Annual Report on Technology Transfer

FY 2024 Activities

U.S. Department of the Interior

Description of Cover Photos

Upper Left: Field evaluation of surface water dispersant monitoring using DSD instrumentation and instrument carriage system. This research investigates how available technology can support oil spill preparedness and response activities. Source: BSEE

Upper Right: High-Altitude Platform Systems developed by Sceye launching in Roswell, New Mexico. USGS collaborative research with Sceye and NASA is intended to enhance climate and environmental imaging, monitoring, and data collection from the stratosphere. Source: Sceye

Lower Left: Emigrant National Historic Trail, Wyoming. A 2024 BLM report provides best practices to support inventory efforts for National Scenic and Historic Trails, such as Emigrant National Historic Trail. Source: Bob Wick, Bob Wick, BLM

Lower Right: Underground Mining Technology Course in Morgantown, WV, June 2024. The National Technical Training Program is a collaborative effort among State, Tribal, and OSMRE offices to enhance the technical skills and professionalism of regulatory and reclamation staff. Source: OSMRE

March 2025

Table of Contents

I. Executive Summary 1

II. Introduction 2

III. Technology Transfer in the Department of the Interior 3

IV. Overview of Technology Transfer Activities 4

V. Technology Transfer Agreements 5

VI. U.S. Geological Survey 10

VII. U.S. Fish and Wildlife Service 18

VIII. Office of Surface Mining Reclamation and Enforcement 20

IX. National Park Service 28

X. Bureau of Reclamation 30

XI. Bureau of Safety and Environmental Enforcement 34

XII. Bureau of Ocean Energy Management 39

XIII. Bureau of Land Management 44

XIV. Joint Fire Science Program 47

XV. Conclusion 50

XVI. Data Appendix 51

XVII. Acronyms and Abbreviations 55

I. Executive Summary

This report identifies and describes how the Department of the Interior (Interior, Department) advanced technology transfer in Fiscal Year (FY) 2024. These activities demonstrate the innovation, expertise, and dedication of Departmental employees to help reduce risks to public health, safety, and the environment, and to honor Federal trust and treaty responsibilities or special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

During FY 2024, the Department continued to engage in a broad range of technology transfer activities – 23 cooperative research and development agreements (CRADAs), 3,149 other cooperative research and development (R&D) activities, 11 new invention disclosures, 44 active licenses for inventions and other intellectual property, and over 5,390 publications – to achieve key outcomes including:

- To protect wildlife, the Department studied the impact of various rat poison formulations on raptor species that consume exposed or poisoned rodent prey.
- To keep aquatic animals healthy and to facilitate safe fisheries management activities, the Department advanced collaborations through its Aquatic Animal Drug Approval Partnership program.
- To strengthen relationships between Federal and state technical staff, the Department held Technology Transfer Roadshows to share information about available technology.
- To determine the potential for hydrokinetic units in inland canals to serve as a source of renewable energy, the Department tested lab-scale units to evaluate how canal and unit configurations affect energy generation.
- To enhance understanding of ice dynamics as they relate to offshore exploration and safety, the Department investigated ice conditions during freeze-up and break-up seasons in the Alaskan Beaufort and Chukchi Seas.
- To enhance environmental protection of whales, the Department developed a new ocean noise reduction framework; researched weathering and bioavailability of oil in Cook Inlet, Alaska; initiated a new research activity for population characterization of Rice's Whale in the vicinity of offshore energy development activities in the Gulf of America; and modeled interactions of humpback whales with floating wind turbine structures in the Pacific region.
- To ensure robust information is available for use in land management and research across the western United States, the Department evaluated the availability of ecological site identification, soil observations, and geomorphology characteristics in 14 western United States.
- To aid resource managers and practitioners in managing for wildfire risk, the 15 exchanges of the Department's Fire Science Exchange Network synthesized, interpreted, and disseminated fire science findings for application in management decisions.

II. Introduction

Each year, technology transfer at Interior advances the goals of the Technology Transfer Commercialization Act of 2000. In FY 2024, the Department strengthened the Nation's competitive ability in the global marketplace; furthered collaboration among government, industry, and universities that carry out the scientific enterprise; and improved the quality of life for the American people. Achieving these goals also helped advance Interior's mission:

- To protect and manage the Nation’s natural resources and cultural heritage;
- To provide scientific and other information about those resources; and
- To honor our trust and treaty responsibilities or special commitments to American Indians, Alaska Natives, and affiliated Island Communities.

The FY 2024 report shares examples of technology transfer activities at the Department in three categories:

- Publishing and exchanging scientific and technical information;
- Protecting and licensing intellectual property rights; and
- Sharing specialized scientific material and resources that the Department manages.

The report is the result of a cooperative effort by Interior’s Departmental Working Group on Technology Transfer, which is coordinated by the Department’s Office of Policy Analysis. The working group, which included bureau and office personnel involved with their respective research and development programs, provided the underlying data. Interior prepared this report using data compiled according to the most recent guidance from the Interagency Working Group on Technology Transfer.[1]

[1] The Technology Partnerships Office, National Institute of Standards and Technology, in conjunction with the Interagency Working Group on Technology Transfer, Guidance for Preparing Annual Agency Technology Transfer Reports Under the Technology Transfer Commercialization Act, Published April 2020, Revised September 2022. Available at: https://www.nist.gov/system/files/documents/2022/10/03/2020%20Metrics%20Guidance%20-%20Revised%20September%202022.pdf

III. Technology Transfer in the Department of the Interior

Interior's FY 2024 enacted budget included $704 million for R&D. Most funding, about $577 million, was for applied R&D, while basic R&D and experimental development received about $40 million and $87 million, respectively.[2] The programs supported through these funds generate new and improved knowledge, information, and technology, which are then transferred to resource managers within and beyond the Department, other stakeholders, and the public to help Interior meet its mission objectives.

The Department's bureaus have varying levels of involvement with scientific and technical research, and innovation and technology transfer. In FY 2024, as in previous years, most technology transfer activities reported by the Department under the Federal Technology Transfer Act of 1986 (FTTA) were undertaken by the U.S. Geological Survey (USGS), which is the Department's largest R&D organization, both in terms of budget and personnel. Typically, the USGS accounts for about two-thirds of the Department's R&D budget.

Interior advances the state of knowledge related to the resources it manages and ensures that this information is accessible to resource managers, private industry, and the public. The 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. Bureaus also use other conventional approaches to share scientific and technical resources and expertise with universities and other entities to address resource management issues.

In addition, some bureaus and offices have offered prizes to help develop new or improve existing technologies. The bulk of the prize competition activities at the Department are undertaken by Reclamation's Prize Competitions Program.

Bureaus that are active in R&D 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 the non-governmental sector (including private entities) to pool their expertise and resources to jointly create and advance technologies that support agency missions while helping U.S. industries innovate and commercialize technologies that strengthen the economy and create jobs. This report focuses primarily on, but is not limited to, aspects of technology transfer related to the FTTA.

[2] Estimates furnished by the Office of Budget, Department of the Interior.

IV. Overview of Technology Transfer Activities

During FY 2024, the Department continued to engage in a broad range of cooperative activities to develop and disseminate innovative technologies, including:

- Collaborated on 23 CRADAs, of which four were initiated in FY 2024. In addition, the Department engaged in at least 3,149 other collaborative R&D relationships.
- Disclosed 11 new inventions, filed 1 new patent application, and awarded 0 new patents.
- Managed 44 active licenses for inventions and other intellectual property.
- Published more than 5,390 reports, books, fact sheets, and other publications, disseminating mission-relevant scientific and other technical information to the public and peers in and out of government.

Interior bureaus use 12 mechanisms to transfer information, knowledge, and technology within and outside their agencies (Table 1).

TABLE 1: INTERIOR TECHNOLOGY TRANSFER ACTIVITIES BY BUREAU

	USGS	FWS	OSMRE	NPS	BSEE	BOR	BOEM	BLM
Technical/Scientific Publications	X	X	X	X	X	X	X	X
Workshops/Seminars	X	X	X	X	X	X	X	X
Educational Courses & Other Outreach	X	X	X		X	X	X	X
Cooperative Research and Development Agreements (CRADAs)	X	X		X		X	X	
Technical Assistance Agreements (TAAs)	X							
Facility Use/Service Agreements (FUSAs)	X					X		
Material Transfer Agreements	X			X		X		
Demonstration/Joint Projects	X				X	X	X	X
Patents	X	X		X				
Licenses	X	X						
Other Cooperative Ventures & Agreement Types	X	X	X	X	X	X	X	X
Web and Other Mechanisms	X	X	X	X	X	X	X	X

V. Technology Transfer Agreements

In FY 2024, Interior bureaus were involved in 23 active CRADAS and at least 3,149 other collaborative R&D relationships (Table 2).

TABLE 2: COLLABORATIVE RELATIONSHIPS FOR RESEARCH & DEVELOPMENT (FY 2024)

	USGS	BOR	FWS	NPS	BLM	Total
CRADAs						
Total Active CRADAs	12	4	5	2	0	23
New CRADAs	1	2	1	0	0	4
New CRADAs Involving Small Businesses	0	2	0	0	0	2
Other collaborative R&D relationships						
Other Collaborative Agreements, total active in FY 2024	2,879	4	0	0	266	3,149

Interior bureaus disclosed 11 new inventions in FY 2024, most from the USGS (Table 3).

TABLE 3: INTERIOR PATENT ACTIVITY (FY 2024)

	USGS	BOR	Total
Invention Disclosures			
Total Invention Disclosures Received	10	1	11
Patents			
Total Patent Applications Filed	1	0	0
US	1	0	0
Foreign	0	0	0
Total PCT Applications Filed **(NOTE: PCT = Patent Cooperation Treaty. See https://www.wipo.int/pct/en/)**	0	0	0
Total Patents Issued	0	0	0
US	0	0	0
Foreign	0	0	0

Interior managed 44 invention licenses in FY 2024. Table 4 presents data on active licenses and the time required to grant them.

TABLE 4: ACTIVE LICENSES MANAGED BY INTERIOR BUREAUS (FY 2024)

	USGS	FWS	Total
Invention Licenses, Total Active	43	1	44
New Invention Licenses	2	0	2
New Invention Licenses to Small Businesses	1	0	1
Income bearing licenses, Total Active	12	1*	13
New Income Bearing Licenses	2	0	2
Exclusive licenses	9	1	10
Partially exclusive licenses	0	0	0
Non-exclusive licenses	3	0	3
Other Licenses, Total Active	31	0	31
New Other Licenses	0	0	0
New Other Licenses Granted to Small Businesses	0	0	0
Average (months)	8.5	0	8.5
Minimum (months)	7	0	7
Maximum (months)	11	0	11
Licenses terminated for cause	0	0	0

*Although this license has the potential to bear income, by the end of FY 2024 it had not produced any income and FWS does not anticipate that it will in the future.

Total income in FY 2024 from licenses is still being calculated, as many license agreements report royalty data on a calendar year basis and this data will not be received before the submission deadline for this report. In FY 2023, total income was $76,794 from 12 income-bearing licenses. Under 15 USC § 3710c, for all inventions originating in a Federal agency, the agency must pay to the employee-inventors the first $2,000 per year in license income, and a minimum of 15% of the yearly income thereafter. Each agency has discretion to implement its own sharing scheme, but the maximum that a single inventor can receive per year is $150,000. Any residual funds are usually retained by the agency or laboratory where the intellectual property was developed.[3]

The scope and nature of Interior bureaus' technology transfer activities reflects their missions (Table 5).

[3] URL: https://www.govinfo.gov/content/pkg/USCODE-2011-title15/html/USCODE-2011-title15-chap63-sec3710c.htm

TABLE 5: SCOPE OF ACTIVITIES AND PLANS RELATED TO THE FTTA, BY BUREAU

Mission	Technology Transfer
U.S. 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.	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. The USGS also pursues technology transfer opportunities under the FTTA and the Stevenson-Wydler Act in a variety of ways.
U.S. Fish & Wildlife Service (FWS). The mission of FWS is working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.	FWS's R&D is primarily focused on providing the basis for effective conservation to meet its mission. For example, the FWS Fish Technology Centers (FTCs) were established in 1965 to develop and improve fish culture technology and to assist Federal and State agencies, Tribes, and other nations interested in aquaculture research and solutions. FTCs have worked with industry and government to improve aquaculture opportunities.
Office of Surface Mining Reclamation and Enforcement (OSMRE). OSMRE is responsible for ensuring, through a nationwide regulatory program, that coal mining is conducted in a manner that protects communities and the environment, restores the land to beneficial use following mining, and mitigates the effects of past mining by aggressively pursuing reclamation of abandoned mine lands.	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 R&D 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.
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. NPS cooperates with partners to extend the benefits of natural and cultural resource	Technology transfer and employee inventions are addressed under the NPS benefits-sharing policy and procedural guidance.[4] Benefits sharing occurs when NPS receives monetary or nonmonetary benefits from the commercial use of a discovery or invention resulting from research originating under an NPS Scientific Research and Collecting Permit or other NPS permit or authorization. Authorities under the FTTA are essential to the NPS benefits-sharing program.

[4] URL: https://www.nps.gov/subjects/policy/index.htm

Mission	Technology Transfer
conservation and outdoor recreation throughout this country and the world.	
Bureau of Safety and Environmental Enforcement (BSEE). BSEE works to promote safety, protect the environment, and conserve resources offshore through vigorous regulatory oversight and enforcement.	The BSEE R&D program activities operate through the Office of Offshore Regulatory Programs (OORP) Emerging Technologies Branch (ETB) and the Oil Spill Preparedness Division (OSPD) Oil Spill Response Research (OSRR) role. BSEE research is associated with operational safety, pollution prevention, and oil spill cleanup techniques and technologies. BSEE research results are used to inform regulatory decision-making and promote Best Available and Safest Technology on the U.S. Outer Continental Shelf (OCS).
Bureau of Reclamation (Reclamation or BOR). 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 applied toward the development of solutions that increase efficiency, reduce maintenance costs, improve work safety, enhance infrastructure reliability, and increase the effectiveness of using desalination and other water treatment technologies to expand water supplies. The research programs use technology transfer fundamentals to help speed field deployment of new innovations.
Bureau of Ocean Energy Management (BOEM). BOEM manages the exploration and development of the Nation's offshore energy, geologic, and mineral resources in an environmentally and economically responsible way. 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 develops, conducts, and oversees scientific research specifically to inform policy decisions regarding development of OCS energy, geologic, and mineral resources. The research covers physical oceanography, atmospheric sciences, biology, protected species, social sciences, economics, submerged cultural resources, and environmental fates and effects. BOEM also funds research into offshore renewable energy technologies.
Bureau of Land Management (BLM). The BLM mission is for multiple-use and sustained yield in managing public land resources for a variety of uses, such as energy and mineral development, recreation, wildlife conservation, wilderness, livestock grazing, clean water, and timber harvesting, while also protecting a wide array of natural, cultural, scientific, and historical resources. The Federal Land Policy and Management Act of 1976 (FLPMA) mandates that BLM manages public land resources for a combination of balanced	BLM's scientific and technical focus has been on place-based applications to improve public land management in accordance with FLPMA. BLM focuses on traditional technology transfer activities to help advance FLPMA's multiple-use mandate.

Mission	Technology Transfer
and diverse resource uses that take into account the long-term needs of future generations for renewable and nonrenewable resources, including, but not limited to, recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific, and historical values.	

Subsequent sections briefly describe each bureau's technology transfer program and provide examples of their activities in FY 2024. The tabular data requested by Office of Management and Budget (OMB) Circular A-11 are reported in section XVI, "Data Appendix."

VI. U.S. Geological Survey

The USGS is a science bureau within 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. The USGS focuses on the following interdisciplinary mission areas: Core Science Systems; Ecosystems; Energy and Mineral Resources; Natural Hazards; and Water Resources. The combined expertise from several Earth-science disciplines (such as hydrology, geology, and biology) addresses 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 the Nation, customers, and partners.

Delivering scientific information is the USGS's primary mission. Technology transfer activities with the public and private sectors, including academia and nonprofits, are integral to fulfilling this mission. These efforts typically support knowledge dissemination, including the collection and transfer of scientific data. The USGS also cooperates with its public and private collaborators to help them maintain essential and necessary services, better understand the environmental consequences of their commercial and noncommercial activities, and develop new products and services. The USGS has over 280 laboratories across the country.

Within the USGS, technology transfer extends beyond traditional publications, meetings, and conferences. It builds on the Stevenson-Wydler Innovation Act of 1980, as amended by the FTTA and the National Technology Transfer and Advancement Act of 1995 and is managed through the USGS Office of Policy and Analysis (OPA). OPA serves USGS centers and offices throughout the country.

OPA negotiates and drafts CRADAs and other types of collaborative agreements, including technical assistance agreements, facility use service agreements, material transfer agreements, data use licenses, and patent licenses. OPA also manages the USGS intellectual property and inventions program; markets USGS technology opportunities; and facilitates partnerships with industry, nonprofits, academic institutions, federally recognized Tribes, and State agencies. OPA also provides training to USGS personnel on technology transfer and intellectual property matters.

In FY 2024, the USGS had 12 active CRADAs, one of which was new. In addition to those CRADAs, the USGS executed 2,879 collaborative agreements. Of these agreements, 2,338 were joint funding agreements. The remaining agreements include 197 technical assistance agreements, 237 collaborative agreements, and 107 facility use and service agreements.

The USGS published a total of 5,117 scholarly articles, papers, and book chapters focused on diverse areas (such as matters about understanding the Earth; minimizing loss of life and

property from natural disasters; and managing water, biological, energy, and mineral resources). The USGS also managed a total of 43 active intellectual property licenses.

In FY 2024, USGS science and research contributed to a broad range of collaborative projects in the private and academic sectors. Examples include the following:

Secure Water Data. Timely and reliable information on water resource monitoring—including water quality, quantity, soil moisture, and meteorological dynamics—is critical for both human and aquatic health, as well as effective water resource modeling and management. However, this data collection can be labor intensive and expensive (especially in remote locations). The USGS CRADA with OTT HydroMet establishes a collaborative framework to develop and test innovative environmental monitoring technologies and produce environmental observations from instruments, cameras, and wireless precipitation gauges using the SatLink3 data collection. Through this partnership, the USGS aims to advance hardware and software solutions for sensing, logging, telemetry, and data management. This cooperative research is advancing USGS monitoring and modeling to improve efficiency, lower costs, and better protect life and property.

These efforts are aligned with the objectives of the USGS Water Mission Area (WMA). A key requirement of the USGS WMA, specifically the Next Generation Water Observing System Program, is to enhance the capabilities of the widely used SatLink3 data collection platform. In 2024, a SatLink3 data collection platform equipped with a commercially available off-the-shelf camera monitoring system featuring night vision capabilities achieved a readiness level that ensures a familiar user interface and enables the storage of imagery files for transmission using compatible and compliant USGS telemetry. This system enhancement allows for the timely transmission of still-frame imagery indexed to environmental monitoring observations, such as turbidity and water level, from USGS monitoring locations to the Hydrologic Imagery Visualization and Information System dashboard. Coupling environmental observations from instruments and cameras significantly reduced operational and maintenance costs while enhancing the ability to find, access, interoperate, and retrieve these critical observations. Additionally, the USGS is mitigating its reliance on more costly third-party cloud hosting services for USGS field imagery and video by developing USGS data frameworks on a less costly web service.

Research and development of both innovative and existing hardware and software solutions—including sensing and logging ecosystems, telemetry, and web services—will continue in both laboratory and field environments. 2025 efforts will focus on eliminating dependency on third-party resources for telemetering images and video, while also evaluating wireless precipitation gauges for their readiness to provide secure and timely representative water data.

Eco-friendly Rodenticides Research.
Anticoagulant rodenticides are an effective tool for the control of vertebrate pest species, such as invasive rats. However, they often pose a significant risk to non-target wildlife that consume exposed or poisoned rodent prey. In FY 2023 and 2024, the USGS and scientists at VetAgro Sup, University of Lyon, France, undertook studies of two brodifacoum formulations (rat poisons) with varying elimination times in organisms. One of the formulations can be eliminated more quickly, meaning that less poison remains in the rodent after death, and therefore the rodent becomes less hazardous if consumed by non-target wildlife.

CLOSE-UP OF AMERICAN KESTREL IN THE WILD. THE USGS AND SCIENTISTS AT VETAGRO SUP, UNIVERSITY OF LYON, STUDIED THE IMPACTS OF VARYING RODENTICIDE FORMULATIONS ON AMERICAN KESTRELS. SOURCE: PUBLIC DOMAIN

These formulations were tested in a 7-day dietary feeding trial with American kestrels (*Falco sparverius*). Compared to unexposed control kestrels, birds that ingested the longer-lived formulation exhibited impaired blood clotting. In contrast, the same dose of the shorter-lived formulation yielded little or no effect on blood clotting time in these non-target test raptors. This proof-of-concept finding aligns with the notion that anticoagulant rodenticide baits enriched with less persistent compounds are less toxic to non-target wildlife, including threatened and endangered species.

Studies of Fish Locomotion and Passage at Barriers. Human activities have caused extensive fragmentation of river corridors. Dams, culverts, and other barriers prevent migratory and river fishes from accessing key habitats. This is particularly problematic for diadromous fishes like Atlantic salmon and American shad that must transition between freshwater and saltwater habitats to complete their life cycles. The USGS is leading several studies on fish swimming performance to inform management activities that affect valuable and ecologically important species nationwide. Swimming performance and behavioral responses to hydraulic conditions (turbulence, velocity, etc.) and development of quantitative methods for identifying and characterizing barriers are elements of this work. Other aspects include developing structures that promote passage of native species while blocking invasive species from critical habitats. This work has broad relevance to stewardship and management of aquatic resources, as well as understanding fundamental aspects of the ecology and evolution of fishes.

Methods and structures designed by the USGS and collaborators have led to assisting passage of 70,000 American shad into the upper Connecticut River during 2024, compared to 2,000 American shad in 2003, a 30 fold increase, using the same habitat. This work provides economic benefits by supporting recreational and commercial fisheries across America, including support of important marine species that feed on the young shad. In addition, USGS studies of sturgeon swimming ability found these fish are much stronger swimmers than previously believed. This means that fish ladders designed to pass them around dams and other obstacles can be built and operated at reduced societal costs while still promoting successful navigation to their breeding grounds.

SHORTNOSE STURGEON, AN ENDANGERED FISH SPECIES, FLOATING IN THE ABIKIS BURST FLUME DURING RESEARCH RUNS AT THE EASTERN ECOLOGICAL SCIENCE CENTER-CONTE FISH RESEARCH LAB IN TURNERS FALLS, MA. THIS RESEARCH SUPPORTS DEVELOPMENT OF NEW OR REFINED FISH PASSAGE AND HYDROELECTRIC STRUCTURES. SOURCE: PUBLIC DOMAIN

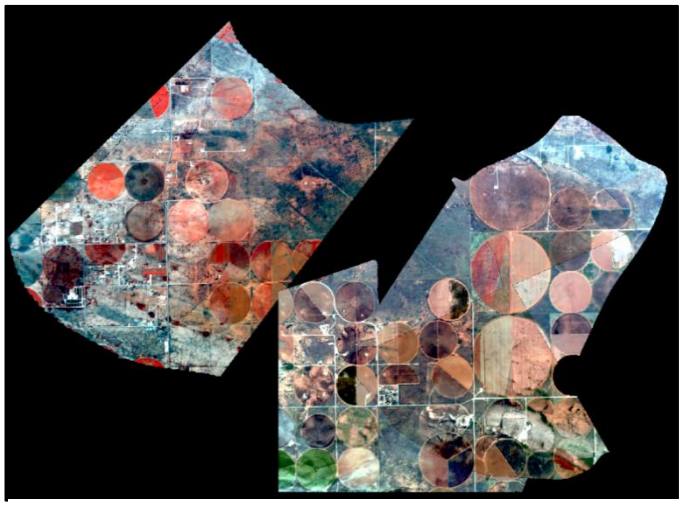
In May 2024, over 500 people from over 30 countries attended Fish Passage, a joint conference with the American Society of Civil Engineers, the American Fisheries Society, and the International Association of Hydroenvironment Engineering and Research. This conference was organized by the USGS CRADA partner, Elsa Goerig, a Senior Research Fellow at Harvard University. The USGS delivered the Keynote Address highlighting the USGS's "Studies of Fish Locomotion and Passage at Barriers."

Stratospheric Lidar and Remote Sensing Concept of Operations for USGS Research.

Enhanced climate and environmental imaging, monitoring, and data collection from the stratosphere can support the monitoring of wildfire activity, storms, earthquakes, and other extreme weather events. Improved tracking of environmental data can help to mitigate environmental harms and keep people safe. Sceye, a leading U.S. aerospace company specializing in High-Altitude Platform Systems (HAPS), has a CRADA with the USGS and a Space Act agreement with the National Aeronautics and Space Administration (NASA) to collaborate on more precise earth observation. HAPS provide a unique vantage because they can linger over events and take high resolution data continuously in real time, providing a more accurate understanding of what may happen before, during, and after an event.

HIGH-ALTITUDE PLATFORM SYSTEMS DEVELOPED BY SCEYE LAUNCHING IN ROSWELL, NEW MEXICO. THE CRADA WITH SCEYE IS INTENDED TO ENHANCE CLIMATE AND ENVIRONMENTAL IMAGING, MONITORING, AND DATA COLLECTION FROM THE STRATOSPHERE. SOURCE: SCEYE

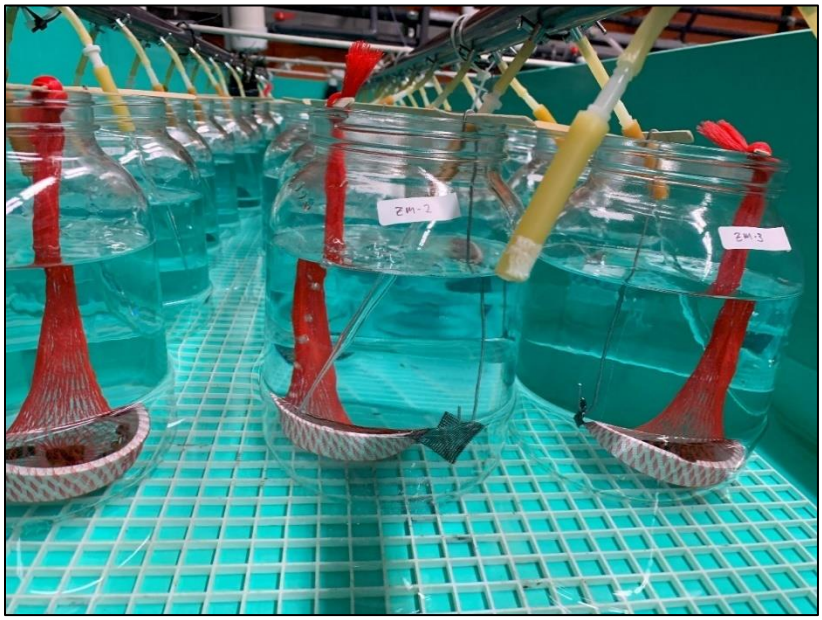
Sceye had a successful 2024 flight program, demonstrating the platform's readiness for commercialization and long duration missions in 2025. Challenges— including high altitude, payload weight, hovering ability, and power requirements to operate the equipment— were overcome to complete a successful test run, and images were taken from the stratosphere over farmland in New Mexico. Sceye's airship collected the first images with a USGS-owned 400-1000nm hyperspectral imager from HySpex on a HAPS flight under this CRADA.



FIRST IMAGES OF PIVOT IRRIGATION FIELDS TAKEN FROM THE STRATOSPHERE OVER NEW MEXICO, USING A MJOLNIR HYPERSPECTRAL IMAGER ON THE SCEYE PLATFORM. SOURCE: PUBLIC DOMAIN

Invasive Mussel Control Tools. Invasive mussels, including zebra and quagga mussels, can cause negative environmental and economic impacts. The USGS is working with the U.S. Environmental Protection Agency (EPA) and the multiagency Invasive Mussel Collaborative on the development of control tools that can be used in closed systems, such as hydropower facilities and municipal water supplies, to prevent biofouling by mussels. Control tools for open water systems are needed to reduce the impact of invasive mussels on commercial and recreational fisheries and imperiled native mussel species and the development of harmful algal blooms.

The USGS continues to investigate control tools that are cost effective and safe to the public and the environment. Zequanox was registered with the EPA as a molluscicide for controlling invasive mussels in closed and open systems. Applications of Zequanox in open water have shown its effectiveness for reducing invasive mussel populations; however, widespread use of Zequanox has been hindered by cost of production, formulation, and application challenges with the current formulation. Invasive Species Corporation (ISC) is developing a second generation of Zequanox that will be less expensive and easier to apply. Scientists at the USGS Upper Midwest Environmental Sciences Center are collaborating with ISC to evaluate improved formulations and delivery mechanisms of Zequanox as a feasible tool that industry, municipalities, and natural resource managers could use as an alternative to the currently available molluscicides. This research is relevant to aquatic invasive species control efforts across the US by demonstrating tool development for increased efficacy, improved delivery, and decreased production cost. This approach can be more widely applied to other aquatic invasive species and lead to safer and less expensive management options.



EXPERIMENTAL LABORATORY TEST OF NEW ZEQUANOX FORMULATION, WHEREIN ZEBRA MUSSELS ARE EXPOSED (RED BAG) TO A ZEQUANOX PELLET (BLACK BAG) TO MEASURE EFFECTIVENESS. SOURCE: MATT MEULEMANS, USGS

Antimycin-A Formulation Manufacturing and Development for Fish Restorations. Invasive fish cause significant ecological and economical damage to the United States. Since FY 2022, the USGS and Invasive Species Corporation have partnered to manufacture Antimycin-A and support the EPA reinstatement of a historical liquid pesticide formulation. A pesticide

containing the active ingredient Antimycin-A was previously used by resource managers for native fish restorations throughout the United States. However, the previous manufacturer let its registration lapse. ISC is developing the techniques for Antimycin-A production and purification, while scientists at the USGS are testing this Antimycin-A to verify its toxicity. This partnership aims to register the fish control product under the new name, Piscamycin. The USGS and ISC will soon meet with the EPA to review production data as the initial step in getting this product reregistered for use. This will lead to the product being commercially available to fishery managers nationwide.

LEFT: **SCIENTISTS ADDING LIQUID ANTIMYCIN-A FORMULATION TO EXPERIMENTAL CHAMBERS DURING A FISH BIOACTIVITY STUDY TO VERIFY A NEW ANTIMYCIN-A BATCH AND DETERMINE ITS TOXICITY. SOURCE: PUBLIC DOMAIN. *RIGHT:* A FISH CAGE AND ANTIMYCIN-A FORMULATION DRIP STATION USED DURING A STREAM FISH RESTORATION PROJECT. SOURCE: PUBLIC DOMAIN**

Genetic Controls for Invasive Carps. The USGS and Sundew Aps are continuing to develop an RNA interference control tool for eliminating invasive grass carp (*Ctenopharyngodon idella*). Grass carp are a significant concern to states, fishermen, waterfowl hunters and observers, as their presence degrades water quality and promotes nuisance algal growth. Grass carp have invaded the Great Lakes and Mississippi River basins and are substantially harming native fishes and waterfowl by decimating the aquatic plants that commercially and recreationally important native species depend on for food and habitat. In the Great Lakes, grass carp pose a significant socioeconomic risk to the recreational and commercial fishing industry over the next 10 years.

Commercial harvesting is effective at reducing large populations of grass carp. Chemical treatments are effective at extirpation in small waterbodies but are prohibitively expensive to treat large waterbodies and have substantial non-target impacts (e.g., killing all fish rather than just grass carp). USGS scientists and scientists at Sundew Aps are developing an alga that will synthesize the interfering RNA and deliver it to the grass carp as part of a USGS-developed grass carp bait. The use of such genetic control and delivery tools could revolutionize fishery management because they can specifically target grass carp, even at low-density populations, without impacting commercially, recreationally, and ecologically important species. Techniques and technologies developed in this collaboration will help create a blueprint for further development of tools for control of aquatic invasives. This research can be impactful nationwide and beyond by providing natural resource managers with a new tool for controlling grass carp that is more selective than existing methods.

GRASS CARP INVASIONS ARE HARMING NATIVE FISHES AND WATERFOWL IN WATER BODIES ACROSS THE UNITED STATES. USGS AND SUNDEW APS ARE WORKING TO DEVELOP GENETIC CONTROL AND DELIVERY TOOLS TO REDUCE GRASS CARP POPULATIONS. SOURCE: USGS

VII. U.S. Fish and Wildlife Service

The FWS is dedicated to the conservation, protection, and enhancement of fish, wildlife, and plants and their habitats. FWS is the only Federal agency whose primary responsibility is managing fish and wildlife resources for the American public. The National Wildlife Refuge System's 855 million acres of lands and waters includes 572 national wildlife refuges, waterfowl production areas in 213 counties managed within 38 Wetland Management Districts and 48 Coordination Areas, and five Marine National Monuments, including more than 759 million cooperatively managed acres of submerged lands and waters. FWS also operates National Fish Hatcheries, which, in conjunction with Fish and Wildlife Conservation Offices, its Fish Health Centers and Fish Technology Centers, restore native aquatic populations, mitigate fish losses caused by Federal water projects, and support recreational fisheries throughout the United States.

R&D within FWS is primarily focused on applying the latest scientific and technical information to fulfill its mission. Transferring FWS's technology and knowledge to the public and collaborators accelerates the adoption and use of agency research while improving the economic and societal benefit from its R&D investments to help solve natural resource problems.

The technology transfer function of FWS is shared among several programs, including Science Applications, Fish and Aquatic Conservation (FAC), and Joint Administrative Operations (JAO). The majority of FWS's technology transfer is done via dissemination to the public and scientific community through traditional avenues such as peer-reviewed papers, presentations, reports, and fact sheets. Science Applications and JAO help coordinate technology transfer activities in the Service while other programs are more directly involved with partners.

FWS employees are actively involved in the larger scientific community and participate in scientific societies, meetings, and conferences and publish scientific research. Sharing scientific and technical information via public outreach and partnerships is a high priority for FWS. For example, FWS is a partner to all units within the 17 Cooperative Ecosystem Studies Units (CESU) Network, allowing FWS to be involved in interdisciplinary and multiagency research projects with the host university and other non-Federal partners. Each year, FWS pursues dozens of projects through the CESU network, including surveying and monitoring efforts, climate change vulnerability assessments, streamflow projections, and many others.

Scientists within the agency published 398 scholarly articles, papers, or book chapters in publications focused on diverse topics such as ecology, biodiversity conservation, fisheries, zoology, ornithology, environmental sciences, and evolutionary biology. FWS also 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 electronic journals are in the public domain. 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 Program systematically obtains a range of biological data about the status, trends, and management responses of species and habitats within the National Wildlife Refuge System.

Fish and Aquatic Conservation. In FY 2024, FWS created one new CRADA and maintained four CRADAs through the Aquatic Animal Drug Approval Partnership (AADAP) program for a total of 5 within FAC. These CRADAs were created with pharmaceutical companies in collaboration to work towards drug approvals for use in aquaculture and fisheries management. They are essential for AADAP's work in obtaining U.S. Food and Drug Administration approval of new medications needed to help keep aquatic animals healthy and to facilitate safe handling, spawning, marking, and other fisheries management activities.

FWS AQUATIC ANIMAL DRUG APPROVAL PARTNERSHIP PROGRAM WORKS WITH PARTNERS TO CONDUCT RESEARCH WITH NEW MEDICATIONS TO GAIN APPROVALS THROUGH THE FDA FOR AQUATIC ANIMALS. SOURCE: FWS

VIII. Office of Surface Mining Reclamation and Enforcement

The OSMRE, established by the Surface Mining Control and Reclamation Act of 1977 (SMCRA), is responsible for ensuring that coal mining is conducted in a manner that protects communities and the environment and restores the land to beneficial use following mining, and mitigating the effects of past mining by aggressively pursuing reclamation of abandoned mine lands (AML). OSMRE achieves this in part by providing technical assistance and technology transfer activities to its State and Tribal partners to enhance their ability to maintain effective programs.

The goals 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. These combined lines of effort provide better informed decision-making and more enduring remediation of hazards and environmental degradations for our programmatic partners and ultimately the public. OSMRE accomplishes these goals via the Technical Innovation and Professional Services (TIPS) program, the National Technical Training Program (NTTP), and the National Technology Transfer Team (NTTT).

Technical Innovation and Professional Services (TIPS). TIPS is a national program that researches and applies emerging technologies to SMCRA workflows. TIPS provides 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 software and technical hardware supported by OSMRE in partnership with the States and Tribes. The TIPS suite of scientific, hydrologic, and mapping core software aids the technical decision-making associated with a wide variety of tasks that surface mining agencies must perform regularly.

Currently, TIPS assistance includes providing commercial software applications and hardware to State, Tribal, and OSMRE offices at considerable cost savings by sharing the commercial licenses for 20 commercially available software applications via the Internet and an OSMRE-wide area network. The customer base covers more than 60 State, Tribal, and OSMRE office locations throughout the country.

Demand for TIPS tools and support continues to increase, especially for geospatial data and mobile computing tools for field use. TIPS is offering more onsite training for state, Tribal, and Federal personnel to familiarize them with use of mobile computing devices by inspectors. The TIPS Training Program is a collaborative effort among OSMRE, States, and Tribes. Course developers and instructors are reclamation experts who use TIPS software to solve a wide range of complex permitting, enforcement, and AML problems. Although most TIPS tools are off-the-shelf applications, TIPS training is tailored exclusively to mining and reclamation uses.

TIPS courses are delivered at OSMRE's Regional Offices in Alton, Illinois; Pittsburgh, Pennsylvania; in rental training facilities at various locations; and on site at the customer's request. When trained, the students are able to use the technical resources to solve complex SMCRA permitting, enforcement, and AML related matters to protect the public and the environment.

In FY 2024, the TIPS training program received a customer satisfaction rating of 96.6 percent, exceeding the annual Government Performance and Results Act (GPRA) goal of 96 percent. TIPS held its first TIPS led in-person classes since the COVID-19 pandemic. TIPS held 29 virtual classes and taught seven in-person classes, which included five special training session requests from the States and Tribes. For FY 2024, there were 245 students trained.

IN-PERSON TIPS NAVAJO AML MOBILE GEOSPATIAL TRAINING IN SHIPROCK, NEW MEXICO, SEPTEMBER 2024. THIS TRAINING HELPS STUDENTS ADDRESS AML RELATED MATTERS TO PROTECT THE PUBLIC AND THE ENVIRONMENT. SOURCE: OSMRE

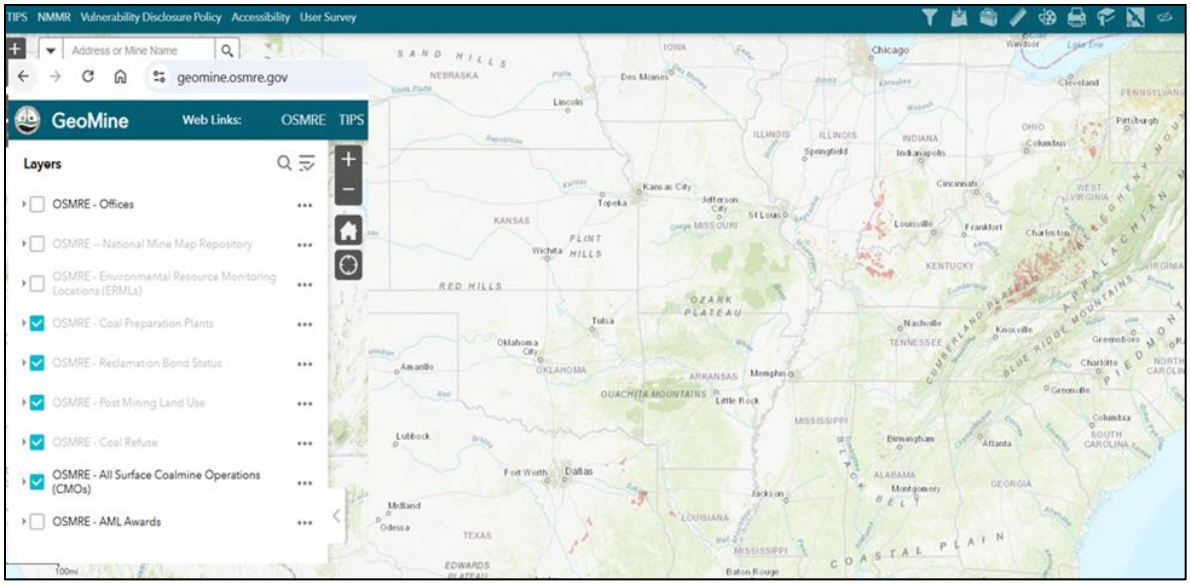
Mobile computing increases efficiency in resolving State, Tribal, and industry issues. Below are additional details on the computing and mapping tools the TIPS program supports. Deployment of the TIPS technical solutions result in better-informed decision-making and resource

management, ultimately maximizing the value of public investments in technology and ensuring that taxpayer dollars are used effectively.

Remote Sensing Program. Remote sensing data are essential for OSMRE and its partners to effectively monitor mining and reclamation efforts, ensuring that former mined lands are safely and thoroughly restored. The Western Region (DOI Regions 5, 7-11) successfully renewed a contract with Planet Labs. This collaboration enables OSMRE to access lower-resolution satellite data and related products, allowing inspectors to examine critical features such as vegetation, impoundments, and geological characteristics. Although some limitations exist with lower-resolution data, this resource provides a basic foundation for long-term monitoring of reclamation efforts and the early detection of significant issues, such as large highwall failures.

E-AMLIS (Public Mapping Viewer) System. OSMRE has significantly enhanced the public mapping component of the e-AMLIS system, facilitating crucial technology transfer to the public. The modernization combines interactive maps, dashboards, charts, and widgets to provide users with an upgraded experience that enhances accessibility and data utilization. The improved mapping system allows users to overlay problem area descriptions on various datasets, including census data. This capability enables stakeholders to analyze reclamation progress in relation to social and environmental factors. With both basic and advanced query functionalities, users can explore a comprehensive nationwide dataset by leveraging multiple attributes. This empowers the public to extract valuable insights into reclamation efforts, fostering transparency and informed decision-making.

GeoMine. GeoMine is an interactive web-based mapping application of coal mining and reclamation activities within the United States. It is an ongoing effort to provide the best available data for surface coal mining operations across the country, merging data from numerous sources to create standardized, seamless layers that cross State boundaries. All GeoMine layers, consisting of data compiled from State and Federal partners, are publicly available. FY 2024 saw major increases in the state data represented in GeoMine. Four additional states were added to the application, with three of them being significant coal mining states. Only a few coal mining states are not yet included. This is a significant step toward creating standardized polygon layers of coal mining data with full nationwide coverage--the only data of its kind. These layers already have a diverse user base, but other Federal groups are now looking to leverage them in suitability models and other projects. The need for full nationwide datasets of this information will only continue to grow. OSMRE is now much closer to being able to provide them. FY 2024 usage increased slightly from FY 2023 with 2,400 users and 164 data downloads.



SCREENSHOT OF GEOMINE (12/11/2024) SHOWING COAL MINING AND RECLAMATION ACTIVITIES WITHIN THE UNITED STATES. GEOMINE IS AN ONGOING EFFORT TO PROVIDE BEST AVAILABLE DATA FOR SURFACE COAL MINING OPERATIONS ACROSS THE COUNTRY. SOURCE: OSMRE

ArcGIS Online. The AcrGIS Online (AGOL) web mapping system enables mine inspectors to work in near-real time with SMCRA partners, significantly improving workflow efficiency. By the end of FY 2024, OSMRE's AGOL had 842 active accounts, with 232 new accounts added for States and Tribes, alongside 53 OSMRE users. This collaborative platform enhances inter-agency communication and data-sharing capabilities, crucial for efficient fieldwork. ArcGIS Online serves as the primary licensing mechanism for Esri's ArcPro, which is essential for daily operations concerning active and abandoned mines. The migration to AGOL has resulted in a stable account level of around 850-900, and with most users now licensed through AGOL, OSMRE anticipates a slowdown in new account requests as users adapt to ArcPro. Overall, OSMRE's strategic use of ArcGIS Online fosters significant technology transfer, enabling enhanced collaboration and improved efficiency in geospatial data management across all workflows.

Geospatial Mobile Technology. Mobile technologies are increasingly integral to fieldwork, significantly enhancing data collection and analysis capabilities. Geospatial personnel at OSMRE collaborate with other OSMRE staff, States, and Tribes (e.g., Navajo and Hopi) to maximize the use of these technologies. In FY 2024, OSMRE expanded use of tablets and smartphones for displaying and collecting geospatial data during mine and AML site investigations. OSMRE also provided training to State and Tribes in the field to ensure effective use of mobile applications. OSMRE-supported mobile applications include:

- *Esri Survey123:* Primary tool for field data collection, leveraging enterprise datasets in ArcGIS Online.

- *Esri Field Maps*: Application for real-time data access and collection.
- *Avenza Maps:* Used in non-enterprise data situations; supports individuals needing map access in the field.
- *Global Mapper Mobile:* Used for offline data collection and storage.

National Technical Training Program (NTTP). Established in 1985, the NTTP enhances the technical skills and professionalism of State, Tribal, and OSMRE regulatory and reclamation staff. NTTP keeps participants up to date with the latest technologies, methodologies, and policies to ensure best practices in protection and land restoration. The program, a collaborative effort among State, Tribal, and OSMRE offices, offers comprehensive training aligned with SMCRA mandates.

In FY 2024, 94 instructors and subject matter experts from State, Tribal, and OSMRE offices provided support for curriculum delivery and curriculum development for 43 courses, three special session, and 10 course revisions. These experts specialize in mining regulatory and reclamation practices. NTTP's training portfolio also includes 12 online self-paced courses, which complement in-person offerings.

UNDERGROUND MINING TECHNOLOGY COURSE IN MORGANTOWN, WV, JUNE 2024. THE NATIONAL TECHNICAL TRAINING PROGRAM IS A COLLABORATIVE EFFORT AMONG STATE, TRIBAL, AND OSMRE OFFICES TO ENHANCE THE TECHNICAL SKILLS AND PROFESSIONALISM OF REGULATORY AND RECLAMATION STAFF. SOURCE: OSMRE

Following enactment of the 2021 Infrastructure Investment and Jobs Act (IIJA), NTTP developed the Introduction to SMCRA and IIJA curriculum. This training covers SMCRA, NEPA, e-AMLIS, and Reclamation Planning and was revised in 2024 and updated with STREAM Act[5] curriculum. The training is available online through DOI Talent. In FY 2024, 31 students completed this curriculum.

[5] The Consolidated Appropriations Act, 2023 (PL 117-328) included an amendment, commonly referred to as the STREAM Act, to section 40701 of the Infrastructure Investment and Jobs Act. This amendment authorized eligible States and Tribes to deposit up to 30 percent of their annual IIJA AML grant amount in a long-term AML reclamation fund established under State or Tribal law.

NTTP courses cover diverse technical areas such as AML restoration, inspection techniques, soils and revegetation, handling toxic materials, water-quality assessments, legal enforcement procedures, and preparation of evidence and testimony. In FY 2024, there were 697 in-person and 310 online course completions, achieving a 94% course effectiveness rating based on student feedback.

The training provided by NTTP ensures that the individuals responsible for regulating and overseeing mining activities are well-equipped with the latest knowledge and techniques. This helps prevent environmental damage, ensures safe land restoration, and promotes the responsible use and protection of natural resources.

National Technology Transfer Team (NTTT). The NTTT team brings together members of OSMRE, State and Tribal SMCRA programs, as well as representatives from the Interstate Mining Compact Commission and the National Association of Abandoned Mine Land Programs (NAAMLP), to coordinate understanding of mining-related issues across the country. The NTTT collaborations result in exchanges of latest technologies in various mine-related aspects such as mine drainage treatment processes, UAS (uncrewed aerial services), reclamation best management practices that result in increased efficiencies and cost savings to State and Tribal partners.

OSMRE's NTTT also coordinates OSMRE's Applied Sciences Program with the goal to develop, demonstrate, and share improved technologies to address environmental issues related to the mining of coal and subsequent reclamation of the land. The program accomplishes this by funding studies conducted by universities, nonprofit 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, rare earth elements, and other topics relevant to environmentally responsible mining and reclamation. These projects go beyond theoretical research and investigate application of existing theory to on-the-ground mining and reclamation issues.

In FY 2024, the ASP team continued to manage eight projects that were selected in FY 2021, along with an additional eight projects selected in FY 2023 through a Notice of Funding Opportunity (NOFO) issuance for approximately $1.6 million each fiscal year. Additionally, eleven topics have been approved for the FY 2024 NOFO solicitation which will be posted in Grants.gov in early FY 2025. The proposals were evaluated based on scientific and technical merit. The projects have a two-year term, but a no-cost extension can be granted if warranted. Reports and findings of completed projects are available on the OSMRE Applied Science website. [6]

[6] URL: https://www.osmre.gov/programs/applied-science

NTTT continued to manage the interactive Applied Science GIS application that allows any interested party to access quarterly status reports for funded and ongoing projects. The GIS application can be accessed on the ArcGIS dashboard for OSMRE Applied Science. [7]

Additional Technology Transfer Activities.

The Geospatial Services Branch (GSB) within Regions 1 and 2 (AR) represented OSMRE at the 2024 National Historically Black Colleges and Universities (HBCU) Conference. OSMRE showcased the Truetown mine complex and paint pigment project.

The GSB also supported the Pennsylvania of Department of Environmental Protection (PA DEP) by piloting UAS missions in support of reclamation and mining features. Specifically, OSMRE provided detailed reports which calculated volumes of refuse piles to determine reclamation costs. Additionally, GSB provided critical mapping to PA DEP for a request for proposals related to the Little Conemaugh mine pool complex and water treatment system.

OSMRE BOOTH DISPLAY AT 2024 NATIONAL HISTORICALLY BLACK COLLEGES AND UNIVERSITIES CONFERENCE. SOURCE: OSMRE

The Geospatial & Technology Transfer Branch within Regions 3, 4, and 6 (MCR) conducted three Technology Transfer Roadshows during FY 2024 in Texas, Missouri and Kansas. The goal of a roadshow is to strengthen relationships between MCR and the mid-continent States technical staff. At the roadshows, OSMRE presents existing and new technology accessible to the mid-continent States and throughout OSMRE. States can request on-site demonstrations and training during the roadshow or schedule them for the future. MCR States can develop their own skills by borrowing OSMRE equipment, or if needed, they can rely on OSMRE technical staff to directly perform tasks. During the roadshow lengthy and detailed discussions with OSMRE staff help

[7] URL: https://experience.arcgis.com/experience/ff3243e737cc476da6ab1368f4836b9c

define problems, conceptualize solutions, and inform decisions regarding technology acquisition strategies and future supporting engagements between staff.

The National Mine Map Repository (NMMR) team fulfilled over 120 customer requests in FY 2024, which includes both internal end users and members of the public. The NMMR facilitated a visitor's tour for the Bureau of Reclamation and began collaborating with the Interior Museum to spread awareness about the availability of both hard rock and coal mine maps. The NMMR closed out five archive projects, including a collection from West Virginia University.

IX. 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. Most of these activities are undertaken at the level of each individual park unit, but service-wide 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. In cooperation with partners, NPS also works to preserve and interpret 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.

To expand the range of expertise and tools available to it, NPS participates in many collaborative ventures with universities and other governmental and nongovernmental organizations, including the Cooperative Ecosystem Studies Units Network.

NPS Cultural Programs include the National Center for Preservation Technology and Training (NCPTT), which Congress created to fill a fundamental need for research and technology transfer among Federal, State, local, and Tribal governments, Native Hawaiian organizations, educational institutions and other public entities with historic preservation programs. The NCPTT serves as a research and development laboratory for historic preservation and advances the application of science and technology to preservation issues. 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.

NPS encourages qualified scientists to undertake research on parks' physical, biological, and other resources under the aegis 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 policies 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.[8]

[8] For further information on NPS benefits sharing, see Benefits Sharing in the National Parks (U.S. National Park Service) (nps.gov). URL: https://www.nps.gov/nature/benefits-sharing.htm

X. Bureau of Reclamation

The Bureau of Reclamation is a water management agency whose mission 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 is the largest supplier and manager of water in the 17 western States and the Nation's second-largest producer of hydroelectric power. Reclamation manages water for agricultural, municipal, and industrial uses and provides flood risk reduction and recreation for millions of people.

Reclamation's management and recreation activities contribute more than $34.1 billion to the economy and support 450,700 jobs.[9] Reclamation provides western farmers with irrigation water for 10 million farmland acres that produce 60 percent of the nation's vegetables and one quarter of its fresh fruit and nut crops. Further, Reclamation delivers about 10 trillion gallons of water to 31 million people for municipal, residential, and industrial use. Through the process of providing water deliveries, Reclamation also generates hydropower through 77 owned power plants, 53 of which are operated and maintained by Reclamation. The latter 53 power plants account for 15 percent of the hydroelectric generating capacity in the United States and generate roughly 40 billion kilowatt hours of electricity annually, which is enough to supply more than 3.8 million U.S. households.

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's R&D Office manages two appropriated R&D programs: the Science and Technology (S&T) Program and the Desalination and Water Purification Research (DWPR) Program.

The S&T Program is the primary R&D program for Reclamation and funds intramural research that spans the spectrum of its water-related technical challenges. Its goals are to identify and develop cost-effective solutions to the technical and scientific problems affecting the accomplishment of Reclamation's mission and to communicate those solutions to Reclamation offices, its stakeholders, other water and power management officials, and the general public. In addition to supporting internally led research, the S&T Program supports other program areas. S&T prize competitions enlists crowdsourced innovation to address some of Reclamation's most difficult challenges in infrastructure, water availability, and environmental compliance. S&T Snow Water Supply Forecasting aims to advance emerging technologies to enhance snow monitoring and subsequent water supply forecasts. Finally, S&T Facilitated Adoption supports the transition of promising research and prize outcomes into broader use throughout Reclamation.

[9] Bureau of Reclamation, "About Us—Fact Sheet." Updated 1/19/2024. URL: https://www.usbr.gov/main/about/fact.html

The DWPR Program invests in extramural R&D that advances the capabilities of water treatment technologies to enable them to be used more broadly for the creation of new water supplies from non-traditional sources (e.g., seawater, brackish groundwater, produced waters from oil and gas, municipal and industrial wastewater), nationwide or even globally. Such new supplies can relieve water stress on western communities, Tribes, western river basins supporting Reclamation projects, the Nation as a whole, and worldwide in water-constrained areas. The program also supports the operation and maintenance of the Brackish Groundwater National Desalination Research Facility, which hosts Federal and non-Federal R&D clients conducting bench-scale studies to pilot-scale demonstrations.

Although Reclamation's R&D focuses on developing solutions that address Reclamation technical mission needs, such solutions can also have broad applicability beyond Reclamation's jurisdiction in the western United States. 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. Most of Reclamation's R&D reports, data, and information on technology advancements are transferred through public dissemination via the R&D Office website[10] as well as through Reclamation's new open data sharing platform, the Reclamation Information Sharing Environment.[11]

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 and serves as the Bureau's Office of Research and Technology Applications (ORTA), as required by 15 USC § 3710(b).

Reclamation also works to increase awareness across U.S. industries and other nongovernmental organizations of 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, 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.

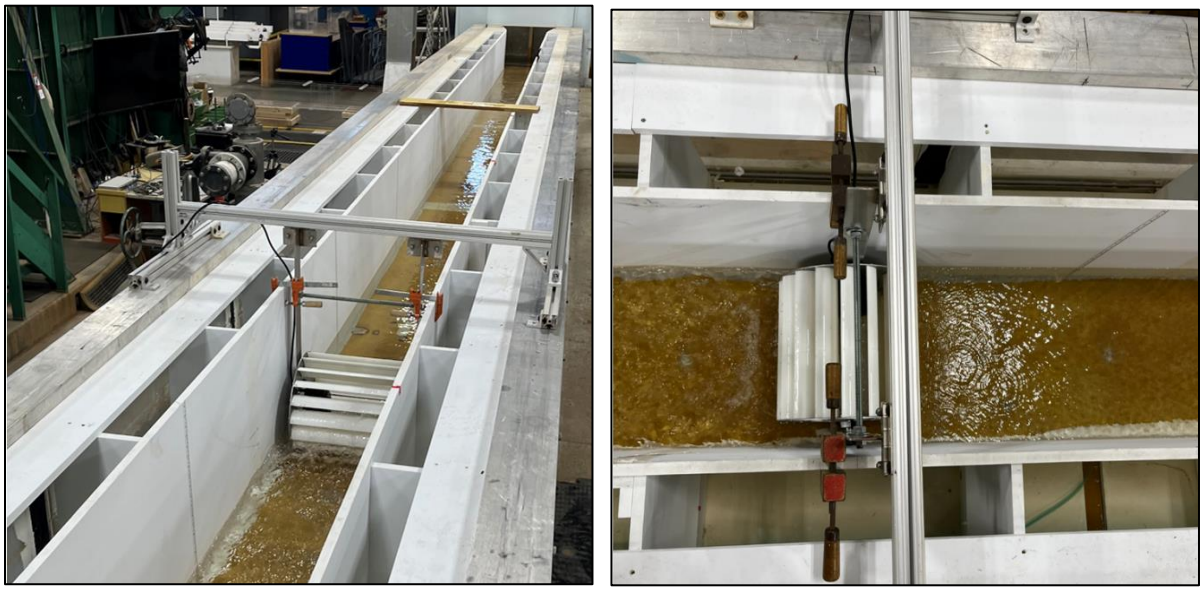
The following are examples of Reclamation's FY 2024 technology transfer activities.

---

[10] URL: www.usbr.gov/research

[11] URL: https://data.usbr.gov

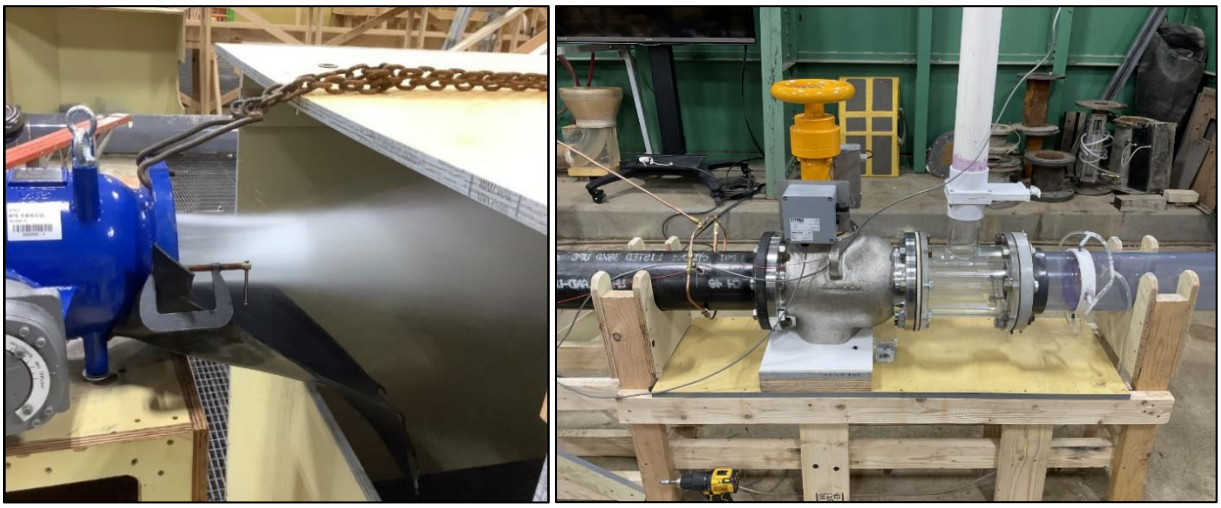
Hydraulic Impacts of Hydrokinetic Units in Canals. The implementation of hydrokinetic (HK) units in inland waterways has seen expanded interest as a renewable energy source. To understand the viability of HK units in canals, the Hydraulics Laboratory at Reclamation's Technical Service Center has performed field studies to quantify operational impacts to canal systems and has expanded their research to the laboratory. Reclamation has partnered with HeliosAltas to test lab-scaled versions of their HK units at Reclamation's Hydraulics Laboratory through a Cooperative Research and Development Agreement. The lab-scale HK units are tested in a modified flume to represent a range of canal operational conditions and unit performance where power output is measured. The modular nature of the HK units in the lab allows for evaluating several variables that were not possible in field tests, such as longitudinal spacing between units, canal section geometry (i.e., rectangular vs. trapezoidal), and flow regime (i.e., subcritical vs. supercritical flow). In 2024, testing was completed to evaluate how the spacing of the HK units affected water levels, velocities, and power available in the canal for typical subcritical flow conditions. Further testing will continue with HeliosAltas as part of the CRADA through 2026.



LAB-SCALE HYDROKINETIC (HK) UNIT UNDERGOING TESTING IN RECLAMATION'S HYDRAULICS LABORATORY. THIS TESTING HELPS UNDERSTAND THE VIABILITY OF HK UNITS IN INLAND WATERWAYS AS A RENEWABLE ENERGY SOURCE. SOURCE: RECLAMATION

Plunger Valve Flow Control Technologies. As Reclamation's infrastructure continues to age, many flow control gates and valves need to be replaced or rehabilitated. Reclamation's inventory still includes older technologies such as hollow-jet and tube valves that are difficult to rehabilitate. Modern flow control options such as plunger and axial control valves are used in the water resources industry throughout Europe and other areas of the world but are new to

Reclamation. They have a potentially wide range of free discharge and inline applications for dams and hydropower plants. Through laboratory testing and field studies, this research aims to evaluate the hydraulic performance of these valves to determine their benefits and limitations for application to Reclamation facilities. Reclamation's Hydraulics Laboratory at the Technical Service Center has partnered with several valve manufactures to perform laboratory testing. Material Transfer Agreements have allowed Reclamation to access lab-scale control valves from the companies VAG, Armacon, Kurimoto, and Mokveld. In 2024, testing of these valves in free discharge and inline configurations began to characterize their hydraulic performance for a range of operating conditions. Lab results will be compared to field operations from several facilities in Utah in collaboration with local water authorities and Reclamation's Upper Colorado Basin region. This study is expected to be completed by late 2025.



PLUNGER VALVE PROVIDED BY VAG UNDERGOING TESTING IN AN OPEN ATMOSPHERE FREE DISCHARGE CONDITION (LEFT) AND PLUNGER VALVE PROVIDED BY MOKVELD IN A PRESSURIZED INLINE CONDITION (RIGHT). RECLAMATION HAS PARTNERED WITH VALVE MANUFACTURERS TO EVALUATE HYDRAULIC PERFORMANCE OF VALVES AND INFORM POTENTIAL APPLICATION TO RECLAMATION FACILITIES. SOURCE: RECLAMATION

XI. Bureau of Safety and Environmental Enforcement

The Bureau of Safety and Environmental Enforcement (BSEE) is America's lead agency charged with advancing safety, environmental protection and conserving natural resources related to energy development on the U.S. Outer Continental Shelf (OCS). BSEE's R&D focus is on offshore energy issues and activities. These activities primarily involve the Office of Offshore Regulatory Programs (OORP) and the Oil Spill Preparedness Division (OSPD).

OORP drives and supports continual improvement in safety, environmental protection, and offshore resource conservation through data and risk analysis, safety improvement initiatives, regulatory development and maintenance, standards and stakeholder engagement, policy development and oversight, and emerging technology evaluations to provide strategic guidance in support of BSEE's regulatory oversight and enforcement mission. OSPD ensures that owners and operators of offshore facilities are ready to mitigate substantial threats of, and respond to, actual oil spills that may result from their activities. OSPD performs numerous functions to improve oil spill preparedness and response capabilities including comprehensive contingency planning, equipment testing and inspection, quality training, unannounced exercises, R&D, and engaging with the stakeholders of the National Response System.

BSEE R&D programs operate through OORP's Emerging Technologies Branch (ETB) and OSPD's Response Research Branch (RRB). The ETB is the agency's focal point on operational safety and pollution prevention research. Such research has been conducted with Interior since the late 1970s. OSPD's Oil Spill Response Research in its Oil Spill Preparedness Program contributes to the interagency collaborative efforts formalized in Title VII of the Oil Pollution Act of 1990 and focuses on improving the methods and technologies used for oil spill detection, containment, treatment, recovery, and cleanup.

OSPD operates Ohmsett, the National Oil Spill Response Research and Renewable Energy Test Facility in Leonardo, New Jersey. The Ohmsett facility provides independent and objective performance testing of full-scale oil spill response equipment and marine renewable energy devices. Additionally, the facility is available to help improve existing technologies through R&D, as well as train first responders on oil spill response equipment with oil in an environment simulating open oil conditions. BSEE continues to advance the Nation's preparedness for oil spills through its Testing of Oil Spill Response Technology initiative as authorized in the Oil Pollution Act of 1990, Section 7001, to evaluate and test technologies at the Ohmsett facility. In 2024, BSEE partnered with the U.S. Coast Guard (USCG) Research and Development Center to evaluate four oil skimmers with two dielectric fluids used in offshore wind energy facilities. Wind turbines contain a variety of dielectric fluids for operations and the increasing number of wind turbines increase the likelihood of a spill. This work helped Federal on Scene Coordinators,

the National Response Team, Federal/state agencies, and oil spill response organizations to better understand technology limitations and encourage product improvement.

The majority of BSEE's technology advances are shared with the public through reports that are publicly available on its website. In FY 2024, BSEE also continued to share its research results at conferences, workgroups, and other fora, such as the triennial International Oil Spill Conference, the annual Clean Gulf Conference, the Pacific States-British Columbia Oil Spill Task Force Annual Meeting, the National Response Team Science and Technology Committee, the Northern Oil and Gas Research Forum, the BSEE/USCG Response Work Group, BSEE/USCG Research Sharing meetings, industry meetings, and the Ocean Energy Safety Institute's Public Research Forum.

BSEE continues cooperative research with the Ocean Energy Safety Institute (OESI). OESI is a collaborative initiative engaging the government, academia, industry, and scientific stakeholder communities. The OESI was established in FY 2021 through a cooperative agreement between BSEE, the Department of Energy, and the Texas A&M Engineering Extension Service (TEES). In support of OESI, TEES has assembled a consortium of industry, national labs, non-governmental organizations, and academia. The consortium includes 16 universities across 10 states, three national labs, and more than 20 stakeholders representing both conventional and renewable energy. In addition, there is a commitment to develop and employ an outreach program to Minority Serving Institutions to encourage their engagement and participation. The OESI will support critical improvements for all offshore energy activities, encompassing renewable and traditional energy, as well as facilitate new offshore energy technology development.

BSEE's primary research synergy is with State, Tribal, Federal, and international government organizations, the offshore energy industries, and oil spill removal organizations. Research is typically in areas pertaining to critical equipment and technology, environmental impact, and risk reduction and assessment tools and techniques applicable to the U.S. OCS to ensure that the best available science is utilized in regulatory decision-making.

BSEE is a member of the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR) and its Executive Steering Committee. Comprising 16 Federal agencies, ICCOPR was established by Title VII 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." ICCOPR publishes the Oil Pollution Research and Technology Plan (R&T Plan) that establishes the official Federal priorities to address research gaps in preparedness, prevention, response, and injury assessment and recovery for oil spills. BSEE led efforts by the Executive Steering Committee to publish the FY 2022-2027 R&T Plan.

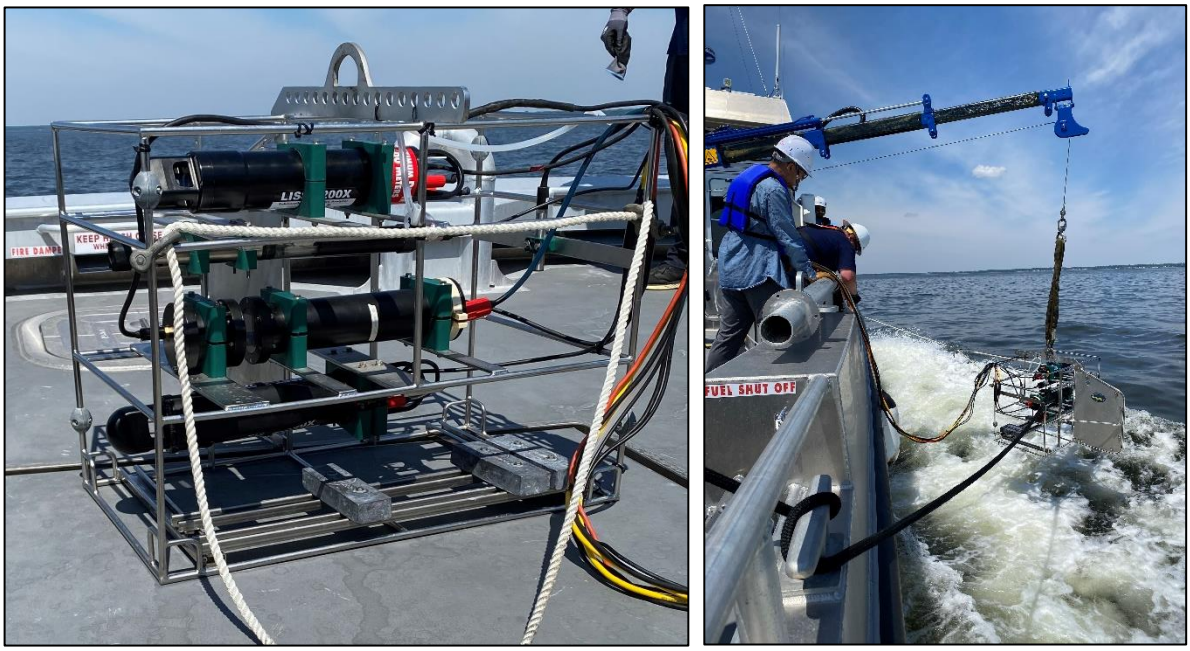
BSEE is a member of the International Regulators' Forum, which consists of members from 11 countries whose goal is to provide leadership on safety and safety-related regulatory matters for offshore energy activities. Other members include Norway, Canada, Brazil, and the United Kingdom.

The following are examples of FY 2024 completed or ongoing research projects that would, among other things, advance technological options and transfer knowledge.

Surface Water Droplet Size Distribution Instrument Evaluation. In order to improve oil spill preparedness and response, BSEE continued to investigate how surface water dispersant monitoring can be implemented with existing droplet size distribution (DSD) and water quality instruments. The outcome of this research informs BSEE preparedness analysts and the oil spill response community about how available technology could meet most stipulations of Subpart J of the National Oil and Hazardous Substances Pollution Contingency Plan.

The project's multiple phases include laboratory-scale water tank tests, larger-scale Ohmsett wave tank tests, and a realistic offshore deployment field trial. Initial laboratory-scale and wave tank tests provided data to illustrate the optimized DSD detection ranges for the monitoring instruments; identified important deployment requirements; and enhanced data acquisition protocols. These results led to a new sturdy instrument carriage system manufactured for offshore ocean vessel deployment in both static and towed configurations. Leveraging findings from earlier tests, the offshore field trial phase consisted of deploying the DSD instrumentation package (carriage system, instruments, and cables from sensors to laptops) from a 47' oil spill removal vessel to identify and document any potential limitations for deployment from a small boat. The components evaluated to ensure a safe and successful deployment from an ocean-going vessel included: installing instruments and handling the stainless-steel carriage system; managing cables; operating monitoring instruments; following user guides; and capturing data with laptops.

In June 2024, Marine Spill Response Corporation and BSEE project researchers successfully deployed the DSD instrumentation package in multiple configurations (down/upcast), which provided researchers the ability to analyze DSD and water quality data at multiple depths. After researchers captured vertical profile data, the carriage system was secured to travel in a lifted configuration (see photo). This configuration allowed the vessel to travel quickly to a new pre-determined station to collect more data. Lessons learned from the field trial included improvements related to communications devices, equipment stowage, instrument software training, cable lengths, cable spooling, sample water collection, instrument towing, instrument installation to carriage system, real-time data processing times and sufficient staffing.



FIELD EVALUATION OF SURFACE WATER DISPERSANT MONITORING USING DSD INSTRUMENTATION AND INSTRUMENT CARRIAGE SYSTEM. THIS RESEARCH INVESTIGATES HOW AVAILABLE TECHNOLOGY CAN SUPPORT OIL SPILL PREPAREDNESS AND RESPONSE ACTIVITIES. SOURCE: BSEE

Dynamics of Arctic Sea Ice: 2022-2023 Freeze-up and Break-up of Arctic Sea Ice in the Alaskan Beaufort and Chukchi Seas. To enhance understanding of ice dynamics as they relate to offshore exploration and safety, BSEE investigated ice conditions during the 2022-2023 freeze-up and break-up seasons in the Alaskan Beaufort and Chukchi Seas. This study marks the twelfth installment in a series of annual freeze-up investigations initiated in 2009 and break-up investigations initiated in 2016. Research focused on five primary objectives: describing evolving ice conditions during freeze-up and break-up seasons, mapping significant features important for offshore activities, characterizing ice pileups on shorelines and structures, correlating ice changes with meteorological conditions, and analyzing contemporary freeze-up and break-up processes relative to historical data. Data collection utilized a combination of publicly available and proprietary sources, including open-source meteorological data, ice charts, 20 high-resolution RADARSAT-2 images, and Aerial reconnaissance missions. Key findings from the study indicated a significantly warmer winter season for the region, with 2022-2023 air temperatures recorded as the fourth warmest at Utqiagvik Airport and the seventh warmest at Deadhorse Airport in a 14-year context. The thickness of undeformed first-year ice at the end of the season in the Beaufort Sea and represented some of the lowest thickness readings recorded historically. During the break-up season, both the Chukchi and Beaufort Seas displayed trends of early break-up occurrences and changes in landfast and lagoon ice stability, indicating significant shifts in regional climate patterns. The addition of storm events has grown, particularly impacting ice dynamics and break-up processes. The investigation highlights significant trends affecting the region's ice dynamics, including rising air

temperatures, increasing storm frequency during freeze-up seasons, and a delayed timing for both nearshore and complete freeze-up, correlating strongly with climate change. Trends indicate a potential lengthening of the open-water season, posing implications for offshore operations and environmental management strategies. This comprehensive study will serve as a vital resource for BSEE and industry stakeholders, informing regulatory decisions and enhancing understanding of ice conditions that are critical for safely conducting offshore exploration and production activities. By continuing to serve as a model for effective regulatory governance, BSEE can ensure the promotion of safety and environmental protection in the face of evolving climatic conditions.

XII. Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) manages the Nation's offshore energy, geologic, and mineral resources in an environmentally and economically responsible way. It ensures access to, and the fair return for, conventional and renewable energy, geologic, and mineral resources on the U.S. OCS to help meet the Nation's energy and mineral needs while protecting the human, marine, and coastal environments and addressing climate change.

As one of the Nation's offshore energy, geologic, and mineral resource managers, BOEM is committed to using the best available science and knowledge across a range of relevant disciplines that provide the scientific and technical foundation and the human capital needed to make sound decisions at all levels of the organization. Management of the OCS's energy, geologic, and mineral resources is governed by the OCS Lands Act, which establishes procedures for leasing, exploration, and development and production of those resources, including oil, gas, renewable energy, carbon sequestration, and marine minerals such as sand and gravel used for coastal restoration projects and critical minerals.

BOEM conducts and publishes environmental reviews, including National Environmental Policy Act analyses and compliance documents, for each major stage of resource planning and development. These analyses are carried out by BOEM's Office of Environmental Programs,[12] Office of Renewable Energy Programs,[13] and its regions.[14] These analyses inform BOEM's decisions on its National OCS Oil and Gas Leasing Program and other energy and mineral leasing and development activities. In addition, BOEM's scientists conduct and oversee environmental studies to support decisions relating to the management of energy, geologic, and marine mineral resources on the OCS through its Environmental Studies Program (ESP).

BOEM's four regions—located in Louisiana, California, Alaska, and Virginia—manage oil and gas resource evaluations; renewable energy development; environmental studies and assessments; leasing activities; reviews of required plans submitted by lessees; fair market value determinations; and geological and geophysical permitting.

BOEM manages the exploration and development of the Nation's offshore resources in a way that appropriately balances economic growth, energy development, and environmental protection. BOEM's ESP strives to apply the best science and knowledge available for informed decision-making. It plans, conducts, and oversees world-class scientific research to inform policy decisions regarding leasing and developing OCS energy, geologic, and mineral resources. BOEM's environmental studies cover a broad range of disciplines, including archaeological

[12] URL: http://www.boem.gov/Environmental-Stewardship
[13] URL: http://www.boem.gov/renewable-energy
[14] URL: https://www.boem.gov/regions

resource protection, physical oceanography, meteorology and air sciences, biology, protected species, social sciences and economics, submerged cultural resources evaluation, and the overall environmental effects of energy and mineral development. BOEM continues to be 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, partnerships, and cooperative or other agreements with other Federal agencies, Tribes, State institutions, and universities. 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's technology transfer activities include disseminating information, knowledge, and technologies to commercial entities and other stakeholders with interests in the OCS. Virtually all these activities are undertaken using authorities provided to BOEM other than the FTTA. Studies undertaken or funded by BOEM are available to the public through the BOEM environmental studies website.[15] The website includes 208 ongoing and 2098 completed BOEM-sponsored environmental research projects and provides online access to more than 3,954 research reports. In 2024, ESP completed 28 studies that accounted for approximately $18.5 million in BOEM-funded ocean research.

BOEM also partners with BSEE to select and fund renewable energy research to facilitate industry development, promote operational safety, and prevent pollution through BSEE's Technology Assessment Program.[16]

BOEM participates in and funds interdisciplinary projects, including partnerships with other Federal agencies, academic institutions, and the private sector. These projects are directed toward offshore ecosystem studies that utilize state-of-the-art technologies, such as autonomous underwater vehicle surveys, deep-water human-occupied submersibles, and remotely operated vehicles. These partnerships leverage expertise and technologies to meet common management goals.

The following are examples of BOEM's scientific R&D activities initiated or ongoing in FY 2024, including some conducted in cooperation with other parties.

Feasibility Study for Renewable Energy Technologies in Alaska Offshore Waters. BOEM completed a study in partnership with DOE's National Renewable Energy Laboratory to evaluate capacity for offshore renewable energy on the OCS offshore Alaska. The study found

[15] URL: https://www.boem.gov/environment/environmental-studies/environmental-studies-information

[16] More information on this research is available at https://www.boem.gov/Technology-Assessment/

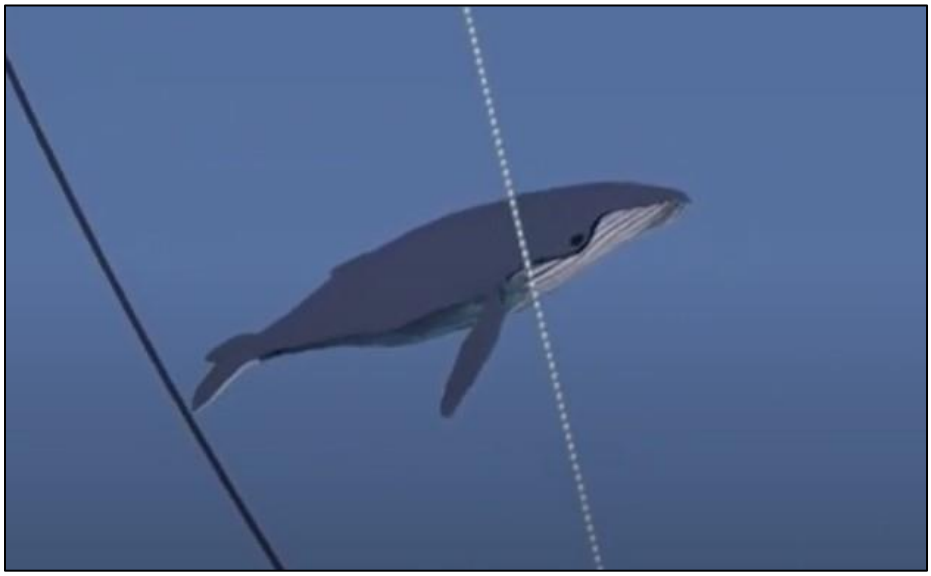
that the Alaska OCS has abundant offshore wind, tidal, and wave energy resource potential. However, most of this energy resource is too far from areas where the power could be used to make development practical. Offshore wind is more feasible than wave or tidal energy production on the OCS offshore Alaska over the next 10–20 years. Floating wind facilities in the Lower Cook Inlet have the greatest chance of success, while development scenarios in more remote locations like Dutch Harbor and Nome would require other delivery mechanisms (e.g., hydrogen) to be viable. Cook Inlet has a great deal of tidal energy near areas of the State of Alaska with contiguous populated areas. Technology is not mature enough to be developed in Cook Inlet's Federal waters, though tidal energy development in Alaska State waters may be feasible.

Crude Oil Degradation and Hydrocarbon Oxidation Products in Cook Inlet, Alaska. BOEM completed a cooperative agreement with the University of Alaska, Fairbanks that looked at the fates and effects of Cook Inlet crude oil exposed to photochemical degradation in the marine environment. The chemical derivatives are more toxic than the crude oil due to the relative ease of uptake in biological systems. Further, these derivatives are more mobile in the marine environment and can be harder to detect using chromatographic methods typically used for this purpose. An initial study found that a targeted method couldn't reliably measure these derivative products. A follow up study developed a non-targeted assay to measure these derivatives. The results indicate that the new assay could provide a better tool for detecting derivative presence in the marine environment in the case of a spill associated with oil production in Cook Inlet, Alaska.

Rice's Whale Conservation Research in the Northern Gulf of America. BOEM published a desktop study and embarked on new fieldwork activities to help protect the Rice's Whale in the Northern Gulf of America. The Rice's Whale was listed as an endangered sub-species in 2020 and reclassified from the Gulf Bryde's whale in 2021. The Rice's Whale has been seen by vessel surveys and detected in acoustic recordings in the Northern Gulf of America in areas of high vessel movement and OCS development activity. However, additional observations are needed to properly manage this population. BOEM initiated a new research activity in 2024 to run dedicated ship-based observing surveys and passive acoustic monitoring. This is part of a larger protected species management study that will include aerial surveys and automated image detection technology. Additional data from dedicated Rice's Whale observing would fill a vital data gap about when and where the Rice's whale naturally occurs, and potential risks from ongoing and proposed BOEM activities.

Floating Offshore Wind Platform Marine Species Entanglement Hazards. BOEM and BSEE initiated a research project in 2024 through the Technology Assessment Program to look at engineering aspects of floating wind farm facility construction, and how the floating turbines are tethered to the ocean floor. Floating turbines are fixed by several moorings that have structural properties (e.g., a cable that runs from the ocean floor to the floating platform), that

need to be assessed for environmental compliance before the construction of floating wind facilities. One of the concerns about floating wind that has been raised through stakeholder engagement in California and elsewhere is the possibility that these tethers can pose hazards to marine life, especially if they are not properly maintained. The Technology Assessment will look at vibration signatures from the mooring cables that could be used to inform maintenance needs such as removal of fishing gear and other entanglements that may pose a hazard to marine life. This will inform ongoing research funded by BOEM's environmental studies program to simulate the interactions of marine life with the mooring cables, as well as a new project planned for FY 2025, which would simulate the probability of fishing gear entanglement in order to better understand level of risk during the operations of floating wind farms offshore California.



HUMPBACK WHALE SWIMMING AROUND A FLOATING WIND TURBINE STRUCTURE.[17] BOEM AND BSEE ARE STUDYING POTENTIAL HAZARDS TO MARINE LIFE ASSOCIATED WITH TETHERING OF FLOATING TURBINES TO THE OCEAN FLOOR. SOURCE: PACIFIC NORTHWEST NATIONAL LABORATORY

Port Assessments for Renewable Energy Development in the Pacific. The BOEM Pacific Office published a report assessing Hawai'i port infrastructure and needs to support growing floating offshore wind demand. It used spatial analysis, interviews, and available records to collect the necessary data regarding infrastructure readiness. This research was conducted as part of an ongoing contract with Moffatt & Nichol that services BOEM Pacific OCS Region's infrastructure information needs, which may include assessments and requirements of the infrastructure as well as its impacts. Infrastructure refers to the aspects of offshore energy development outside

[17] Still image captured from video, "Humpback Whales and Floating Offshore Wind Farms," available at https://www.boem.gov/about-boem/humpback-whales-and-floating-offshore-wind-farms

of the offshore energy facility itself which may include ports, navigation, transmission, and supply chain. Previous work completed under the contract includes an assessment for Coos Bay in 2022 and for California floating offshore wind in 2023. BOEM has options on the contract to address port assessment research for Guam and American Samoa that it could pursue in future years.

Noise Reduction Framework. Many marine animals use sound to navigate, communicate, find food, or defend territories. Human activity has steadily increased the levels of ocean sound, and this can affect marine species by causing temporary or permanent hearing loss, behavioral disturbance or masking, or mortality. BOEM's Center for Marine Acoustics (CMA) has developed a Noise Reduction Framework aimed at reducing underwater noise produced during BOEM's activities on the OCS. The framework seeks to incentivize and expedite the use of alternatives to traditional seismic air guns, or to mitigate sounds produced using traditional air guns. CMA has also identified a noise limit for impact pile driving, to drive innovation in noise abatement and alternative foundation installation methods. In 2024, BOEM and DOE co-funded several projects that advance this field. The quieting work that BOEM is doing domestically is being shared internationally via the Management of Offshore Noise by Multinational Energy Regulators group.

XIII. Bureau of Land Management

The BLM manages approximately 245 million surface acres and 700 million subsurface acres in the United States. BLM's multiple-use and sustained yield mandate directs the management of public land resources for a variety of uses, such as recreation, wildlife conservation, energy and minerals development, wilderness, livestock grazing, clean water, and timber harvesting, while also protecting a wide array of natural, cultural, scientific, and historical resources for the use and enjoyment of present and future generations. To support this dual mission, the BLM annually conducts and supports hundreds of research and development projects with diverse entities such as Cooperative Ecosystem Studies Units; colleges and universities; scientific societies and institutes; national laboratories; museums; botanic gardens and arboretums; Federal, State, and Tribal government agencies; non-governmental organizations; and the private sector. These projects advance the state of knowledge and technology concerning all aspects of BLM resource management and transfer of those advances to entities and persons outside the BLM through publication of reports, technical references, scientific journal articles, data releases, fact sheets, presentations, web-based products, books, and more.

Examples of BLM's FY 2024 technology transfer activities include the following Bureau-wide and program-specific efforts.

Inventory Analysis Units for National Scenic and Historic Trails Inventory, Assessment, and Monitoring Programs. BLM administers, manages, and protects 19 National Scenic and Historic Trails (NSHTs) as part of its system of national conservation lands. Various laws, regulations, and policies require that the BLM conduct and maintain an inventory to protect trail-related resources, qualities, values, associated settings, and primary use or uses. One of the first steps in the inventory, assessment, and monitoring process is deciding the area along a trail to inventory. However, existing technical references[18] do not specify how

A 2024 BLM REPORT PROVIDES BEST PRACTICES TO SUPPORT INVENTORY EFFORTS FOR NATIONAL SCENIC AND HISTORIC TRAILS, SUCH AS EMIGRANT NATIONAL HISTORIC TRAIL, WYOMING (PICTURED HERE). SOURCE: BOB WICK, BLM

[18] Volumes 1 and 2 of BLM Technical Reference 6280-1

"inventory analysis units" (IAUs) should be delineated. In 2024, BLM published a report that reviews the approach used to delineate the IAUs for an inventory effort and identifies best practices for creating initial or "draft" IAUs.[19] The best practices within the report use standard parameters for performing a viewshed analysis to identify a proxy of land to include in an initial inventory effort. Draft IAUs would provide standardization across multiple management jurisdictions by applying the same parameters for delineation. Delineating draft IAUs could also help trigger an inventory, if a project were proposed within the delineated area surrounding an NSHT.

Rare Plant Habitat Modeling. Intensified energy development and other land use changes across the Southwestern United States have increased the need for proactive management to mitigate impacts to rare plants. Habitat suitability models can inform decision-making and lead to more effective conservation of rare plants and their habitats, but high-quality models that are suited for use at local scales are lacking for many species. A team of BLM scientists and managers developed ensembles of habitat suitability models for five rare plant species in New Mexico using a coproduced, iterative framework complemented by comprehensive ground truthing and tailoring of products for use in public land decisions.[20] The team's process resulted in substantial differences from initial models through changes to environmental predictors, species occurrence and background data, and development of new species-specific predictors.

Soil and Geomorphology Data Across the Western United States. Ecological site information is essential to interpreting monitoring data and guiding site-specific management of ecosystem functions and services. Ecological information (e.g., soil properties, geomorphology characteristics, and ecosystem dynamics), are critical elements of rangeland monitoring programs such as the Assessment, Inventory, and Monitoring (AIM) strategy conducted by the BLM. Based on field observations, AIM identifies ecological sites according to ecological site concepts uniquely developed within individual Major Land Resource Areas. BLM published an article that evaluated the availability of ecological site identification, soil observations, and geomorphology characteristics determined by AIM data collectors between 2012 and 2021 in 14 western United States.[21] The article confirmed that the AIM database is a robust source of georeferenced soil and geomorphology information that can be used for land management and

---

[19] Lindley, S.M., Wilkins, E.J., Farley, C., Rogers, K., and Schuster, R., 2024, Delineating draft inventory analysis units for National Scenic and Historic Trails inventory, assessment, and monitoring programs: U.S. Geological Survey Scientific Investigations Report 2024–5060, 14 p., https://doi.org/10.3133/sir20245060.

[20] Catherine S. Jarnevich, Sarah K. Carter, Zoe M. Davidson, Nicole (Nik) D. MacPhee, Patrick J. Alexander, Brandon Hays, Pairsa N. Belamaric, Benjamin R. Harms, 2024, Modeling rare plant habitat together with public land managers using an iterative, coproduced process to inform decision-making on multiple-use public lands, Conservation Science and Practice, Volume 6, Issue 8, https://doi.org/10.1111/csp2.13179

[21] P. Martinez, J.R. Brehm, A.M. Nafus, A. Laurence-Traynor, S.W. Salley and S.E. McCord, Journal of Soil and Water Conservation May 2024, 79 (3) 132-144; DOI: https://doi.org/10.2489/jswc.2024.00068

research on land potential, soil geography, and assessment of soil health indicators across the western United States.

XIV. Joint Fire Science Program

The Joint Fire Science Program (JFSP) was congressionally established in 1998 and is a joint U.S. Department of the Interior and U.S. Department of Agriculture Forest Service (USDA FS) program. JFSP provides funding and technology transfer for scientific studies associated with managing wildland fire, fuels, and fire-impacted ecosystems to respond to emerging needs of managers, practitioners, and policymakers from local to national levels. The JFSP is hosted by the BLM and overseen by a 12-member Governing Board with representation across DOI bureaus (BIA, BLM, FWS, NPS, and USGS), the DOI Office of Wildland Fire (OWF), and USDA FS. In FY 2024, the JFSP received $10 million in funds from DOI and USDA FS (some funding from the IIJA). Funds were distributed via an annual cycle of open, competitive, peer-reviewed proposal solicitations for current wildland fire research priorities in three categories – science delivery and exchange, primary research, and graduate research innovation. All three categories will advance the science of fire management to enhance public safety and ecological health.

The following are examples of FY 2024 research projects completed by JFSP.

Science Delivery and Knowledge Exchange. The JFSP provides leadership to the fire science community by identifying high-priority fire science research to meet management objectives. Transferring research findings to managers, practitioners, and policymakers is a key focus area for the program, and that is managed through the JFSP's 15 regional fire science exchanges called the Fire Science Exchange Network (FSEN). The exchanges are successful at sharing, synthesizing, interpreting, demonstrating and validating science products to facilitate science integration with on-the-ground land management. FSEN a national collaboration that provides the most relevant, current wildland fire science information to stakeholders. Exchanges bring together fire managers, practitioners, and scientists to address common needs and challenges.

In FY 2024, the exchanges:

- Produced 235 newsletters;
- Published 93 blog posts;
- Hosted 82 webinars;
- Developed 23 syntheses;
- Hosted 101 conferences/workshops;
- Developed 44 short courses and continuing education units; and
- Created 102 video productions.

Approximately 22,000 individuals participated in FSEN organized wildland fire science delivery activities in FY 2024.

MAP OF THE REGIONAL FIRE SCIENCE EXCHANGES THAT MAKE UP THE FIRE SCIENCE EXCHANGE NETWORK. THE EXCHANGES FACILITATE SCIENCE INTEGRATION WITH ON-THE-GROUND LAND MANAGEMENT. SOURCE: JOINT FIRE SCIENCE PROGRAM

Primary Research. JFSP funded 18 research projects in FY 2024 for five task statements:

- *Wildland fire impacts, mitigation, response, and recovery:* The objective of this task statement is to gain better understanding of a broad range of direct and indirect wildfire impacts, the time horizons over which these impacts occur, and factors that influence the ability of individuals and communities to prepare for, respond to, and recovery from wildfire.
- *Accelerating science to action in fire-prone ecosystems: Spurring innovation in adaptation through knowledge exchange and place-based partnerships***:** The objective of this task statement is to strengthen partnerships among scientists, practitioners, managers, and other interested parties to accelerate the identification and adoption of science-based management strategies that facilitate adaptation to changing fire regimes.

- *Prescribed fire effects on water quality and quantity:* The objective of this task statement is to inform the use of fire in highly valued watersheds by evaluating the effects of prescribed fire on water quality and quantity.
- *Managing carbon emissions in ecosystems with deep organic soils:* The objective of this task statement is to inform effective strategies for managing carbon stores in deep organic soils that are increasingly impacted by wildfire.
- *Characterizing wildfire risk in wildland-urban interface and urban settings:* The objective of this task statement is to evaluate and improve existing methods to characterize wildfire risk to wildland urban interface (WUI) and urban settings.

Graduate Research Innovation. Every year, the JFSP invites current master and doctoral students enrolled at colleges or universities within the U.S. in the field of wildland fire and related physical, biological, and social sciences to apply for a Graduate Research INnovation (GRIN) award. The purpose of the award is to enhance student exposure to the management and policy relevance of their research to achieve beneficial outcomes of funded work. The GRIN program has received accolades from across the fire science community. GRIN funding helps fire science students dig deeper into their thesis or dissertation research and apply it through access to outreach resources with JFSP's Fire Science Exchange Network. In addition, it gives students professional experience with proposal development, helps students become more competent scientists, and provides mentorship across the research and management communities. JFSP funded 12 GRIN projects in FY 2024 for the following six focused topics. Funds were distributed to 19 academic institutions.

- Fuel management and fire behavior,
- Changing fire environment,
- Emissions and air quality,
- Fire effects and post-fire recovery,
- Relative impacts of prescribed fire versus wildfire, or
- Human dimensions of fire.

XV. Conclusion

During FY 2024, Interior's technology transfer activities provided critical information and technologies to improve our understanding of and ability to address key issues such as drought, wildland fire, and threatened and endangered species. During FY 2024, the Department's technology transfer activities included the following activities:

- Engaged in 23 Cooperative Research and Development Agreements (CRADAs) and at least 3,149 other collaborative R&D relationships.
- Disclosed 11 new inventions, filed 1 new patent application, and received 0 new patents.
- Managed 44 active licenses for inventions and other intellectual property.
- Published more than 5,390 reports, books, fact sheets, and other publications, disseminating mission-relevant scientific and other technical information to the public and peers in and out of government.

XVI. Data Appendix

The following tables provide cumulative data for the Department from FY 2020 through FY 2024. Data for individual bureaus are available online.[22]

Data are provided if they are collected and readily available. These tables include updates to previous years' data, where appropriate.

Table 1: Disclosures and Patents

		FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
	Invention Disclosures					
1	Invention Disclosures Received	4	2	3	10	11
2	Total Patent Applications Filed	4	1	3	0	1
3	*US*	2	1	3	0	1
4	*Foreign*	0	0	0	0	0
5	Total PCT Applications Filed. (**NOTE**: PCT = Patent Cooperation Treaty. See https://www.wipo.int/pct/en/)	0	0	0	0	0
6	Number of patents Issued	3	1	1	0	0
7	*US*	0	1	1	0	0
8	*Foreign*	0	0	0	0	0

[22] URL: https://www.doi.gov/techtransfer/annual-reports

Table 2: Licenses

		FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
9	Invention Licenses, Total Active	2	10	11	74	44
10	*New Invention Licenses*	0	2	2	2	2
11	*New Invention Licenses to Small Businesses*	0	1	2	2	1
12	Income bearing licenses, Total Active	14	9	10	13	13
13	*New Income Bearing Licenses*	0	1	2	0	2
14	*Exclusive licenses*	7	8	9	10	10
15	*Partially exclusive licenses*	0	0	0	0	0
16	*Non-exclusive licenses*	6	2	2	3	3
17	Other Licenses, Total Active	0	48	61	61	31
18	*New Other Licenses*	0	42	13	6	0
19	*New Other Licenses Granted to Small Businesses*	0	40	10	0	0
	Elapsed Amount of Time for Granting Invention Licenses					
20	Average (months)	7	30.5	7	2.5	8.5
21	Minimum (months)	7	29	5	2	7
22	Maximum (months)	7	32	9	3	11
23	Licenses terminated for cause	1	1	0	0	0

Table 3: License and Royalty Income

		FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
24	**Invention License Income**	$122,749	$67,694	$108,761	$76,794	Information Pending*
25	**Other License Income**					
26	**Total Earned Royalty Income (ERI)**	$122,749	$67,694	$107,761	$76,794	
27	*ERI from top 1% of licenses*		$53,630	$98,356	$55,656	
28	*ERI from top 5% of licenses*		$53,630	$98,356	$55,656	
29	*ERI from top 20% of licenses*		$53,630	$98,356	$62,793	
30	Minimum Earned Royalty Income		$3,195	$25,000	$1,000	
31	Maximum Earned Royalty Income		$53,630	$98,356	$36,111	
32	Median Earned Royalty Income		$10,925	$19,302	$4,500	
	Disposition of ERI					
33	Percent of ERI distributed to inventors	39%	36%	33%	33%	
33A	Amount of ERI distributed to inventors	$47,872	$24,045	$35,561	$25,342	
34	Percent of ERI distributed to the agency or laboratory	34%	37%	33%	33%	
34A	Amount of ERI distributed to the agency or laboratory	$41,735	$24,762	$35,561	$25,342	

* Total income in FY 2024 from licenses is still being calculated, as many license agreements report royalty data on a calendar year basis and complete data will not be received before the submission deadline for this report.

Table 4: CRADAs

		FY 2020	FY 2021	FY 2022	FY 2023	FY 2024
	CRADAs					
35	Total Active CRADAs	489	429	32	34	23
36	New CRADAs	237	139	5	2	4
37	New CRADAs Involving Small Businesses	2	1	1	0	2
	Other collaborative R&D relationships					
38	Other Collaborative Agreements, total active in the FY	353	625	1,034	1,669	3,149

XVII. Acronyms and Abbreviations

AADAP	Aquatic Animal Drug Approval Partnership Program
ACP	American Clean Power Association
AGOL	ArcGIS Online
AIM	Assessment, Inventory, and Monitoring
AIS	Aquatic Invasive Species
AML	Abandoned mine lands
ANL	Argonne National Laboratory
ASP	Applied Sciences Program
AUV	Autonomous underwater vehicle
BIL	Bipartisan Infrastructure Law (2021 Infrastructure Investment and Jobs Act)
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
BOR	Bureau of Reclamation
BSEE	Bureau of Safety and Environmental Enforcement
CAMS	Continuous Ambient Monitoring Station
CESU	Cooperative Ecosystem Studies Units
CMA	Center for Marine Acoustics
CRADA	Cooperative Research and Development Agreement
CVOW	Coastal Virginia Offshore Wind
DNA	Deoxyribonucleic acid
DOE	U.S. Department of Energy
DOI	Department of the Interior
DSD	Droplet size distribution
DWPR	Desalination and Water Purification Research
e-AMLIS	Electronic Abandoned Mine Lands Inventory System
eDNA	Environmental DNA
EDRR	Early detection and rapid response
EPA	U.S. Environmental Protection Agency
ERI	Earned Royalty Income
ESA	Endangered Species Act
ESP	Environmental Studies Program
ETB	Emerging Technologies Branch
FAC	Fish and Aquatic Conservation
FO	Forward osmosis
FSEN	Fire Science Exchange Network
FTC	Fish Technology Center
FTTA	Federal Technology Transfer Act of 1986
FUSA	Facility Use/Service Agreement

FWS	U.S. Fish and Wildlife Service
FY	Fiscal Year
GIS	Geographic information system
GPRA	Government Performance and Results Act
GRIN	Graduate Research INnovation
GSB	Geospatial Services Branch
HAPS	High-Altitude Platform Systems
HBCU	Historically Black Colleges and Universities
HK	Hydrokinetic
IAU	Inventory Analysis Unit
IBAT	Interagency Bolt Action Team
ICCOPR	Interagency Committee on Oil Pollution Research
IIJA	2021 Infrastructure Investment and Jobs Act
ISC	Invasive Species Corporation
JAO	Joint Administrative Operations
JFSP	Joint Fire Science Program
LBNL	Lawrence Berkeley National Laboratory
LMRP	Lower marine riser package
MDTI	Mine Drainage Technology Initiative
NAAMLP	National Association of Abandoned Mine Land Programs
NAMC	National Aquatic Monitoring Center
NASA	National Aeronautics and Space Administration
NCPTT	National Center for Preservation Technology and Training
NCTC	National Conservation Training Center
NGO	Non-governmental organization
NMMR	National Mine Map Repository
NOAA	National Oceanic and Atmospheric Administration
NOFO	Notice of Funding Opportunity
NPS	National Park Service
NTTP	National Technical Training Program
NTTT	National Technology Transfer Team
OCS	Outer Continental Shelf
OMB	Office of Management and Budget
OESI	Ocean Energy Safety Institute
OORP	Office of Offshore Regulatory Programs
OPA	Office of Policy and Analysis (U.S. Geological Survey)
ORTA	Office of Research and Technology Applications
OSMRE	Office of Surface Mining Reclamation and Enforcement
OSPD	Oil Spill Preparedness Branch
OSRO	Oil Spill Response Organization
OWF	Office of Wildland Fire (U.S. Department of the Interior)

PCT	Patent Cooperation Treaty
PPA	Office of Policy Analysis (U.S. Department of the Interior)
R&D	Research and Development
ROV	Remote operated vehicle
S&T	Science and Technology
SDE	Spatial Database Engine
SMCRA	Surface Mining Control and Reclamation Act of 1977
SME	Subject matter expert
TAA	Technical Assistance Agreement
TCEQ	Texas Commission on Environmental Quality
TEAMER	Testing and Expertise for Marine Energy
TEES	Texas A&M Engineering Extension Service
TIPS	Technical Innovation and Professional Services
UAS	Uncrewed aerial (or aircraft) services
USC	United States Code
USCG	U.S. Coast Guard
USDA FS	U.S. Department of Agriculture Forest Service
USGS	U.S. Geological Survey
USWTDB	U.S. Wind Turbine Database