrient-reduction scenarios and climate change impacts on Gulf hypoxia is due at the end of FY 2014. (Note: These are high-performance 3-D computer models that require specific expertise to run. ORD could make the expertise available for states and/or regions to run the model, but they do require a specific expertise and are not the kind of “plug and play” model that the public can utilize.)
* **Integrated Model for Gulf of Mexico**—A multimedia modeling approach is being developed to enable exploration of nutrient management decision making in the Gulf of Mexico from a one-environment perspective. The modeling approach is accomplished by (1) coupling air quality with land use and agricultural land management; (2) connecting the hydrosphere (i.e., coupling meteorology and hydrology); and (3) linking the air/land/hydrosphere with ecosystem models and benefits models. The collective results of this work will allow a multimedia assessment of broad management activities addressing hypoxia in the Gulf of Mexico and will move beyond the traditional single-media approach to recognize the importance of integrated air-water-land modeling research.

**Cumulative Risk/Effects on Disadvantaged Communities—Environmental Justice Issues**

**Develop a method to evaluate the social impacts from exposure to pollutants in light of current and future policies, including Environmental Justice and Title VI policies.**

* **Health and Well-Being Index (HWBI)**—The HWBI is a sustainability metric for human health and well-being that incorporates a holistic approach to provide a snapshot characterization of people’s well-being. The resulting HWBI is intended to be linked to ecosystem, economic and social services and to be input to cumulative risk assessment evaluations. The components of well-being, referred to as domains, are Connection to Nature, Cultural Fulfillment, Education, Health, Leisure Time, Living Standards, Safety and Security, and Social Cohesion. The HWBI is a combination of the scores for each of the eight domains. Twenty-five indicators and 80 metrics are used to calculate the domain scores. This index has been pilot tested in the Tampa Bay, FL, area and is expected to be available early 2015. <http://www.epa.gov/ged/tbes/tampaswellbeing.html>.

**Issues Related to Hydraulic Fracturing and Oil and Gas Development**

**Study air quality around oil and gas development to identify any pollution issues that need to be addressed.**

ORD has several ongoing and recent research activities related to oil and gas activities, done primarily through the Regional Applied Research Effort (RARE) and Regional Methods (RM) programs. Current RARE and RM projects are underway in EPA Regions 3, 6 and 8. In addition, ORD plans to initiate an extended research effort in FY 2014 to assess potential air quality issues associated with unconventional oil and gas production as part of collaborative efforts with DOE and USGS in response to a Presidential Executive Order.

* ORD is currently working on **remote mobile measurement, passive sampler, and sensor development for oil and gas emissions**. ORD researchers recently submitted a conference paper outlining **The Geospatial Measurement of Air Pollution—Remote Emission Qualification Other Test Method 33, and 33A,** and the method was recently submitted for potential posting by OAR as a Category C method.
* EPA is continuing to develop and evaluate techniques to measure emissions from oil and gas operations. This work includes a field study (target July 2014) in Region 8 as part of a RARE project to investigate production pad enclosed combustor control device effectiveness using hyperspectral remote sensing. ORD is also executing a Materials Transfer Agreement with the University of Wyoming for remote mobile measurement technology, and we are developing similar agreements with Colorado State University. ORD is continuing work with Regions 6 and 8 to deploy passive sampler/sensor packages around production pads in Texas and Colorado to identify the potential for long-term fugitive emissions.
* ORD, Texas A&M University and DOE’s National Energy Technology Laboratory are initiating a collaborative effort on optical remote sensing measurements of oil and gas production operations. The Texas A&M group is funded by a DOE grant.

**To the extent we are aware, what related work are program offices doing in this area?**

* **Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews (Final Rule)**—On April 16, 2012, EPA published promulgated regulations under the new source performance standards program to address air emissions from gas wells that are hydraulically fractured.   
  <http://www.gpo.gov/fdsys/pkg/FR-2012-08-16/pdf/2012-16806.pdf>
* OAR and ORD are working together in the application of remote sensing technologies for improving emissions data from oil and gas operations.

**Small Drinking Water and Wastewater Treatment Systems**

**Develop alternative treatments for drinking water, especially for small systems, to help address issues with disinfection byproducts.**

* **Implementing Ultraviolet (UV) Disinfection Systems for Treatment of Groundwater for Small- to Medium-Sized Utilities**—To comply with the Groundwater Rule (GWR), a utility will have to demonstrate 4-log virus inactivation. UV technology has been progressively increasing its footprint in the drinking water industry for disinfection purposes because of its ease of use and sustainability metrics. UV technologies would allow a utility to achieve the necessary log-removal credits, thereby allowing the utility to use much less chlorine in its distribution system, for residual purposes. These benefits help utilities that do not have round-the-clock operator presence. Also, implementing UV treatment helps where disinfection byproducts are a concern. Finally, although not typically pursued, the GWR allows a utility to skip using a residual disinfectant if it can demonstrate the necessary inactivation under the rule. UV technologies could be used in that instance.

This project will accomplish a number of tasks: (1) Develop recommendations and guidance from lessons learned applicable to ground water and stormwater, (2) harmonize testing protocol for UV systems in collaboration with state regulatory agencies and water utilities, (3) generate data that support a simplified approach for validating UV reactors for 4-log virus inactivation, and (4) conduct validation testing for adenovirus, MS2 (less resistant to UV than adenovirus), and *B. pumilus* (more resistant to UV than adenovirus). Both low-pressure and medium-pressure UV lamp systems will be evaluated. The low-pressure system is currently being tested and will be finished by July 2014. It is expected that the entire project will finish in the fall of 2015.

* **Establishing a Treatability Translation: A Relationship Between Source Water Quality Variability and Drinking Water Treatment Impacts**—The focus of this study is to examine the linkage between nutrient loading to a drinking water source and the effect that may have on treatment. In particular we are examining the effect of nutrients on algal growth and, subsequently, on formation of disinfectant byproduct (DBP) precursors, as well as algal-related impairment such as taste-and odor compounds and algal toxins. These linkages are likely complex and the establishment of relationships will require in-depth field monitoring coupled with lab-based experimentation. It is expected that this work will be presented in the fall of 2015.
* **Reducing Volatile Disinfection Byproducts in Treated Drinking Water Using Aeration Technologies**—EPA Region 6, in collaboration with ORD Cincinnati, is conducting a field-scale project that focuses on controlling the concentrations of volatile DBPs (primarily total trihalomethanes [THMs]) directly at the water plant’s clearwell. Aeration technologies will be investigated to remove volatile DBPs after they form in the clearwell, but before the water enters the distribution system. The need for the project is based on DBP data collected in Region 6 showing significant THM formation in many small rural systems’ treated waters before the water leaves the treatment plant’s clearwell and reaches the first customer. These rural systems are unable to optimize their plant operations to meet the Stage 2 Disinfectants and Disinfection Byproducts Rule and require treatment technologies with extremely low operator intervention to lower DBPs. It is expected that this project will be completed in the fall of 2014.
* **Control of Emerging Contaminants of Concern in Chloramination Systems: The Impact of Pre-chlorination N-Nitroso-dimethylamine (NDMA) and iodo-DBP formation**—This study examines the impact of free chlorine contact time on controlling the formation of emerging contaminants of concern: NDMA and iodo-DBPs. This study will inform the regulatory review of DBP regulations. It is expected that this project will be completed in the fall of 2014.
* **Control of Emerging Contaminants of Concern Formed During Drinking Water Disinfection: The Impact of Pre-ozonation on Halonitromethane Formation**—This study is examining the impact of pre-ozonation on the formation of halonitromethanes. Recent research on halonitromethanes (e.g., chloropicrin) has suggested that this class of compounds is orders of magnitude more cytotoxic than the regulated DBPs classes of the 4 regulated trihalomethanes and the 9 chloro/bromohaloacetic acids. Established research has shown that at least for one species, trichloronitromethane (also known as, chloropicrin), formation is enhanced when pre-ozonation is employed ahead of traditional chlorination. The mechanism for halonitromethane formation is not fully understood. Some formation mechanisms suggest nitrite may comprise the N source in the nitromethane. This study examines the role of ozone, nitrite, bromide, and dissolved organic matter type in the formation of halonitromethanes and will inform the regulatory review of DBP regulations. It is expected that this project will be completed in the fall of 2014.

**Research and identify new and affordable technologies for small community wastewater treatment plants.**

* **Wastewater Treatment Plants: Decentralized High Rate Treatment of Peak Wet-Weather Flows**—An evaluation of ballasted flocculation treatment technology for the decentralized treatment of peak wet-weather flows to control the water quality impacts of CSO and sanitary sewer overflow discharges is being undertaken. Municipal wastewater collection and treatment systems are overloaded during wet-weather events, causing discharges of untreated stormwater/sanitary wastewater into local streams and system backups into buildings. Ballasted flocculation treatment technologies are very adaptive to dynamic wet-weather flows and can be very effective in controlling the discharge of pathogenic microorganisms into local water bodies. This project is expected to be completed in the fall of 2014.
* **Net Zero Sustainability Initiative: Decentralized Water Reuse**—EPA’s ORD and the Army signed a Memorandum of Understanding on November 28, 2011, for the purpose of developing and demonstrating innovative technologies on Army installations in support of the Army’s Net Zero Initiative. This specific project will reduce potable water use via safe reuse of wastewater through the decentralized treatment of water from sewer lines, sewer mining. In addition to the quality of water being produced by demonstrated systems, the assessment will focus on the long-term operating costs of the systems, including energy consumption and maintenance costs. The approach will emphasize reductions in the expenses by sequential testing of alternative, innovative treatment systems, such as novel membrane materials developed with plasma technologies. In addition, the project will provide near-term water savings by recycling treated wastewater. This work will be presented in 2015.

**Greenhouse Gas Emissions Reductions**

**Work with states to develop one or more scenarios that will produce an 80-percent reduction in greenhouse gas emissions nationally, from a 2005 baseline, in 2050 or beyond.**

* Research is underway to improve the representation of different energy technologies in the database. Examples include expansion of the types of equipment that are explicitly included in the industrial sector and more detailed information regarding the cost of biofuel feedstocks.

**Specific Waste Issues**

**Study the economics of control activities and cleanup efforts to evaluate the overall effects of the use of pollution controls and environmental cleanup.**

For states seeking to learn more about current research published in the economic literature that examines the economic impacts of land cleanup and reuse, the following offer some important empirical findings:

* + Haninger, K., L. Ma, and C. Timmins. 2012. “Estimating the Impacts of Brownfields Remediation on Property Values.” Working Paper, Duke Environmental Series.   
    Finds evidence of large increases in property values accompanying cleanup, ranging from 5.1 percent to 12.8 percent. Online at <http://sites.nicholasinstitute.duke.edu/environmentaleconomics/files/2013/01/WP-EE-12-08.pdf>
  + Gamper-Rabindran, S., and C. Timmins. 2013. “Does hazardous waste remediation raise housing values? Evidence of spatially localized benefits.” *Journal of Environmental Economics and Management* 65 (3): 345–360.   
    Paper finds median housing property values increased between 14.7 percent and 20.8 percent near Superfund sites when they were deleted from the National Priorities List.
  + Zabel, J., and D. Guignet. 2012. “A Hedonic Analysis of the Impact of LUST Sites on House Prices.” *Resource and Energy Economics* 34 (4): 549–564.   
    Focusing on home sales from 1996 to 2007 in three Maryland counties, a hedonic house price model is used to estimate willingness to pay to clean up leaking underground storage tank (LUST) sites. Results suggest that although the typical LUST may not significantly affect nearby property values, more publicized (and more severe) sites can decrease surrounding home values by more than 10 percent.

**Work with states on green chemistry and toxic substances studies because there is not capacity for each state and the federal government to duplicate one another’s work.**

***Tools to evaluate chemical manufacturing processes:***

* **Toxicity Estimation Software Tool (TEST)**—With tens of thousands of chemicals currently in commerce, and hundreds more introduced every year, the ability to attain experimental measurements of toxicity for each chemical is extremely time consuming and expensive. To address this data availability gap, it is imperative that alternative methods to estimate toxicity be developed. One such alternative method for estimating toxicity is the use of Quantitative Structure–Activity/Property Relationship models, which are based on the molecular structure of the chemical. To make use of these models EPA scientists have developed the TEST program, which allows users to easily estimate toxicity values for a variety of toxicity endpoints including acute aquatic toxicity, acute mammalian toxicity, bioaccumulation factor, developmental toxicity and mutagenicity. The software program can be assessed at  
  <http://www.epa.gov/nrmrl/std/qsar/qsar.html>

* **Program for Assisting the Replacement of Industrial Solvents (PARIS)**—Industrial solvents whose continued use raises concern for worker health and toxics in the environment should be replaced in a cost-effective manner. PARIS Version 3 (PARIS III) is a software tool that addresses this need by identifying pure chemicals or designing chemical mixtures that can serve as alternatives to more hazardous substances currently in use. A ranked list of replacement solvents can be created within minutes and, because the alternatives proposed have similar properties to the original solvent, users do not have to change equipment or modify their chemical processes in order to adopt safer, “greener” solvents. The “greener” solvents formulated by PARIS III are identified to have improved environmental properties, and they can perform as well as the solvents they were designed to replace. Information on a previous version, PARIS II, can be accessed at   
  <http://www.epa.gov/nrmrl/std/paris/paris.htm>.
* **Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI)**—The most effective way to achieve long-term environmental results is through the use of a consistent set of metrics and decision-making frameworks. EPA has developed TRACI to assist in impact assessment for application in sustainability metrics, life-cycle assessment, industrial ecology, process design, and pollution prevention. This impact assessment methodology allows for the characterization of the potential impacts and effects of a chemical in the areas of ozone depletion, global warming, acidification, eutrophication, tropospheric ozone (smog) formation, ecotoxicity, human particulate effects, human carcinogenic effects, human noncarcinogenic effects, fossil fuel depletion and land use effects. TRACI developers ensured consistency with previous EPA and international models and made minimal modeling assumptions, aiming to minimize uncertainty in every category.  
  <http://www.epa.gov/nrmrl/std/traci/traci.html>
* **Waste Reduction Algorithm (WAR)**—WAR is a chemical process design tool used to reduce the environmental impact of a chemical process. In traditional chemical process design, attention may focus primarily upon minimizing cost, while the environmental impact of a process may not be evaluated in requisite detail. In many instances this may lead to the production of large quantities of waste materials. It is possible to reduce the generation of these wastes and their environmental impact by modifying the design of the process. However, design methodologies for waste minimization do not exist, thus EPA focused research activities on developing such methodologies. WAR is based on a potential environmental impact (PEI) balance for chemical processes. The PEI is a relative measure of the potential for a chemical to have an adverse effect on human health and the environment (e.g., aquatic ecotoxicolgy, global warming, etc.). The result of the PEI balance is an impact (pollution) index that provides a quantitative measure of the impact of the waste generated in the process. The goal of this methodology is to minimize the PEI for a process, instead of minimizing the amount of waste (pollutants) generated. The result is a robust process design that integrally incorporates environmental impact reduction.  
  <http://www.epa.gov/nrmrl/std/war/sim_war.htm>
* **Gauging Reaction Effectiveness for Environmental Sustainability of Chemistries with a multi-Objective Process Evaluator (GREENSCOPE)**—Industrial processes, particularly those within the chemical industry, contribute products and services to improve and increase society’s quality of life. However, the transformation of raw materials into their respective final goods involves the consumption of mass and energy and the possible generation of byproducts and releases. To address these issues, the new approach for chemical processing is focused on sustainable production: Minimize raw material consumption and energy loads, minimize or eliminate releases, and increase the economic feasibility of the process. To evaluate these advances, a sustainability assessment methodology, GREENSCOPE, has been developed into a tool to evaluate and assist in the synthesis and design of chemical processes. This systematic methodology and software tool can assist researchers from industry, academia, and government agencies develop more sustainable processes by measuring indicators in terms of environmental, efficiency, energy and economic considerations.  
  <http://nepis.epa.gov/Adobe/PDF/P100BH9U.pdf>

**Research how to deal with plastics in aquatic environments.**

* EPA Region 9 assessed marine debris in the northern Pacific, identifying available data (and data gaps) on the types and sources of debris, the water column depth and density of plastic debris in the gyre, physical transport mechanisms, and physical, chemical, biological and habitat impacts. (The study was published in November 2011.)States can use this information on types and sources of debris, characteristics of the plastic debris, transport mechanisms and impacts to guide their actions to the extent relevant in their region. They may also be able to use the methods in this study to do similar studies in their location.  
  <http://www.epa.gov/region9/marine-debris/pdf/MarineDebris-NPacFinalAprvd.pdf>
* EPA will analyze the “state of the science” on the sources and environmental effects of plastics pollution on aquatic life and habitat, drawing upon many studies that have been done to date. The analysis will include an assessment of toxic chemicals absorbed and/or released from plastics in the aquatic environment. This information may guide states in determining which forms of plastic are most harmful and the severity of plastic pollution effects.
* EPA Region 9 is working with San Francisco State University and UC San Diego to use high-resolution (temporal and spatial) ocean current mapping technology and particle trajectory models to map ocean currents and trajectories of floating marine debris. The mapping approaches used by Region 9 and collaborators can be of use to states interested in conducting similar studies in their region.