# Recent Accomplishments in Sustainable and Healthy Communities Research

How can communities and individuals meet their current needs without compromising the ability of future generations to meet their own? And more specifically, how can they balance the protection of our shared environment—air, water, land, and natural ecosystem—in ways that sustain both human health and a stable economy? Providing the science and engineering to answer those questions is the focus of EPA's Sustainable and Healthy Communities research program.

EPA researchers engage community stakeholders, individuals, partner agencies, and other decision makers to help identify the long-term environmental and related health challenges they face. The scientists and engineer then use that insight to design and implement programs that provide the decision-support tools, information, and models needed to meet those challenges. The impact of their work is exemplified in a host of science-based strategies and models available to decision makers, and in the investments these EPA partners are making today for a healthy, sustainable, and prosperous future.
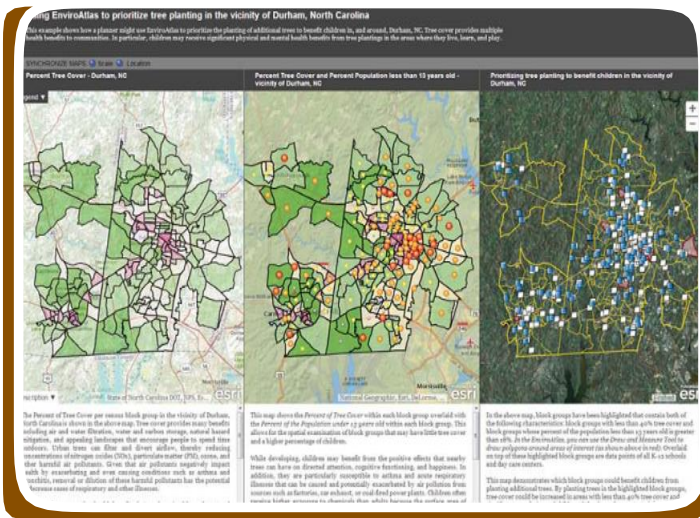
EPA Releases EnviroAtlas

Communities are often faced with difficult decisions, such as trade-offs between transportation, residential or commercial development and maintaining local wetlands, urban greenspaces, or urban forests. To help these decision makers, EPA released EnviroAtlas on May 7th, 2014. EnviroAtlas is a multi-scale (national to community), web-based, interactive mapping, visualization, and analysis tool that provides the first-ever picture of the distribution of ecosystem services for the mainland United States.

EnviroAtlas helps communities better understand the potential benefits and drawbacks of their decisions by providing tools to analyze relationships between nature, health and well-being, and the economy. Users can investigate land cover patterns, see how ecosystem services reduce pollution, and view closer to true scale data to compare them across selected communities.

EnviroAtlas can help people learn about ecosystems, and how they provide us with benefits such as clean air and water, opportunities for recreation, and protection from severe weather. EnviroAtlas also highlights how ecosystems provide habitats for plants, fish, and wildlife as well as the materials people need to produce food, clothing, shelter, and pharmaceuticals, and provides maps on all of these topics. It lets users generate customized maps and images that show the condition of their local community's air, water, and landscape; as well as population density and other demographic data.

The tool integrates over 300 separate data layers developed through a collaboration between EPA, US Geological Survey US Forest Service, other federal, state, and non-profit organizations, and several universities. It is designed to help decision makers understand the implications of planning and policy decisions on our fragile ecosystems and the communities who depend on goods and services from these ecosystems.

People from all levels of government, professionals, researchers, educators, non-governmental organizations and anyone interested in considering the benefits or impacts of a decision, such as building a new road or city park, can use EnviroAtlas. It is available to anybody with access to a computer and an Internet connection. No special software is needed. It is currently not optimized for smartphone or tablet use, but a mobile-friendly version is planned for the future.

By providing EnviroAtlas, EPA is helping to ensure that anyone making decisions that may impact ecosystems will have the best available knowledge to build prosperous communities while conserving our natural resources.

To learn more and use EnviroAtlas visit: http://enviroatlas.epa.gov/enviroatlas/.

Integrated Environmental Modeling for Better Decision Making

EPA researchers are advancing a new paradigm of environmental assessment that uses sophisticated computer modeling to integrate a wealth of data, such as incorporating biological, wildlife, and fishery information with land use patterns, chemical and physical stressors, and human-caused impacts. That work is providing tools and information that paint a clearer picture of current baseline conditions, as well as the ability to forecast (model) potential future impacts and risks. This will better inform decisions for balancing short and long-term goals.

Using the framework outlined above, Agency researchers conducted a case study in the Kanawha Coal Field of West Virginia, focusing on watershed-based, cumulative impacts of land use (primarily mountaintop mining) on the abundance of smallmouth bass and brook trout. Because these two species are sought-after game fish, their population is a potentially important local economic resource, and an indicator of an ecosystem service that can be threatened by impacts associated with mountaintop mining. In addition, two papers were submitted from the work that document how to further the use of integrated environmental modeling to assess the impacts and stressors on landscapes and ecosystem services.

Literature Cited:

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Daniel McGarvey, J.M. Johnston. 2011. A Simple Method to Predict Regional Fish Abundance: An Example in the McKenzie River Basin, Oregon, *Fisheries*, 36:11, 534-546.

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Assessing Long-term Solutions for Contaminated Sites

EPA researchers are advancing techniques and technologies to help communities remediate and rehabilitate Superfund and other contaminated sites. A major focus is to develop and assess solutions that will protect human health and reduce environmental risks associated with the flow of hazardous substances in groundwater. A common technique has been Permeable Reactive Barriers (PRB), low-cost technologies installed underground that absorb or convert hazardous materials into safe compounds. Because of their affordability and ease of use, these barriers offer an accessible, attractive technology for communities looking to reclaim areas for productive uses while also protecting public health. But their long-term, sustainable use has not been well documented.

EPA researchers are changing that. In 2014, they published *Fifteen-year assessment of a Permeable Reactive Barrier for treatment of chromate and tricholoroethylene in groundwater* ("Science of the Total Environment, v.468/469). The research presents an assessment of the longest available record of the performance of a Permeable Reactive Barrier, one installed to treat groundwater contaminants at the U.S. Coast Guard Support Center in

Elizabeth, New Jersey. Conducted to directly support partners in the Agency's Office of Solid Waste and Emergency Response and the local community, the study indicates that the barrier continues to remove contaminants after fifteen years of operation. The ongoing work not only informs such partners, but also serves as a case study to further the understanding of techniques and technologies to rehabilitate contaminated sites.

EPA Releases 2015 Web-based Report on the Environment

In July 2015, EPA publically released the web-based Report on the Environment (ROE). The ROE presents the best available indicators of information on national conditions and trends in air, water, land, human health, and ecological systems. These indicators serve as a tool for EPA decision-makers, program planners, scientists, researchers, the public, and others interested in environmental science and policy to track changes in environmental condition. They allow EPA and the public to assess whether the Agency is succeeding in its mission, and they help alert EPA to new challenges that may need attention and action.
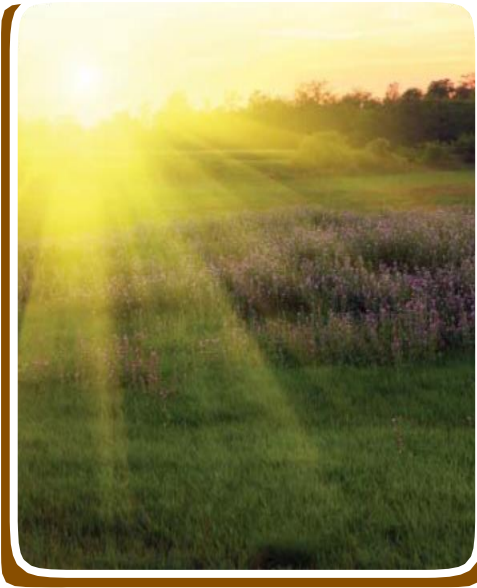
The ROE was first published in 2003 and released for review by the EPA Science Advisory Board. It was substantially revised in 2008 and 2015. The 2015 ROE, published exclusively on the Web, includes six new indicators and many new features. The web-based version provides access to the information from the 2008 ROE. The 2015 ROE also includes a companion Highlights Document, which includes the underlying methodology, references, and sources of additional information, in an on-line searchable format. The ROE compiles, in one place, the most reliable indicators currently available to help answer 24 questions that EPA believes are of critical importance to its mission and the nation's environment.

To learn more and use the Report on the Environment, visit: http://cfpub.epa.gov/roe/

Advancing Vapor Intrusion Monitoring and Mitigation

This pre-1920 residential duplex is the site of an EPA study on vapor intrusion.

EPA researchers and collaborators are advancing the science of monitoring and mitigating vapor intrusion, when radon, volatile organic compounds, or other hazardous gases move from contaminated groundwater through the soil and into the air of homes and other buildings, where exposures can lead to serious health risks. In 2014, they released a draft report for external peer review presenting the results of an extensive study conducted at a pre-1920 residential duplex outfitted with a suite of monitors to intensively measure and track changes in the composition of indoor air.

Comparing weekly measurements, real-time observations from continual monitoring of a host of variables (barometric pressure, air and soil temperature, heating and air conditioning operations, and others), and modeling scenarios allowed the researchers to perform one of the most in-depth analyses to date of the driving forces of vapor intrusion, building on several years' worth of data collected at the research house. Results provide science-based guidance to help partners in EPA's Office of Solid Waste and Emergency Response and elsewhere protect people and inform actions to improve indoor air quality. The final report is expected to be release in 2015.

Ecosystem Service Production Function Library

One of the major challenges that researchers, environmental managers, and community decision makers face is understanding the link between how today's actions and decision might impact the long-term sustainability of ecosystems, particularly the ability of such ecosystems to continue to provide the benefits that form the foundation of healthy, vibrant communities. To help, EPA researchers have created the EcoService Models Library (ESML).

The library compiles a host of different resources to serve as a single site for developing tools and models that illustrate the connection between healthy ecosystems and ecosystem services. ESML was designed for scientists and economists who provide advice to communities, businesses and conservation organizations. It was made available for beta testing in December 2014, and is scheduled for public release in 2016. EPA researchers will continue to build library content to reflect the state of science and address user needs.
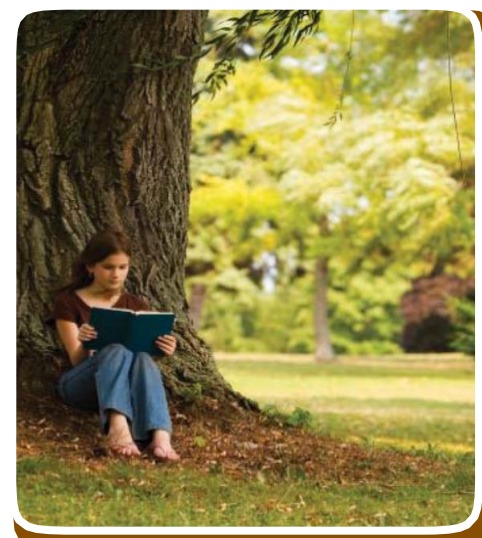
Advancing Tools to Quantify and Explore Human-Well Being

EPA's Human Well-being Index (HWBI), released as a draft in 2012, was designed to help communities live more sustainably. This tool assists decision makers in characterizing and quantifying the potential positive and negative effects on human well-being when various decisions are made. The HWBI incorporates the multiple dimensions of sustainability—environment, economy, and society—while also allowing the results to be widely scalable from national to local levels.

The report goes into a detailed analysis of the development of HWBI and also helps identify the appropriate applications of the data. The web-based predictive model will help communities identify the links between long-term sustainability, understand the flow of ecosystem services, and prioritize the well- being of humans.

Installing green infrastructure in the Proctor Creek neighborhood of Atlanta, GA.

Health Impact Assessment Informs Location and Expansion of Green Infrastructure in Proctor Creek

The community surrounding Proctor Creek in Atlanta faces a host of challenges, including pervasive street flooding, repeated sewage backups, derelict properties, illegal tire dumping, and bacterial contamination (e.coli and other fecal coliforms) in the creek itself. Working with the EPA, the community identified solutions to address multiple problems at once.

The City of Atlanta proposed the "Boone Boulevard Green Street Project," which incorporated green infrastructure elements such as permeable pavement, bioretention systems, and planter boxes to reduce stormwater runoff and associated pollution. In 2015, EPA researchers completed a Health Impact Assessment (HIA) of this green street project and shared the report with the City of Atlanta. The HIA results concluded that the green street was effective in improving human health in the communities adjacent to the

green street.   The HIA also included recommendations to the City of Atlanta to maximize the public health benefits of the project. As a result of these findings, the City of Atlanta has decided to double the length of the green street. Additionally, city officials and community members are working with EPA to complete a second HIA to identify additional locations for green infrastructure that maximize benefits to public health.

Tribal Science Supports Community Health and Sustainability

The Tribal-specific Health Index (previous story) is just one of many examples of how Agency researchers work for healthy and sustainable Native American and Alaskan communities. Working closely with the EPA-Tribal Science Council (composed of tribal representatives from each of EPA's nine regions across the country), they develop decision-support tools that incorporate traditional environmental knowledge with environmental, cultural, and health data. For example, one recently developed tool is the Tribal-Focused Environmental Risk and Sustainability Tool (Tribal-FERST), a web-based, geospatial resource developed specifically for federally recognized tribes.

Another major result of such collaboration is the 2014 report *Tribal Ecosystem Research Program Workshop, Proper Functioning Condition (PFC) Assessment for Management and Monitoring*. It presents results and recommendations from a gathering where participants worked to fuse traditional environmental knowledge with environmental science to advance ecosystem sustainability and resiliency, especially for streams and wetland riparian areas. Such areas are key considerations for meeting tapping ecosystem services to sustain tribal nutritional, cultural, societal, and economic needs

Ecosystem Services Research for Tampa Bay

Agency scientists have partnered with local governments, other research entities, planning organizations, and citizen and business groups to identify and assess the values the Tampa Bay estuary and other local environments provide to the surrounding community. Together, these experts and stakeholders are helping identify environmental information that decision makers can use when establishing plans to guide development and land use in the area.

For example, as part of the overall project, in 2012 researchers completed a two-year study of nine mangrove wetlands and 18 freshwater river and marsh sites, each with differing levels of human disturbance. The final demonstration results were delivered in the form of a website that provides robust, community-based mapping and visualization tools for exploring the impact of development on 8-key ecosystem services. This dynamic model illuminates how disturbances to such wetlands affect associated ecosystem services such as absorbing excess nutrients, a key factor related to water quality across the Tampa Bay and many other watersheds.

Revitalizing Great Lakes Coastal Communities

Throughout the Great Lakes region, EPA and local partners are working to restore and enhance previously degraded areas ("Areas of Concern") to improve conditions for coastal communities. Traditionally, this work has unfolded as focused, site-specific activities with little coordination. To help change for the better, EPA researchers and colleagues from the Agency's Great Lakes National Program Office brought experts from across the area, including partners from the Great Lakes Commission, the U.S. Geological Survey, and state Sea Grant programs, to share success stories and further coordinate efforts to benefit local communities.

Results of the workshop were summarized in the report, *Past Successes, New Approaches and Emerging Needs for Remediation to Revitalization (R2R2R) projects: How Great Lakes Communities Benefit from Area of Concern (AOC) Delisting*. The researchers noted existing opportunities and future ways that the results of their work could support activities that improve economic, public health, and societal well-being for Great Lakes coastal communities. These include advancing geographic-based understandings of "ecosystem goods and services," developing measurable revitalization indicators, and sharing examples of success with workshop participants and others.

Tribal-specific Health Index

To extend the reach of EPA's Human Well-being Index, EPA-supported researchers are developing a set of indigenous health indicators to evaluate aspects of community health that are often left out of health impact assessments.

The indicator set encompasses community health priorities such as self-determination, natural resources security, and cultural use and practice. The indicators can be tailored to individual tribal communities and may be useful for a number of purposes, including baseline community health assessments, climate change impact assessments and planning, natural resource damage assessments, and health risk analyses.

Supporting World-class Research for Sustainable and Healthy Communities

EPA supports some of the nation's leading researchers to conduct focused studies that address local science needs and advance sustainable solutions to today's more pressing environmental and human health challenges. A major priority is to support and facilitate robust, science-based decisions by Agency partners, such as regional and program offices, public health officials, tribes, and

environmental managers. Research grants announced during 2014 follow.

Protecting Children's Health for a Lifetime

EPA and National Institute of Environmental Health Sciences (NIEHS) have worked together for more than 15 years to protect some of our most vulnerable citizens—children—through the EPA/NIEHS Children's Environmental Health and Disease Prevention Research Centers program. Since its establishment, more than 20 multidisciplinary Children's Centers have received grants to engage leading scientists, pediatricians, epidemiologists, other research specialists, and local community representatives to reduce children's health risks, protect them from environmental threats, and promote health and well-being in the communities where children live, learn, and play.

Throughout 2015, Children's Centers researchers continued to add to a foundation of research they have built that is now represented in more than 1000 peer-reviewed journals. Examples include a study conducted by [Name of Center(s) to come], showing that [example to come]. Such results have led to innovative thinking about how to understand and address children's environmental health issues in ways that enable caregivers and health professionals to prevent adverse health effects. The Children's Centers program is an exemplary model of how collaborative, interagency federal research support can effectively improve community and public health for children and other vulnerable groups for real-world, positive impact.

When Students Compete for Sustainability, Everybody Wins!

On October 15, 2014, EPA announced Phase I winners of its People, Prosperity, and the Planet (P3) sustainability competition. Established in 2004, the two-phase competition is focused on supporting innovative designs that benefit people, promote prosperity, and protect the planet. Each of the 42 Phase I teams, made up of students and their faculty advisors, were awarded up to $15,000 and invited to showcase their prototypes at the National Sustainable Design Expo in Washington, DC.

At the National Design Expo, teams compete to move on to Phase II, which includes EPA's coveted "P3 Award" and up to $90,000 in additional support to further develop their design and potentially bring it to the marketplace. Previous P3 Awardees have used their winning ideas to establish small businesses and non-profit organizations. For example, Environmental Fuel Research, a 2008 P3 winner from Drexel University, incorporated their grease waste-trap biofuel technology into a business enterprise and won a $100,000 EPA Small Business Innovation Research Phase I award (See "Sparking Economic Growth Through EPA's Small Business Innovation Research Program" below). This woman-owned startup, headquartered in a historically underutilized business zone, has the potential to revolutionize domestic biodiesel capacity in the United States.

2014 EPA P3 Winners (Phase II)

Institution(s)	Project Title	Project Summary
Cornell University Johns Hopkins University	"Smart" Turbidimeters for Remote Monitoring of Water Quality	Cornell University and Johns Hopkins University's Water Quality team has designed a low-cost monitor for measuring water quality.
mbry-Riddle Aeronautical University	Develop a Concentrated Solar Power-based Thermal Cooling System via Simulation and Experimental Studies	Embry-Riddle Aeronautical University's team demonstrates an innovative air conditioning system that runs on solar power.
Iowa State University	Developing Sustainable Products Using Renewable Cellulose Fiber and Biopolymer Composites	Iowa State University's team is designing a new kind of fabric made with fibers from bacteria and yeast grown in tea and polymers (large molecules) of corn and soy.
Purdue University	Biowall's Impact on Indoor Air Quality and Energy	Purdue University's team is studying how to improve indoor air quality by installing plants in a home's HVAC system.
SUNY Stony Brook	Ocean Wave Energy Harvester with a Novel Power Takeoff Mechanism	SUNY Stony Brook's team has designed and built Poseidon, an ocean energy harvester that infinitely converts wave motion into electrical energy.
University of Tennessee, Knoxville	Green Oak as a Sustainable Building Material	University of Tennessee Knoxville's green building team is exploring ways to use green oak or "heart centers," the low quality part of hardwood logs, in U.S. building construction.
University of Wisconsin-Madison	Exchange Network for Expanded Polystyrene Bio-Shipping Containers	University of Wisconsin-Madison's team has implemented a campus recycling program for Styrofoam packaging.

For a complete list of current and previous Phase I and P3 Award winners, as well as information on applying for future P3 sustainability competitions, please see: www.epa.gov/ncer/p3/index.html.

Environmentally-friendly packaging made by a former EPA-supported small business.

Sparking Economic Growth Through EPA's Small Business Innovation Research Program

EPA is one of 11 federal agencies in the Small business Innovation Research (SBIR) program, established by the Small Business Innovation Development Act of 1982. The Agency's participation is focused on supporting and facilitating the development of new technologies with potential to solve priority environmental problems while also sparking economic growth.

In 2014, EPA awarded 21 small businesses with "proof of concept" contracts (Phase I) totaling $2 million to conduct research on the scientific merit and technical feasibility of new technologies, including three businesses founded by members of winning teams from EPA's People, Prosperity and the Planet (P3) Student Competition for Sustainability (see previous story). Many of the SBIR recipient companies go on to leverage EPA's funding to bring their designs to reality, expand business, and create products that help protect human health and the environment. For example, ten years after winning its first SBIR contract, NanoMech won the Small Business Association's

2014 Tibbetts Award for its chemical-free, nanostructured coating used for industrial cutting and lubrication.

Summary of 2104 EPA Small Business Innovative Research Contract Awards

Small Business	Technology Proposal	Contract
AquaNano LLC	Next Generation of High-Capacity Perchlorate-Selective Resins for Drinking Groundwater Treatment	$100,000
Aspen Products Group, Inc.	High Flux Nanofiltration Membrane for Emerging Contaminant Control	$100,000
Biopico Systems	Environmental Sensing System Enhanced With Nested Concentrating Electrodes (ESSENCE) for Safe and Sustainable Water Resources	$100,000
CLEW	Development of a Cost-effective, Nutrient-removal, Onsite Household Wastewater Treatment System for Environmentally Fragile Areas	$100,000
Enchem Engineering, Inc.	Enhanced Decontamination of Wetted Pipe Material	$99,920
Environmental Fuel Research, LLC*	Biofuel Production From Grease Trap Waste	$100,000
ETSVP-JV	Innovative Filters Using Nanomaterials for Removal of Gaseous Pollutants and Particulates from Contaminated Air Streams	$99,902
HJ3 Composite Technologies, LLC	Green Materials for Doubling the Life of Drinking Water Pipeline	$99,693
Grow Plastics, LLC	Process Development for Sandwich Core Structure PLA Thermoformed Objects	$98,812
Lucid Design Group, Inc.*	Software Framework for Enabling Innovation in Behavior-based Energy Conservation in Commercial Buildings	$99,584
MesoCoat	Development of Zinc Coatings on Steel by Cermaclad^{TM} to Replace Pickling Lines	$99,939
MetaMateria Technologies, LLC	Phosphorus Removal and Recovery From Municipal Wastewater Using Nano-Enhanced Media	$100,000
NEI Corporation	Lithium-ion Batteries Based on Aqueous Electrolyte: A New Generation of Sustainable Energy Storage Devices	$99,992
N5 Sensors, Inc.	Low-power, Small Form-factor Benzene Sensor for Mobile Devices-based Exposure Monitoring	$99,191
Precision Combustion, Inc.	Low-Cost, Regenerable Air Filter for Efficient Gaseous Pollutants Removal	$99,897
Reactive Innovations, LLC	Micro Channel Electrochemical Production of Dimethyl Carbonate	$99,999
SimpleWater*	ECAR- Electrochemical Arsenic Remediation for Affordable Water Security in America	$100,000

Small Business	Technology Proposal	Contract Award
Sustainable Bioproducts, LLC	Direct Conversion of Municipal and Agricultural Wastes to Biodiesel and Ethanol Utilizing a Unique Extremophilic Fungus	$99,944
UltraCell Insulation, LLC	UltraCell - Advanced Cellulose Insulation	$100,000
United Science, LLC	Field Deployable PFCs Sensors for Contaminated Soil Screening	$100,000
Vista Photonics, Inc.	Inexpensive High Performance Continuous Ammonia Monitor	$100,000

Previous EPA P3 Award Winner

Environmental Health Research Grants for Tribal Communities

In July 2014, EPA awarded $5 million in grants to six groups, including universities and tribes, to identify and reduce health risks associated with tribes' reliance on natural resources. Collectively, funded researchers will investigate specific, tribal-focused health risks linked to climate change, indoor wood smoke exposure, environmental asthma, waterborne diseases, and other unique tribal concerns, as well as work to find the most efficient methods of avoiding or addressing these risks.

The grants continue support provided over the past decade for impactful research that has helped tribes address health risks. For example, the funding has resulted in the creation of fish advisory maps that have helped various tribal fishing communities avoid mercury and other contaminant-laden fish. The funding has also led the states of Washington and Oregon to revise their water-quality standards to offer greater protection. In addition, a library of resources in the Mohawk language was created to enhance education about toxic substances and empower the community to protect the health of its citizens.

Grant Recipient	Research
Alaska Native Tribal Health Consortium, Anchorage, Alaska	Assess, monitor, and adapt to threats to the sustainability of food and water in remote Alaska native villages.
Swinomish Indian Tribal Community, La Conner, Washington	Examine coastal climate impacts to traditional foods, cultural sites, and tribal community health and well-being.
Yurok Tribe, Klamath, California	Identify, assess, and adapt to climate change impacts to Yurok water and aquatic resources, food security and tribal health.
Little Big Horn College, Crow Agency, Montana	Research climate change adaptation and waterborne disease prevention on the Crow Reservation.
University of Tulsa, Oklahoma	Improve indoor air quality and reduce environmental asthma triggers in tribal homes and schools.
University of Massachusetts, Amherst	Measure indoor air quality in tents as related to wood smoke exposures and identify potential health risks in remote communities in North America