

U.S. Department of the Interior

Annual Report on Technology Transfer

FY 2014 Activities

January 2015

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I. Introduction

Technology transfer for the Department of the Interior (Department) includes a range of activities designed to disseminate scientific and technical information and knowledge between the Department and other Federal and non-Federal entities. It includes but is not limited to publications, exchange of scientific and technical information, protecting and licensing intellectual property rights, and sharing — or otherwise making available — for scientific or technical purposes the expertise and specialized scientific material and resources which the Department manages. In general, technology transfer activities within the Department are consistent with its mission to protect and manage the Nation's natural resources and cultural heritage; to make available scientific and other information about those resources; to honor trust responsibilities to Tribes; and to supply energy for the future.

This report describes the actions the Department took in FY 2014 to advance technology transfer. These range from developing and distributing new technologies to provide earthquake early warning alerts to developing systems to help reduce collisions between birds and man-made objects to testing new coatings technologies to protect water infrastructure from invasive mussels. It also describes progress on meeting the objectives of the Department's Technology Transfer Plan, submitted to the Office of Management and Budget, to advance its technology transfer activities. These activities demonstrate the innovation, expertise and dedication of the Department's employees, including its many scientists and engineers.

II. Advancing Technology Transfer in the Department of the Interior

The FY 2014 enacted budget for the Department of the Interior included \$828.4 million for research and development. Much of the funding was for applied research (\$665.7 million), while basic research and development received \$52.2 million and \$110.5 million, respectively. The programs supported through these funds generate large amounts of knowledge, information, and technology, which help the Department meet its mission objectives and are transferred to resource managers, stakeholders, and the general public.

The Department's bureaus have varying levels of involvement with scientific and technical research and innovation, and technology transfer. In FY 2014, as in previous years, the majority of technology transfer activities being reported by the Department under the Federal Technology Transfer Act of 1986 (FTTA) was undertaken by the U.S. Geological Survey (USGS). It is the largest research and development (R&D) organization within the Department, both in terms of budget and personnel, and typically accounts for almost 80% of the Department's R&D budget.

The Department's scientists, engineers and other technical personnel advance the state of knowledge related to the Department's resources, and ensure that this information is accessible to resource managers, private industry, and the general public. The vast majority of the Department's technology transfer activities use traditional technology transfer mechanisms such as publications of peer reviewed papers and reports, webpage postings, fact sheets, and presentations at meetings and conferences. In 2014, USGS and U.S. Fish and Wildlife Service

(FWS) personnel, for example, authored or co-authored over 7,500 reports, books, fact sheets, and other publications, including over 2,200 scientific journal articles. Bureaus also use other conventional approaches to share scientific and technical resources and expertise with each other, universities and other entities to address resource management issues. For example, six bureaus are active participants in the network of Cooperative Ecosystem Studies Units (CESUs), a collaboration among 358 partners, including 14 Federal agencies and over 300 non-Federal partners (including universities, Tribes and tribal organizations, State agencies, museums, aquariums, arboretums, and conservation organizations) organized into 17 CESUs, each hosted by a university.

Bureaus that are active in research and development, or have research capabilities that complement U.S. commercial interests, may also utilize technology transfer agreements authorized by the FTTA to join forces with non-Federal partners. Such agreements allow the Department's bureaus and private sector industries to pool their expertise and resources to jointly create and advance technologies that could help fulfill agency missions while helping U.S. industries innovate and commercialize technologies that can strengthen our national economy and create jobs. This report focuses primarily on the aspects of technology transfer related to the FTTA.

FY 2014 Accomplishments

In FY 2014, the Department continued to build on actions initiated in FY 2011, to institutionalize technology transfer programs within the Department and to enable all bureaus to more effectively and efficiently implement the FTTA and related legislation while maintaining focus on their missions. These actions included:

- Adoption of the new Departmental Manual chapter establishing policy and procedures for implementing and administering technology transfer agreements.
- Development of a technology transfer website to provide information on relevant bureau programs and activities, as well as opportunities for other agencies, and private and non-profit institutions to cooperate with the Department's scientists, engineers and technical personnel. The website will be updated, as necessary.
- Issuance of the National Park Service (NPS) benefits-sharing policy on December 19, 2013, and the benefits-sharing handbook on September 29, 2014.
- Initiation of the development of policy and procedural guidance for offering and administering prize challenges and competitions, following intense interest within bureaus to use prize competition authority under the America COMPETES Reauthorization Act of 2010 to advance innovations to fulfill mission goals.

In addition, the Department's scientific, technical and engineering personnel engaged in a broad range of cooperative activities to develop and disseminate innovative technologies, including:

- Publishing over 7,500 reports, books, papers, fact sheets, and other publications.

- Collaborating on 601 Cooperative Research & Development Agreements (CRADAs), of which 422 were new that fiscal year. In addition, the Department was engaged in at least 292 other collaborative R&D relationships.
- Disclosure of five new inventions. In addition, three (3) patents were filed and two (2) patents were received.
- Managing 15 licenses for inventions and other intellectual property earning over \$58,000.

Departmental Plan on Technology Transfer

In response to a Presidential Memorandum, the Department submitted a plan in 2012 that committed to a set of actions that would advance technology transfer activities within the Department. The following summarizes these commitments, and the progress toward fulfilling them:

- The Departmental Manual chapter specifying general policies for implementing technology transfer (TT) activities authorized by the FTTA, and related legislation, has been developed and adopted (Completed: May 2014).
- Revising the current DM chapter on patents and inventions which dates to the 1980s. Work on this is proceeding.
- The Departmental Working Group on Technology Transfer (DWGTT) has developed and implemented a unified website to improve public access to information related to inventions owned by the various bureaus, and other technology transfer activities (Completed: June 2014). The technology transfer web site can be accessed at <http://www.doi.gov/techtransfer/>, and will be updated, as necessary.
- The DWGTT has developed an online repository of documents and legal templates detailing best practices for TT agreements and activities from across the government and other organizations that can be accessed via the DOI technology transfer home page (Completed: June 2014) .
- The Department has institutionalized the process for developing and submitting annual reports to OMB on its technology transfer activities. The current report is the fourth consecutive one produced using this process. Past reports can be accessed at <http://www.doi.gov/techtransfer/annual-reports.cfm>.
- Links to a variety of training resources related to technology transfer are available via the technology transfer home page (Completed: June 2014). These links will be supplemented by additional resources as they become available. The Department's Ethics Office has developed materials specific to technology transfer for DOI employees in 2014.

IV. Technology Transfer Agreements

Table 2 provides a summary of new and active technology transfer agreements undertaken within the Department in FY 2014. There were a total of 601 active CRADAs in FY 2014, of which 422 were newly executed. In addition there were 292 other collaborative R&D arrangements with various parties, including 112 that were new in FY 2014.

	USGS	FWS	BLM	Reclam -ation	Total
• CRADAs, total active in the FY ⁽¹⁾	587	4	0	10	601
- New, executed in the FY	418	0	0	4	422
▪ Traditional CRADAs, ⁽²⁾ total active in the FY	27	4	0	4	35
- New, executed in the FY	10	0	0	1	11
▪ Non-traditional CRADAs, ⁽³⁾ total active in FY	560	0	0	6	566
- New, executed in the FY	408	0	0	3	411
• Other collaborative R&D relationships ⁴					
▪ (Collaborative Agreements), total active in the FY	290	n/a	1	1	292
- New, executed in the FY	110	n/a	1	1	112

CRADA = Cooperative Research and Development Agreement

(1) "Active" = legally in force at any time during the FY. "Total active" is comprehensive of all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partner.

(3) CRADAs used for special purposes -- such as, material transfer or technical assistance that may result in protected information. For USGS, Technical Assistance Agreements (TAA) and Facility Use/Service Agreement (FUSA) fit this category.

(4) Based on available data.

Table 3 summarizes invention and patenting activity within the Department during FY 2014 broken out by bureau. This activity was limited to USGS and Reclamation. The table indicates that five new inventions were disclosed, three new patent applications were filed and two new patents were issued.

Table 3: Invention Disclosure and Patenting (FY 2014)

	USGS	Reclamation	Total
• New inventions disclosed in the FY ⁽¹⁾	4	1	5
• Patent applications filed in the FY ⁽²⁾	3	0	3
• Patents issued in the FY	2	0	2

(1) Inventions arising at the bureau.

(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and Patent Cooperation Treaty (PCT) applications.

Specifically, USGS filed patent applications for a method to degrade the toxin microcystin in a cyanobacteria slurry which would enable a portion to be used as an animal feed additive or diet supplement; a well structure for providing drinking water; and a method to help improve the accuracy of measurements of soil shrinkage due to daily evapotranspiration cycles. In addition, patents were issued to USGS for a device to monitor and record movement of animals through an aquatic animal passage system, regardless of water turbidity; and a spectral method for determining the source of expanded vermiculite insulation in attics and walls.

Table 4 provides a summary of the number of active licenses managed by The Department bureaus.

Table 4: Active and Income Bearing Licenses in FY 2014

	USGS	FWS	Reclamation	Total
• All licenses , number, total active in the FY	13	0	2	15
▫ New, executed in the FY	0	0	0	0
• Income bearing licenses	12	0	2	14

Additional data are contained in the Data Appendix to this report. These show that total income in FY 2014 from all licenses amounted to over \$58,248 (from 14 income bearing licenses).

Table 5 provides a summary of the scope and nature of technology transfer activities and mechanisms that the various bureaus implement currently or might implement in the future.

Table 5: Scope of Activities and Plans Related to the FTTA, by Bureau

Mission	Technology Transfer
<p>United States Geological Survey (USGS). The mission of the USGS is to serve the Nation by providing reliable scientific information to describe and understand the Earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect our quality of life.</p>	<p>The USGS serves the Nation as an independent fact-finding agency that collects, monitors and analyzes scientific and technical information to provide scientific understanding about natural resource conditions, issues, and problems. The USGS makes this information and knowledge readily available to decision makers and the public. Thus, one of the USGS's main thrusts is broad and open dissemination of its knowledge and information. USGS also pursues technology transfer opportunities under the FTTA and the Stevenson-Wydler Act in a variety of ways (see Table 1).</p>
<p>U.S. Fish & Wildlife Service (FWS). The mission of the U.S. Fish & Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.</p>	<p>FWS's Research and Development (R&D) is primarily focused on providing the basis for effective conservation in order to meet its mission. The agency's primary research nexus with the private sector centers on the Fisheries Program. FWS Fish Technology Centers were established in 1965 to develop and improve fish culture technology and to provide assistance to Federal and State agencies, Tribes and other nations interested in aquaculture research and solutions. Today there are seven such centers working with industry and government to improve aquaculture opportunities.</p>
<p>Office of Surface Mining Reclamation and Enforcement (OSMRE). OSMRE helps States develop and implement their own approved surface coal mining programs.</p>	<p>OSMRE advances its mission by providing technical assistance based on sound science, and training to its State and tribal partners to enhance their ability to maintain effective programs. Although OSMRE has no formal research and development activities, its Technology Development and Transfer program promotes and disseminates information on technological innovations to better protect the environment during mining and in reclaiming and restoring active and abandoned mines. The program also provides training to ensure that States, Tribes, and OSMRE's other partners continue to administer their surface mining programs efficiently and effectively.</p>
<p>National Park Service (NPS). The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of current and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.</p>	<p>Consistent with the Final Benefits-Sharing Environmental Impact Statement (2009) and the Record of Decision (2010), the National Park Service issued its benefits-sharing policy and procedural guidance (available at http://www.nps.gov/applications/npspolicy/DOrders.cfm). Benefits sharing occurs when NPS receives monetary or non-monetary benefits from the commercial use of a discovery or invention resulting from research originating under an NPS Scientific Research and Collecting Permit,</p>

Table 5: Scope of Activities and Plans Related to the FTTA, by Bureau

Mission	Technology Transfer
	or other NPS permit or authorization. The benefits-sharing policy and guidance address technology transfer and employee inventions. Authorities under the FTTA are essential to the NPS benefits-sharing program.
Bureau of Safety and Environmental Enforcement (BSEE). The BSEE works to promote safety, protect the environment, and conserve resources offshore through vigorous regulatory oversight and enforcement.	The BSEE R&D program operates through the Emerging Technologies Branch (ETB) and the Oil Spill Response Research (OSRR) Branch. BSEE research is associated with operational safety, pollution prevention, and oil spill cleanup techniques and technologies.
Bureau of Reclamation (Reclamation). The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.	Reclamation has the lead Federal responsibility for water management and hydropower in the 17 Western States. Its research program is highly applied towards development of solutions that benefit its operations and infrastructure reliability. The research programs use technology transfer fundamentals to help speed field deployment of new innovations.
Bureau of Ocean Energy Management (BOEM). The Bureau of Ocean Energy Management manages the exploration and development of the Nation's offshore resources. It seeks to appropriately balance economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.	BOEM's Environmental Studies Program (ESP) develops, conducts and oversees scientific research specifically to inform policy decisions regarding development of Outer Continental Shelf (OCS) energy and mineral resources. Research covers physical oceanography, atmospheric sciences, biology, protected species, social sciences, economics, submerged cultural resources and environmental fates and effects.
Bureau of Land Management (BLM). The BLM mission is to sustain the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future generations. The Federal Land Policy and Management Act of 1976 (FLPMA) mandates that the BLM manage public land resources for a variety of uses, such as energy development, livestock grazing, recreation, and timber harvesting, while protecting natural, cultural, and historical resources.	BLM's science and technical focus has been on place-based applications to improve the management of public lands in accordance with FLPMA's multiple use mandate. In addition to its traditional technological transfer activities, BLM is exploring additional technology transfer opportunities under 15 U.S.C. 3710 and U.S.C. 205 and 207 that could be employed to help advance its multiple-use mandate and which can be used in the landscape approach as the BLM transitions to ecoregional-area land management.

Subsequent sections briefly describe each bureau's technology transfer program and a sample of their activities in FY 2014. The tabular data requested by OMB Circular A-11 are reported in the Data Appendix, to the extent data are available.

V. U.S. Geological Survey

The United States Geological Survey (USGS) is a scientific bureau within the Department of the Interior whose mission is to serve the Nation by providing reliable scientific information to describe and understand the Earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect our quality of life. Under its science strategy outlined in “Facing Tomorrow’s Challenges—U.S. Geological Survey Science in the Decade 2007-2017,” USGS focuses on the following interdisciplinary mission areas: Ecosystems; Climate and Land Use Change; Energy, Minerals, and Environmental Health; Natural Hazards; Water Resources; Core Science Systems; Administration and Enterprise Information; and Facilities. These mission areas combine expertise from several Earth Science disciplines (e.g. hydrology, geochemistry, biology) working together to address relevant issues of concern to people and other living things on the planet. Organization around these mission areas allows the USGS to better address the needs of customers and partners.

Since delivery of science information is a primary purpose of the bureau, technology transfer activities with the public and private sectors, including academia and non-profits, typically support the collection and transference of scientific data (knowledge dissemination). In FY 2014, for example, USGS personnel authored or co-authored over 7,300 reports, books, fact sheets, and other publications and information products, including over 2,040 scientific journal articles, 930 USGS Series scientific publications, and 3,270 abstracts. The USGS also cooperates with its public and private collaborators to help them maintain necessary services, better understand the environmental consequences of their commercial and non-commercial activities, and develop new products and services. The USGS has 35 major laboratories and several hundred field offices located around the country.

Within the USGS, technology transfer that extends beyond traditional publications, meetings and conferences and is related to the Stevenson-Wydler Innovation Act and the FTTA is managed through the Office of Policy and Analysis (OPA) where staff service USGS Science Centers and offices throughout the country. In 2014, the USGS continued negotiating and drafting Cooperative Research and Development Agreements (CRADAs), Technical Assistance Agreements, Facility Use Agreements, Material Transfer Agreements, and Patent Licenses. This office also manages the USGS intellectual property and inventions program; marketing USGS technology opportunities and facilitating partnerships with industry, non-profits, academic institutions, Tribal nations, and State agencies. OPA also provides training to USGS personnel on technology transfer and intellectual property matters. In 2014, USGS managed a total of thirteen (13) active patent licenses. During 2014, USGS filed three (3) patent applications, and received two (2) patents.

USGS science and research contributes to a broad range of valuable collaborative projects in the private and academic sector. Since the implementation of its facility use program in 2003, the USGS has increased to twenty eight (28) the number of specialty analytical laboratory services providing unique capabilities to U.S., foreign, and academic partners that can be made available through the USGS Facility Use program. Examples include:

- The Tephrochronology (Tephra) Project and Laboratory, which conducts unique analyses, compilations and interpretation of volcanic ash layers in the western United States. [Tephrochronology is the study of volcanic ash deposits, combining petrology, geochemistry, and isotopic dating methods.] The project's database includes temporal and spatial distribution of the volcanic ash layers and provides an understanding of the geological evolution over time of the western and Pacific margin region in the U.S.
- The Optically Stimulated Luminescence (OSL) Dating Laboratory conducts a form of geochronology that measures the energy of photons being released to determine how long ago minerals were last exposed to daylight. The applications of luminescence data include: paleoclimatology, tectonic and seismology research, archeology, paleoenvironmental studies, geomorphology and environmental process studies. This laboratory specializes in all geological applications and performs sample preparation, data generation and interpretation of the analyses, with published results mostly on the western region of the U.S.

USGS executed two hundred twenty five (225) new user agreements during 2014.

The following are examples of current USGS technology transfer activities.

Safe, Directional, Drought-Resistant Dug Well. USGS has filed a patent on a new type of well invented by hydrologist Joseph Ayotte that would improve the safety of drinking water for private well users. In northern New England, water from private wells drilled into bedrock often contains naturally occurring contaminants, such as arsenic, at concentrations that exceed the USEPA maximum contaminant level (MCL) for drinking water. Residents who use drilled bedrock wells may find that they require expensive treatment to reduce exposure to arsenic; however, many people do not treat well water or, if they do, treat or maintain their systems incorrectly. The shallow glacial aquifer can provide a safe alternate water source; however, traditionally designed dug wells constructed in these sediments frequently have low yields and are susceptible to bacterial contamination.

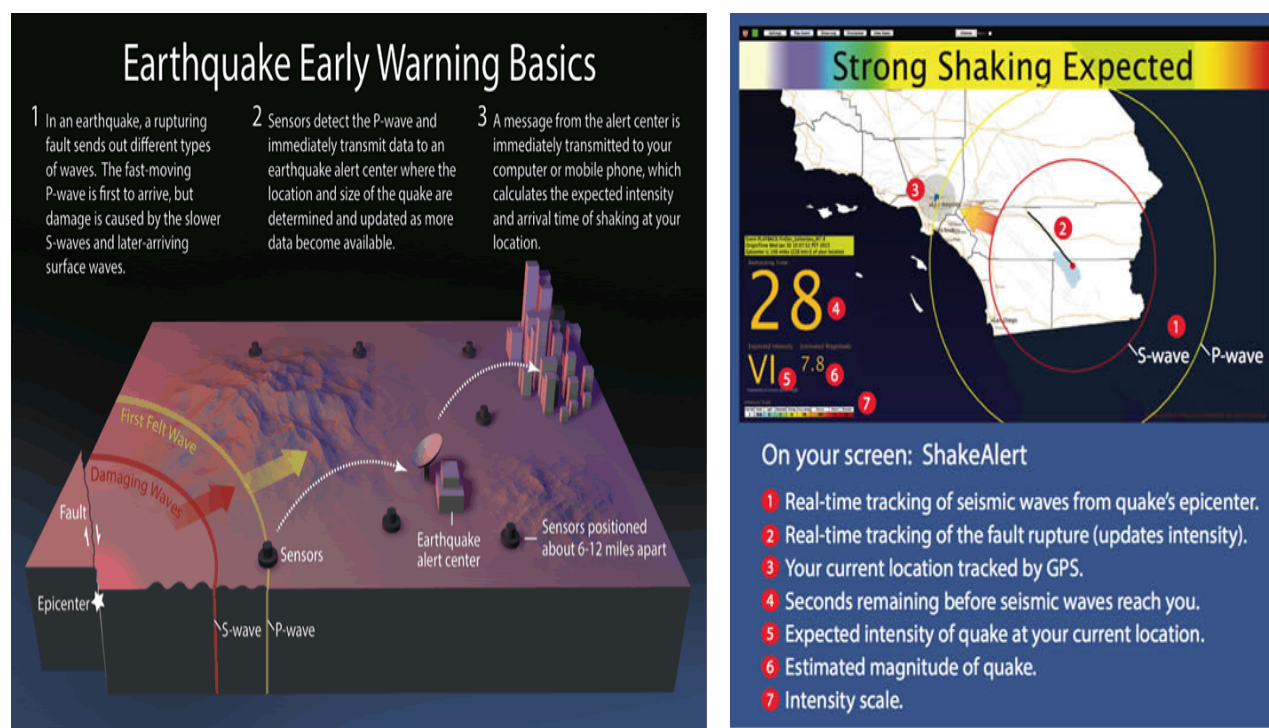
The new type of dug well designed by Mr. Ayotte has the potential to provide water without high arsenic while also providing higher yields and protection from bacterial contamination. The well uses a trench filled with crushed stone, constructed in glacial sediment, in which a 6-inch diameter (potable-water grade PVC) well casing with horizontal collectors is installed. The constructed aquifer is capped by an impermeable geotextile fabric and is covered with low-permeability materials to prevent bacterial contamination. The large volume of water that can collect in the constructed aquifer (within the natural aquifer), along with the large vertical area through which groundwater can flow in to the well, provides a much greater well yield than traditional dug wells, while maintaining sanitary conditions. Because the groundwater is at shallow depths, it is generally well oxygenated and slightly acidic, which inhibits mobilization of arsenic into the water. This invention also virtually eliminates typical bacteriological contaminants found in traditional New England wells.

Seconds Matter — Earthquake Early Warning System. Earthquakes pose a national challenge because 75 million Americans live in areas of significant seismic risk across 39 states. Most of our Nation's earthquake risk is concentrated on the West Coast of the United States. In the next 30 years, California has an estimated 99.7 percent chance of a magnitude 6.7 or larger

earthquake. Today, the technology exists to detect earthquakes so quickly that an alert can reach some areas before strong shaking arrives.

Seconds matter in earthquake safety. Advance warnings of 20 to 40 seconds can give enough time to slow and stop trains and taxiing planes, to prevent cars from entering bridges and tunnels, to move away from dangerous machines or chemicals in work environments and to take cover under a desk, or to automatically shut down and isolate industrial systems. Taking such actions before shaking starts can reduce damage and casualties during an earthquake. It can also prevent cascading failures in the aftermath of an event. For example, isolating utilities before shaking starts can reduce the number of fire initiations.

The principle behind the earthquake early warning system is that information can be sent through electronic communication systems virtually instantaneously, whereas seismic waves travel through the shallow Earth at speeds ranging from one to a few kilometers per second (0.5-3 miles/sec). When an earthquake occurs, both compressional (P) waves and transverse (S) waves radiate outward from the epicenter. The P wave, which travels fastest, trips sensors placed in the landscape, causing alert signals to be sent ahead, giving people and automated electronic systems some time (seconds to minutes) to take precautionary actions before damage can begin with the arrival of the slower but stronger S waves and later-arriving surface waves.



Left: Schematic illustrating the principle behind USGS's ShakeAlert Earthquake Early Warning System. **Right:** Screenshot of a computer screen with an early warning alert sent via the ShakeAlert system. The message is headlined with the intensity of the expected shaking and it displays the number of seconds (28) before arrival of the seismic wave at the computer's location. It also indicates the expected intensity of shaking at that site (VI, or "strong") on a 10-point scale using Roman numerals (X would be strongest wave). The alert also includes a map with the location of the epicenter, the magnitude of the quake, and the current position of the primary (P) and secondary (S) seismic waves. Illustrations: Courtesy — USGS.

USGS, in partnership through a CRADA with Early Warning Labs (EWL) of Santa Monica, CA, is working to distribute earthquake early warning alerts. USGS and EWL researchers aim to improve the distribution of alerts, and initiate automated actions to earthquake early warning alerts using data from the USGS ShakeAlert system.

EWL is developing new technologies and a robust cloud server environment able to handle low cost mass distribution of these warnings. In addition, EWL is researching and developing automated response standards and systems that will allow public and private users to take pre-defined automated actions to protect lives and assets.

As part of its ongoing research, EWL is developing working prototype installations in California to demonstrate its findings in real-life scenarios while allowing the USGS and partners the opportunity to conduct hands-on testing and demonstrations. As a result of this partnership, limited market ready solutions will be available pending partial or full rollout of the ShakeAlert system. These new technologies will provide an alert to the public to prepare for an impending earthquake and allow time for emergency responders to react more quickly.

Development of a System to Reduce Collisions between Birds and Aircraft. USGS has long conducted research involving the movement, survival, and behavior of birds. Bird strikes occur when birds come into contact with moving or fixed objects. Collisions with aircraft, for instance, usually kill the birds while also potentially posing a danger to aircraft and any passengers. In order to minimize such collisions, the USGS Geology, Minerals, Energy and Geophysics Science Center (GMEGSC) is collaborating with Technology International Incorporated of Virginia, a private entity, to develop a bird deterrence method and system. Recent GMEGSC research into avian navigation has shown that birds use naturally occurring infrasonic (low frequency) acoustic signals within the atmosphere below the range of human hearing (<20 Hz) for determining the direction and, possibly, distance of their navigational goal. The objective of the CRADA project is to develop a cost effective system for repelling birds from areas around aircraft and other high value targets in order to eliminate any potential for aircraft or facility damage. This will be accomplished by producing an infrasonic beam within the target area that would repel birds by either jamming their navigational signal, or by producing a sound pressure level high enough to cause discomfort and avoidance. The infrasound frequency and intensity should be at levels that preclude harm to the birds (or humans). In addition, the infrasound frequency range should not interfere with any current operational aircraft or ground-based sensor systems. Although the primary purpose of the system is collision avoidance between aircraft and birds during daily flight operations without impacting mission requirements, the system will also prevent other forms of damage caused by birds nesting and perching in unwanted areas. If the demonstration projects yields positive results, this technique will potentially improve bird and aircraft safety.

Reducing Bat Fatalities from Wind Turbines. Prior to the late 1990's, fatal collisions of bats with tall man-made structures such as buildings and communication towers were extremely rare events. Since then a large and growing number of utility scale wind turbines have increased bat fatalities to the point that they could detrimentally impact bat populations. In addition, legally protected species, such as the endangered Indiana bat (*Myotis sodalis*) and the Hawaiian hoary bat (*Lasiurus cinereus semotus*), are also falling victim to turbines. The phenomenon of bat collisions with wind turbines is new and needs to be studied scientifically to help reduce, if not

prevent, such collisions in the future. As part of this effort, in July 2012, scientists from five USGS science centers partnered with industry (BP Alternative Energy) using a Technical Assistance Agreement, and a conservation organization (Bat Conservation International) to conduct a field experiment to test whether bats are attracted to wind turbines. The research involved manipulation of turbine blade speeds, then simultaneously combining and comparing different methods of monitoring bat fatalities (carcass searches) and activity (radar, acoustic monitoring, and video surveillance) among the different blade speeds. This effort included development of a novel video surveillance method using thermal videography for remotely imaging bats and birds flying in the dark at the heights of wind turbines (greater than 30-story buildings).



Left (A): Field technicians conducting fatality searches around wind turbine. **Center (B):** Carcass of hoary bat (*Lasiurus cinereus*) found beneath turbine on bare ground. **Right (C):** Footage from the thermal videography system revealed that bats approach and interact with wind turbines in consistent and predictable ways. Photo credits: Paul Cryan.

Videography revealed that bats more often approached wind turbines high above the ground and from the downwind side when the wind was blowing. This strong pattern strengthened as wind speed increased and when turbine blades were experimentally prevented from turning at full speed, but decreased in high winds when turbine blades spun normally. Bats also appeared at turbines more often during bright moonlit nights. These patterns suggest that bats might follow air currents around tree-like structures and use visual cues at night, but may not be able to tell a tree from a wind turbine with slow or stopped blades. Bats may be more likely to approach turbines when they sense airflow patterns resembling trees, but then might be put at risk if wind speed rapidly increases and pushes turbine blades to speeds faster than bats can perceive or outmaneuver. The new findings may have practical implications toward the goal of reducing or avoiding bat fatalities at wind turbines. By identifying and substantiating the causes of bat mortality, solutions may be developed to reduce bat mortality while minimizing costs to the wind-energy industry.

San Luis Obispo Central Coast Study of Sea Otters. This study is an offshoot of a CRADA originally conceived to undertake research on earthquake hazards along the California coast. The USGS Earthquake Hazards Program, under the auspices of the National Earthquake Hazards Reduction Program, undertakes a broad range of applied earthquake hazards research, data compilation and archiving, and distribution of earthquake information products and services. The Pacific Gas and Electric Company (PG&E), a publicly regulated utility providing

service within California, is engaged in a long-term, multi-element, action-based seismic risk management program to reduce the impact of future earthquakes on the performance of their gas and electric systems, and to maintain acceptable levels of customer service. To further their programs, PG&E and the USGS have been involved in a series of CRADAs since 1992. The PG&E CRADA, which complements the USGS Earthquake Hazards Program, is carried out using the capabilities of five USGS Science Centers (Earthquake, Geology, Minerals, Energy and Geophysics, Pacific Coastal and Marine, California Water, and Geologic Hazards).

Under one of these CRADAs, a team of wildlife biologists from the USGS Western Ecological Research Center is leading a study to improve our understanding of the ecological impact of high energy seismic studies, including their impacts on sea otter population. Sea otters are a federally-listed threatened species that also serve as crucial indicators of the health of near-shore waters and coastal resources, from kelp forests to fisheries. Results from this study will help managers in shaping recovery strategies for sea otters, and for enhancing ecological services provided by near-shore healthy ecosystems.

To date, the team of biologists, technicians, interns and volunteers has recorded more than 10,000 daily re-sights of tagged sea otters, collected data on more than 13,500 foraging dives and completed 57 focal animal behavior monitoring sessions on tagged animals for a total of 680 hours. Preliminary comparisons show that diet diversity and rate of energy gain while feeding in the current study is similar to the results obtained a decade ago. The data obtained suggests a population at equilibrium with food resources.

VI. U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (FWS) is dedicated to the conservation, protection, and enhancement of fish, wildlife and plants, and their habitats. The FWS is the only agency in the Federal Government whose primary responsibility is management of fish and wildlife resources for the American public. The FWS also helps ensure a healthy environment for people by providing opportunities for Americans to enjoy the outdoors and our shared natural heritage. The agency manages the 150 million acres of land and water in the National Wildlife Refuge System which receives over 45 million visitors each year. Those visitors participate in hunting, fishing, wildlife observation and photography, environmental education and interpretation, and other outdoor recreation activities. The FWS also operates 70 National Fish Hatcheries which, in conjunction with Fish Health Centers and Fish Technology Centers of the FWS (see below), restore native aquatic populations, mitigate for fisheries lost as a result of Federal water projects, and support recreational fisheries throughout the United States.

Research and Development (R&D) of the FWS is primarily focused on applying the latest scientific and technical information to fulfill its mission of working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. The majority of the technology advancements of the FWS are transferred through public dissemination. FWS employees are actively involved in the larger scientific community, including participating in scientific societies, participation at scientific meetings and conferences, and generating and publishing scientific research. A high priority of the FWS is sharing our scientific and information via public outreach and partnerships.

The transfer of FWS's technology and knowledge to the public and collaborators accelerates the adoption and use of agency research while improving the economic and societal impact from its R&D investments to help solve natural resource problems. For example, FWS works closely with the aquaculture feed industry to develop sustainable animal feed options that use plant-based ingredients to reduce impacts on animal protein sources, refine our understanding of the nutritional needs of fish and other aquatic wildlife, while minimizing solid waste and aquatic pollution.

FWS also uses its research to help inform a wide range of wildlife management decisions in the interest of the general public. For example, the National Wildlife Refuge Inventory and Monitoring (I&M) Program systematically obtains a range of biological data about the status, trends and management responses of species and habitats within the Refuge System. Those data inform and improve conservation of fish, wildlife, and plant natural resources.

The technology transfer function of the FWS is shared among several FWS programs/divisions including the Division of Science Applications, the Division of Policy and Directives Management (PDM) for patent questions, and the Office of the Solicitor. While the vast majority of FWS's technology transfer is done via dissemination to the public and scientific community through traditional avenues such as peer reviewed papers, reports and fact sheets, the FWS has been issued four patents since 1998. For example, a patent was awarded in 2005 for calcein detection devices developed at the FWS' Northeast Fishery Center in Lamar, PA, for detecting non-invasively-marked hatchery-reared Atlantic salmon for up to three years of age post-marking. Western Chemical (Ferndale, Washington) was granted an exclusive license for that non-invasive marking method for a period of eight years. Other inventions include a rocker/agitator for transportation and storage of fish sperm (e.g., in captive breeding programs of imperiled species), a fistula device to gather eggs from inside a fish, and a method for agglomerating fine powders for larval aquatic feed. The FWS is currently in the process of evaluating a new report of invention.

The FWS manages two online peer reviewed publications focused on the practical application and integration of applied science to wildlife conservation and management—the *Journal of Fish and Wildlife Management* and the *North American Fauna Monograph Series*. These journals are in the public domain and are completely electronic. In addition, the FWS continues to support and encourage its scientists to publish in peer reviewed journals. In FY 2014, FWS personnel published over 250 articles in peer reviewed science journals. Many of those articles are available online via open access journals, while others are available through paid subscription because of publishers' terms of copyright.

National Conservation Training Center. The FWS's National Digital Library, run by the National Conservation Training Center (NCTC) in Shepherdstown, West Virginia, is a searchable collection of selected documents, images, historical artifacts, audio clips, publications, and video, most of which are in the public domain. The collection includes reports, brochures, historic texts, oral history transcripts, and other texts that are integrated with image and video collections as well. The FWS also makes internal publications, reports, and information available to the public through the FWS website which includes links the public can use to access specific publications.

Collections of current and legacy publications are also available online from the NCTC library catalog and websites. NCTC also maintains links to biological and technical publications, as well as additional publications regarding birds, wetlands, fish hatcheries, and National Wildlife Refuges.

NCTC also hosts publicly-accessible webinars dealing with a variety of scientific and technical issues that affect the nation's fish and wildlife resources. Webinars are generally led by distinguished scientists sharing their research, or by fish and wildlife managers describing scientific and technical issues they are addressing for achieving the conservation mission of the FWS. During FY2014, NCTC and the FWS hosted 80 science-technology webinars on topics covering climate change, conservation genetics, conservation biology, habitat restoration, invasive species, and other scientific/technical topics related directly to managing the nation's fish, wildlife and plant resources.

Fisheries and Aquatic Conservation Division. The agency's primary research nexus with the private sector centers on programs and facilities within the Division of Fisheries and Aquatic Conservation (FAC). This division includes a network of Fish Hatcheries, Fish & Wildlife Conservation Offices, Fish Health Centers, Fish Technology Centers, the Conservation Genetics Laboratory in Anchorage, Alaska, and the Aquatic Animal Drug Approval Program. These centers and programs provide assistance and support to conservation partners of the FWS, including Federal, State, tribal, and non-government organizations that cover a broad range of disciplines including biostatistics, population ecology, genetics, nutrition, and fish health and pathology. FWS research entities provide leadership in science and technology, especially for restoration and recovery of native species. The technology centers of the FWS assist fish and wildlife managers with problem solving and new methods for meeting conservation goals and objectives with a focus on rapid turn-around of applied science research to fish and wildlife management.

FWS Aquatic Animal Drug Approval Program. The Aquatic Animal Drug Approval Program within the FAC Division currently has four CRADAs in place. These agreements — with Merck Animal Health (Summit, NJ), Aquatic Life Sciences (Ferndale, WA), Frontier Scientific (Logan, UT), and PennField Animal Health (Omaha, NE) — permit the parties to identify research opportunities that support development of new aquatic animal drugs, broaden the U.S. technology base, and support accomplishment of FWS scientific mission objectives. New aquatic animal drug approvals are critically needed to (a) maintain the health and fitness of aquatic species in a world where challenges are constantly evolving and (b) to provide similar benefits to both public and private sector aquaculture programs throughout the U.S.

Fish Technology Centers. Fish Technology Centers (FTCs) were established in 1965 to develop and improve fish culture technology and provide assistance and advice on fish culture to National Fish Hatcheries, other Federal and State agencies, Tribes, other Nations, and the aquaculture industry. The FTCs developed culture techniques and fish diets now used around the world, including dehydrated long-lasting feeds that revolutionized the fish-culture industry. Today, the FWS's seven FTCs use state of the art laboratory methods and equipment (e.g., automated DNA sequencers) in genetics, physiology, ecology, nutrition, fish pathology, and microbiology to support conservation and management actions for restoration and recovery of fish and other aquatic species. Results of studies conducted by FWS scientists are published in peer-review journals, and management recommendations are communicated within the Service

and to our partners through conservation science partnerships. Following are descriptions of the various FTC laboratories and examples of advances shared through publications and reports in 2014:

- **Nutrition and Diet Development Laboratories.** These facilities allow for the manufacture of experimental larval, fingerling, and broodstock fish feeds and the testing of many different kinds of ingredients to improve fish nutrition, performance and quality. This program also develops specialized diets for use in captive rearing of endangered fish species like woundfin, razorback sucker, June sucker and Rio-Grande silvery minnow. Recent work includes development of plant-based fish feeds to reduce reliance on ocean forage fish for fish feed protein in partnership with public and industry partners. Examples include
 - Advancing Alternative Fish Feeds: Alternative fish feed ingredients are increasingly sought after, due to rising feed costs and the finite availability of wild fish ingredients. Physiologists at the Bozeman Fish Technology Center (MT) assessed the nutritional value and qualities of an emerging new feed ingredient, known as threonine biomass (TBM) as a dietary protein and amino acid source in fish feed. Evaluation of new feed ingredients available to the industry is critical to the production of fish for many purposes including restoration and recovery. Results of this study, shared with USDA and industry partners, are expected to contribute to more cost effective production of fish meal, while maintaining optimal fish health and condition.
 - Advancing Captive Propagation Efficiency: Tilapia is the second most consumed farmed fish after carp and the most widely grown farmed fish. Accordingly, scientists at the Bozeman Fish Technology Center have undertaken several experiments to evaluate dietary protein and energy utilization associated with fish warm water fish feeds. The long-term goal is to optimize warm water fish diet formulations for intensive culture systems in order to improve the economics of fish farming while limiting its demands on other resources, which will benefit both conservation and commercial interests.
- **Conservation Genetics Laboratories.** These laboratories support related conservation and management needs to the FWS and its partners, including, but not limited to: (a) using genetic DNA methods to meet real-time fishery needs to conserve and manage species; (b) assisting with Endangered Species Act status reviews and recovery planning via baseline data on genetic population structures and genetic monitoring and evaluation of listed populations and species; (c) establishing and maintaining genetic tissue/DNA repositories for imperiled species; (d) characterizing diversity within and among wild populations. Example activities include:
 - Science-based Management of Listed Populations: Geneticists at the Southwestern Native Aquatic Resources and Recovery Center (a Fish Technology Center in NM) conducted the first comprehensive population genetic analysis of the threatened Devils River minnow. An enriched microsatellite library (a

database to help identify various genetic markers in DNA)¹, screened clones, and markers were developed for the species.

- Saving Species from Extinction: Scientists at the Warm Springs Fish Technology Center (GA) developed methods to freeze reproductive cells (gametes) of imperiled amphibians and to assess their viability when they are thawed in the field or hatchery. Successful cryopreservation preserves genetic material, provides for the transfer of genes from wild populations to captured stock, and assists in dispersing genetic material among populations in the wild. This tool is especially valuable for depleted populations, to allow gametes to be stored economically until enough samples are available to make appropriate crosses with adequate genetic material. The laboratory is investigating techniques for preserving and thawing reproductive cells for axolotl (the Mexican salamander), an endangered amphibian. This species may serve as a model for other endangered amphibians, and results may help develop field cryopreservation protocols for such species.
- **Conservation Physiology and Ecology Laboratories.** These laboratories focus on understanding the physiological requirements and tolerances of threatened and endangered species. Less-invasive or non-invasive tools, such as measurement of plasma sex steroids and ultrasound, are used to determine gender, stage of sexual maturity, and spawn readiness of individual fish in wild and captive populations of threatened and endangered species. These laboratories also provide contract services which include blood chemistry analysis, histology, proximate analysis, and radioimmunoassays. Their recent accomplishments include developing methods to:
 - Prevent the spread of invasive species. Scientists at the Southwestern Native Aquatic Resources and Recovery Center (a Fish Technology Center in NM) developed a treatment protocol for transport tanks moving fish from mussel-positive waters to ensure 100% mortality of quagga mussel veligers while having a minimal impact on native fish species.
 - Identify factors impacting survival and behavior of larval sturgeon. Understanding the effects of reservoirs on the survival of pallid sturgeon, an endangered species of fish that is endemic to the Missouri and Lower Mississippi River basins of the United States, is critical to the recovery of the species. A study conducted at the Bozeman FTC evaluated larval pallid and shovelnose sturgeon behavior and survival at different stages in controlled environments simulating the river, transition zone, and headwater environments at various temperature and dissolved oxygen regimes and with different substrates.
- **Fish Passage and Screening Laboratories.** These laboratories support research into areas such as open-channel flume and swim tunnels and artificial streams, where researchers can simulate varied stream conditions for addressing a wide variety of

¹ Microsatellites are short segments of DNA with a repeating structure. They tend to occur in non-coding DNA, that is, DNA that is not directly involved in producing proteins.

questions on fish ecology, behavior, and life-history requirements relative to selected environmental factors.



Artificial stream set up, Bozeman Fish Technology Center, Montana. Photo: FWS.

Fish Health Centers. The FWS's Fish Health Centers play an integrated role in applied science and technical transfer. Their scientists are leaders both nationally and internationally in the diagnosis of wildlife diseases and in the science of aquatic animal health, developing and validating tests that benefit, and are adopted by, the aquaculture industry. Fish Health Centers work closely with Federal, State, tribal, academic and NGO partners to promote the scientific management of fisheries and aquaculture by reducing the effects of wildlife pathogens.

Aquatic Invasive Species: The FWS Aquatic Invasive Species program works to prevent transfer and introductions of exotic, introduced, non-native, and other potentially harmful species (e.g., zebra mussels) and to develop early detection and rapid response capabilities. For example, through the Great Lakes Restoration Initiative (GLRI), the FWS is partnering with the University of Notre Dame to develop a surveillance program for invasive species at risk of invading the Great Lakes (e.g., several species of Asian carp). That research has developed methods for detecting minuscule amounts of free-floating DNA (environmental DNA or eDNA) in random water samples obtained from the aquatic environment to confirm the presence (or absence) of carp at levels undetectable by traditional sampling methods. This new and innovative technology is expected to significantly benefit both FWS programs and partners by allowing earlier detections of invasive species.

VII. Office of Surface Mining Reclamation and Enforcement

One of the purposes of the Surface Mining Control and Reclamation Act of 1977 (SMCRA) is to help States develop and implement their own approved surface coal mining programs. The Office of Surface Mining Reclamation and Enforcement (OSMRE) achieves this in part by providing technical assistance based on sound science, and training to its State and Tribal partners to enhance their ability to maintain effective programs.

Although OSMRE has no formal research and development activities, the Technology Development and Transfer program promotes and disseminates information on technological innovations to better protect the environment during mining and in reclaiming and restoring active and abandoned mines. The program also provides training to ensure that States, Tribes, and the bureau's other partners continue to administer their surface mining programs efficiently and effectively.

The principles that underlie OSMRE's Technology Development and Transfer program include: (a) increasing the technical knowledge of the reclamation of active and abandoned coal mines; (b) developing and enhancing working relationships among the bureau's partners in Federal, State, and tribal governments, and in industry and academia; and (c) leveraging its resources through partnerships.

The OSMRE accomplishes these principles via the Technical Innovation and Professional Services (TIPS) program, the National Technical Training Program (NTTP) and the Technical Training program, as elaborate below.

Technical Innovation and Professional Services (TIPS). The goal of TIPS is to provide State, Tribal, and OSMRE personnel with a comprehensive set of analytical tools to aid in technical decision-making related to regulatory and reclamation processes. The services provided are centered on off-the-shelf scientific and engineering computer hardware and software. This technical assistance has grown from a few software applications available on a single specially-designed shared workstation, to a suite of software on each user's desktop computer.

TIPS is a national program that continues to research emerging technologies and their application to SMCRA. A fundamental premise of TIPS is that it enables every official responsible for the implementation and enforcement of SMCRA to use the same technological tools, thereby promoting consistent enforcement of SMCRA nationwide. This also means that personnel enforcing SMCRA can easily exchange data with one another, and since the tools that TIPS provides are predominantly the same as those used by coal mining companies and reclamation contractors, data is easily exchanged between mining and SMCRA officials.

The following are examples activities undertaken by the TIPS program in FY 2014.

GeoMine Web Application: GeoMine is designed to be an interactive web-based digital map of coal mining and reclamation activities in the United States. During FY 2014, GeoMine launched a prototype of this system. It uses a web-based Viewer (GeoMine Viewer) developed by OSMRE in collaboration with the Fish and Wildlife Service (FWS), Environmental Protection Agency (EPA), Army Corps of Engineers (ACE), and coal mining regulatory authorities in Kentucky, Tennessee, Virginia and West Virginia. GeoMine supports the decision-making processes associated with surface coal mining activities by improving accessibility to data, improving the timely delivery of authoritative information, and enhancing understanding of geospatial data at various scales. It should also help mines comply with the requirements of SMCRA, Clean Water Act (CWA) and Endangered Species Act (ESA). When fully deployed, the application will display geospatial data that is already publicly available from each contributing coal-producing State and Tribe nationwide. This would increase transparency and

allow the public to better understand the impact of both coal mining and reclamation activities. The OSMRE also continued updating maps in Kentucky and West Virginia using Americorps, Environmental Stewards (under Americorps) as well as college students. The GeoMine Viewer should be ready for public launch in 2015.

Remote Sensing Pilot Project: The OSMRE Remote Sensing Specialists in the TIPS program have been working since 2009 on a pilot project to “determine the best satellite image data, products, and services that will support effective and efficient SMCRA solutions for the regulatory program.” The project explored the processes and requirements involved in acquiring image data, products and services from the National Geospatial-Intelligence Agency (NGA) Office of Commercial Partnerships through the USGS. The President’s Commercial Remote Sensing Space Policy (CRSSP), signed in 2003 and supported through President Obama’s 2010 National Space Policy, tasked the NGA with sharing satellite imagery with Federal agencies. In 2009, the OSMRE also entered into an official partnership with the NGA through the USGS to assist the goals of this pilot project. OSMRE is working with the Civil Applications Committee (CAC), for which USGS is the co-chair, to obtain satellite imagery. The OSMRE plans to release the Remote Sensing Pilot Project Final Report in 2015.

OSMRE will continue to work with the NGA to further improve products and services for the use of satellite imagery in SMCRA applications. In the interim, TIPS has established an annual imagery purchase process to provide images for mines where OSMRE is the regulatory authority and will assist States on a case-by-case basis.



Oversight of mining activities: At 400 feet above the surface, the T-Hawk, an Unmanned Aerial Vehicle (UAV), captures an image of drainage control ponds constructed at the Hobet 21 surface coal mine complex, near Danville, Boone Co, West Virginia. The complex is operated by Hobet Mining Inc. Photo: OSMRE

ArcGIS Image Server: A result of the Remote Sensing Pilot Project was that in FY 2014, the OSMRE deployed the ArcGIS Image Extension for Server (ArcGIS Image Server) for internal testing and loading of satellite images. In FY 2015, the ArcGIS Image Server will be used to deliver over 4 Terabytes of imagery into the hands of TIPS SMCRA program customers in an efficient and effective manner. TIPS users will be able to connect to the Image Server, set specific search parameters and readily be able to view and download geospatial data pertinent to their individual projects. The TIPS Remote Sensing Team will also catalog a searchable digital library of raw and processed satellite imagery and derived products. These

products will be served through the ArcGIS Image Server and will be accessible to multiple users throughout OSMRE, State, and Tribal offices.

The OSMRE Charleston Field Office (CHFO) in cooperation with the TIPS Technology Transfer Team also conducted aerial inspections of several mine sites in West Virginia using a small Unmanned Aerial Vehicle (UAV), the RQ-16 T-Hawk Micro Air Vehicle (T-Hawk). The OSMRE was able to cover multiple coal mining permits over a three day period. The T-Hawk captured data using a high definition video camera. These areas included approximately 6,500 acres with 4 miles of sediment control structures. This is part of a multi-year ongoing project to determine whether UAVs may be used effectively, efficiently, and with a reasonable cost, as a tool to assist in OSMRE's mandated oversight duties.

University Partnerships - Minority Higher Education Program: The OSMRE continues to work on building mutually beneficial partnerships with minority serving colleges and universities under its Minority Higher Education Program (MHEP). This includes collaborating with its MHEP partners on training and education programs and providing guidance and direction to ensure that the intended results are achieved. In 2014, the 29th annual Minorities in Agriculture, Natural Resources and Related Sciences (MANRRS) Conference was held in Birmingham, Alabama. During this conference, the OSMRE and Bevill State Community College sponsored a Mine Simulation Tour for interested students where the students were able to immerse themselves in real life mining scenarios. In addition to traditional training within the SMCRA community, the TIPS program continued its collaborative partnership with Adams State University (ASU), a Hispanic Serving Institution in Alamosa, CO, by entering into a cooperative agreement with ASU recognizing that shared cooperation of resources and knowledge, as well as the advancement of the Clean Energy Economy through initiatives would benefit the government, ASU, and the public. The agreement is expected to guide the parties in pursuit of common objectives to enhance education, job opportunities and increased access to "real world" experience.

TIPS Training Program. This is a collaborative effort among OSMRE, States, and Tribes that provides specialized training to use specialized hardware and software related to mining and reclamation. Course developers and instructors are reclamation experts who use TIPS software to solve a wide-range of complex permitting, enforcement and abandoned mine land problems. Although most of these tools are off-the-shelf applications, TIPS training is unique in that it is tailored exclusively to mining and reclamation uses. The OSMRE delivers TIPS courses on-site at the customer's request, and in specialized training centers in OSMRE Regional Offices. In FY 2014, the TIPS training program received a customer satisfaction rating of 98 percent, exceeding the annual GPRA goal by 5 percent. Twenty-one instructor-led classes were held in FY 2014 with 253 students completing class sessions. Another 50 students attended online training courses sponsored by TIPS. The OSMRE conducted 5 of the 21 training classes at on-site locations to meet the specific training needs of particular offices or groups of students, and enable broader participation throughout the SMCRA community.

National Technical Training Program (NTTP). Established in 1985, NTTP is an ongoing training program designed to aid the bureau's mission by increasing the technical competence and professionalism of State, Tribal and OSMRE regulatory and reclamation staff. The NTTP provides comprehensive training in the skills needed to carry out the mandates of SMCRA. The entire program from identification of training needs through course development and presentation is a cooperative effort between State, Tribal, and OSMRE offices. The NTTP

utilized 129 subject matter expert instructors (mostly volunteers) from State, Tribal, and OSMRE offices in FY 2014 to teach classes. The instructors are experts in mining regulatory and reclamation practices who keep abreast of changing technologies, evolving methodologies and policies to ensure the training reflects the best protection and land restoration practices. These instructors participate in course instruction, development, and content revisions. In FY 2014, NTTP trained 688 students from State, Tribal and OSMRE programs. It offered 39 training sessions covering 32 technical, legal, and programmatic subjects ranging from best practices and technologies to protect society and the environment from the adverse effects of surface and underground mining to methods to restore land use capabilities. The course subjects are, where appropriate, tailored to conditions and characteristics specific to each mining region, and offered in or near those regions. Course subjects include a wide variety of technical areas including design of abandoned mine land restoration, proper inspection tools and techniques, soils and revegetation, identification and handling of acid/toxic forming materials, water quality assessment, legal aspects of enforcement procedures, and preparation of evidence and testimony. In FY 2014, the program achieved an overall effectiveness rating of 95 percent, based on student and supervisor responses regarding the value of the training in their current positions.

Technology Transfer Program. The OSMRE National Technology Transfer Team brings together representatives of OSMRE, State, and Tribal SMCRA programs in order to coordinate understanding of mining related issues that span across all three regions. Through regular meetings, the parties involved discuss and try to find solutions to common issues that arise through their program's daily implementation of SMCRA. The team also hosts and participates in technical programs such as workshops, forums, and symposia, in order to collaborate with partners outside the SMCRA community. This includes the **Applied Science Program**, whose goal is to develop and demonstrate improved technologies to address environmental issues related to the mining of coal and the reclamation of the land after mining. The program has accomplished this by funding studies by universities, non-profit organizations, and SMCRA Regulatory Authorities covering topics such as coal mine reclamation, revegetation, blasting, hydrology, coal mine voids and fires, soil productivity, acid mine drainage and other topics relevant to environmentally responsible mining and reclamation. Final reports and fact sheets resulting from these projects may be viewed at: <http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience/ASbySubject.shtm>. The applied science program has been funding mining and reclamation related projects from 2005-2014. In FY 2014, the OSMRE had 16 cooperative agreements in place.

The NTTTT also supports public outreach, through the Youth Initiative Program via participation in such activities as Chemistry Week, Engineer's Week, and the Ohio River Watershed Celebration activities. The main target audiences for these events are elementary students, high school students, and upcoming young professionals.

VIII. National Park Service

As part of its mission, the National Park Service (NPS) actively manages the natural, cultural and historical resources entrusted to it. This management includes preserving and maintaining these resources and, where necessary, preventing impairment, mitigating adverse impacts, or restoring

these resources. The vast majority of these activities are undertaken at the level of each individual park unit, but servicewide networks, programs, and centers make related scientific contributions in areas such as inventory and monitoring, and preservation technology.

Scientific activities within NPS focus on improving the understanding and management of park natural and cultural resources, and in cooperation with partners, preserving and interpreting similar resources outside parks. The information generated by these activities is shared with park managers and stakeholders, including public and private land managers, as well as the broader public, largely through interpretive programs, exhibits, conferences, meetings, training, and standard publication media such as reports, newspapers, journals, magazines, fact sheets, and webpage postings.

In order to expand the range of expertise and tools available to it, NPS participates in many collaborative ventures with universities and other governmental and non-governmental organizations, including the CESU Network.

The NPS Cultural Programs include the National Center for Preservation Technology and Training (NCPTT), which was created by Congress to fill a fundamental need for research and technology transfer among Federal, State, and local historic preservation programs. NCPTT serves as a research and development laboratory for historic preservation and advances the application of science and technology to preservation problems. The NCPTT also supports applied research, partners with professional and scientific organizations, publishes technical guidance for preservation professionals, and trains students and practitioners in the latest preservation techniques.

The NPS also encourages qualified scientists to undertake research on park physical, biological and other resources under theegis of park Scientific Research and Collecting Permits and other permits. Such permits are issued for scientific and educational purposes only. The collected specimens and other materials and components of such specimens and materials may not be used for commercial or other revenue-generating purposes. Parties proposing commercial use of research results must enter into an agreement to share benefits with NPS or an agreement in which NPS explicitly declines to share benefits. In accordance with the National Parks Omnibus Management Act of 1998, which authorizes the Secretary of the Interior to enter into negotiations with the research community and private industry for equitable, efficient benefits-sharing arrangements, NPS has developed policy and procedures to implement benefits sharing. For each benefits-sharing agreement, NPS proposes to choose an applicable agreement type from among several available authorities. The CRADA, authorized by the FTTA, is one such option. NPS issued the benefits-sharing policy on December 19, 2013, and the benefits-sharing handbook on September 29, 2014. See <http://www.nps.gov/applications/npspolicy/DOrders.cfm>.

Mobile Condition Assessments for Cultural Resources

The NPS provides technical information and tools to Federal/State/local/Tribal agencies to assist in response and recovery efforts for natural and cultural resources damaged by natural disasters. To facilitate recovery of historic buildings and other cultural sites, NCPTT has developed a mobile system to inventory damaged resources and assess their condition. This system, called

MoCA (Mobile Condition Assessments), can be used on iPad, iPhone, and Android devices. Response and recovery teams can quickly conduct assessments in the field. When an Internet connection is available, data is synchronized between devices and a server. MoCA enables responders to assess impacts and allocate recovery resources more effectively.

This system uses open source software. Each survey is designed for rapid assessment in areas with no data connection. The first release includes a building damage assessment. Surveys for archeological sites, trees, and other cultural landscape features will follow in subsequent releases.



NPS contractor Ed FitzGerald surveys the interior of historic Seaplane Hangar #38 using a beta version of MoCA, NCPTT's mobile app for post-disaster condition surveys. Miller Army Airfield, Gateway NRA, Staten Island, NY, Superstorm Sandy recovery, June 2013. Photo: NPS.

IX. Bureau of Reclamation

The Bureau of Reclamation (Reclamation) is a water management agency whose mission is to help provide water and power to the 17 Western States and numerous Tribes while protecting the environment and the public's investment in the infrastructure it has constructed and operates. It is the largest wholesaler of water in the country. It brings water to 31 million people, and to one out of five Western farmers, who produce 60% of the Nation's vegetables and 25% of its fruit and nut crop. Reclamation is the second largest producer of hydroelectric power in the Western United States. Its 53 power plants annually provide more than 40 billion kilowatt hours of electricity, enough to power 6 million homes, generating \$1 billion in revenues.

Reclamation R&D – Reclamation's R&D is primarily focused on applications to identify and develop solutions related to the broad spectrum of water and hydropower related issues. Reclamation conducts both programmatic and project-specific R&D. Programmatic R&D is managed by Reclamation's R&D Office and funded through the Science and Technology Program. Science and Technology Program projects are competitively selected based on the

ability to meet priority needs that have broad application across Reclamation and the West. Project-specific research is typically driven by the necessity to improve solutions and processes at a particular Reclamation facility or project, and is done as part of the technical studies and engineering work associated with operating, updating, and maintaining a specific Reclamation facility or project operational responsibility. In either case, expert Reclamation engineers and scientists typically lead or are heavily involved in the effort.



Theodore Roosevelt Dam and Bridge, Salt River, Arizona. This Dam, originally completed in 1911, was the first multipurpose project built by the Bureau of Reclamation. The bridge was added and the Dam renovated and expanded between 1986 and 1996. Photo: Bureau of Reclamation. Photographer: Andy Pernick.

Reclamation Collaborative R&D Activities – Management of water resources is a shared responsibility across Federal, State, and local agencies and the water user organizations. Collectively, these organizations possess a broad range of scientific and technical expertise and managerial perspectives that drive research used to inform decisions, produce solutions to real world problems and increase operational efficiency. Universities and non-governmental organizations also possess cutting edge technical and scientific expertise that can augment Reclamation's R&D activities. Collaborative endeavors are, thus, central to these activities. Reclamation dedicates significant resources to foster and, where appropriate, lead collaborative R&D endeavors in order to bring together complementary capabilities, leverage resources, and avoid duplication of effort. The majority of these cooperative activities does not involve the

need to protect intellectual property or exchange funds between parties, but instead involves cooperation without the need for formal agreements or use of authorities provided by the FTTA. In addition, cooperation involving the exchange of funds or a formal commitment of resources can be achieved via other non-FTTA related formal agreements (e.g., interagency agreements, cooperative agreements, and procurement contracts) authorized by other statutes.

Reclamation Technology Transfer – Although Reclamation’s R&D focus is on water issues specific to the arid and variable climates characteristic of the Western U.S., the new solutions, tools, and information developed can have broad applicability regardless of location. The transfer of Reclamation’s technology and knowledge across the national and international communities of practice maximizes public benefits of Reclamation’s R&D investments.

The majority of Reclamation’s technology advancements are transferred through public dissemination, while others require the capabilities and know-how of the private sector to mature, mass produce and otherwise commercialize the technology into market-ready products. Reclamation’s research nexus with industry is typically in the area of hydroelectric power generation, water infrastructure, water conservation, and desalination/water purification technologies.

If an industry partner is needed to ultimately transfer the technology into a market-ready product, Reclamation utilizes the authorities available under Federal technology transfer legislation to protect intellectual property, as needed, and form research and licensing partnerships with U.S. manufacturing industries. Reclamation’s R&D Office implements these authorities on behalf of the bureau. It also serves as a surrogate for an Office of Research and Technology Applications (ORTA) as required by 15 USC 3710(b). The R&D Office also utilizes a funded interagency agreement with the USDA Agricultural Research Service (ARS) Office of Technology Transfer to have access to the full range of expert skills needed to implement technology transfer authorities (e.g. experienced technology transfer specialists, patent advisors, license specialists, CRADA specialists) on a project-by-project basis. This arrangement benefits the government since it avoids the need to build similar capabilities within Reclamation or the Department.

Reclamation also works to create more awareness across U.S. industries and other non-government organizations about the specialized research resources (people, lands, and facilities) that they can access through technology transfer agreements authorized by 15 USC 3710a. In addition to physical research laboratories, Reclamation’s R&D assets include engineering and scientific expertise, and extensive water storage, water delivery and hydropower facilities that offer unsurpassed real-world laboratories for field tests, evaluations, and demonstrations of new technologies and processes related to water and hydropower. Although the majority of its R&D activities do not involve development of patents or industry involvement to mature technologies into viable products, the technology transfer activities that Reclamation conducts under the authorities of the FTTA are an important subset of its technology transfer responsibilities. Examples of active projects in 2014 authorized under the FTTA are summarized below.

Developing New Technologies to Protect Water Infrastructure from Invasive Mussels

Invasive mussels can attach to and clog pipes, pumps, trash racks, cooling water systems, fire protection systems and virtually any water related infrastructure surface, thereby reducing the reliability and efficiency of water and hydropower systems while simultaneously increasing maintenance costs. Quagga mussels were discovered in Lake Mead in the Lower Colorado River in early 2007 and continue to be a major issue. Quagga mussels can grow to about 1.5 inches and clog water lines that are used to cool the 17 massive hydropower turbines at Hoover Dam, Davis Dam in Lake Mohave and Parker Dam in Lake Havasu.

Reclamation conducts research across a broad portfolio of technologies and methods to reduce fouling of infrastructure by mussels. This includes research into durable, “foul-release” coatings that would negate mussels’ ability to attach to the infrastructure.

Reclamation has tested more than 100 coatings over the last six years to better understand their ability to prevent mussels from attaching to metal surfaces in the quagga mussel infested water on the Colorado River. Most of these coatings are commercially available but they are not as effective in preventing mussel attachment in marine environments, especially in continually flowing water conditions. Therefore, they fail to meet the durability and non-fouling specifications required for Reclamation’s water infrastructure

From 2012 to 2014, Reclamation entered into material transfer agreements with several U.S. companies to test whether their experimental coatings would meet its needs for durability and non-fouling specifications. During 2014, Reclamation entered into six Material Transfer Agreements. On October 21, 2014, Reclamation released a report, *Coatings for Mussel Control — Results from Six Years of Field Testing*, prepared by researchers at the Denver-based Materials Engineering and Research Laboratory (MERL) detailing results of the field tests, including results from the recent material transfer agreements. Although a few experimental formulations show potential, the six-year testing program has not yet identified a coating formulation suitable for both the durability and the non-fouling specifications required for Reclamation’s water infrastructure.

In FY 2014, with no commercially available coating identified from the 6-year testing program suitable for Reclamation’s purposes, Reclamation entered into a CRADA with a U.S. coating manufacturer, FujiFilm Hunt Smart Surfaces, LLC (FujiFilm). FujiFilm is a subsidiary of Fujifilm Hunt Chemicals U.S.A, located in Allendale, New Jersey. It is an advanced technology firm focused on the development and commercialization of environmentally safe, high performance fouling-release coatings for maritime and industrial applications. The goal of the CRADA is to create new commercially available, durable, foul-release coatings that will prevent



Outboard motor encrusted with quagga mussels. Photo: Neal Muirhead, Bureau of Reclamation.

mussel attachment for Reclamation's water infrastructure. Under the CRADA, both parties are contributing background intellectual property, specialized material, science and coatings expertise, testing equipment, and specialized laboratory facilities. In addition, FujiFilm is providing scale-up, product manufacturing know-how, and insights on other fields of use that can benefit from such formulations while Reclamation is providing a field-based testing facility on the Colorado River.

Prize Competitions to Develop Innovative Solutions to Water-Related Problems

Reclamation's Research and Development Office (through the Science and Technology Program) plans to launch several nationwide prize competitions to help develop innovative solutions related to a number of mission-critical areas. Reclamation has approached other Federal agencies that have a shared priority or stake in these theme areas to form Challenge Management Teams. These teams will identify, scope, and ensure that candidate prize competition problems are a shared priority of Reclamation and its collaborating agencies. Based on input from these teams, Reclamation will select specific prize competitions that would be announced nationally.

Federal collaboration will enable Federal agencies to leverage Federal capabilities and find solutions that have a broader impact across the missions of multiple agencies, the stakeholders we collectively serve, and overall public good.

The specific areas and progress to date in implementing prizes in these areas are described below:

- *Infrastructure Sustainability.* These prizes would be designed to help increase the efficiency and effectiveness of operations, maintenance and repair of the nation's extensive inventory of water storage, water delivery, and hydropower generation infrastructure managed by Reclamation. They would help meet increasing water demands of the West while protecting the environment and the public's investment in these facilities. Reclamation and the U.S. Army Corps of Engineers are also contacting other Federal agencies to form an Infrastructure Challenge Management Team.
- *Ecosystem Restoration.* These prizes are intended to help recover threatened and endangered fish and the prevention of new listings under the Endangered Species Act. Effective solutions will help Reclamation comply with environmental laws and regulations and sustain healthy aquatic ecosystems, while continuing to meet its water delivery obligations. A Fish Recovery Challenge Management Team has been established that includes representatives from Reclamation, USGS, FWS, NOAA Fisheries, and the Army Corps of Engineers.
- *Water Availability.* These prizes would assist Reclamation to better conserve existing water supplies, create new sources of useable supplies, and forecast and manage water supplies to meet competing water needs under a variable and changing climate. Reclamation plans to use an existing Climate Change and Water Working Group (CCAWWG) as an initial forum to develop a Water Availability Challenge Management Team. CCAWWG agencies include Reclamation, NOAA, U.S. Geological Survey, U.S. Army Corps of Engineers, NASA, EPA, U.S. Forest Service, and the USDA-Agricultural

Research Service. Reclamation also intends to incorporate other agencies and subject matter experts aligned with the broad scope of this challenge area.

Results of these efforts will be reported in future Annual Reports.

Re-delegation of Commissioner's Authority to Implement Technology Transfer Activities

On October 6, 2011, the Department released a new Departmental Manual Chapter (207 DM 8) that formalizes statutory delegations related to technology transfer activities. This Chapter provides the delegation of authority for carrying out technology transfer activities to Assistant Secretaries and Bureau Directors. This helps to encourage the transfer of federal technologies and allows Bureau Directors to enter into Cooperative Research and Development and license agreements. This authority may also be re-delegated, where appropriate, to the "lowest levels in the organization to better address issues and strengthen communications."

In accordance with 207 DM 8, Reclamation's Commissioner re-delegated these authorities to the Director of Technical Resources on October 10, 2013, through Release No.476 of Reclamation's Delegations Manual. The Director of Technical Resources further re-delegated these authorities to Reclamation's Chief of Research and Development through a formal re-delegation memorandum dated December 23, 2013. Reclamation's Research and Development Office serves as Reclamation's Research and Technology Applications Office as required by 15 USC 3710.

Reclamation's efforts to re-delegate these authorities are critical to meeting the goals of the October 28, 2011 Presidential Memorandum, *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses*. The Memorandum directs Federal agencies that conduct research and development to improve the results from their technology transfer and commercialization activities. Specifically, the Memorandum calls for agencies to establish goals and measure performance, streamline administrative processes, and facilitate local and regional partnerships. As part of the effort to streamline administrative processes and speed up the transfer Reclamation's technologies, the Commissioner has delegated authority for signing technology transfer agreements to the Chief of Research and Development.

Partnership Intermediary Agreement to Advance Reclamation's Transfer of Technologies

On September 2014, Reclamation entered into a Partnership Intermediary Agreement, as authorized by 15 USC 3715, with the Center for Innovation (CFI), LLC, in Arlington, TX, to assist Reclamation in its technology transfer efforts. Partnership Intermediary Agreements allow Federal research agencies to enter into an agreement with a partnership intermediary, a nonprofit organization or an agency of a State or local government, to assist the Federal agency with its technology transfer activities. Under this Agreement, CFI will help promote and facilitate cooperative research partnerships and expand the transfer of technology between Reclamation, other Federal laboratories and the private sector.

The CFI is a non-profit organization based in Texas established in 2001 by the Arlington Chamber of Commerce Foundation to serve as catalyst for technology-led economic development. CFI facilitates research partnerships between the federal laboratories, industry, and academia that help promote further research, product development, commercialization, and economic opportunities. Through these research partnerships, CFI can help transfer technology to and from Reclamation and strengthen state and national economic development, enhancing U.S. competitiveness in the global marketplace. Currently, CFI already serves as a partnership intermediary to several other federal agencies, including U.S. Department of Agriculture, U.S. Department of Defense, U.S. Department of Energy, National Institutes of Health, U.S. Environmental Protection Agency, and others.

Benefits to Reclamation from the Agreement include:

- Identification and facilitation of potential research partnerships with the private sector early in the research process where the private sector plays a significant role in manufacturing and supplying the end product. Such partnerships provide multiple advantages:
 - Industry shares the cost of the overall research effort;
 - Industry can help expedite and guide the lab-to-market research process;
 - Industry can advise on the need to patent intellectual property in the U.S. and other countries; and
 - Industry partner potentially provides a ready-made reliable manufacturer for products needed by Reclamation.
- Increased access to businesses, academia, and other Federal research agencies that have similar research needs,
- Identification of potential licensing partners that can help Reclamation channel its resources primarily toward research that has higher impacts and better outcomes, and
- Increased likelihood that Reclamation’s research solutions will reach a broader user base that can benefit from Reclamation research results.

The Partnership Intermediary Agreement with CFI is also aligned with the directions established for federal agencies to increase transfer of technologies through local and regional partnerships in the October 2011 Presidential Memorandum, *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses*.

X. Bureau of Safety and Environmental Enforcement

The Bureau of Safety and Environmental Enforcement (BSEE) works to promote safety, protect the environment, and conserve resources offshore through vigorous regulatory oversight and enforcement.

Within BSEE, the Office of Offshore Regulatory Programs (OORP) develops standards and regulations to enhance operational safety and environmental protection for the exploration, development, and production of offshore oil and natural gas on the U.S. Outer Continental Shelf (OCS).

The Oil Spill Preparedness Division (OSPD) is responsible for developing standards and guidelines to ensure that offshore operators are prepared to respond to an offshore oil spill. It also ensures their Oil Spill Response Plans comply with regulatory requirements. OSPD plays a critical role in the review and creation of policy, guidance, direction and oversight of activities related to the agency's role in ensuring industry's preparedness for oil spill response. The Division oversees the Oil Spill Response Research program, and works closely with sister agencies such as the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, and Environmental Protection Agency to continually enhance response technologies and capabilities.

OSPD also operates Ohmsett in Leonardo, NJ, which serves as the National Oil Spill Response Research and Renewable Energy Test Facility. Although not classified as a Federal laboratory, Ohmsett is available for use by industry and government. Advances made by research conducted at the Ohmsett facility are vital to the oil spill response industry.



The Ohmsett facility in Leonardo, NJ, at Naval Weapons Station Earle Waterfront. The 2.6 million-gallon salt water tank in the foreground is used to test full scale oil spill response technologies and to train response personnel from other government agencies (e.g., U.S. Coast Guard and the Navy), private industry and other non-governmental organizations. More than twenty-four countries have conducted tests or training at the Ohmsett facility. Photo credit: BSEE.

BSEE R&D programs operate through the Emerging Technologies Branch (ETB) and the Oil Spill Response Research (OSRR) Branch. The former supports research associated with operational safety and pollution prevention (including renewable energy). The ETB, established in 2012 to replace the Technology Assessment and Research (TA&R) group, is the agency's

focal point on operational safety and pollution prevention research. It also helps ensure that industry operations on the Outer Continental Shelf incorporate the use of Best Available and Safest Technologies (BAST) as required in the 1978 Outer Continental Shelf Lands Act amendments. The OSRR program was established through the Oil Pollution Act of 1990 to research oil spill response technology and operational techniques. Its Ohmsett facility is available to provide independent and objective performance testing of full-scale oil spill response equipment and marine renewable energy devices, and improving technologies through research and development.

BSEE's R&D focus is on offshore operational oil/gas and renewable energy issues. The majority of the bureau's technology advancements are transferred through public dissemination. In addition to making the final reports of research projects publicly available on the BSEE website, BSEE also makes its research results available via conferences, and other fora, e.g., the annual Clean Gulf Conference; the Pacific States-British Columbia Oil Spill Task Force Annual Meeting; and the Coastal Response Research Center's Oil Spill Dispersant Research Forum.

BSEE's primary research synergy is with international government organizations, the oil/gas and renewable energy industries, and oil spill response organizations. It is typically in the area of ensuring that the best available and safest technology is used on the US Outer Continental Shelf. Additional information and research deliverables are available at: <http://www.bsee.gov/Technology-and-Research/Technology-Assessment-Programs/index/>, and <http://www.bsee.gov/Technology-and-Research/Oil-Spill-Response-Research/index/>.

BSEE is a member of the International Committee on Regulatory Authority Research and Development (ICRARD), which focuses on transferring knowledge worldwide between governmental entities in the area of health, safety, and environment in the petroleum sector. Although membership is only available to government entities, ICRARD cooperates with industry to coordinate and transfer technology.

BSEE is also a member of the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR). Comprised of 15 Federal agencies, ICCOPR was established as part of the Oil Pollution Act of 1990 to "coordinate a comprehensive program of oil pollution research, technology development, and demonstration among the Federal agencies, in cooperation and coordination with industry, universities, research institutions, state governments, and other nations, as appropriate."

A complete listing of current and completed research can be found at <http://www.bsee.gov/Research-and-Training/index/>. The following are examples of publicly available research projects completed in FY 2014 which would, among other things, advance technological options and transfer knowledge about best technological practices to industries and among regulators operating on the Outer Continental Shelf.

North Slope Coastal Imagery Initiative. The North Slope of Alaska is a region of both onshore and offshore oil development and stretches 6,000 km (4,000 mi) from Cape Lisburne, Alaska, to the Canadian border. The shoreline is entirely permafrost and, as a result, includes unique coastal processes and habitats. Because of its extreme environment, were an oil spill to

occur in that area clean up would be a significant challenge. This [project's](#) objective was to develop a coastal imagery-based response tool that could be implemented on the North Slope and used to assist the Federal On-Scene Coordinator and Incident Command with a decision-support system for spill response. This tool provides online access to over 30 hours of geo-referenced high-definition videography and more than 16,000 high resolution, geo-referenced photographs. The provision of geo-referenced, high resolution imagery would provide the Federal On-Scene Coordinator and Incident Command with invaluable information to support their decision-making during an oil spill incident.

Oil Spill Detection and Mapping under Arctic Sea Ice using Autonomous Underwater Vehicles (AUV). The goal of this [project](#) was to develop and evaluate an AUV-based system for detection and mapping of oil in ice-infested waters from below the water and/or ice. There were two main elements of this effort. Extensive laboratory ice-tank tests were conducted to test and evaluate each candidate sensor, and provide a 'fit-for-purpose' AUV-based sensor suite to detect and quantify the thickness of oil under sea ice from below the ice. Also an AUV mission strategy was developed to efficiently map the distribution of oil under complex sea ice terrain, and in the variety of ice conditions found in US Arctic coastal waters.

Real-Time Data Monitoring of Offshore Oil and Gas Operations. Real-time data monitoring is a key element in ensuring safe, clean and efficient operations in virtually any setting. This [project](#) was an independent assessment of the various types of real-time data monitoring systems available for offshore oil and gas operations. The assessment focused on drilling and production technologies and included a cost-benefit analysis that detailed potential costs to industry, potential increases in safety performance, government resources needed for implementation, and necessary training for all parties involved. The assessment identified which automation systems are available or being developed, the potential they have to increase offshore drilling safety, and potential negative impacts they have on operations.

Efficient Atomization and Combustion of Emulsified Crude Oil. One conceivable method of cleaning up spilled oil or other hazardous materials in waters is to attempt to atomize the oil and burn it on site. The objective of this [project](#) was to assess the effectiveness of low pressure atomizing burners as a means to augment *in situ* burning, especially for emulsified crude oil. The project demonstrated the feasibility of using a flow-blurring atomizer to form a combustible aerosol of air and crude oil or emulsified crude oil. This burner system allowed for stable combustion of oil/water flows up to 800 mL/min and with emulsified fractions of up to 25% seawater. A [follow-on project](#) has been funded to transition the Technology Readiness Level (TRL) of this system from a TRL 3 to TRL 5 by developing and refining the performance of the flow blurring atomizer spray burner. The new system will have capability goal of burning at a minimum liquid flow rate of 225 barrels per day.

Development of a Real-time Monitoring Protocol for Assessing Volatile Organic Compound (VOC) Impacts on Response and Cleanup Workers' Safety During Dispersant Operations. The objective of this [project](#) was to develop real-time and passive monitoring techniques and protocols to effectively assess the impact of dispersant use and VOC release, in both surface and subsurface applications, on oil spill response worker safety. Laboratory tests were conducted to quantify hazardous components detectable in the air and water following

exposure to naturally and chemically dispersed oil at various temperatures and dispersant to oil ratios. A field study was conducted at Ohmsett to test these analytical methods and monitoring protocols. These were reviewed by National Oceanic and Atmospheric Administration (NOAA) and United States Coast Guard (USCG) Gulf Coast Strike Team personnel to provide recommendations and countermeasures to optimize dispersant use for VOC control and worker safety.

Checklist for Design of Offshore Wind Turbines. The objective of this [project](#) was to develop a checklist to identify the specific topics that need to be addressed in the design basis of offshore turbines, identify which standards are applicable for each topic, and make a determination on whether each standard is sufficient for this purpose. Such checklists are an efficient method for training and increasing awareness of best practices related to engineering designs.

Analysis of Cementing Procedures Employed in the US Outer Continental Shelf. Poor cementing practices were among the major factors responsible for the 2010 Deepwater Horizon oil spill in the Gulf of Mexico. This [project](#) identified the current cementing practices in the OCS and analyzed them to determine the best practices based on technical criteria. Practices which present safety risks were identified and safer alternatives were proposed. Recommendations were made for additional research in areas that could benefit from better fundamental understanding.

XI. Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) is charged with managing the Nation's offshore resources in a balanced way that promotes efficient and environmentally responsible energy and mineral development through oil and gas leasing, renewable energy development, and marine mineral leasing based upon a commitment of rigorous, science-based environmental review and study.

BOEM manages access to and fair return for the energy and mineral resources of the Outer Continental Shelf (OCS) to help meet the energy demands and mineral needs of the Nation, while also balancing such access with the protection of the human, marine, and coastal environments. As the Nation's offshore energy and mineral resource manager, BOEM administers a comprehensive, progressive cycle of analyses to provide the key information necessary for decisions about whether, where, and when offshore energy and mineral development can or should occur.

Management of the oil and gas resources of the OCS is governed by the OCS Lands Act, which sets forth procedures for leasing, exploration, and development and production of those resources. Section 18 of the OCS Lands Act calls for the preparation of a nationwide offshore oil and gas leasing program, setting forth a five-year schedule of lease sales designed to best meet the Nation's energy needs. BOEM is responsible for implementing the requirements of the OCS Lands Act related to preparing the leasing program.

BOEM's Office of Environmental Programs conducts environmental reviews, including *National Environmental Policy Act* (NEPA) analyses and compliance documents for each major stage of energy development planning. These analyses inform the bureau's decisions on the Five Year Program, and conventional and renewable energy leasing and development activities. Additionally, BOEM's scientists conduct and oversee environmental studies to inform policy decisions relating to the management of energy and marine mineral resources on the OCS through its Environmental Studies Program.

BOEM's three regional offices — New Orleans, Louisiana; Camarillo, California; and Anchorage, Alaska — manage oil and gas resource evaluations, environmental studies and assessments, and leasing activities, including the review of Exploration Plans and Development Operations and Coordination Documents, fair market value determinations, and geological and geophysical permitting.

BOEM Science. The BOEM's Environmental Studies Program (ESP) plans, conducts and oversees world-class scientific research to inform policy decisions regarding leasing and development of OCS energy and mineral resources. BOEM works to manage the exploration and development of the Nation's offshore resources in a way that appropriately balances economic growth, energy development, and environmental protection through oil and gas leases, renewable energy development, and environmental reviews and studies.

BOEM's environmental studies cover a broad range of disciplines including physical oceanography, atmospheric sciences, biology, protected species, social sciences and economics, submerged cultural resources and the environmental effects of energy development. BOEM is a leading contributor to the growing body of scientific knowledge about the Nation's marine and coastal environment.

BOEM oversees scientific research conducted through contracts, cooperative agreements with State institutions or universities and interagency agreements. These arrangements enable the bureau to leverage resources, meet national priorities and satisfy common needs for robust scientific information. Many of the Bureau's studies are collaborations with partners under the umbrella of the National Oceanographic Partnership Program.

BOEM Technology Transfer. BOEM's technology transfer activities include dissemination of information, knowledge and technologies to the various regions, and to commercial entities and other stakeholders with interests in the OCS.

Studies that have been undertaken by or through funding from BOEM are available to the public through the Environmental Studies Program Information System (ESPIS), and technical summaries of more than 700 BOEM-sponsored environmental research projects, as well as copies of more than 2,000 research reports, are available for online full text search. To learn more about BOEM's ongoing work to further environmental studies, go to: <http://www.boem.gov/studies>.

BOEM's Environmental Studies Program typically conducts or supports approximately 10 scientific meetings, Information Transfer Meetings, symposia, and its Federal Advisory Act

Committee meetings ([OCS Scientific Committee](#)). BOEM-funded research has also supported and directly led to the publication of hundreds of peer-reviewed scientific articles including research papers from master's and doctoral students and post-doctoral fellows.

Many large interdisciplinary projects with funding from BOEM have included partnerships with other Federal agencies and academic institutions as well as private companies directed towards offshore ecosystem studies that utilize state-of-the-art technologies such as autonomous underwater vehicles surveys, deep-water human-occupied submersibles and remotely operated vehicles. Many projects have developed innovative imaging technologies and digital analysis techniques for establishing long-term biological monitoring stations in deep water. These partnership studies have leveraged expertise and technologies to meet common management goals.

One notable transfer of technology-derived information to the research community as well as the general public has been in mapping of seafloor features in the northern Gulf of Mexico (GoM) derived from 3-dimensional seismic surveys performed by the energy industry. BOEM scientists have mapped over 31,000 seafloor seismic amplitude anomalies since their efforts began in 1997. The resulting database, available on a BOEM webpage at <http://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/Map-Gallery/Seismic-Water-Bottom-Anomalies-Map-Gallery.aspx>, represents a roadmap to the relatively rare exposed hard substrate in the deep GoM created by the natural seepage of hydrocarbons. The mapping of these features has proved invaluable in the selection of sites for the study of deep-water corals and chemosynthetic communities in the GoM as well as damage assessment surveys after the *Deepwater Horizon* accident. Bottom features are now divided into several varieties and also include verified locations of natural oil seeps and some major types of biological communities.

BOEM occasionally also funds technology development studies. Two studies underway in FY 2014 are described below. These studies, which are complementary, were undertaken specifically to deal with offshore environmental issues but they could have applications onshore and provide significant benefits beyond BOEM's immediate mission needs both onshore and offshore.

Some BOEM studies, particularly in the emerging realm of offshore renewable energy are focused on the assessment of the best currently available technology to apply to management decisions. The use of newer technologies will yield improvements in the quality and character of the observations (for example, higher resolution profiling and mapping, or real-time measurements for control) that will feed back into improvements in the design and perhaps operating envelope of power extraction devices. One currently ongoing study is titled, *Roadmap: Technologies for Cost Effective, Spatial Resource Assessments for Offshore Renewable Energy*. Another example of an evaluation-themed study is represented by a project related to hydrokinetic energy device impacts titled, *Evaluating acoustic technologies to monitor aquatic organisms at renewable energy sites*. Extreme velocities at potential sites (desirable for energy extraction) can increase water turbidity and reduce optical imagery ranges. Robust technologies that can effectively survey large ranges over wide apertures are required for impact monitoring. This project will evaluate abilities and weaknesses of different technologies and

result in management recommendations for deployment and data acquisition procedures at tidal and wave energy projects.

Use of new DNA analysis techniques has expanded in recent years affecting everything from species taxonomy to the mechanisms of human diseases. As an addition to the invertebrate archiving program BOEM has had with the Smithsonian Institution's National Museum of Natural History, the bureau has initiated the archiving of tissue samples taken from specimens collected through the BOEM Environmental Studies Program. This further enhances a long-term relationship BOEM has had with the Smithsonian since 1979 recognizing that extensive biological samples collected during BOEM environmental studies were invaluable not only to the relevant studies, but also to science in general. More than 400 new species to science have been identified from new tissue sample submissions that came from BOEM study collections from the Arctic, Pacific, Gulf of Mexico, and Atlantic. Similar to the continuing archiving and curation of invertebrate samples, these tissue/DNA samples will be available from the Smithsonian's new Biorepository for the use by scientists from all over the world into the future. See <http://invertebrates.si.edu/boem/boem.htm>.

XII. Bureau of Land Management

The Bureau of Land Management's (BLM's) multiple-use and sustained yield mandate, set forth in the Federal Land Policy and Management Act of 1976, directs it to manage America's public land resources for a variety of uses, such as energy development, livestock grazing, recreation, and timber harvesting, while also protecting a wide array of natural, cultural, and historical resources for the use and enjoyment of present and future generations. The BLM administers more public land – over 245 million surface acres – than any other Federal agency in the United States. Most of this land is located in the 17 Western States and Alaska. The BLM also manages 700 million acres of sub-surface mineral estate throughout the Nation.

The BLM invests \$16-18 million/year in research and development. It also makes significant investments in applied research projects. The BLM defines applied research as systematic study, with on-the-ground validation, to gain knowledge or understanding necessary to inform management questions. BLM research projects are intended to provide knowledge necessary to help the BLM address social, economic, biological, political, technical, or physical challenges effecting its management of the public lands. Projects are focused on addressing specific 'researchable' problems recognized by the BLM. They usually have applicability beyond a particular place (site) and time and are usually directed at development of new methodologies and technologies. Currently, the focus of BLM research and development efforts are towards developing basic foundational research and ensuring scientific integrity (e.g., through peer review, etc.). As explained below, technology transfer occurs as part of these existing efforts, and the BLM is currently evaluating the feasibility and benefits of additional technology transfer opportunities authorized under 15 U.S.C. 3710 and 35 U.S.C. 207 and 209.

Currently, the BLM's Technology transfer efforts include, but are not limited to, information dissemination. For example, the BLM recently issued an in-depth manual explaining how new

technology (e.g., geospatial) is to be incorporated into existing procedures, techniques, and training (e.g., the landscape approach) and made available within and outside the BLM, as appropriate.

The BLM is also developing recreational mapping products that will assist with its management and the public's use of the BLM's approximately 30 million-acre National Conservation Lands. These lands include 221 Wilderness Areas, totaling 8.7 million acres, 20 National Monuments, comprising 5.6 million acres, and 21 National Conservation Areas and similar designations, comprising 4.1 million acres. Wilderness Study Areas, National Scenic and Historic Trails, and Wild and Scenic Rivers also are included in the National Conservation Lands. The recreational mapping products BLM is developing will help ensure the public has access to consistent maps and information across all BLM recreational areas. This project includes three specific products: (1) static, printable maps; (2) interactive online maps; and, (3) story maps showcasing unique sites and resources at recreational areas.



Dominguez-Escalante National Conservation Area, Colorado. Photo: BLM.

Similarly, in connection with its emphasis on “landscape approaches” to its planning and management obligations, the BLM has established and continues to fund Rapid Ecoregional Assessments (REAs). The REAs will provide geospatial base data to support future decision making, management, and projects. This base data can be used to move the BLM towards new conceptual models, innovative methods, and new practices that more fully integrate science into its everyday work processes.

Finally, in FY 2014 the BLM's Wild Horse and Burro (WHB) program began designing a Prize Challenge. The intent of this challenge is to help the program leverage limited resources in order to facilitate the development of tools to help the program address the enormous challenge of fulfilling its vision of sustaining healthy horse and burro populations on public lands.

Specifically, the BLM is seeking a sustainable solution through the prize challenge that responds to the rapid growth of wild horse and burro herds on public rangelands. This solution is particularly important since the demand to adopt or buy horses and burros remains low and the capacity for additional gathered animals at BLM's short- and long-term holding facilities is dwindling. To develop its Prize Challenge, the BLM has contracted with InnoCentive, a global leader in crowdsourcing innovation problems, to design a competition (or "challenge") through which potential solvers can compete to win a prize based on the solution they come up with to the challenge identified (in this case managing wild horse population growth rates). Prize challenges offer several benefits over traditional approaches to solving problems. Because they are open to solvers from a variety of disciplines, the BLM's Prize Challenge has the potential to access untapped talent to deliver unexpected solutions to tough problems. Reaching out to a variety of disciplines increases the chance for new approaches being identified. A prize will only be awarded to a solution that is judged viable. Currently, the BLM is wrapping up the development phase of its Prize Challenge and determining next steps for soliciting private funds for the prize, including potentially forming partnerships with external entities. BLM anticipates that technology transfer will be a component of any solutions identified as part of this effort.

XIII. Conclusion

Over the past year the Department has continued its progress toward institutionalizing technology transfer as a routine part of its science, engineering and other technical activities. In particular, it has incorporated policy and procedures for advancing technology transfer into the Departmental Manual, and developed a web site accessible to the public to provide information on technology transfer programs and activities within the Department and its bureaus. The web site also helps provide education and training on technology transfer to scientists, engineers and other technical personnel within the Department.

During FY 2014, the Department:

- Engaged in 601 CRADAs, an increase of 125 over the previous fiscal year. Of the 601 CRADAs, 422 were new in FY 2014.
- Published over 7,500 reports, books, papers, fact sheets, and other publications. These represent the primary form of technology transfer that the Department's scientists, engineers and technical personnel engage in.

In FY 2015 and coming years:

- Bureaus will revise, as appropriate, their policies, manuals and guidelines to incorporate the policy and guidance outlined in the Departmental Manual chapter on technology transfer.

- In response to demand from several bureaus, the Departmental Working Group on Technology Transfer expects to formulate policy and procedural guidance for offering and administering prize competitions to stimulate innovation and effect technology transfer. It is expected that a number of bureaus will avail themselves of this guidance to offer prize competitions to help fulfill their missions.

DATA APPENDIX

Data are provided if they are collected and readily available. Note that a blank cell or N/A indicates either zero, the data is not collected or it is otherwise unavailable.

FY 2014 DATA

Table 1: Invention Disclosures and Patents

		USGS	Reclamation	TOTAL
	Invention Disclosures			
1	Number of new inventions disclosed	4	1	5
	Patents			
2	Number of patent applications filed	3	0	3
3	Number of patents received	2	0	2

Table 2: Income Bearing Licenses

		USGS	Reclamation	TOTAL
	Income Bearing Licenses			
4	Number of income bearing licenses	12	2	14
5	Exclusive licenses	5	0	5
6	Partially exclusive licenses	0	0	0
7	Non-exclusive licenses	7	2	9
	Elapsed Amount of Time for Granting Licenses			
8	Average (months)	12		
9	Minimum (months)	12		
10	Maximum (months)	12		

Table 3: Licensing Income

		USGS	Reclamation	TOTAL
	Earned Royalty Income			
11	Earned Royalty Income from top 1% of licenses	\$11,815	\$5,000	\$16,815
12	Earned Royalty Income from top 5% of licenses	\$11,815	\$5,000	\$11,815
13	Earned Royalty Income from top 20% of licenses	\$11,815	\$5,000	\$11,815
14	Minimum Earned Royalty Income	\$500	\$2,475	\$2,975
15	Maximum Earned Royalty Income	\$11,815	\$5,000	\$16,815
16	Median Earned Royalty Income	\$3,502	\$3,737	\$7,239
	Disposition of Earned Royalty Income			
17	Total amount of Earned Royalty Income received	\$45,531	\$7,475	\$53,006
18	Percent of Earned Royalty Income distributed to inventors	68	66	
19	Percent of Earned Royalty Income distributed to the agency or laboratory	32	33	
20	Licenses terminated for cause	0	0	0
	Total Income			
20 A		\$50,773	\$7,475	\$58,248

Table 4: CRADAs

		USGS	Reclamation	FWS		TOTAL
	CRADAs					
21	Number of active CRADAs	587	10	4		601
22	Number of newly executed CRADAs	418	4	0		422
23	Active CRADAs with small business involvement	n/a				
24	Number of small businesses involved in active CRADAs	n/a	3			n/a
	Traditional CRADAs					
25	Active traditional CRADAs	27	4	4		35
26	Newly executed traditional CRADAs	10	1	0		11
	Non-traditional CRADAs					
27	Active non-traditional CRADAs	560	6	0		566
28	Newly executed non-traditional CRADAs	408	3	0		411

Table 5: Other Performance Measures Deemed Important by the Agency

		USGS	Reclamation	BLM	TOTAL
	<i>(Add agency specific metrics)</i>				
	Collaborative Agreements, total active	290	1	1	292
	Collaborative Agreements, new	110	1	1	112