

# U.S. Geological Survey Program Book

Coastal bluffs on Pescadero State Beach, California.  
Source: USGS.

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*The U.S. Geological Survey (USGS) provides science for a changing world.*

## **INTRODUCTION**

The U.S. Geological Survey (USGS) was established in 1879 (43 U.S.C. 31) for “the classification of the public lands and examination of the geological structure, mineral resources, and products of the national domain.” In 1962, Congress amended the USGS Organic Act to include examinations outside the national domain.

Today, the USGS serves the public through a diverse range of science activities that inform decisions on land and natural resource management, economic development, addressing climate change, and protecting the health and safety of our Nation. The Nation relies on USGS science to understand the location, supply, use, and environmental impacts of energy and mineral resources, including renewable and alternative energy resources, which are critical to the U.S. economy and national security. USGS science on natural hazards helps keep our citizens safe from earthquakes, floods, hurricanes, landslides, volcanic eruptions, wildfires, and other hazards. Land, water, fish, and wildlife resource managers depend on USGS science to improve understanding and management of those resources, and to inform decisions on mitigating and adapting to climate change, protecting public health, and fostering environmental stewardship. Furthermore, accurate, foundational geospatial data and remotely-sensed imagery provided by the USGS are applied to a variety of uses, ranging from land change science to infrastructure management and to monitoring and responding to natural disasters. The diversity of USGS scientific expertise enables the bureau to carry out large-scale, multidisciplinary investigations and provide objective, scientific information to resource managers and planners, emergency response officials, and the public.

This product, the USGS Program Book, is intended as a programmatic overview and reference document on the USGS. Chapters are organized by Mission Area and Program, highlighting activities carried out by the USGS across the landscape.

The USGS Program Book includes information on how each USGS Mission Area serves the public, USGS partners, reimbursable activities, where the work takes place, and how USGS work aligns with the U.S. Department of the Interior’s 2018-2022 Strategic Plan.

The USGS Program Book will be updated every four years in parallel with Interior’s Strategic Plan, or when major organization restructures are put into place. Accordingly, the USGS will be updating the Strategic Plan information in this document following the publication of DOI’s 2022-2026 Strategic Plan.

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# Ecosystems Mission Area



Source: USGS.

## Programs

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Species Management Research Program

Environmental Health Program

Land Management Research Program

Biological Threats and Invasive Species Research Program

Climate Adaptation Science Centers and Land Change Science

Cooperative Research Units

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*America relies on ecosystem science to achieve sustainable management and conservation of its biological resources.*

## **ECOSYSTEMS MISSION AREA OVERVIEW**

Ecosystems science advances our understanding of how living and nonliving components interact in the environment, and how those components are influenced by both natural and human activity. This knowledge is used by partners to inform land and water stewardships to enhance our Nation's economic and environmental well-being.

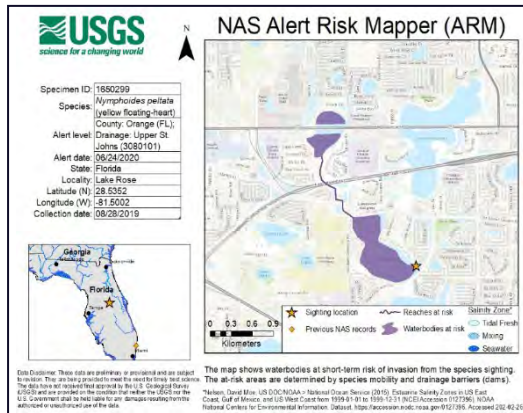
### **What We Do**

- Work with managers and policy makers to provide the information needed for decisions that sustain healthy fish and wildlife populations, such as sustainable harvests, cost-efficient fish and wildlife monitoring strategies, and how to mitigate threats to species.
- Identify conservation measures designed to preclude the need for a Federal listing of a species as endangered or threatened now and into the future and provide science to inform decisions on down listing or delisting species with current Federal protections.
- Provide science to prevent or control biological threats such as invasive species, disease causing pathogens, and other environmental contaminants to help mitigate threats and preserve environmental health to protect public safety, public health, and property.
- Deliver decision support tools for emergency managers and public officials to respond to hazards (for example, wildland fire, flooding, drought) and identify the impacts on ecosystems, improve preparation and response, and protect public health to reduce the loss of life and property.
- Provide science on how various components of priority ecosystems interact with each other with a focus on critical ecosystems (Arctic, coastal zones, wetlands, forests, deserts) and their response to both natural events and changing land management practices.
- Identify the implications of climate and land change on habitats and their functions, anticipate and prepare for the effects of change, and assess the efficacy and risks associated with different management and restoration strategies.

The Ecosystems Mission Area provides science to meet the natural resource information needs of the Department of the Interior, its bureaus, and other partners, stakeholders, and the public through six nationally recognized research programs: Species Management Research, Environmental Health, Land Management Research, Biological Threats and Invasive Species Research, Climate Adaptation Science Centers and Land Change Science, and Cooperative Research Units. These programs use advanced technologies and methods such as remote sensing, machine learning and artificial intelligence, data visualization, and crowdsourcing to produce actionable information for USGS partners and stakeholders.

## HOW THE MISSION AREA SERVES THE PUBLIC

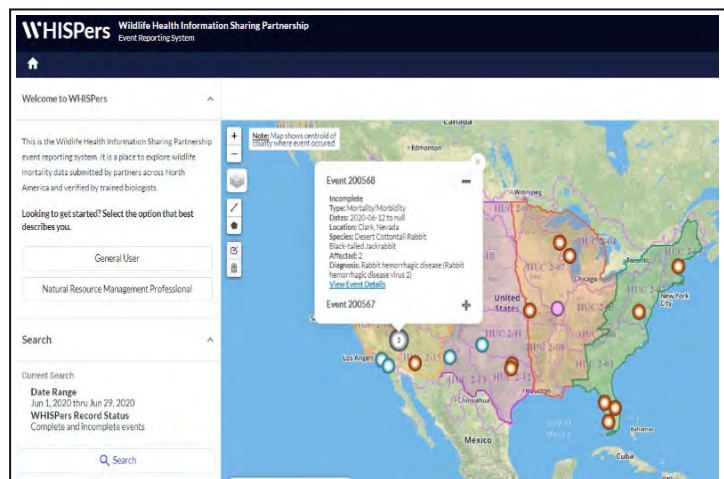
The Ecosystems Mission Area designs national research, data collection and monitoring programs that provide baseline natural resource information and tools for its partners that are used in addressing critical management challenges. These publicly available tools provide an “early warning system” function – for a new aquatic invader, a declining bird population, or an emerging wildlife disease – often with citizen science participation and using rigorous methods and protocols developed by USGS scientists.



NAS Alert Risk Mapper. Source: USGS.

**Nonindigenous Aquatic Species (NAS):** The USGS NAS includes a database that can display where in the United States, non-native aquatic species have been found. The database provides online/real-time queries, spatial data sets, distribution maps, and general information. The data are available for use by biologists, interagency groups, and the public. The NAS Alert Risk Mapper depicts waterbodies at risk of invasion after a new observation of a non-native species.

**Wildlife Health Information Sharing Partnership event reporting system (WHISPers):** WHISPers is a partner-driven tool that provides a dynamic, up-to-date, searchable system to increase public awareness of wildlife disease outbreaks and enables collaboration and data sharing among wildlife professionals, allowing them to explore wildlife mortality data submitted by partners across North America that have been verified by trained biologists.



WHISPers. Source: USGS.

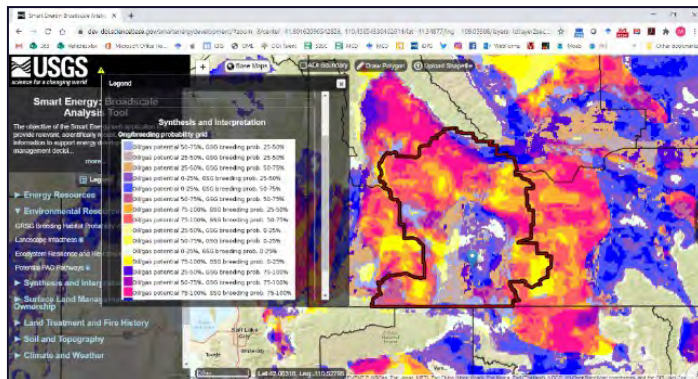
## North American Bat Monitoring Program (NABat):

Bats likely save farmers billions of dollars each year in the United States and other parts of the world by being the main predators of many night-flying insect pests, yet bats face unprecedented threats including habitat loss and fragmentation, white-nose syndrome, wind energy development, and climate change. The North American Bat Monitoring Program (NABat) was established in 2015 to acquire the information needed to help conserve and manage bat populations across North America. The USGS is



North American bats. Source: USGS.

leading the effort with scientific survey design and providing the data repository for a partnership that includes 47 State agencies and 5 Canadian provinces, 6 Federal government agencies, Tribal organizations, and numerous nongovernmental organizations (NGOs). The results are already allowing these partners to better document changes in bat populations, estimate extinction risk, set conservation priorities, and evaluate the effectiveness of conservation actions.



Smart Energy Web Application. Source: USGS.

## The Smart Energy Web Application:

Development of the Nation's energy resources is an important economic activity; however, energy development can conflict with other land management priorities such as promoting land health and conservation. The Smart Energy suite of web tools was developed in partnership with the Bureau of Land Management, the Department of the Interior, States, industry, NGOs, and

other partners to help managers make more defensible decisions faster by providing a central source for accessible data and information.

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## ECOSYSTEMS PARTNERS

### Department of the Interior (DOI) Bureaus

The USGS partners with the **Bureau of Land Management (BLM)**, the **National Park Service (NPS)** and the **Fish & Wildlife Service (FWS)** to develop and provide standardized scientific methods to measure changing biodiversity and forecast possible scenarios of future change. This information is used by land and resource management bureaus to plan for possible changes in biodiversity scenarios.

The USGS provides research and decision support tools to support FWS species listing, delisting, down listing, and recovery decisions. For example, in collaboration with FWS and NPS, the USGS convened the Monarch (Butterfly)



USGS scientist works with National Park service and private landowners. Source: USGS.

Conservation Science Partnership, which provided scientific information to support a “prelisting conservation” agreement to restore and maintain monarch-friendly habitats across the Nation.

The USGS collaborates with BLM, FWS, and other Federal and State agencies to inform long-term conservation and management strategies for the sage steppe landscape and to support the process of adaptive management in sagebrush ecosystems.

The USGS partners with the **Bureau of Ocean Energy Management (BOEM)** to provide information on species and their responses to ecosystem change to inform management decisions related to development of oil, gas, and mineral resources on public lands and on the outer continental shelf.

The USGS collaborates with the **Bureau of Reclamation (BOR)** on the Glen Canyon Dam Adaptive Management Program. Since 1997, the USGS has conducted science supporting the Secretary of Interior’s Federal Advisory Committee for this program, which consists of 25 stakeholders, including all 7 Colorado Basin States, and 6 Tribes in this precious southwestern ecosystem. USGS research studies the effects of operations from Glen Canyon Dam on the physical, biological, and ecological processes and resources of the Colorado River downstream of the dam. The USGS also collaborates more broadly with BOR—sharing research findings and information with decisionmakers, scientists, and stakeholders—to improve the effective management of native and nonnative invasive aquatic species.

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## **Other Federal Agencies**

The USGS collaborates with many other Federal agencies, including the Environmental Protection Agency (EPA), Department of Defense (DOD), National Geospatial Intelligence Agency (NGA), U.S. Army Corps of Engineers (USACE), Department of the Navy (Navy), Department of Homeland Security (DHS), Department of Energy (DOE), Federal Emergency Management Agency (FEMA), Centers for Disease Control (CDC), Department of Health and Human Services (HHS), National Aeronautics and Space Administration (NASA), U.S. Forest Service (USFS), and the National Oceanic and Atmospheric Administration (NOAA).

## FAST FACTS

# Ecosystems Mission Area

**Ecosystems Mission Area produces 52% of all USGS publications (4,000 since March 2018).**

**In Louisiana, an average of one American football field's worth of coastal wetlands is lost every 34 minutes when losses are rapid, or every 100 minutes at more recent rates.**

**Road mortality is among the major threats to the survival for 21 species that are Federally listed as threatened or endangered in the U.S.**



**The USGS provides support for the management of harvested migratory gamebird populations and science-based population data supporting 400 bird species.**

**Economic, ecological, & biological health threats costs the U.S. economy more than \$137 billion.**



**Humans cause about 85% of wildfires or unplanned ignitions. It costs \$5 billion a year to respond to wildfires (a net economic impact of about \$72 billion a year).**

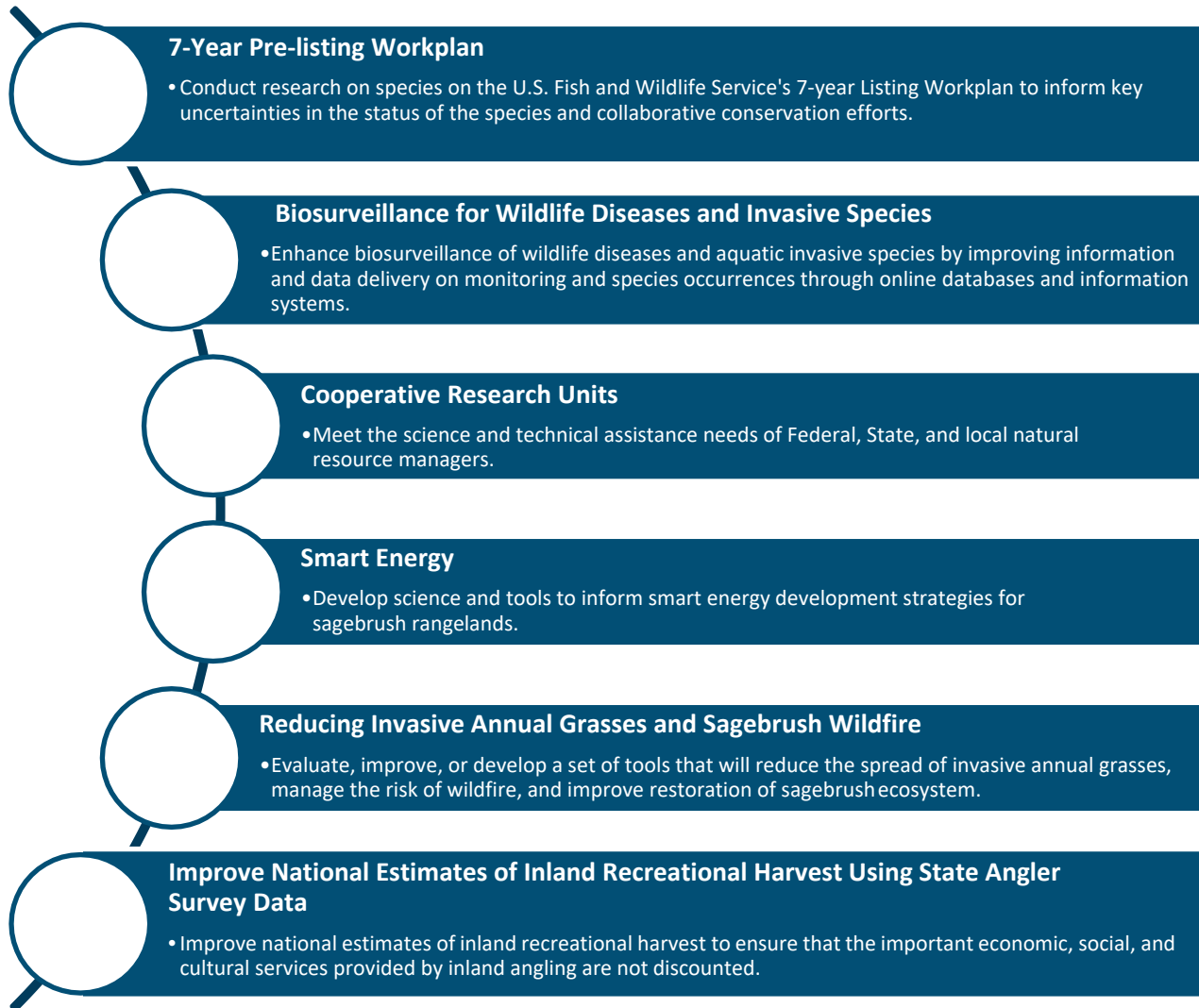
Source information for each of the facts above is on page 40.

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## USGS AND THE DOI STRATEGIC PLAN

### COMMITMENTS TO DEPARTMENT OF THE INTERIOR PRIORITIES

Within the 2018–2022 DOI Strategic Plan, EMA programs provide science to inform land, water, and species management decisions to meet the DOI goal of Conserving Our Land and Water. The USGS is committed to working on the following priorities to meet both USGS and DOI goals.



### Performance and Strategic Planning Documents

- DOI Annual Financial Report (the most recent report can be found [here](#))
- DOI Annual Performance Plan & Report (APP&R; the most recent can be found [here](#))
- DOI Strategic Plan (2018–2022) ([link](#))

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## SPECIES MANAGEMENT RESEARCH PROGRAM

*The USGS provides science to protect and conserve species that are important to the American public, with a focus on Interior trust responsibilities.*

The Species Management Research Program produces research that improves the ability of managers to anticipate, prevent, or respond to the impacts of natural stressors and to make better informed management decisions about hunting and fishing regulations, species and their populations, and land and water use.



Westslope cutthroat and bull trout in Montana. Source: USGS.

In support of the FWS National Listing workplan for Endangered Species Act listing decisions, the program conducts research to address uncertainties in aquatic and terrestrial species population status to enable more accurate listing decisions. This work facilitates proactive and collaborative conservation between DOI, State fish and wildlife management agencies, and other stakeholders and partners.

The program maintains research portfolios on manatees, sea otters, walrus, grizzly bears, and polar bears in support of Interior's management responsibility for these species. The program also provides the scientific information on migratory bird populations and trends used by the migratory bird Flyway Councils to develop recommendations on waterfowl harvest needed by biologists to make informed management decisions.

In addition, the Species Management Research Program helps to meet Interior's responsibility under the 1954 Convention on Great Lakes Fisheries (16 USC 15A) for technical support for multijurisdictional fisheries, harvest, and allocation. The program conducts fish population surveys and fisheries research that often involve the development and application of advanced technologies such as remote sensing and molecular genetics to assess population status and health.

Species Management Research Program activities fall under two areas:

- Species Biology
- Species Stressors

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## **SPECIES BIOLOGY**

Species Biology provides research on the life history, conservation, and recovery of species of management concern, including threatened and endangered species, trust species protected by Federal law, species under consideration for listing, and species that are economically important for commercial and recreational hunting and fishing.

The program studies the life history, population ecology, and conservation and restoration strategies for at-risk species, Federal and State listed species, migratory species, interjurisdictional species, and the habitat requirements of these species. This research improves the effectiveness and viability of conservation actions, which can eliminate the need for formal listing or lead to down-listing or delisting. Research includes development and novel application of advanced technologies such as remote sensing and molecular genetics to assess population status and health.

The Species Management Research Program conducts research across the United States to determine the status of imperiled species including migratory fishes such as sturgeon and Atlantic salmon, freshwater mussels, and studies of species of management concern including lake trout, coregonids (whitefish and bloaters), and American eels.

## **SPECIES STRESSORS**

The Species Management Research Program studies a range of human-caused and natural environmental stressors that affect species of management interest. Stressors include energy development from conventional and unconventional oil and gas, hydropower, hydrokinetics, dams and other barriers to fish migration, extreme events such as drought, fires and floods, and water removal for domestic, industrial, and agricultural use. Program research focuses on species physiology and behavioral characteristics, vulnerability assessments, and development of indicator tools that can be used to inform decisions with the goal of sustaining and enhancing species and their populations in concert with human uses.

## **REIMBURSABLE ACTIVITIES**

The Species Management Research Program conducts studies with various Federal, State, Tribal, and international partners to meet their science needs. This science is often cofunded and coproduced by Interior bureaus (for example, FWS, NPS, BLM, BOR), and by other Federal agencies (for example, USACE, EPA, U.S. Department of Agriculture [USDA]), and State governmental groups via the Association of Fish & Wildlife Agencies, as well as with individual States and other government agencies where complex land management science needs emerge. The program also works on producing scientific information collaboratively with a broader diversity of stakeholders through consortia such as the Joint Ventures (Atlantic Coast Joint Venture), Regional Landscape Partnerships (Midwest Landscape Initiative), Conservation Partners (Partners in Amphibian and Reptile Conservation), and fisheries commissions (such as the Atlantic Marine Fisheries Commission).

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## ENVIRONMENTAL HEALTH

*The USGS assesses and differentiates the environmental contaminant and pathogen exposures that cause actual health risks versus those that are only perceived.*



Hen and drake northern pintail at Colusa National Wildlife Refuge. Source: USGS.

The health of our land, water, and living resources can be affected by environmental exposures to toxicological or pathogenic disease agents (collectively referred to as “environmental contaminants”). The Environmental Health Program brings together interdisciplinary teams of natural-science expertise and laboratory capabilities (hydrologists; geologists; chemists; toxicologists; ecologists; microbiologists; and geospatial, process, and statistical modelers) to address scientific understandings of environmental contaminants, how they move through the environment and interact with it, and how to mitigate health hazards if they exist.

The work focuses on potential toxicants such as mercury, arsenic, hormones, per- and polyfluoralkyl substances (PFAS), and pesticides; pathogens such as avian influenza, viruses, and antibiotic-resistant bacteria; and naturally occurring toxins such as algal toxins. The integration of natural-science disciplines produces extensive, comprehensive, peer-reviewed science and actionable data.

The program also provides decision tools for situational awareness, planning, and forecasting that show how environmental contaminants originate and move through the environment to points of exposure, and whether they pose a health hazard. In this way, the program science approach produces a foundation of knowledge for a range of land and resource management and related economic decisions such as maintaining the safety of harvested fish and wildlife species; the re-use of solid and liquid wastes from municipal, energy, and mineral activities; protection of recreational and drinking water resources; and other ecological and public health matters potentially related to environmental contaminants.

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## **REIMBURSABLE ACTIVITIES**

The Environmental Health program participates in reimbursable activities with various Federal, State, Tribal, and international partners, including Interior bureaus (NPS, FWS), other Federal agencies (EPA, National Institutes of Health [NIH], DOD, CDC, OSTP, NOAA, NASA), States (various State environmental and public health agencies), and consortia such as the American Water Works Association, Water Research Foundation, and various National Academy of Sciences groups.

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## LAND MANAGEMENT RESEARCH PROGRAM

*The USGS provides science to understand natural and human influences on lands, waters, and ecosystems to help resource managers balance land uses, resolve and avoid resource management conflicts, enhance and maintain trust lands, and keep communities safe.*



Colorado Plateau native plant community in New Mexico. Source: USGS.

The Land Management Research Program works with Interior bureaus and other partners to inform how land and water management activities influence terrestrial, aquatic, coastal, and estuarine habitats. The science the program provides helps us understand the most effective—and cost-effective—solutions to challenges in ecologically important areas.

The program funds research, decision science, and adaptive management support to Interior bureaus to identify, maintain, and improve habitat to reach species management goals for Federally listed species, as well as species of management responsibility, including migratory birds and fish. The program also provides research to support decision-making designed to prevent the need for species to be listed, and to better provide recreational hunting and fishing opportunities to the American public.

The program also develops tools to help reduce economic and environmental impacts of hazards, with an emphasis on decision-support for Interior-managed lands that improves landscapes resistance to and recovery from fire. The program also provides science to improve coastal resilience to, and recovery after, major storms.

The program provides science to support energy development across the Nation, including science that reduces environmental and permitting conflict around oil and gas, solar, wind, and hydropower development and operation. Program-led collaborative activities, such as those in the American Southwest provide science on effective strategies to support restoration and rehabilitation planning and implementation by Interior and other agencies in sensitive dryland ecosystems.

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The program is working with DOI bureaus and Western States to develop maps and analyze datasets to improve understanding of how large game animals such as elk and mule deer use winter and summer habitats and migrate seasonally across the landscape. Federal and State land managers are using this information to preserve wildlife corridors that effectively conserve and protect these animals during migrations and reduce the incidence of vehicle collisions that pose economic and public safety concerns.

Land Management Research Program activities fall under two areas:

- Priority Landscapes
- Management and Restoration

### **PRIORITY LANDSCAPES**

Priority Landscapes science includes place-based research to inform management decisions within lands owned or comanaged by Interior. Current areas of focus include national parks, wildlife refuges, BLM lands, and priority ecosystems including the Arctic, Chesapeake Bay, Columbia River, Colorado River, Everglades, Great Lakes, Klamath River, Mississippi River, Pacific Islands, Puget Sound, Sagebrush Steppe, San Francisco Bay, and Southwest deserts.

### **MANAGEMENT AND RESTORATION**

Management and restoration research provide science to support energy development across the Nation, including providing science that reduces conflict around oil and gas, solar, wind, and hydropower development and operation. Program-led collaborative activities such as those in the American Southwest provide science on effective strategies to support restoration and rehabilitation planning and implementation by Interior and other agencies in sensitive dryland ecosystems.

### **REIMBURSABLE ACTIVITIES**

The Land Management Research Program conducts studies with various Federal, State, Tribal, and international partners. Examples include Interior bureaus (Bureau of Indian Affairs [BIA], BLM, BOEM, International Technical Assistance Program [ITAP], Office of the Secretary, BOR, FWS, NPS), other Federal agencies (USACE, U.S. Agency for International Development [USAID], NOAA, Navy, Federal Highway Administration [FHWA], USFS, Natural Resources Conservation Service [NRCS], Farm Service Agency [FSA], DOE, U.S. Marine Corps [USMC], EPA), and States through the Association of Fish & Wildlife Agencies, and other State agencies. The program also works on producing scientific information collaboratively with universities (University of Colorado, University of Hawaii, Columbia University), nongovernmental organizations (Keystone Center, The Nature Conservancy, National Fish and Wildlife Federation) and the Great Lakes Fisheries Commission.

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## BIOLOGICAL THREATS AND INVASIVE SPECIES RESEARCH PROGRAM

*The USGS provides essential research, data, detection and management methods, and decision-support tools to help resource managers reduce the threat of invasive species and fish and wildlife disease.*



USGS scientist holds a bighead carp caught in the Illinois River. Source: USGS.

Wildlife diseases and invasive species are costly threats that face the American public. Invasive species, for instance, annually cost the U.S. economy more than all-natural disasters combined, and three out of four emerging and infectious diseases can be harbored in wildlife species. The Biological Threats and Invasive Species Program develops decision-support tools and technologies to better and more efficiently manage invasive species and wildlife diseases. Program scientists develop and improve the ability to detect, monitor, assess risks, and control nationally significant invasive species and fish and wildlife diseases. Research and technology development focus on species that cause, or have potential to cause, significant economic or ecological impacts, or harm human health. The program integrates control strategies to empower land and water managers to respond quickly and effectively to a wide variety of new invasions.

The USGS is the primary Federal agency conducting surveillance for wildlife disease. The Biological Threats and Invasive Species Program aids partners to determine where to conduct surveillance and which animals to target, which requires an understanding of wildlife population dynamics pathogen spread within their populations. The program supports whole-of-government efforts to respond to high impact and emerging infectious diseases. Field and laboratory surveillance, cause of death determination and pathogen discovery, decision support tools, and research are leveraged with activities to support Federal responses to diseases that impact public health and the agricultural economy. The program often provides important information to the Centers for Disease Control and Prevention (CDC), the U.S. Department of Agriculture (USDA),

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the National Oceanic and Atmospheric Administration (NOAA), Interior, and other Federal agencies to improve management of fish and wildlife disease outbreaks across the country.

The program also conducts multiscale, integrated assessments to map and monitor infestations of high-impact invasive plants and animals across the Nation. The program also develops decision support frameworks and risk assessments to better empower natural resource managers to minimize the ecological and economic impacts of invasive species. Work by scientists in the program enhances biosurveillance of invasive species by improving information and data delivery on monitoring and species occurrences through field and lab research, online databases, and information systems to advance our understanding of the complex interactions affecting the spread of invasive species

Biological Threats and Invasive Species Research Program activities fall under two areas:

- Invasive Species
- Wildlife Diseases

## **INVASIVE SPECIES**

The program develops and improves methods for early detection and rapid response to invasive species and improves situational awareness of local, State, and Federal managers through the Nonindigenous Aquatic Species (NAS) database (<https://nas.er.usgs.gov>). The NAS provides species profiles and distribution maps, identifies areas of potential spread, sends alerts of new observations, and provides aquatic species data scanning tools to identify nonindigenous aquatic species.

In response to the threat Asian carp pose in the Great Lakes, the Mississippi River and its subbasins, the Biological Threats and Invasive Species Program continues to work with Federal and State partners to develop and implement deterrent, containment, and control tools. Program scientists are also developing models that integrate hydrology, life history, habitat characteristics, and potential management actions in a decision-making framework to decrease management costs and increase the potential for management success.

The program conducts multiscale, integrated assessments to map and monitor infestations of invasive plants in the West, helping us to predict areas most vulnerable to invasive species. In addition, the program examines the effects of management practices and natural disturbances on invasive species and evaluates how invasive plants alter the frequency and intensity of wildfires, which enables land managers to reduce the risks posed by wildfire. The program also provides science, training, and logistical support to aid the USDA and Pacific Island governments in rapid response and control of brown treesnakes on Guam; conducts research to help Florida and the NPS reduce the impacts of Burmese pythons and other invasive reptiles in the Everglades; and has particular and unique expertise in developing species-specific control for aquatic invasive species.



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## **WILDLIFE DISEASES**

The Biological Threats and Invasive Species Program is investigating vector-borne diseases of concern to Interior and other Federal agencies. Sylvatic plague was one of eight zoonotic diseases prioritized by CDC, USDA, and DOI that needs to be addressed by the Federal government with a “One Health” approach (One Health is a collaborative, multisectoral approach working at local, regional, national, and global scales that recognizes the interconnection of health outcomes among people, animals, plants, and their shared environment.) Endangered black-footed ferrets, prairie dogs, domestic and wild cats, as well as humans, can die from sylvatic plague, a flea-borne bacterial disease. The program is investigating the ecology of plague and harnessing that information to develop and adapt integrated pest management tools, such as a novel vaccine, for this and other wildlife diseases. The technology behind the plague vaccine is also being used by the program to develop a White Nose Syndrome (WNS) vaccine for bats. WNS has killed millions of bats across the United States, causing significant negative effects on agriculture and potentially increasing the spread of insect-borne diseases.

The program also assesses mass mortalities and develops fish and wildlife disease management tools for species, such as salmon, sturgeon, trout, whitefish, and mussels. This work enhances biosurveillance of aquatic diseases by improving information and data delivery on monitoring and species occurrences through field and lab research, online databases, and information systems to advance our understanding of the complex interactions that influence disease outbreaks. Program scientists also conduct investigations into marine diseases impacting sea turtles and other organisms to support FWS, NPS, and NOAA species management. By understanding disease patterns and processes, the science is being used by managers to take actions to improve the health of threatened or endangered fish populations.

## **REIMBURSABLE ACTIVITIES**

The Biological Threats and Invasive Species Program works with various Federal, State, Tribal, and international partners, including DOI bureaus (Office of Insular Affairs [OIA], Office of the Secretary [OS], BLM, BOR, NPS, FWS), other Federal agencies (USDA, Commerce, DOD, HHS, DHS, FDA, NASA, EPA), States, and a host of other consortia, academia and industry.

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## CLIMATE ADAPTATION SCIENCE CENTER AND LAND CHANGE SCIENCE PROGRAM

*The USGS delivers science to support the development of adaptive management plans that incorporate environmental changes and their impacts on fish, wildlife, water, land, and people.*



Scientist measuring changes by ablation stake in Wolverine Glacier, Alaska. Source: USGS.

The [Climate Adaptation Science Center](#) and [Land Change Science Program](#) conducts research to understand habitat response to changing climate and environment and assess how different management and restoration strategies would affect the habitats and their ecological functions. The program provides foundational and applied research needed to understand and anticipate impacts of climate and other environmental changes on ecosystems and wildlife. The program serves as an interface between Federal researchers, land managers, and front-line stewards of natural and cultural resources.

The scientific work conducted is responsive to the following guiding principles:

- Meets the needs of resource managers.
- Prioritizes evaluation, translation, and synthesis of climate-impact research findings.
- Promotes rigorous and integrated research to advance fundamental understanding of climate impacts to fish, wildlife, and their habitats.
- Develops approaches to ensure broad dissemination of results to the public and foster professional scrutiny, critique, and learning.
- Promotes institutional efficiencies through partnerships to avoid duplication of effort and leverage opportunities in climate-impact research.

The program synthesizes and analyzes the effects of a changing climate on terrestrial and aquatic communities and natural resources at local, regional, and national scales. The program focuses on

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Interior's highest priorities, such as wildfires, wildlife disease, drought, and their effects on federally listed species or critical habitat, recreational fisheries, migratory corridors, and tribal lands and waters.

The Climate Adaptation Science Center and Land Change Science Program activities fall under two areas:

- National and Regional Climate Adaptation Science Centers
- Land Change Science

## **NATIONAL AND REGIONAL CLIMATE ADAPTATION SCIENCE CENTERS**

The National and Regional Climate Adaptation Science Centers (NRCASCs) are focused on better understanding impacts of climate and other stressors to the Nation's fish, wildlife, and their habitats. The NRCASCs deliver the science to support development of adaptive management plans that incorporate a range of environmental changes and their impacts on fish, wildlife, water, land, and people. They provide data, tools, and applications that help resource managers meet current and emerging challenges that threaten the sustainability of natural resources and delivers research, investigations, models, and applications that provide the scientific basis for land use decisions affecting the safety of communities, economic prosperity, and the natural resources of the Nation.

Each NRCASC is a cooperative arrangement between the USGS National Climate Adaptation Science Center and a regional host university. Most NRCASCs are composed of multi-institution consortia, which include university and non-university partners. Each NRCASC is reviewed on an annual basis, and a larger review is undertaken at the conclusion of each 5-year agreement.

The NRCASCs focus on a better understanding of the implications of changing climate on invasive species, high priority species, communities, and ecosystems; increasing understanding of the uncertainties associated with models and modeling results; and advancing the design and evaluation of adaptation strategies. Likewise, they serve as an essential interface between Federal researchers, land managers, and front-line stewards of natural and cultural resources. The NRCASC also provide the basic understanding necessary to support climate impact applications developed within the program and provide long-term data and interpretations needed by the Land Management Research Program and other USGS programs to anticipate impacts of changing climate and land use on critical habitats. NRCASC research combines long-standing expertise in geology, hydrology, biogeochemistry, and ecology to document patterns of change over a range of timescales and to assess and model impacts of these changes at local, regional, and national scales.

## **LAND CHANGE SCIENCE**

Land Change Science provides the foundational data needed to understand and forecast how the Earth system responds to a range of climate and environmental changes.

Scientists conduct research to improve understanding of the rates, causes, and consequences of changing climate and land use for ecosystems and habitats and to assess the vulnerability and

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resilience of those systems to change. Researchers draw on expertise in past and present climate, geology, hydrology, geography, and biology to document patterns of climate and land-use change on daily to millennial timescales and to assess and model the impacts of changes on local, regional, and national spatial scales. By combining data generation with modeling efforts, Land Change Science researchers are improving knowledge of the processes that influence climate and land-use change and the responses of critical habitats and ecosystems. These efforts provide managers and policymakers with real-world data on the response of critical ecosystems to climate and land-use change.

Land Change Science research is critical to understand how changing land use, environment, and climate can affect our Nation's natural resources, infrastructure, and water, energy, and food security. Some areas of focus include

- Long-term patterns and impacts of droughts and floods
- Response of coastal and wetland regions to changing land use and climate
- Impacts of changing climate and land management on the cycling of water, nutrients, and carbon in terrestrial and aquatic systems
- Patterns, drivers, and impacts of change on Arctic habitats
- Magnitudes and rates of past, present, and future changes and impacts on North American ecosystems
- Drivers and patterns on land use and land cover change and impacts on society

These efforts provide data that show how different forces shape the landscape, distinguish between changes caused by natural forces and those driven by land management choices, and provide the scientific basis for future land use decisions that affect the safety and prosperity of communities and our Nation's natural resources.

Land Change Science enhances USGS capabilities by collaborating with scientists in other Federal agencies (NPS, FWS, USFS, BIA, NOAA, and the Smithsonian Institution) and academic institutions across the globe. Additionally, Land Change Science research supports national and international efforts to understand climate change through the U.S. Global Change Research Program Strategic Plan, U.S. National Climate Assessment, and the Intergovernmental Panel on Climate Change.

## **REIMBURSABLE ACTIVITIES**

The NRCASC works with various Federal, State, Tribal, and international partners, including DOI bureaus (FWS, NPS), other Federal agencies (USFS, USACE), States (Colorado and Maryland), and many universities, such as University of Alaska, Fairbanks and Duke University.

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## COOPERATIVE RESEARCH UNITS PROGRAM

*The USGS provides education, research, and technical assistance for managing our natural resources.*

The [Cooperative Research Units](#) (CRU) program is a unique cooperative relationship between the USGS, State fish and wildlife agencies, host universities, and the Wildlife Management Institute. The FWS is also a formal cooperator at most of the individual Units. Since 1935, this cooperative relationship has provided a strong connection between the USGS, State and



Herd of mule deer in Wyoming. Source: BLM.

Federal management agencies, and the national university community. The individual resources of each cooperator are leveraged to deliver program outcomes that far exceed what any one cooperator could achieve alone.

The goals of the CRU program are to sustain and maintain

- A cost-effective, national network of Federal, State, and university partnerships pursuant to the Cooperative Research and Training Units Act of 1960 ([P.L. 86-686](#)), with a legislated mission of research, education, and technical assistance focused on fish, wildlife, ecology, and natural resources.
- A customer-oriented network of expertise for actionable science, research, teaching, and technical assistance that is responsive to information needs of State and Federal resource agency decisionmakers.
- Science capabilities responsive to resource management needs of Interior bureaus.
- A premier program for graduate education, mentoring, and training of future natural resources professionals having skills to serve the broad natural resource management community successfully.

The CRU program is composed of 40 cooperative units located at universities in 38 States. The program is designed to leverage cooperative partnerships with Federal and State agencies to address mutual needs of all partners in a cost-effective manner. The USGS stations Federal scientists at universities to help identify and respond to natural resource information needs through pooling of resources among agencies; participate in advanced scientific training and mentoring of

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university graduate students to represent the various agencies workforce of the future; and provide Federal and other natural resource managers' access to university expertise and facilities.

Federal support of the CRUs is multiplied by State and university cooperator contributions of expertise, equipment, facilities, and project funding, thereby enhancing the program's cost-effectiveness. The program's appropriated dollars continue to be matched by Federal, State, university, and other entities' contributions at a ratio of three matching dollars to each appropriated dollar. Through university affiliations, CRU scientists train future natural resource professionals and provide opportunities through graduate education to diversify the Federal workforce.

Each CRU is directed by a Coordinating Committee composed of Federal, State, university, and Wildlife Management Institute representatives. Each Coordinating Committee establishes goals and expectations for its unit within the program's mission of research, education, and technical assistance. The mix of priorities is established locally and is updated annually based on the needs of cooperators and available funding. Program accountability measures, performance standards, and oversight of Federal scientists are used to ensure research and the resulting scientific information products support the goals of the USGS and Interior.

### **REIMBURSABLE ACTIVITIES**

The program works with various Federal, State, Tribal, and international partners, including Interior bureaus (FWS, BLM, BOR, NPS, BOEM), other Federal agencies (EPA, NASA, USDA, Commerce, DOD), 36 States and other consortia (including the Wildlife Management Institute, The Wildlife Society, American Fisheries Society, Association of Fish & Wildlife Agencies, National Association of University Fish and Wildlife Programs, and Association of Public and Land-grant Universities).

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## ECOSYSTEMS CENTERS WITHIN INTERIOR UNIFIED REGIONS

The following is a summary of the USGS science centers that receive major funding from the Ecosystems Mission Area and their locations with Department of the Interior's Unified Regions. *A brief overview of each center is provided on pages 33-34.*

### **Region 1 – North Atlantic Appalachian** (*USGS Northeast Region*)

1. Eastern Ecological Science Center, Kearneysville, WV; Laurel, MD

### **Region 2 – South Atlantic-Gulf** (*USGS Southeast Region*)

2. Wetland and Aquatic Research Center, Gainesville, FL

### **Region 3 – Great Lakes** (*USGS Midcontinent Region*)

3. Great Lakes Science Center, Ann Arbor, MI
4. Upper Midwest Environmental Sciences Center, La Crosse, WI
5. National Wildlife Health Center, Madison, WI

### **Region 4 – Mississippi Basin** (*USGS Southeast Region*)

6. Columbia Environmental Research Center, Columbia, MO

### **Region 5 – Missouri Basin** (*USGS Midcontinent Region*)

7. Northern Prairie Wildlife Research Center, Jamestown, ND
8. Northern Rocky Mountain Science Center, Bozeman, MT

### **Region 7 – Upper Colorado Basin** (*USGS Rocky Mountain Region*)

9. Fort Collins Science Center, Fort Collins, CO

### **Region 8 - Lower Colorado Basin** (*USGS Southwest Region*)

10. Southwest Biological Science Center, Flagstaff, AZ

### **Region 9 – Columbia Pacific Northwest** (*USGS Northwest Pacific Islands Region*)

11. Western Fisheries Research Center, Seattle, WA
12. Forest and Rangeland Ecosystem Science Center, Corvallis, CO

### **Region 10 – California-Great Basin** (*USGS Southwest Region*)

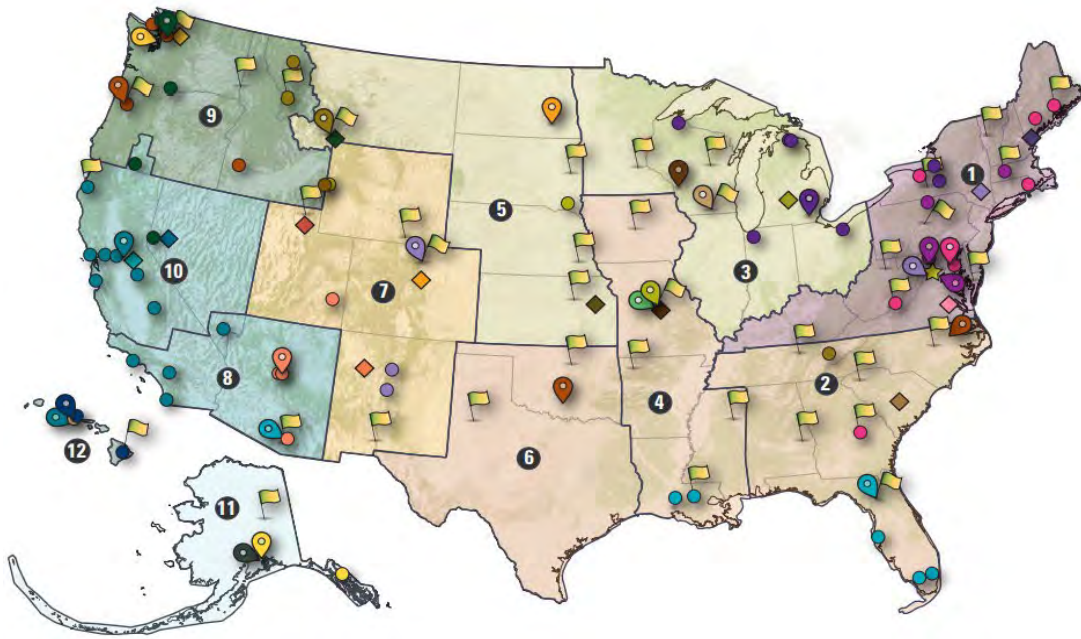
13. Western Ecological Research Center, Sacramento, CA

### **Region 11 – Alaska** (*USGS Alaska Region*)

14. Alaska Science Center, Anchorage, Alaska

### **Region 12 – Pacific Islands** (*USGS Northwest-Pacific Islands Region*)

15. Pacific Island Ecosystems Research Center, Island of Hawaii, HI



**Ecosystems Science Centers**

**National Centers**

★ Ecosystems Mission Area Headquarters

📍 **Alaska Science Center (ASC) \*\***  
● Field Stations

📍 **Pacific Island Ecosystems Research Center**  
● Field Stations

📍 **Oregon Water Science Center**

📍 **Northern Rocky Mountain Science Center**  
● Field Stations

📍 **Western Fisheries Research Center \*\***  
● Field Stations

📍 **Forest and Rangeland Ecosystem Science Center**  
● Field Stations

📍 **Western Ecological Research Center**  
● Field Stations

📍 **California Water Science Center**

📍 **Nevada Water Science Center**

📍 **Southwest Biological Science Center**  
● Field Stations

📍 **Northern Prairie Wildlife Research Center**  
● Field Station

📍 **Columbia Environmental Research Center \*\***  
● Field Stations

📍 **Upper Midwest Environmental Sciences Center \*\***  
● Field Stations

📍 **National Wildlife Health Center \*\***  
● Field Stations

📍 **Michigan Bacteriological Research Laboratory**

📍 **Kansas Water Science Center**

📍 **Wyoming-Montana Water Science Center**

📍 **Fort Collins Science Center \*\***  
● Field Stations (Guam not shown)

📍 **Colorado Water Science Center**

📍 **New Mexico Water Science Center**

📍 **Utah Water Science Center**

📍 **Great Lakes Science Center**  
● Field Stations

📍 **Leetown Science Center \*\***  
● Field Stations

📍 **Patuxent Wildlife Research Center \*\***  
● Field Stations

📍 **New England Water Science Center**

📍 **New York Water Science Center**

📍 **Virginia Water Science Center**

📍 **Wetland and Aquatic Research Center \*\***  
● Field Stations (U.S. Virgin Islands not shown)

📍 **South Atlantic Water Science Center**

📍 **Iowa Water Science Center**

📍 **Oklahoma-Texas Water Science Center**

**USGS Regions**

- 🟩 Northwest - Pacific Islands
- 🟦 Southwest
- 🟨 Alaska
- 🟪 Rocky Mountain
- 🟫 Midcontinent
- 🟬 Southeast
- 🟭 Northeast

📍 **National Climate Adaptation Science Center, Land Change Science and Land Remote Sensing Program Offices**

**Climate Adaptation Science Centers (CASC)**

- 📍 Alaska
- 📍 North Central
- 📍 Northeast
- 📍 Northwest
- 📍 Pacific Islands
- 📍 South Central
- 📍 Southeast
- 📍 Southwest

**Cooperative Research Units**

🚩 Locations with Cooperative Research Units

**DOI Unified Regions**

- 1 North Atlantic-Appalachian
- 2 South Atlantic-Gulf
- 3 Great Lakes
- 4 Mississippi Basin
- 5 Missouri Basin
- 6 Arkansas-Rio Grande-Texas Gulf
- 7 Upper Colorado Basin
- 8 Lower Colorado Basin
- 9 Columbia-Pacific Northwest
- 10 California-Great Basin
- 11 Alaska
- 12 Pacific Islands

\*\* In support of Environmental Health Programs



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### **Alaska Science Center (ASC)**

The ASC provides objective and timely data, information, and research findings about the Earth and its flora and fauna to Federal, State, and local resource managers and the public to support sound decisions regarding natural resources, natural hazards, and ecosystems in Alaska and circumpolar regions.

### **Columbia Environmental Research Center (CERC)**

The CERC provides scientific information and data needed to address national and international environmental contaminant issues, and the effects of habitat alteration on aquatic and terrestrial ecosystems. The center has a unique capability for conducting multidisciplinary research that includes large river floodplains, coastal habitats, wetlands, streams, and lakes.

### **Eastern Ecological Science Center (EESC)**

The EESC produces innovative science and technology to support natural resource management and preserve our Nation's fisheries resources and fishing to meet our Nation's most pressing conservation challenges. EESC research topics include bird population dynamics, ecotoxicology, migratory fish conservation, aquatic animal health, aquatic ecology and fish biology, and invasive and imperiled species. The EESC also supports the development of quantitative and decision analysis tools and conducts several national programs, including the Bird Banding Lab and the Breeding Bird Survey.

### **Forest and Rangeland Ecosystem Science Center (FRESC)**

The FRESC capitalizes on its diverse expertise to answer scientific questions shaped by the environments of the western United States. FRESC collaborates with partners to provide rigorous, objective, and timely information and guidance for the management and conservation of biological systems in the West and worldwide.

### **Fort Collins Science Center (FORT)**

The FORT develops and disseminates research-based information and tools needed to understand the Nation's biological resources in support of effective decision making.

### **Great Lakes Science Center (GLSC)**

GLSC scientists work in the Great Lakes region and other parts of the country to meet the Nation's need for scientific information used by resource managers to restore, enhance, manage, and protect the living resources and habitats in the Great Lakes basin.

### **National Wildlife Health Center (NWHC)**

The NWHC provides information, technical assistance, and research on national and international wildlife health issues. The center also monitors and assesses the impact of disease on wildlife populations; defines ecological relationships leading to the occurrence of disease; transfers technology for disease prevention and control; and provides guidance, training, and on-site assistance for reducing wildlife losses. The center also includes a 5,300 square foot biosafety level 3 (BSL-3) necropsy facility and BSL-3 animal research facilities.

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### **Northern Prairie Wildlife Research Center (NPWRC)**

The NPWRC's priority is to provide the scientific information needed to conserve and manage the Nation's natural capital for current and future generations, with an emphasis on migratory birds, the Department of the Interior trust resources, and ecosystems of the Nation's interior.

### **Northern Rocky Mountain Science Center (NOROCK)**

The NOROCK works in the northern Rocky Mountains of the United States. Many of our scientists also work throughout the world on issues as diverse as global climate change, aquatic ecology, wildlife diseases, bison ecology, and large carnivores. The center generates and communicates scientific information needed to address issues of critical importance to natural resource managers of the region.

### **Pacific Island Ecosystems Research Center (PIERC)**

The PIERC focuses on providing the scientific understanding and technologies needed to support and implement sound management and conservation of our Nation's biological resources occurring in Hawaii and other Pacific island locations.

### **Southwest Biological Science Center (SBSC)**

The SBSC conducts quality, objective research on the lands and aquatic systems of the Southwest. This research can assist those who manage, conserve, and rehabilitate the arid regions of the Nation.

### **Upper Midwest Environmental Sciences Center (UMESC)**

The UMESC provides the scientific information needed by managers, decision makers, and the public to protect, enhance, and restore the ecosystems in the Upper Mississippi River Basin, the Midwest, and worldwide.

### **Western Ecological Research Center (WERC)**

The WERC serves primarily California and Nevada. WERC scientists work closely with Federal, State, academic, and other collaborators to address a diverse array of high-profile topics. Topics include research on the effects of wildfire, sea level rise, drought, energy development, and more on Federal Trust species.

### **Western Fisheries Research Center (WERC)**

The WERC focuses on the environmental factors responsible for the creation, maintenance, and regulation of fish populations, including their interactions in aquatic communities and ecosystems.

### **Wetland and Aquatic Research Center (WARC)**

The WARC conducts relevant and objective research, develops new approaches and technologies, and disseminates scientific information needed to understand, manage, conserve, and restore wetlands and other aquatic and coastal ecosystems and their associated plant and animal communities throughout the Nation and the world.

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## SOCIAL MEDIA PRESENCE

Links below taken from <https://www.usgs.gov/mission-areas/ecosystems/social-media>

	<a href="https://www.facebook.com/CRU1935">https://www.facebook.com/CRU1935</a> <a href="https://www.facebook.com/USGSPatuxent/">https://www.facebook.com/USGSPatuxent/</a>
	<a href="https://twitter.com/usgswetlands">https://twitter.com/usgswetlands</a> <a href="https://twitter.com/USGSAquaticLife">https://twitter.com/USGSAquaticLife</a>
	<a href="https://www.instagram.com/usgs_wild/">https://www.instagram.com/usgs_wild/</a> <a href="https://www.instagram.com/usgscoopunits/">https://www.instagram.com/usgscoopunits/</a> <a href="https://www.instagram.com/usgsbiml/">https://www.instagram.com/usgsbiml/</a>
	<a href="http://usgscoopunits.tumblr.com/">http://usgscoopunits.tumblr.com/</a> <a href="https://usgsbiml.tumblr.com/">https://usgsbiml.tumblr.com/</a>
	<a href="https://www.usgs.gov/mission-areas/1738/news/feed">https://www.usgs.gov/mission-areas/1738/news/feed</a> <a href="https://www.usgs.gov/podcasts/audio/158035/feed.xml">https://www.usgs.gov/podcasts/audio/158035/feed.xml</a> <a href="https://www.usgs.gov/centers/pacific-island-ecosystems-research-center/news/feed">https://www.usgs.gov/centers/pacific-island-ecosystems-research-center/news/feed</a>
	<a href="https://www.youtube.com/channel/UCeXH8GZyV3sVqAr45AvupOA">https://www.youtube.com/channel/UCeXH8GZyV3sVqAr45AvupOA</a>
	<a href="https://www.flickr.com/photos/usgeologicalsurvey/">https://www.flickr.com/photos/usgeologicalsurvey/</a> <a href="https://www.flickr.com/photos/soilcarbon">https://www.flickr.com/photos/soilcarbon</a> <a href="https://www.flickr.com/photos/usgsbiml/">https://www.flickr.com/photos/usgsbiml/</a>
	<a href="https://www.usgs.gov/podcasts/audio/outstanding-field">https://www.usgs.gov/podcasts/audio/outstanding-field</a>
	<a href="https://github.com/usgs">https://github.com/usgs</a>

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## LEGAL AUTHORITIES FOR MISSION AREA ACTIVITIES

### **43 U.S.C. 31 | The Organic Act of March 3, 1879**

An act that established the Geological Survey, as amended (1962), and restated in annual appropriation acts. This section provides, among other things, that the Geological Survey is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Interior Department. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285 Sec. 10(a) establishes United States Geological Survey as its official name.

### **16 U.S.C. 1531-1543 | Endangered Species Act of 1973**

As amended, provides for the conservation of threatened and endangered species of fish, wildlife, and plants; and authorizes establishment of cooperative agreements and grants-in-aid to States that establish and maintain active and adequate programs for endangered and threatened wildlife and plants.

### **16 U.S.C. 661 | Fish and Wildlife Coordination Act of 1934 (P.L. 79-732)**

Authorizes the Secretary of the Interior to prepare plans to protect wildlife resources, to conduct surveys on public lands, and to accept funds or lands for related purposes. It also authorizes the investigation and reporting of proposed Federal actions that affect the development, protection, rearing, and stocking of all species of wildlife and their habitat in controlling losses, minimizing damages, and providing recommendations to minimize impacts on fish and wildlife resources.

### **16 U.S.C. 703-711 | Migratory Bird Treaty Act of 1918**

As amended, implements four international treaties that individually affect migratory birds common to the United States, Canada, Mexico, Japan, and the former Soviet Union. This Act establishes Federal responsibility for protection and management of migratory and nongame birds, including the establishment of season length based on scientific information relative to zones of temperature, distribution, abundance, breeding habits and times, and lines of migratory flight of migratory birds. It also establishes the Secretary of the Interior's responsibility for bag limits and other hunting regulations, as well as the issuance of permits to band, possess, or otherwise make use of migratory birds.

### **16 U.S.C. 753a | The Fish and Wildlife Improvement Act of 1978**

As amended by P.L. 95-616, authorizes the Secretary of the Interior to enter into cooperative agreements with colleges and universities, State fish and game agencies, and nonprofit organizations for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources.

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### **33 U.S.C. 1251 | Federal Water Pollution Control Act Amendments of 1972**

The act and its successors, the Clean Water Act of 1977 and the Water Quality Act of 1987, authorize extensive water quality planning, studies, and monitoring under the direction primarily of the Environmental Protection Agency (EPA). The Geological Survey is called upon to participate in many of these activities, partly by EPA and partly by State agencies in the Federal-State Cooperative Program. The act of 1987 includes new water quality work concerning Chesapeake Bay, the Great Lakes, Estuary and Clean Lakes Programs, and studies of water pollution problems in aquifers.

### **42 U.S.C. 4331 | National Environmental Policy Act of 1969 (NEPA)**

Requires prior-to-action determination that any major Federal action will not have a significantly adverse effect upon the environment. Consequently, the Geological Survey is called upon to provide technical review or inputs to resource related actions proposed by other Federal agencies.

### **42 U.S.C. 6901 | Resource Conservation and Recovery Act of 1976 and Hazardous and Solid Waste Amendments of 1984**

Requires EPA to promulgate guidelines and regulations for identification and management of solid waste, including its disposal. The Geological Survey's expertise is a present and potential source of assistance to EPA in defining and predicting the hydrologic effects of waste disposal.

### **42 U.S.C. 9601 | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)**

Establishes a superfund to pay, in part, for the massive cleanup programs needed at sites that are heavily contaminated with toxic wastes. The Geological Survey is called upon by EPA and State agencies to investigate and determine the extent of contamination and remedial measures at some of these sites.

### **43 U.S.C. 1334; 43 U.S.C. 1346 | Outer Continental Shelf (OCS) Lands Act**

Authorizes the Secretary of the Interior to prescribe rules and regulations to provide for the prevention of waste and conservation of the natural resources of the OCS; to conduct geological and geophysical explorations of the OCS; and directs the Secretary of the Interior to conduct a study of any region in any gas and oil lease sale to obtain information necessary for assessment and management of environmental impacts on human, marine and coastal areas, which may be affected by oil and gas development on such areas.

### **43 U.S.C. 1701 et seq.; 43 U.S.C. 1737 | The Federal Land Policy and Management Act of 1976 (FLPMA) and the Studies, Cooperative Agreements, and Contributions Implementation Provisions**

Authorizes the Secretary of the Interior to conduct investigations, studies, and experiments involving the management, protection, development, acquisition, and conveying of public lands; and to prepare and maintain inventories of all public land and resources.

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**P.L. 86-686 | Cooperative Research and Training Units Act of 1960**

Established for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife resources. The Secretary of the Interior is authorized to continue to enter into cooperative agreements with colleges and universities, with game and fish departments of the several States, and with nonprofit organizations relating to cooperative research units.

**P.L. 111-307 | Asian Carp Prevention and Control Act**

Added species of carp to the list of injurious species that are prohibited from being imported or shipped.

**P.L. 99-552, 100 Stat. 3 | Klamath River Basin Restoration Program Act**

Provides for the restoration of the fishery resources in the Klamath River Basin and the establishment of the Klamath Fishery Management Council and the Klamath River Basin Fisheries Task Force. The Secretary shall designate the anadromous fish habitats and resources of the Klamath River basin as the Klamath River Basin Conservation Area.

**18 USC 42 | The Lacy Act of 1900**

Amended in 1998, designates species injurious to human beings or resources. Prohibits import of a list of designated species and other vertebrates, mollusks, and crustacea that are “injurious to human beings, to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States.” Declares importation or transportation of any live wildlife as injurious and prohibited, except as provided for under the act.

**P.L. 109-326 | Great Lakes Fish and Wildlife Restoration Act of 2006**

Amends the Great Lakes Fish and Wildlife Restoration Act of 1990 to provide for implementation of recommendations of the United States Fish and Wildlife Service contained in the Great Lakes Fishery Resources Restoration Study.

**15 USC 2901, 2908 | The National Climate Program Act of 1978**

Establishes a national climate program to assist the Nation and the world in understanding and responding to natural and human-induced climate processes and their known and potential effects. The Department of the Interior has a mandated role in this Program to establish a national climate program to assist the Nation and the world in understanding and responding to natural and human-induced climate processes and their known and potential effects. The Department of the Interior has a mandated role in this Program.

**P.L. 101-606, 15 USC 2921-2953 | The Global Change Research Act of 1990**

Establishes the United States Global Change Research Program aimed at understanding and responding to global change, including the cumulative effects of human activities and natural processes on the environment, to promote discussions toward international protocols in global change research, and for other purposes.

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**7 USC 136-136y | Federal Environmental Pesticide Control Act of 1972**

Establishes a program for controlling the sale and distribution of “economic poisons” and requires registration of pesticides to avoid unreasonable adverse effects to humans or the environment.

**P.L. 101-646 | Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990**

Establishes a Federal program to prevent introduction of, and to control the spread of, introduced aquatic nuisance species and the brown treesnake.

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## SOURCES FOR FAST FACTS

- Fact: Ecosystems Mission Area produces 52% of all USGS publications (4,000 since March 2018).

*Source:*

<https://usgs.maps.arcgis.com/apps/Cascade/index.html?appid=f025d06be5eb4c1d8b099d0940579615>, USGS.

- Fact: In Louisiana, an average of one American football field's worth of coastal wetlands is lost every 34 minutes when losses are rapid, or every 100 minutes at more recent rates.

*Source:*

<https://www.usgs.gov/news/usgs-louisiana-s-rate-coastal-wetland-loss-continues-slow>, USGS.

- Fact: Road mortality is among the major threats to the survival for 21 species that are Federally listed as threatened or endangered in the U.S.

*Source:* <https://www.usgs.gov/media/images/discover-ecosystems>, USGS.

- Fact: The USGS provides support for the management of harvested migratory gamebird populations and science-based population data supporting 400 bird species.

*Source:* <https://www.usgs.gov/centers/pwrc/science/comprehensive-1966-2015-results-north-american-breeding-bird-survey>, USGS.

- Fact: Economic, ecological, & biological health threats costs the U.S. economy more than \$137 billion.

*Source:*

<https://usgs.maps.arcgis.com/apps/Cascade/index.html?appid=f025d06be5eb4c1d8b099d0940579615>, USGS.

- Fact: Humans cause about 85% of wildfires or unplanned ignitions. It costs \$5 billion a year to respond to wildfires (a net economic impact of about \$72 billion a year).

*Source:* <https://www.usgs.gov/news/fast-fire-facts-usgs>, USGS.





# Energy and Mineral Resources Mission Area



## Programs

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Energy Resources Program

Mineral Resources Program

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*America relies on scientific information for energy and minerals development to power our homes and businesses, and to manufacture products we rely on every day.*

## **ENERGY AND MINERAL RESOURCES MISSION AREA OVERVIEW**

The [Energy and Mineral Resources Mission Area](#) conducts scientific research, completes energy and mineral resource assessments, and compiles information and statistics on the worldwide supply and flow of minerals, including critical minerals, and materials essential to our economy and national security.

Energy and mineral resources are vital components of the Nation's economy. As of 2020, the United States is 100 percent dependent on foreign nations for 17 different mineral commodities, including multiple minerals that are critical for national security and economic growth. In addition, the United States is 50 percent reliant on foreign imports for another 29 minerals. The Nation depends on energy resources to power homes and businesses, and mineral resources to manufacture products such as cell phones, laptops, cars, and renewable energy technologies. As demands for energy and mineral resources grow, USGS research and assessments become increasingly critical for understanding the occurrence, quality, supply, and use of national and global resources. The in-depth science provided by the USGS Energy and Mineral Resources Mission Area informs strategic, evidence-based economic and geopolitical decisions and facilitates responsible natural resource development.



USGS scientist Sarah Hawkins, lead scientist for the Mancos Shale assessment, examining a core drilled by the USGS Core Research Center. Source: USGS.

### **What We Do**

- Conduct national and global inventories and assessments of energy and mineral resources.
- Provide publicly available scientific information on the origin and distribution of energy and mineral resources.
- Characterize the full life cycle of energy and mineral resource production, supply, consumption, waste, and interaction with the environment.
- Provide information on supply chain risks for energy and mineral resources necessary to support national security and the development of infrastructure and new technologies.

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## HOW THE MISSION AREA SERVES THE PUBLIC

**Minerals Information:** Every month, specialists from the USGS Mineral Resources Program's National Minerals Information Center (NMIC) answer more than 2,000 inquiries from stakeholders including Federal and State agencies, domestic and international organizations, foreign governments, and the public. Mineral Resources Program scientists also conduct analyses of minerals conservation, sustainability, materials flow, availability, and the economic health of the U.S. minerals industry. Minerals information is provided to other Federal agencies, including the U.S. Census Bureau, the Department of Defense (DOD), the Department of State (DOS), the U.S. Environmental Protection Agency (EPA), the Department of Commerce (DOC), intelligence agencies, the Federal Reserve Board, and the Office of the U.S. Trade Representative. As an example, this information helps EPA quantify material flows in annual solid waste reporting and helps the DOC's Bureau of Economic Analysis track the Nation's natural resource wealth. Every year, about 700 reports are prepared by the NMIC and added to the minerals information Web pages (<http://minerals.usgs.gov/minerals>).



Spodumene, a primary mineral commodity of lithium. Uses include batteries for cell phones, laptops, and electric and hybrid vehicles. Source: USGS.



USGS field work for an oil and gas assessment for the Eagle Ford of the Gulf Coast Basins. Source: USGS.

**Energy Resource Assessments:** The Energy Resources Program (ERP) provides publicly available estimates of a variety of geological energy resources for the United States and estimates of oil and gas resources for the world. The ERP conducts basic and applied research on geologic energy resources and on the environmental and economic impacts of their use. The program studies geologic energy resources such as oil, natural gas, coal, coalbed methane, gas hydrates, geothermal resources, uranium, oil shale, bitumen, and heavy oil, as well as the carbon, water, and waste implications of energy development. The ERP also studies wind energy and the impacts of wind development on wildlife. The ERP is coordinating with the USGS Ecosystems Mission Area on the Wind Energy Impact Assessment Methodology to assess population-level impacts of wind energy development on birds and bats, helping to inform decisions on the placement of wind turbines and related environmental considerations.

**Energy and Minerals Research:** Research includes the development of tools to make energy and mineral resources information more useful for land and resource management decisions so that economic alternatives and tradeoffs can be assessed. This research also includes studies to conduct multiresource assessments that combine energy and mineral resources assessments with information about the quantity and quality of other natural resources. This work is done in collaboration with other Federal agencies, universities, and nongovernmental organizations.

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## ENERGY AND MINERAL RESOURCES PARTNERS

### Department of Interior (DOI) Bureaus

**Bureau of Land Management (BLM)** uses a wide variety of USGS energy and minerals information, and collaborates with the USGS on efforts to support their agency mission and inform land management decisions, including the following

- Critical mineral resource assessments in Alaska, which are essential for the BLM's mandated duties to manage Federal land.
- Collaboration on the construction of a new geospatial minerals information database (USMIN) that captures historical mine features from topographic maps and links to a tabular database of minerals information.
- Collaboration to update the hydrocarbon resource potential of the Alaska North Slope.
- Coordination on Earth Mapping Resources Initiative (Earth MRI) geologic, geophysical, and topographic mapping activities on BLM-managed lands.
- Partnering on geothermal energy on Federal lands and on a variety of energy resource projects.
- Supporting geological input related to coal-bearing formations on Federal lands in the Williston Basin of North Dakota, South Dakota, and eastern Montana.

**Bureau of Ocean Energy Management (BOEM)** uses a wide variety of USGS energy and minerals information, and collaborates with USGS on efforts to support their agency mission, including the following

- Collaboration with BLM to update the hydrocarbon resource potential of the Alaska North Slope.
- Establishment of a Cooperative Research and Development Agreement to facilitate the exchange of geological and geophysical data and interpretations.
- Signing a Memorandum of Agreement to complete publications based on the USGS assessment of Tertiary strata along the U.S. Gulf Coast.

**Bureau of Indian Affairs (BIA)** uses a wide variety of USGS energy and minerals information, and collaborates with the USGS on efforts to support their agency mission, including the following

- Working with BIA and Tribes on opportunities for data gathering on Tribal lands, including geological, geophysical, and topographic mapping activities in support of Earth MRI.

**National Park Service (NPS)** uses a wide variety of USGS energy and minerals information, and collaborates with the USGS on efforts to support their agency mission, including the following

- Collaborating in the Yellowstone National Park to understand an active hydrothermal system as a model for epithermal mineral deposits.

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**Interior Office of International Affairs** collaborates with the USGS on efforts to support the DOI mission, including the following

- Providing funding to USGS, through the International Technical Assistance Program, which provided design assistance, on-site support, and data review and validation for a hyperspectral survey in Greenland. The survey supports geologic mapping and evaluates rare earth element potential.

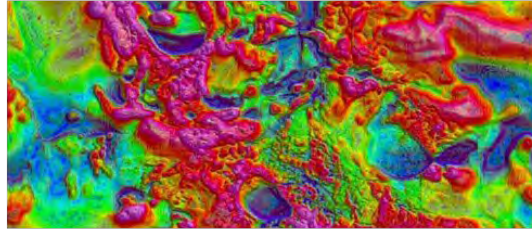
**Federal Agencies:** National Aeronautics and Space Administration (NASA), National Institute for Standards and Technology (NIST), National Science Foundation (NSF), National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health (NIH), Nuclear Regulatory Commission (NRC), U.S. Census Bureau, DOC, Department of Homeland Security (DHS), Department of Transportation (DOT), DOD, Department of Energy (DOE), EPA, Federal Reserve Board, National Oceanic and Atmospheric Administration (NOAA), U.S. Army Corps of Engineers (USACE), and U.S. Forest Service (USFS).

**Other Organizations:** American Association of Petroleum Geologists, American Geophysical Union, American Geosciences Institute, American Institute of Professional Geologists, Association of American State Geologists, Association of Environmental & Engineering Geologists, Geoscience Information Society, Geological Society of America, Industrial Minerals Association–North America, National Mining Association, Petroleum History Institute, Seismological Society of America, Society of Economic Geologists, State of Alaska, State geological surveys, Western Governors Association, State and local governments, and private sector companies and researchers for oil, gas, and mineral exploration.



## FAST FACTS

### Energy and Mineral Resources Mission Area



The National Minerals Information Center collects, analyzes, and disseminates data for about 100 mineral commodities in 180 countries.

The Energy Resources Program has assessed potential for undiscovered oil and gas resources in more than 170 geologic basins worldwide.



The Earth Mapping Resources Initiative is modernizing mapping of the Nation's shallow geology and deeper subsurface. Only 20% and 5% of the U.S. has detailed geologic mapping and geophysical surveys, respectively.

The U.S. Wind Turbine Database viewer (USWTDB) includes data on 64,553 wind turbines covering 43 states, Guam and Puerto Rico.



USGS and its industry and university partners identified enough potential geothermal energy resources in the Portland, Oreg. area to heat and cool 10,000 large buildings.



In 2015, the USGS completed a global assessment of undiscovered copper resources and estimated a mean of 3.5 billion metric tons enough to satisfy world demand for 150 years.



In 2020, the U.S. is 100% reliant on foreign imports for 17 minerals, including multiple minerals critical for national security and economic growth; and at least 50% reliant on imports for another 29 mineral commodities.

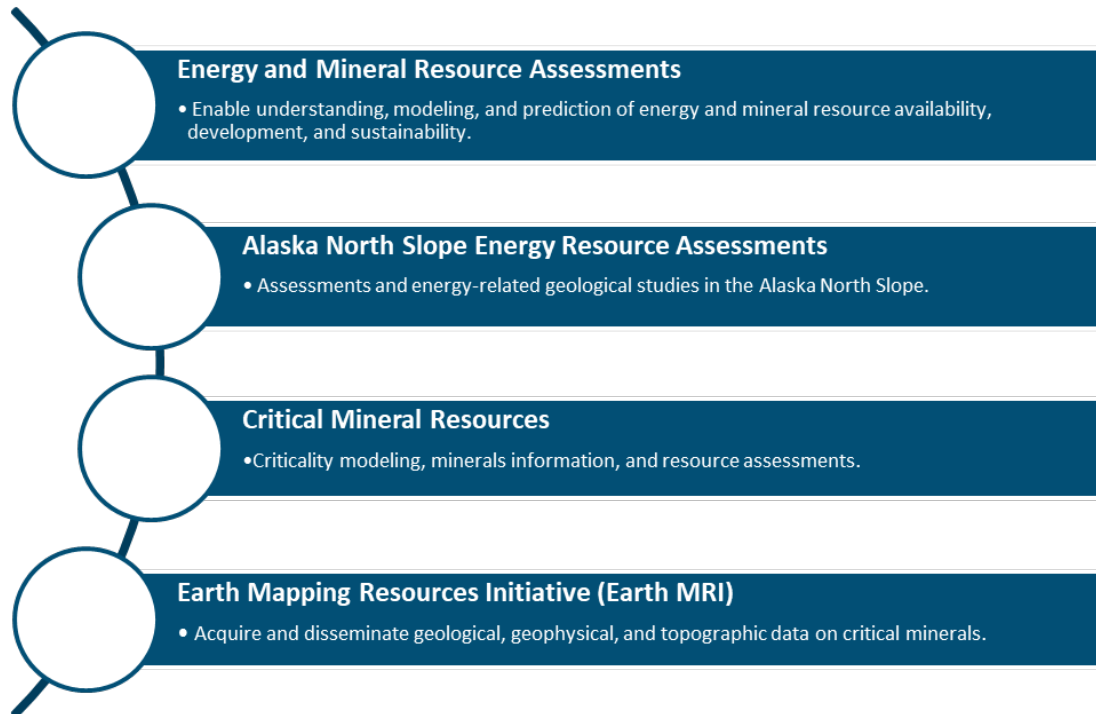
Source information for each of the facts above is on page 65.

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## USGS AND THE DOI STRATEGIC PLAN

### COMMITMENTS TO DEPARTMENT OF THE INTERIOR PRIORITIES

Within the 2018–2022 DOI Strategic Plan, Energy and Mineral Resources programs provide science to ensure energy and economic security for America and to ensure access to mineral resources to meet the DOI goal of Utilizing Our Natural Resources. The USGS is committed to working on the following priorities to meet both USGS and DOI goals.



### Performance and Strategic Planning Documents

- DOI Annual Financial Report (the most recent report can be found [here](#))
- DOI Annual Performance Plan & Report (APP&R; the most recent can be found [here](#))
- DOI Strategic Plan (2018–2022) ([link](#))

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## ENERGY RESOURCES PROGRAM

*Energy resource assessments of the U.S. provide publicly available estimates related to geological energy resources and global coal, oil, and gas.*

The [Energy Resources Program](#) (ERP) is the sole provider of unbiased, publicly available estimates of undiscovered, technically recoverable energy resources for the United States (exclusive of the U.S. Outer Continental Shelf). The ERP addresses the challenge of increasing demand for energy resources by conducting basic and applied research on geologic energy resources and on the environmental and economic impacts of their use. The program studies geologic energy resources such as oil, natural gas, coal, coalbed methane, gas hydrates, geothermal resources, uranium, oil shale, bitumen, and heavy oil, as well as the carbon, water, and waste implications of energy development. USGS science informs decision making related to domestic and foreign energy resources, as well as the management of energy resources on Federal lands. As demand for energy resources continues to increase, understanding the Nation's supply and recoverability of energy resources is necessary to sustain a strong national economy. The ERP provides the publicly available data and tools to inform energy policy discussions and to support science-based decisions that facilitate an all-of-the-above approach to energy development and responsible use of resources.



Bluff in Lower Cretaceous Nanushuk Formation along Colville River in southern National Petroleum Reserve – Alaska (NPR-A), 100 miles west of Umiat. Source: USGS.

Energy Resources Program activities fall under two areas:

- Energy Resource Assessments and Methods Development
- Energy Resources Research

### ENERGY RESOURCE ASSESSMENTS AND METHODS DEVELOPMENT

The ERP's work includes assessment of oil and gas resource potential through in-depth studies of geology and resources in various petroleum provinces throughout the United States. Studies of the geologic, geophysical, and geochemical framework of these areas allow for better understanding of the resource potential and environmental impacts of oil and gas development. The ERP assessments of oil and gas resources are highly relevant to energy policy, especially as recovery processes such as directional drilling and hydraulic fracturing have become widespread in the United States. The ERP's resource assessments are widely used by a variety of stakeholders including local, State, and Federal governments; land resource managers; and the public.

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In response to Secretarial Order 3352, in 2017 the ERP initiated leadership of a multiagency effort (with the Bureau of Land Management and the Bureau of Ocean Energy Management) to assess the Alaska North Slope (ANS) energy resource potential through a series of oil and gas resource assessments. The ERP also continues to collaborate with its counterparts in Natural Resources Canada to improve the understanding of the geologic framework (including petroleum systems elements) from eastern Arctic Alaska through the Mackenzie Delta and into the southern



The Alaska North Slope view southward from Fortress Mountain Formation on Atigun syncline towards Brooks Range. Source: USGS.

passive margin of the Canadian Arctic Islands. In addition to assessments in Alaska, the ERP assesses the potential for undiscovered oil and gas resources in priority geologic provinces in the United States and around the world. As part of its National and Global Oil and Gas Assessment subcomponent, the ERP uses two methodologies: one for assessing conventional oil and gas resources, and one for assessing unconventional (continuous) oil and gas resources such as shale gas and coalbed gas. The ERP reassesses prospective formations on a periodic basis, taking into account production history, new geological information, and the availability of new technologies that may allow for additional oil and gas recovery, which, in turn, affect the variation in the amount of technically recoverable resources.

As part of its resource assessment portfolio, the ERP is pioneering the development of tools and techniques for multiresource assessments (MRAs) that combine energy resource assessments with information about the quantity and quality of other natural resources. The MRAs will help natural resource managers better understand the connections between the resources they manage and the changes that might occur as a result of natural events and human decisions. The relationship between energy and water is a crucial component of MRAs.

The ERP also supports studies to understand and quantify the Nation's renewable and alternative energy resources, including geothermal energy resource assessments and uranium resource evaluations, to further diversify the U.S. energy portfolio. The potential to harness our Nation's renewable and alternative energy potential is important for informed decision-making that considers the resulting effects on our economy and environment.

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## ENERGY RESOURCES RESEARCH

The ERP conducts early-stage research on the geologic processes that form energy resources and the geologic setting of these resources to enable and improve assessments of current national and global coal, oil, gas, and geothermal resources. Accurate and scientifically based assessments of coal, oil, and gas resources of the Nation and world are dependent upon this geologic information. The work of the ERP in geologic process and resource characterization also provides a scientific basis upon which to evaluate the potential contributions to future energy supplies from currently used hydrocarbon energy resources such as oil, gas, and coal, as well as from emerging resources such as gas hydrates and geothermal energy. The ERP geologic process and resource characterization research also provides a fundamental understanding of the economic viability and potential environmental factors associated with resource development and use.



Rig used in drilling the stratigraphic test well on the North Slope in 2018. Source: Japan Oil, Gas and Metals National Corporation.

ERP research addresses the complete life cycle of energy resources from geologic setting and source; to exploration, extraction, processing, and use; to reclamation, recycling, and disposal. Benefits from this research apply to a variety of stakeholders, including resource industries, who use the information to identify best practices to limit adverse environmental impacts and for other purposes; citizens who want unbiased scientific information about the risks and benefits of resource development; and land use managers and regulators to enhance stewardship of public lands for multiple uses and for national energy and economic security.

The ERP supports research to anticipate or consider the near-term and long-term costs, benefits, and cumulative effects of resource development. Spatial analyses and other data delivery and analysis tools (for example, interactive maps), combined with economic analyses of energy resources, facilitate data dissemination and synthesis within and among other USGS activities and external collaborators and stakeholders. Products include the National and Global Oil and Gas Assessment Website, U.S. Wind Turbine Database, Geologic Carbon Sequestration interactive map, and National Coal Resources Data System database. Outcomes from ERP-supported research efforts generate large volumes of science-driven research and information in compliance with Federal data management (OpenData) policies, requiring specialized data management expertise and services to assist with documentation, data sharing, Web applications, and delivery systems.

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## MINERAL RESOURCES PROGRAM

*The USGS Mineral Resources Program provides publicly available information on nonfuel mineral potential, production, consumption, and interaction with the environment.*



USGS geologist Carol Reiss examining hydrothermal vent sample using a hand lens. Sulfide-silicate minerals precipitate from 330°C mineral laden water venting along volcanically active spreading ridges. Source: USGS.

The [Mineral Resources Program](#) (MRP) is the sole Federal source of scientific information and research on nonfuel mineral potential, production, consumption, and interaction with the environment. The MRP supports data collection and research on a wide variety of nonfuel mineral resources that are critical to the economic stability and national security of the United States. Research by the MRP helps to define and forecast foreign dependencies on mineral commodities and to inform Federal decision makers. The MRP also provides the scientific data required to grow the Nation's minerals industry, thus strengthening the economy and our national security. Furthermore, a scientific understanding of how minerals and mine wastes interact with the environment is essential to inform the management of our public lands and resources, and for protecting and improving public health and safety.

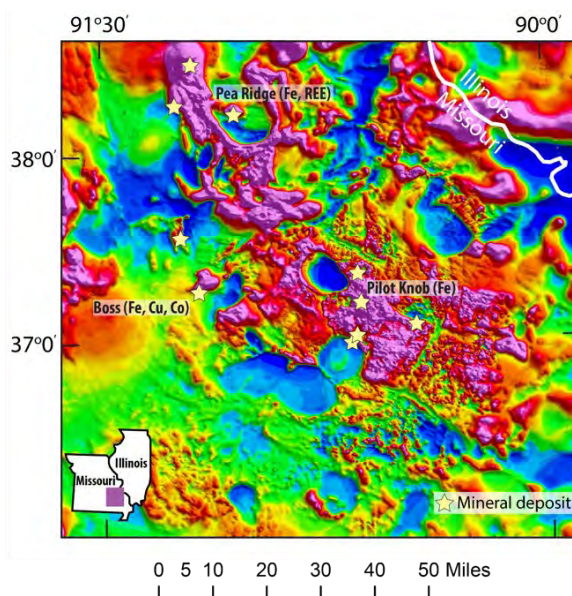
The MRP's National Minerals Information Center (NMIC) collects, analyzes, and disseminates data on the production and consumption of about 100 mineral commodities, both domestically and internationally, for 180 countries. The data provide decision makers with information to ensure that the Nation has an adequate and dependable supply of minerals and mineral materials to meet its defense and economic needs at acceptable costs. The NMIC provides hundreds of reports annually such as the Minerals Commodity Summaries, the Minerals Yearbook, the Mineral Industry Surveys, Metal Industry Indicators, and the Nonmetallic Mineral Products Industry Indexes. The public and private sectors use this information to understand the use of mineral materials in the economy and to forecast supply and demand. Minerals information is provided to other Federal agencies, including the U.S. Census Bureau, DOD, DOS, EPA, DOC, intelligence agencies, the Federal Reserve Board, and the Office of the U.S. Trade Representative. These data are used to formulate plans to address shortages and interruptions in mineral supplies in the global economy. Data are also utilized by the Defense Logistics Agency as part of an Early Warning System screening tool to identify supply chain vulnerabilities of mineral commodities.

Mineral Resources Program activities fall under three areas:

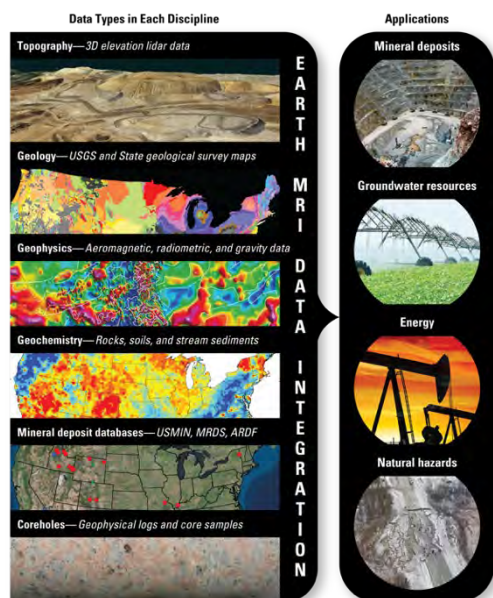
- Critical Mineral Resources
- Mineral Resources Research
- Mineral Resources Assessments and Methods Development

## CRITICAL MINERAL RESOURCES

The MRP's work on critical mineral resources includes responding to Executive Order 13817 (December 2017), which resulted in the development of the Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals (June 2019). Much of the MRP's work currently focuses on critical minerals research, mapping, and information to better inform the public, industry, land managers, and policy makers about domestic critical mineral resources. Critical minerals are essential to the economy. Today many critical minerals are metals that are central to high-tech sectors, including rare earth elements used in wind turbines, solar panels, and electronics such as smart phones and computers. The Department of the Interior published a list of 35 critical minerals in the Federal Register ([83 FR23295](#)) in May 2018, based largely on methodologies developed by NMIC. NMIC developed and continues to refine a "criticality tool" which can be used to identify emerging supply risks and evaluate the impact of commodity supply restrictions.



Example of Earth MRI Aeromagnetic Survey, which allows mapping of concealed Precambrian basement rocks and potential mineral deposits. Source: McCafferty and Johnson (2019).



Examples and applications of Earth MRI data. Source: USGS.

The Executive Order and Federal Strategy on critical minerals also called on the USGS to implement a plan to improve the topographic, geologic, and geophysical mapping of the United States and make the resulting data and metadata electronically accessible to support private sector mineral exploration of critical minerals. The implementation of the plan is the Earth Mapping Resources Initiative (Earth MRI), which began in Fiscal Year 2019. This nationwide effort of geologic mapping, airborne geophysical surveys, and high-resolution topographic mapping (using light detection and ranging [lidar]) is a partnership, led by the Mineral Resources Program, that brings together several USGS Programs: the Mineral Resources Program, the National Cooperative Geologic Mapping Program, the National Geospatial Program, and the National Geological and Geophysical Data Preservation Program. Another key

partner in this initiative is the Association of American State Geologists, which represents the individual State geological surveys that conduct the geologic mapping component. These data are

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also essential for decisions on infrastructure, transportation, and land-use planning; hazard assessments for landslides, volcanoes, and floods; water resources management; and emergency response.

The Federal Strategy also calls for closer relationships with international partners such as Australia and Canada. Both Australia and Canada have recently invested significantly in modern, detailed mapping of the surface and subsurface of their nations. USGS geologists work together with foreign counterparts to define opportunities for collaboration in the study of mineral systems and ore deposits that host critical minerals.

## **MINERAL RESOURCES RESEARCH**

In addition to the collection, synthesis, and dissemination of minerals information by NMIC, the MRP supports a wide variety of research, including geological framework studies, research on the environmental impact and potential for reprocessing of so-called above-ground waste resources from legacy mining, and the development of analytical tools and databases to support mineral research and assessments. The MRP supports geologic framework research on how and where mineral deposits form and develops methods to detect potential mineral resources. This research has produced innovations in mineral resource science, ranging from partnering with other Federal agencies to incorporate the latest space-based and airborne Earth observation instruments and the latest data science, to the discovery of new minerals by USGS researchers. The MRP conducts research studies to understand the geologic history and characteristics of an area, define what processes formed the mineral deposits, and identify keys to predicting undiscovered deposits. Teams of experts analyze available information, identify characteristics that suggest the presence of undiscovered mineral deposits, and evaluate the quality and quantity of potential mineral deposits.

MRP-funded scientists conduct research into the interactions of mineral resources with the environment, both natural and because of resource extraction, to understand emerging challenges and opportunities for future mining, as well as new uses of previously mined materials. The NMIC has unique expertise in the flow of resources through the global economy as both commodity and waste and works to improve the Nation's understanding of the potential for deriving value from above-ground resources such as waste streams from manufacturing and mining.

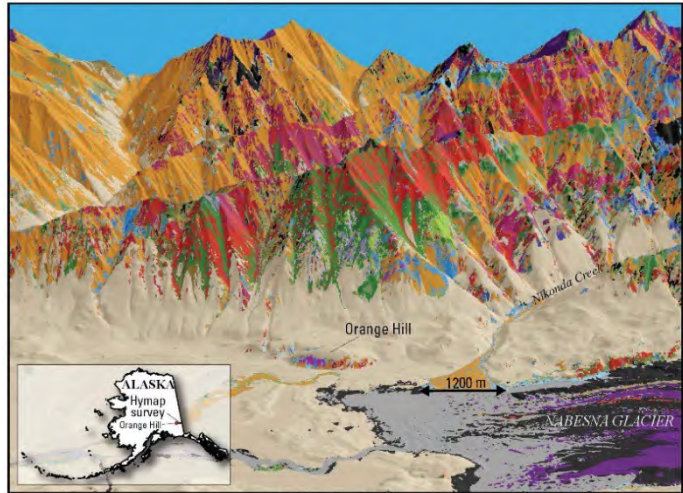
The MRP has also launched several efforts to modernize subsurface research databases and digitize legacy mining and minerals information. These include USMIN, a national-scale geospatial database that is the authoritative data source on the most important mines, mineral deposits, and mineral districts of the United States, including digitized mine features from historical paper topographic maps.



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## MINERAL RESOURCES ASSESSMENTS AND METHODS DEVELOPMENT

MRP mineral assessments and inventories are tools used for evaluating the potential for undiscovered domestic and global deposits of minerals such as copper and rare earth elements. MRP supports research on methods, tools, and techniques that inform assessments, including research on how and where mineral deposits form and what happens when these mineral deposits are weathered or mined. These assessments are informed by a diverse array of data types and sources, including space-based and airborne Earth observation instruments, aeromagnetic and radiometric surveys conducted as part of Earth MRI, hyperspectral remote sensing data, and innovative new geochemical tools and methods.



Regional mineral classification map overlaying a digital elevation model of the Orange Hill area, Wrangell–St. Elias National Park and Preserve, Alaska. Colors representing different dominant minerals were generated from a hyperspectral survey utilizing a HySpex™ Spectrometer. Data collected at 6-meter spatial resolution. Source: USGS.

The 2019 *Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals* tasks the USGS with delivering at least one national or regional domestic multicommodity critical mineral resource assessment every 2 years. Such assessments enable land managers to make more informed decisions for land-use planning and management and aid policy makers in understanding global resource issues. Examples of their usage include (1) The Sagebrush Mineral Resource Assessment, which informed BLM about mineral resources in sage-grouse habitat areas considered for mineral closing orders; and (2) the recent Global Copper Assessment, which has been used by geologic surveys and the mining industry around the world, is cited in NMIC’s annual Mineral Commodity summaries, and has been used by the International Copper Study Group in its annual World Copper Factbook.

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## **ENERGY AND MINERAL RESOURCES CENTERS WITHIN THE INTERIOR UNIFIED REGIONS**

The following is a summary of the USGS science centers that receive major funding from the Energy and Mineral Resources Mission Area and their locations with Interior's Unified Regions. *A brief overview of each center is provided on pages 60-61.*

### **National Centers**

1. Energy and Mineral Resources Mission Area Headquarters, Reston, VA

### **Region 1 – North Atlantic Appalachian** (*USGS Northeast Region*)

1. Geology, Energy, and Minerals Science Center, Reston, VA
2. National Minerals Information Center, Reston, VA
3. Science and Decisions Center, Reston, VA

### **Region 7 – Rocky Mountain** (*USGS Rocky Mountain Region*)

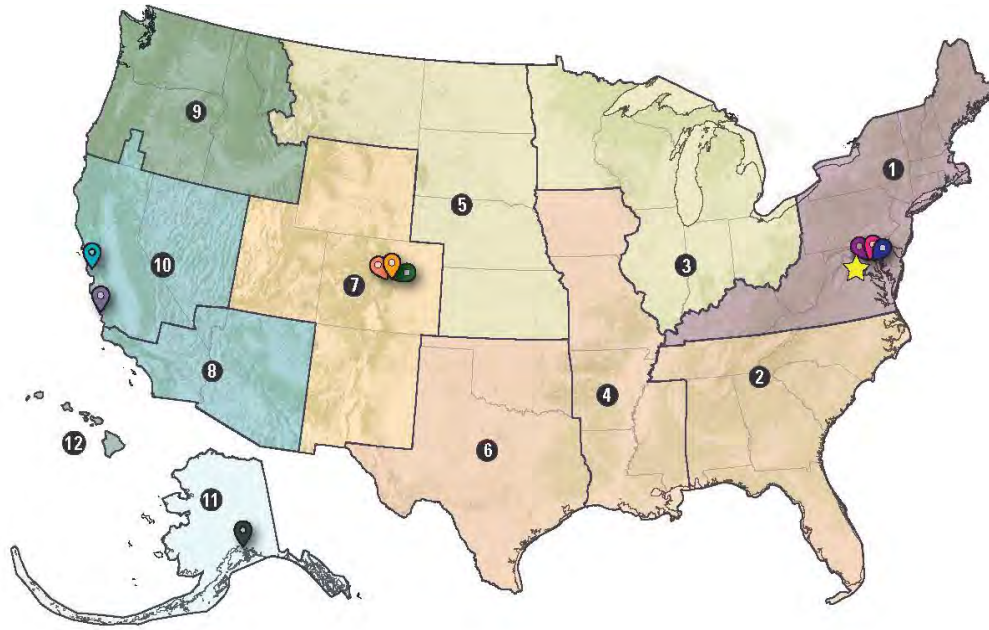
4. Central Energy Resources Science Center, Denver, CO
5. Geology, Geophysics, and Geochemistry Science Center, Denver, CO
6. TRIGA Reactor, Denver, CO

### **Region 10 – California Basin** (*USGS Southwest Region*)

7. Geology, Minerals, Energy, and Geophysics Science Center, Moffett Field, CA
8. Sensitive High-Resolution Ion Microprobe – Reverse Geometry Laboratory (SHRIMP-RG Lab), Stanford, CA

### **Region 11 – Alaska** (*USGS Alaska Region*)

9. Alaska Science Center, Anchorage, AK



**DOI Unified Regions**

- 1 North Atlantic-Appalachian
- 2 South Atlantic-Gulf
- 3 Great Lakes
- 4 Mississippi Basin
- 5 Missouri Basin
- 6 Arkansas-Rio Grande-Texas Gulf
- 7 Upper Colorado Basin
- 8 Lower Colorado Basin
- 9 Columbia-Pacific Northwest
- 10 California-Great Basin
- 11 Alaska
- 12 Pacific Islands

**USGS Regions**

- Northwest - Pacific Islands
- Southwest
- Alaska
- Rocky Mountain
- Midcontinent
- Southeast
- Northeast

**Energy and Minerals Science Centers**

**National Centers**

- ★ Energy and Minerals Headquarters
- Alaska Science Center
- Central Energy Resources Science Center
- Geology, Energy, and Minerals Science Center
- Geology, Geophysics & Geochemistry Science Center
- Geology, Minerals, Energy & Geophysics Science Center
- National Mineral Information Center
- Science and Decisions Center
- SHRIMP-RG Lab
- TRIGA Reactor

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### **Alaska Science Center (ASC)**

The Alaska Science Center provides objective and timely data, information, and research findings about the Earth and its flora and fauna to Federal, State, and local resource managers and to the public to support sound decisions regarding natural resources, natural hazards, and ecosystems in Alaska and circumpolar regions. Geologic research conducted at the ASC encompasses a wide range of topics including bedrock geology, and mineral and energy resources. Alaska is still a frontier with respect to geologic investigation and has high potential for holding undiscovered strategic mineral commodities and petroleum resources. The ASC supports Earth MRI activities in Alaska and provides geographic information system (GIS) and database support for Alaska-based research projects.

### **Central Energy Resources Science Center (CERSC)**

The Central Energy Resources Science Center studies processes critical to the formation, accumulation, occurrence, and alteration of geologically based energy resources; prepares resource assessments including multiresource analysis of the energy-water nexus; and evaluates the environmental and socioeconomic effects of energy resource occurrence, production, and use.

### **Geology, Energy, and Minerals Science Center (GEMSC)**

The GEMSC provides Earth science information and interpretations essential to building a framework for the identification and assessment of economically stable and environmentally sound resources of petroleum, natural gas, and coal. The center addresses the economic and environmental effects of energy production and studies unconventional resources including gas hydrates; geothermal resources; uranium; oil shale; bitumen and heavy oil; and carbon capture, utilization, and storage. In addition, it conducts unbiased research on the occurrence, quality, quantity, and availability of mineral resources to help the Nation make informed decisions using Earth science information.

### **Geology, Geophysics, and Geochemistry Science Center (GGGSC)**

The Geology, Geophysics, and Geochemistry Science Center applies expertise in geology, geophysics, and geochemistry to interdisciplinary efforts to address the Nation's important Earth science issues, with an emphasis on mineral resources.

### **Geology, Minerals, Energy, and Geophysics Science Center (GMEG)**

Scientists with the GMEG Science Center work on issues related to geologic processes; mineral and energy resource potential, such as rare earth elements and geothermal resources; and past climate, primarily in the western United States. The science staff includes geologists, geophysicists, geochemists, biologists, and GIS specialists located in Arizona, California, Nevada, Oregon, and Washington.

### **National Minerals Information Center (NMIC)**

The National Minerals Information Center provides statistics and information on the worldwide supply of, demand for, and flow of minerals and materials essential to the U.S. economy, national security, and protection of the environment.

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## **Science and Decisions Center (SDC)**

The Science and Decisions Center conducts research to increase the use and value of science in decision-making. The SDC's multidisciplinary efforts focus on improved decision-making throughout a variety of natural resource science disciplines, including energy and mineral resources.

## **Sensitive High-Resolution Ion Microprobe – Reverse Geometry Laboratory (SHRIMP-RG Lab)**

The SHRIMP-RG is at Stanford University as a result of a partnership between the USGS and Stanford School of Earth, Energy & Environmental Sciences. The laboratory has been jointly operational since 1998, supporting scientists and students from the USGS, Stanford, and external visitors from around the world who visit the laboratory to analyze specimens for a variety of scientific research objectives. Geological applications include determining ages of granite and other types of plutonic rock bodies, volcanic ash beds, metamorphic recrystallization of rocks, and formation of metallic ore deposits, as well as ages of individual sand grains that have been deposited by water and wind. The SHRIMP-RG's high mass-resolving power also allows key trace element concentrations in accessory minerals to be determined, revealing the origins of these minerals.

## **TRIGA Reactor**

The USGS TRIGA® Reactor (GSTR) is a low-enriched, uranium-fueled, pool-type reactor. The mission of the TRIGA® is to support USGS science by providing information on geologic, plant, and animal specimens to advance methods and techniques unique to nuclear reactors. The reactor is also used to produce nuclear changes in rock and mineral samples to determine their ages. Elemental analyses using other methods often result in data of less precision and (or) less accuracy. The GSTR provides high-quality data on rock and mineral elemental composition using state-of-the-art techniques, while providing the research tools needed to develop new and improved analytical techniques.

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## SOCIAL MEDIA PRESENCE

Links below taken from <https://www.usgs.gov/mission-areas/energy-and-minerals/social-media>

	<a href="https://www.facebook.com/USGeologicalSurvey">https://www.facebook.com/USGeologicalSurvey</a>
	<a href="https://twitter.com/usgs_Pubs">https://twitter.com/usgs_Pubs</a> <a href="https://twitter.com/USGSMinerals">https://twitter.com/USGSMinerals</a> <a href="https://twitter.com/USGSEnergy">https://twitter.com/USGSEnergy</a>
	<a href="https://www.instagram.com/usgs/">https://www.instagram.com/usgs/</a>
	<a href="https://www.youtube.com/user/usgs">https://www.youtube.com/user/usgs</a>
	<a href="https://www.flickr.com/photos/usgeologicalsurvey/">https://www.flickr.com/photos/usgeologicalsurvey/</a>
	<a href="https://github.com/usgs/">https://github.com/usgs/</a>

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## LEGAL AUTHORITIES FOR MISSION AREA ACTIVITIES

### **43 U.S.C. 31 | The Organic Act of March 3, 1879**

An act that established the Geological Survey, as amended (1962), and restated in annual appropriation acts. This section provides, among others, that the Geological Survey is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Interior Department. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285 Sec. 10(a) establishes United States Geological Survey as its official name.

### **50 U.S.C. 98 | Strategic and Critical Materials Stock Piling Act of 1946 as amended by the Revision Act of 1979.**

Supports the USGS programs for assessment of domestic minerals, especially for strategic and critical minerals, to complement the Federal mineral stockpile program. Section 98(g) of the act requires USGS “to conduct inquiries into the economic conditions affecting mining and materials processing industries ... and related purposes as authorized by law and to publish and disseminate data....” The USGS provides scientific, technologic, and economic investigations concerning the development, mining, preparation, treatment, and utilization of ore and other mineral substances.

### **42 U.S.C. 4321 et seq. | National Environmental Policy Act of 1969, as amended.**

Requires prior-to-action determination that any major Federal action will not have a significantly adverse effect upon the environment. The USGS is called upon to provide technical review or inputs to resource-related actions proposed by other Federal agencies.

### **30 U.S.C. 21(a) | Mining and Minerals Policy Act of 1970.**

Emphasizes Department of the Interior responsibility for assessing the mineral resources of the Nation.

### **30 U.S.C 1601 et seq. | National Materials and Minerals Policy, Research and Development Act of 1980.**

Reemphasizes the responsibility of the Department of the Interior to assess the mineral resources of the Nation.

### **16 U.S.C. 1604. | Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act of 1976.**

The USGS is a party in an interagency agreement with the Forest Service to assess the mineral resources of National Forests.

### **30 U.S.C. 1101, 1121, 1123 | Geothermal Energy Research, Development, and Demonstration Act of 1974.**

Provides that the Department of the Interior is responsible for the evaluation and assessment of the geothermal resource base and the development of exploration technologies. The USGS and other appropriate agencies develop and carry out a plan for the inventorying of all forms of geothermal resources of Federal lands; conduct regional surveys; publish and make available maps, reports,

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and other documents developed from the surveys; and participate with non-Federal entities in research to develop, improve, and test technologies for the discovery and evaluation of geothermal resources.

**30 U.S.C. 201 | Federal Coal Leasing Amendments Act of 1976.**

Provides that no lease sale may be held on Federal lands unless the lands containing the coal deposits have been included in a comprehensive land-use plan. Provides that the Secretary is authorized and directed to conduct a comprehensive exploratory program designed to obtain sufficient data and information to evaluate the extent, location, and potential for developing the known recoverable coal resources within the coal lands. The USGS provides data and information from coal research and field investigations, which are useful to the BLM to meet the requirements of the coal leasing program. Further, the Secretary, (Sec. 208–1(b)) through the USGS, “... is authorized to conduct seismic, geophysical, geochemical, or stratigraphic drilling, or to contract for or purchase the results of such exploratory activities from commercial or other sources which may be needed to implement the ... exploratory program.”

**The Energy Policy and Conservation Act of 1975 (EPCA)** (Pub.L. 94–163, 89 Stat. 871, enacted December 22, 1975)

The act responded to the 1973 oil crisis by creating a comprehensive approach to Federal energy policy. The primary goals of EPCA are to increase energy production and supply, reduce energy demand, provide energy efficiency, and give the executive branch additional powers to respond to disruptions in energy supply. Most notably, EPCA established the Strategic Petroleum Reserve, the Energy Conservation Program for Consumer Products, and Corporate Average Fuel Economy regulations.

**30 U.S.C. 1028 | Energy Policy Act of 1992.**

Directs the Secretary of the Interior, through the USGS and in consultation with the Secretary of Energy, to establish a cooperative government private sector program with respect to hot dry rock geothermal energy resources on public lands. Supports recurring assessments of the undiscovered oil and gas resources of the United States.

**42 U.S.C. 6217 | Energy Act of 2000.**

The act instructs the Secretary of the Interior, in consultation with the Secretaries of Agriculture and Energy, to conduct and update regularly an inventory of all onshore Federal lands. The inventory will identify (1) USGS reserve estimates of the oil and gas resources underlying these lands, (2) restrictions or impediments to development of such resources, and (3) furnish such inventory data to the House Committee on Resources and the Senate Committee on Energy and Natural Resources. Authorizes appropriations as necessary for implementation.

**Energy Policy Act of 2005 (P.L. 109-58)**

Sets forth an energy research and development program covering (1) energy efficiency; (2) renewable energy; (3) oil and gas; (4) coal; (5) Indian energy; (6) nuclear matters and security; (7) vehicles and motor fuels, including ethanol; (8) hydrogen; (9) electricity; (10) energy tax incentives; (11) hydropower and geothermal energy; and (12) climate change technology.



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## SOURCES FOR FAST FACTS

- Fact: The National Minerals Information Center collects, analyzes, and disseminates data for about 100 mineral commodities for 180 countries.

*Source:*

<https://www.usgs.gov/about/organization/science-support/budget/usgs-fy2021-budget>

- Fact: The Energy Resources Program has assessed potential for undiscovered oil and gas resources in more than 170 geologic basins worldwide.

*Source:*

[https://www.usgs.gov/centers/cersc/science/world-oil-and-gas-resource-assessments?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/centers/cersc/science/world-oil-and-gas-resource-assessments?qt-science_center_objects=0#qt-science_center_objects)

- Fact: The Earth Mapping Resources Initiative is modernizing mapping of the Nation's shallow geology and deeper subsurface. Only 20% and 5% of the U.S. has detailed geologic mapping and geophysical surveys, respectively).

*Source:*

<https://www.usgs.gov/about/organization/science-support/budget/usgs-fy2021-budget>

- Fact: The U.S. Wind Turbine Database viewer (USWTDB) includes data on 64,553 wind turbines covering 43 States, Guam, and Puerto Rico.

*Source:* <https://eerscmap.usgs.gov/uswtodb/viewer/#3/37.25/-96.25>

- Fact: USGS and its industry and university partners identified enough potential geothermal energy resources in the Portland, Oreg. area to heat and cool 10,000 large buildings.

*Source:* <https://doi.org/10.1016/j.geothermics.2020.101877>

- Fact: In 2015, the USGS completed a global assessment of undiscovered copper resources and estimated a mean of 3.5 billion metric tons enough to satisfy world demand for 150 years.

*Source:* <https://pubs.er.usgs.gov/publication/sir20185160>

- Fact: In 2020, the U.S. is 100 percent reliant on foreign imports for 17 minerals, including multiple minerals critical for national security and economic growth; and at least 50 percent reliant on imports for another 29 mineral commodities.

*Source:* <https://pubs.usgs.gov/periodicals/mcs2020/mcs2020.pdf>



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# Natural Hazards Mission Area

Source: USGS.

## Programs

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Earthquake Hazards Program

Volcano Hazards Program

Landslide Hazards Program

Global Seismographic Network

Geomagnetism Program

Coastal/Marine Hazards and Resources Program

David Applegate, Associate Director

[applegate@usgs.gov](mailto:applegate@usgs.gov)

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*America relies on natural hazards science to protect life, health, and property.*

## NATURAL HAZARDS MISSION AREA OVERVIEW

The [Natural Hazards Mission Area](#) provides scientific information to emergency responders, policy makers, and the public to reduce losses from a wide array of natural hazards, including earthquakes, hurricanes, landslides, tsunamis, volcanic eruptions, wildfires, and geomagnetic storms. USGS delivers actionable assessments of these hazards and helps to develop effective strategies for achieving more-resilient communities. The USGS is the Federal agency responsible for monitoring and notification of earthquakes, volcanic activity, and landslides and coastal erosion in the United States. For many other hazards, the USGS directly supports the warning responsibility of the National Oceanic and Atmospheric Administration (NOAA).



During an earthquake, a surface fault cracked and ruptured an asphalt road surface. Source: USGS.

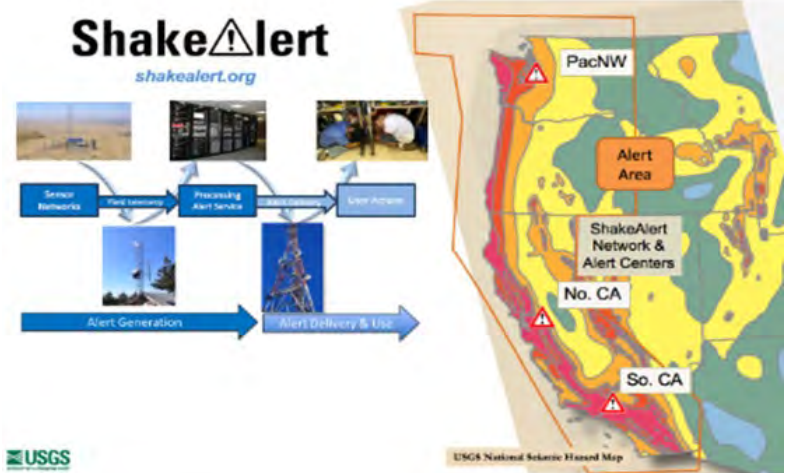
### **What We Do**

- Hazard alerting for earthquakes, volcanic eruptions, and the associated monitoring networks.
- Hazard response activities (for all hazards, including landslides, coastal inundation, and magnetic storms).
- Hazard assessment activities that are currently integrated into risk reduction activities (for example, for building codes, land use planning, and so forth).
- Key targeted research projects that support these activities.

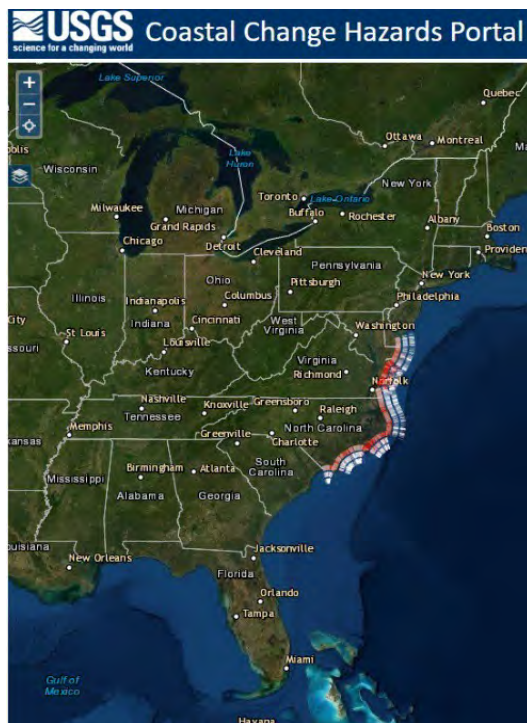
## HOW THE MISSION AREA SERVES THE PUBLIC

**ShakeAlert:** [ShakeAlert](#) is an earthquake early warning (EEW) system that detects significant earthquakes so quickly that alerts can reach many people before shaking arrives. ShakeAlert is not earthquake prediction; rather, a ShakeAlert message indicates that an earthquake has begun and that shaking is imminent.

The USGS, along with State and university partners, have now deployed about two-thirds of the ShakeAlert EEW System for the West Coast of the United States. Public alerts began in California in October 2019 through the Wireless Emergency Alert system and several cell phone apps.



A map of the West Coast of the United States showing the boundaries of the ShakeAlert alert areas in the Pacific Northwest, and in northern and southern California. Source: USGS.



Map of the East Coast of the United States showing colored strips along the coast at the locations forecast to have potential coastal change impacts. Source: USGS.

**Coastal Change Hazards Portal:** The [Coastal Change Hazards Portal](#) provides interactive access to coastal change science and data for our Nation's coasts. Information and products are organized into three coastal change hazard themes: (1) Extreme storms – Provides real-time and scenario-based predictions of coastal change, and the supporting data, induced by storms; (2) Shoreline change – Historical shoreline positions and rates of change along ocean shorelines of the United States; and (3) Sea-level rise – Probability of observing either static or dynamic coastal response, a Coastal Vulnerability Index, and a probabilistic assessment of shoreline change.

**Volcano Notification Service:** The [Volcano Notification Service](#) (VNS) is a free service that sends notification emails about volcanic activity happening at U.S.-monitored volcanoes. Citizens can customize the VNS to deliver notifications for certain volcanoes or a range of volcanoes, as well as choose the separate notification types users want to receive. These

notifications are issued by the Alaska, California, Cascades, and Yellowstone Volcano Observatories.



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## NATURAL HAZARDS PARTNERS

### Department of the Interior (DOI) Bureaus

USGS partners with the **Bureau of Ocean Energy Management** to assist in its management of ocean and energy resources by providing various geophysical and seafloor mapping tools to improve the understanding of seafloor processes and associated geologic hazards, and to provide enhanced seafloor mapping.

USGS partners with the **Bureau of Land Management (BLM) and the National Park Service (NPS)**, as lands managed by BLM and NPS host earthquake and volcano monitoring stations as well as geomagnetic observatories.

USGS provides hazards information and products to the **DOI Office of Emergency Management (OEM)** to assist the Office in providing expertise and leadership for the Department's emergency management responsibilities through the integration of emergency management programs, functions, and supporting activities to prevent, protect against, mitigate the effects of, respond to, and recover from natural hazards. OEM runs the Interior Operations Center as the principal focal point for reporting of significant incidents to the Secretary; sharing of emergency information with the National Operations Center, Department of Homeland Security; and the dissemination of alerts, warnings, and other emergency information to bureaus and offices.

**Federal Agencies:** Federal Aviation Administration (FAA), Federal Emergency Management Agency (FEMA), Federal Energy Regulatory Commission (FERC), National Aeronautics and Space Administration (NASA), National Institute for Standards and Technology (NIST), National Science Foundation (NSF), Nuclear Regulatory Commission (NRC), Department of Homeland Security (DHS), Department of Transportation (DOT), Department of Defense (DOD), Department of Energy (DOE), National Oceanic and Atmospheric Administration (NOAA), and U.S. Army Corps of Engineers (USACE).

# FAST FACTS

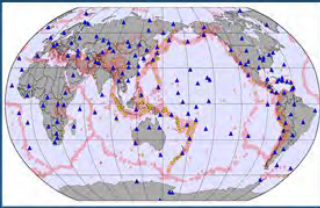
## Natural Hazards Mission Area

The USGS operates approximately 3,400 earthquake sensors in the United States

31 States are exposed to Annualized Earthquake Loss exceeding \$10 million per year.



The National Seismic Hazard Model underlies the International Building Code (IBC), the standard for building design in the United States.



The Global Seismographic Network (GSN) consists of 150 globally distributed seismic stations, 100 of which are operated by the USGS.



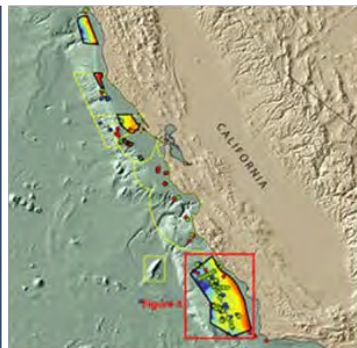
There are 161 potentially active volcanoes in the United States.

The USGS has 14 geomagnetic observatories located across the globe that monitor the Earth's magnetic field for geomagnetic hazards.

Landslides occur in all 50 States. The USGS has the only Federal program dedicated to landslide science.



The USGS Coastal/Marine Hazards and Resources Program is only Federal science program focused on the geology and processes that form, maintain, and alter coastal and marine landscapes.



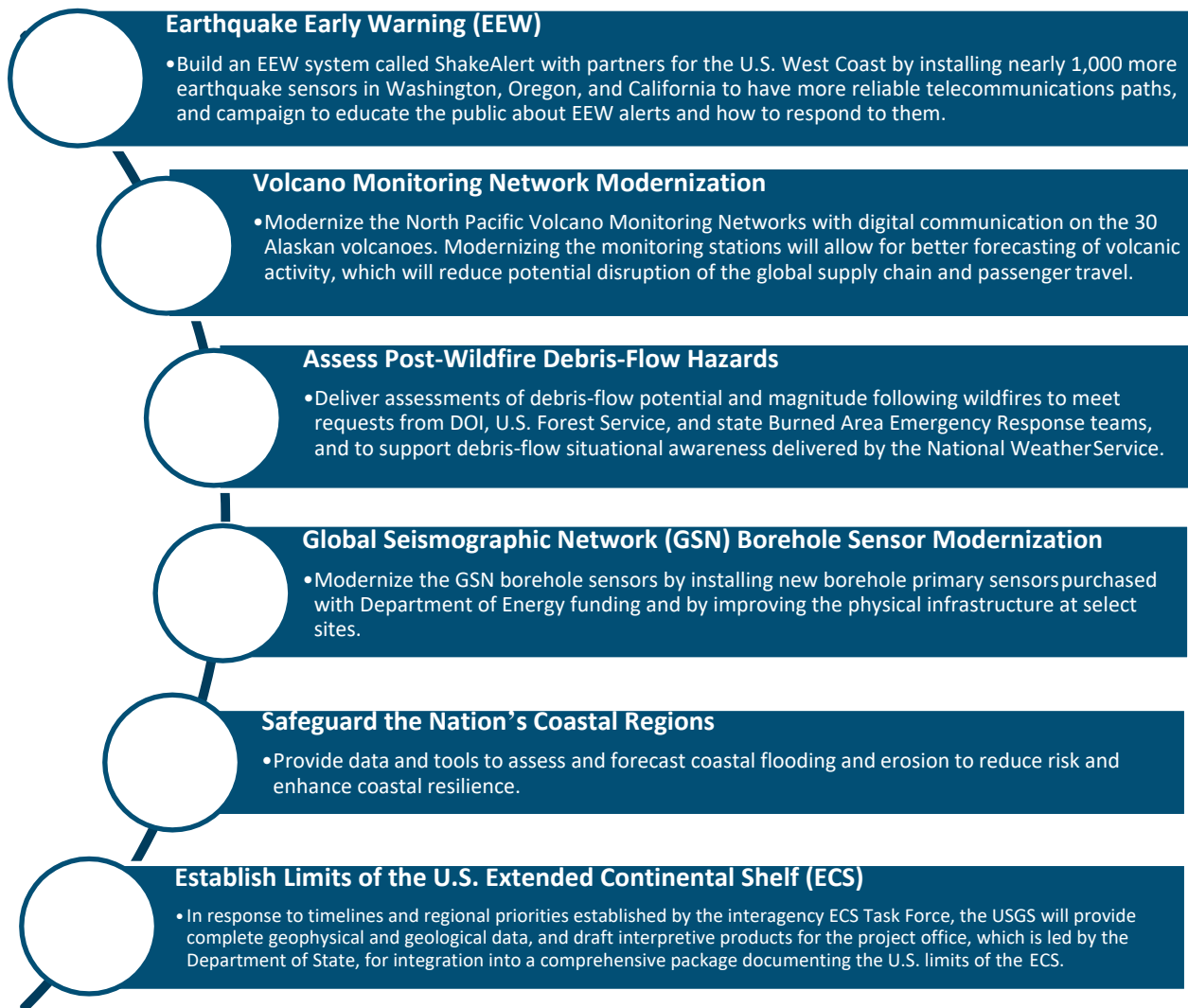
Source information for each of the facts above is on page 101.

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## USGS AND THE DOI STRATEGIC PLAN

### COMMITMENTS TO DEPARTMENT OF THE INTERIOR PRIORITIES

Within the 2018 – 2022 DOI Strategic Plan, Natural Hazards programs provide science to safeguard communities against natural hazards. The USGS is committed to working the following priorities to meet both USGS and DOI goals.



### Performance and Strategic Planning Documents

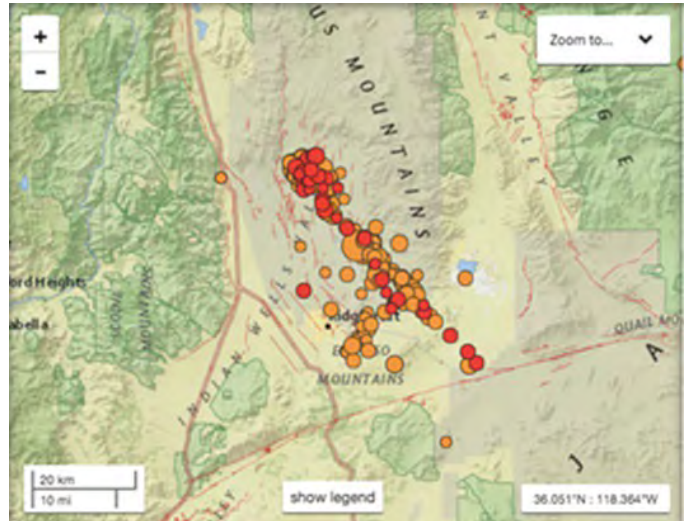
- DOI Annual Financial Report (the most recent report can be found [here](#))
- DOI Annual Performance Plan & Report (APP&R; the most recent can be found [here](#))
- DOI Strategic Plan (2018–2022) ([link](#))

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# EARTHQUAKE HAZARDS PROGRAM

*The USGS provides and applies earthquake science information to mitigate and reduce deaths, injuries, and property damage that result from earthquakes.*

The USGS provides the scientific information, situational awareness, and knowledge necessary to reduce deaths, injuries, and economic losses from earthquakes and earthquake-induced tsunamis, landslides, and soil liquefaction. The USGS Earthquake Hazards Program (EHP) is the applied Earth science component of the four-Agency agency [National Earthquake Hazards Reduction Program \(NEHRP\)](#). Through NEHRP, the USGS partners with the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST) to reduce earthquake



Mainshock and aftershock locations of the July 5, 2019 magnitude 7.1 earthquake are shown on a map of eastern California's Searles Valley. Source: USGS.

losses in the United States. To effect loss reduction, the EHP supports a highly coordinated set of monitoring, hazards assessment, applied research, and risk translation and communication activities in at-risk regions nationwide. Through the [National Earthquake Information Center](#), the USGS is the only U.S. agency that routinely and continuously reports on current domestic and worldwide earthquake activity. Through the [Advanced National Seismic System \(ANSS\)](#), the USGS and its State and university partners monitor and report on earthquakes nationwide. Through the [National Seismic Hazard Model](#), the EHP provides the basis for seismic provisions in the Nation's building codes, which affects \$1 trillion of new construction annually in the United States, as well as a host of other risk mitigation activities.

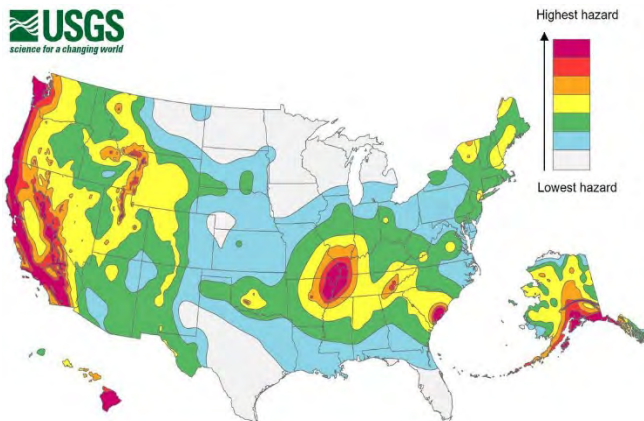
Earthquake Hazards Program activities fall under three areas:

- ANSS Monitoring and Reporting Earthquake Activity and Crustal Deformation
- Assessment and Characterization of Earthquake Hazards and Risk
- Targeted Research into Earthquake Causes and Effects

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## ANSS MONITORING AND REPORTING EARTHQUAKE ACTIVITY AND CRUSTAL DEFORMATION

The Advanced National Seismic System (ANSS) collects and analyzes data on earthquakes; issues timely, reliable notifications of their occurrence and impacts; and provides data for earthquake research, hazard, and risk assessment. Deployment of the ANSS is focused on expanding and improving the performance and integration of monitoring networks in the United States. The system includes a national ANSS “backbone” network, the [National Earthquake Information Center \(NEIC\)](#), 11 regional seismic networks operated by or in cooperation with partners, the “N4” regional network (distributed across the central and eastern United States), and the [National Strong Motion Project](#). The program supports several USGS- and partner-operated geodetic networks incorporating geodetic data (data which measures deformation of the Earth’s surface and crust) into ANSS monitoring capabilities. The NEIC receives data from national and worldwide seismic stations and reports 24/7 on significant earthquakes worldwide; it also performs regional monitoring of domestic earthquakes, serving as the source for monitoring in regions not covered by an ANSS regional seismic network. The NEIC provides information on potentially damaging earthquakes to the National Command Center; the White House; the Departments of Defense, Homeland Security, Transportation, Energy, and Interior; State offices for emergency services; numerous public and private infrastructure management centers; the media; and the public. Rapid earthquake notifications are delivered by e-mail and text message and through earthquake information products such as *ShakeMap*, *Did You Feel It?* and rapid *Prompt Assessment of Global Earthquakes for Response (PAGER)*.



National Seismic Hazard Map of the United States with colored gradients shown in areas that represent earthquake risk from highest to lowest. Source USGS.

Recent investment has resulted in the addition to ANSS of a West Coast Earthquake Early Warning system, providing the capability to quickly and automatically identify and characterize an earthquake after it begins and deliver warnings to people and systems that may experience damaging shaking. The system, called ShakeAlert, is still under construction, yet is already sending public alerts throughout California and is preparing for future rollout in Washington and Oregon. The build out follows the design published in [the 2018 EEW implementation plan](#).

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## ASSESSMENT AND CHARACTERIZATION OF EARTHQUAKE HAZARDS AND RISK

The EHP develops seismic hazard maps and other products that describe the likelihood and potential effects of earthquakes nationwide, especially in the urban areas of highest risk. Federal, State, Tribal, and local government agencies; architects and engineers; insurance companies and other private businesses; land use planners; emergency response officials; and the general public rely on this earthquake hazard information to refine building codes, develop land-use strategies, safeguard lifelines and critical facilities, develop emergency response plans, and take other precautionary actions to reduce losses from future earthquakes. The USGS National Seismic Hazard Model for the conterminous 48 States is updated regularly in synchronicity with the building code update schedule. The models for Alaska, Hawaii, and the U.S. territories are updated as new fault and earthquake information becomes available. These activities are an essential component of the USGS role within NEHRP. For example, the USGS National Seismic Hazard Models are the basis for the seismic provisions of building codes that affect domestic construction costs estimated at \$1 trillion per year (*Source: U.S. Census “2020 Value of Construction Put in Place Survey”*).

The EHP also partners with State and local experts to produce detailed urban seismic hazard maps for high- to moderate-risk areas. These products make it possible for local officials to make precise and informed zoning and building code decisions. The EHP conducts workshops to assure the transfer of knowledge and to help design effective mitigation strategies and collaborates with groups and organizations working to build seismic resilience into the Nation’s energy and lifeline systems. The EHP also assesses and forecasts the probability of earthquakes and strong ground motion at shorter time scales to meet user needs, including forecasts of the likelihood of aftershocks following all magnitude 5.0 and greater earthquakes in the United States. Also, several areas of the country are subject to increased seismic shaking hazards related to underground industrial activity. In response to requests from regulators and the petroleum industry, the EHP developed a seismic hazard map that forecasts the ground motion hazard in such areas.

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## TARGETED RESEARCH INTO EARTHQUAKE CAUSE AND EFFECTS

The EHP develops and applies research to inform planning and response activities at individual, local, State, National, and international levels. This includes research on the causes, characteristics, and effects of earthquakes; increasing the accuracy and precision of the agency’s earthquake hazards assessments; earthquake forecasts; and earthquake monitoring and situational-awareness products. Several key areas of targeted research include forecasting hazards from earthquake sequences, post-earthquake investigations, and subduction zone science. The EHP also supports targeted research into the origins of induced seismicity and resulting ground motion hazards, work that informs risk-mitigation efforts by businesses, agencies, and communities. The EHP provides external research support through competitive grants and cooperative agreements that enlist the academic community, State governments, and the private sector. The USGS also has a cooperative agreement with the Southern California Earthquake Center (SCEC), a 40-institution research consortium funded by both the USGS and the National Science Foundation. SCEC manages a comprehensive program of applied research on earthquake occurrence, seismic hazard, and potential earthquake impacts in southern California and adjacent areas.



The NEIC Media Room, located in Golden, CO, contains monitors and instruments showing the current seismic activity around the world. Source: USGS.

## REIMBURSABLE ACTIVITIES

The Earthquake Hazards Program partners with the U.S. Agency for International Development (USAID) to jointly support the USGS/USAID Earthquake Disaster Assistance Team.



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## VOLCANO HAZARDS PROGRAM

*The Volcano Hazards Program enhances public safety and minimizes social and economic disruption from volcano unrest and eruption by delivering forecasts, warnings, and information about volcano hazards.*



A minor ash eruption from Redoubt Volcano, in the Aleutian Range of Alaska. Photograph taken during observation and gas data collection flight by USGS Alaska Volcano Observatory staff, March 2009. Source: USGS.

The Volcano Hazards Program (VHP) studies and evaluates each of the Nation's active volcanoes to determine the monitoring levels needed commensurate with the threat they pose. The USGS and affiliated partners use the threat assessments to design a national-scale plan, the National Volcano Early Warning System (NVEWS), to improve monitoring networks so that unrest can be detected at the earliest stages using in-ground monitoring instrumentation deployed on the Nation's most threatening volcanoes. The VHP has five volcano observatories that organize the Nation's volcanoes into distinct areas of responsibility:

- **Hawaiian Volcano Observatory** – Hawaii
- **Cascades Volcano Observatory** – Idaho, Oregon, and Washington
- **Alaska Volcano Observatory** – Alaska and the Commonwealth of the Northern Mariana Islands
- **California Volcano Observatory** – California and Nevada
- **Yellowstone Volcano Observatory** – Arizona, Colorado, Montana, New Mexico, Utah, and Wyoming.

Each observatory is responsible for volcano monitoring, community preparedness (including development and regular practice of volcano hazard emergency response plans), managing volcanic crises, and coordinating research in their areas of responsibility.

Volcano Hazards Program activities fall under four areas:

- Volcanic Research
- Hazard and Risk Assessments
- Monitoring and Reporting
- Communication and Outreach

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## **VOLCANIC RESEARCH**

The VHP conducts applied research to advance understanding of how volcanoes work, what causes them to erupt, and how to interpret signals that may be precursors to eruption. This applied research includes a variety of key topics:

- Characterizing erupted products from past eruptions and their location on the landscape.
- Determining eruption histories, recurrence intervals, and hazards from past eruptions.
- Analyzing volcanic subsurface activity.
- Measuring and interpreting the earthquakes and ground movements at monitored volcanoes.
- Surveying volcanoes from satellite-based remote sensing to detect subtle changes.
- Modeling the physical and chemical processes that occur prior to, and during, eruptions.
- Developing new tools to forecast eruptions.
- Tracking geologic changes effected by volcanic eruptions.



An eruption of Mount St. Helens. Source: USGS.

Applied research allows for accurate assessment of volcano threat levels, improved analysis and interpretation of observed data, and cost-effective design of modern monitoring networks. Results from applied research are fully integrated in an iterative approach to VHP's long-term volcano monitoring efforts to maintain effective, cost efficient, and state-of-the-art volcano monitoring capability.

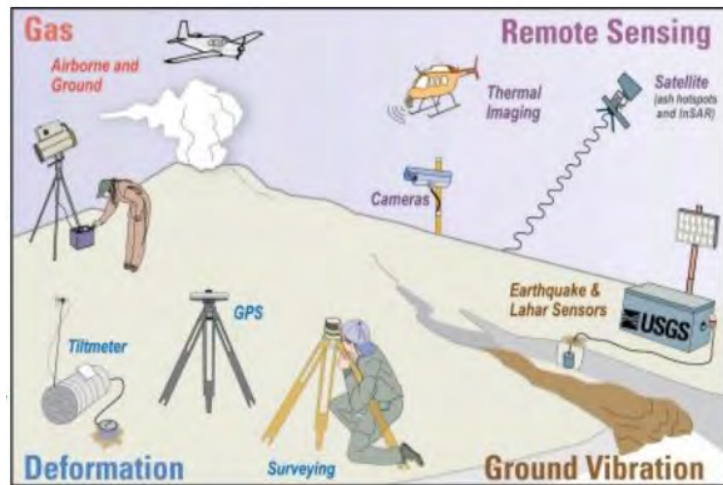
## **HAZARD AND RISK ASSESSMENTS**

The VHP generates, updates, publishes, and disseminates short- and long-term volcanic hazard assessments for specific volcanoes and for wider volcanic regions. These products are aimed at providing land managers, decision makers, emergency responders, and the public with information on the likely volcanic hazards that can be expected, the probability of their recurrence, and the areas likely to be impacted by similar hazardous activity in the future. These actions proactively mitigate adverse consequences from future activity and ultimately protect lives and property. Volcano hazard assessments serve as critical inputs for informed public policy on land-use planning, emergency response plans, and other preparedness activities that promote community resilience. The VHP also conducts risk and vulnerability assessments by integrating volcanic hazard information with geographic information systems (GIS) data on population centers, critical infrastructure, and volcano proximity to commercial air routes in partnership with other Federal, State, and local emergency managers for the development of effective, coordinated eruption response plans.

---

## MONITORING AND REPORTING

Volcano monitoring involves collection, management, analysis, interpretation, and distribution of data, as well as the issuance of warnings of volcanic activity. There are 161 volcanoes (<https://pubs.er.usgs.gov/publication/sir20185140>) in the continental United States, Hawaii, the Commonwealth of the Northern Mariana Islands, and American Samoa, and all of them require varying levels of hazard monitoring capabilities. These volcanoes are ranked by threat level and categorized as Very High, High, Moderate, Low, or Very Low. The degree of monitoring required at each volcano is determined largely by its threat level. As of 2020, the USGS now has ground-based instrument monitoring at about 70 of the 161 identified volcanoes. Efforts have focused on modernizing and expanding the instrumentation at existing networks and there have been nearly 100 such upgrades in the past 5 years. These in-ground instruments are augmented by airborne and satellite-based remote sensing instruments. Over the last decade, significant expansion of the network in Alaska's Aleutian Islands was performed by the VHP, with support from the FAA, to mitigate the threat of volcanic ash to aviation in the North Pacific Air Corridor. In addition, lahar detection system stations have been installed on Mount Rainier and there are plans to install stations in Mount Rainier National Park.



Different volcano monitoring types and methods employed by the USGS. Source: USGS.

## COMMUNICATION AND OUTREACH

The VHP uses a variety of tools to inform the public about volcanic activity. The Volcano Notification Service (VNS) is a free email and text messaging service that sends notifications about the status of volcanic activity and other significant events at volcanoes in the United States. The VHP delivers its warnings and forecasts to the public through the Internet, social media, teleconferences, community meetings, and other effective means such that all sections of potentially impacted populations are informed. The VHP provides communication and outreach with land managers, emergency responders, scientists from other Federal agencies, and the public. The VHP also conducts exercises with land managers and emergency responders to refine and test volcano emergency response plans.

## REIMBURSABLE ACTIVITIES

The Volcano Hazards Program has a long-standing partnership with USAID to jointly support the USGS/USAID Volcano Disaster Assistance Program.

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## LANDSLIDE HAZARDS PROGRAM

*The USGS reduces the loss of life and property from landslides by improving our understanding of the causes and triggers of landslides.*

Landslides occur in all 50 States and territories; where landslides affect human activities, lives may be lost and property and infrastructure damaged. Widespread landslides can accompany big storms, fires, or earthquakes, impacting broad areas and hindering rescue and recovery efforts. In 2017, Hurricane Maria generated more than 70,000 landslides across Puerto Rico, affecting people, transportation, and other lifelines.



Oblique aerial photograph of the 2014 landslide in northwest Washington. This image shows the entire extent of the landslide source area and path. This event is commonly called the “Oso Landslide” in many official reports. It is also referred to as the “SR530 Landslide,” as named by Snohomish County and Washington State. Source: USGS.

### The USGS Landslide Hazards

Program (LHP) is the only Federal program dedicated to landslide hazard science and conducts targeted studies to understand landslide initiation and mobility processes. This understanding is used to (1) develop methods and models for landslide hazard assessment, (2) develop and deploy systems to monitor threatening landslides, and (3) to develop methods and tools for landslide early warning and situational awareness. Program activities are targeted toward the types of landslides that result in human and economic losses in the United States, such as those with long travel distances, those initiated by heavy rainfall, and those exacerbated by the effects of wildfire. The USGS assists Federal, State, and local agencies through landslide site evaluations and provides strategies for reducing ongoing and future impacts from landslides. The LHP deploys near-real-time monitoring systems at active landslide sites to gather continuous movement, rainfall, and hydrologic data needed to understand the mechanisms of landslide occurrence and mobility and forecast future behavior. Such data and understanding form the scientific underpinnings for early warning of conditions that may trigger landslides.

Landslide Hazards Program activities fall under two areas:

- Landslide Research
- Hazard and Risk Assessments.

---

## LANDSLIDE RESEARCH



Emergency responders survey the scene of a home buried up to the roof in landslide debris. Source: USGS

The LHP conducts research targeted to improve understanding of landslide processes that informs the development and enhancement of tools for hazard assessment and early warning. Activities include surface and subsurface investigation of past and ongoing landslide activity, operation of natural laboratories to monitor landslide processes, and development of tools and methods for landslide hazard assessment. Sustained efforts in landslide monitoring have led to significant advances in understanding slope stability and landslide processes.

## LANDSLIDE HAZARD ASSESSMENTS

The knowledge and improved understanding gained through applied research is used to develop and improve tools and methods for landslide hazard assessment and early warning. The LHP provides susceptibility maps, hazard assessments, and situational awareness to a broad range of Federal and State agencies ranging from the U.S. Forest Service (USFS) to emergency managers of local communities. These agencies and jurisdictions use USGS products to mitigate the effects of landslides and debris flows through land use planning, response planning, and warning systems. The LHP delivers debris-flow hazard assessments for major wildfires in the western United States. For other landslide types and in other settings, landslide hazard assessments are typically produced as demonstration projects or in response to a request from Federal or State partners. In 2014, the LHP developed a Web-based system for delivery of post-wildfire hazard assessments to Burned Area Emergency Response (BAER) teams and emergency managers, with timely information in a format that can be readily ingested into data systems they use.

## REIMBURSABLE ACTIVITIES

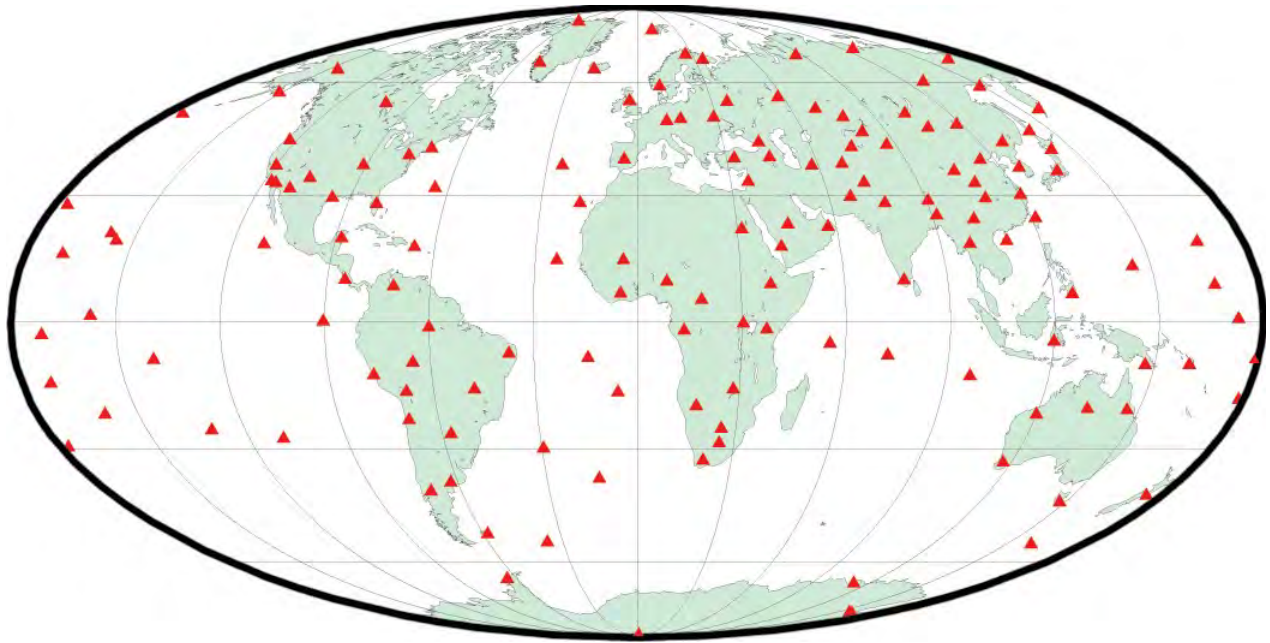
The Landslide Hazards Program has no reimbursable activities.

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## GLOBAL SEISMOGRAPHIC NETWORK

*GSN is a network of state-of-the-art seismological and geophysical sensors connected by a telecommunications network, serving as a multi-use scientific facility and societal resource for monitoring, research, and education.*

The Global Seismographic Network (GSN) consists of more than 150 globally distributed stations, 100 of which are operated by the USGS. The GSN is a partnership between the USGS and the National Science Foundation and is implemented in partnership with the Incorporated Research Institutions for Seismology (IRIS) university consortium and many other entities. It provides the high-quality seismic data needed for global earthquake alerts and situational awareness products, tsunami warnings, national security (through nuclear test treaty monitoring and research), seismic hazard assessments and earthquake loss reduction, as well as research on earthquake sources and the structure and dynamics of the Earth.



Locations of the more than 150 Global Seismic Network stations (shown as red triangles) on a map of the globe. Source: USGS.

Because of its real-time data delivery, the GSN is a critical element of USGS hazard alerting activities, as well as supporting activities of other Federal agencies, including the National Oceanic and Atmospheric Administration (NOAA) tsunami warning; National Science Foundation (NSF) basic research; and the Department of Energy (DOE) and the Department of Defense (DOD) nuclear test treaty monitoring and research. GSN stations transmit real-time data continuously to the USGS NEIC in Golden, CO, where they are used to rapidly determine the locations, depths, magnitudes, and other parameters of earthquakes worldwide, in conjunction with data from other networks. GSN data allows for the rapid determination of the location and orientation of the fault that caused an earthquake and provides an estimate of the size of the fault and how much slip

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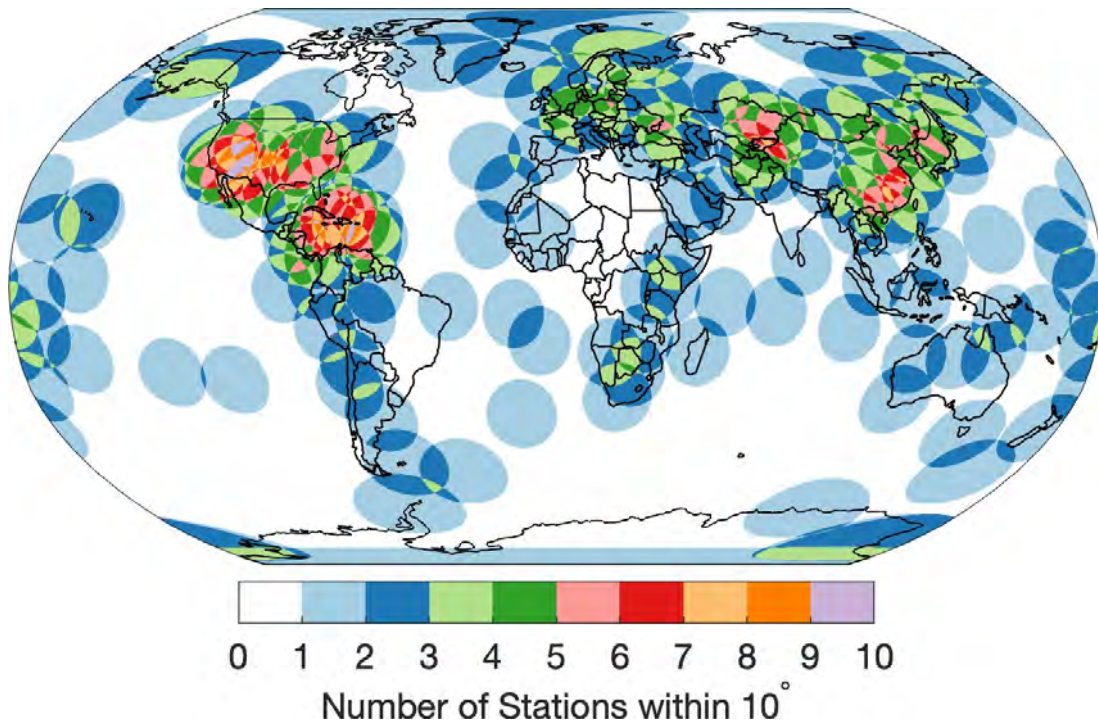
occurred, which are essential for modeling earthquake effects. The broadband, low noise, high-quality nature of GSN data are a critical aspect of their application to these problems. An additional important aspect of GSN activities is evaluating, developing, and advancing new technologies for seismic instrumentation, sensor installation, and seismic data acquisition and management.

Global Seismographic Network activities fall under two areas:

- GSN Operations
- GSN Station Upgrades

## GSN OPERATIONS

GSN operation is accomplished in cooperation with international partners who, in most cases, provide facilities to shelter the instruments and personnel to oversee the security and operation of each station. USGS responsibilities include station maintenance and upgrades, overseeing telecommunications, troubleshooting problems and providing major repairs, conducting routine service visits, training station operators, providing limited financial aid in support of station operations at sites lacking a host organization, and ensuring data quality and completeness.



GSN station coverage as represented through the geographical density of stations. Contoured values show the number of GSN stations within 10 degrees of each point on the map. Source: Incorporated Research Institutions for Seismology (IRIS).

GSN data are a critical element of the tsunami warning system operated by the National Oceanic and Atmospheric Administration (NOAA) National Weather Service and are transmitted in real time to the NOAA Tsunami Warning Centers in Hawaii and Alaska. The National Tsunami Hazard Mitigation Program (a NOAA-led Federal-State partnership that includes all 28 U.S. coastal States, territories, and commonwealths, as well as the USGS and FEMA) is also served. GSN data are

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used by the U.S. Air Force and Department of Energy (DOE) nuclear test monitoring research programs. NSF projects use GSN data for basic research on solid Earth structure and dynamics, seismic wave propagation, and earthquake source complexity, as well as to study seismic signals associated with processes in the oceans, atmosphere, and cryosphere.

### **GSN STATION UPGRADES**

The USGS has expanded efforts to refresh, support, and maintain the GSN at a high level of quality and reliability. Specifically, the USGS has worked to install new Department of Energy-funded sensors and to improve the physical infrastructure of select GSN sites. The site improvements were deferred maintenance tasks prioritized by the Global Seismographic Network Standing Committee and were necessary for the installation of the new sensors. The GSN data quality has improved in recent years, as a result of the upgrades of data loggers and the development of software to automatically assess GSN data quality and to identify and diagnose performance issues.

### **REIMBURSABLE ACTIVITIES**

The Global Seismographic Network has no reimbursable activities.

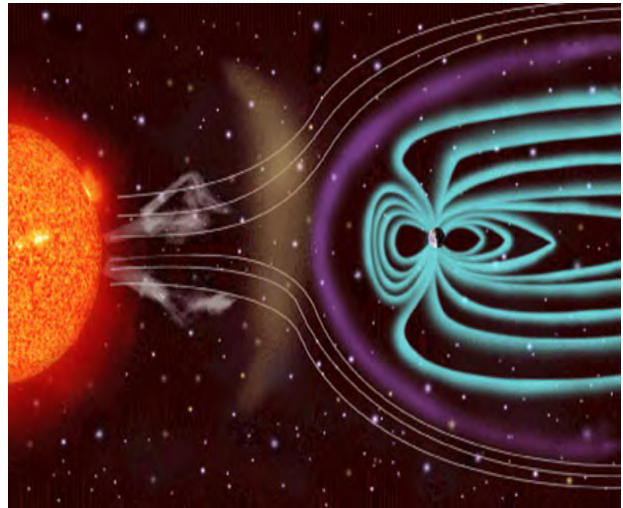


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## GEOMAGNETISM PROGRAM

*USGS conducts research on geomagnetic disturbances to help improve scientific understanding and hazard mitigation.*

The Geomagnetism Program provides data and information on short-term and long-term variations in the strength and direction of the Earth's magnetic field, including the intensity of magnetic storms, through operation of a network of geomagnetic observatories and supporting research, and analyzes related geomagnetic hazards that threaten the economy and national security. Magnetic storms can interfere with radio communication, global positioning system (GPS) orientation and timing, satellite operations, geophysical surveys, directional drilling for oil and gas, and the operation of electric power grids. The Geomagnetism Program represents the USGS contribution to the multiagency National Space Weather Program (NSWP) and requires high-level coordination with the Department of Defense (DOD), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the National Science Foundation (NSF), and the Department of Energy (DOE). Geomagnetism Program data are also supplied to foreign national space weather agencies and to [INTERMAGNET](#), an agency that coordinates geomagnetic monitoring around the world.



The sun and its interaction with the Earth's magnetic field in space. Source: USGS.

The Geomagnetism Program is currently leading efforts to complete a magnetotelluric (MT) survey of the conterminous United States to improve U.S. electrical grid resilience, improve forecast models for geomagnetic storms, and aid in mineral resource assessments.

Geomagnetism Program activities fall under two areas:

- Observatory Operations
- Magnetotelluric (MT) Survey

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## OBSERVATORY OPERATIONS



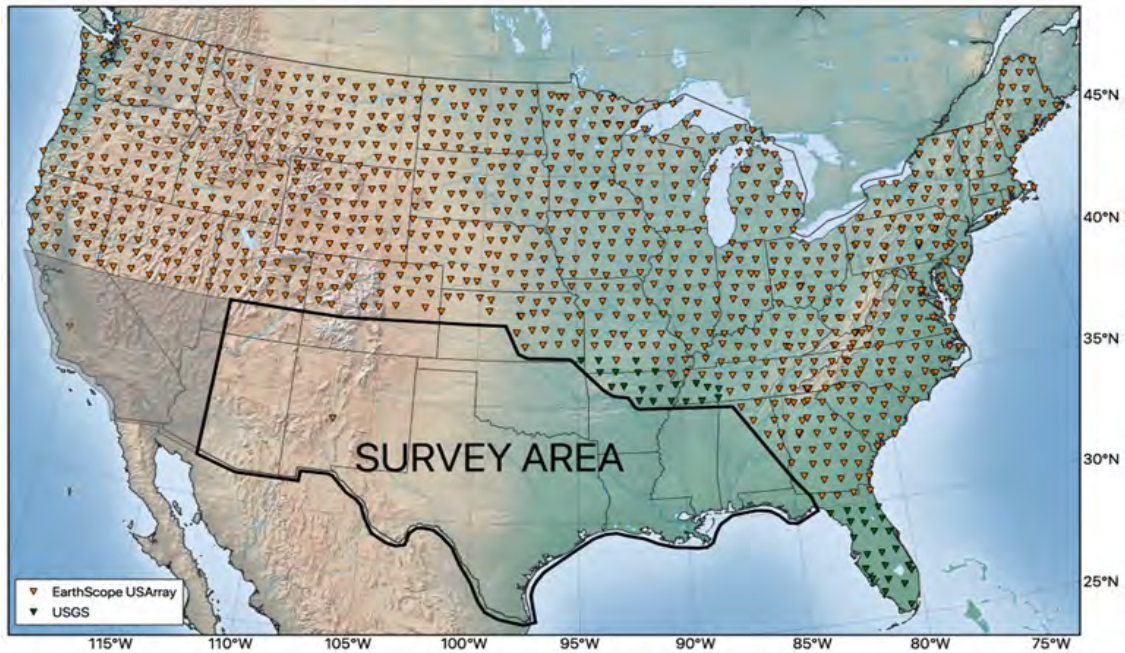
Locations of the 14 USGS Geomagnetic Observatories on a map of the globe. The global observatories shown on the map are **BOU**–Boulder, CO.; **BRW**–Barrow, AK; **BSL**–Stennis, MS; **CMO**–Fairbanks, AK; **DED**–Deadhorse, AK; **FRD**–Fredericksburg, VA; **FRN**–Fresno, CA; **GUA**–GU; **HON**–Honolulu, HI; **NEW**–Newport, WA; **SHU**–Shumagin, AK; **SIT**–Sitka, Japan; **SJG**–San Juan, PR; **TUC**–Tucson, AZ. Source: USGS.

The USGS Geomagnetism Program operates 14 magnetic observatories across the United States and its territories. Data are collected continuously from each observatory by sensor systems that are operated in carefully controlled conditions to ensure long-term measurement accuracy. USGS Geomagnetism Program observatory standards are consistent with those set by INTERMAGNET, an international consortium that promotes the worldwide collection of high-quality, ground-based magnetometer data, and within which the USGS Geomagnetism Program has an important leadership role. Data are transmitted in realtime to the project’s headquarters in Golden, CO, through a set of satellite and Internet linkages. One-minute and one-second preliminary data are sent to INTERMAGNET in near realtime, to allow access by the world

community. Data are also transmitted to the NOAA Space Weather Prediction Center (SWPC), the U.S. Air Force 557th Weather Wing (557th WW), the NASA Goddard Space Flight Center, to several foreign space weather agencies, and to private companies in the United States. Auxiliary calibration measurements are combined with real-time data time series to produce accurate definitive data. These data are used for constructing maps of the geomagnetic field and for analysis of long-term changes in geomagnetic activity. USGS data products are available through INTERMAGNET and through the program’s Website (<https://www.usgs.gov/natural-hazards/geomagnetism>).

## MAGNETOTELLURIC (MT) SURVEY

The Geomagnetism Program will complete an MT survey of the conterminous United States to improve U.S. electrical grid resilience, improve forecast models for geomagnetic storms and their impacts, and aid in mineral resource assessments. This survey is responsive to priorities established in the *National Space Weather Strategy*, released by the White House National Science and Technology Council, Executive Order 13865 on *Coordinating National Resilience to Electromagnetic Pulses* (March 26, 2019), as well as international initiatives for pursuing induction hazard research.



Map of the United States showing the area of the country which has been surveyed for magnetotelluric data (shaded) with the area being surveyed by the USGS Geomagnetism Program. Source: USGS.

## REIMBURSABLE ACTIVITIES

The Geomagnetism Program has no reimbursable activities.

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## COASTAL/MARINE HAZARDS AND RESOURCES PROGRAM

*USGS provides information and tools to anticipate and reduce the risk of natural hazards and coastal change, and to assess and manage marine and coastal resources.*

The Coastal/Marine Hazards and Resources Program (CMHRP) provides surveys, knowledge, and tools to characterize the hazard and resource potential of the Nation's offshore and coastal landscapes.

### The CMHRP

- Is the only Federal science program focused on the geology and processes that form, maintain, and alter coastal and marine landscapes.
- Provides Federal, State, and local users with improved assessments of hazard sources (earthquakes, tsunami, submarine landslides) and their potential impacts on offshore operations, coastal communities, and infrastructure, including support of bureau-wide investigations of subduction zone processes and hazards.
- Provides forecasts, in realtime, of erosion and inundation resulting from coastal storms, including hurricanes, and long-term forecasts of the likelihood of future coastal change owing to storms, erosion, and sea-level rise for the majority of conterminous United States ocean beaches and barrier islands.
- Works with other Federal and academic partners to characterize marine methane systems and associated seabed processes to enhance understanding of their substantial energy resource potential, the risk they represent to offshore operations, and their role in the global carbon system and marine ecological productivity.
- Contributes analyses and expertise to delineate the U.S. Extended Continental Shelf consistent with international law, expanding U.S. sovereignty over resources on and beneath the sea floor.



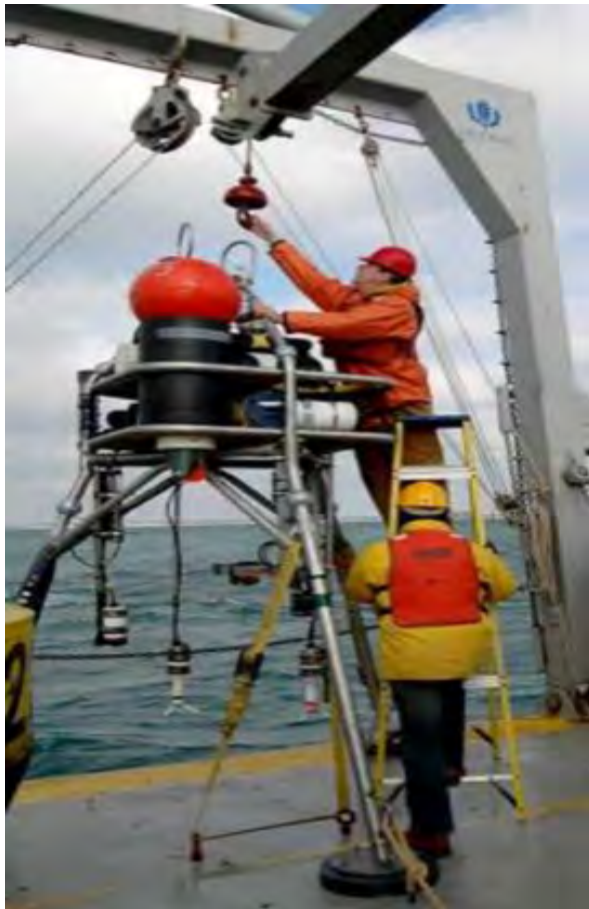
A breach in the coastline of Rodanthe, N.C., caused by Hurricane Irene in 2011. Repeated storm impacts, combined with sea level rise, make the development and improvement of models that help forecast coastal change very important to planners working to build more resilient communities. Source: USGS.

The unique capabilities and expertise of CMHRP are applied in support of the mission objectives of the U.S. Department of the Interior (Interior) and other Federal, State, and local agencies, and nongovernmental organizations.

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Coastal/Marine Hazards and Resources Program activities fall under four areas:

- Characterizing Marine Geologic Hazards and Resources
- Coastal Change Hazards
- Coastal and Marine Resources and Resilience
- Data Delivery.



Instrumented tripods are deployed on Diamond Shoals near Cape Hatteras, N.C. These tripods recorded data quantifying the currents, waves, turbidity, temperature, and salinity at several levels near the seafloor. Source: USGS

## **CHARACTERIZING MARINE GEOLOGIC HAZARDS AND RESOURCES**

Ocean hazard events like tsunamis triggered by earthquakes and landslides; storm surges associated with hurricanes and extreme storms; oil and gas spills; and floods and associated delivery of watershed contaminants affect the health and safety of our Nation’s ocean and coastal communities, infrastructure and ecosystems. USGS scientists study the causes, distribution, and hazard potential of coastal and submarine hazard events, including earthquakes and submarine landslides, as well as the associated tsunami potential. Additionally, USGS studies focus on geologic mapping, sampling, and understanding offshore energy and mineral resources, including studies of geologic settings and processes to inform offshore renewable energy development. This work benefits the Bureau of Ocean Energy Management in its management of ocean and energy resources, by improving the understanding of seafloor processes and associated geologic hazards.

## **COASTAL CHANGE HAZARDS**

Coastal change poses substantial risk to coastal communities across the Nation. CMHRP provides real-time forecasts of erosion and inundation resulting from coastal storms, including hurricanes, and long-term forecasts of the likelihood of future coastal change owing to storms, erosion, and sea-level rise. The CMHRP is the recognized Federal provider of research, information, and tools to anticipate and respond to physical change along our Nation’s coast and to understand the consequences of change on communities, infrastructure, and resources.

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## COASTAL AND MARINE RESOURCES AND RESILIENCE

CMHRP's unique understanding of the processes that shape, alter, and threaten coastal landscapes is developed and delivered to inform management and restoration strategies. Coastal communities and resource managers require data and tools that inform decisions reflecting the complex ecosystem linkages between watersheds, estuaries, wetlands, coral reefs, and offshore ocean regions. CMHRP brings together multidisciplinary expertise focused on developing tools and models to improve understanding of how healthy ecosystems function as well as how they respond to environmental change and human impacts, including regional ecosystem restoration. Research studies address the condition, health, and societal value of coral reef, coastal wetland, benthic (at the bottom of a body of water) habitat, and groundwater resources.

### DATA DELIVERY

The CMHRP develops, maintains, and delivers a wide range of resources to access and apply scientific data, expertise, technology, tools, and other resources. The CMHRP provides coastal and marine emergency and resource managers with data, models, and tools for use in planning and managing activities in the ocean and along the



USGS Research Vessel *Stephens* operating within Lake Powell, Utah-Ariz. A multibeam echosounder is deployed off the starboard side of the vessel and is used to collect depth information within the reservoir. Source: USGS.

coast. The CMHRP is an innovator in mapping and laboratory analyses, whose expertise is sought by other governmental agencies, educational institutions, and private companies. In turn, the USGS seeks collaborative research and development to continually improve and enhance the data collection tools, analytical techniques, and technologies utilized in coastal and marine studies.

### REIMBURSABLE ACTIVITIES

The Coastal/Marine Hazards and Resources Program has no reimbursable activities.

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## **NATURAL HAZARDS CENTERS WITHIN INTERIOR UNIFIED REGIONS**

The following is a summary of the USGS science centers that receive major funding from the Natural Hazards Mission Area and their locations within Interior's Unified Regions. *A brief overview of each center is provided on pages 97-98.*

### **Region 1 – North Atlantic Appalachian** (*USGS Northeast Region*)

1. Woods Hole Coastal and Marine Science Center, Woods Hole, MA
2. Natural Hazards Mission Area Headquarters, Reston, VA (additional staff co-located with science centers in Sacramento, CA; Pasadena, CA; Golden, CO; and St. Petersburg, FL)

### **Region 2 – South Atlantic-Gulf** (*USGS Southeast Region*)

3. St. Petersburg Coastal and Marine Science Center, St. Petersburg, FL

### **Region 7 – Rocky Mountain** (*USGS Rocky Mountain Region*)

4. Geologic Hazards Science Center, co-located at Colorado School of Mines, Golden, CO (includes Albuquerque Seismological Laboratory, NM)

### **Region 8 - Lower Colorado Basin** (*USGS Southwest Region*)

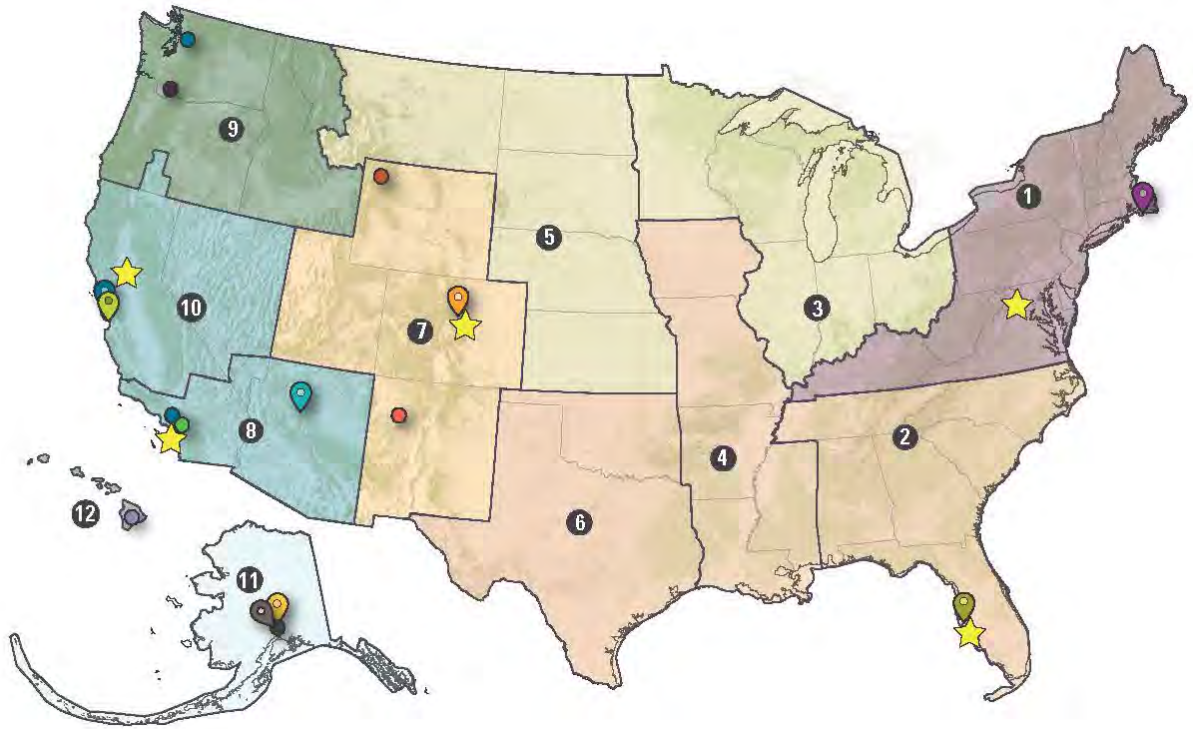
5. Astrogeology Science Center, Flagstaff, AZ (almost entirely funded by NASA)

### **Region 10 – California Basin** (*USGS Southwest Region*)

6. Pacific Coastal and Marine Science Center, Santa Cruz, CA
7. Earthquake Science Center, Menlo Park, CA and Moffett Field, CA

### **Region 11 – Alaska** (*USGS Alaska Region*)

8. Volcano Science Center, Anchorage, AK  
Includes the U.S. Volcano Observatories: Alaska Volcano Observatory (AVO), Anchorage, AK; California Volcano Observatory (CVO), Menlo Park, CA; Cascades Volcano Observatory (CVO), Vancouver, Wash.; Hawaiian Volcano Observatory (HVO), Hilo, HI; Yellowstone Volcano Observatory (YVO), Yellowstone National Park, WY
9. Alaska Science Center, Anchorage, AK



- USGS Regions**
- Northwest - Pacific Islands
  - Southwest
  - Alaska
  - Rocky Mountain
  - Midcontinent
  - Southeast
  - Northeast

- DOI Unified Regions**
- 1** North Atlantic-Appalachian
  - 2** South Atlantic-Gulf
  - 3** Great Lakes
  - 4** Mississippi Basin
  - 5** Missouri Basin
  - 6** Arkansas-Rio Grande-Texas Gulf
  - 7** Upper Colorado Basin
  - 8** Lower Colorado Basin
  - 9** Columbia-Pacific Northwest
  - 10** California-Great Basin
  - 11** Alaska
  - 12** Pacific Islands

**Natural Hazards Science Centers**

- National Centers**
- ★ Natural Hazards Headquarters
  - 📍 Alaska Science Center
  - 📍 Astrogeology Science Center
  - 📍 Earthquake Science Center
  - 📍 Geology, Minerals, Energy & Geophysics Science Center
    - Field Office
    - Albuquerque Seismological Laboratory
  - 📍 Geologic Hazards Science Center
  - 📍 Pacific Coastal & Marine Science Center
  - 📍 St. Petersburg Coastal & Marine Science Center
  - 📍 Woods Hole Coastal & Marine Science Center
  - 📍 Volcano Science Center
    - Alaska Volcano Observatory
    - California Volcano Observatory
    - Cascades Volcano Observatory
    - Hawaiian Volcano Observatory
    - Yellowstone Volcano Observatory



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### **Alaska Science Center (ASC)**

The ASC provides objective and timely data, information, and research findings about the Earth and its flora and fauna to Federal, State, and local resource managers and the public to support sound decisions regarding natural resources, natural hazards, and ecosystems in Alaska and circumpolar regions.

### **Astrogeology Science Center (ASC)**

The Astrogeology Science Center in Flagstaff, AZ, has a rich history of participation in space exploration and planetary mapping, starting in 1963 when the Flagstaff Science Center was established to provide lunar geologic mapping and assist in training astronauts destined for the Moon. The USGS Astrogeology Science Center is a national resource for the integration of planetary geoscience, cartography, and remote sensing. Although affiliated with the Natural Hazards Mission Area (NHMA), the center is managed by the Southwest Region and receives nearly all its funding through reimbursable agreements from NASA.

### **Earthquake Science Center (ESC)**

The Earthquake Science Center has been a flagship research center for the USGS in the western United States for more than 50 years, housing extensive research laboratories and scientific infrastructure. The ESC collects a wide range of data on earthquakes, faults, and crustal deformation; conducts research to increase our understanding of earthquake source processes, occurrence, and effects; and synthesizes this knowledge into probabilistic seismic hazard assessments, aftershock forecasts, and ground-shaking scenarios for anticipated major earthquakes. The ESC disseminates these data products, hazard assessments, and research discoveries to scientists, engineers, emergency managers, and the public.

### **Geologic Hazards Science Center (GHSC)**

The Geologic Hazards Science Center (GHSC), on the Colorado School of Mines campus, is home to the National Earthquake Information Center (NEIC) and to many scientists supported by the Earthquake Hazards Program, Landslide Hazards Program, and Geomagnetism Program. The NEIC rapidly determines the location and size of all destructive earthquakes worldwide and immediately disseminates this information to national and international agencies, scientists, and the public. The NEIC compiles and maintains an extensive, global seismic database on earthquake parameters and their effects, which serves as a solid foundation for basic and applied Earth science research.

### **National Center (Natural Hazards HQ)**

The Natural Hazards Mission Area headquarters staff members are primarily located at the USGS National Center in Reston, VA. These staff provide national coordination for the programs and activities of the NHMA. Additional NHMA headquarters staff are collocated with science centers in Sacramento, CA; Pasadena, CA; Golden, CO; and St. Petersburg, FL.

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### **Pacific Coastal and Marine Science Center (PCMSC)**

The Pacific Coastal and Marine Science Center, located in Santa Cruz and Menlo Park, CA, studies coastal and offshore areas of the western United States, including Alaska, Hawaii, and other Pacific islands. The center employs geologists, geophysicists, oceanographers, and geographers, and maintains state-of-the-art lab facilities for rock, sediment, and geochemical analyses. The marine facility provides vessel operation, equipment design and fabrication, and support for field sampling and mapping.

### **St. Petersburg Coastal and Marine Science Center (SPCMS)**

The USGS St. Petersburg Coastal and Marine Science Center has a primary focus of investigating processes related to coastal and marine environments and their societal implications related to natural hazards, resource sustainability, and environmental change.

### **Volcano Science Center (VSC)**

The Volcano Science Center encompasses five volcano observatories where research and monitoring occur. The observatories are Alaska Volcano Observatory (AVO), Anchorage, AK; California Volcano Observatory (CVO), Menlo Park, CA; Cascades Volcano Observatory (CVO), Vancouver, WA; Hawaiian Volcano Observatory (HVO), Hilo, HI; and the Yellowstone Volcano Observatory (YVO), Yellowstone National Park, WY. Each observatory is assigned a geographic area of responsibility and issues formal notices of activity for volcanoes in those regions. The observatories and their partner organizations operate real-time volcano monitoring networks, disseminate forecasts and notifications of significant activity, assess volcano hazards, conduct scientific research into volcanic processes, and work with communities to prepare for volcanic eruptions.

### **Woods Hole Coastal and Marine Science Center (CMSC)**

The Woods Hole Coastal and Marine Science Center is part of the USGS Coastal/Marine Hazards and Resources Program, which is the primary Federal marine geology and physical science research program. The CMSC conducts mapping of the coastal and marine environment to define offshore hazards and sediment processes, support habitat and resource management, and monitor change. The center also collaborates on research and development opportunities with other governmental agencies, educational institutions, and private companies to continually correct and perfect data collection tools, analytical techniques, and technologies utilized in coastal and marine studies.

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## SOCIAL MEDIA PRESENCE

	<a href="https://www.facebook.com/USGSNaturalHazards/">https://www.facebook.com/USGSNaturalHazards/</a> <a href="https://www.facebook.com/USGSVolcanoes/">https://www.facebook.com/USGSVolcanoes/</a> <a href="https://www.facebook.com/USGScoastalandoceanscience">https://www.facebook.com/USGScoastalandoceanscience</a> <a href="https://www.facebook.com/USGSstpete/">https://www.facebook.com/USGSstpete/</a> <a href="https://www.facebook.com/USGSAstrogeology/">https://www.facebook.com/USGSAstrogeology/</a>
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	<a href="https://www.youtube.com/user/USGSCMG">https://www.youtube.com/user/USGSCMG</a>
	<a href="https://www.flickr.com/photos/usgeologicalsurvey">https://www.flickr.com/photos/usgeologicalsurvey</a>
	<a href="https://github.com/USGS">https://github.com/USGS</a>

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## LEGAL AUTHORITIES FOR MISSION AREA ACTIVITIES

### **43 U.S.C. 31 ET SEQ. | The Organic Act of March 3, 1879**

An act that established the Geological Survey, as amended (1962), and restated in annual appropriation acts. This section provides, among other things, that the Geological Survey is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Interior Department. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285 Sec. 10(a) establishes United States Geological Survey as its official name.

### **43 U.S.C. 31K | The Dingell Act**

Authorizes the USGS to establish a National Volcano Early Warning System and Monitoring System, commonly known as NVEWS (without the ‘M’). The system has been designed to “...monitor, warn, and protect citizens of the United States from undue and avoidable harm from volcanic activity.” Authorized in 2019 by P.L. 116-9, expires in 2023.

### **42 U.S.C 5201 ET SEQ. | The Disaster Relief Act of 1974, Section 202(A)**

States that “The President shall insure that all appropriate Federal agencies are prepared to issue warnings of disasters to State and local officials.” In addition, Section 202(b) States that “The President shall direct appropriate Federal agencies to provide technical assistance to State and local governments to ensure that timely and effective disaster warning is provided.” By agreement with the Federal Emergency Management Agency, the Director of the Geological Survey, through the Secretary of the Interior, carries out the responsibility to issue disaster warnings “...for an earthquake, volcanic eruption, landslide, or other geologic catastrophe.”

### **42 U.S.C. 7701 ET SEQ. | The Earthquake Hazards Reduction Act of 1977**

Sets as a national goal the reduction in the risks of life and property from future earthquakes in the United States through the establishment and maintenance of a balanced earthquake program encompassing prediction and hazard assessment research, seismic monitoring, and information dissemination. Was last reauthorized in 2018 by P.L. 115-307, expires in 2023.

### **43 U.S.C. 3101 ET SEQ. | National Landslide Preparedness Act**

Authorizes the USGS to establish an interagency program, modeled on National Earthquake Hazards Reduction Program, for landslide hazards. The program will establish an interagency committee and an external advisory committee. The program is authorized to develop a national strategy, a database of landslide hazards, and develop best practices for risk reduction and emergency response. The USGS and NOAA are also authorized to expand the debris-flow early warning system. The USGS is authorized to provide grants for landslide mapping and assessment, while NSF is authorized to provide research grants. Authorized by P.L. 116-323, expires 2024.

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## SOURCES FOR FAST FACTS

- Fact: The USGS operates approximately 3,400 earthquake sensors in the United States.  
*Source: Earthquake Hazards Program, USGS.*
- Fact: 31 States are exposed to annualized cost of \$10 million in earthquake losses. *Source: Earthquake Hazards Program, USGS.*
- Fact: The National Seismic Hazard Model underlies the International Building Codes (IBC), the standard for building design in the United States.  
*Source: <https://www.usgs.gov/natural-hazards/earthquake-hazards/hazards>*
- Fact: The Global Seismographic Network (GSN) is consists of 150 globally distributed seismic stations, 100 of which are operated by USGS.  
*Source: [https://www.usgs.gov/natural-hazards/earthquake-hazards/gsn-global-seismographic-network?qt-science\\_support\\_page\\_related\\_con=4#qt-science\\_support\\_page\\_related\\_con](https://www.usgs.gov/natural-hazards/earthquake-hazards/gsn-global-seismographic-network?qt-science_support_page_related_con=4#qt-science_support_page_related_con)*
- Fact: There are 161 potentially active volcanoes in the United States.  
*Source: <https://pubs.er.usgs.gov/publication/sir20185140>*
- Fact: The USGS has 14 geomagnetic observatories located across the globe that monitor the Earth's magnetic field for geomagnetic hazards.  
*Source: <https://www.usgs.gov/natural-hazards/geomagnetism>*
- Fact: Landslides occur in all 50 States. The USGS is the only Federal program dedicated to landslide science.  
*Source: <https://www.usgs.gov/natural-hazards/landslide-hazards>*
- Fact: The Coastal/Marine Hazards and Resources Program is the only Federal science program focused on the geology and processes of marine landscapes.  
*Source: <https://www.usgs.gov/natural-hazards/coastal-marine-hazards-and-resources/>*

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# Water Resources Mission Area

Source: USGS.

## Programs

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Water Availability and Use Science Program

Groundwater and Streamflow Information Program

National Water Quality Program

Water Resources Research Act Program

Don Cline, Associate Director

[dcline@usgs.gov](mailto:dcline@usgs.gov)

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*Water information is fundamental to the protection of life and property, the well-being of national and local economies, and the effective management of the Nation's water resources.*

## WATER RESOURCES MISSION AREA OVERVIEW

Beginning in 1888 with the National Streamgaging Program on the Rio Grande River under the direction of John Wesley Powell, the USGS has since become one of the largest providers of in-situ water data in the world. The [Water Resources Mission Area](#) (WMA) works with partners to monitor, assess, conduct targeted research, and deliver information on a wide range of water resources and conditions including streamflow, groundwater, water quality, and water use and availability. These activities support an overarching science strategy to observe, understand, predict, and deliver water science to the Nation. Through integrated activities with various partners, the WMA serves society by providing tools that managers and policymakers can use to manage water resources so they meet both human and environmental needs.



An aerial view of a cyanobacterial bloom in Lake Okeechobee, Fla. (July 2016). Understanding how water conditions influence the formation and persistence of harmful algal blooms is one example of the many ways USGS water information is used. Source: USGS.

### **What We Do**

- Collect and deliver impartial, timely, and societally relevant data on the quantity, quality, and use of water resources.
- Conduct assessments of the water available for human and ecological uses in terms of quantity and quality.
- Identify long-term trends in the quantity, quality, and use of water resources.

### **Cooperative Matching Funds (CFM)**

Much of WMA work with partners is supported by a subset of funds referred to as Cooperative Matching Funds. Required by law to be matched at least 50:50 by State, local, or Tribal partners, CMF is matched by more than 1,600 of these partners to monitor and assess water resources in every U.S. State, protectorate, and territory. CMF are in three of the WMA budget programs: Water Availability and Use Science (WAUSP), Groundwater and Streamflow Information (GWSIP), and National Water Quality (NWQP).

### **Science Planning and Management**

The WMA plans and manages its science through a portfolio structure where funding from WAUSP, GWSIP, and NWQP is used to support two overarching portfolios of science: Water Resources Availability and Water Observing Systems. Although funds maintain their intended use (for example, NWQP funds support water-quality work), this management structure allows WMA to manage science with an integrated lens, looking at the water quantity, quality, and use aspects of water availability and water observing systems. With this in mind, there is some overlap between major program areas in each of the program sections of this document.

## HOW THE MISSION AREA SERVES THE PUBLIC

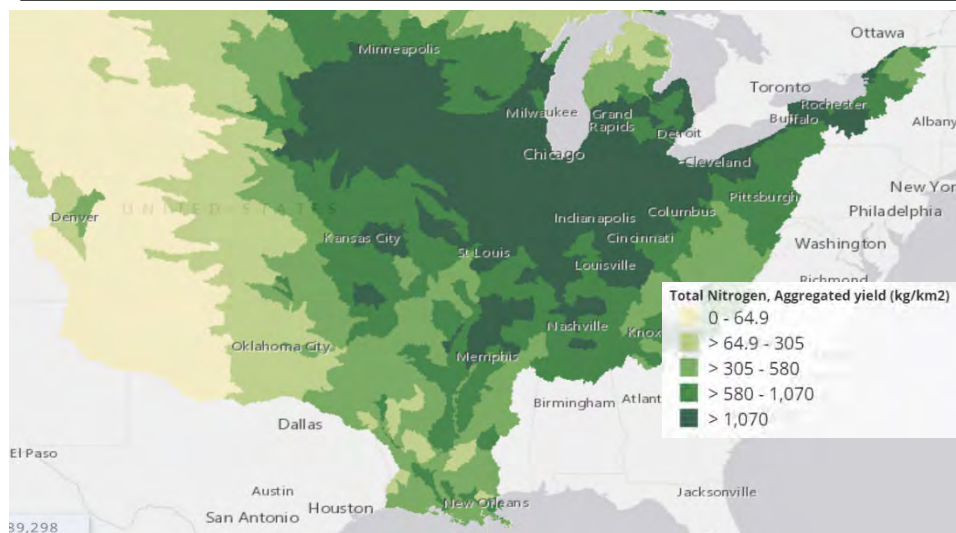
*The WMA collects data, produces models, and provides information that is fundamental to economic well-being, protection of life and property, and effective management of water resources for both human and ecological uses. Below are some examples of WMA data and tools available to the public.*

### USGS Water Data for the Nation

The National Water Information System: Web Interface (NWISWeb) provides public access to data from more than 20,000 groundwater wells and 10,000 streamgages. In FY 2019 alone, NWISWeb pages were accessed more than 1.2 billion times, with streamgage sites being the most popular.



NWIS Mapper (<https://waterdata.usgs.gov/nwis>) showing the distribution of groundwater (in red) and surface water (in black) monitoring sites across the United States. Source: USGS.



The SPARROW Mapper for the Midwest showing the areas where nitrogen yields are greatest. Areas in the darkest green have the highest yields, whereas yellow areas have the lowest yields. Source: USGS.

### SPARROW

#### Models & Mappers

These mappers are interactive tools that allow users to explore streamflow, nutrient and sediment loads and yields, as well as the importance of different contaminant sources in a river basin. SPARROW Mappers have been developed for five major U.S. regions: Midwest, Northeast, Pacific, Southeast, and Southwest.

### Water Data Collection and Validation

Rain or shine, USGS hydrographers are out measuring high water marks, streamflow, and water levels, as well as taking water-quality samples, across the United States. This data is meticulously validated with national standards to ensure it can be used by Federal, State, local, academic, and various other stakeholders to make critical decisions about life and property.



Left: USGS hydrographer Dave Thompson makes a near-peak flood measurement off a bridge at Tenmile River (Tusten, N.Y.). Right: USGS hydrographer Brent Hanson wades out in freezing waters to collect flood measurements on the Sheyenne River (Cooperstown, N. Dak). Source: USGS.



## FAST FACTS

# Water Resources Mission Area

There are 27 Water Science Centers with locations in all 50 States.



USGS operates more than 10,000 streamgages as part of the National Streamgaging Network.



Most are funded with one or more of about 1,600 Federal, State, local, and Tribal partners.



More than 8,400 measure real-time streamflow as part of the National Streamflow Network.



More than 3,600 are Federal Priority Streamgages, which meet specific, long-term Federal needs.

Groundwater accounts for almost 40% of the water withdrawn for public supply.

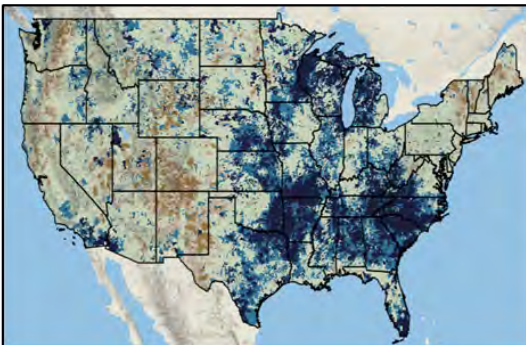


USGS monitors water levels, water-quality conditions, or both at more than 17,000 groundwater wells across the United States.

Excess nutrients in America's waters are one of its most widespread, costly, and challenging environmental problems.

USGS monitors nutrients, sediment, and pesticides at more than 110 surface water sites as part of the National Water Quality Network for Streams and Rivers.

Cooperative Matching Funds are appropriated to the WMA every year and can only be used to fund cooperative studies or data collection with State, local, or Tribal partners.



USGS is developing Integrated Water Availability Assessments to evaluate water quantity, quality, and use at regional and national scales.

USGS provides base and competitive grants to the Nation's 54 Water Resources Research Institutes.

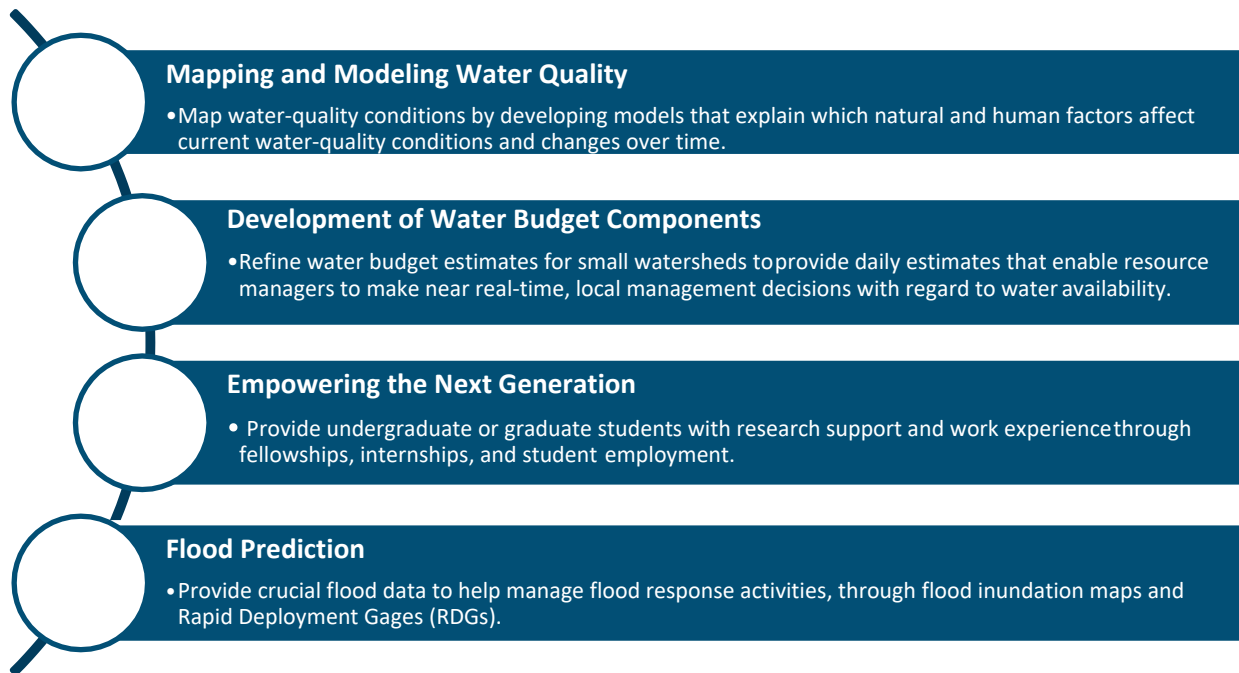
Source information for each of the facts above is on page 141.

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## USGS AND THE DOI STRATEGIC PLAN

### COMMITMENTS TO DEPARTMENT OF THE INTERIOR PRIORITIES

Within the 2018–2022 DOI Strategic Plan, Water Resources programs provide science to inform land, water, and species management decisions to meet the DOI goal of Conserving Our Land and Water, as well as science to safeguard communities against natural hazards to meet the DOI goal of Protecting Our People and the Border. The USGS is committed to working on the following priorities to meet both USGS and DOI goals.



### Performance and Strategic Planning Documents

- DOI Agency Financial Report (the most recent report can be found [here](#))
- DOI Annual Performance Plan & Report (APP&R; the most recent can be found [here](#))
- DOI Strategic Plan (2018-2022) ([link](#))

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## WATER AVAILABILITY AND USE SCIENCE PROGRAM

*USGS integrated water availability assessments provide information on the quantity, quality, and use of the water that is available for human and ecological uses.*



The Colorado River, Coconino County, Ariz. Models of the Upper Colorado River Basin indicate decreases in streamflow (Milly and Dunne, 2020). Source: Alan Cressler, USGS, used with permission.

The Water Availability and Use Science Program (WAUSP) fulfills the goals established by Congress in the SECURE Water Act (Public Law 111-11, Section 9508) by investing in research and assessments that improve the Nation's understanding of water availability. Specifically, the WAUSP supports the National Water Census, a USGS activity designed to systematically provide

information that will allow resource managers to assess the quantity, quality, and use of the Nation's water. The WAUSP focuses on conducting national and regional water availability assessments, developing methods to estimate water budgets, and evaluating trends in water availability. In addition, the WAUSP supports efforts to develop techniques to evaluate water availability, advance the models and infrastructure that support assessments, and deliver tools that resource managers can use to support resource planning.

Water Availability and Use Science Program activities fall under three areas:

- National Water Census
- Water Prediction and Information Delivery
- High Impact Hydrologic Research

### NATIONAL WATER CENSUS

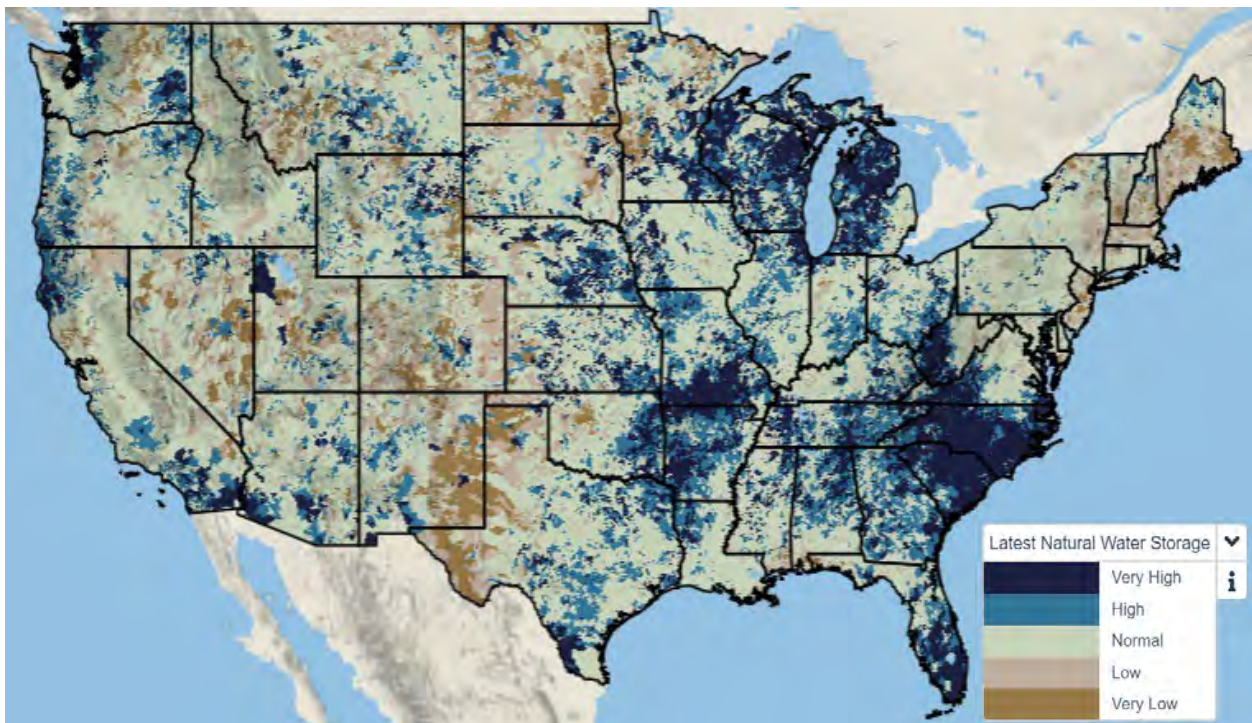
The goal of the USGS National Water Census (NWC) is to provide nationally consistent, well-documented information on water quantity, quality, and use that will allow resource managers to assess the Nation's water availability. Although this goal is supported by three of the four Water Resources programs, the WAUSP supports this goal by investing in efforts to understand and quantify the inputs, outputs, and changes in the water budget. Furthermore, the USGS is examining the dynamic interactions and complex roles that major factors (such as water quality, drought, ecological flows, and water use) can have in water availability. Estimates of water budget components, as well as an understanding of how various factors can impact water availability, provide a means for the USGS to provide water availability assessments.

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## Integrated Water Availability Assessments (IWAAAs)

A critical component of the NWC is the development and delivery of Integrated Water Availability Assessments. These stakeholder-driven assessments will provide a near real-time census and seasonal prediction of water availability for both human and ecological uses at regional and national extents. At a national scale, the USGS is working to deliver an IWAA that conveys periodic snapshots of current conditions and trends across the United States. Although it currently only shows natural water storage as an indicator of water quantity, this National IWAA will be expanded to include pilot indicators for water quality and use as well. The WAUSP supports the National IWAA through efforts to develop and refine models to simulate water budget components and factors that influence water availability. USGS is providing daily estimates for four of nine targeted water budget components (precipitation, streamflow, soil moisture, and groundwater recharge).

The USGS is developing regional IWAAAs in partnership with stakeholders to ensure they are timely and informative at the local and regional level but can also be assimilated into national-scale products as part of the National IWAA. The WAUSP is actively integrating regional assessment activities focused on water quantity and use into Regional IWAAAs. Regional IWAAAs are planned or ongoing in the Delaware River and Upper Colorado River basins. Moving forward, in collaboration with Next Generation Water Observing System and Integrated Water Prediction efforts across the WMA, Regional IWAAAs will be conducted in other regions throughout the country. In addition, the WAUSP supports cooperative projects with State and local partners to provide data and models to inform IWAAAs capabilities.



Snapshot of the National IWAA Concept Map showing estimates (as of May 31, 2020) of current natural water storage relative to historical conditions for the same time of year. Blue shading indicates where current water storage is higher than historical conditions, whereas brown areas indicate where current water storage is lower than historical conditions. Source: USGS.

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## **WATER PREDICTION AND INFORMATION DELIVERY**

The USGS is participating in an ambitious Federal partnership with agencies like the National Oceanic and Atmospheric Administration, Bureau of Reclamation, and U.S. Army Corps of Engineers to develop a new national, interagency capacity for water prediction. To do this, the USGS is working through an Integrated Water Prediction program that is focused on developing nationally consistent approaches for predicting and forecasting hydrologic conditions, changes, and outcomes for water availability. These approaches are being designed to consider water quantity, quality, and use together in an integrated water availability model. Funded by both WAUSP and the National Water Quality Program, WAUSP funding supports activities that focus on understanding and modeling the quantity and use aspects of water availability, as well as efforts to incorporate these aspects into larger, integrated models. Advancements from these activities provide the tools used by IWAAs.

At the foundation of the ability to model and deliver information to the public is the need to store, access, and manage large, complex datasets. The National Water Information System (NWIS) is the USGS enterprise system that supports the storage, processing, and delivery of real-time and historical water data. However, the current version of NWIS is inflexible, suffers from extensive technological debt, and is at increased risk of system failure because of aging infrastructure. To ensure NWIS can manage new data and data types produced through all WMA activities, integrate water data from multiple agencies and sectors, and continue to deliver data and model results to the public, funding from across the WMA is used to support activities to modernize NWIS data systems. WAUSP funding is focused on the modernization of infrastructure associated with water use information, which lies at the heart of understanding human demands for available water. In addition, the WAUSP is investing in activities to ensure that state-of-the-art tools are used to develop information and visualization products that meet the decision-making needs of water managers.

## **HIGH IMPACT HYDROLOGIC RESEARCH**

Research and development are critical foundations to the effective management of the Nation's water challenges, providing a foundation for understanding how the hydrologic process works and how it impacts water availability. To this end, the WAUSP and National Water Quality Program both support the research that is needed to understand the water quantity, quality, and use aspects of water availability. The WAUSP supports research to better understand the interactions between socioeconomics, emerging contaminants, and water availability, as well as their associated impacts, to provide water resource managers the data, tools, and information they need to make management decisions. Efforts focus on understanding how socioeconomics influences water demand, use, and movement regionally, as well as what drives these changes. In addition, the WAUSP is working to better understand how extreme events (for example, floods, spills, wildfires, and subsidence) impact water availability through short-term changes in the quantity of water resources accessible for use. By better understanding how factors like socioeconomics and extreme

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events interact with water demand, water use, and the natural hydrologic cycle, the USGS can improve its capacity to predict water availability for both human and ecological uses under a variety of conditions.

### **REIMBURSABLE ACTIVITIES**

WAUSP activities are focused on conducting water resource assessments and developing models with local, regional, or State partners. Most of this work is funded through the cooperative matching program to address local priorities and meet goals of national interest. In fact, on average, over three-quarters of WAUSP reimbursable funds are matched by cooperative partners. For the WAUSP, these activities vary with areas of focus on aquatic biota in the Great Lakes region, basin characteristic and bridge studies in the northwest, and water use in the west and southwest. Studies focused on watershed and groundwater modeling are more widespread. Many reimbursable projects rely heavily on methods and tools developed and maintained through programs within the National Water Census, Water Prediction and Information Delivery, and High Impact Hydrologic Research.

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## GROUNDWATER AND STREAMFLOW INFORMATION PROGRAM

*Monitoring networks that generate data on the quantity and quality of the Nation's water resources are the foundation for situational awareness and understanding of the Nation's water resources.*



A USGS gage on Bass Harbor near Tremont, Maine, with a rainbow in the background. Source: USGS.

The Groundwater and Streamflow Information Program (GWSIP) focuses on the collection, management, and dissemination of high-quality and reliable water information in real-time and over the long-term, both of which are critical for managing the Nation's water resources and anticipating and responding to water hazards that can result in loss of life and property. Serving as one of the largest water data holders in the world, the USGS partners with more than 1,600 Federal, regional, State, Tribal, and local agencies to maintain and manage its water monitoring networks. Furthermore, the GWSIP is increasingly targeting integrated monitoring for parameters of water

quality and quantity at a single location providing continuous real-time water data used for decisions such as emergency response, flood forecasting, reservoir management, water-use restrictions, drinking water deliveries, permit compliance, water-quality studies, and recreational safety. The long-term data supplied by the program are a critical component to sustaining the viability of industries such as agriculture, fishing, and outdoor recreation and are used for decisions related to water-supply planning, aquifer storage and recovery, infrastructure design, floodplain and ecosystem management, energy development, and resolution of water disputes.

Groundwater and Streamflow Information Program activities fall under three areas:

- National Water Census
- Observing Systems
- Data Systems

### NATIONAL WATER CENSUS

The goal of the USGS National Water Census (NWC) is to provide nationally consistent, well-documented information on water availability that will allow resource managers to assess the quantity, quality, and use of the Nation's water resources. Although this goal is supported by three of the four WMA programs, the GWSIP supports this goal by funding activities that collect, analyze, and assess hydrologic data in key transboundary rivers along the U.S.-Canada border. Initiated in 2019, these activities are aimed at documenting baseline conditions and assessing any potential impacts related to mining activities in British Columbia.

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## OBSERVING SYSTEMS

Water monitoring networks are the foundation of any understanding of the Nation’s hydrologic systems; they provide information that is critical for defining, using, and managing water resources. The USGS operates a suite of real-time surface water and groundwater networks that provide data on water levels, streamflow, and a variety of water-quality parameters. The GWSIP primarily supports the networks that provide data on water quantity (water levels and streamflow), while also investing in next-generation water observing systems designed to integrate monitoring for water quantity, quality, and use.

### National Streamgaging Network

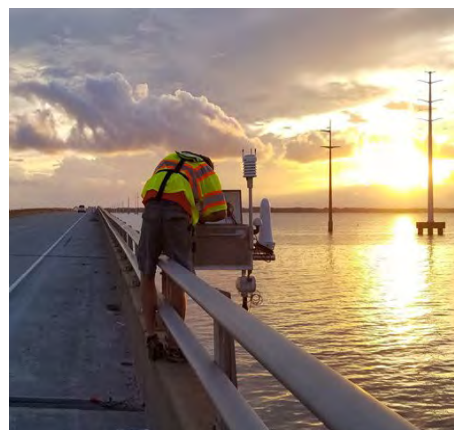
In the late 1800s, John Wesley Powell, second Director of the USGS, proposed gaging the flow of rivers and streams in the Western United States to evaluate the potential for irrigation. Around the same time, cities in the Eastern United States established primitive streamgages for use in designing water-supply systems. Today, the GWSIP supports the collection and (or) delivery of both streamflow and water-level information for more than 8,400 sites and water-level information alone for more than 1,700 additional sites. The data are served online—most in near real-time—and form the basis for decisions related to protection of life and property from hazards, such as floods; cost-effective management of freshwater that is safe and available for drinking, irrigation, energy, industry, recreation, and ecosystem health; and national, State, Tribal, and local economic well-being.

### Federal Priority Streamgage (FPS) Network

The FPS Network (previously known as the National Streamflow Information Program) is a subset of the National Streamgaging Network and was conceived in 1999 to be a core, federally funded network. The original network design identified 4,300 sites that were strategically positioned across the country to address long-term Federal information needs, such as supporting National Weather Service flood forecasts or interstate and international compacts and decrees. Now, that design has expanded to more than 4,700 target locations; however, only about 3,640 FPS are active. These sites are supported through a combination of USGS and partner funding—approximately one-quarter are fully funded by the USGS.

### Additional Monitoring Capabilities for Flood Hazards

The USGS has developed a suite of tools that can be used to temporarily augment the monitoring capacity of the Streamgaging Network during flood response. For example, Rapid Deployment Gages (RDGs) are temporary sensors that provide real-time water-level and meteorological data to communities lacking permanent streamgages, or where temporary stream information is needed. Storm-tide sensors are monitoring devices that observe and document storm-surge, waves and tides as coastal storms make landfall. Instruments like these can be deployed prior to a storm event and then retrieved shortly after. Data is useful for informing



Hydrographer Shawn Spivey installing a rapid deployment gage, in advance of Hurricane Florence, on Currituck Sound in the Outer Banks of North Carolina. Source: USGS.

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forecasts on potential coastal erosion and flooding hazards and helps public officials to assess storm damage, enhance flood forecasting models, and improve long-term planning for future coastal storms.

### **National Groundwater Monitoring Network (NGWMN)**

The NGWMN was designed in 2009 in response to the SECURE Water Act (P.L. 111-11). Authorized as a collaborative groundwater network among intergovernmental agency data providers, the NGWMN provides access to water-level and (or) water-quality data from over 10,500 groundwater wells that are supported by over 30 Federal, State, local, and Tribal agencies. This data is used to support a variety of water management decisions and uses such as providing timely, authoritative information that State drought management teams use to make decisions during droughts; facilitating the development and maintenance of groundwater models that require standardized water level and lithology data across multiple States; and answering questions of groundwater availability at a principal or major-aquifer scale.

As part of its support for the NGWMN, the USGS works cooperatively with agencies to either help them become a new NGWMN data provider or enhance the data that they already provide. The USGS also supports 680 Climate Response Network sites, representing 244 of 366 Climate Divisions in the United States as outlined in P.L. 111-11. These sites are supported by a combination of USGS and partner funding. The primary purpose of these data is to portray the effect of climate on groundwater levels, which is a critical measure of groundwater conditions during drought and provide long-term groundwater levels. All data is made publicly available through the NGWMN portal hosted by USGS.

### **Next Generation Water Observing System (NGWOS)**

In efforts to modernize the Streamgaging Network, the USGS has developed a strategy for implementing a Next Generation Water Observing System (NGWOS). The USGS would establish advanced, intensive monitoring networks in medium-sized watersheds across the United States. Selected watersheds would be representative of the Nation's larger water-resource regions and would be instrumented to monitor water quantity, quality, and use with a mixture of monitoring equipment in the water, ground, and air. When fully implemented, the NGWOS will provide high temporal and spatial resolution data on streamflow, evapotranspiration, snowpack, soil moisture, water quality, groundwater/surface-water connections, stream velocity distribution, sediment transport, and water use. These data could then be coupled with the National Water Model and other modeling tools to lower prediction uncertainty of forecasting models and methods as well as provide flood and drought forecasts; drive emergency- and water-management decision support systems; and address a variety of other water-resource questions in a given region. Further, the NGWOS will provide a foundational dataset as the USGS develops Integrated Water Availability Assessments. Thus far, the USGS has selected three basins for NGWOS implementation (the Delaware River, Headwaters of the Colorado and Gunnison River, and Illinois River Basins).

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## **DATA SYSTEMS**

The National Water Information System (NWIS) is the USGS enterprise system supporting the transmission, storage, processing, and delivery of real-time and historic water data. However, the current version of NWIS is inflexible, suffers from extensive technological debt, and is at increased risk of system failure because of aging infrastructure. As the USGS moves its monitoring networks forward through initiatives like NGWOS, it must ensure that NWIS can efficiently manage the associated new data and data types, integrate water data from multiple agencies and sectors, and continue to deliver data to the public, but in new and more user friendly formats. To this end, the GWSIP is funding activities to modernize NWIS. In addition, the GWSIP is investing in activities to ensure that state-of-the-art tools are used to develop information and data visualizations that meet the decision-making needs of stakeholders.

## **REIMBURSABLE ACTIVITIES**

GWSIP activities are focused on monitoring the quality and quantity of water in the Nation's streams, rivers, and groundwater with local, regional, or State partners. Most of this work is funded through the cooperative matching program to address local priorities and meet goals of national interest. In fact, over three-quarters of GWSIP reimbursable funds are matched by cooperative partners. These activities are primarily focused on monitoring of stream and groundwater conditions for various local water-management decisions, but all contribute to a larger understanding of water-resources conditions on a national scale.

One of the largest reimbursable activities associated with the GWSIP is the California-Bay Delta Monitoring Program. This program supports a dense monitoring network that provides critical data on water-quantity, quality, and use, as well as surface-water hydraulics to help manage the complex Bay-Delta system. The system provides water for more than 22 million people and supports a \$27 billion agricultural industry, which are critical components of California's trillion-dollar economy—the sixth largest in the world.



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## NATIONAL WATER QUALITY PROGRAM

*Water resources are used by people across the Nation for drinking, irrigation, industry, and recreation. Water-quality data and information provides a basis for policies and management strategies to improve and protect these resources.*



Corrosion of pipes and fixtures is a multibillion-dollar infrastructure issue for drinking water across the United States. Such corrosion can also release lead, copper, and other toxic metals into drinking water supplies. USGS studies the water-quality factors that contribute to corrosivity such as alkalinity, pH, and concentrations of chloride. Source: USGS.

To effectively manage the Nation's water resources, decision makers depend on understanding what resources are available for various purposes, and whether the quality of those resources is fit for the intended purpose. The National Water Quality Program (NWQP) supports the data collection, assessments, modeling, and research needed to determine the quality of freshwater resources. Activities are focused on understanding the role that water quality plays in water availability. The long-term data, assessments, and models supported by the program are a critical component to sustaining the viability of industries such as agriculture, fishing, and outdoor recreation, and are used for decisions related to water-supply planning, aquifer storage and recovery, infrastructure design, floodplain and ecosystem management, energy development, and resolution of water disputes.

The National Water Quality Program activities fall under five areas:

- National Water Census
- Water Prediction and Information Delivery (*described with Data Systems on page 19*)
- High Impact Hydrologic Research
- Observing Systems
- Data Systems (*described with Water Prediction and Information Delivery on page 19*)

### NATIONAL WATER CENSUS

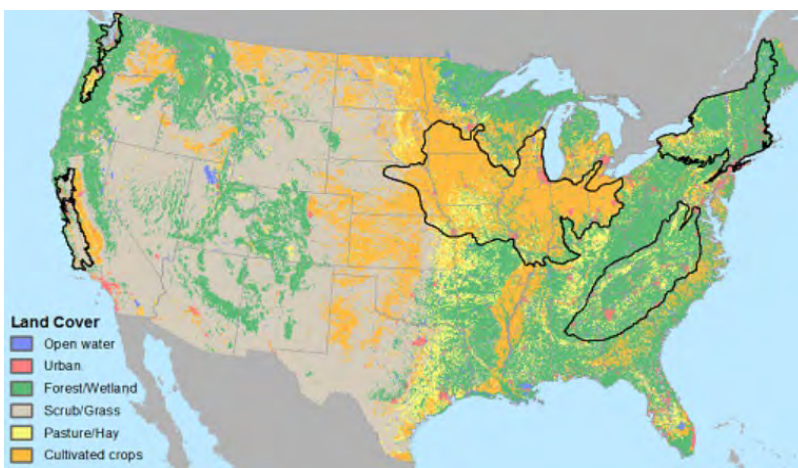
The goal of the USGS National Water Census (NWC) is to provide nationally consistent, well-documented information on water availability that will allow resource managers to assess the quantity, quality, and use of the Nation's water resources. Although this goal is supported by three of the four WMA program, the NWQP supports this goal by investing in efforts to estimate and evaluate the water-quality aspects of water availability. At the foundation of these activities, the NWQP supports work to examine the impact that factors like water use, ecological flows, and drought can have on the quality of water resources. Given the cost of treating water for various uses (for example, public supply, irrigation, and energy development), water-quality is a critical consideration in the availability of water for human and ecological purposes.

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## Integrated Water Availability Assessments (IWAAs)

IWAAs will provide a near real-time census and seasonal prediction of water availability for both human and ecological uses at regional and national extents. As part of this effort, the NWQP is working to analyze trends and develop advanced techniques to account for water quality. At a national scale, efforts are focused on developing water availability indicators related to water quality that will convey periodic snapshots of current conditions and national trends. Water-quality indicators will show water availability based on suitable uses and untreated quality (for example, water may be available, but must be treated before using in an industrial setting yet could be used untreated for mining.).

At regional scales, the NWQP is actively integrating regional assessment and evaluation activities, currently focused on water-quality factors, into Regional IWAAs. These Regional IWAAs are being developed in partnership with stakeholders to ensure they are informative at local and regional levels but can also be assimilated into national-scale products as part of the National IWAA. Regional IWAAs are planned or ongoing in the Delaware River and Upper Colorado River basins.



Regional Stream Quality Assessments conducted in five regions of the United States (outlined in black above). For each, about 100 stream sites were sampled and surveyed. Resulting data were used to assess water quality and ecological conditions within the region and develop a better understanding of the factors that affect those conditions. Assessment capabilities developed through these studies are the types of regional activities being integrated into Regional IWAAs. Source: USGS.

## WATER PREDICTION AND INFORMATION DELIVERY/DATA SYSTEMS

As part of an ambitious Federal partnership, agencies such as the National Oceanic and Atmospheric Administration, Bureau of Reclamation, U.S. Army Corps of Engineers, and USGS are developing a new national, interagency capacity for water prediction. As part of this effort, the USGS is working to advance its water modeling capabilities through an Integrated Water Prediction program that is focused on developing nationally consistent approaches for predicting hydrologic conditions, changes, and outcomes for water availability. These approaches are being designed to consider water quantity, quality, and use together in an integrated water availability model. NWQP funding supports activities to better understand and model the quality aspects of water availability, as well as efforts to incorporate water-quality into larger, integrated models.

At the foundation of the ability to model and deliver information to the public is the need to store, access, and manage large, complex datasets. The National Water Information System (NWIS) is the USGS enterprise system that supports the storage, processing, and delivery of real-time and historical water data. However, the current version of NWIS is inflexible, suffers from extensive

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technological debt, and is at increased risk of system failure because of aging infrastructure. To ensure NWIS can manage new data and data types, integrate water data from multiple agencies and sectors, and continue to deliver data and model results to the public, the NWQP is funding efforts to modernize NWIS. The NWQP is also investing in activities to ensure that state-of-the-art tools are used to develop information products that meet the needs of USGS stakeholders.

## **HIGH IMPACT HYDROLOGIC RESEARCH**

Research is a critical foundation to the effective management of the Nation's water challenges. By better understanding the processes that drive water availability, the USGS can improve the models and tools available for resource management. To this end, the WAUSP and NWQP both support the research that is needed to better understand the water quantity, quality, and use aspects of water availability. The NWQP is working to understand how extreme events (for example, wildfires and subsidence) impact water availability through changes in the quality of water resources that are accessible for use. In addition, the NWQP supports the methods development and research needed to detect and measure constituents in the environment, as well as quantify how fate and transport can impact water-quality. Through these activities, the USGS seeks to better understand the processes that drive the water-quality challenges (for example, harmful algal blooms (HABs), perfluorinated compounds (PFAS), and microplastics) that can impact water availability.

## **OBSERVING SYSTEMS**

The USGS operates a suite of surface water and groundwater networks that provide real-time data on water levels, streamflow, and a variety of water-quality parameters such as dissolved oxygen, pH, and temperature, as well as discrete water-quality data on contaminants. The NWQP primarily supports the networks that provide data on water quality, while also investing in next-generation water observing systems designed to enhance and integrate monitoring for water quantity, quality, and use. This integration is increasingly important as the WMA works to improve the prediction skill of complex hydrologic and water-quality models and ultimately improve water management and stakeholder decision making.

### **National Water Quality Network (NWQN) for Streams and Rivers**

The NWQN is the only nationally designed, long-term monitoring network for tracking the quality of rivers and streams with consistent, comparable methods at all sites. There are currently 110 sites in the NWQN covering important environmental settings (for example, small agricultural and urban watersheds, large inland and coastal rivers, and minimally disturbed reference watersheds). The primary source of data from this network is from discrete sampling at these sites; however, a growing number of sites have sensors that provide continuous, real-time water-quality conditions. Through NGWOS, new sensors and instruments will be developed and implemented to measure more types of contaminants on a continuous basis and be delivered to users in real-time.

Data from this network are used by a variety of stakeholders, including the EPA and States. The following are some current examples of the myriad of uses for these data:

- Assessing if and (or) how long it takes for contaminants to leave the environment once management actions are implemented.

- 
- Fulfilling Congressional standards for the registration of pesticides and seeing if what is being detected in streams corresponds with what manufacturers projected.
  - Modeling nutrients in large rivers and delivery to estuaries like the Gulf of Mexico and Chesapeake Bay.
  - Understanding whether the quality of the Nation's rivers is changing in response to climate, land-use changes, or management practices.

### **National Groundwater Quality Monitoring Networks**

The USGS supports an enterprise of approximately 80 long-term groundwater-quality monitoring networks across the Nation to track the water quality in principal aquifers, the primary source of the Nation's groundwater used for drinking. Concentrations of constituents, such as arsenic, nitrate, metals, pesticides, and volatile organic compounds, are compared to benchmarks established for the protection of human health. Users can access an online tool to see how concentrations of these constituents in groundwater are changing during decadal periods across the Nation and see in real-time how chemical properties of groundwater at some sites are fluctuating.

These networks provide the data needed by water managers such as the EPA and State environmental and human health agencies to evaluate trends in groundwater-quality beneath urban and agricultural lands and in domestic and public-supply wells, as well as implement necessary policies and guidance to protect human health. Currently, groundwater-quality samples for these contaminants are collected at various intervals, from monthly to as long as 10 or more years, which can miss pulses of contaminants that move through aquifers. Emerging NGWOS sensor technologies may allow for continuous, real-time measurements of groundwater-quality and provide more safeguards for human health.

### **National Atmospheric Deposition Program (NADP)**

The USGS monitors wet atmospheric deposition (chemical constituents deposited by snow, sleet, or rain) in the United States through the interagency NADP. The USGS supports sites in the National Trends, Mercury Deposition, and Mercury Litterfall networks, which provide long-term, high-quality data to support decisions in areas such as water quality, agricultural effects, and watershed studies.

### **REIMBURSABLE ACTIVITIES**

NWQP activities are focused on monitoring, assessing, and modeling the quality of the Nation's water resources. Most of this work is funded through the cooperative matching program to address local priorities and meet goals of national interest. In fact, about 80 percent of NWQP reimbursable funds are matched by cooperative partners. Although water quality data collection tends to be pervasive across the United States, specific topics of interest include sediment in the Northwest and Midwest, dissolved solids in the Southwest, nutrients in the Ohio River valley, and models and trends work in the eastern United States.

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## **WATER RESOURCES RESEARCH ACT PROGRAM**

*The WRRR Program provides an institutional mechanism for promoting State, regional, and national coordination of water resources research, information, and technology transfer; and promotes student education and training.*

The Water Resources Research Act, authorized by section 104 of the Water Resources Research Act (WRRR) of 1984, is a Federal-State partnership that plans, facilitates, and coordinates water resources research, education, and information transfer through a matching grant program. The WRRR authorized the establishment of State Water Resources Research Institutes (National Institutes for Water Resources; NIWR) at land grant universities across the Nation.

There are currently 54 institutes: one in each State, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam. The institute in Guam serves the Federated States of Micronesia and the Commonwealth of the Northern Mariana Islands.

### **ANNUAL BASE GRANTS**

Under the provisions of section 104 of the Water Resources Research Act of 1984, annual base grants (104b) are awarded to the institutes or centers that have been established in each of the 50 States, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam. Annual base grants are required to have a 2:1 match by the institute and are used to fund projects that are selected at the institute level through a competitive selection process that is run by each institute within their respective States. The annual base grants help each institute or center to plan and conduct applied and peer-reviewed research on water resource issues that address State needs.

Institutes also use their base grants to help train new scientists, disseminate research results to water managers and the public, and to cooperate with other colleges and universities in their respective States and with other institutes and other organizations in their regions to promote regional coordination. Through research projects, the WRRR program directly supports about 250 student undergraduate and graduate students each year.

### **NATIONAL COMPETITIVE GRANTS**

The WRRR program, in cooperation with the institutes, supports an annual call for proposals to focus on water problems and issues that are of a regional or interstate importance, or relate to a specific priority identified by the Department of the Interior and the institutes. Through these grants, the WRRR program seeks to promote research collaboration between the USGS and university scientists on significant national and regional water resources issues, promote the dissemination and results of this research, and to assist in training scientists in water resources.

Funding for this program is \$1.5 million in Federal funds per year that are required to be matched with non-Federal dollars. Any investigator at an accredited institution of higher learning in the United States is eligible to apply for a grant through an institute or center established under the provisions of the Water Resources Research Act of 1984. Successful research topics have included improving and enhancing the Nation's water supply, developing innovative approaches to water

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treatment, evaluation of the dynamics of extreme hydrological events and associated costs, development of methods for better estimation of the physical and economic supply of water, developing approaches for integrated management of ground and surface waters, and the evaluation and assessment of conservation practices.

### **COORDINATION GRANTS**

These grants allow other Federal agencies, including those within the Department of the Interior, to use and take advantage of the expertise and capabilities that are available through the network of institutes. The USGS may accept funds from other Federal agencies for the purposes of establishing a grant with an institute to conduct hydrologic research with Federal programs concerned with water resources problems and issues. The USGS fully supports and encourages other Federal programs concerned with water resources problems and issues to develop grants with the Water Resources Institutes in cooperation with the USGS.

### **STUDENT INTERNSHIPS**

The NIWR-USGS student internship program provides undergraduate and graduate students with career enhancing field, laboratory, and research experience through participation in USGS activities as interns. The program is a collaborative effort between the WRRRA program and NIWR. On a need basis, the USGS, through our science centers, will fund interns hired by the institute. Interns are employees of participating universities and colleges and may be a student from any college or university in the institute's State. Information about the availability of the Internship program in a State may be obtained by contacting the USGS representative or Institute Director in the State.

### **REIMBURSABLE ACTIVITIES**

This program does not currently do reimbursable work with partners.

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## WATER CENTERS WITHIN THE INTERIOR UNIFIED REGIONS

The following is a summary of the USGS science centers that receive major funding from the Water Resources Mission Area and their locations within Interior's Unified Regions. *A brief overview of each center is provided on pages 130-136.*

### National Centers

1. Hydrologic Instrumentation Facility, Stennis Space Center, MS
2. National Water Quality Laboratory, Lakewood, CO
3. Water Mission Area Headquarters, Lakewood, CO; Reston, VA; Menlo Park, CA

### Region 1 – North Atlantic Appalachian (*USGS Northeast Region*)

4. Maryland-DC-Delaware Water Science Center, Catonsville, MD; Dover, DE
5. New England Water Science Center, Augusta, ME; East Hartford, CT; Northborough, MA (services Rhode Island as well); Pembroke, NH (services Vermont as well)
6. New Jersey Water Science Center, Lawrenceville, NJ
7. New York Water Science Center, Troy, NY
8. Ohio-Kentucky-Indiana Water Science Center, Louisville, KY
9. Pennsylvania Water Science Center, New Cumberland, PA
10. Virginia-West Virginia Water Science Center, Richmond, VA; Kearneysville, WV

### Region 2 – South Atlantic-Gulf (*USGS Southeast Region*)

11. Caribbean-Florida Water Science Center, Guaynabo, PR; Lutz, FL
12. South Atlantic Water Science Center, Norcross, GA; Raleigh, NC; Columbia, SC
13. Lower Mississippi Gulf Water Science Center, Montgomery, AL; Nashville, TN

### Region 3 – Great Lakes (*USGS Midcontinent Region*)

14. Central Midwest Water Science Center, Urbana, IL
15. Ohio-Kentucky-Indiana Water Science Center, Indianapolis, IN; Columbus, OH
16. Upper Midwest Water Science Center, Lansing, MI; Mounds View, MN; Middleton, WI

### Region 4 – Mississippi-Basin (*USGS Southeast Region*)

17. Central Midwest Water Science Center, Iowa City, IA; Rolla, MO
18. Lower Mississippi Gulf Water Science Center, Little Rock, AR; Baton Rouge, LA; Jackson, MS

### Region 5 – Missouri-Basin (*USGS Midcontinent Region*)

19. Kansas Water Science Center, Lawrence, KS
20. Dakota Water Science Center, Bismarck, ND; Rapid City, SD
21. Nebraska Water Science Center, Lincoln, NE
22. Wyoming-Montana Water Science Center, Helena, MT

### Region 6 – Arkansas-Rio Grande-Texas Gulf (*USGS Southeast Region*)

23. Texas-Oklahoma Water Science Center, Oklahoma City, OK; Fort Worth, TX

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**Region 7 – Upper Colorado-Basin** (*USGS Rocky Mountain Region*)

24. Colorado Water Science Center, Denver, CO
25. New Mexico Water Science Center, Albuquerque, NM
26. Utah Water Science Center, Salt Lake City, UT
27. Wyoming-Montana Water Science Center, Cheyenne, WY

**Region 8 – Lower Colorado-Basin** (*USGS Southwest Region*)

28. Arizona Water Science Center, Tucson, AZ
29. California Water Science Center, San Diego, CA

**Region 9 – Columbia-Pacific Northwest** (*USGS Northwest-Pacific Islands Region*)

30. Idaho Water Science Center, Boise, ID
31. Oregon Water Science Center, Portland, OR
32. Washington Water Science Center, Tacoma, WA

**Region 10 – California-Great Basin** (*USGS Southwest Region*)

33. California Water Science Center, Sacramento, CA
34. Nevada Water Science Center, Carson City, NV

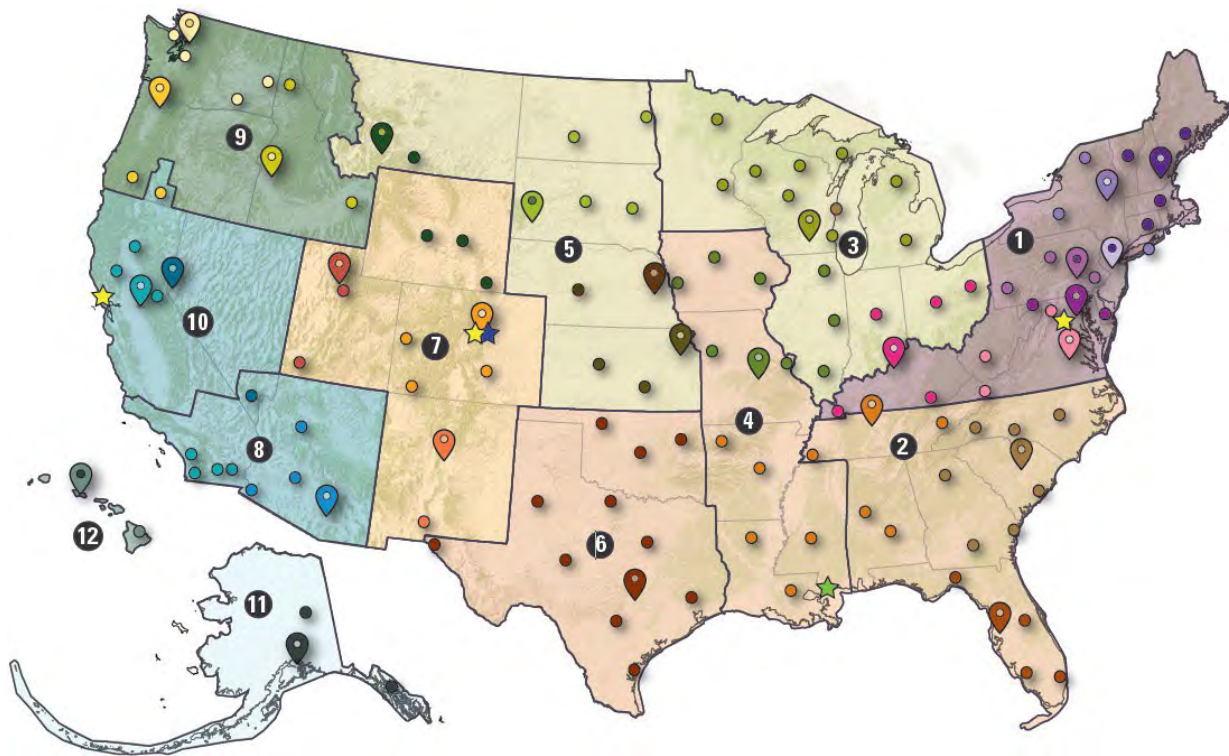
**Region 11 – Alaska** (*USGS Alaska Region*)

35. Alaska Science Center, Anchorage, AK

**Region 12 – Pacific Islands** (*USGS Northwest-Pacific Islands Region*)

36. Pacific Islands Water Science Center, Honolulu, HI





### Water Science Centers

- Maryland-Delaware-D.C. Water Science Center  
● Office
- New England Water Science Center  
● Office
- New Jersey Water Science Center
- New York Water Science Center  
● Office
- Pennsylvania Water Science Center  
● Office
- Virginia and West Virginia Water Science Center  
● Office

- Colorado Water Science Center  
● Office
- New Mexico Water Science Center  
● Office
- Utah Water Science Center  
● Office

#### National Centers

- National Water Quality Laboratory
- Hydrologic Instrumentation Facility
- Water Mission Area Headquarters

*\*USGS Water Science Centers usually have several locations throughout the State. These offices are geographically located in the State to respond to hydrologic events and liaison with cooperating agencies and organizations.*

- Caribbean-Florida Water Science Center  
● Office (Puerto Rico not shown)
- Central Midwest Water Science Center  
● Office
- Lower Mississippi-Gulf Water Science Center  
● Office
- Oklahoma-Texas Water Science Center  
● Office
- South Atlantic Water Science Center  
● Office

- Arizona Water Science Center  
● Office
- California Water Science Center  
● Office
- Nevada Water Science Center  
● Office

- Alaska Science Center  
● Office

- Dakota Water Science Center  
● Office
- Kansas Water Science Center  
● Office
- Nebraska Water Science Center  
● Office
- Ohio-Kentucky-Indiana Water Science Center  
● Office
- Upper Midwest Water Science Center  
● Office
- Wyoming-Montana Water Science Center  
● Office

- Idaho Water Science Center  
● Office
- Oregon Water Science Center  
● Office
- Pacific Islands Water Science Center  
● Office
- Washington Water Science Center  
● Office

### DOI Unified Regions

- 1 North Atlantic-Appalachian
- 2 South Atlantic-Gulf
- 3 Great Lakes
- 4 Mississippi Basin
- 5 Missouri Basin
- 6 Arkansas-Rio Grande-Texas Gulf
- 7 Upper Colorado Basin
- 8 Lower Colorado Basin
- 9 Columbia-Pacific Northwest
- 10 California-Great Basin
- 11 Alaska
- 12 Pacific Islands

### USGS Regions

- Northwest - Pacific Islands
- Southwest
- Alaska
- Rocky Mountain
- Midcontinent
- Southeast
- Northeast

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### **Alaska Science Center (ASC)**

The ASC conducts research and monitoring on a wide variety of hydrological issues affecting streams, rivers, lakes, and groundwater in Alaska. Topics include catchment hydrology, transboundary water quality, streamflow statistics, impacts of glaciers, and streambed scour at bridges. The center strives to meet the changing needs of those who use its information, from the distribution, availability, and quality of water resources to topic-oriented research that addresses current hydrological issues. The center has locations in Anchorage, Fairbanks, and Juneau.

### **Arizona Water Science Center (AZWSC)**

The AZWSC collects, interprets, and provides high quality, impartial scientific information to resource managers and the public so they can manage the critical water resources of Arizona and the Southwest. Headquartered in Tucson on the University of Arizona campus, the center is composed of about 75 hydrologic experts and support staff who are committed to the highest professional standards for collection and dissemination of data, resource-assessment studies, and related research. The center also has three additional offices in Tempe, Flagstaff, and Yuma. Much of the science is planned and completed in cooperation with a wide variety of other Federal, State, and local agencies, universities, nongovernmental organizations, and companies to address their specific needs for hydrologic data and interpretations.

### **California Water Science Center (CAWSC)**

The CAWSC works in partnership with more than 140 State, local, and Federal agencies to provide foundational hydrologic data and scientific analyses to address California's complex water challenges. With a dedicated staff of more than 300 scientists, technicians, and support personnel, the center collects data and conducts studies on a wide range of hydrologic issues throughout the State, including water-supply and availability, water quality, sustainable groundwater management, droughts and floods, the Bay-Delta, and watershed management. In addition to the main office in San Diego, the center has locations in Sacramento, Truckee, Redding, Eureka, Ukiah, Santa Cruz, Santa Maria, Poway, and Redlands. The center also operates a research drilling program headquartered in Las Vegas.

### **Caribbean-Florida Water Science Center (CFWSC)**

The CFWSC focuses on the water resources of Florida, Puerto Rico, and the U.S. Virgin Islands, and cooperates with local, State/commonwealth, county, or municipal partners to address challenges relevant to society. The center's data networks monitor water levels and flow, water quality, precipitation, evapotranspiration, and water use. The center also conducts interpretive studies that examine hydrogeologic characterization, flow and transport, flood and drought frequency, water use, evapotranspiration, reservoir storage, regional water quality, and environmental disposal of treated wastewater. The center has locations in Davie, Fort Myers, Lutz, Orlando, and Tallahassee in Florida, and San Juan in Puerto Rico.

### **Central Midwest Water Science Center (CMWSC)**

The CMWSC investigates the occurrence, distribution, quantity, movement, and quality of the water resources in Illinois, Iowa, and Missouri. Specific activities include maintenance and analysis of long-term data for streams, reservoirs, estuaries, and groundwater, as well as short-term studies of local, State, regional, and national water-resource issues. Such investigations include the study of urbanization and flooding, water quality, sedimentation of rivers and lakes, and hazardous waste contamination. The center has three locations in Missouri (Rolla, Olivette, Lee's Summit), three locations in Illinois (Urbana, DeKalb, Mt. Vernon), and three locations in Iowa (Iowa City, Council Bluffs, Fort Dodge).

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### **Colorado Water Science Center (COWSC)**

The COWSC conducts water-resources activities throughout Colorado in partnership with many other organizations. These activities include the operation of statewide data-collection networks for streamflow, water quality, and groundwater levels, as well as studies that investigate surface water, groundwater, sediment, and alpine hydrology issues. Results are documented in reports and as information served on the Internet. The center is headquartered in Denver but has three additional locations in Pueblo, Grand Junction, and Durango.

### **Dakota Water Science Center (DWSC)**

The DWSC mission is to collect high-quality hydrologic data and conduct objective scientific investigations on the quantity, quality, and use of surface-water and groundwater resources of the Dakotas. The center maintains a network of more than 270 hydrologic data-collection sites across the Dakotas and compiles the data collected from these sites for public use. In addition, the center conducts studies of the water resources of North and South Dakota. These studies focus on providing timely and objective hydrologic information to Federal, Tribal, State, and local agencies regarding water-supply availability, water quality, water-source identification, and water-resource management. The DWSC works cooperatively with many tribes in the Dakotas to assist them as they manage their water resources. The center has three locations in South Dakota (Rapid City, Huron, and Pierre) and two in North Dakota (Bismarck and Grand Forks).

### **Hydrologic Instrumentation Facility (HIF)**

The HIF supports water-resource monitoring by providing quality-assured hydrologic equipment and instrumentation support to the USGS and other Federal agencies. The instruments and equipment provided by the HIF are used by Federal agencies to monitor water quality, river levels, river flow, and groundwater, and to provide the water data for the Nation. The HIF provides training, repairs, calibrations, and testing services for instruments and equipment to the USGS and other Federal agencies through the instrument warehouse and laboratories. The HIF includes a warehouse, testing laboratories, and a hydraulic laboratory with large calibration tow tanks and tilting flume. The Hydraulic Laboratory is available to USGS, other Federal agencies, State and local agencies, academic partners, and private industry.

### **Idaho Water Science Center (IDWSC)**

The IDWSC conducts research and monitoring on a variety of hydrological issues affecting streams, rivers, lakes, reservoirs, and groundwater in Idaho, neighboring States, and across the Nation. The center maintains a statewide network of more than 200 real-time streamgages, 400 active groundwater sites, and 30 real-time water-quality sites. The IDWSC also conducts studies that span surface water, groundwater, water-quality, and water availability topics and support the water resource management needs of communities and partners throughout Idaho. The IDWSC has three locations—Boise, Post Falls, and Idaho Falls—and also hosts the [Idaho National Laboratory](#), with the responsibility to monitor and study the water resources of the eastern Snake River Plain in partnership with the U.S. Department of Energy.

### **Kansas Water Science Center (KSWSC)**

Information about water is fundamental to the economic well-being, protection of life and property, and effective management of Kansas and the Nation's water resources. The KSWSC partners with more than 40 Federal, State, and local agencies to monitor, assess, and conduct unbiased research on a wide range of water resources and conditions. The KSWSC collects streamflow and gage-height data; reservoir levels; water-quality, suspended sediment, and water-quantity data; as well as groundwater level data. Hydrologic

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studies are conducted on national, regional, statewide, and local levels. The center has locations in Lawrence, Wichita, and Hays. The center also hosts the [Organic Geochemistry Research Laboratory](#).

### **Lower Mississippi-Gulf Water Science Center (LMG)**

The LMG collects, investigates, and interprets hydrologic data across Alabama, Arkansas, Louisiana, Mississippi, and Tennessee. This data is available to the public as well as cooperators and is used to provide science that can be used by a broad range of industries and other services. Combining services for five States has given the center a unique opportunity to reach across State boundaries and work together as one united entity. The LMG has 11 locations across the region: 2 in Alabama (Montgomery, Tuscaloosa), 2 in Arkansas (Fayetteville, Little Rock), 3 in Louisiana (Baton Rouge, Fort Polk South, Ruston), 1 in Mississippi (Jackson), and 3 in Tennessee (Knoxville, Memphis, Nashville).

### **Maryland-DC-Delaware Water Science Center (ME-DC-DE WSC)**

The MD-DC-DE WSC collects streamflow, groundwater levels, water-quality, and water-use data at numerous locations throughout the area in cooperation with other Federal, State, and local agencies, universities, and research centers. In addition, the center conducts hydrologic projects that address a wide variety of water-resources issues, including water supply, groundwater contamination, nutrient loading in streams, effects of land use on water quality, and basic hydrologic data collection. Of note is the center's contributions to an overarching USGS Chesapeake Bay Science Strategy, designed to guide USGS science activities in the watershed as it works to address the Chesapeake Bay Watershed Agreement (2014–2025) and support the Department of the Interior's Bay restoration efforts. The center has a main office in Baltimore at Research Park near the University of Maryland, Baltimore County campus and two offices in Delaware (Dover and Frostburg).

### **National Centers (WMA HQ)**

There are three locations across the country that serve as national centers for WMA headquarters operations. The WMA is organized into three primary offices: Office of the Associate Director, Office of Planning and Programming, and the Office of the Chief Operating Officer. These offices align WMA units around the core science functions needed to achieve the vision for water science and provide national coordination and management for the programs of the WMA, as well as technical support for Water Science Centers. The national centers are in Menlo Park, CA; Lakewood, CO (Denver Federal Center); and Reston, VA.

### **National Water Quality Laboratory (NWQL)**

The NWQL is a world-class environmental analysis and research laboratory offering a wide range of analytical services, including inorganic, organic, and radiochemical constituents, which provide high-quality, reproducible data. The laboratory specializes in trace- and ultratrace-level chemical analyses of water, sediment, and tissue, and the taxonomic identification and quantitation of benthic invertebrates. Many of the chemical analysis methods are developed specifically for the scientific investigations of the USGS and are not available elsewhere. The NWQL is on the Denver Federal Center in Lakewood, CO.

### **Nebraska Water Science Center (NEWSC)**

The NEWSC leads, innovates, and excels in hydrologic monitoring, investigations, research, and data delivery for Nebraska. Its monitoring efforts include the operation of almost 100 groundwater wells, 130 real-time streamgages, 17 real-time water-quality sites, and 74 precipitation gages across the State. In addition, the NEWSC conducts studies of Nebraska's water challenges to support the informational needs

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of decisionmakers. Study topics include harmful algal blooms in Willow Creek Reservoir, groundwater availability in the High Plains Aquifer, groundwater/surface water connections in the Loup River Basin, and sediment management strategies in the Lewis and Clark Reservoir. Headquartered in Lincoln, the NEWSC also has a location in North Platte.

### **New England Water Science Center**

The New England WSC mission is to collect and deliver timely and reliable information on the water resources of our six-State region (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont). Throughout the region, the WSC monitors streamflow at more than 440 locations and groundwater at nearly 300 wells. It is also installing more than 200 sites along the coast to monitor storm surges. In addition, the WSC partners with more than 100 Federal, State, Tribal, and local agencies in hydrologic studies that advance human health, public safety, and environmental sustainability goals across the region. Serving the needs of all six States, the WSC has four locations—Augusta, Maine; East Hartford, Conn.; Northborough, Mass. (services Rhode Island as well); and Pembroke, N.H. (also serves Vermont).

### **New Jersey Water Science Center (NJWSC)**

Since 1903, the NJWSC has been collecting high-quality hydrologic data and conducting unbiased water-science research to support the water-resource priorities of the Nation and statewide water-resource infrastructure and management needs. The relevant, emerging issues that currently are deemed most in need of NJWSC support, form four broad program areas: watershed and water-supply management, real-time hydrologic hazards, water-quality vulnerability analysis, and hazardous-waste site characterization and remediation research. Work in these program areas defines what the center does on a daily basis—collection of water data, analysis of hydrologic processes through research, and publication of hydrologic information.

### **New Mexico Water Science Center (NMWSC)**

The NMWSC collects, analyzes, and distributes the impartial hydrologic data and information needed to wisely manage water resources for the people of the United States and the State of New Mexico. To do this, the center operates local and statewide networks to monitor streamflow, water levels, and water-quality conditions. In addition, the NMWSC conducts studies, develops models, and uses state-of-the-art analytical techniques to help cooperating agencies solve water problems. Examples of how NMWSC information has been used include managing storm-water runoff, developing groundwater management plans, and identifying areas of water-quality degradation across the State. The center carries out its mission from its headquarters in Albuquerque as well as two field offices in Las Cruces and Roswell.

### **New York Water Science Center (NYWSC)**

The NYWSC leads the scientific and water-resources management communities by providing high-quality, timely, and unbiased scientific data, reports, and other information that benefit the science interests of all levels of government, academia, the private sector, and the public. In fact, the center is the first choice of many stakeholders as a source for environmental and water-science information in the State. Through eight science themes—groundwater and streamflow information, water use and availability, water quality, coastal science, ecosystem health, geospatial applications, laboratory analysis, and geophysics—the NYWSC helps decision makers in the State manage New York’s water resources. The NYWSC operates from four locations: Troy, Potsdam, Coram, and Ithaca.

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### **Nevada Water Science Center (NVWSC)**

The NVWSC provides decision makers with information needed to understand and make decisions about the State of Nevada's water resources. The center accomplishes this through maintaining a network of hydrologic data-collection sites that monitor stage and discharge of principal rivers and streams; water quality; and water levels in selected aquifers. In addition, the NVWSC conducts investigations and assessments of the water resources of Nevada with emphasis on providing information to Federal, State, Tribal, and local agencies related to water-supply availability, water quality, water-source identification, and water-resource management. The center has two locations in the State: Carson City and Henderson.

### **Ohio-Kentucky-Indiana Water Science Center (OKI WSC)**

The OKI WSC provides information for the management, assessment, and vulnerability analyses of water supply, water quality, flood hazard, drought, and watershed issues across Ohio, Kentucky, and Indiana. Center activities include maintenance and analysis of long-term data for streams, reservoirs, and groundwater, as well as interpretative studies of water-resource issues such as groundwater contamination, availability, and protection; contamination and transport in water; and analysis of floods and flood potential. The center operates from three locations in Kentucky (Louisville, Murray, and Williamsburg.), two locations in Ohio (Columbus and New Philadelphia), and one location in Indiana (Indianapolis).

### **Oklahoma-Texas Water Science Center (OK-TX WSC)**

The OK-TX WSC works in cooperation with approximately 100 municipalities, river authorities, groundwater districts, and State and Federal agencies in Texas and Oklahoma to provide reliable, impartial scientific information to resource managers, planners, and other customers. This information is gathered by the center to minimize the loss of life and property from natural disasters; to contribute to the conservation and sound economic and physical development of the Nation's natural resources; and to enhance the quality of life by monitoring water, biological, energy, and mineral resources. The OK-TX WSC has three locations in Oklahoma (Oklahoma City, Tulsa, and Woodward) and nine locations in Texas (Austin, Corpus Christi, El Paso, Conroe/Houston, Lubbock, Fort Worth, San Angelo, San Antonio, and Wichita Falls).

### **Oregon Water Science Center (ORWSC)**

The ORWSC is a multifaceted science organization that collects, analyzes, and distributes water information for Oregon and the Northwest Region. Since 1904, ORWSC scientists have been addressing hydrology issues important to people and communities in Oregon and beyond, including water use and availability, water quality, and water hazards such as flooding, landslides, and contaminants. Today, the center works closely with partners—Tribes, Federal and State agencies, municipalities, universities, and others—to provide data through a statewide network of more than 200 water monitoring stations, peer-reviewed scientific information, and applied research tools for natural resource management. The ORWSC is headquartered in Portland, but also has two field locations in Medford and Klamath Falls.

### **Pacific Islands Water Science Center (PIWSC)**

Located in Honolulu, the PIWSC conducts hydrologic monitoring and investigative studies on a variety of issues affecting the water resources of Hawaii and the U.S.-affiliated Pacific Islands. Center science is focused on four primary areas: hydrologic monitoring, groundwater availability, quantity and variability of streamflow, and water quality related to land use. This work is conducted in partnership with Federal, State, and local agencies to ensure that information assists these agencies in managing water resources.

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### **Pennsylvania Water Science Center (PAWSC)**

The PAWSC roots date back to the late 1800s, with the initiation of streamflow gaging on the Delaware and Susquehanna Rivers. Today, the center provides real-time water monitoring data from more than 350 streamgages, 74 groundwater wells, 135 water-quality stations, and 92 precipitation stations across the State. In addition, the PAWSC works in cooperation with numerous Federal, State, and local agencies to collect data and conduct studies on the source, quantity, quality, ecology, and use of Pennsylvania's water resources, the results of which affect every citizen in some way, every day. The PAWSC main office is in New Cumberland, with other offices in Downingtown (Philadelphia), Pittsburgh, and Williamsport.

### **South Atlantic Water Science Center (SAWSC)**

The SAWSC collects high-quality hydrologic data and conducts unbiased, scientifically sound research on the water resources of Georgia, North Carolina, and South Carolina. In addition to a network of more than 800 streamgages, 100 groundwater wells, and 220 water-quality monitoring sites, the center conducts studies on the distribution, availability, and quality of water resources to address hydrological issues. These studies cover six primary themes: groundwater and streamflow monitoring; floods, droughts, and hurricanes; water quality; water availability and use; coastal science; and advanced capabilities and research. The SAWSC has eight locations—three in Georgia (Norcross, Savannah, and Tifton), three in North Carolina (Charlotte, Raleigh, and Asheville), and two in South Carolina (Columbia and Charleston).

### **Upper Midwest Water Science Center (UMid WSC)**

The UMid WSC is committed to providing accurate and timely information about the water resources of Minnesota, Michigan, and Wisconsin. To do this, the center collaborates with a variety of Federal, State, and local agencies, universities, and research centers to collect, analyze, and interpret water data. In addition, the UMid WSC provides unique capabilities to the USGS and partners, including the [Mercury Research Lab](#); the [Michigan Bacterial Research Lab](#); the [TC Chamberlin Modeling Center](#); and the [Web Informatics and Mapping \(WIM\) group](#). The center has 11 locations across the 3 States: 2 in Minnesota (Mounds View and Grand Rapids), 3 in Michigan (Lansing, Grayling, and Gladstone), and 6 in Wisconsin (Green Bay, Marshfield, Middleton, Milwaukee, Rhinelander, and Rice Lake).

### **Utah Water Science Center (UTWSC)**

The UTWSC has been serving the needs of Utah water resources managers since 1913. Today, the center offers real-time discharge at more than 150 gages statewide, monitors water levels across a statewide network annually, and engages in many relevant and unbiased scientific studies and modeling efforts. UTWSC data collection and studies fall into at least one of three basic themes (surface water, groundwater, or water quality) as well as several geographic themes (for example, the Great Salt Lake, the Great Basin of western Utah, and the Colorado River Basin of eastern and southern Utah). The center has four locations throughout the State: West Valley City, Cedar City, Moab, and Salt Lake City.

### **Virginia-West Virginia Water Science Center (VA-WV WSC)**

The VA-WV WSC monitors, studies, and analyzes the nature of streams, rivers, lakes, springs, groundwater, and landscapes in Virginia and West Virginia. In cooperation with State, local, and Federal agencies, the center operates streamgages, observation wells, and water-quality monitoring stations to ensure reliable scientific information is available to make informed management decisions. In addition, the VA-WV WSC investigates specific water-resource problems related to water availability, water quality,

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floods and droughts, climate change, and ecosystems. To do this, the center operates from four locations: two in Virginia (Richmond and Marion) and two in West Virginia (Charleston and Leetown).

### **Washington Water Science Center (WAWSC)**



The WAWSC mission is to collect, analyze, and disseminate the impartial hydrologic data and information needed to manage water resources for the United States and State of Washington. To do this, the center operates the most extensive satellite network of stream-gaging stations in the State, many of which form the backbone of flood-warning systems. In addition, the WAWSC conducts studies to help cooperating agencies solve water problems. For example, investigative results have been used to manage storm-water runoff, to develop ground-water management plans, and to identify areas of water-quality degradation. The center operates from four locations throughout the State: Tacoma, Kennewick, Ferndale, and Spokane.

### **Wyoming-Montana Water Science Center (WY-MT WSC)**






The WY-MT WSC uses state-of-the-art techniques for data collection and interpretation and partners with Federal, State, and local agencies to provide impartial scientific analyses of water in Wyoming and Montana. The center collects streamflow, water-quality, and groundwater level data at more than 300 sites across both States. These data are used by a variety of public and private entities for applications ranging from flood forecasting to infrastructure planning to groundwater assessments. In addition, Center investigations with cooperating agencies provide information used to develop water management plans. Studies cover a range of issues such as floods and drought, geospatial analyses to understand hydrologic systems, sediment, streamflow and groundwater availability, water quality, and water use. The WY-MT WSC operates from three locations in Wyoming (Casper, Cheyenne, and Riverton) and two locations in Montana (Billings and Helena).



## SOCIAL MEDIA PRESENCE

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## LEGAL AUTHORITIES FOR MISSION AREA ACTIVITIES

### **43 U.S.C. 31 | The Organic Act of March 3, 1879**

An act that established the Geological Survey, as amended (1962), and restated in annual appropriation acts. This section provides, among others, that the Geological Survey is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Interior Department. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285 Sec. 10(a) establishes United States Geological Survey as its official name.

### **44 42 U.S.C 50 et seq. Each year, the U.S. Geological Survey’s appropriations bill**

states that “The share of the Geological Survey in any topographic mapping or water resources investigations carried on in cooperation with any State or municipality shall not exceed 50 per centum of the cost thereof.” This is the statute that limits how cooperative agreements with State and local entities for water-resources work must be funded.

### **45 43 U.S.C. 36(b) | The Act of December 24, 1942 (as amended by P.L. 86-406)**

Provides that “The Secretary of the Interior may, on behalf of the United States and for the use by the Geological Survey in gaging streams and underground water resources, acquire lands by donation or when funds have been appropriated by Congress by purchase or condemnation” 36(c) Acceptance of contributions from public and private sources; cooperation with other agencies in prosecution of projects.

### **46 43 U.S.C. 36(c) | P.L. 99-500 (as amended by P.L. 500-591)**

States that “In fiscal year 1987 and thereafter the United States Geological Survey is authorized to accept lands, buildings, equipment, and other contributions from public and private sources and to prosecute projects in cooperation with other agencies, Federal, State, or private.” This language supports administrative provisions language in each year’s appropriations bill related to the “acquisition of lands for gauging stations and observation wells.”

### **47 42 U.S.C. 10367, 10368 | The Omnibus Public Land Management Act of 2009 (SECURE Water; P.L. 111-11).**

Title IX, Subtitle F, Sec. 9507 and 9508 authorizes the completion of a national brackish groundwater assessment; implementation of the national water availability and use assessment program, and a grant program to collect and improve State water use data; implementation of the national streamflow information program (more than 4,700 Federal priority streamgages); and development of a systematic groundwater monitoring program for each major aquifer system (the National Groundwater Monitoring Network). Title XI, Sec. 11002 directs the USGS to conduct a study of water resources in New Mexico, specifically including the Estancia Basin, Salt Basin, Tularosa Basin, Hueco Basin, and middle Rio Grande Basin.

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**48 42 U.S.C. 10301 et seq. | The Water Resources Research Act of 1984**

Provides for water resources research, information transfer, and student training in grants and contract programs that will assist the Nation and the States in augmenting their science and technology to discover practical solutions to water shortage and quality deterioration problems. This legislation also establishes a Federal-State partnership in water resources research, education, and information transfer through a matching grant program that authorizes State Water Resources Research Institutes at land grant universities across the Nation. This authorization expired in 2011.

**49 33 U.S.C. 4001 et seq. | The Harmful Algal Blooms and Hypoxia Research and Control Act of 1998 (P.L. 105-383; as amended by P.L. 113-124 and 115-423)**

Names DOI as one of the Inter-agency Task Force members; members are directed to “support the implementation of the Action Strategy, including the coordination and integration of the research of all Federal programs.”

**50 42 U.S.C. 1962 | The United States-Mexico Transboundary Aquifer Assessment Act (P.L. 109-448)**

Directs DOI to consult and cooperate with “Participating States [Texas, New Mexico, and Arizona], the water resources research institutes, Sandia National Laboratories, and other appropriate entities in the United States and Mexico, and the IBWC, as appropriate, [to] carry out the United States-Mexico transboundary aquifer assessment program to characterize, map, and model priority transboundary aquifers along the United States-Mexico border.” Those priority aquifers were identified in the language as the Huevo Bolson, Mesilla, Santa Cruz, and San Pedro. This authorization expired in 2016, but the USGS continues to receive appropriations for this work.

**51 42 U.S.C. 10301 | Title III, Sec. 306 of the Water Resources Development Act of 1986**

Authorizes and directs the USGS, in cooperation with the States of the High Plains region, to monitor the levels of the Ogallala aquifer and report biennially to Congress.

**52 33 U.S.C. 1271 | The Water Resources Development Act of 1992**

Establishes a National Contaminated Sediment Task Force, with USGS as a member, to conduct a comprehensive national survey of aquatic sediment quality.

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## SOURCES FOR FAST FACTS

- Fact: There are 27 Water Science Centers with locations in all 50 States.  
*Source:* <https://www.usgs.gov/mission-areas/water-resources/about/water-resources-mission-area-science-centers-and-regions>
- Fact: USGS operates more than 10,000 streamgages as part of the National Streamgaging Network.  
*Source:* <https://pubs.er.usgs.gov/publication/fs20183081>
- Facts: Most are funded with one or more of about 1,600 Federal, State, local, and Tribal partners. Almost 8,400 measure real-time streamflow as part of the National Streamflow Network. More than 3,600 are Federal Priority Streamgages, which meet specific, long-term Federal needs.  
*Source:*  
<https://prd-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/atoms/files/fy2021-usgs-budget-justification.pdf>
- Fact: Groundwater accounts for almost 40 percent of the water withdrawn for public supply.  
*Source:* <https://pubs.er.usgs.gov/publication/cir1441>
- Fact: USGS monitors water levels, water-quality conditions, or both at more than 17,000 groundwater wells across the United States.  
*Source:* *Groundwater and Streamflow Information Program, USGS.*
- Fact: Excess nutrients in America's waters are one of its most widespread, costly, and challenging environmental problems.  
*Source:* <https://www.epa.gov/nutrientpollution/issue>
- Fact: USGS monitors nutrients, sediment, and pesticides at more than 110 surface water sites as part of the National Water Quality Network for Streams and Rivers.  
*Source:* <https://www.usgs.gov/water-resources/national-water-quality-program/national-water-quality-assessment-project-nawqa>
- Fact: Cooperative Matching Funds are appropriated to the WMA every year and can only be used to fund cooperative studies or data collection with State, local, or Tribal partners.  
*Source:* *42 U.S.C 50 et seq.*
- Fact: USGS is developing Integrated Water Availability Assessments to evaluate water quantity, quality, and use at regional and national scales.  
*Source:* [https://www.usgs.gov/mission-areas/water-resources/science/integrated-water-availability-assessments-iwaas?qt-science\\_center\\_objects=0#qt-science\\_center\\_objects](https://www.usgs.gov/mission-areas/water-resources/science/integrated-water-availability-assessments-iwaas?qt-science_center_objects=0#qt-science_center_objects)
- Fact: USGS provides base and competitive grants to the Nation's 54 Water Resources Research Institutes.  
*Source:* <https://water.usgs.gov/wrri/index.php>

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# Core Science Systems Mission Area

USGS 3D Elevation Program (3DEP) image of Chicago, Ill.  
Source: USGS.

## Programs

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National Geospatial Program

National Cooperative Geologic Mapping Program

Science Synthesis, Analysis and Research Program

National Land Imaging Program

Kevin T. Gallagher, Associate Director

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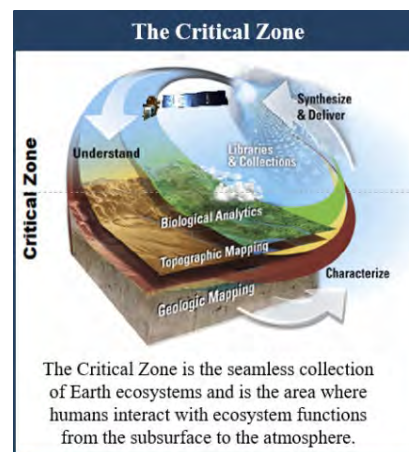
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*America relies on our broad range of nationally focused Earth system science, geospatial research, and foundational data to remain informed, safe, and healthy.*

## CORE SCIENCE SYSTEMS MISSION AREA OVERVIEW

The USGS [Core Science Systems](#) (CSS) Mission Area leads the bureau's mission as the civilian mapping agency for the Nation—a 141-year legacy since its establishment in 1879.

The CSS Mission Area conducts detailed surveys; develops high quality, highly accurate topographic, geologic, hydrographic, and biogeographic maps and data; and provides remote sensing imagery and analyses. USGS maps allow for precise planning for critical mineral assessments, energy resource development, infrastructure projects, urban planning, flood prediction, emergency response, and hazard mitigation.



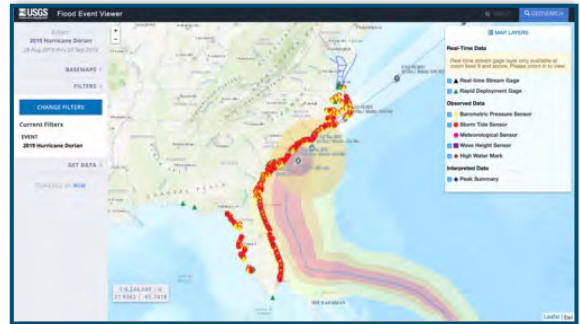
Source: USGS.

### What We Do

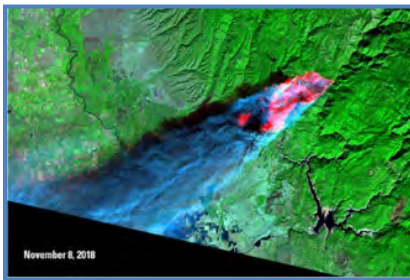
- Serve as the Nation's civilian mapping agency.
- Provide baseline geospatial, remote sensing, geological, and biogeographical data and maps to the Nation.
- Create products that serve the Nation, State and local governments, Tribes, and the world.
- Conduct science, surveys, and research on the Nation's geological and biological resources.
- Coordinate effective and economical use and management of geospatial data assets for Federal agencies and the Nation.
- Provide remote sensing imagery and analyses from satellites and unmanned aerial vehicles.
- Support data management, data synthesis, and analysis across science disciplines.
- Connect USGS scientists to published literature, data, and collections to support evidence-based practices.
- Inventory and preserve geological and geophysical data collections to provide a framework for geoscience data and information sharing.
- Improve Federal-State cooperation and collaboration by effectively leveraging partnerships.
- Produce land cover change analyses and classification applications.
- Provide high performance computing and modeling activities.

## HOW THE MISSION AREA SERVES THE PUBLIC

**Hurricane Response:** During major hurricanes, first responders often rely on the USGS National Geospatial Program, which collects, archives, and shares digital records on the Nation’s topography, natural landscape, and human-made environment. Information—such as the storm’s track, light detection and ranging (lidar) elevation data, and the locations of hospitals, airports, government buildings, and other important sites—is shown on multilayered Websites or on custom-printed maps.



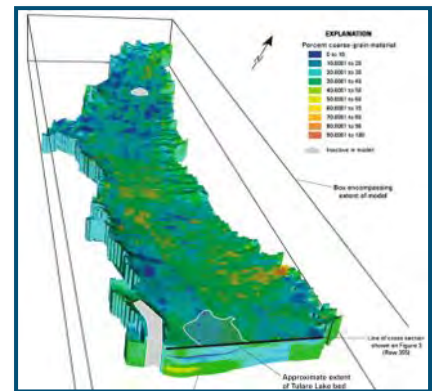
USGS Flood Event Viewer Website. Source: USGS.



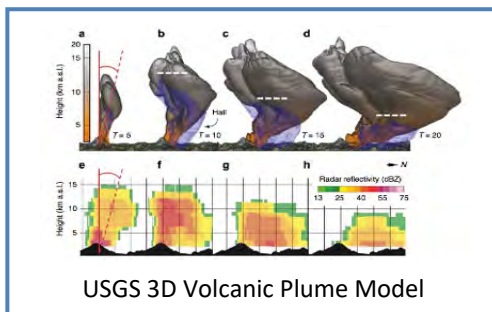
Landsat 8 image of the 2018 Camp Fire in Butte County, CA. Source: USGS.

**Wildfire Support:** When fires occur, the USGS and its partners produce extensive datasets and tools necessary to monitor and detect fires. To assist in these situations, the USGS can turn to data from the Landsat series of satellites, with more than 40 years of multispectral remote imaging information for the Earth. The public can use pre-, current, and post-wildfire satellite imagery for disaster preparation, migration, response, and recovery.

**Hazards Support:** The National Cooperative Geologic Mapping Program constructs new 2-D and 3-D geologic maps that address issues identified by the States, including earthquake, flood, karst, volcanic, and landslide hazards; water, mineral, and energy resources; soil conditions; coastal resiliency; and urban and infrastructure development. These geologic maps and models enable the hydrologic modeling of critical groundwater basins and inform seismic hazards assessments of faults.



3-D geologic map. Source: USGS.



3-D volcanic plume model. Source: USGS.

The USGS uses high performance computing (HPC) to enhance forecasting capacity in support of emergencies. In 2018, the USGS used the Yeti HPC computing cluster to predict Kīlauea lava flows for decision making. Yeti can optimize code that runs more than 3,300 times faster than a personal computer, enabling near real-time hazards forecasting for emergency response.

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## CORE SCIENCE SYSTEMS PARTNERS

### Department of the Interior (DOI) Bureaus

**Bureau of Indian Affairs (BIA)** is a recipient of the following USGS science:

- Partnering with Tribes for 3D Elevation Program (3DEP) lidar acquisition over Tribal lands.
- Sponsorship of geographic information system (GIS) training classes to Tribes/Nations.

**Bureau of Ocean and Energy Management (BOEM)** is a recipient of the following USGS science:

- Coastal and bathymetric mapping coordination with NOAA and BOEM.
- Coleadership of the Office of Management and Budget (OMB) Circular A-16 Geology.

**Bureau of Land Management (BLM)** is a recipient of the following USGS science:

- 3DEP lidar acquisition for BLM lands.
- Geophysical surveys and geologic mapping in northeastern California to inform land management.
- Surficial geology and earthquake hazards assessments on Federal land in the Mojave Desert.
- High-performance computing capacity and expertise for large-scale processing and analysis of unmanned aerial systems (UAS) imagery.

**Bureau of Reclamation (BOR)** is a recipient of the following USGS science:

- 2-D and 3-D geologic mapping and paleoseismic studies in California, Oregon, and Washington.
- Surficial and groundwater geologic mapping in the lower Colorado River.
- Bedrock geologic mapping of the Lake Mead area.
- High-performance computing capacity and expertise for conducting hydrologic, environmental, and agricultural modeling and simulation.

**Fish and Wildlife Service (FWS)** is a recipient of the following USGS science:

- Collaboration on land and habitat management through geomorphic process mapping in Hawaii.
- Consultation with the Carolina Sandhills National Wildlife Refuge on clay resources for road maintenance.
- Coleadership of the OMB Circular A-16 Waters-Inland Theme.
- High-performance computing capacity and expertise for at-risk species modeling, landscape conservation, invasive species detection, and large-scale UAS and wildlife imagery processing.
- Science data management tools to better document and discover FWS data.

- 
- National biogeographic data for protected areas and species occurrence to support refuge and species management decisions.

**National Park Service (NPS)** is a recipient of the following USGS science:

- 3DEP lidar acquisition for the Nation's National Parks.
- Surficial geologic mapping in Channel Islands National Park and Yosemite National Park to inform land management decisions. Geologic maps for Joshua Tree, Grand Canyon, Death Valley, and other National Parks.
- Geochronology studies at Hagerman Fossil Beds for improved understanding of fossil history.
- Planned infrastructure improvements at multiple recreation sites in consideration of mapped aquifers.
- High-performance computing capacity and expertise for water modeling to inform vegetation management, firefighting, and infrastructure maintenance.
- National biogeographic data for protected areas and species occurrence to support park management decisions.

**DOI Office of Emergency Management** is a recipient of the following USGS science:

- Disaster tracking and management support through the coordination of geospatial and remotely sensed products and Web mapping services with topographic data layers.
- High-performance computing capacity and assistance with hazard modeling.
- Wildfire satellite imagery for disaster preparation, migration, response, and recovery.
- High-performance computing and expertise to support hazard and risk modeling and simulations.

**DOI Office of Surface Mining Reclamation and Enforcement** is a recipient of the following USGS science:

- High-performance computing capacity and expertise for large scale processing and analysis of UAS imagery.

**DOI Operations Center** is a recipient of the following USGS science:

- Management support through the coordination of geospatial and remotely sensed products.

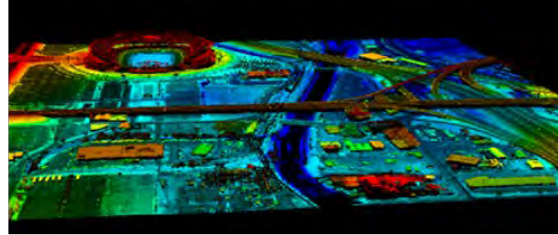
**Federal Agencies:** Federal Emergency Management Agency (FEMA), National Aeronautics and Space Administration (NASA), National Science Foundation (NSF), Defense Logistics Agency (DLA), Department of Defense (DOD), Department of Energy (DOE), Department of Homeland Security (DHS), National Oceanic and Atmospheric Administration (NOAA), Natural Resources Conservation Service (NRCS), U.S. Army Corps of Engineers (USACE), U.S. Forest Service, Wildland Fires Community-Wildland-Fire Information (IRWIN), Smithsonian Institution, and Office of Science and Technology Policy.

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**Other Organizations:** 3D Elevation Program (3DEP) Coalition, American Association of Petroleum Geologists, American Geophysical Union, American Geosciences Institute, American Institute of Professional Geologists, Association of American State Geologists, Association of Environmental & Engineering Geologists, Civil Air Patrol, Earth Science Information Partners, Geoscience Information Consortium, Geoscience Information Society, Geological Society of America, Industrial Minerals Association–North America, Global Biodiversity Information Facility, Management Association for Private Photogrammetric Surveyors, National Mining Association, National States Geographic Information Council, North American Committee on Cooperation for Wilderness and Protected Areas Conservation, Petroleum History Institute, Seismological Society of America, Society of Economic Geologists, State of Alaska, State geological surveys, US Group on Earth Observations, Western Governors Association, Tribes, State and local governments, and private sector companies and researchers for oil, gas, and mineral exploration.

## FAST FACTS

### Core Science Systems Mission Area



Leveraged funding from Federal, State, and local partners for 3DEP lidar data acquisition to cover 74% of the Nation.



Distributed detailed to intermediate scale geologic maps for more than 54% of the US.



Achieved 100 percent IfSAR coverage over Alaska—improving accuracy of maps and digital map data for Alaskans.

Collaborated with the Association of American State Geologists on the Earth Mapping Resources Initiative (Earth MRI). Issued 15 Cooperative Agreements to States for geologic mapping of critical minerals.



Released the latest edition of the National Land Cover Database for the U.S. – the most comprehensive land cover database that the USGS has ever produced.

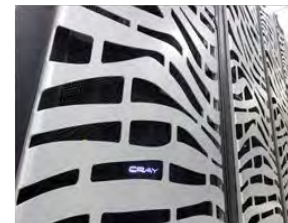


Completed high-resolution hydrography data (NHDPlus HR) coverage for 83% of the Nation.

Continued development of Landsat 9 systems and Landsat-Next mission formulation and system development activities in joint effort with NASA.



Enabled access to high-performance computing capabilities to process large datasets for hazards forecasting, landscape change, and biological modeling. Processing time reduced from days to minutes using the USGS Yeti, Denali, and Tallgrass supercomputers.



Source information for each of the above facts is on page 178.

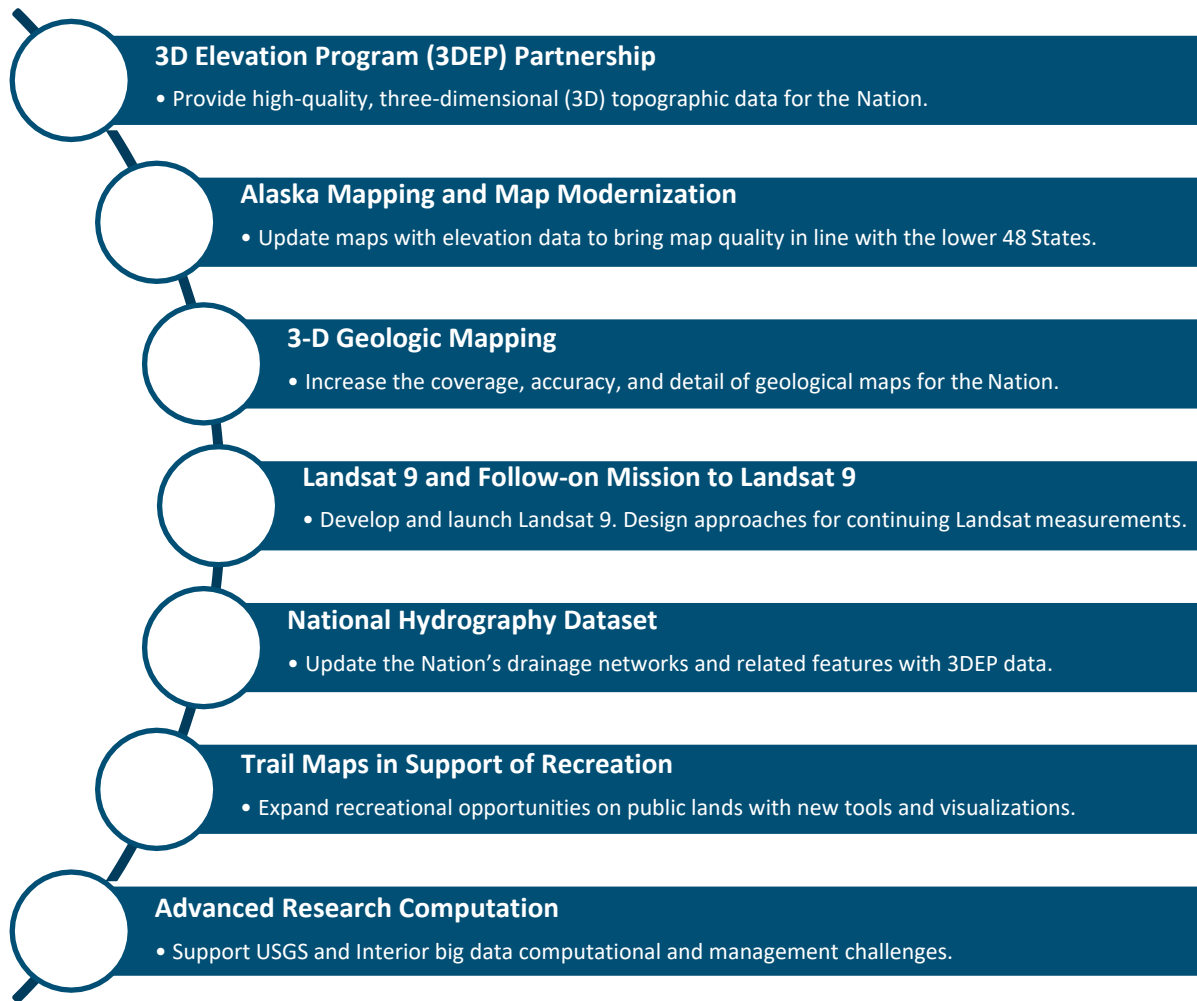


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## USGS AND THE DOI STRATEGIC PLAN

### COMMITMENTS TO DEPARTMENT OF THE INTERIOR PRIORITIES

Within the 2018–2022 DOI Strategic Plan, Core Science Systems programs inform land use planning processes, especially those for public use and access to meet the DOI goal of Conserving Our Land and Water. The USGS is committed to working the following priorities to meet both USGS and DOI goals.



### Performance and Strategic Planning Documents

- DOI Annual Financial Report (the most recent report can be found [here](#))
- DOI Annual Performance Plan & Report (APP&R; the most recent can be found [here](#))
- DOI Strategic Plan (2018–2022) ([link](#))

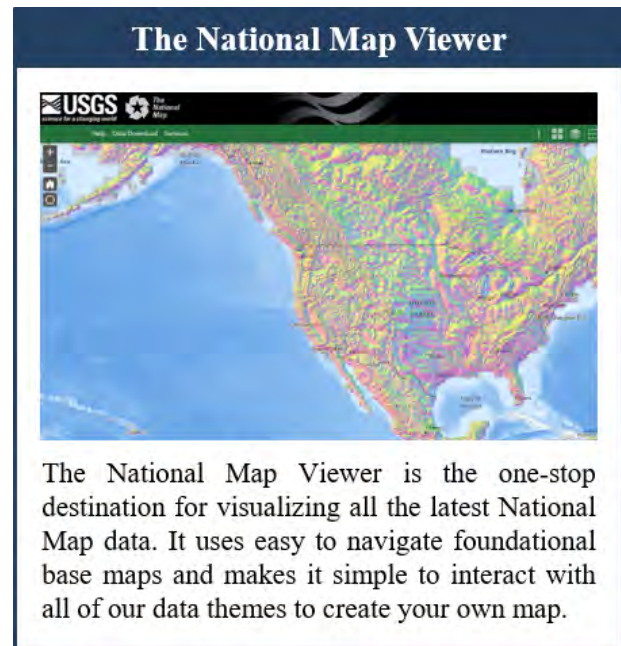
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## NATIONAL GEOSPATIAL PROGRAM

*Mapping for the 21<sup>st</sup> century: Accurate digital geospatial data representing America's topography, natural landscape, and manmade environment.*

The [National Geospatial Program](#) (NGP) organizes, updates, and publishes the baseline for nationwide topography, the natural landscape and built environment, through [The National Map](#)—a compilation of the foundational geospatial data layers for the entire Nation, maintained in the public domain.

The USGS supports Interior's responsibilities for national geospatial coordination and carries out the USGS's governmentwide leadership responsibilities for elevation data, hydrography data, and watershed boundaries, as well as geographic names. The National Map is readily accessible for display on the Internet, as products and Web services, and as downloadable data for use in recreation, scientific analysis, and emergency response. Nationwide topographic maps and geospatial data remain a pivotal part of many business processes and applications across the country, particularly for hunting and outdoor recreation, wildfire management and suppression, aerial navigation and safety, and natural hazards mitigation and recovery.



The National Map Viewer is the one-stop destination for visualizing all the latest National Map data. It uses easy to navigate foundational base maps and makes it simple to interact with all of our data themes to create your own map.

National Geospatial Program activities fall under five areas:

- Elevation
- Hydrography
- Published Maps, Products & Services
- Center of Excellence for Geospatial Information Science (CEGIS)
- Federal Geographic Data Committee (FGDC)

## ELEVATION

The goal of the [USGS 3D Elevation Program \(3DEP\)](#) is to complete acquisition of elevation data for the Nation in the form of light detection and ranging (lidar) by 2023 to provide the first-ever baseline of consistent high-resolution data—both bare earth and 3D point clouds—collected in a timeframe of less than a decade. For the State of Alaska, where cloud cover hinders the use of lidar, the USGS collected elevation data using interferometric synthetic aperture radar (IfSAR).

As one of the cornerstones of the National Geospatial Program, [The National Map](#) is a collaborative effort among the USGS and other Federal, State, and local partners to improve and deliver topographic information for the Nation using 3DEP data. It has many uses, ranging from immediate safety of life, property, and environment to long term planning for infrastructure projects. The elevation theme of The National Map provides foundational elevation information (topography) for Earth science studies and mapping applications in the United States.

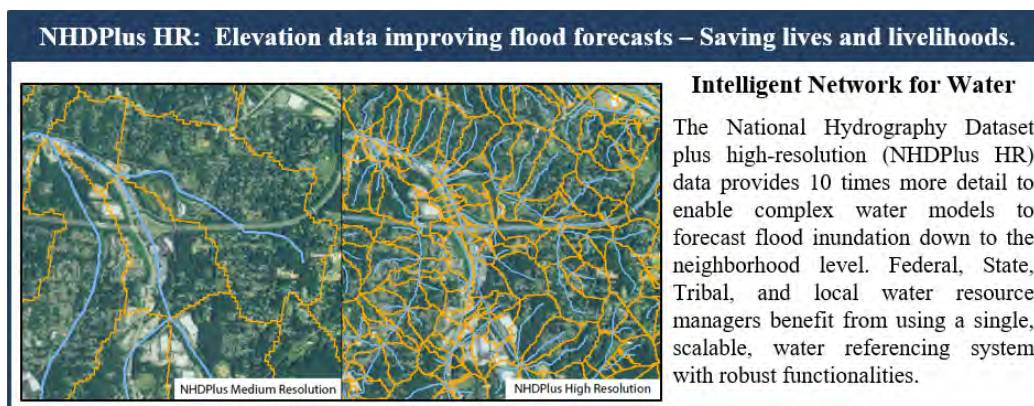
The first full year of 3DEP production began in 2016 and in August 2020, 74 percent of the Nation had elevation data available or in-progress that met 3DEP specifications for high accuracy and resolution. This includes the completion of 100 percent interferometric synthetic aperture radar (IfSAR) data collection in Alaska. The 3DEP products inform critical decisions made across our Nation every day that depend on elevation data, ranging from immediate safety of life, property, and the environment to long-term planning for infrastructure projects.



Source: USGS.

## HYDROGRAPHY

The National Geospatial Program manages the [National Hydrography Dataset \(NHD\)](#), the [NHDPlus High Resolution \(NHDPlus HR\)](#), and comanages the [Watershed Boundary Dataset \(WBD\)](#) with the Water Mission Area. These geospatial datasets represent the surface water of the United States for mapping and modeling applications.



Source: USGS.

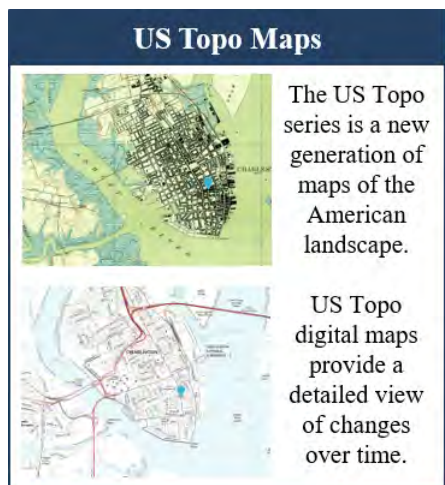
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The NHD represents the Nation’s drainage networks and related features, including rivers, streams, canals, lakes, ponds, glaciers, coastlines, dams, and streamgages. The WBD represents drainage areas of the country in eight nested levels.

The USGS processes the NHD and WBD—along with elevation data from the 3DEP—to create the NHDPlus High Resolution (NHDPlus HR), a networked geospatial framework. When completed, the NHDPlus HR will increase the number of features nationally from 2.7 million in the medium resolution NHDPlus to approximately 26 million, and will provide richer, more current content that can be used at a variety of scales.

In August 2020, the USGS made the National Hydrography Dataset Plus High Resolution (NHDPlus HR) available for 83 percent of the Nation. These data are integral to a myriad of mission-critical activities undertaken and managed by Federal, State, Tribal, and local governments, nonprofit organizations, and private companies. Hydrography data make it possible to

- Manage water such as stream flow and stormwater.
- Monitor, manage, and report water quality.
- Assess water availability and water rights.
- Model and map flood risk.
- Conserve terrestrial and aquatic habitats.
- Manage fisheries, rangeland, timberlands, and agricultural lands.
- Assess coastal hazards.
- Plan for future land development activities and infrastructure development.
- Manage riverine and coastal navigation and safety.
- Provide recreational opportunities for citizens.



Source: USGS.

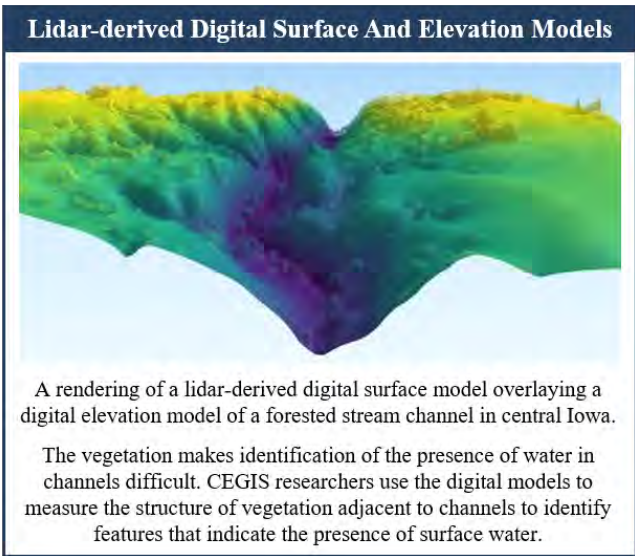
## **PUBLISHED MAPS, PRODUCTS & SERVICES**

The Published Maps, Products, and Services component of the National Geospatial Program ensures the production and delivery of the digital geospatial foundation for the Nation. This includes [US Topo](#) providing free and open topographic maps to the public, as well as aggregating and maintaining data layers and Web services of [The National Map](#).

US Topo maps package geographic information system data in traditional map form, benefitting nonspecialist map users. Having authoritative maps available in a digital format is critical for public safety and effective response to natural disasters.

## CENTER OF EXCELLENCE FOR GEOSPATIAL INFORMATION SCIENCE (CEGIS)

The CEGIS is a national capability conducting research that supports the NGP, including The National Map and 3DEP. The CEGIS researchers conduct, lead, and influence the research and innovative solutions required by the National Spatial Data Infrastructure vision and the emerging Geospatial Web. CEGIS is a virtual organization with Federal and academic affiliate scientists conducting research involving feature extraction from lidar, elevation, and imagery; generalization of geospatial data to support cartographic, geographic, and scientific uses; semantic modeling of topographic features to enable the map as a knowledge base; and application of machine learning and artificial intelligence in combination with high-performance computing infrastructure to geospatial computations.



Source: USGS FGDC.

## FEDERAL GEOGRAPHIC DATA COMMITTEE (FGDC)

The [FGDC](#) is an interagency coordinating committee with the responsibility for implementing the Geospatial Data Act (GDA) of 2018. This includes cross-government geospatial initiatives, such as the [Geospatial Platform](#) (GeoPlatform) and the [National Spatial Data Infrastructure \(NSDI\)](#). The FGDC Office of the Secretariat provides executive, administrative, and technical support to the Committee as directed by the GDA. The FGDC leads the development of the NSDI Strategic Plan, in accordance with OMB Circular A-16 (the Coordination of Geographic Information and Related Spatial Data Activities).

OMB Circular A-16 identifies 17 National Geospatial Data Assets (also known as themes) and assigns responsibility for each theme to one or more Federal agencies. Of the 17 data themes, the USGS leads or co- leads 6 of those themes. The thematic subcommittees ensure that the national data assets are high quality, dependable, consistent, and available to agencies and the public.



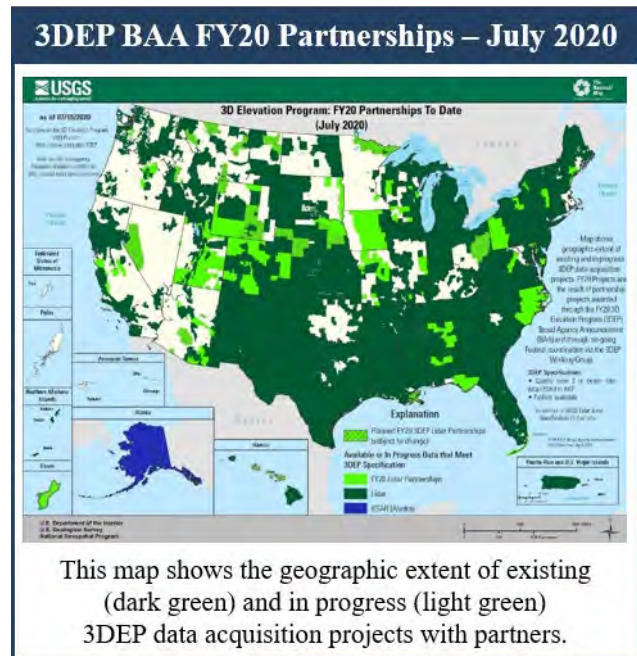
Source: USGS FGDC.

## REIMBURSABLE ACTIVITIES

The [3D Elevation Program \(3DEP\)](#) is a cooperative program with a goal of acquiring nationwide lidar (IfSAR in Alaska) by 2023 to provide the first-ever national baseline of consistent, high-resolution elevation data—both bare earth and 3D point clouds.

The NGP’s annual Broad Agency Announcement process effectively leverages USGS dollars with matching partner funds (approximately four partner dollars for each USGS dollar invested), to speed national elevation data coverage completion.

The [FGDC](#) Office of the Secretariat receives partner funding from 23 Federal agencies to support the [Geospatial Platform](#), a Web-based capability that provides shared, trusted geospatial data, applications, and Web services to the public.



Source: USGS 3DEP Program.

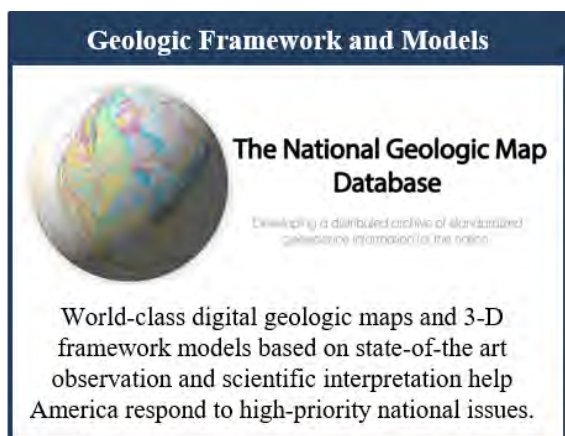
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## NATIONAL COOPERATIVE GEOLOGIC MAPPING PROGRAM

*2-D and 3-D Geologic Mapping: Accurate geologic maps and three-dimensional framework models that help to sustain the economy and mitigate natural hazards.*

The [National Cooperative Geologic Mapping Program](#) (NCGMP) conducts scientific (geologic) investigations and produces geologic maps through collaboration with State geological surveys and university partners. Federal and State decision makers use the digital geologic maps and three-dimensional geologic framework models and visualizations to help mitigate natural hazards; conduct energy and mineral resource assessments at county and regional scales; and assess hydrogeology and groundwater availability—all of which sustain and improve the quality of life and economic vitality of the Nation.

The USGS characterizes, interprets, and distributes the geologic framework model of the Nation through geologic mapping and derivative research. The national geologic framework model is a three-dimensional visualization of surface and subsurface rock, soil, and sediment layers. This model is used to inform the responsible use of land, water, energy, and mineral resources and address the Nation’s rapidly changing natural resource needs.



Source: USGS.

The USGS [National Geologic Map Database](#) (NGMDB) is a hallmark collaborative effort with the Association of American State Geologists. It provides rapid access for the public, scientists, and decision makers to well-documented and standardized Federal and State geoscience information to support research, understanding, and decisions in response to societal needs. The NGMDB leads national-level information exchanges and the development of more efficient methods for digital mapping, cartography, geographic information system analysis, and information management.

National Cooperative Geologic Mapping Program activities fall under four areas:

- FEDMAP
- STATEMAP
- EDMAP
- 3-D Geologic Framework

The NCGMP represents nearly 30 years of successful cooperation among Federal, State, and university partners to deliver digital geologic maps for a wide range of public and private sector customers.

## FEDMAP

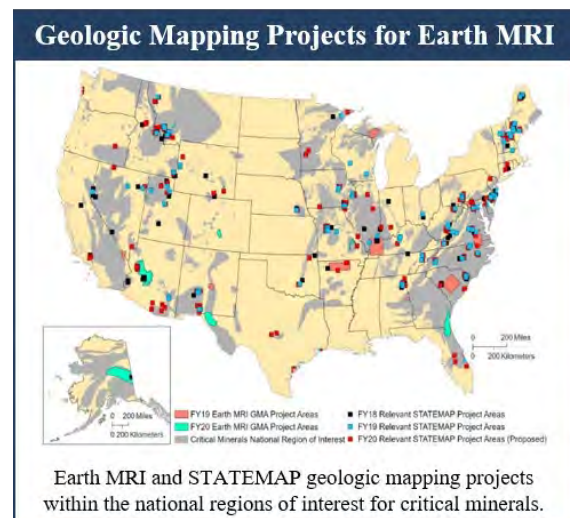
This component of the NCGMP supports hypothesis-driven applied research on the structure and function of an earth framework to solve critical geoscience problems to (1) support the responsible use of land, water, energy, and minerals; and (2) to mitigate the impact of geologic hazards on society. [FEDMAP](#) projects have accelerated research in geologic specialties, including subsurface geophysical methodology and modeling, 3-D geologic modeling, petrology and geochemistry, hydrogeology, and paleo-environmental study, while maintaining core geologic mapping expertise. FEDMAP researchers also work on high-priority national water resources issues that cross jurisdictional boundaries by integrating geologic data into one seamless format.



Source: USGS.

## STATEMAP

The [STATEMAP](#) component oversees the geologic mapping studies conducted by approximately 44 State geological surveys through a competitive cooperative agreement program that effectively leverages and matches every Federal dollar with a State dollar. This program balances the diverse needs of the Nation with those of individual States. The State-matched grants focus on producing new geologic maps that address societally relevant issues identified by the States, including water, mineral, and energy resources; earthquake, flood, sinkhole, volcanic, and landslide hazards; soil conditions; coastal erosion and flooding; and urban and infrastructure development.



Source: USGS.

## EarthMRI Geologic Mapping

The [Earth Mapping Resources Initiative](#) (Earth MRI) is a partnership between the USGS and the [Association of American State Geologists](#), which represents States, to generate geologic mapping, geophysical surveys, and lidar data for the Nation in mineral-rich regions. EarthMRI expands existing NCGMP geological mapping, in cooperation with the USGS Mineral Resources Program and almost 30 State geological surveys, to cover targeted regions with potential for critical minerals. The NCGMP awarded approximately 15 Cooperative Agreements—totaling more than \$2.0 million—with State geological surveys for Earth MRI in 2020.



## EDMAP

[EDMAP](#) is a 1-year, mentor-guided program designed to teach students geologic mapping techniques through rigorous field mapping. Colleges and universities in the United States and Puerto Rico are eligible to apply through an annual competitive grants process.

The EDMAP component provides oversight for the competitive grants process. EDMAP projects typically involve one season of fieldwork and require a one-to-one match of Federal dollars from the university. EDMAP geology professors and their students frequently work closely with [STATEMAP](#) and [FEDMAP](#) geologists who may be mapping nearby.

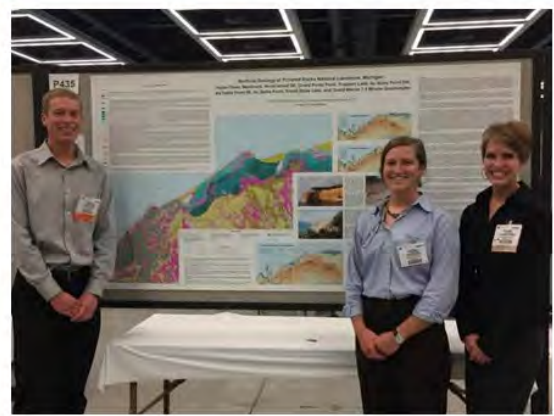
## 3-D GEOLOGIC FRAMEWORK

This component of the NCGMP supports efforts to compile the foundational data needed to construct the first national 3-D geologic framework model, which will aid in determining earthquake, flood, karst, volcanic, and landslide hazards; groundwater, surface water, mineral, and energy resources; soil conditions; and urban and infrastructure development. States can partner with the USGS through the STATEMAP program to continue progress on developing a geographic information system with standardized geologic map information, bringing together national- and continental-scale resolution information into one seamless GIS format.

## REIMBURSABLE ACTIVITIES

The NCGMP's FEDMAP centers conduct geologic research that enables the land management missions of the Department of Interior sister agencies (BLM, BOR, USFWS); other Federal agencies (Department of Energy; U.S. Department of Agriculture, U.S. Forest Service; NASA Goddard Space Flight Center); State agencies and universities (California Geological Survey and Utah State University); and the private sector. The FEDMAP centers receive a modest amount of reimbursable funding for these collaborative activities.

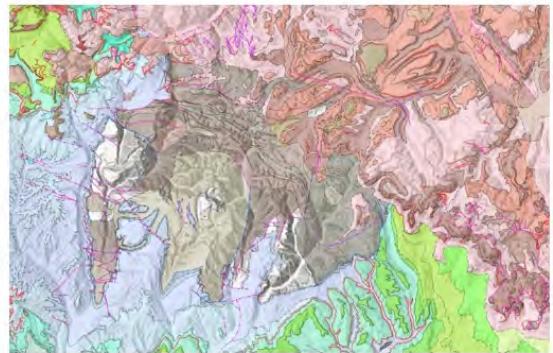
### EDMAP – Growing a 21st century workforce



Best Student Geologic Map Competition winners from 2017 posing with award winning entry.

Source: USGS.

### Integrating Many Maps into One Seamless Product



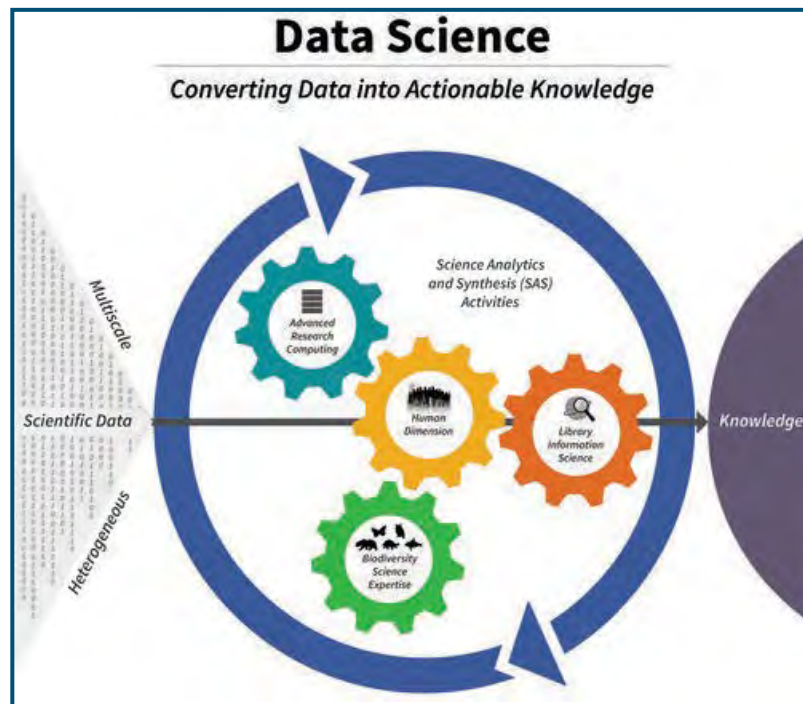
3-D Geologic mapping framework helps to integrate geologic data into a seamless digital GIS format shown here for the San Juan and Needle Mountains, Colo.

Source: USGS.

## SCIENCE SYNTHESIS, ANALYSIS, AND RESEARCH PROGRAM

*Actionable Intelligence: Accelerating research and decision making through data science, information delivery, high-performance computing, biodiversity analytics, and geoscientific assets and preservation.*

The [Science Synthesis, Analysis, and Research Program](#) (SSAR) provides analysis and synthesis of scientific data and information, and long-term preservation of scientific data and library collections. This program strives to accelerate research and decision making through data science, information delivery, advanced computing, biodiversity analytics, and preservation of geoscientific assets. The SSAR ensures that data are strategically managed, integrated, and available to decision makers and others as they focus on issues associated with Earth and life science processes.



Source: USGS.

Science Synthesis, Analysis and Research Program activities fall under five areas:

- Biogeographic Science
- Data Integration and Synthesis
- USGS Library
- National Geological and Geophysical Preservation Program
- Risk and Vulnerability Assessments

## BIOGEOGRAPHIC SCIENCE

This component provides nationally consistent, foundational biogeographic data that underpins USGS science to characterize and understand the Nation's natural resources in the context of biological species, habitats, conservation measures, and changing conditions.

This scientific research and development results in national base data products such as [The National Biogeographic Map](#), the [USGS Gap Analysis Project \(GAP\) Analytical Database](#), the [Protected Areas Database – United States](#), and the [Integrated Taxonomic Information System](#) help resource managers, industry, and citizens make informed decisions on conservation

policy and habitat management actions. Relevant to the private and public-sector, this tool will evolve to provide actionable intelligence for decision makers on the most prevalent and severe threats to our Nation's habitats.



Source: USGS.

## DATA INTEGRATION AND SYNTHESIS

This component provides bureau-wide leadership in establishing and implementing [science data-management](#) practices; expertise in data lifecycle best practices; and access to standards, workflows, training, and enterprise tools to help ensure that the USGS and its bureau partners properly maintain, describe, preserve, and make accessible Federal data to the American public. Enterprise data release tools include [ScienceBase](#) (a Trusted Digital Repository), and the [USGS Science Data Catalog](#), along with internal tools to assist scientists in documenting their data.



Source: USGS.

The USGS also maintains [Advanced Research Computing](#) framework to execute complex computational models required to quickly and efficiently process large quantities of data, including high-resolution elevation datasets, integrating elevation and hydrography data, and three-dimensional geologic datasets.

The [Community for Data Integration](#) (CDI) is a dynamic community of practice with more than 1,600 members working together to grow USGS knowledge and capacity in scientific data and information management and integration.

The [John Wesley Powell Center for Analysis and Synthesis](#) serves as a catalyst for innovative thinking in Earth system science research by providing the time, creative space, and computational data manipulation and data management resources to promote synthesis of existing information leading to emergent Earth system science knowledge.

## USGS LIBRARY

The [USGS Library](#) is one of the world’s largest Earth and natural science libraries, providing services, collections, and expertise essential to the USGS mission and the geoscience community. The physical collections consist of materials dating back to the 16th century, including an estimated 1,500,000 volumes, 750,000 maps, and 30,000 field records. The USGS Library continues to expand online through optimized technology and processes to digitize collections. The USGS Library has three locations: [Reston, VA](#); [Denver, CO](#); and [Menlo Park, CA](#).



Source: USGS.

## NATIONAL GEOLOGICAL AND GEOPHYSICAL PRESERVATION PROGRAM

The [National Geological and Geophysical Preservation Program](#) provides technical and financial assistance to State geological surveys to support preservation of geoscience collections (samples, logs, maps, data) and promote their discovery and re-use for research and development. The program helps to reduce duplicative collection costs by providing information on accessing the preserved assets for geoscientific research.

A composite image with a dark blue header titled "The Value of Preservation". On the left, a man in a light blue shirt is examining a long, thin, yellowish-brown strip of material. On the right, a close-up shows a reddish-brown, crystalline mineral specimen. Below the images, text reads: "Michigan Potash and Western Michigan University’s Michigan Geological Repository for Research and Education analyzed USGS cores and discovered the richest grade of potash ever produced globally—estimated at \$65 billion, making it a major source of revenue for the State of Michigan."/>

Michigan Potash and Western Michigan University’s Michigan Geological Repository for Research and Education analyzed USGS cores and discovered the richest grade of potash ever produced globally—estimated at \$65 billion, making it a major source of revenue for the State of Michigan.

Source: M. Lanka, Western Michigan University.

The [National Digital Catalog](#) helps to reduce duplicative collection costs by providing information on accessing the preserved assets for geoscientific research.

The program also maintains the Geological Materials Repository (formerly the [Core Research Center](#)), which permanently stores rock cores available for examination and testing by researchers, and the [National Science Foundation Ice Core Facility](#) a repository for approximately 22,000 meters of ice cores primarily from polar regions.

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## RISK AND VULNERABILITY ASSESSMENTS

[Land Change Science](#) research utilizes models, sensitivity analyses, and geographic distributions of people and infrastructure along with the probability of specific disturbance factors, to evaluate a community's vulnerability and risk. The societal vulnerability assessments, scenarios, and decision-support tools help local and State governments assess their vulnerability by developing fully realized scenarios of disaster events in collaboration with Federal, State, local, and university partners.



Source: USGS.

## REIMBURSABLE ACTIVITIES

The program works with various domestic and international environmental and resource management partners, including Interior bureaus (BOR and USFWS) and Federal agencies (NASA, NSF, and USFS).

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## NATIONAL LAND IMAGING PROGRAM

*Remote Sensing: Acquiring images of the Earth's land surface and providing data to help decision makers make informed decisions about the environment.*

The [National Land Imaging Program](#) (NLI) delivers remote sensing observation capacity, data, and research to inform land and resource managers and advance understanding of how landscapes and associated natural resources are changing at local, regional, and global scales. The USGS plays a leading role in land surface observations through its Landsat satellite missions, which are designed and implemented in collaboration with NASA.

Through the [Earth Resources Observation and Science \(EROS\) Center](#), the NLI program collects, processes, and provides the Nation with digital land-surface images acquired by satellite and airborne sensors for decision makers in all 50 States and 185 countries.

Landsat imagery uses include natural resource and infrastructure monitoring; forest management; wildfire recovery; understanding effects of drought on water supplies, flooding, and other disaster recovery; optimizing agricultural production; energy exploration and extraction; education; and enabling development of commercial geospatial products and services.

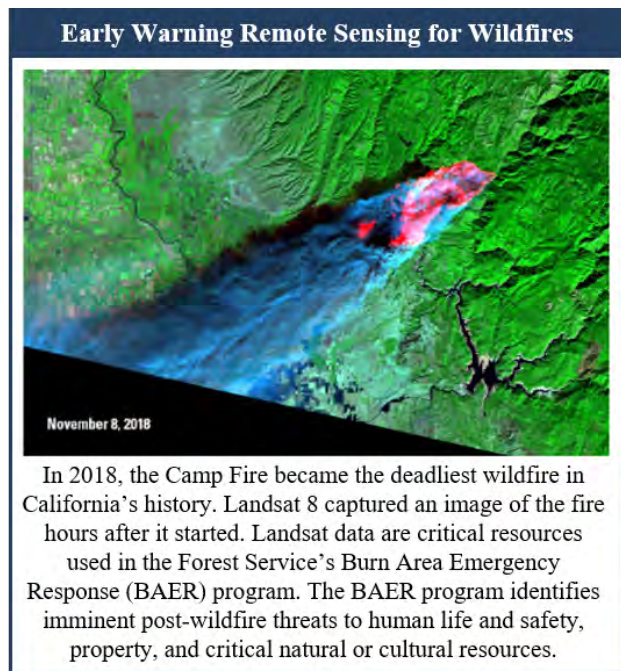
The public can search and download [Landsat data products](#) on the Internet at no charge. Landsat operates with a free and open data policy that allows users to access imagery at no cost.

National Land Imaging Program activities fall under three areas:

- Science, Research, and Investigations
- Satellite Operations
- Land Cover Monitoring and Assessments

### SCIENCE, RESEARCH, AND INVESTIGATIONS

The NLI program conducts and sponsors research in collection, access, distribution, and applications of remotely sensed land data. Scientists and engineers investigate new types of satellite systems and sensors, study new data sources, develop new data acquisition programs and sources including [unmanned aircraft systems](#), and assess the potential for innovative data applications to understand how these technologies can support emergency response and environmental, economic, and security activities. The program seeks new ways to make remotely



Source: USGS.

sensed data products more accessible, to leverage data more effectively from available satellite platforms, and to enhance the overall use and usefulness of remotely sensed data and emerging technologies.

The NLI also manages a State grants program that supports the use of Landsat and other public domain remote sensing satellite data through applied remote sensing research and technology transfer.

#### Enabling Access to Commercial Satellite Data



Through the National Civil Applications Center, Federal civil agencies have access to commercial remote sensing data procured and purchased by the National Geospatial Intelligence Agency and the National Reconnaissance Office.

In September 2017, the USGS documented the locations of landslide impacts from Hurricane Maria in Puerto Rico. The blue markers show the approximate location of roads and buildings impacted by landslides.

Source: USGS and DigitalGlobe NextView License.

#### National Civil Applications Projects

The USGS National Civil Applications Center serves Federal civil agencies by providing for the acquisition, dissemination, and exploitation of classified remote sensing systems and data in support of mission responsibilities for disaster response, public safety, and scientific research.

The use of declassified data from the intelligence community or military sectors helps with hazards response and scientific monitoring for specialized areas that require higher resolution remote sensing imagery. The center supports the USGS Volcano Hazards Program to improve volcano monitoring, and the National Interagency Fire Center and other partners to improve wildland fire detection. It also manages the [Global Fiducials Library](#), a long-term Earth surface monitoring project.

### SATELLITE OPERATIONS

The USGS operates Landsat 7 and Landsat 8 satellites, the only operational civil satellite program with both thermal and short-wave infrared sensors. These sensors are used extensively in water resource and agricultural management. They allow users to discriminate moisture content of soils and vegetation, estimate heat temperatures in urban areas, or monitor wildfires in various terrains.

The USGS's [EROS Center](#) performs the Landsat satellite operations and image data collection, archiving, processing, and distribution. In its National Satellite Land Remote Sensing Data Archive (NSLRSDA), the EROS Center houses more than 9 million Landsat satellite scenes acquired globally since 1972. The NSLRSDA also houses more than 6.5 million high-definition aerial mapping photos of U.S. sites, some dating to 1937.

#### Landsat in Orbit



Since 1972, the joint NASA/USGS Landsat program is the only U.S. satellite system designed and operated to repeatedly make multispectral observations of the global land surface at a moderate scale that shows both natural and human-induced change.

With the addition of Landsat 9, the Landsat program's record of land imaging will extend for more than half a century.

Source: USGS.



Source: USGS/NASA.

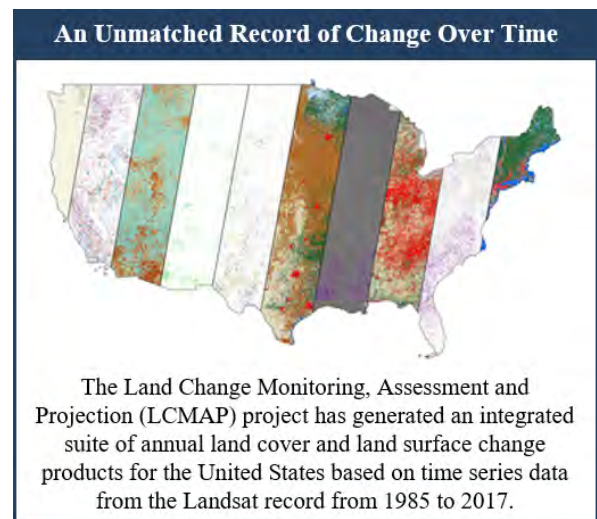
Landsat 9 is the direct replacement for Landsat 7 and will extend the long-term Landsat observational record to more than five decades of coverage. Together with Landsat 8, it will continue to support a near-weekly Landsat revisit for hundreds of land-cover applications, supporting tens of thousands of government, commercial, and academic users across the Nation. As with previous missions, Landsat 9 is being developed and operated through a long-standing partnership between NASA and the USGS.

As the Landsat 9 launch nears, work has already begun on the follow-on mission. The USGS and NASA will continue to initiate Landsat next-mission formulation and related system development, including development of a concept of operations, a formal program-level requirements document, and an acquisition strategy. Both agencies anticipate leveraging rapidly advancing technologies for space systems development, launch and operations, data communications, and cloud-based data management services. The resulting next-generation land-observing capabilities will continue to support advanced, integrated, and predictive science by USGS and its partners.

## LAND COVER MONITORING AND ASSESSMENTS

This component provides land and natural resource managers with data, tools, and scientific products that inform decisions relevant to the safety of communities, economic prosperity, and condition of natural resources across the Nation. USGS research provides critical data needed to understand how natural disturbances (for example, droughts, fire, flooding, and sea level change) and land use decisions (for example, urbanization, agriculture, ecosystem stewardship, and water management) affect the composition, distribution, and functioning of land and natural resources. The USGS produces research products based upon Landsat including the [Analysis Ready Data](#) (ARD), the National Land Cover Database (NLCD) and [Land Change Monitoring, Assessment, and Projection](#) (LCMAP).

Both ARD and LCMAP employ a machine learning-based approach to integrative data science that can enhance landscape change analysis, provide input into a wide range of environmental modeling studies, and provide more timely information for land managers.



Source: USGS.



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## REIMBURSABLE ACTIVITIES

The program works with various domestic and international environmental and resource management partners, including Interior bureaus, Federal agencies (NASA, NOAA, DOD), State agencies, and nongovernmental organizations.

**SilvaCarbon:** The [USGS SilvaCarbon program](#) helps selected countries build capacity for forest and land carbon monitoring by training in-country personnel in field inventory techniques and remote sensing analyses. The U.S. Agency for International Development Sustainable Landscapes program and the U.S. Department of State's Bureau of Oceans and International Environmental and Scientific Affairs provides 100 percent reimbursable funding to this program.

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## **CORE SCIENCE SYSTEMS CENTERS WITHIN THE INTERIOR UNIFIED REGIONS**

The following is a summary of the USGS centers and facilities that receive major funding from the Core Science Systems Mission Area and their locations within Interior's Unified Regions. A brief overview of each center is provided on pages 172-173.

### **National Centers**

1. Core Science Systems Mission Area Headquarters, Reston, VA
2. Earth Resources Observation and Science Center, Sioux Falls, SD
3. Geological Materials Repository (formerly the Core Research Center), Denver, CO
4. John Wesley Powell Center for Analysis and Synthesis, Ft. Collins, CO
5. National Civil Applications Center, Reston, VA; Denver, CO
6. National Geospatial Technical Operations Center, Rolla, MO; Denver, Colo.
7. National Science Foundation Ice Core Facility, Denver, CO
8. USGS Library, Reston, VA; Denver, CO; Moffett Field, CA

### **Region 1 – North Atlantic Appalachian (USGS Northeast Region)**

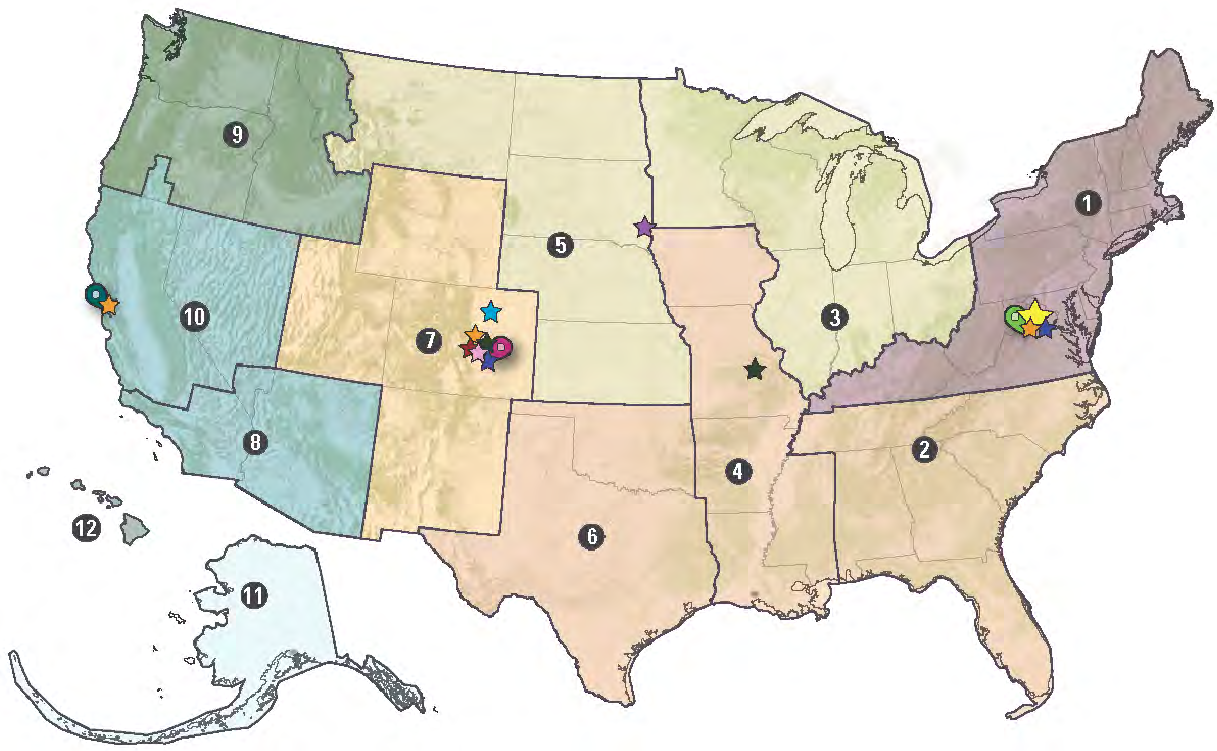
9. FEDMAP – Florence Bascom Science Center (FBSC), Reston, VA

### **Region 7 – Upper Colorado Basin (USGS Rocky Mountain Region)**

10. FEDMAP – Geosciences and Environmental Change Science Center, Denver, CO

### **Region 10 – California Basin (USGS Southwest Region)**

11. FEDMAP – Geology, Minerals, Energy, and Geophysics Science Center, Moffett Field, CA



**DOI Unified Regions**

- ① North Atlantic-Appalachian
- ② South Atlantic-Gulf
- ③ Great Lakes
- ④ Mississippi Basin
- ⑤ Missouri Basin
- ⑥ Arkansas-Rio Grande-Texas Gulf
- ⑦ Upper Colorado Basin
- ⑧ Lower Colorado Basin
- ⑨ Columbia-Pacific Northwest
- ⑩ California-Great Basin
- ⑪ Alaska
- ⑫ Pacific Islands

**USGS Regions**

- Northwest - Pacific Islands
- Southwest
- Alaska
- Rocky Mountain
- Midcontinent
- Southeast
- Northeast

**Core Science Systems National Centers**

**National Centers**

- ★ Core Science Systems Mission Area Headquarters
- ★ Earth Resources Observation and Science Center
- ★ Geological Materials Repository
- ★ John Wesley Powell Center for Analysis and Synthesis
- ★ National Civil Applications Center
- ★ National Geospatial Technical Operations Center
- ★ National Science Foundation Ice Core Facility
- ★ USGS Library

**FEDMAP Centers**

- 📍 Florence Bascom Science Center
- 📍 Geosciences and Environmental Change Science Center
- 📍 Geology, Minerals, Energy, and Geophysics Science Center

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## **Earth Resources Observation and Science Center**

The Earth Resources Observation and Science Center (EROS) near Sioux Falls, SD, performs satellite operations and image data collection, archiving, processing, and distribution. In its National Satellite Land Remote Sensing Data Archive, EROS houses more than 9 million Landsat satellite scenes acquired globally since 1972. In its Long-Term Archive for aerial photos and geospatial data, EROS houses more than 6.5 million high-definition aerial mapping photos of U.S. sites, some dating to 1937.

## **Geological Materials Repository**

The Geological Materials Repository (GMR) provides for the preservation of rock cores for use by scientists and educators from government, industry, and academia. Most of the core and cuttings materials have been donated by industry. Public access to this collection saves billions of dollars by not re-drilling and replicating collections. The GMR is one of the largest and most heavily used public core repositories in the United States. The GMR also provides storage, curation, and access to diverse USGS scientific materials, creating efficiency by reducing dispersed storage space and warehouse services.

## **John Wesley Powell Center for Analysis and Synthesis**

The John Wesley Powell Center for Analysis and Synthesis (Powell Center) located in Ft. Collins, CO, serves as a catalyst for innovative thinking in Earth system science research by providing the time, creative space, and computational data manipulation and data management resources to promote synthesis of existing information leading to emergent Earth system science knowledge. Powell Center working groups have supported studies including optimizing satellite resources for the global assessment and mitigation of volcanic hazards, integrating satellite and ground-based estimates of groundwater storage changes, high-impact insect invasions, geographically isolated wetlands, and creating a predictive framework for biological soil crust function.

## **National Center (Core Science Systems HQ)**

The Core Science Systems Mission Area headquarters programs are located at the USGS National Center in Reston, VA. The National Geospatial Program; National Cooperative Geologic Mapping Program; the Science Synthesis, Analysis and Research Program; the National Geologic and Geophysical Data Preservation Program; and the National Land Imaging Program provide national coordination and management of national centers located in Ft. Collins, CO; Denver, CO; Menlo Park, CA; Rolla, MO; and Sioux Falls, SD.

## **National Civil Applications Center**

The National Civil Applications Center (NCAC) acquires and disseminates classified remote sensing systems and data in support of mission responsibilities for land and resource management and science, homeland security, and hazards/disaster management. The NCAC has two secure compartmentalized information facilities (also known as SCIFs) located in Reston, VA, and Denver, CO.

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### **National Cooperative Geologic Mapping Program FEDMAP Centers**

FEDMAP geologic mapping and research is carried out by USGS geologists and geophysicists at three primary USGS Science Centers: Florence Bascom Science Center (FBSC) in Reston, VA, the Geosciences and Environmental Change Science Center (GEC) in Denver, CO; and the Geology, Minerals, Energy, and Geophysics Science Center (GMEG) in Moffett Field, CA.

### **National Geospatial Technical Operations Center (Rolla, MO and Denver, CO)**

The National Geospatial Technical Operations Center (NGTOC) has a rich history dating back to 1889, when Congress first made annual appropriations to the USGS for topographic mapping. NGTOC staff located in Rolla, MO, and Denver, CO, continue to perform the USGS national mapping mission by supporting The National Map, 3D Elevation Program, National Hydrography, and US Topo.

### **National Science Foundation Ice Core Facility**








The National Science Foundation Ice Core Facility (NSF-ICF) is the Nation's repository for processing and archiving approximately 22,000 meters of ice cores—with an approximated value of \$300 million—recovered primarily from the ice sheets of Antarctica and Greenland in a safeguarded, temperature-controlled environment. The facility provides samples to researchers to conduct examinations and measurements on the working scientific collections of ice cores that have been drilled over the past 50 years. The USGS operates and maintains the NSF-ICF through an interagency agreement with the National Science Foundation.

### **USGS Library (Reston, VA; Denver, CO; Menlo Park, CA)**

Authorized by Congress in 1879, the U.S. Geological Survey Library is recognized as one of the world's largest Earth and natural science libraries, providing services, collections, and expertise that are essential to the USGS mission and the global geoscience community. The USGS Library is a multisite (Reston, VA; Denver, CO; and Menlo Park, CA), centralized library, providing bureau-wide access to scholarly journals and research support services to USGS employees around the Nation.

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## SOCIAL MEDIA PRESENCE

	<a href="https://www.facebook.com/USGeologicalSurvey">https://www.facebook.com/USGeologicalSurvey</a> <a href="https://www.facebook.com/USGSEROS/">https://www.facebook.com/USGSEROS/</a> <a href="https://www.facebook.com/fgdcgov/">https://www.facebook.com/fgdcgov/</a>
	<a href="https://twitter.com/usgs">https://twitter.com/usgs</a> <a href="http://twitter.com/usgstnm">http://twitter.com/usgstnm</a> <a href="https://twitter.com/usgslandsat">https://twitter.com/usgslandsat</a> <a href="https://twitter.com/usgs_pubs">https://twitter.com/usgs_pubs</a> <a href="https://twitter.com/usgs_cdi">https://twitter.com/usgs_cdi</a> <a href="https://twitter.com/UsgsNgmdb">https://twitter.com/UsgsNgmdb</a> <a href="https://twitter.com/usgsjwp">https://twitter.com/usgsjwp</a>
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	<a href="https://www.usgs.gov/science-explorer-results?es=Eyes%20on%20Earth">https://www.usgs.gov/science-explorer-results?es=Eyes%20on%20Earth</a>
	<a href="https://github.com/USGS">https://github.com/USGS</a>

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## LEGAL AUTHORITIES FOR MISSION AREA ACTIVITIES

### **43 U.S.C. 31 et seq. | The Organic Act of March 3, 1879**

An act that established the Geological Survey, as amended (1962), and restated in annual appropriation acts. This section provides, among others, that the Geological Survey is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Interior Department. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285 Sec. 10(a) establishes United States Geological Survey as its official name.

### **43 U.S.C. 31 et seq. | The National Geologic Mapping Act of 1992, National Geologic Mapping Reauthorization of 1997, National Geologic Mapping Reauthorization of 1999, Omnibus Public Lands Management Act of 2009, and Title V of the John Dingell Jr., Conservation, Management, and Recreation Act (§5002) (P.L. 102-285 (1992); P.L. 105-36 (1997); P.L. 106-148 (1999); P.L. 111-11, §11011(i)(1); and P.L. 116-9, §5002 (2019))**

Established and reauthorized in the U.S. Geological Survey a National Cooperative Geologic Mapping Program to enhance geologic mapping of the United States, and for other purposes. The objectives of the geologic mapping program include (1) determining the Nation's geologic framework through systematic development of geologic maps at scales appropriate to the geologic setting and the perceived applications, such maps to be contributed to the national geologic map database; (2) developing of a complementary national geophysical-map database, geochemical-map database, and a geochronologic and paleontologic database that provide value-added descriptive and interpretive information to the geologic-map database; (3) applying cost-effective mapping techniques that assemble, produce, translate and disseminate geologic-map information and that render such information of greater application and benefit to the public; and (4) developing public awareness for the role and application of geologic-map information to the resolution of national issues of land use management.

### **43 U.S.C. 2801 | The Geospatial Data Act of 2018 (§751) (P.L. 115-254)**

Codifies the Federal Geospatial Data Committee and expands agency responsibilities in managing and reporting geospatial data and services; includes extensive reporting requirements for agencies using geospatial data in mission execution; and includes additional reporting for agencies with National Geospatial Data Asset leadership and management roles.

### **42 U.S.C. 15801 | The Energy Policy Act of 2005 and the National Geological and Geophysical Data Preservation Program Act of 2005 (§351) (P.L. 109-58 (2005))**

Establishes the National Geological and Geophysical Data Preservation Program (NGGDPP) to (1) archive geologic, geophysical, and engineering data, maps, well logs, and samples; (2) provide a national catalog of such archival material; and (3) to provide technical and financial assistance related to the archival material.

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**43 U.S.C. 38 | Topographic surveys; marking elevations.**

This section provides for the establishment and location of permanent benchmarks used in the making of topographic surveys.

**43 U.S.C. 41 | Publications and reports; preparation and sale.**

This section provides that the publications of the Geological Survey shall consist of geological and economic maps illustrating the resources and classification of lands and other reports.

**43 U.S.C. 42 | Distribution of maps and atlases, etc.**

This section authorizes and directs the Director of the Geological Survey, upon the approval of the Secretary of the Interior, to distribute topographic and geologic maps and atlases of the United States. The prices and regulations are to be fixed by the Director with the approval of the Secretary. This Section further provides that copies of each map or atlas, not to exceed five hundred, shall be distributed gratuitously among foreign governments, departments of our own Government, literary and scientific associations, and to educational institutions or libraries.

**43 U.S.C. 43 | Copies to Senators, Representatives and Delegates.**

This section provides that one copy of each map and atlas shall be sent to each Senator, Representative, and Delegate in Congress, if published within his term, and that a second copy be placed at the disposal of each.

**43 U.S.C. 44 | Sale of transfers or copies of data.**

This section provides that the Geological Survey may furnish copies of maps to any person, concern, institution, State, or foreign government.

**43 U.S.C. 45 | Production and sale of copies of photographs and records.**

This section authorizes the Geological Survey to produce and sell on a reimbursable basis, copies of aerial or other photographs, mosaics, and other official records.

**43 U.S.C. 49 | Extension of cooperative work to Puerto Rico.**

This section authorizes the making of topographic surveys in Puerto Rico by the Geological Survey.

**43 U.S.C. 50 | Topographic mapping cost shares.**

The share of the Geological Survey in any topographic mapping or water resources investigations carried on in cooperation with any State or municipality shall not exceed 50 per centum of the cost thereof.

**43 U.S.C. 1318 | Geological Survey; classes and sizes of publications.**

This section requires that publications of the Geological Survey shall include maps, folios, and atlases required by law. This Section further provides for printing and reprinting of Geological Survey reports and distribution to Congress and the Library of Congress.



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**15 U.S.C. 5631 *et seq.* and 5652 *et seq.* | The Land Remote Sensing Policy Act of 1992 (Pub. L. 102-555 (1992); Pub. L. 114-90 (2015)).**

Enables the United States to maintain its leadership in land remote sensing by providing data continuity for the Landsat program. Assigns responsibility for the “National Satellite Land Remote Sensing Data Archive” to the Department of the Interior. Authorizes and encourages the Department of the Interior and other Federal agencies to carry out research and development programs in applications of these data and makes Landsat data available to the public.

---

## SOURCES FOR FAST FACTS

- Fact: Leveraged funding from Federal, State, and local partners for 3DEP lidar data acquisition to cover 74 percent of the Nation.

*Source: National Geospatial Program, 3DEP Elevation Program, USGS.*

- Fact: Distributed detailed to intermediate-scale geologic maps for more than 54 percent of the United States.

*Source: National Cooperative Geologic Mapping Program, USGS.*

- Fact: Achieved 100 percent IfSAR coverage over Alaska – improving accuracy of maps and digital map data for Alaskans.

*Source: National Geospatial Program, 3DEP Elevation Program, USGS.*

- Fact: Collaborated with the Association of American State Geologists on the Earth Mapping Resources Initiative (Earth MRI). Issued 15 Cooperative Agreements to States for geologic mapping of critical minerals.

*Source: National Cooperative Geologic Mapping Program, USGS.*

- Fact: Completed high-resolution hydrography data (NHDPlus HR) coverage for 83 percent of the Nation.

*Source: National Geospatial Program, USGS.*

- Fact: Released the latest edition of the National Land Cover Database for the United States—the most comprehensive land cover database that the USGS has ever produced.

*Source: <https://www.mrlc.gov/> and the Land Change Science Program, USGS.*

- Fact: Continued development of Landsat 9 systems and Landsat Next mission formulation and system development activities in joint effort with NASA.

*Source: National Land Imaging Program, USGS.*

- Fact: Enabled access to high-performance computing capabilities to process large datasets for hazards forecasting, landscape change, and biological modeling. Processing time reduced from days to minutes using the USGS Yeti, Denali, and Tallgrass supercomputers.

*Source: Science Synthesis, Analysis, and Research Program, USGS.*

# Science Support



Source: USGS.

## Programs

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Administration and Management Program

Information Services Program

Roseann Gonzales-Schreiner, USGS Deputy Director of Administration and Policy

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*The USGS Science Support Mission Area provides the core functions that make it possible to conduct USGS science.*

## **SCIENCE SUPPORT OVERVIEW**

USGS Science Support provides business and information services including acquisitions and grants; finance; internal controls; communications; budget and performance; monitoring and evaluation of science quality and integrity; information assurance; information management and technology services; strategic planning; and human capital, each of which are crucial to conducting quality science. Science Support also contains the Office of Policy and Analysis, which includes technology transfer, intellectual property, agreement reviews, and directive management. Also included under the Science Support umbrella are the Office of Communications and Publishing, International Affairs, and Office of Diversity and Equal Opportunity.

Science Support includes the executive leadership and management that provide guidance, direction, and oversight for all USGS science activities.

### **What We Do**

- Lead and maintain core business and operational capabilities that provide the framework for the scientific mission of the USGS.
- Enhance and promote an ethical culture throughout USGS.
- Provide bureau-wide leadership and direction, including the establishment of organizational vision, mission, and goals.

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## HOW SCIENCE SUPPORT SERVES THE PUBLIC

**Scientific Excellence:** Science Support aids USGS science by providing science and operational leadership and oversight, including ensuring fiduciary responsibility, communicating the value and relevance of USGS science to the public and Congress, and verifying the validity and quality of USGS science.



An acoustic televiewer for borehole geophysical logging in Monroe County, WV. Source: USGS.

**Communications and Publishing:** The Office of Communications and Publishing (OCAP) is the front door to the USGS. OCAP shares the results of USGS research with key audiences including Congress, the news media, stakeholders, and the public. Communications products increase awareness of the complex natural science issues facing the Nation and enhance understanding of the value and relevance of USGS science to policy- and decision makers at the Federal, State, and local levels. OCAP also supports USGS scientists by providing the full range of professional publishing services for USGS scientific information products.

**Science Quality and Integrity:** The Office of Science Quality and Integrity (OSQI) monitors and enhances the integrity, quality, and health of USGS science through executive oversight and development of strong practices, policy, and supporting programs, including Science Integrity, Fundamental Science Practices, Tribal Relations, Youth, Education, Mendenhall Research, and more.



Aerial photograph of the Barry Arm of Harriman Fjord, Prince William Sound, Alaska. Included in the view are Barry Glacier and Cascade Glacier. The USGS Science Support Mission Area enables the USGS to fulfill its scientific mission, including research on landslides and mapping, such as that being conducted on Barry Glacier in Alaska. Source: USGS.



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## **SCIENCE SUPPORT PARTNERS**

Department of the Interior (DOI) bureaus and agencies from which USGS receives reimbursable funding for activities related to the Science Support mission. Partnering with other bureaus helps to reduce administrative costs and duplication of service decisions.

### **Department of the Interior (DOI) Bureaus**

**Office of the Secretary, Office of the Solicitor, Bureau of Land Management, Bureau of Reclamation, U.S. Fish & Wildlife Service, Office of Surface Mining Reclamation and Enforcement, National Park Service, and Bureau of Safety and Environmental Enforcement.**

**Federal Agencies:** General Services Administration, Government Printing Office, Department of Labor, Office of Management and Budget, Office of Personnel Management, U.S. Forest Service, U.S. Army Corps of Engineers, U.S. Department of State, and U.S. Agency for International Development.

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## FAST FACTS

### Science Support

Responded to and coordinated more than 160 media interviews regarding the California Ridgecrest sequence of earthquakes.

Completed Web migration of 409 separate public Websites to a single platform, enabling efficient and effective distribution and communication of science data and information.

Reviewed and processed more than 1,243 international travel certifications in FY 2019 to ensure that all foreign travel regulations are followed by all USGS employees when traveling.

Implemented an enterprise cellular modem management service in FY 2019, transitioning 85 percent of USGS cellular modems to more secure information sensors across the bureau.

Reorganized the Office of Tribal Relations to better focus on establishing new partnerships with Tribes throughout the country.

Led the way in creating the DOI process for Mobile Credentialing Units for DOI access card enrollment, significantly reducing travel costs and saving time.

Expanded the Secondary Transition to Employment Program—USGS Partnership (STEP-UP) for young adults with intellectual disabilities to seven USGS locations.

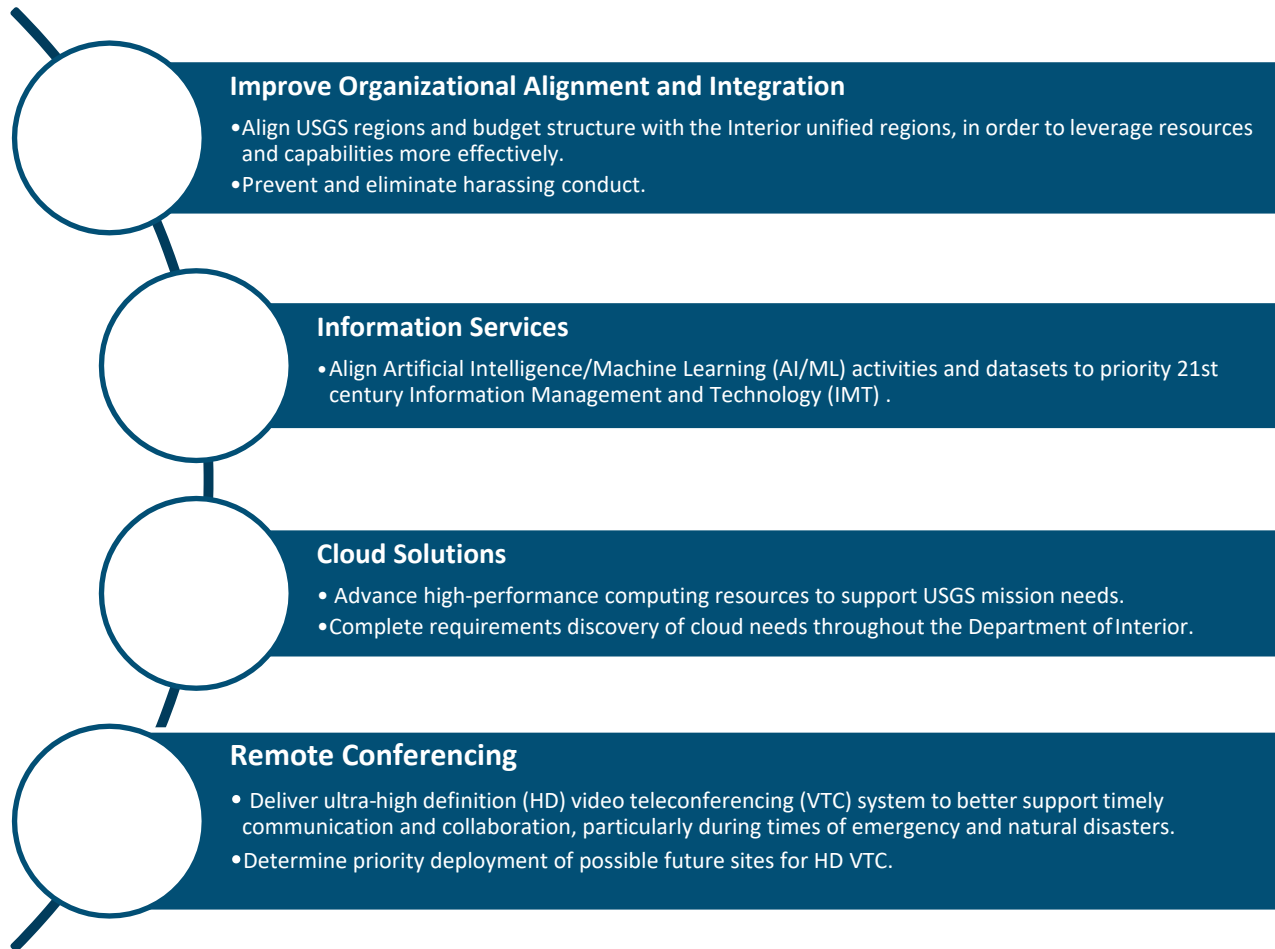
Source information for each of the facts above is on page 197.

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## USGS AND THE DOI STRATEGIC PLAN

### COMMITMENTS TO DEPARTMENT OF THE INTERIOR PRIORITIES

Within the 2018–2022 DOI Strategic Plan, Science Support is working to modernize the DOI organization and infrastructure. The USGS is committed to the following priorities to meet both USGS and DOI goals.



### Performance and Strategic Planning Documents

- DOI Annual Financial Report (the most recent report can be found [here](#))
- DOI Annual Performance Plan & Report (APP&R; the most recent can be found [here](#))
- DOI Strategic Plan (2018–2022) ([link](#))

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## ADMINISTRATION AND MANAGEMENT PROGRAM

*Conducting mandatory and high-priority activities and preserving core capabilities that provide the framework for the USGS science mission.*

The offices and personnel that make up Administration and Management include the Director's Office and the Offices of Administration; Budget, Planning, and Integration; Communications and Publishing; Science Quality and Integrity; International Programs; and Diversity and Equal Opportunity.

Administration and Management, within Science Support, provides bureau-wide leadership and direction; establishes organizational vision, mission, goals and scientific priorities; develops and enforces standards for scientific rigor and integrity; plans, obtains, and manages necessary resources, including people, budget authority, facilities, and equipment; provides resource management systems; implements statutory and regulatory requirements and monitors and enforces compliance; and communicates the USGS mission and science to Congress and the public.

Administration and Management Program activities fall under two areas:

- Science Coordination and Services
- Bureau-wide Bills

### SCIENCE COORDINATION AND SERVICES

Science Coordination and Services establishes program direction and goals for the USGS, exercises line management responsibility for science centers, and implements science projects on the landscape; ensures scientific rigor and integrity; and carries out international activities as a complement to domestic science programs. Science Coordination and Services provides bureau leadership with foundational administrative services for the conduct of science by organizing and conducting operational planning and budgeting; providing policy guidance and direction; implementing, monitoring, and enforcing statutory requirements; managing and acquiring people, equipment, funds and facilities; and communicating the USGS mission and science to the public and others.

### BUREAU-WIDE BILLS

A notable portion of the Administration and Management subactivity goes directly to paying must-pay bills, such as bills related to programs and enterprise-wide systems managed by Interior's Working Capital Fund. Interior's Office of the Secretary and the Interior Business Center provides oversight, Department-wide coordination, and operational and business support services in lieu of duplicative systems in each bureau. Funding from the bureaus maintain programs and systems such as the infrastructure and support for the Financial and Business Management System (FBMS); the Department-wide e-Travel system (Concur); the Interior Operation Center, which



A USGS employee tests drone-based ground-penetrating radar. Source: USGS.

serves as the focal point for emergency response activities; the consolidated financial statement audit; operations and maintenance of the Federal Personnel and Payroll System (FPPS); the DOI University and online learning system; and the Office of Aviation Services, which provides policy and oversight on aviation activities. Additionally, the Administration and Management Activity manages the mandated costs associated with the Department of Labor's Worker's Compensation (P.L. 94-273) and Unemployment Compensation (P.L. 96-499) programs.

### **REIMBURSABLE ACTIVITIES**

Science Support has reimbursable agreements with several offices in the Department of the Interior, as well as with several sister bureaus. Among these are an agreement between the Interior Office of the

Solicitor and the USGS, in which the USGS serves as their Human Resources service provider. Outside of Interior, USGS has agreements with the General Services Administration and other agencies. For facilities, USGS has agreements with the Government Printing Office, Department of Labor, and Office of Personnel Management. For human resources, USGS has agreements with the U.S. Forest Service, U.S. Army Corps of Engineers, U.S. Department of State, and U.S. Agency for International Development. Additionally, the USGS Store, located on the campus of the Denver Federal Center (DFC), provides services for the America The Beautiful–The National Parks and Federal Recreational Lands Passes.

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## INFORMATION SERVICES PROGRAM

*Securing science data assets to ensure scientific integrity by providing access to advanced technologies such as artificial intelligence and high-performance computing.*



Advanced Research Computing (ARC)'s "Yeti" supercomputing cluster contains over 38,600 total cores; 23,800 GB of RAM; and 793 TB of usable storage. Source: USGS.

This subactivity includes the Office of the Associate Chief Information Officer (ACIO). The ACIO leads the Office of Enterprise Information (OEI) and has five major components within its organization. These components include the Office of the Chief, Enterprise Infrastructure, End User Services, Information Security, and Information Management and Delivery.

The subactivity provides the critical Information Management and Technology (IMT) foundation for the USGS science mission by implementing advances in IMT and using them to facilitate research, data gathering, analysis, modeling,

scientific collaboration, knowledge management, and work processes. The subactivity supports numerous IMT services such as the USGS information assurance program; network capacity and cloud services; applications and customer support; information investment, management, and delivery programs; and supports the Interior IMT activities through the Department of Interior's Working Capital Fund.

Information Services Program activities currently are aligned to three areas:

- Information Management & Technology Services
- Information Management & Technology Bureau Bills
- Communications Infrastructure

## INFORMATION MANAGEMENT & TECHNOLOGY SERVICES

Information Services is broken into three parts: Information Assurance, IT Applications and End User Services, and Information and Investment Management.

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*Information Assurance* protects infrastructure and data from improper or malicious access or manipulation, protects the integrity and availability of science information, preserves the confidentiality of privacy and other sensitive information, and ensures compliance with Federal information technology mandates and regulatory requirements. Oversight is applied to security control implementation to ensure well-rounded information system management is used to increase the reliability of the technology supporting science information delivery. The Information Assurance office provides specialized security training to 9 major USGS systems, and more than 100 subcomponents in the appropriate remediation of vulnerabilities, planning, and internal control implementation to ensure risks are managed commensurate with data sensitivity and mission requirements.

*IT Applications and End User Services* supports Interior and USGS automated resource management systems and electronic processes. This includes the analysis, design, development, testing, implementation, documentation, user training, operations, maintenance, and user support for business workflow applications used across the bureau. Included in these applications are the required security reviews, Privacy Act information evaluations, and Assessment and Authorization activities. As a part of end-user services, the USGS Service Desk serves as a single point of contact for support to USGS employees. The Service Desk has primary responsibility for incident resolution, service request tracking, and customer satisfaction. The continuing consolidation of services into the USGS Service Desk creates an integrated environment that improves service excellence and extends the ability to support mobile resources.

*Information and Investment Management* supports responsible practices for managing and preserving information, as well as ensuring that IMT funds are spent in the most efficient and effective manner to support the science mission of the USGS. Information Management oversees a broad suite of activities that support information delivery and ensures the collection, storage, sharing, preservation, and publication of scientific data are done in accordance with Federal laws and regulations. Information Management also provides policies, guidance, services, and tools that promote appropriate public access to data and enables the effective delivery of USGS science and information products.

## **INFORMATION MANAGEMENT & TECHNOLOGY BUREAU BILLS**

A notable portion of the Information Services budgetary resources are must-pay bills on behalf of the bureau. These bills include funding necessary to provide and maintain services throughout the USGS that represent key IMT support functions, where Department-wide contracts are largely determined by organizations outside the bureau. To ensure the effective performance of the USGS, these costs are managed on a centralized basis.

IMT bureau-wide bills are assessed to the USGS from Interior's Working Capital Fund. These are must-pay bills, such as services for the enterprise Continuous Diagnostics & Monitoring (CDM) program, Threat Management, Enterprise Services Network (ESN), unified messaging, and other IMT initiatives.

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## COMMUNICATIONS INFRASTRUCTURE

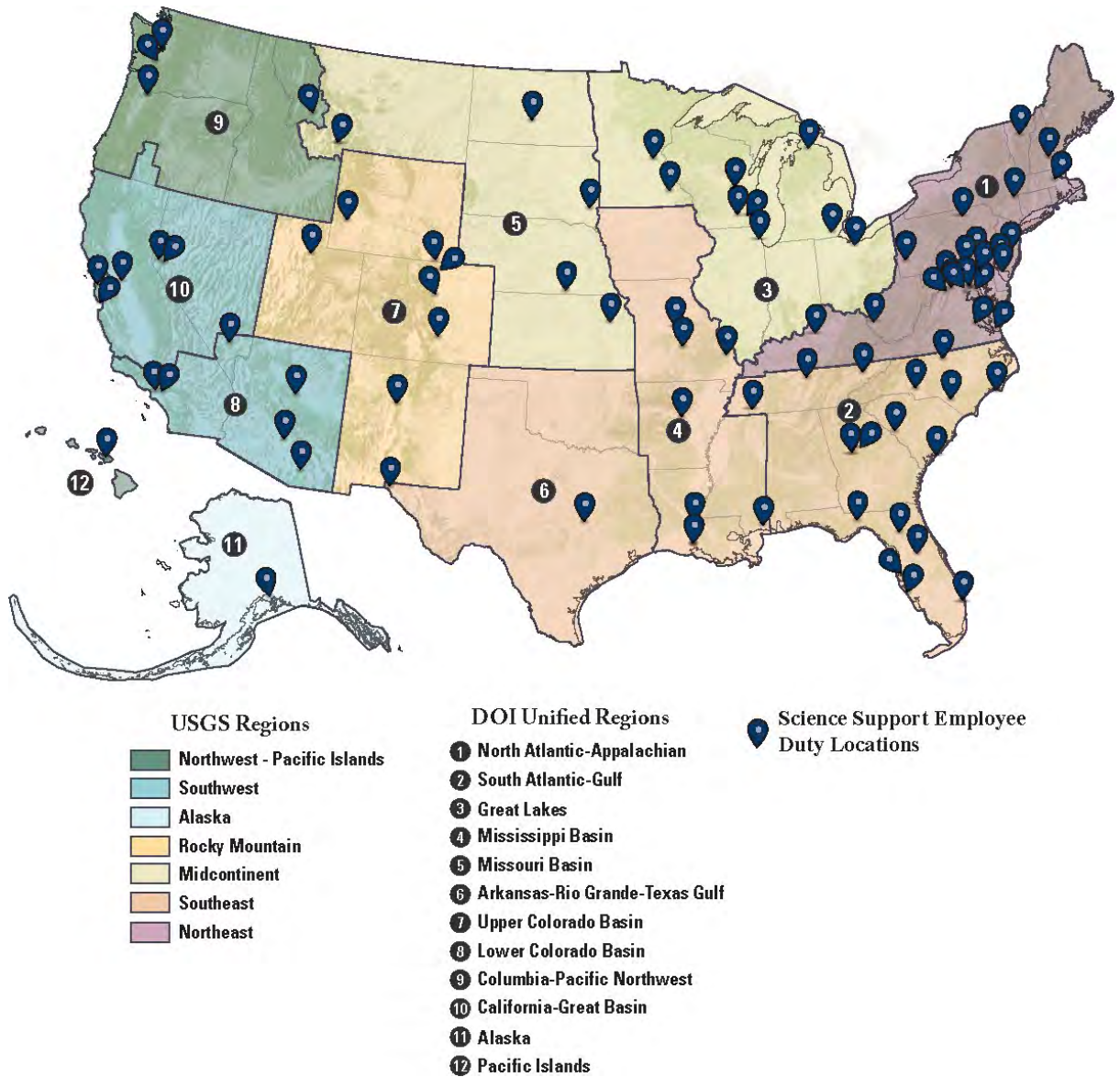
*Information Technology (IT) Infrastructure* delivers telecommunications and hosting infrastructure services throughout the USGS. Telecommunications support timely transmission and sharing of emergency and routine data such as those from earthquakes, flooding, volcanic eruptions, and business information system data. This complex network, telephone, and video architecture is used to provide timely access to global environmental ecosystem data to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. To fulfill its responsibilities, the Telecommunications Program ensures that current and future mission-related telecommunications needs are accurately assessed and supported through fully integrated and secure services. Hosting infrastructure services are provided on premise and through the USGS Cloud Hosting Solutions program. In addition, the cloud program also provides an expanding number of other services.

Hosting Services provides enterprise-level and local science center support for multiple IMT services including directory services, mobile device management, SharePoint, Internet, intranet services (NatWeb), and cloud hosting. The primary services include secure authentication, group policy management, directory services, IMT asset management, and security compliance monitoring. Microsoft is the primary avenue of delivering information quickly throughout the USGS, as well as to cooperators and colleagues throughout the world. It allows scientists to receive notifications quickly from automated systems that send information on earthquakes, tsunamis, hurricanes, and flooding around the country and the world.



# SCIENCE SUPPORT LOCATIONS WITHIN UNIFIED INTERIOR REGIONS

The following is a summary of USGS Science Centers and their locations within Interior’s Unified Regions.





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## SOCIAL MEDIA PRESENCE

	<a href="https://www.facebook.com/USGeologicalSurvey">https://www.facebook.com/USGeologicalSurvey</a>
	<a href="https://twitter.com/USGS">https://twitter.com/USGS</a>
	<a href="https://www.instagram.com/usgs/">https://www.instagram.com/usgs/</a>
	<a href="https://www.youtube.com/user/usgs">https://www.youtube.com/user/usgs</a>
	<a href="https://www.flickr.com/photos/usgeologicalsurvey/">https://www.flickr.com/photos/usgeologicalsurvey/</a>
	<a href="https://www.usgs.gov/products/multimedia-gallery/audio/podcasts">https://www.usgs.gov/products/multimedia-gallery/audio/podcasts</a>
	<a href="https://github.com/usgs">https://github.com/usgs</a>

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## LEGAL AUTHORITIES FOR MISSION AREA ACTIVITIES

### **43 U.S.C. 31 | The Organic Act of March 3, 1879**

An act that established the Geological Survey, as amended (1962), and restated in annual appropriation acts. This section provides, among others, that the Geological Survey is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the Interior Department. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285 Sec. 10(a) establishes United States Geological Survey as its official name.

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## **SOURCES FOR FAST FACTS**

- The source for all Fast Facts is the Science Support Mission Area, USGS.

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# Facilities



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

12201  
Sunrise Valley Drive

USGS headquarters  
sign in Reston, Va.  
Source USGS.

## Programs

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Rental Payments and Operations & Maintenance

Deferred Maintenance and Capital Improvement

Roseann Gonzales-Schreiner, USGS Deputy Director of Administration and Policy

[rgonzalez-schreiner@usgs.gov](mailto:rgonzalez-schreiner@usgs.gov)

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*Coordination of facility planning with science planning to provide safe, high-quality workspace aligned with science needs.*

## FACILITIES OVERVIEW



USGS headquarters in Reston, VA. Source: USGS

Facilities provides safe, functional workspace to accomplish the bureau's scientific mission, with an emphasis on the USGS mission driving facility needs. The Facilities goal is to meet bureau science needs while optimizing facility locations, distributions, and use to control or reduce costs.

The USGS defines facilities to include all sites where USGS activities are housed and mission related work is conducted. Facilities typically provide space for offices, laboratories, storage, parking, shared support for cafeterias, conference rooms, and other common space uses. The USGS also classifies its eight larger (greater than 45 feet in length) research vessels as laboratory facilities.



Morning snowfall at the Eastern Ecological Science Center's Administration building in West Virginia. Source: USGS.

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Owned assets are usually part of a campus of buildings, for example, the Eastern Ecological Science Center includes all associated land, buildings, and other structures.



USGS Baltimore, Md. office. Source: USGS.

### **What We Do**

- Support the Department of the Interior’s goal of facilities improvement by tracking outcomes such as overall condition of buildings and structures.
- Increase energy efficiency at USGS facilities by meeting annual goals to reduce energy intensity.
- Meet sustainable building goals of Executive Order (E.O.) 13514 through efficient management of facilities footprint and cost savings initiatives through space consolidations.
- Provide oversight and support in managing the USGS facility portfolio, including both owned and rented facilities across the Nation.

---

## **HOW FACILITIES SERVES THE PUBLIC**

USGS Facilities serves the public by saving money through improving space utilization, disposing of underutilized assets, consolidating operations within, and, where appropriate, relinquishing space to General Services Administration (GSA)-provided offices, laboratories, data centers, and warehouses.

## **FACILITIES PARTNERS**

USGS Facilities partners with other Federal agencies, State and local governments, universities, and the private sector. Collaboration with these partners supports the USGS's scientific work and facilitates communication of the results of this work to the public, emergency managers, and the scientific community. Partners generally have a mission like that of the USGS. In these instances, the USGS occupies space in return for science-related services or space is acquired as part of a larger cooperative agreement. Typically, the USGS pays a reduced rent rate or the cost of operations and maintenance. Colocations with other bureaus, agencies, or universities is a space management strategy that advances science, creates partnerships, and facilitates recruitment of new talent.

## FAST FACTS

# Facilities

USGS has reduced its energy usage by 2.5 percent annually since 2015.



The USGS occupies approximately 3.89 million square feet of rentable space in about 161 GSA buildings.

Only 21.1 percent of the USGS space is owned by USGS; the remaining 78.9 percent of USGS space is provided through GSA, direct leases with the private sector, and cooperative and inter-agency agreements.

The USGS has continued to increase colocation and consolidation opportunities consistent with mission objectives. Since 2017, colocations within the USGS have increased by 5% and across bureaus and agencies it has increased by 10%.

**USGS Facilities:**  
GSA owned or leased (61%)  
USGS owned (21%)  
Cooperative Agreements (9%)  
Other Agency provided (6%)  
USGS leased (3%)



The USGS analyzes all space actions to work toward goals set in the Office of Management and Budget's *Reduce the Footprint* policy. Between 2010 and 2019, the USGS has reduced space by more than 830,000 rentable square feet, which represents a 10% reduction.

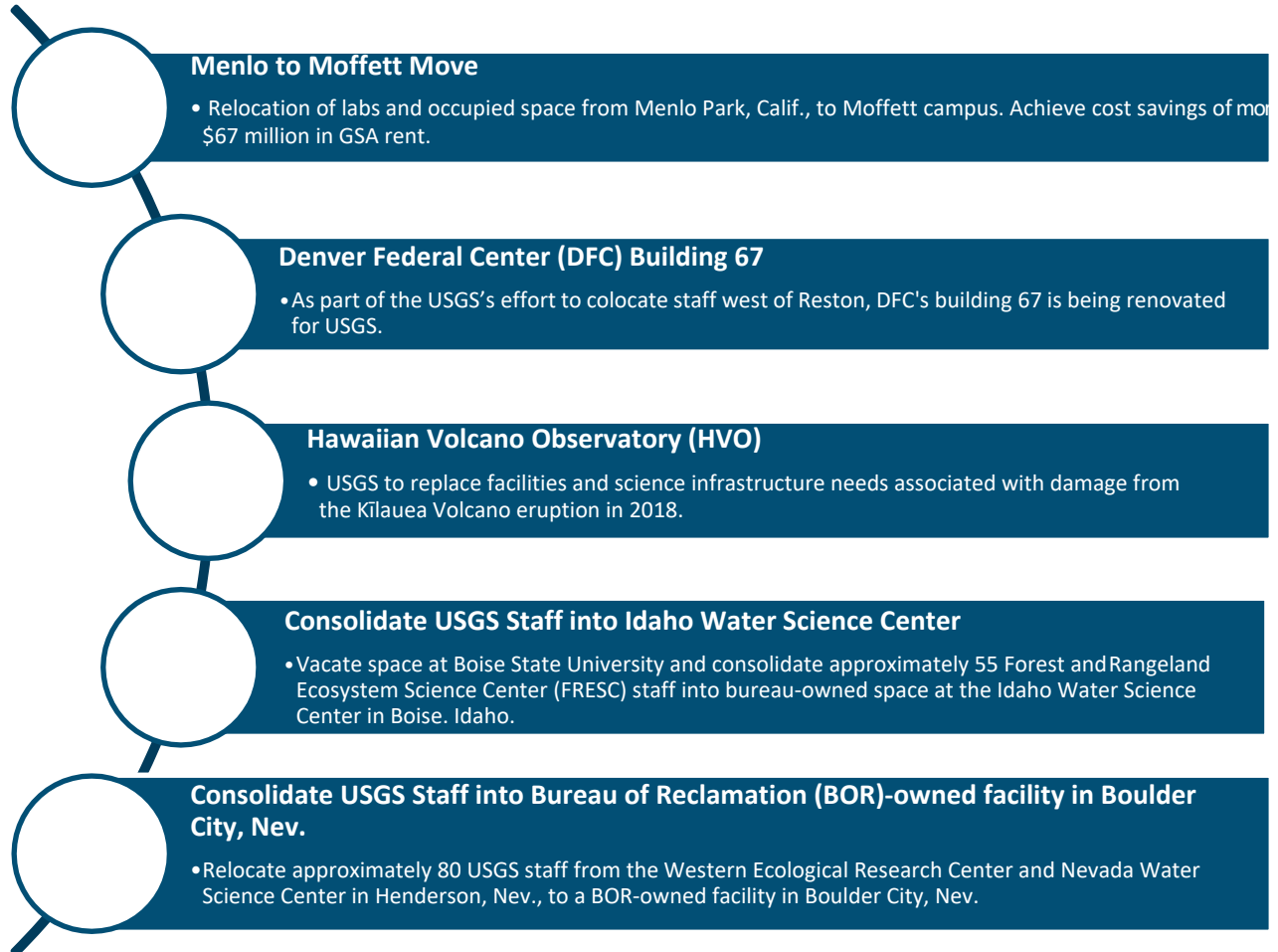
Source information for facts above is on page 217.

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## USGS AND THE DOI STRATEGIC PLAN

### COMMITMENTS TO DEPARTMENT OF INTERIOR PRIORITIES

Within the 2018–2022 DOI Strategic Plan, Facilities supports the DOI goal of Modernizing Our Organization and Infrastructure. The USGS is committed to working the following priorities to meet both USGS and DOI goals.



### Performance and Strategic Planning Documents

- DOI Annual Financial Report (the most recent report can be found [here](#))
- DOI Annual Performance Plan & Report (APP&R; the most recent can be found [here](#))
- DOI Strategic Plan (2018–2022) ([link](#))

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## RENTAL PAYMENTS AND OPERATIONS & MAINTENANCE

*The Facilities provides safe, functional workspace to accomplish the USGS's scientific mission with an emphasis on the mission driving facility needs.*

The Rental Payments and Operations and Maintenance Program provides the USGS with funding needed to pay for annual recurring rent and operations and maintenance. Rental payments are made to GSA, other Federal sources, private lessors, and cooperators for space occupied by the USGS. The USGS is working to continually enhance facilities efficiencies, in terms of both costs and mission needs. For example, the consolidation of USGS employees into the Bureau of Reclamation facility in Boulder City, NV, provides both enhanced collaboration opportunities between the two DOI bureaus as well as lower and more stable facilities costs for the foreseeable future.



A pre-design rendering of a new portion of the USGS National Wildlife Health Center (NWHC). The NWHC is the only national center dedicated to wildlife disease detection, control, and prevention in the U.S. Its mission is to advance wildlife health science for the benefit of animals, humans, and the environment. Source: USGS.

Rental Payments and Operations & Maintenance activities fall under two areas:

- Rental Payments
- Operations & Maintenance



The National Water Quality Lab in Lakewood, CO. Source: USGS.



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## RENTAL PAYMENTS

Rental payments are provided for space occupied by the USGS to the GSA, other Federal sources, private lessors, and cooperators. The USGS has unique facility requirements for supporting science functions and relies primarily on GSA to meet those needs, including modern laboratory space.



This historic brick Studebaker Building, originally built in 1925, was chosen as the location for the USGS St. Petersburg Coastal and Marine Science Center in the late 1980s. Source: USGS.

The USGS occupies multiple types of space including laboratory (lab), warehouse, and office space. Space is acquired through several sources, including GSA- and USGS-owned or leased buildings, and through interagency and cooperative agreements. The total owned and leased space is approximately 6.34 million square feet. Nationwide, the USGS owns 33 installations consisting of 287 buildings yielding approximately 1.34 million gross square feet, which accounts for 21 percent of the portfolio. This includes 10 biological science centers; 5 biological field and research stations; the National Center for Earth Resources Observation Systems (EROS); the Boise Water Science Center; and 12 geomagnetic, seismic, and volcano observatories. The USGS also owns eight large research vessels, each more than 45 feet in length.

GSA-provided space is the largest portion of the USGS space portfolio at 61 percent. The USGS occupies approximately 3.89 million square feet of rentable space in about 161 GSA buildings nationwide. The remaining 39 percent of the USGS space is provided through direct leases with the private sector, and cooperative and interagency agreements with State and local governments, universities, and other Federal agencies.

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## OPERATIONS & MAINTENANCE



The large research vessel (R/V) Arcticus enables USGS Great Lakes Science Center scientists to explore fish health and water quality in Lakes Michigan and Huron. The 77-foot R/V Arcticus replaced the oldest vessel in the USGS fleet, the R/V Grayling. The Arcticus offers greater research capabilities, increased fuel efficiency, improved health and safety features and lower maintenance costs than its predecessor. Source: USGS.

Operations and Maintenance funding provides for basic facility operations, security, and facility maintenance, as well as provides a safe working environment for USGS employees, visiting partners, and customers. Maintenance involves the upkeep of USGS-owned facilities, structures, and capitalized equipment necessary to maintain the useful life of the assets. To protect our important resources, ongoing investments in annual and cyclic maintenance, repair, revitalization, and disposal of assets must be considered as a part of a long-

term operations and maintenance program. Operations of USGS owned facilities include costs such as utilities, janitorial and pest services, waste management, and salaries for staff responsible for the day-to-day operations of the facility.

USGS is also responsible for assets where we have delegated authority. This delegated authority allows the USGS to operate and manage these facilities day to day. Delegated functions include building operations, maintenance, recurring repairs, minor alterations, historic preservation, concessions, and energy management.

### REIMBURSABLE ACTIVITIES

Reimbursable partners provide approximately 22 percent of funding to this program, facilities appropriation funds 69 percent, and Science programs fund the remaining 9 percent. Reimbursable partners include other Federal agencies, universities, and State and local agencies working with USGS.

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## DEFERRED MAINTENANCE AND CAPITAL IMPROVEMENT

*Addressing critical facilities maintenance and repair needs in support of the USGS science mission.*



Plaque outside the Hawaiian Volcano Observatory. The eruption of Kīlauea Volcano in 2018 resulted in the loss of the USGS Hawaiian Volcano Observatory. Source: USGS.

Deferred Maintenance and Capital Improvement (DMCI) funding provides for deferred maintenance and repair projects on USGS-owned and maintained assets. Funding is provided to the highest priority facility requirements over \$100,000 in support of USGS mission needs. Prioritization follows annual Interior budget guidelines. Funding is primarily directed towards projects that stabilize, restore, replace, or improve life-cycle performance of assets that are mission critical. Projects that facilitate

space consolidation, improve utilization, and reduce the bureau space footprint also receive DMCI funding, as do other facilities maintenance and management activities that identify, document, track, and remediate maintenance needs.

For example, following the eruption of Kīlauea Volcano in 2018 and the subsequent loss of the Hawaiian Volcano Observatory (HVO) USGS facility in Hawaii Volcanoes National Park, the USGS completed a move from HVO into new long term, but temporary, facilities in Hilo and Kea‘au, Hawaii. DMCI funding allowed for this mission critical move to happen, ensuring continued monitoring of the volcano.

Another example of DMCI funding being used to support the USGS mission is the move from Menlo Park, CA, to Moffett Field, CA. The USGS is relocating more than 200 employees from Menlo Park, CA, to Moffett Field, owing to high rent costs in Menlo Park. This 5- to 6-year long endeavor is in partnership with both GSA and NASA and will ultimately result in an estimated \$15 million in annual facility savings to USGS, including an approximate reduction of 40–50 percent of the current USGS footprint. DMCI funding was used to relocate employees and renovate space in Moffett Field for USGS to occupy.

### USGS FACILITIES CENTERS

The USGS has facilities in each of the 50 States, Puerto Rico, the U.S. Virgin Islands, and Guam. The list below reflects the number of facilities within each Region and State. A description of the work performed at each center can be found in the science Mission Area chapters:

#1 North Atlantic- Appalachian	#2 South Atlantic Gulf	#3 Great Lakes	#4 Mississippi Basin	#5 Missouri Basin	#6 Arkansas-Rio Grande-Texas Gulf	#7 Upper Colorado Basin	#8 Lower Colorado Basin	#9 Columbia- Pacific Northwest	#10 California- Great Basin	#11 Alaska	#12 Pacific Islands
CT	AL	CT	AR	KS	OK	CO	AZ	ID	CA	AK	HI
DC	FL	IL	IA	MT	TX	NM	CA	MT	NV		GU
DE	GA	IN	LA	ND		UT	NV	OR	OR		
KY	NC	MI	MO	NE		WY		WA			
MA	NE	MN	MO	SD							
MD	PR	OH	MS								
ME	SC	WI									
NH	TN										
NJ	VI										
NY											
PA											
RI											
VA											
VT											
WV											

The list below describes the number of USGS facilities in each State and USGS Region:

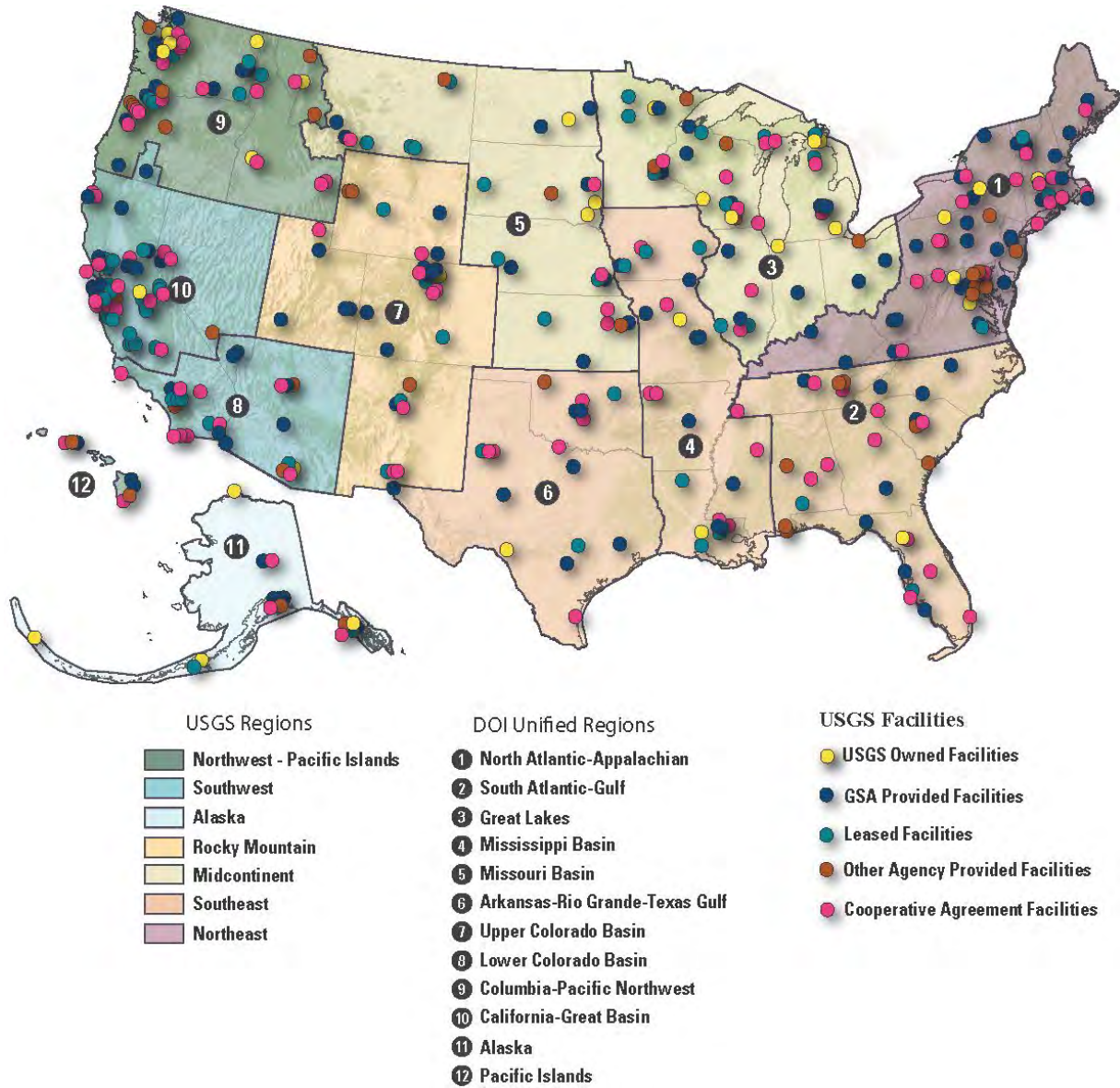
<b>USGS Regions</b>	<b>Number of Facilities</b>
<b>Northeast Region</b>	<b>62</b>
Connecticut	2
District of Columbia	2
Delaware	1
Kentucky	3
Massachusetts	6
Maryland	6
Maine	3
New Hampshire	1
New Jersey	3
New York	8
Pennsylvania	9
Rhode Island	1
Virginia	9
Vermont	4
West Virginia	4
<b>Southeast Region</b>	<b>80</b>
Alabama	4
Arkansas	3
Florida	9
Georgia	3
Iowa	6
Louisiana	8
Missouri	7
Mississippi	5
North Carolina	4

---

<b>USGS Regions</b>	<b>Number of Facilities</b>
<b>Southeast Region cont.</b>	
Oklahoma	6
Puerto Rico	2
South Carolina	4
Tennessee	6
Texas	12
Virgin Islands	1
<b>Northwest-Pacific Islands Region</b>	<b>58</b>
Guam	2
Hawaii	11
Idaho	7
Oregon	15
Washington	23
<b>Southwest Region</b>	<b>82</b>
Arizona	10
California	65
Nevada	7
<b>Alaska Region</b>	<b>17</b>
Alaska	17
<b>Rocky Mountain</b>	<b>34</b>
Colorado	15
New Mexico	7
Utah	5
Wyoming	7
<b>Midcontinent Region</b>	<b>77</b>
Illinois	5
Indiana	2
Kansas	5
Michigan	11
Minnesota	10
Montana	13
North Dakota	3
Nebraska	5
Ohio	3
South Dakota	6
Wisconsin	14

## FACILITIES CENTERS WITHIN THE INTERIOR UNIFIED REGIONS

The following is a summary of USGS facilities and their locations within Interior's Unified Regions.



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## SOCIAL MEDIA PRESENCE

	<a href="https://www.facebook.com/USGeologicalSurvey">https://www.facebook.com/USGeologicalSurvey</a>
	<a href="https://twitter.com/USGS">https://twitter.com/USGS</a>
	<a href="https://www.instagram.com/usgs/">https://www.instagram.com/usgs/</a>
	<a href="https://www.youtube.com/user/usgs">https://www.youtube.com/user/usgs</a>
	<a href="https://www.flickr.com/photos/usgeologicalsurvey/">https://www.flickr.com/photos/usgeologicalsurvey/</a>
	<a href="https://www.usgs.gov/products/multimedia-gallery/audio/podcasts">https://www.usgs.gov/products/multimedia-gallery/audio/podcasts</a>
	<a href="https://github.com/usgs">https://github.com/usgs</a>

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## LEGAL AUTHORITIES FOR MISSION AREA ACTIVITIES

### **43 U.S.C. 31 | The Organic Act of March 3, 1879**

An act that established the Geological Survey, as amended (1962), and restated in annual appropriation acts. This section provides, among others, that the Geological Survey is directed to classify the public lands and examine the geological structure, mineral resources, and products within and outside the national domain. This section also establishes the Office of the Director of the Geological Survey, under the U.S. Department of the Interior. The Director is appointed by the President by and with the advice and consent of the Senate. P.L. 102-285 Sec. 10(a) establishes United States Geological Survey as its official name.



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## SOURCES FOR FAST FACTS

- The source for all the Fast Facts is the most recent Space Management Plan (SMP), dated April 2020. The SMP can be found at this [link](#) from the Buildings [and Facilities](#) Web page under the subject "Asset Management."

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# **USGS**

## **Multi-disciplinary**

### **Activities**

Landsat satellite image of harmful algal bloom in Lake Erie.  
Source: USGS/Landsat.

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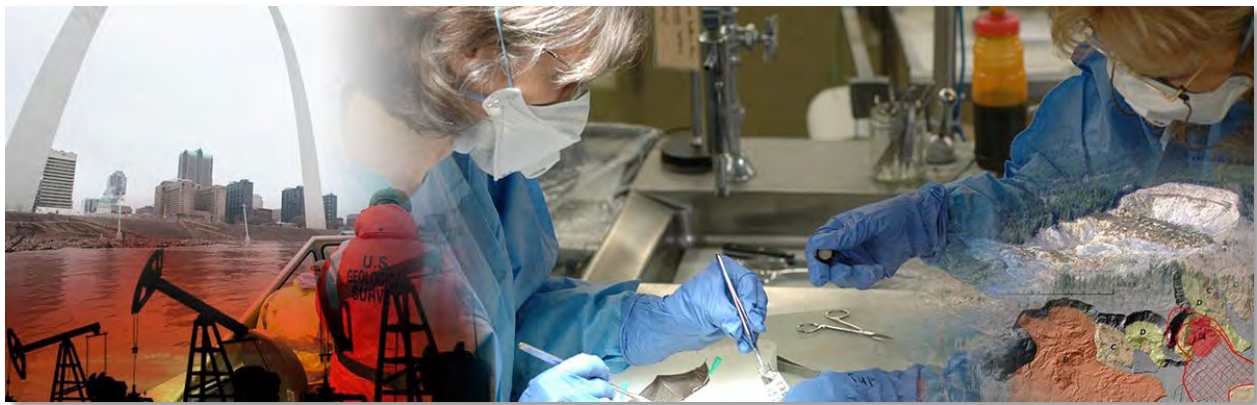
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*Multi-disciplinary activities are areas of focus where science is applied via multiple scientific disciplines found across USGS Mission Areas.*

## MULTI-DISCIPLINARY ACTIVITIES OVERVIEW

The diversity of scientific expertise at the U.S. Geological Survey (USGS) enables the bureau to carry out large-scale, multidisciplinary scientific investigations. The USGS provides research and analysis that can be used by decision makers to understand complex land and resource management issues that rely on integrated science from a confluence of scientific disciplines.



Examples of multidisciplinary USGS science on topics such as water resources, energy and mineral resources, species biology, and mapping disciplines. Source: USGS

Crosscutting activities are topical areas of focus where USGS science is applied by way of scientific disciplines through collaboration across multiple USGS Mission Areas. Crosscutting activities involve multiple USGS Programs or a Program’s area of responsibility. Multidisciplinary activities provide the bureau multifaceted research funded across multiple Mission Areas through project-level collaboration. For example, geophysical equipment and techniques developed “in-house” at USGS are now used in a variety of traditional and nontraditional mineral, energy, and water resource studies; military applications; and environmental investigations.

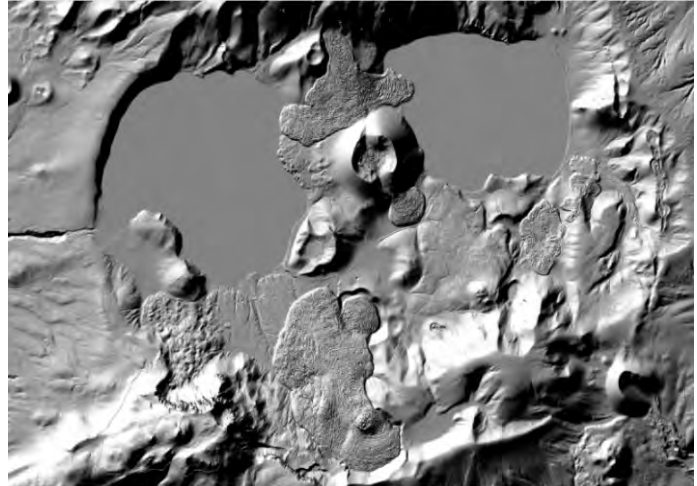
These internal collaborations assist the bureau in advancing key Administration and Secretarial priorities, including support for energy security, natural hazard monitoring, and research to inform water, land, or species resource management. The USGS continues to evaluate new activities with crosscutting components to track internally.

Examples of such crosscutting activities include:

- **Earth MRI.** The Energy and Mineral Resources and Core Science Systems Mission Areas collaborate on the Earth Mapping Resources Initiative (Earth MRI). Earth MRI leverages the USGS’s existing relationships with States and the private sector to conduct state-of-the-art geologic mapping and airborne geophysical and topographic (light detection and ranging [lidar]) surveys. Analyses of these datasets provides information on the location,







quantity, and quality of potential sources of critical mineral resources across the Nation. Enhancement of the Nation’s domestic mineral supply will decrease reliance on foreign sources of minerals that are fundamental to U.S. security and economic prosperity.

- **Volcano Monitoring.** The Natural Hazards Mission Area, through the Volcano Hazards Program, works cooperatively with the Core Science Systems Mission Area to leverage resources toward acquiring high- resolution lidar data over Very-High-Threat and High-Threat volcanoes. This lidar data is used to support volcano monitoring and assessments.
- **Harmful Algal Bloom (HABs) Research.** The Ecosystems and Water Resources Mission Areas leverage each other’s laboratory capabilities and research specialties to study the drivers, occurrence, characteristics, and ecological impacts of HABs.



Bare-earth digital elevation model of central Newberry Volcano in southern Oregon, created from 1-meter resolution lidar data acquired through the USGS 3D Elevation Program. Lidar unveils many geologic deposits that are hidden by vegetation, which aids in reconstructing a volcano's eruptive history and the prediction of future volcanic hazards. Source: USGS.

**Mission Area Key:**

- Ecosystems 
- Energy and Mineral Resources 
- Natural Hazards 
- Water Resources 
- Core Science Systems 
- Science Support 

Below is a detailed list of the USGS crosscutting science areas (crosscuts) and definitions currently tracked by the Office of Budget, Planning, and Integration (OBPI) for budget reporting purposes. Crosscutting data is also reported to Congress, DOI, OMB, and other Federal agencies as requested. Crosscutting data requested by other Federal agencies may be published online by that agency for the public.

The icons listed in the explanation box (left) correspond with each Mission Area that participates in the crosscut.



---

## USGS CROSSCUTTING SCIENCE

### ALASKA — ARCTIC AND REST OF ALASKA

This crosscutting science includes activities within, and outside of, the area defined by the Arctic Research and Policy Act of 1984. The United States is one of several Arctic nations responsible for the stewardship of the polar region, and the USGS provides a scientific foundation for understanding the physical processes that shape the Arctic. Whether leading the first effort to digitally map Alaska, understanding the unique natural hazards and ecosystems native to the region, or creating the first publicly available assessment of the petroleum resources north of the Arctic Circle, USGS science is informing the Nation's resource management policies and improving the stewardship of the Arctic region.



USGS scientists collecting field data on snowpack at the Gulkana Glacier in the eastern Alaska Range. Source: USGS.

### CALIFORNIA BAY DELTA

This crosscutting science includes activities related to the San Francisco Bay and Sacramento-San Joaquin Delta (Bay-Delta). USGS conducts projects that are designed to inform State and Federal water managers as they balance the needs of California's communities, agriculture, and endangered species. Science activities focus on water availability, environmental contamination, habitats, natural hazards, land subsidence, climate impacts, and management-critical programs that monitor the effect of salt-water intrusion, contamination, and pesticide runoff. The California Bay-Delta system provides water to more than 25 million California residents and vast farmlands, as well as key habitat for birds, fish, and other wildlife. The Bay-Delta forms one of the largest estuaries in the Nation, providing unique habitat for a great variety of birds, fish, and other wildlife.



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## CHESAPEAKE BAY

Science on the Chesapeake Bay includes activities to provide data to decision makers, land managers, and citizens to meet their resource needs and protect the natural abundance and beauty of Chesapeake Bay. This includes projects conducted from southern New York to southern Virginia within the Chesapeake Bay watershed. The Chesapeake Bay watershed is home to almost 20 million people, more than double the region's population in 1950, and the Bay itself is America's largest estuary and the source for a seafood industry and other services worth about \$1 billion. USGS science informs decisions related to balancing the needs of population growth while restoring and protecting the Bay's natural resources.



A white heron flying across a marsh in York County, VA.  
Source: [USGS](#).



## COLUMBIA RIVER

The Columbia River Basin extends from British Columbia to Nevada, and from Wyoming to Oregon. Crosscutting science activities include assessing the effects of dam operations; tracking salmon populations; assisting in restoration of Tribal first foods, including lamprey; discovering chemicals in fish species that are harmful to humans; and informing DOI's Columbia River Treaty recommendations to the Department of State. The Columbia River system is home to about 8 million people, including Tribal Nations, and is one of the most important salmon habitats in the world.



## ENERGY

As the Nation works to ensure a steady supply of energy resources, reliable energy science is more important than ever to ensuring our Nation's economic security and environmental health. USGS scientists provide unbiased, reliable energy assessments needed to better understand our Nation's energy resource supply. Both conventional energy sources (including fossil fuels) and renewable energy sources (including wind, solar, biofuels, and geothermal energy) comprise our Nation's domestic energy supply mix. Understanding the availability of these domestic resources, and how to develop them sustainably, is critical to curbing our dependence on foreign energy resources, promoting growth of new industries in the United States, and ensuring the Nation can meet its energy needs into the future. In addition to energy resource assessments, the USGS conducts research aimed at understanding the potential

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impacts that energy resource development can have on the environment, health, and water availability. Federal regulatory agencies and policymakers alike rely on unbiased data from the USGS to make significant decisions that influence national energy policy, economic security, and human and environmental health. USGS science activities in this area cross mission areas and include conventional energy activities, unconventional oil and gas (hydraulic fracturing) activities, and other alternative energy activities.



## EVERGLADES

USGS research conducted in the Everglades ecosystems stretches from the middle of the Florida peninsula to Florida Bay. The USGS conducts research to fill key science information gaps and to assist in the sustainable use, protection, and restoration of the South Florida ecosystem through the Comprehensive Everglades Restoration Plan (CERP) and in partnership with the South Florida Ecosystem Restoration Task Force (SFERTF).



USGS researchers conducting a fish survey in Everglades National Park, FL. Source: USGS.



## GREAT LAKES

USGS provides crosscutting science in the Great Lakes Basin – Illinois, Indiana, Minnesota, Michigan, New York, Ohio, Pennsylvania, and Wisconsin. The Great Lakes are the largest group of freshwater lakes on Earth and serve as an important source of drinking water, transportation, power, and recreational opportunities for the United States and Canada. The Great Lakes support a wealth of biological diversity, including more than 200 globally rare plants and animals, and more than 40 species that are found nowhere else in the world. However, more than a century of environmental degradation has taken a substantial toll on the Great Lakes. The USGS continues to work with Interior bureaus and other agencies to provide scientific tools for strategic decision making in restoration efforts. USGS research includes long-term, consistent, lake-wide assessments of forage fish stocks that support sport and commercial fish species; monitoring invasive species for protection and restoration of Great Lakes fisheries; beach health and monitoring; and developing scientific and technological monitoring tools to assess and conserve aquatic species.



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## GULF COAST

USGS conducts scientific initiatives including coastal restoration and landscape analysis, climate change impact studies, and indigenous and invasive species research in coastal areas in Alabama, Florida, Louisiana, Mississippi, and Texas. The Gulf Coast is an economically important yet ecologically vulnerable region that is home to more than 20 million people and a rich assortment of wildlife. The yearly gross domestic product of the five Gulf Coast States combined exceeds \$2 trillion and the economy of the region, which is highly dependent on its natural resources, is driven by crude oil production, commercial fishing, and recreation and tourism.



## HARMFUL ALGAL BLOOMS (HABS)

HABs are a global concern in lakes, rivers, and oceans. They occur when algae grow out of control and are considered harmful because they may pose a risk to the health of humans and other organisms (including fish, shellfish, birds, livestock, and domestic animals) who come in contact with them. In addition to the potential health risks, HABs can hurt local economies owing to waterway advisories and closures, impacts to commercial and sport fishing industries, and decreases in recreation and tourism activities as a result of aesthetic concerns. Furthermore, HABs can be expensive to treat and mitigate. Some of the direct impacts of HABs include lower dissolved oxygen concentrations in water, affecting the organisms living in the water and often resulting in fish die-offs; scum accumulation along shorelines; drinking water and fish flesh that tastes bad; and the production of poisonous toxins that can have health implications for both animal and human health. If HABs produce toxins, they can poison organisms on land and in water such as fish, shellfish, birds, livestock, and domestic pets. In addition, there are potential human health concerns related to eating fish or shellfish exposed to toxins, drinking water contaminated by toxins, or exposure to toxins during recreational activities.

This crosscutting science includes a diverse range of multidisciplinary studies that work to address harmful algal bloom and harmful algal toxin issues in water bodies throughout the Nation. Under this crosscut, the USGS is working to develop analytical laboratory and field methods that detect and quantify blooms and associated toxins, understand causal factors of blooms and toxin production, develop early warning systems for potentially harmful blooms, and, in partnership with public health agencies, understand the human and animal health impacts of exposure to harmful algal toxins. In addition, USGS Water Science Centers work in cooperation with local, State, and Tribal partners to conduct HAB monitoring, modeling, and forecasting studies.

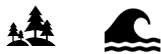


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## KLAMATH BASIN

The Klamath Basin covers more than 15,000 square miles in southern Oregon and northern California. Upper Klamath Lake, the primary body of freshwater within the basin, is home to federally recognized endangered species and is as a major source of water for agricultural irrigation in the region. The Klamath Tribes have a stake in maintaining instream flows for fish and wildlife.

USGS work in the Klamath region includes research on endangered suckerfish, the effects of harmful algal blooms, fish health, and climate variability; monitoring water conditions; and modeling runoff. USGS studies and data collection are aimed at providing information to Federal, State, and Tribal decision makers as they manage resources, undertake restoration actions, monitor ecosystem health, and reduce risks to humans and biota.



## NATURAL HAZARDS

Every year, natural disasters threaten lives and livelihoods and cause billions of dollars in damage. Although these events are often unpredictable and unpreventable, the USGS is working to provide policymakers and the Nation with necessary information to enhance their understanding of, and preparedness for, natural hazards. Through hazard science, the USGS is working to lessen the effects of, and improve the human response to, natural disasters. This crosscut includes activities with a direct relationship to earthquakes, floods, volcanic activity, landslides, hurricanes, storms, tsunamis, geomagnetic storms, and wildfires. It also includes assessments of societal impacts and decision support related to these natural hazards.



An active lava lake contained within the Overlook crater at the summit of Kilauea Volcano. Source: USGS.



## OCEANS/COASTAL/GREAT LAKES

This crosscutting science includes research activities focusing on coastal and ocean resources. USGS activities include efforts to characterize the hazard and resource potential of the Nation's offshore and coastal areas; provide information and tools to anticipate and reduce the risk of natural hazards and coastal change; and assess and manage marine and coastal resources. More

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than half of our Nation's population lives within 50 miles of the coast, along estuaries and extensive coastlines of the Gulf of Mexico, the Atlantic and Pacific Oceans, and the Caribbean Sea. Healthy coastal and offshore resources are vital to our Nation's economy, which relies on coastal regions for energy development, commerce and shipping, fisheries, tourism, and recreation. Scientists and technical staff within the USGS study coastal and ocean resources from shorelines and estuaries to the continental shelf and deep sea, providing expertise, tools, products, and data that address and inform a broad array of resource challenges facing our Nation.



### **PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)**

Per- and polyfluoroalkyl substances, collectively called PFAS, are a group of more than 4,000 compounds commonly used in applications such as stain-resistant coatings on carpeting and clothing, nonstick coatings on cookware, linings of fast-food boxes, and fire-fighting foams. PFAS are increasingly noted for their occurrence in groundwater and the environment, their potential impacts to public and ecological health, and the challenges they pose for cleanup. They are of rapidly growing concern to a wide range of stakeholders such as the Department of Defense, the Environmental Protection Agency, the Centers for Disease Control and Prevention, State and local public health and environment agencies, and the public.

Under this crosscutting area, the USGS uses its science capabilities and expertise to measure and understand the sources, occurrence, movement, persistence, and degradation of PFAS compounds in the environment; exposure pathways to humans and other organisms; uptake by and toxicological impacts on fish and wildlife; and implications for human health through sources of self-supplied or public drinking water (in cooperation with public health experts).



### **PUGET SOUND**

USGS conducts projects and research within the Puget Sound estuary in Washington State—the second largest estuary in the United States. Puget Sound supports hundreds of species of fish, sea birds, and marine mammals, many of which are of enormous economic and cultural importance to the region. Recent USGS research found that protection and restoration of floodplains along the 17 major rivers in the Puget Sound Basin could increase the health of rivers and their ecological value. USGS scientists also analyzed flood-related risks to people on these floodplains and determined that these important habitats can be managed to protect people from future natural flooding disasters.



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## RANGELAND FIRE

USGS supports the Department of Interior's Integrated Rangeland Fire Management Strategy. The Integrated Rangeland Fire Management Strategy outlines the need for coordinated, science-based adaptive management to achieve long-term protection, conservation, and restoration of the sagebrush ecosystem. A key component of this management approach is the identification of knowledge gaps that limit implementation of effective strategies to meet current management challenges. The tasks and actions identified in the strategy address several broad topics related to management of the sagebrush ecosystem. This science plan specifically focuses on fire, invasive plant species and their effects on altering fire regimes, restoration, sagebrush and greater sage-grouse, and climate and weather.

Activities include the development of a geospatial tool that highlights areas of concern, increasing the capabilities of rural/volunteer fire departments and Rangeland Fire Protection Associations (RFPAs), enhancing the development and use of veteran crews, conducting large-scale research and demonstration of projects for control of cheat grass, and implementing the National Seed Strategy.



## SAGE STEPPE

The sage steppe landscape extends across 11 Western States and 2 Canadian Provinces; 60 percent of that landscape is on public lands, half of which are managed by Interior. This area is dominated by sagebrush, which is priority habitat for more than 350 wildlife species, most notably the greater sage grouse, an at-risk and iconic species of this landscape. Alterations in the sage steppe landscape, including changing fire regimes, the spread of invasive grasses, climate change, and development, have led to new challenges to these species and the landowners and public that live and recreate in this area. Land and species managers, landowners, and other stakeholders need scientific information to improve their ability to understand and address these challenges, and to implement landscape-scale management decisions, regardless of surface management or ownership.

This crosscutting science includes research activities to understand how wildfire and habitat fragmentation affect greater sage-grouse populations. Focus areas include developing buffer and mitigation strategies, forecasting distributions of sagebrush in the face of long-term seasonal trends, describing rangeland fire frequency and size, evaluating the effectiveness of restoration techniques, and developing conservation and restoration strategies to benefit greater sage-grouse.



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## SALTON SEA

The Salton Sea (Sea) is California’s largest lake, located in Imperial and Riverside Counties. In addition to its opportunities for outdoor recreation, such as camping, fishing, and hiking, it serves as a vital stop on the Pacific Flyway for millions of birds. However, the Sea faces a long-term challenge: it is shrinking. Changes in regional water management practices have reduced freshwater inflow to the Sea and it loses approximately 1 million acre-feet of water a year to evaporation. These changes have transformed a once a popular vacation destination to a shrinking hypersaline lake. As the lakebed dries to a dusty playa, air, water, and wildlife managers need careful monitoring and research to inform decisions affecting the future of the lake and surrounding communities.

This crosscutting science includes activities related to the Interior’s Memorandum of Understanding with the State of California Natural Resources Agency regarding the coordination of activities to manage the Salton Sea in the interest of both Federal and State management responsibilities.



## STEM

The USGS is committed to growing the next generation of Earth scientists and will continue to invest in programs that develop science, technology, engineering, and mathematics (STEM) skills to ensure the success of that goal. The USGS captures major investments from programs that develop our future workforce by hiring, mentoring, and engaging young people between the ages of 15 and 35,



USGS staff at 2014 St. Petersburg Science Festival. Source: USGS.

in the science and science support mission of the USGS. This crosscut includes activities with STEM components or programs that invest heavily in STEM support including the Mendenhall Research Fellows Program, Student Interns in Support of Native American Relations, the National Association of Geoscience Teachers and Youth and Education in Science Education Component, Cooperative Research Units, EDMAP, the National Geological and Geophysical Data Preservation Program grants, and the Water Resources Research Act Program.





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## UPPER MISSISSIPPI RIVER

The Upper Mississippi River system is a 1,300-mile national waterway that links five States to the Gulf Coast export markets and supports a wide range of uses. More than 30 million residents rely on the river for public and industrial supplies, power plant cooling, wastewater assimilation, and other uses. In addition, commercial navigation, recreation, and fish and wildlife all flourish on the Upper Mississippi. Millions of people visit the area every year to participate in water activities and annual recreation expenditures exceed \$1.2 billion. This crosscut includes research on living resources (including aquatic invasive species), human uses, and impact mitigation in the Upper and Middle Mississippi River Basins, as well as research to examine how natural and human factors affect ecosystem sustainability, restoration, and resilience.



## WATER CHALLENGES

Meeting the water resource needs of the Nation is an increasing challenge because of rapidly changing drivers of water availability, such as population increases, and changes in water use, land use, and climate. At a time when ensuring sustainable water supplies is more important than ever, the change in the frequency and magnitude of extreme hydrologic events, such as floods and droughts, are creating uncertainty for water managers. As competition for water resources grows for irrigation of crops, cities and communities, energy production, and the environment, so does the need for information and tools to aid water and natural resource managers. This crosscut supports an Interior initiative, WaterSMART, that leverages and directs existing expertise and resources within the USGS and Bureau of Reclamation toward addressing complex, national- and regional-scale water challenges.

Under this crosscutting science, the primary focus of this initiative includes developing a National Water Census, which will allow resource managers to better understand and quantify water budgets in their area of concern that, in turn, will support sound water management. The goal of this effort is to (1) improve the data and understanding associated with groundwater, surface water, human water use, and the ways in which these and other water budget components influence water availability, and (2) to develop tools that will allow managers to apply the new understanding and data. To this end, the USGS leverages scientific expertise and foundational resources across multiple USGS mission areas to enable a broader focus so water resource, ecosystem, and land use managers can address these challenging issues in a time of growing competition for water resources.

